NYSG Completion Report Instructions & Required Format

Please include the following information for your project. The text of this report should be at least 5-8 pages and be composed for an audience of your peers. Other formats, or reports with incomplete sections, will not be accepted. The expectation is that information or material will be provided under each section.

REPORT WRITTEN BY: Robert J. Johnston **DATE:** March 6, 2026

A. PROJECT NUMBER AND TITLE:

R/CHD-17-NYCT, Coupled Prediction of Residential Fertilizer Use and Nitrogen Loads to Long Island Sound: An Integrated Targeting Tool for Nitrogen-Reduction Behavior Change Campaigns

B. PROJECT PERSONNEL:

Table 1: Senior Personnel (list the PI, Co-PI(s), and AI(s), should match what was in the proposal (90-2 form). Changes in senior project personnel require prior notification and approval from NYSG.

Name	Role (PI, CO-PI, or AI)	Institution	Note
Robert J. Johnston	PI	Clark University	
David Dickson	Co-PI	University of Connecticut	
Jamie Vaudrey	Co-PI	University of Connecticut	
David A. Newburn	Co-PI	University of Maryland	
Haoluan Wang	AI	University of Miami	
Qian Lei-Parent	AI	University of Connecticut	

Table 2: Postdocs (list post-doctoral researchers who worked on the project and were supported by the grant).

Name	Institution	Note

Table 3: Research Support Specialists (list any professional staff who worked on the project and were paid by the grant).

Name	Institution	Note
Tom Ndebele	Clark University	

Table 4: Sea Grant Scholar Fellows and Research Assistants (list all Scholar Fellows and graduate and undergraduate Research Assistants who were paid from the project's budget during this reporting period, i.e., on payroll).

Student Name	New or Continuing?*	Degree Program	Type (choose from list)	Graduation Date	Anticipated or Confirmed?+
Derek Wietelman	Continuing	PhD	GRA	May 2027	Anticipated

Kaichao Chang	New	PhD	GRA	May 2028	Anticipated

*New students are working on the project for the first time during the reporting period. It would include all students in the first year and any students who begin in the second year or later. Students still working on the project in the second year are continuing.

+Anticipated or confirmed graduation date. For Scholar Fellows on the project, submit their thesis or dissertation after publication.

Student Types List (enter three-letter code in the Type column):
SGS – Sea Grant Scholar Fellow
GRA – Graduate Research Assistant
RA – Undergraduate Research Assistant or Technician

Table 5: Student Volunteers (list all graduate and undergraduate students who worked on the project and were not paid from the project's budget during this reporting period).

Student Name	New or Continuing?*	Degree Program	Graduation Date	Anticipated or Confirmed?+

Table 6: Public Volunteers (list any volunteers from the public (e.g., citizens, high school students), if any, who worked on the project during this reporting period).

None

Student notes or details: Write details about the contribution to the project and other relevant details for each student listed in Table 4 as necessary.

Kaichao Chang provided the analysis for statistical modeling on household lawn fertilizer and predictions for lawn fertilizer application rates in the New York portion of the study region. Derek Wietelman used the high-resolution land cover data from NOAA C-CAP to calculate the lawn area footprint for all residential parcels in both Connecticut and New York, which were used in the calculation of predicted lawn fertilizer nitrogen application rates.

Non-supported students: Provide details about each student's contribution to the project and any other relevant information as needed from Table 5. Students who receive payment from other sources for work done on this project are considered student volunteers on this project.

Volunteers: Write details about the contribution to the project from any volunteers listed in Table 6. Indicate their activity and estimate the amount of time (hours) they contributed.

C. PROJECT RESULTS:

Complete the following sub-sections to discuss your results as they relate to the project's objectives:

C1. Meeting the Objectives:

Objective 1: To update/extend the extant fertilizer application model—based on household survey data developed through the PI's prior Long Island Sound Study (LISS) project—to produce parcel-level predictions of fertilizer use across residential parcels in coastal counties and municipalities within the LIS watershed.

