2016 Annual Report
In Support of Maintaining and Restoring Water Resources
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EXECUTIVE SUMMARY

We report progress to date on the WPF-funded project, "A land cover mapping, modeling, and monitoring system for the Delaware River Basin in support of maintaining and restoring water resources." In this executive summary, we highlight major project management milestones and our key accomplishments. We also present a summary of challenges and obstacles encountered, modifications to the original scope of work, a description of unintended outcomes, and lessons learned so far. Following the executive summary is a detailed description of the progress made on each milestone and activity outlined in the original award agreement.

Some clarifying points:

- *We use the terms 'DRB' and 'basin' to refer to the Delaware River watershed basin, and we use the term 'AOI', short for area-of-interest, to refer to the 43-county region that completely covers the DRB.*
- *Regular text outlines the language used in the original award agreement, while italics indicate current progress and comments. Grant activities in gray text were addressed in the 2015 annual report. Light blue text represents activities still to be completed.*

Project Management Milestones:

- *In-person and web-based research team meetings were held in months 13, 15, 16, 18, and 21.*

Key accomplishments since last report:

- *Our outreach plan is being successfully implemented.*
  - *Project website (http://drbproject.org/) was overhauled in June 2016. Project is housed at the Center for Land Use and Sustainability (http://centerforlanduse.org/) at Shippensburg University. Updates continue to be posted via Social Media on Twitter (https://twitter.com/ShipCLUS) and Facebook (https://www.facebook.com/ShipCLUS).*
  - *Four e-newsletters containing project updates was sent during months 13, 16, 19, and 23. The mailing list currently has 108 subscribers. Future e-newsletters will be sent during months 26 and 29.*
  - *Our project was featured in the Winter 2016 Water Resources Association of the Delaware River Basin Newsletter, in articles by Shippensburg University and the Academy of Natural Sciences of Drexel University, and in mailings from the Coalition for the Delaware Watershed.*
  - *We have presented our work at a variety of venues, including the Science of Sourcewater Workshop, the Pennsylvania GIS Conference, the Central Pennsylvania GIS Day, the Delaware River Watershed Forum, the Susquehanna River Symposium, and the International Association of Landscape Ecology (US Division).*

- *SU led a scenario workshop that resulted in defining the narratives for a baseline scenario and two alternative and divergent scenarios.*
- *SU has modeled Sea Level Rise and Storm Surge risk for the AOI, and this dataset will be made available on PASDA.*
- *At SU, we have developed a comprehensive urban suitability model that incorporates a model of socio-economic influences, environmental constraints, accessibility, and protected lands. This is a key input into the SLEUTH model, and is the platform for modeling the trend and alternative future scenarios.*
- *SU has completed SLEUTH model calibration for the entire AOI. Barring unforeseen delays, validation and the trend forecast will be completed in early 2017.*
- *UVM has completed the high-resolution land cover data for counties intersecting the Delaware River Basin in Delaware and Pennsylvania. The data is available via PASDA, was featured in our e-newsletter, and shared through our partners. Email communication from UVM in January 2017 indicated the New Jersey data is 70% complete.*
    - *Delaware State: www.pasda.psu.edu/uci/DataSummary.aspx?dataset=3138*
    - *Pennsylvania Counties: www.pasda.psu.edu/uci/DataSummary.aspx?dataset=3193*

Challenges and obstacles encountered:

- *At UVM, problems were encountered with the PA LiDAR tiles. The original LiDAR data contractor deleted the original files, and it took some time to recover and reprocess those data. The shrub and wetland classes for NJ and NY also presented a challenge because of the different LiDAR acquisitions. New York data has been delayed because the new LiDAR that was supposed to be acquired did not occur. The UVM team must now rely on old LiDAR and aerial imagery to complete the product, which requires a great deal of time-intensive manual interpretation to achieve the desired accuracy.*
- *At SU, we neglected to submit for IRB approval prior to the DRB2070 workshops. This caused some stress as we prepared to submit for IRB approval on the Target End User Survey. However, we were able to retroactively apply to use the secondary data from the workshops without a problem and followed that application with an addendum.*
- *When we started the modeling process, we chose to use CCAP data, as it appeared to be most useful to professionals. However, as our project progressed, many users and the Stream Reach Assessment Tool (SRAT) began to utilize NLCD data. In order to ensure our data compatibility, we switched from CCAP to NLCD, requiring a reprocessing of our modeling input data. This caused a minor delay in calibrating SLEUTH for our modeling process.*
- *At USGS, funding was cut for the Land Change Science Program, which provided support for the development of the Chesapeake Bay Land Change Model (CBLCM). This presents a major obstacle for our collaborators there, as deadlines related to CBLCM work for the Chesapeake Bay Program have been moved up before staff support is reduced.*

