

Watershed Approach to Toxics Assessment and Restoration (WATAR) Program

2017 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 six (6) specific activities for 2017. Those 6 activities are listed below with a status report on each. In addition to the 6 items, there were numerous additional activities that arose during 2017 in which the WATAR team became involved. Those activities are also listed and discussed in this progress report.

1. Continue data compilation

Status: Ongoing

Discussion: As of December 31, 2017, all WATAR data reported during calendar year 2017 has been successfully entered into the EQUiS database. Additional data from samples collected from

Delaware's Chesapeake Basin drainages at the end of 2017 will be entered into the EQUiS database as it is received. Further, data collected at other sites where the high-resolution WATAR sampling approach was followed have been imported into EQUiS as part of the overall data compilation effort.

2. Update Quality Assurance Project Plan (QAPP) for 2017 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 QAPPs or Sampling and Analysis Plans (SAPs) developed each year.

In August 2017, the WATAR team finalized a separate QAPP for submittal to the United States Environmental Protection Agency's Chesapeake Bay Program titled QAPP for Collection and Analysis of Surface Water, Sediment and Fish Tissue Samples for Toxics in Delaware Watersheds that Flow to the Chesapeake Bay.

3. Perform Delaware Estuary striped bass sampling to assess progress on Delaware Estuary PCB TMDL.

Status: Completed

Discussion: Sampling and analysis of striped bass samples from the Delaware Estuary were performed as planned. Results were used to update fish consumption advisories (FCAs) for striped bass from the Delaware Estuary.

<http://www.dnrec.delaware.gov/fw/Fisheries/Pages/Advisories.aspx>.

4. Assess overall status of WATAR program and develop a work plan to carry forward

Status: Ongoing; Draft work plan completed

Discussion: The WATAR Team expects to finalize its next 5-year plan, which will cover 2018 through 2022, in early 2018.

5. Continue tech transfer

Status: Ongoing

Discussion: Calendar year 2017 marked the end of the fifth full year of the WATAR Program. Tech transfer is constantly occurring, both inside and outside of the Department. A summary of presentations and publications by WATAR team members is included. 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.

6. Progress Report and Accounting for items listed above

Status: Completed

Discussion: This document represents the Progress Report for 2017.

Ongoing/Unfinished Work from Previous Years

HSCA Sediment Guidance

Status: Not completed

Discussion: An overarching framework/technical guidance document for assessing contaminated sediments has not been completed. However, an initial outline of the document was completed in 2015/2016. Furthermore, the WATAR team has documented several of its sediment quality screening assessment procedures and data evaluation methods based on previous site-specific assessments. That documentation will eventually become part of the guidance document. The WATAR team intends to increase attention to this task during 2018.

Roll out pilot web-based mapping utility

Status: Not completed

Discussion: As indicated in the WATAR 2015 and 2016 Summary Report, 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 to justify the cost associated with third party utility development. However, just recently, the EQUiS Enterprise utility was configured to allow some basic data mapping, by location and concentration, to occur. DNREC is continually working to expand data import/export capabilities utilizing the software that is already owned by the Department. As work continues to progress with the EQUiS database, a re-evaluation and cost/benefit analysis will be completed for a comprehensive and user friendly third party web-based mapping utility.

Other significant activities of the WATAR Team during 2017 are presented below.

- **Chesapeake Drainage Sampling:** On June 16, 2014, Governor Jack Markell signed the new Chesapeake Bay Watershed Agreement. The Agreement included a goal to “ensure that the Bay and its rivers are free of effects of toxic contaminants on living resources and human health.” In response, the DNREC-WATAR team developed a multi-year plan to assess and address toxics in the portion of Delaware that flows to the Chesapeake Bay. Preliminary planning was conducted in 2016, field reconnaissance was conducted in early-mid 2017, a compilation of existing toxics data was completed in June 2017, development of a QAPP was completed in July 2017, and collection of new data was completed in November 2017.

Between October 30, 2017 and November 21, 2017, all samples specified in the QAPP were successfully collected, including sediment, surface water, and fish tissue from select locations. Personnel from four 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).

All samples were submitted to various specialty laboratories for analysis, including WATAR’s usual targets of PCBs, DxF, OC pesticides, PAHs and metals in water, sediment and fish. Since much of the area that flows into the Chesapeake is dominated by agriculture, the WATAR Team expanded the target list of analytes to include contemporary herbicides, insecticides and some other ag-related compounds. Sampling for many of these compounds is scheduled for 2018.