This objective was completed as planned. The novel, integrated model produces parcel-level, large-scale predictions of residential fertilizer and nitrogen applications across the landscape, for single-family residential parcels between 0.1-5.0 acres. Predictions have been implemented for the combined study area, including Connecticut coastal counties within LIS watershed (>430,000 parcels) and municipalities of Suffolk, Nassau, and Westchester Counties (NY) that overlap the LIS watershed (>500,000 parcels).

The approach integrates a statistical, two-part hurdle model of household lawn fertilizer behavior—estimated using large-sample household survey data—with information from a spatially explicit tax assessor parcel database that provides data on explanatory variables for households that both did and did not participate in the survey. Model results, combined the use of high-resolution land cover data to identify lawn areas and a simulation procedure to incorporate demographic information for households that were not in the survey sample, allow the probability of fertilizer application, the conditional frequency of application, and the resulting quantity of nitrogen deposition to be predicted and mapped for all single-family residential parcels within the study area. Predictions of nitrogen application accommodate the portion of each parcel covered by turfgrass lawn, based on NOAA C-CAP high-resolution land cover data. Spot validations of derived lawn footprints were conducted via images of the study area (see Figure 1). Predictions also incorporate standardized information on residential parcels from newly released parcel mass appraisal data for CT (https://geodata.ct.gov/pages/parcels). Parallel modeling and predictions were implemented for NY portions of the study area, with model adjustments and data imputation to accommodate missing parcel data on housing characteristics in several Long Island communities.

Figure 1 shows an illustration of how lawn footprints were derived using high-resolution land cover data and spot check validations via satellite images.

Figure 2 shows an illustrative example of predictions for annual nitrogen application via lawn fertilizer by single-family residential parcels in Connecticut and New York.

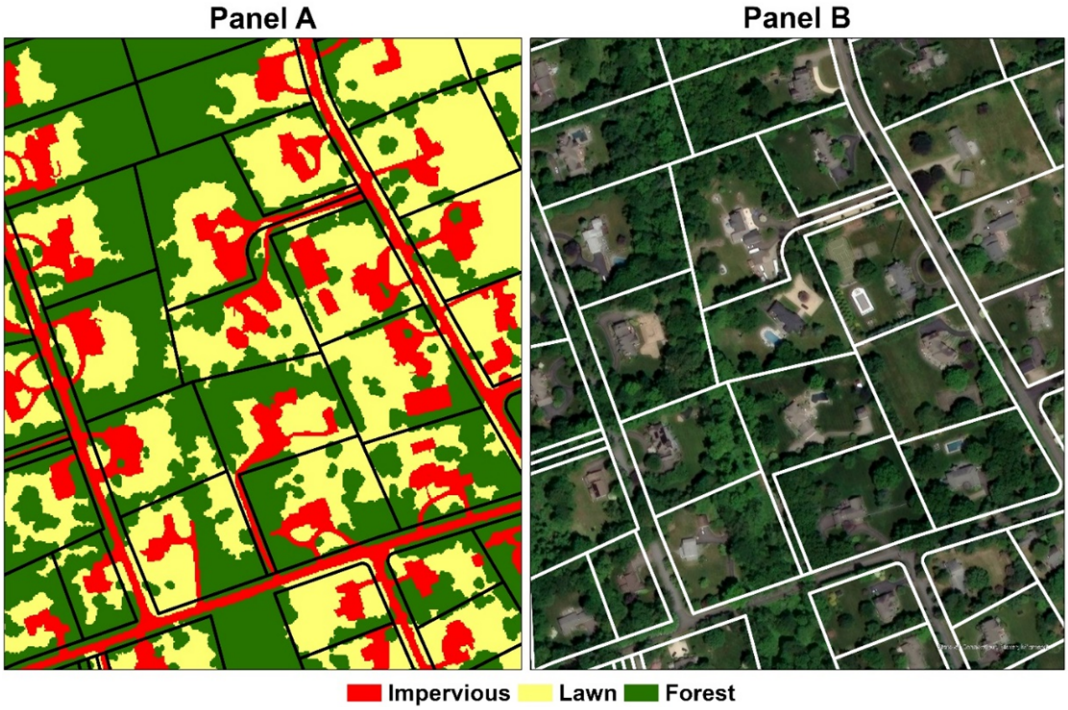


Figure 1. Example of Lawn Footprint Calculation and Validation Using High-Resolution Land Cover from NOAA C-CAP Data

