Watershed Approach to Toxics Assessment and Restoration (WATAR) Program

2015 Progress Report
Delaware Department of Natural Resources and Environmental Control (DNREC)

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Introduction: The Watershed Approach to Toxics Assessment and Restoration (WATAR) was conceived by DNREC in 2012 with the intention of building a bridge between the surface water toxics program and the site investigation and restoration program in Delaware. The focus of the WATAR program is surface waters, sediments, fish and other aquatic life impacted by toxics, the health of fish and shellfish consumers, and the link to the sources/sites responsible for those impacts. The concept was officially endorsed by DNREC leadership in the fall of 2012 following a series of briefings and the completion of a 5-year work plan. Data and information collected in conjunction with this plan will be used to document progress toward implementing Total Maximum Daily Loads (TMDLs) for PCBs in the Delaware Estuary and its tributaries. The data and information collected will also be used to identify other contaminants that may need TMDLs or other clean up actions in order to restore water quality.

The WATAR work plan identifies 8 specific activities for 2015. Those 8 activities are listed below with a status report on each. In addition to the 8 items, there were numerous additional activities that arose during 2015 which the WATAR Team became involved in. Those activities are listed and discussed at the end of this progress report.

1. **Continue data compilation**
   Status: Ongoing
   Discussion: As of December 31, 2015, all WATAR data collected during 2013 and 2014 has been successfully entered into the EQUiS database. Not all data collected during 2015 have been received from the laboratories yet and so some but not all 2015 data have been entered into EQUiS as of December 31, 2015. As of the publication of this document, all but a small fraction of the data collected during 2015 have been received and entered into the EQUiS database. Data collected at sites that have used the high-resolution forensic-grade WATAR sampling approach along with the data from the PCB Mass Loading Study (noted below) have been imported into EQUiS as part of the overall data compilation effort.

2. **Update Quality Assurance Protection Plan (QAPP) for 2015 toxics monitoring**
   Status: Completed
   Discussion: The WATAR program operates under an existing QAPP developed by DNREC's Environmental Laboratory Section (ELS) and a separate QAPP developed by DNREC's Site Investigation and Restoration Section (SIRS). Field and laboratory procedures used by the WATAR program that go beyond what is covered in those existing QAPPs are fully documented in detailed project-specific Sampling and Analysis Plans (SAPs) developed each year (see next item).

3. **Perform toxics monitoring in the Christina Basin and Shellpot Creek watershed in accordance with the QAPP/Sampling Analysis Plan (SAP)**
   Status: Completed
   Discussion: The WATAR team completed an unprecedented sampling effort to characterize toxic substances in the water, sediment and fish in the Christina Basin and Shellpot Creek in northern New Castle County, Delaware. All samples specified in the SAP were successfully collected during the period 12 October 2015 through 4 November 2015. Approximately three dozen people from five separate DNREC Divisions were involved in the effort: the Division of Watershed Stewardship (DWS); the Division of Waste and Hazardous Substances (DWHS); the Division of Water (DW); the Division of Fish and Wildlife (DFW); and the Division of Parks and Recreation (DPR). In addition, personnel from the Delaware River Basin Commission (DRBC) also complemented the Department's efforts by collecting surface water samples that were tested for toxicity using laboratory bioassays. Coordination also occurred between the Department and the National Park Service, who manages lands along the Brandywine Creek in Beaver Valley near Smith Bridge as part of the First State National Historical Park. Several positive interactions between the sampling teams and the public occurred in the field during the sampling campaign. When the public asked what was occurring, DNREC provided details and feedback was consistently positive and supportive. Additional positive public support was received in response to a full length video produced by the DNREC Public Affairs Office describing the sampling effort and how it relates to the WATAR Program. That video is available at the following URL: https://www.youtube.com/watch?v=r_rIGEXd9mA.

   All samples were submitted to the various specialty laboratories for analysis. Following receipt of the data, detailed assessments will be performed, including: an assessment of current conditions; an assessment of long-term trends; a determination whether fish advisories can be adjusted; identification of areas of concern with regard to contaminants in sediments; and identification of linkages between upland sources and in-stream impacts.