Following receipt of all data, detailed assessments will be performed, including: i) an assessment of current conditions; ii) an assessment of long-term trends (as data permit); iii) a determination

whether fish consumption advisories may be needed; iv) identification of areas of concern with regard to contaminants in sediments; and v) identification of linkages between upland sources and in-stream impacts.

- **Sediment Coring Study from the Tidal Nanticoke River:** As part of the 2017 WATAR-Chesapeake Drainage Sampling, DNREC contracted its partners at the University of Delaware to collect and radiodate sediment cores at two strategic locations in the Nanticoke River (one at the DE/MD state line and another near Seaford). The objective is to establish the relationship between sediment depth and age and to characterize the associated pollution history of the Nanticoke River over a period from approximately WWII up until present. By the end of 2017, the sediment cores had been collected; the cores had been sectioned into 2 centimeter intervals; subsamples for contaminant analyses had been collected/archived; and preliminary radiodated had been performed. Based on the final results of the radiodating (expected mid-2018), DNREC will select samples for contaminant analyses.
- **Christina River Geophysical and Bathymetric Surveys & Sediment Sampling in both the Lower Christina River & Brandywine Creek:** During 2017, DNREC's WATAR Team provided the Christina Conservancy a proposed scope-of-work for bathymetric, sedimentological and geophysical mapping of the tidal Christina River between I-95 (Peterson Marsh) and its mouth, including a portion of the tidal Brandywine River. The scope-of-work was requested by the Conservancy in their effort to assist DNREC in identifying and quantifying the geographic extent of sediment depositional zones within the area. The work will also help DNREC, the Christina Conservancy and others to locate partially or completely buried/submerged objects that could serve as hazards or obstacles during any major sediment excavation project of the River. The Christina Conservancy contracted with AquaSurvey, Inc., who completed all sonar work in December 2017. Sampling of surface and deep sediments is scheduled for early 2018 to ground truth the sonar data. A specific objective of the study is to create a comprehensive map of sedimentary environments with respect to bottom morphology and sediment type that can later be used as a baseline for development of a Feasibility Study of options to remediate contaminated sediments within the area of interest.
- **DRBC Toxics Advisory Committee and Review of Stage II Delaware River PCB TMDL :** DNREC's WATAR team is represented on the DRBC Toxics Advisory Committee and assisted with following items in 2017:
 - Provided detailed comments on the Draft Stage 2 PCB TMDL for the Delaware Estuary. Water, sediment and fish data sets, along with interpretation of conditions and trends, have been shared with DRBC for TMDL development. In addition, a review and edit of current loads from Delaware waste sites was completed and provided to DRBC for inclusion in the TMDL document.
 - Coordination of fish sampling for toxics in the Delaware Estuary in 2017 so that combined efforts of the WATAR team, NJDEP and the DRBC were complementary.
- **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 303(d) toxics-listed Delaware watersheds. The Delaware Toxics in Biota Committee reviews these 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 2016 and 2017, DNREC and DHSS issued revised fish consumption advisories for the tidal Delaware River, lower Delaware River and Delaware Bay, Atlantic Coastal waters, Waples Pond, Prime Hook Creek and Slaughter Creek. The revised advisories were announced on February 19, 2018 (<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 most of these waters.

- **Public Outreach/Advisory Signs:** Fish consumption advisories are communicated to the public in various ways, including a DNREC/DHSS press release issued to regional media outlets and to DNREC's extensive list serve. The release and updated fish consumption advisories table are posted to DNREC's website and the table and recommendations outlining ways the public can reduce their exposure to fish contaminants are included in Delaware Annual Fishing Guide produced by the Division of Fish & Wildlife. Approximately 100,000 copies of the 2017 Guide were distributed through December 2017.