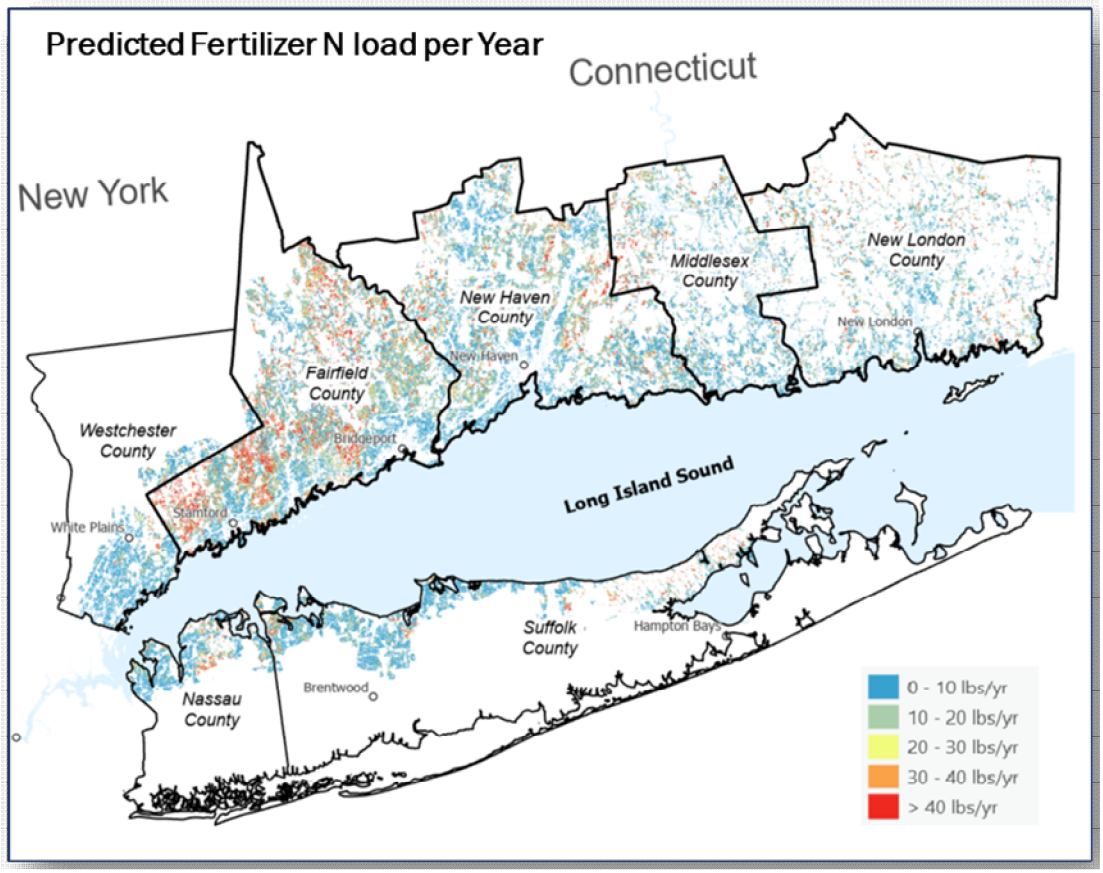


Figure 2. Predicted Annual Nitrogen Application via Lawn Fertilizer by Single-family Residential Parcels for Connecticut and New York

Objective 2: To structurally integrate an updated LIS Nitrogen Loading Model (NLM) with N-Sink to enable fine-grid predictions of nonpoint N-load to LIS and its embayments attributable to actions "on the ground," accounting for dimensions such as population density, sewered regions, N transport, and N removal.