4. **Continue to provide technical assistance to the City of Wilmington and the New Castle County Department of Special Services on the City's PCB trackback effort**
   Status: Ongoing
   Discussion: As a follow-up to a meeting between the City, County, DNREC and the DRBC, the WATAR team analyzed 10 years of PCB effluent data generated by the City during TMDL development and PCB Pollution Minimization Plan (PMP) implementation. We documented that PCB concentration and mass-load has dropped exponentially over the period and, that the gross reduction has been approximately 90%. This exceeds the 70% reduction documented by the DRBC for all major National Pollutant Discharge Elimination System (NPDES) discharges in the Delaware Estuary. SIRS completed an extensive site data and site specific fact sheet compilation in response to a City of Wilmington Freedom of Information Act (FOIA) request submitted in support of the track-back study. Data sets were generated from the EQUiS database and transmitted for all of the

sites above the Chesapeake and Delaware (C+D) Canal that had undergone a PCB mass-loading analysis for soil and groundwater. The FOIA requested a site specific fact sheet for all sites above the C+D Canal. This request was completed in an expedited fashion though a team effort within SIRS.

In a related effort, members of the WATAR team, the County, and the DRBC met with pigment manufacturer BASF to discuss progress on BASF's internal PCB trackdown effort. BASF verified that PCBs are being inadvertently produced in their manufacturing process and pledged to substantially reduce the amount of PCB discharged to the County sewer (which flows to the City of Wilmington's wastewater treatment plant). BASF is currently evaluating engineering controls to abate the release to the sewer.

5. **Finalize HSCA Sediment Guidance**
   Status: Not completed
   Discussion: An overarching framework/technical guidance document for assessing contaminated sediments was not completed in 2015. However, an initial outline of the document was completed in 2015. Furthermore, the WATAR team documented several of its sediment quality screening assessment procedures and data evaluation methods based on previous site-specific assessments it has completed. That documentation will eventually become part of the guidance document. The WATAR Team intends to make development of its sediment quality assessment guidance a priority during 2016.

   While the HSCA Sediment Guidance was not completed during 2015, other in-roads were made that enhanced the HSCA program's approach to assessing contaminated sediments, specifically those contaminated with PCBs. The "Policy for Polychlorinated Biphenyl (PCB) Analysis Method 11/24/ 2014 (Effective January 1, 2015) standardizes the use of EPA Method 680, at a minimum, when sampling at HSCA sites. This method is more effective at detecting weathered PCBs in the environment than the previous standard EPA Method 8082. While not as sensitive or precise as EPA Method 1668, EPA Method 680 will improve DNREC's ability to detect historic releases of PCB to the environment.
   http://www.dnrec.delaware.gov/dwhs/SIRB/Documents/Policy%20for%20Polychorinated%20Biphenyl%20Analysis%20Method.pdf

   Also noteworthy with regard to this task is that, at the end of 2015, a WATAR Team member was invited to join an ASTM International Task Group related to development of a national standard guide for Sediment Corrective Actions. Involvement in this task group will help to ensure that Delaware's sediment guidance is developed in accordance with the rapidly advancing science of sediment assessment and management.

   A final point regarding this task is that the WATAR Team reached out to EPA headquarters in August 2015 to find out if there might be some seed money available to States interested in furthering their sediment quality assessment/management programs. No reply was received.

6. **Roll out pilot web-based mapping utility**
   Status: Not completed
   Discussion: The WATAR team selected the Saint Jones watershed as its pilot for the web-based mapping utility.

Evaluation of a web-based mapping utility by the WATAR team between 2014 and 2015 resulted in the conclusion that it would be best to wait until we have a more substantial data set (as opposed to a single watershed) to justify the cost associated with utility development. As work continues to progress with the EQUiS database and historic data entry of WATAR -type data, a re-evaluation and cost/benefit analysis will be completed for a comprehensive and user friendly web-based mapping utility.

7. **Continue tech transfer**
   Status: Ongoing
   Discussion: Calendar year 2015 marked the end of the third full year of the WATAR program. Tech transfer is ever-occurring, both inside and outside of the Department. A summary of presentations and publications by WATAR Team members is summarized below. While more difficult to document, the WATAR Team gathers on a regular basis to provide insight from lessons learned on projects amongst technical peers as well as newly hired staff within DNREC. These meetings are part of the technical and policy mentoring that the WATAR team has implemented through this plan.

8. **Progress Report and Accounting for items listed above**
   Status: Completed
   Discussion: This document represents the Progress Report for 2015.