Due to lack of funding and manpower resources, DPH/DNREC have been unable to maintain and update advisory signage. Many of the signs now include outdated advisories and contact information, and several of them have been removed or destroyed by citizens. The Committee is developing a plan to secure funding for a project that will modify and post existing signage. The project includes:

- Developing a Community Environmental Project Fund grant proposal.
 - Modifying existing signage with new messaging that includes updated advisories, contact information, a web link sticker, and a QR (Quick Response) Code that can be scanned by a smartphone for access to DNREC's website
 - Developing a GPS plan for posting signs.
 - Securing a volunteer organization or contractor to post signs along waterways throughout the state
 - Updating *Fish, Smart, Eat Smart* brochure (English/Spanish); print and distribute new brochures. Post brochures on DNREC's website.
- **Calculation of Delaware Specific Bioaccumulation Factors for Delaware:** In 2016, the WATAR Team reported that Delaware specific BAFs may be much lower than some of the BAFs used by USEPA to derive national recommended human health water quality criteria (specifically for B[a]P). This evaluation was based upon Delaware's unique set of WATAR data. Based on the strength of the analysis, EPA has agreed to consider a Delaware proposal to adopt Delaware-specific human health criteria using Delaware-specific BAFs. Compilation of data necessary to complete BAF calculations from Delaware's robust data set was partially completed in 2017, and is ongoing. It is anticipated that Delaware's comprehensive evaluation of State-specific BAFs will be completed in 2018.
 - **Review of DNREC Environmental Laboratory Section (ELS) metals data generated by ICP-MS:** The ELS began generating metals data for surface water samples in late 2015 using ICP-MS. ICP-MS is the gold standard for the analysis of metals in environmental samples. It is more sensitive and more accurate than standard methods. These attributes are very important in the assessment of metals data used by DNREC in Clean Water Act Section 303(d) listing decisions. Delaware's 2016 303(d) List for metals is based on data generated between 2010 and 2014 using a less sensitive instrument

(atomic absorption spectrometry). The WATAR review indicates that many of those listings will be able to be delisted once there is a minimum of 3 years' worth of data generated using the new ICP-MS equipment.

- **Saint Jones/Tar Ditch Coring Study by USEPA:** 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 October 2013, followed quickly by the Mirror Lake Remediation and Restoration Project in November 2013. Additional extensive sampling and analysis was conducted in 2015 in the area downstream of Mirror Lake to Route 13. Among other findings, that work revealed elevated concentrations of polyaromatic hydrocarbons (PAHs) in the Saint Jones River between Court Street and Route 13. In partnership with University of Maryland – Baltimore County (UMBC) professor Upal Ghosh, DNREC's modeled toxicity to benthic aquatic life was confirmed; potential upland watershed sources of PAHs were evaluated; multiple lines of evidence were collected to support the hypothesis that historic contamination associated with the former Dover Gas Light NPL site (coal gasification plant) is responsible for the current impacts within the study area; and in-situ carbon amendment to sediments, among other remedial technologies, may be effective in reducing/eliminating measured toxicity. The results of the assessment were presented to an EPA project team for evaluation in February 2017.

In response to DNREC's presentation, USEPA's Environmental Response Team (ERT) developed a QAPP for sediment coring and PAH sample collected in the area of concern identified in 2013 and further studied in 2015. In August 2017, ERT mobilized to the site with a mobile laboratory and collected approximately 30 cores from the Saint Jones River, and to deploy passive samplers into the subsurface sediments. Data reported from the mobile laboratory confirmed DNREC's hypothesis regarding the location of PAHs in the system. Passive samplers were collected in September 2017 for further analysis by USEPA. A final report from USEPA is anticipated in 2018.

- **City of Wilmington, New Castle County and DeIDOT MS4 Permit PCB PMP:** The WATAR team coordinated with the City of Wilmington, New Castle County Special Services and DeIDOT on PCB PMP monitoring requirements in respective point source and MS4 NPDES permits. As part of the effort, a previously reported 90% reduction in PCB concentrations and mass loading from the Wilmington wastewater treatment plant effluent was re-evaluated with more recent data from the DRBC. The evaluation showed that the City of Wilmington is continuing to make progress in minimizing the release of PCBs to the Delaware Estuary. For MS4s, the WATAR team completed a detailed assessment of PCB data for stormwater runoff samples collected by New Castle County and DeIDOT. That assessment was provided to the DRBC to incorporate the information into a revised Stage 2 PCB TMDL for the Delaware Estuary.

These and other data continue to provide the WATAR team with evidence that links sources and sinks, therefore providing compelling information to require remediation and restoration.