This objective was completed as planned. When N is added or collected on the landscape, whether from residential lawn or agricultural fertilizer, atmospheric deposition, or other sources, it interacts differently based on the type of surface. Some areas absorb nitrogen (N sinks), such as vegetated areas, wetlands, and stream corridors, while other areas have low nitrogen removal. To accommodate patterns such as these, an updated version of LIS NLM (including updated data inputs and N loading factors) was integrated with the N-Sink transport map, an index that reflects the percentage of N originating at a given location within a watershed that is expected to reach downstream receiving waters in LIS. The updated NLM/N-Sink model was then used to produce 30m maps for the study area, including updated N application to the land, N transport index, and total N loads to embayments or LIS waters. This integrated hydrological model transforms the fertilizer and N predictions to spatially explicit predictions of N loads to LIS.

Objective 3: To integrate the data and models from (1) and (2) into a coupled GIS-based tool that produces spatially explicit fertilizer-application rates, other point- and non-point N sources, transport of N in the watershed, and N-load predictions.

This objective was completed as planned. Integrating the data and model components described in Objectives 1 – 2 above, we developed a fully integrated assessment model and prediction tool that allows spatially explicit predictions of fertilizer-application rates, other point- and non-point N sources, transport of N in the watershed, and N-load predictions for any area across the study region. For any modeled level of spatial resolution, the fertilizer-prediction model (Objective 1) produces estimates of N applied to the landscape as total fertilizer—for example, under current baseline conditions and as they might change under future behavior-change scenarios. These predictions are generated via the two-step parameterized model described under Objective 1, overlaid via ArcGIS onto each single-family residential parcel across the study area. The coupled NLM/N-Sink model (Objective 2) transforms this spatial information (i.e., N applied to particular areas) into spatially explicit predictions of N loads to embayments and coastal waters. These models have been integrated to produce end-to-end, spatially explicit predictions that link predicted residential fertilizer use to N loads. To enable this integration, parcel-level fertilizer and N application predictions were mapped to the native spatial resolution of NLM/N-Sink (30m x 30m grid), accounting for the proportion of each parcel overlapping each grid cell. Integrated model output is then used as the foundation for Objectives 4 through 8.

Objective 4: To use the coupled tool in (3) to characterize baseline conditions for fertilizer applications and N loads across the LIS coastal watershed and coastal waters/embayments.

This objective was completed as planned. Using the integrated assessment model described under Objective 3, we developed maps and quantitative results illustrating current conditions for fertilizer applications and N loads across the LIS coastal watershed and coastal waters/embayments. These predictions are drawn from an overlay of parcel-specific predictions of current fertilizer use (number of applications per year), with predicted household lawn nitrogen application (lbs./year) calculated as the predicted number of fertilizer applications for each parcel multiplied by lawn acreage and a mean nitrogen applicate rate (lbs./acre/year).

The analysis yields novel results that are directly salient to policy and program design. For example, densely populated urban and suburban areas are often targeted by non-profit organizations for behavior change campaigns focused on lawncare, in part due to the existence of active community organizations in these areas and in part due to the ease of locating and contacting households within densely populated communities. Yet results of this project suggest

that interventions of this type are likely among the least effective strategies, due to lower levels of fertilizer use among these households and smaller lawn footprints. In contrast, the model reveals that exurban households with larger lots play an outsized role in N loads due to lawn fertilizer use. Exurban communities, particularly wealthier households in newer and larger homes, represent a small proportion of the population but are a dominant source of nutrient pollution from lawn fertilizer.

In the Connecticut case study area, for example, while households with smaller lots (0.1-0.5 acres), largely in urban and suburban areas, represent more than half the number of households, they are responsible for only one-quarter of the cumulative annual nitrogen lawn fertilizer. Households on larger lots (1-5 acres), mostly in the exurban areas, comprise one-quarter of the number of households but constitute more than half the cumulative nitrogen fertilizer applications. Due to systematic patterns such as these, the highest predicted lawn fertilizer applications and associated N loads tend to be concentrated in the western region of Connecticut, in close proximity to New York City. This is due largely to the combined effect of property characteristics on lawn fertilization. Households with newer larger homes, particularly in exurban areas, generally have higher fertilizer applications and apply fertilizer to larger lawn areas, leading to higher N loads to LIS. In contrast, households with the lowest predicted fertilizer applications are mostly in the eastern region of Connecticut, which is more rural and has modest home sizes and relatively older housing stock.