Modifications to the original scope of work:

- *Because of the development of the SRAT, we will be processing our data to release the results for the same stream reach areas that are utilized in SRAT.*

Unintended outcomes:

- *To model land use change effectively and realistically out to 2070, we learned that we need to explicitly consider climate change impacts (i.e. sea-level rise, increase in inland and coastal flooding). To keep to our project scope, we are focused on existing data sets that can be used as a proxy for some of the potential impacts. We also modeled Sea Level Rise and Storm Surge risk for*

the AOI, a separate dataset that will be available on PASDA. To specifically study these impacts, we will begin work in January 2017 on a project funded by the Delaware Watershed Research Fund to better understand the effects of land use change and climate change on hydrology and forests. That project will tie in to this work and will eventually be made available to the same target end user group.

- *Model my Watershed and the Stream Reach Assessment Tool have developed in parallel with our project, and we have worked closely with those developers to ensure that our data can be easily integrated into these systems. This will greatly increase the adoption and utility of our work.*
- *This project has emphasized the need for basin-wide data sharing and data storage protocols. We are actively contributing to the DRWI GIS working group to assist in the development of these protocols.*

Lessons learned so far:

- *Because of the relatively short time frame for a project of this scope we have been concerned about our ability to disseminate final products effectively. It is extremely important for us to develop a strong dissemination strategy for this project, and to collaborate with others to develop effective outreach and dissemination strategies for the DRWI as a whole. We plan to spend time in Spring 2017 sharing our results, both online and in-person through meetings, conferences, and workshops, as supported by existing grant funds. We have developed an extensive network and will need to rely on contacts throughout the watershed to disseminate our findings.*

MILESTONE 1

Throughout the project, target End-User Community informed and engaged in LiDAR collection, land cover and growth model development activities; End User Advisory Groups actively engaged in production, review, feedback and refinement of all project deliverables.

Activities:

1.1: With WPF/DRWI Coordinating Committee, identify Target and Steering Committee end-users. Target End-Users represent a potentially large and broad group of scientists and conservation practitioners who are identified as potential users. Steering Committee users are committed users who have a vested interest in the project outcomes for specific scientific or conservation applications. (months 1-2)

- *A Target End User contact list was started during month 3 of the project. Including county GIS coordinators, this list currently has over 400 individuals.*

1.2: Conduct at least 4 Target End-User and 6 Steering Committee meetings over the project period

- *Target End-User Meetings have been held in Philadelphia, PA (month 10), Narrowsburg, NY (month 11), Reading, PA (month 13), Washington, NJ (month 14), Dover, DE (month 14), and Media, PA (month 22). See Appendix 1 for a list of 2016 workshop participants.*
- *Since the last report, Steering Committee Meetings have been held via webinar (months 14, 17, 20, 24). Future meetings will be held every three months (months 26 and 29). Meeting minutes can be found online: http://drbproject.org/about/steering-committee/*

1.3: Present mapping and modeling plans and receive feedback (months 2-12)

1.4: Interview key Target End Users and Steering Committee users re: participation in Long Term Monitoring and Modeling (months 2-12)

1.5: Present basin-wide high resolution land cover; get feedback (months 13-24)

- *Delaware (month 14), Pennsylvania (month 19), New Jersey and New York should be available in early 2017.*

1.6: Present basin-wide calibrated and validated CBLCM model; get feedback (months 4-9)
- *Calibrated models for SLEUTH finished (month 12) and validation is underway. Problems encountered with CBLCM work, which will likely be delayed until Spring.*