- **BASF Inadvertent PCB Production:**

As part of PCB PMP trackback efforts in 2014-2015, BASF (a pigment manufacturer in Newport, DE) was identified as a potentially important source of PCBs entering the New Castle County sewer system. After reviewing DNREC's lines of evidence, BASF confirmed that they were inadvertently producing PCBs as a byproduct of their manufacturing process. They also noted that PCBs may be present in raw materials used in their pigment manufacturing process. During 2016 and 2017, BASF

installed and tested a pilot treatment unit at their facility to remove particulate PCB from their effluent to the New Castle County sewer. The company has had trouble consistently operating the unit but is committed to resolving that problem. In addition, the company is working with its suppliers to identify and minimize PCBs in raw materials.

- **Mirror Lake Post-Treatment Monitoring:** Sediment, surface water and fish samples (as well as passive samplers in sediment and surface water) were collected from the Mirror Lake Remediation and Restoration project area in Fall 2016, three years after the activated carbon product SediMite™ was incorporated into the sediments of Mirror Lake. Results from data analyses were received from UMBC in early-mid 2017.

Data collected from the site in October/November 2014, one year after remediation, showed: 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. Similar data collected in 2016, three years after remediation, showed: 61% reduction of dissolved PCB concentrations in the sediment pore water; 80% reduction of dissolved PCB in the water column; and 56% to 87% reduction in total PCB in fish within Mirror Lake, dependent upon species.

Overall reductions in PCB concentrations are slightly less than expected, and is likely the result of residual transport of PCBs into Mirror Lake from both upstream and downstream sources. However, the system recovery has been accelerated by approximately 20 years as compared to equivalent models of Monitored Natural Recovery. Key results from the study are being summarized in a journal article that should be completed by summer 2018.

- **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. DNREC will have the sampling and analysis report for this project completed in spring 2017. The report details the expedited sampling methodology, risk-based approach to analysis of the data obtained and the final disposition of the bank-side soil that was excavated to complete the flood risk mitigation project in LMC. The project partners responded to unanticipated contaminant conditions using methods employed by the WATAR team. The WATAR team drafted a sampling and analysis plan (SAP) to assess changes in Meco Ditch and Little Mill Creek following completion of the construction phase of the Little Mill Creek Flood Mitigation Project and Meco Ditch Remediation Project. The team was unable to complete the sampling in 2017 due to inclement weather and extreme temperatures.
- **NVF Zinc Remediation:** The WATAR team continues to monitor zinc concentrations in the Red Clay Creek, track compliance with the zinc TMDL and NVF Waste Load Allocation, and provide management of the NVF-Yorklyn site cleanup and oversight of the redevelopment effort. In December 2016, earthwork began on a large scale source removal effort at the former vulcanized fiber manufacturing facility. By mid-2017, earthwork was completed and a new 2-acre wetland was constructed in the area where zinc contaminated soils were removed, thus providing flood storage during heavy rain events. The remediation work was funded through DNREC's Clean Water State Revolving Loan Fund, and represents the first time these funds have been used for remediation

purposes in Delaware. The project was recognized by the USEPA for its innovative use of funds and unique partnerships through receipt of a USEAP PISCES award (summarized in more detail below).

In addition, an unanticipated sewer line rupture in late 2017 forced DRNEC to temporarily shut down the existing zinc groundwater treatment system during the cold winter months (to protect an existing New Castle County sewer line adjacent to the site. DNREC's WATAR Team is utilizing the opportunity to conduct a 3 month long system shutdown test to determine if the remediation efforts for the soil source were successful enough to protect the Red Clay Creek from dissolved zinc in groundwater discharge at the site.