Other significant activities of the WATAR Team during 2015 are presented below.

- **Saint Jones Watershed and Tar Ditch Storm-water Drainage System:** The Saint Jones River watershed was selected by the WATAR Team as its priority watershed. WATAR sampling was first performed in the Saint Jones watershed in the fall of 2013. Among other things, that work revealed elevated concentrations of polyaromatic hydrocarbons (PAHs) in water and sediment of the Saint Jones River between Court Street and Route 13. PAHs in the sediments were predicted to be high enough to cause toxicity to benthic aquatic life. It was unclear at the time whether this was largely a legacy issue or whether there was ongoing release from a local source. Our suspicions turned to the Tar Ditch storm-water conveyance system in southern Dover, DE, which came by its name based upon impacts imparted by the Dover Gas Light Federal Superfund Site (DE-0057) more than a half century ago. The WATAR Team briefed EPA Region 3 Superfund Program about our findings and our intention to perform an investigation of the Tar Ditch conveyance system and the Saint Jones River to verify or refute that suspicion. The WATAR Team developed a detailed project-specific Sampling and Analysis Plan (SAP) which was executed in late summer of 2015. That work was complemented with sampling of the Saint Jones River that included whole and filtered water samples; passive samplers in the water column, shallow sediment and deep sediment; bulk sediment chemistry; sediment toxicity tests; sediment bioaccumulation tests; and fish tissue testing. The work in the River is a collaborative effort between the WATAR Team and Dr. Upal Ghosh from University of Maryland, Baltimore County (UMBC) who is an international expert in sediment bioavailability and in-situ sediment treatment technology. The data from the Tar Ditch storm-water conveyance system and the Saint Jones River is being used to: assess the spatial distribution of PAH contamination in the area; assess contemporary PAH mass loading from Tar Ditch vs upstream Saint Jones vs downstream Saint Jones vs groundwater vs diffusive flux from legacy contamination in sediments; confirm or refute the predicted sediment toxicity; and ultimately, whether the tidal Saint Jones River between Court Street and Route 13 is a good candidate for sediment remediation.

  In a related activity, the City of Dover (Dover) is planning to make major modifications to the Tar Ditch storm-water conveyance system to alleviate flooding at the BayHealth regional hospital and to improve storm-water management (municipal separate storm-water sewer system - MS4) in the area. The WATAR Team assisted Dover on the project by collecting and analyzing soil samples along the new storm-water system alignment. The data is being used by Dover to assess proper handling and disposal of the excavated soils.

  Also in the Saint Jones watershed during 2015, the WATAR Team worked with the DNREC NPDES group and the DRBC to ensure that the McKee Run Generating Station in Dover, DE contained a proper PCB Pollutant Minimization Plan (PMP) requirement in their NPDES Permit (DE0050466). PCBs are known to be released from this facility through their NPDES discharge. The purpose of the PCB PMP is to identify and eliminate the source(s) contributing to the release from this facility. The PMP requirement was incorporated into the permit and the permitee submitted a PCB PMP to DNREC and the DRBC in April of 2015. The PMP was accepted and deemed complete in late 2015.

  Finally during 2015, the WATAR Team provided the DRBC with extensive PCB data that the WATAR Team had collected in the Saint Jones River watershed during 2013 and 2014. The DRBC requested the data to help them update the Delaware Estuary PCB TMDL. As an aside, similar WATAR data was provide to the DRBC for the Chesapeake & Delaware Canal, the Red Lion Creek watershed, the Army Creek watershed, and the Appoquinimink watershed.

- **New Castle County and DelDOT MS4 Permit PCB PMP:** The WATAR Team coordinated with New Castle County Special Services and DelDOT on PCB PMP monitoring requirements in the County and DelDOT's MS4 NPDES permit. The coordination led to successful PCB storm-water sampling of the Army Creek and Appoquinimink watersheds in 2015. The storm-water data collected by the County and DelDOT will complement the receiving water data previously collected by the WATAR team in these same watersheds. This will provide a more complete picture of sources and sinks of PCBs in these watersheds.

  Also during 2015, the WATAR Team worked with New Castle County and DelDOT on selecting suitable sites in the Christina Basin and Shellpot Creek watersheds for MS4 PCB storm-water sampling. A sampling and analysis plan was not finalized by the end of the year. Actual PCB storm-water sampling is expected to occur in 2016.