1.7: Solicit feedback on land use/land cover change scenarios (months 6-12)
- *Feedback on drivers of land use change was collected from DRB2070 workshops (months 10-15). This information was compiled and shared via basin-wide land use survey (month 18).*
- *Draft land use change scenarios were completed at the DRB2070 scenario development workshop (month 22), which was informed by previous workshop and survey data.*

1.8: Present; get feedback on land use/land cover change forecasts (months 9-15)
- *Draft scenario themes were shared in the basin-wide land use survey (month 18). Draft baseline land use change forecast will be presented in January 2017, followed by alternative forecasts.*

1.9: Present; get feedback on long term monitoring and modeling draft plan (months 12-18)
- *Baseline land use scenario finished for the DRB (month 23). First drafts of alternative futures available (month 24). Forecasts will be finalized in months 25-26.*

1.10: Present results of Feasibility Study for long term monitoring and modeling plan to WPF/DRWI Coordinating Committee (months 18-24)

MILESTONE 2

By December 2016, new high-resolution land cover produced, sustainably-housed and available to Target End User Community for ongoing use.

Activities:

2.1: Identify and collect relevant local digital data sets through End-Users. (months 1-6)
2.2: Data prep and processing (months 3-18)
2.3: Data accuracy assessment and metadata production (months 18-20)
2.4: Land cover summarization (months 20-24).
- *Land cover available for Delaware State (month 15), and DRB intersecting counties in Pennsylvania (month 19), New Jersey and New York are forthcoming.*

MILESTONE 3

By June 2016, land use/cover change modeling complete with minimum 10-year increments over a 30-year horizon. Results sustainably-housed and available to Target End User Community for ongoing use.

Activities:

3.1: Assemble required GIS data and complete model calibration and validation (months 1-6)
3.2: Develop initial land use/cover change forecast (months 4-9)
3.3: Generate finalized future land use/cover change scenarios (months 9-18)
- *Draft baseline land use scenario using SLEUTH will be available in January 2017 (month 25)*
- *Two alternative futures under development using SLEUTH (expected release in months 25-27)*

MILESTONE 4

By December 2016, long term monitoring and modeling feasibility study completed and summary report presented to WPF/DRWI Coordinating Committee.

Activities:

4.1: Interview staff at state mapping offices, identify frequency of LiDAR mapping (months 1-6)

- *While we have not conducted formal interviews with state mapping offices, we have had the opportunity to converse with state, regional, and local experts regarding plans for LiDAR mapping. At this time, and to the best of our knowledge, LiDAR mapping across the DRB occurs as a highly ad hoc and opportunistic process, driven largely by sporadic and limited funding opportunities, such as the USGS's 2015 Hurricane Sandy Supplemental Funding lidar and DEM acquisition plan.*
- *At the national level, the USGS has launched the 3D Elevation Program (3DEP) initiative. The primary goal of 3DEP is to collect LiDAR data for the conterminous United States, Hawaii, and U.S. territories, with data acquired over an 8-year period. The USGS provides cost-share funds for local, regional, and state agencies to acquire LiDAR data. We note that this effort is intended to create a nationwide LiDAR-based elevation data set using data that is not more than 8 years old. On-going LiDAR funding and acquisition plans have not yet been set.*

4.2: Interview Target End Users re: needs for ongoing high-resolution land cover; modeling interface and tools (months 1-12)

- *There is a high demand for high-resolution land cover. Once the baseline data is completed, there will be a need for regular updates, ideally on a 1 - 5 year time cycle. Likewise, for the land change model, there will be a need for iterative refining once the initial forecasts are released. Future modeling work is appropriate at 5 - 10 year intervals. It is worth noting that land change modeling technology is currently in a phase of rapid development, so it will be important to consider data compatibility in future work.*

4.3: Interview Target End Users re: participation interest in long term monitoring plan (months 1-12)

4.4: Develop draft long term monitoring and modeling plan and budget (months 10-18)

4.5: Prepare final plan and feasibility report (16-24)

Appendix 1- Workshop Attendees

This lists indicates the 2016 workshop attendees in Reading, PA (R), Washington/Harmony, NJ (W), Dover, DE (D), or Media, PA (M).