- **Supplemental Focused Feasibility Study (FFS) – 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) received a final Focused Feasibility Study (FFS) on June 30, 2017. Due to the complexity of the site and the proposed remedial actions, DNREC and TSCA are still in the process of reviewing the report. Environmental investigation work on the adjacent Maintenance Facility property is ongoing. A Final Plan of Remedial Action is expected by summer 2018.
- **Amtrak West Yard:** The Amtrak West Yard site is located west of Wilmington in close proximity to Little Mill Creek and the Peterson Wildlife Area. Cleanup of this site is being overseen by DNREC-SIRS through its Voluntary Cleanup Program. Sampling of Little Mill Creek in anticipation of the Meco Drive ditch remediation and the Little Mill Creek flood risk mitigation project identified the Amtrak West Yards as a probable source of PCB loading to Little Mill Creek and the Christina River. These data along with data collected as part of a USACE project to restore wetlands on the site indicated significant levels of PCBs in site soils directly adjacent to the wetlands. Amtrak submitted a remedial investigation work plan that included all existing data points along with a plan to collect additional soil, sediment, and groundwater samples across the site. DNREC-SIRS approved the work plan at the end of 2016. The work to investigate and evaluate the site began in spring 2017 with the report pending in early 2018.
- **South Wilmington Wetland Assessment Project/A Street Ditch Assessment:** 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. A Final Plan of Remedial Action was issued in January 2017. Construction is anticipated to begin in the summer of 2018, with some of the excavated soils approved for use in the Former CitiSteel Operable Unit 4 remedial activities.

In addition to the wetland project footprint, WATAR team members conducted a cursory review of data collected in 2015 and more in late 2017 from the ditch that provides flow in and out of the proposed South Wilmington Wetland. Elevated levels of PCBs have been confirmed, and need to be remediated along with, or prior to the construction of the new wetland. The WATAR team is assisting with the development a plan for remediating the ditch.

- **Former CitiSteel/EVRAZ Claymont Steel Remedial Investigation (RI):** 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 420+ acre site located on the Delaware River in Claymont, Delaware. The site has been divided into 7 operable units. A status of each operable unit is summarized below:

OU-1 (former Scrap Yard): Final Plan of Remedial Action was issued in June 2016

OU-2 (undeveloped land adjacent to Delaware River): Remedial Investigation report review in progress. Several areas of concern exist on this portion of the property.

OU-3 (former process and storage facilities): Remedial Investigation report review in progress. Several areas of concern exist on this portion of the property.

OU-4 (former cooling water pond): Final Plan of Remedial Action was issued in July 2016. The former cooling pond must be closed/filled. DNREC is expecting a Remedial Action Work Plan soon that contains a component of Delaware River Dredging and placement of dredge spoils within the former cooling water pond.

OU-5 (former product storage area): Final Plan of Remedial Action was issued in July 2016.

OU-6 (former administrative building area): Final Plan of Remedial Action issued in January 2017.

OU-7 (Area planned for new Claymont Train Station): Final Plan of Remedial Action issued in December 2017.

- **Del Chapel Zinc:** Currently, the WATAR team is evaluating whether the mobile zinc groundwater treatment system that has been in operation at the NVF-Yorklyn site since 2008 can be retrofitted into a cleanup strategy at the Del Chapel site. WATAR team members have been assisting DNREC SIRS staff in monitoring and assessing surface water downstream of the Del Chapel Site in Newark, Delaware for several years. Zinc contamination associated with a former vulcanized fiber production facility discharges to a small tributary that flows into Cool Run, which in turn flows into the White Clay Creek near Ogetown, Delaware. Groundwater at the Del Chapel site was previously treated with magnesium hydroxide to precipitate dissolved zinc and prevent it from discharging to surface water. The approach worked for approximately 5 years, but zinc levels in surface water are starting to increase.

WATAR Related Presentations: Members of the WATAR team delivered the following presentations during 2016:

- Cargill IV, J.G., 2017. ITRC Contaminated Sediments Guidance, Battelle Ninth International Conference on Remediation and Management of Contaminated Sediments, US and International Sediment Guidance Compendium Short Course, New Orleans, LA, January 9, 2017.
- Cargill IV, J.G., 2017. ASTM International – New Standard Guides for Sediment Corrective Action, Battelle Ninth International Conference on Remediation and Management of Contaminated Sediments, US and International Sediment Guidance Compendium Short Course, New Orleans, LA, January 9, 2017.
- Cargill IV, J.G., 2017. Delaware’s Watershed Approach to Toxics Assessment and Restoration (WATAR), Presentation given as part of Battelle Ninth International Conference on Remediation and Management of Contaminated Sediments, Panel Discussion titled CERCLA

and Clean Water Act Cross-Program Coordination Strategies, New Orleans, LA, January 10, 2017.