  Data from these sampling events will be utilized for the drafting of the 2014 and 2015 WATAR data reports. The data will provide the WATAR team with evidence that may link sink to source and therefore providing compelling information to require remediation and restoration.

- **Phase II PCB Mass Loading Study of Hazardous Substance Release Sites in Delaware under the Hazardous Substance Control Act (HSCA):** With contractor assistance, the WATAR Team completed Phase II of the PCB Mass Loading Study of Hazardous Substance Release Sites in Delaware (http://www.dnrec.delaware.gov/dwhs/Info/Pages/Phase-II---PCB-Mass-Loading-in-Delaware.aspx). Phase II was a Statewide effort that followed up on Phase I, which focused on the Christina Basin and Shellpot Creek watershed in northern New Castle County, DE. Both Phase I and Phase II reports summarize PCB data at hazardous substance release sites in Delaware and provide estimates of PCB release to surface waters via overland flow and groundwater discharge from each site. This work provides a basis for prioritizing cleanups, implementing the Delaware Estuary PCB TMDL, and tracking progress into the future. The News Journal ran a feature article on this project (http://delonline.us/1UTK2kD). The article showcased the important work being done by Delaware's WATAR Team and the connection between legacy pollutants like PCBs, fish contamination and fish advisories.

- **Interface between WATAR Team and Delaware's Toxics in Biota Committee (Fish Advisories):** The WATAR Team, in accordance with its 5-year plan, collects fish tissue samples from 303d toxics-listed Delaware watersheds. The Delaware Toxics in Biota Committee reviews such data and makes recommendations to the Secretary of DNREC and the Secretary of the Department of Health and Social Services (DHSS) when new or revised fish consumption advisories may be needed. Based on fish tissue data that the WATAR Team had collected in the fall of 2014, DNREC and DHSS issued revised fish consumption advisories for the Army Creek watershed and the Appoquinimink watershed. The revised advisories were announced on September 11, 2015 (http://www.dnrec.delaware.gov/fw/Fisheries/Pages/Advisories.aspx). Overall, the revisions reflect long-term improvements and lower risk associated with consuming fish from these waters.

- **Mirror Lake Post-Treatment Monitoring:** Data collected in October/November 2014, one year after placement of the activated carbon product, SediMite™ into the sediments of Mirror Lake, were received in early 2015. Data collected immediately before and one year after activated carbon treatment shows: 78% reduction of dissolved PCB concentrations in the sediment pore water; 72% reduction of dissolved PCB in the water column; and 60% reduction in total PCB in resident fish within Mirror Lake. Based on modeling forecasts, this degree of reduction in the fish would have

required 20 years to accomplish if the lake had not been treated with activated carbon. This was the first full scale application of activated carbon to sediments anywhere in the United States. Based on the innovative approach and early performance data, the project was awarded second place in the nation in the small projects category (<$5M) by the American Academy of Environmental Engineers & Scientists. During 2015, the WATAR Team presented its findings at several conferences, including the Battelle Sediment Remediation Conference and the Society of Environmental Toxicology and Chemistry (SETAC) Conference. We were also contacted by sediment researchers and practitioners from around the country during 2015 regarding the project. Another full round of water, sediment and fish tissue sampling is scheduled for the fall of 2016.

- **Little Mill Creek Flood Risk Mitigation Project – Meco Drive Remediation**: The Little Mill Creek Flood Risk Mitigation Project was completed in the summer of 2015. This project, spearheaded by the US Army Corps of Engineers (USACE), the New Castle Conservation District (NCCD), DNREC, and New Castle County, commenced in 2014. The project involved excavation and removal of bank soils and creek sediments to increase hydraulic storage capacity and decrease flooding of nearby properties. Planning for the project relied heavily on the expertise of the WATAR Team to determine the nature and extent of contamination in the bank soils and creek sediments to be excavated. The WATAR Team also ensured that remedial action in Meco Ditch occurred well before initiation of the Little Mill Creek project so that Meco Ditch would not recontaminate the completed Little Mill Creek project. The remediation employed typical excavation methods for mass removal of toxic contaminants but also employed mats containing activated carbon to sorb residual contamination that could not be easily removed due to the industrial park setting. In addition, a particularly innovative feature of the Little Mill Creek project involved application of activated carbon to contaminated sediments in Little Mill Creek directly adjacent to and downstream of the Meco Ditch remediation project. The WATAR Team worked with the USACE to define the area that needed to be treated with activated carbon, the appropriate dose, and how the carbon should be incorporated into the sediments. A major press event involving Federal, State, and New Castle County officials was held at the project site on September 21, 2015 to announce successful completion of the project. The critical role of the WATAR Team in the project was noted during the event. Several videos are on the DNREC YouTube page that describe the work that was completed at the Meco Drive Site (De-1103) Little Mill Creek Flood Risk Mitigation Project.