Attendee	Title	Organization	R/W/D/M
Beth Burkovich	GIS Analyst	Berks County Planning Commission	R
Michael Griffith	Education and Watershed Specialist	Berks Nature	R
Madeline Urbish	Director	Coalition for the Delaware River Watershed	R
Brad Shirey	GIS Manager	County of Berks - IS Department	R
Jason Miller	CAD Designer/GIS Analyst	Great Valley Consultants	R
Joseph Hebelka	Hydrogeologist	PA Department of Environmental Protection	R
Nicholas Maziekas	Assistant Planner	Schuylkill County	R
Susan Smith	Planning and GIS Director	Schuylkill County	R
Ashton Hogarth	Environmental Specialist	SSM Group, Inc.	R
Mike Shanahan	Conservation Coordinator	The Nature Conservancy	R
Eli Bracken	GIS Specialist	Wildlands Conservancy	R
Angela Wenger	Chief Operating Officer	Center for Aquatic Sciences	W
Steven Rinker	GIS Coordinator/Manager	Monroe County Planning Commission	W
Kathy Commisso*	GIS Specialist	National Park Service	W
Nathan McLean	GIS Manager	NJ Highlands Council	W
Kathryn Semmens	Science Director	Nurture Nature Center	W
Kate Hutelmyer	Watershed Institute Coordinator	Stony Brook-Millstone Watershed Association	W
Sylvia Kovacs	Founder	Sustainable Highlands	W
Chris Ross	Senior Resource Management Specialist	NJ Highlands Council, Water Protection and Planning	W
Autumn Sylvester	Principal Planner	County of Sussex	N/W
Seung Ah Byun	Senior Planner for Water Resources	Brandywine Conservancy	D
Mary Raley	Project Planner	Delaware Department of Transportation	D
Mark Biddle	Environmental Scientist	Delaware Department of Natural Resources and Environmental Control, Watershed Assessment	D
Jimmy Kroon	Planner/GIS Coordinator	Delaware Department of Agriculture	D
Christie Bonniwell	Wetland Scientist	Delaware Department of Transportation	D
Naomi Bates	GIS/LiDAR Analyst	Delaware Geological Survey	D
Rose Ozbay	Research Assistant Professor	Department of Agriculture and Natural Resources	D

** Steering Committee Member*

Appendix 1- Workshop Attendees (continued)

This lists indicates the 2016 workshop attendees in Reading, PA (R), Washington/Harmony, NJ (W), Dover, DE (D), or Media, PA (M).

Attendee	Title	Organization	R/W/D/M
James Gregory	GIS Specialist	Delaware Department of Natural Resources and Environmental Control	D
Anne Mundel	Hydrologist	Delaware Department of Natural Resources and Environmental Control	D
Brittany Sturgis	Watershed Planner	Delaware Department of Natural Resources and Environmental Control	D
Stephen Wright	Engineer IV	Delaware Department of Natural Resources and Environmental Control, Watershed Stewardship	D
John Inkster	Senior Application Support Specialist	Delaware Department of Natural Resources and Environmental Control, Watershed Stewardship	D
Sharon Dutton	Lab and Field Technician	Environmental Lab Section, Division of Water, Delaware Department of Natural Resources and Environmental Control	D
Sari Rothrock	Watershed Planning Specialist II	Partnership for the Delaware Estuary	D
Kathy Klein*	President	Water Resources Association of the Delaware River Basin	D, M
Karen Reavy*	GIS Coordinator	Delaware River Basin Commission	M
Melissa Andrews	Environmental Planner	Delaware Valley Regional Planning Commission	M
Steven Schwartz	Pocono/Kittatinny Cluster Coordinator	DRWI Cluster: Pocono/Kittatinny; Pinchot	M
Ryan Walker	Conservation Easement Program Manager/Municipal Planning Specialist	Natural Lands Trust	M
Rob Altenburg	Director, Energy Center	PennFuture	M
Kelly Anderson	Sourcewater Protection Program	Philadelphia Water Department	M
Molly Hesson	Sourcewater Protection Program	Philadelphia Water Department	M
Charles Dow*	Director of Information Services	Stroud Water Research Center	M
Clare Billett*	Program Officer, Watershed Protection	William Penn Foundation	M

** Steering Committee Member*