- Greene R. W., Cargill J.G. and Ghosh U., 2017. St. Jones River & Tar Ditch PAH Assessment. Presentation made to EPA Superfund Program at DNREC, New Castle, DE, February 15, 2017.
- Keyser T.A., 2017. WATAR - 5 x 5. Presentation given at Delaware National Estuarine Research Reserve Symposium, Dover, Delaware, April 12, 2017.
- Greene R.W., 2017. Prime Hook National Wildlife Refuge 2016 Toxics Sampling. Presentation dated May 17, 2017. Presentation made to USFWS at Prime Hook National Wildlife Refuge, Milton, DE.
- Cargill, J.G. DDT (and other contaminants) in the Red Clay Creek Watershed. Presentation given at DNREC's Water Quality Roundtable, September 13, 2017.
- McKenna, T.E., Keyser, T.A., Asreen, R.C., and Cargill, J.G., 2017. Environmental Thermography Determines Contaminant Transport Pathways and Groundwater Sampling Locations During Site Investigations in Delaware, USA. Poster Presentation given at Geological Society of America Conference, Seattle, Washington, October 22-25, 2017.
- Ghosh, U., Greene, R., Cargill, J., Remediation & Restoration of Mirror Lake, Dover, Delaware, 2017. Guest lecture given by Dr. Upal Ghosh of UMBC at University of Delaware, Newark, Delaware, December 5, 2017.

WATAR-Related Awards: Members of the WATAR team received the following awards in 2016:

- USEPA PISCES Award: The USEPA honored the State of Delaware with one of 5 national Exceptional Project Awards through its Performance and Innovation in the SRF Creating Environmental Success (PISCES) program. DNREC's Waste & Hazardous Substances and Parks and Recreation were awarded the distinction for work at the NVF-Yorklyn facility in Yorklyn, Delaware for creatively using Clean Water State Revolving Fund loan for environmental cleanup and wetland creation at the site. The project cleaned up zinc and lead contaminated soil that acted as a source of impact to the adjacent Red Clay Creek. The project also provided needed flood water storage capacity in the Red Clay Creek Valley in Delaware. WATAR Team member John Cargill is the DNREC Environmental Project Manager for the cleanup at the site.

Peer Reviewed Publications: There were no peer reviewed publications from WATAR Team members in 2017.

Other Publications:

- Cargill IV, J. G., 2017. NVF-Yorklyn Cleanup and Redevelopment – An Unprecedented Partnership, Delaware Wetlands WMAP Blog, September 13, 2017 Posting.
- Greene, R.W. and Stangle M., 2017. Feasibility of Stocking Red Clay Creek with Trout, Delaware Department of Natural Resources & Environmental Control, Watershed Assessment and Management Section, Dover, Delaware.
- Cargill, J.G., Greene, R.W., and Wolanski, D.P., 2017. Summary of Toxics Data for Surface Water, Sediment, and Biota Samples Collected from Delaware Watersheds that Drain to the

Chesapeake Bay, Delaware Department of Natural Resources & Environmental Control,
Watershed Assessment and Management Section, Dover, Delaware.

National Organization Involvement: WATAR team Members play key roles in advancing watershed scale assessment and management of contaminated sediments nationally in 2017:

- ITRC Contaminated Sediments Internet Based Training Team. WATAR team member John Cargill 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. Training events were offered on February 14, 2017 and September 14, 2017.
- ASTM International Task Group for Developing a New Standard Guide for Sediment Corrective Action. WATAR team member John Cargill is a co-facilitator for the Risk Evaluation Standard subgroup. The standard will apply to the assessment/management and remediation of contaminated sediments. Work is ongoing, with an anticipated standard going to ballot through ASTM by mid-2018.
- 2017 Battelle International Conference on Remediation and Management of Contaminated Sediments. WATAR team member John Cargill served on the Technical Advisory Committee for the conference, which was held in New Orleans, LA in January 2017. In addition to his work on the advisory committee, Mr. Cargill developed and helped teach a short course titled "US and International Sediment Guidance Compendium," and also moderated a session related to "Perspectives in the Decision Making Process," and participated as a panelist in a discussion titled "CERCLA and Clean Water Act Cross-Program Coordination Strategies."
- Association of State and Territorial Solid Waste Management Officials (ASTSWMO) – WATAR team member Todd Keyser is a member of the ASTSWMO Sediments Focus Group. In this role Todd participates in several national forums designed to foster collaboration, innovation and consistency amongst state agencies when determining regulation, policy and innovative approaches to contaminated sediment investigation, analysis and remediation.