- **NVF Zinc Remediation:** The WATAR Team continued to monitor zinc concentrations in the Red Clay Creek, track compliance with the zinc TMDL and NVF Wasteload Allocation, and provide management of the NVF Yorklyn site cleanup and oversight of the redevelopment effort. In March 2015, two new ground-water recovery wells were installed, adding to the three already operating on site. During 2015, these 5 wells recovered a total of 9,815 pounds of zinc from the groundwater. Since 2008 when the groundwater recovery system was installed, an estimated 75,000 pounds (37.5 tons) of zinc has been kept from entering the Red Clay Creek through groundwater discharge. In July 2015, SIRS issued a Final Plan of Remedial Action for operable unit #2 (i.e. 5 acre are including Mill #6 and surrounding land). In December of 2015, SIRS proposed a plan of remedial action for operable unit #1 (i.e., 11 acre area containing the majority of the former mill buildings and structures) and operable unit #3 (i.e., 3 acre area containing NVF Mill #1). The proposed plan for operable unit #1 includes significant soil source removal and continued groundwater treatment. Final Plans of Remedial Action were issued in January 2016. This site is well on its way to being cleaned up and repurposed into productive use.

- **Red Lion Creek Wetlands:** The WATAR Team worked with the EPA Region 3 Superfund Program on a technical evaluation of chlorobenzene contamination in wetland sediments impacted by a catastrophic release approximately 30 years ago at the Standard Chlorine of Delaware (a.k.a. Metachem) site in Delaware City, DE. The evaluation predicted the magnitude and extent of toxicity in the sediments; predicted the extent of dense non-aqueous-phase liquids (DNAPL) in the sediments; assessed whether EPA's cleanup objective for chlorobenzenes in wetland sediments is still appropriate; and estimated the volume of contaminated sediment that exceeds the cleanup objective. This and additional information are being used by the EPA and DNREC to evaluate cleanup options and costs. The cost estimates for the remediation of the wetlands are substantial due to the widely-dispersed, highly concentrated chlorobenzene material within the marsh.

- **Supplemental Focused Feasibility Study – Amtrak Former Refueling Facility:** This site represents one of the largest, if not *the* largest, contributor of PCBs to the Brandywine Creek and the Delaware Estuary. DNREC, specifically WATAR Team members, and EPA Region 3 Toxics Substance Control Act (TSCA) staff spent considerable time in 2014 reviewing the Focused Feasibility Study Report and risk assessments submitted by Amtrak's consultant for the site. DNREC and EPA Region 3 TSCA did not agree with all of the technical content in the report submitted by Amtrak's consultant, but was willing to approve it, with conditions, in order to move forward with remediation at the site. Amtrak was not agreeable to DNREC/EPA conditions, and therefore chose to collect an additional 400 soil samples to fill data gaps. DNREC approved the sampling plan in October 2015. The new data as well as previously collected data will be compared to a required, back-calculated, risk based remediation goal for each compound to determine the extent of cleanup required. It is anticipated that a revised Feasibility Study will be submitted to DNREC and EPA in 2016 for review.

  One part of the Feasibility Study that all parties came to agreement on, however, was the use of In-Situ Stabilization for eastern and western drainage ditch sediments. DNREC agreed that the technology seemed viable at the site, but needed better site-specific testing to ensure that it would work at full scale. As a result, in November 2015, DNREC and EPA Region 3 TSCA reviewed and commented on a pilot study work plan for in-situ sediment stabilization. A revised work plan has not been submitted for agency approval as of the writing of this status report.

  Lastly, Amtrak is planning some site improvements that require excavation and dewatering of site soils and groundwater, respectively. Specifically, three projects have been reviewed by DNREC, and Final Plans of Remedial Action have been issued for each project. The DNREC plans require compliance with EPA Region 3TSCA Self-Implementing Cleanup Plans. Further, DNREC permits for the construction projects were required. Due to the complexity of contaminant issues and multiple agency involvement, WATAR Team members have assisted in review of permit applications to ensure that contaminated materials are managed appropriately during intrusive activities.

- **South Wilmington Wetland Assessment Project**: The South Wilmington Wetlands Area (SWWA) is a large remediation, restoration and flood mitigation project along the tidal Christina River in south Wilmington. The WATAR Team is providing comments and technical support to the designers of this project to ensure that the remediation portion of the project meets criteria and objectives. The project reached the final design and feasibility study phase in 2014. Supplemental sampling based upon the final design has defined the new "final" grade following excavation. This new final grade soils were sampled and the material has undergone a bioavailability analysis to determine its toxicity. This analysis follows the WATAR approach to determine if the presence of PCBs in the environment combined with the site-specific characteristics poses a risk to ecological receptors or

not. The application of this bioavailability analysis provided vital information and resulted in an adjustment to the default cleanup standards (and thus the amount of material that requires excavation and disposal) for the project, and allowed for site-specific cleanup goals to be calculated. An updated Ecological Remediation Goals Report was prepared at the end of 2015, and was submitted to DNREC for review in January 2016. Taking the updated report into consideration, a Proposed Plan of Remedial Action will be developed by DNREC and will be published for public comment in early 2016.

- **Former CitiSteel/EVRAZ Claymont Steel Remedial Investigation:** During 2014, WATAR Team members developed a Facility Evaluation Work Plan to investigate potential releases from operation of the former EVRAZ Claymont Steel facility in Claymont, adjacent to the tidal Delaware River. The investigation was designed in the style of WATAR, to investigate surface waters and sediments in the creeks that bisect the site, in addition to upland soil sampling to verify sources of contamination. Work was halted by the potential purchase of the site by a subsidiary of Environmental Liability Transfer, Inc. A Voluntary Cleanup Program agreement was signed in January 2015 between Claymont Properties, LLC (the subsidiary) and DNREC for completion of a Remedial Investigation through Certificate of Completion of Remedy for all unacceptable risk to human health and ecological receptors from releases at the site. During 2015, the site was divided into 5 operable units. A status of each operable unit is summarized below:

  OU-1 (former Scrap Yard)*:* RI Work Plan was approved in August 2015. Fieldwork was completed, and an RI Report was submitted to DNREC-SIRS on February 1, 2016.

  OU-2 (undeveloped land adjacent to Delaware River)*:* No Work Plan has been submitted to DNREC as of yet. Several areas of concern exist on this portion of the property.

  OU-3 (former process and storage facilities): Demolition activities prohibit any environmental work from occurring until completed.

  OU-4 (former cooling water pond)*:* RI Work Plan was approved in June 2015. Fieldwork was completed. An RI Report was submitted to DNREC electronically on November 5, 2015, but the risk assessment was not done properly. DNREC provided comment and direction on the risk assessment, and anticipates a final RI report in early 2016. Discussions

  OU-5 (former product storage area): RI Work Plan was approved in September 2015. Fieldwork was completed. RI report expected in early 2016.

- **I-495 Arsenic Investigation/University of Delaware Partnership:** WATAR Team members negotiated a mutually beneficial partnership with Dr. Don Sparks at the University of Delaware (UD) in 2014 to better characterize arsenic contamination at a site adjacent to the Christina River at the Port of Wilmington. Dr. Sparks, an international recognized expert in soil chemistry, and his students are speciating arsenic from sediment and soil samples collected at the Halby Chemical Superfund Site (DE-0067) and the Potts Property (DE-0169) HSCA site to characterize the nature of and help determine the source of elevated arsenic concentrations detected in a drainage ditch that parallels I-495 near the Port of Wilmington. A draft report was completed by UD in late 2015. The report was provided to the EPA R3 Superfund Program, who manages the Halby Chemical site, who subsequently submitted comments to DNREC in January 2016. Preliminary conclusions suggest that arsenite (3+) may have sourced from the Halby Chemical site and has migrated via natural

groundwater flow under the Potts Property site where it encountered an abundance of the more stable arsenate (5+). Due to the anaerobic conditions below the Potts Site and the abundance of arsenate, the majority of arsenite did not change valence state and continued to migrate through groundwater to the ditch face, where is quickly oxidized and transformed almost entirely to arsenate. DNREC is meeting with Dr. Sparks in early 2016 to discuss results and clarify conclusions prior to issuing a final report to DNREC and EPA. Once the final report is issued, the agencies will meet with potentially responsible parties to discuss a path forward.

- **Chesapeake Bay Toxics:** Delaware is now a signatory State to the Chesapeake Bay Agreement. The Agreement was recently modified to include toxics. The WATAR Team developed a multi-year plan to assess and address toxics in the portion of Delaware that flows to the Chesapeake Bay. The work has been scheduled to begin in 2017 following completion of the current five-year WATAR work plan. Specific tasks include: development of a QAPP; compilation of existing toxics data; collection of new data (including radio-dated sediment cores to characterize trends); and creation of a priority list of sources in need of clean-up and restoration.

- **Interface between WATAR Team and Remediation Funding:** Funding to carry out the existing 5-year WATAR work plan comes from the Watershed Assessment & Management Section (WAMS) and the Site Investigation and Restoration Section (SIRS). Those funds are primarily being used to gather state-of-the-science data on toxics in impacted watersheds so that informed decisions can be made about cleanup activities. The existing WATAR budget does not include funds for actual site and/or watershed remediation or restoration. Funds for cleanup activities typically come from the State HSCA fund and the Federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) funds, where applicable. Further, funds for restoration may come from settlement of Natural Resource Damage (NRDA) claims filed by Federal and State Trustees, or through other sources. State funding allocated to cleaning up WATAR-related sites since 2013 has been significant. Those cleanups include the Mirror Lake assessment and remediation (~$1M), Meco Ditch assessment and remediation (~$400k), Little Mill Creek assessment and remediation (~$350k), South Wilmington Storm-water Pilot Brownfield assessment and planned remediation (~$500k as of drafting), NVF assessment and planned remediation (~$10M total anticipated), Fort DuPont permeable reactive barrier (~$65K) and portions of the Tar Ditch assessment (~$10K). Available funding under HSCA is diminishing, however, based on lower revenue. This has led the WATAR Team to seek alternative sources of funding to supplement and accelerate its cleanup work. One such source is the State of Delaware Water Pollution Control Revolving Fund. The WATAR Team worked with the DNREC's Financial Assistance Branch (FAB) during 2015 to incorporate consideration of toxics into FAB's "Standard Operating Procedures for Establishing the Project Priority List".
  http://www.dnrec.delaware.gov/fab/Documents/Intended%20Use%20Plan%20and%20Project%20Priority%20List/Project%20Priority%20List.pdf

  Another potential future source of funding for WATAR-related projects emerged during 2015. The Delaware State Senate passed Senate Concurrent Resolution No. 30 establishing a Clean Water and Flood Abatement Task Force. The Task Force was established to study and make findings and recommendations regarding ways to improve water quality and alleviate flooding in Delaware. The WATAR Team was asked to make a presentation to the Task Force, which it did on October of 2015 (see title of presentation below). That presentation was well-received. The Task Force also heard the results of a statewide survey commissioned by the Delaware Nature Society to gauge the level of support or opposition for a clean water fee in Delaware. Among the findings, the survey found that

Delaware residents are especially interested in removing toxics from the State's waters and are strongly inclined to support a plan and fee that will address this priority. The Task Force is scheduled to complete its work in March of 2016.

WATAR Related Presentations: Members of the WATAR Team delivered the following presentations during 2015:

- Cargill J. 2015. Remediation and Restoration of Mirror Lake, Dover, Delaware. Presentation dated January 13, 2015. Delaware DNREC. Presentation given at Battelle Conference on Remediation and Management of Contaminated Sediments, New Orleans, LA.
- Cargill J. 2015. Watershed Approach to Toxics Assessment and Restoration. Presentation dated January 14, 2015. Delaware DNREC. Presentation given at Battelle Conference on Remediation and Management of Contaminated Sediments, New Orleans, LA.
- Cargill, J. 2015. Interagency Coordination: Integration of Regulatory Authorities to Optimize Sediment Remediation and Restoration. Delaware DNREC. Panel Discussion on January 14, 2015. Battelle International Conference on Remediation and Management of Contaminated Sediments, New Orleans, LA.
- Keyser T. 2015. Watershed Approach to Toxics Assessment and Restoration. Presentation dated January 26, 2015. Delaware DNREC. Presentation given at Delaware Estuary Science and Environmental Summit, Cape May, NJ.
- Greene R and Cargill J. 2015. Saint Jones River PAH Assessment. Presentation dated April 9, 2015. Delaware DNREC. Presentation given at U.S. EPA Region 3, Philadelphia, PA.
- Cargill, J. 2015. WATAR – Addressing Chemical Contaminants and Legacy Pollutants in Delaware Waterways. Presentation dated May 6, 2015. Presentation given at Delaware Source Water Citizens and Technical Advisory Committee Meeting. Dover, DE.
- Greene R and Cargill J. 2015. Remediation and Restoration of Mirror Lake, Dover, Delaware. Presentation given at the September 16, 2015 walking tour sponsored by the Delaware Chapter of the American Water Resources Association. Dover, DE.
- Cargill, J. 2015. WATAR – Not Just Another Silly Acronym. Presentation dated October 2, 2015. The Delaware Water Well Licensing Board 11th Annual Fall Seminar. Georgetown, DE.
- Keyser T. 2015. Watershed Approach to Toxics Assessment and Restoration – Addressing Chemical Contaminants and Legacy Pollutants in Delaware Waterways. Presentation dated October 15, 2015. Delaware DNREC. Presentation given to the Delaware Clean Water Task Force, Dover, DE.
- Cargill, J. 2015. The Science Behind WATAR. Presentation dated November 17, 2015. Presentation given at DNREC's First Annual Hydro Roundtable. Smyrna, DE.

WATAR-Related Awards: Members of the WATAR Team received the following awards in 2015:

- On April 15, 2015, WATAR Team member R Greene received the DNREC Employee of the Year Award.
- On April 23, 2015, the WATAR Team received an Honor Award from the American Academy of Environmental Engineers & Scientists for the Mirror Lake Remediation and

Restoration Project. The award was given in the small projects category (<$5M) and represents second place nationally. The award ceremony was held at the National Press Club in Washington D.C.

- On May 5, 2015, R Greene received The Delaware Award for Excellence and Commitment in State Service. The award was given in the "innovative idea" category. Governor Markell delivered the award personally and mentioned the new interagency initiative (WATAR) that was developed to more efficiently address toxics problems in the State's waters. He cited the Mirror Lake project as a working example of the approach.

Peer Reviewed Publications: The following article, coauthored by WATAR Team member R Greene, was published in 2015:

Gosnell K, Balcom P, Ortiz V, DiMento B, Schartup A, Greene R, Mason R. 2015. Seasonal Cycling and Transport of Mercury and Methylmercury in the Turbidity Maximum of the Delaware Estuary. Aquat Geochem, Published online 20 November 2015, pp 1 – 24.

In addition, the following two articles published in 2015 cited research previously published by WATAR Team member R Greene:

Fischer D, Yonkos LT, and Staver KW. 2015. Environmental Concerns of Roxarsone in Broiler Poultry Feed and Litter in Maryland, USA. Environ Sci Technol, 49(1): 1999 – 2012.

Howell NL and Rifai HS. 2015. PCDD/F and PCB Water Column Partitioning Examination Using Natural Organic Matter and Black Carbon Partitioning Coefficient Models. Environ Sci Pollut Res, Published online 28 November 2015, pp 1 – 12.

National Organization Involvement: WATAR Team Members play key roles in advancing watershed scale assessment and management of contaminated sediments nationally in 2015:

ITRC Contaminated Sediments Internet Based Training Team. WATAR Team Member is active in the training efforts related to the 2014 publication of the Interstate Technology and Regulatory Council's Remedy Selection for Contaminated Sediments web-based guidance document.

ASTM International Task Group for Developing a New Standard Guide for Sediment Corrective Action. WATAR Team Member was invited to assist with the development of a standardized practice guide(s) for issues related to the assessment/management and remediation of contaminated sediments.

Battelle International Conference on Remediation and Management of Contaminated Sediments. WATAR Team Member was invited to serve on the Technical Advisory Committee for the 2017 Conference to be held in New Orleans in January 2017.