Findings such as these are relevant to spatial targeting of behavior change campaigns and other efforts to reduce lawn fertilizer use—as policies and programs targeted at areas of the watershed where lawn fertilizer use already has a minimal impact on LIS N loads are unlikely to have major impacts on water quality.

An illustration of these findings is shown in Table 1 below, again for the Connecticut case study area. Similar findings are illustrated for the New York study area.

Table 1. Total Number of Households, Cumulative Lawn Acreage, and Cumulative Lawn Nitrogen Applications, Connecticut Case Study Area

	Total number of households					
Lot size	Fairfield	New Haven	Middlesex	New London	Total	% Total
[0.1, 0.25] acre	52,188	62,749	6,129	12,672	133,738	31%
(0.25, 0.5] acre	33,633	48,636	8,887	14,894	106,050	25%
(0.5, 1] acre	29,895	32,137	8,369	10,296	80,697	19%
(1, 2] acres	33,132	21,825	6,680	8,912	70,549	16%
(2, 5] acres	20,324	8,196	5,314	6,481	40,315	9%
Total	169,172	173,543	35,379	53,255	431,349	100%
	Cumulative lawn acreage					
Lot size	Fairfield	New Haven	Middlesex	New London	Total	% Total
[0.1, 0.25] acre	2,840	3,482	343	729	7,394	9%
(0.25, 0.5] acre	4,067	6,306	1,186	1,851	13,410	16%
(0.5, 1] acre	7,005	7,487	1,798	2,235	18,525	22%
(1, 2] acres	10,911	6,956	2,027	3,164	23,058	28%
(2, 5] acres	11,092	3,777	2,067	3,471	20,407	25%
Total	35,915	28,008	7,421	11,450	82,794	100%
	Cumulative lawn nitrogen applications (lbs./year)					
Lot size	Fairfield	New Haven	Middlesex	New London	Total	% Total
[0.1, 0.25] acre	136,606	157,019	17,150	31,597	342,372	8%
(0.25, 0.5] acre	224,801	326,957	67,320	87,529	706,607	16%

(0.5, 1] acre	420,684	425,482	105,837	111,994	1,063,997	24%
(1, 2] acres	700,407	401,857	113,033	154,718	1,370,015	30%
(2, 5] acres	665,826	170,920	84,201	123,284	1,044,231	23%
Total	2,148,324	1,482,235	387,541	509,122	4,527,222	100%

Note: This table reports the cumulative nitrogen applications (lbs/year) by lot size and county. The sample used in this table is restricted to single-family households (land use codes of RR101) with a positive lawn area on the parcel (defined as the "developed – open space" using the one-meter high-resolution NOAA C-CAP land cover data) and lot sizes between 0.1 and 5 acres.

Objective 5: To coordinate with end users and leverage both survey data from the PI's prior LISS project and data from past behavior-change campaigns to predict behavioral effects that can occur under these programs, along with effects on residential fertilizer practices among different groups.

This objective was completed as planned. Effects of behavior changes were simulated using data from contingent behavior questions within the household survey, indicating whether and how households would anticipate changing their fertilizer use under alternative future scenarios. We have analyzed the data from behavior-change questions using two-step hurdle models, with a first-step logit regression predicting the probability of fertilizer reduction in response to a specific type of behavior-change program, and a second-step fractional logit regression predicting the proportion of reduction. The model also includes household-level covariates to enable predictions to vary across household types. This model allows us to predict, for any residential parcel across the study area, the expected reduction in fertilizer that would occur under alternative types of behavior-change campaign. Other scenarios are explored in which targeted households are assumed to reduce fertilizer applications by a fixed proportion, to explore the ramifications of alternative targeting of behavior-change campaigns over different types of households, assuming similar effectiveness per household.

To illustrate the implications of these findings, the predicted percent reduction of N fertilizer use under each scenario was first calculated by multiplying the predicted percent reduction in fertilizer application by the N load from fertilizer for each parcel. The parcel-level estimates were aggregated in each neighborhood (i.e., census block group). We then calculated the percent N reduction for each neighborhood by dividing its N reduction by its N load from fertilizer.

An illustration is shown in Figure 3 below, which illustrates the predicted percentage of lawn fertilizer application reduction at the parcel-level for the Connecticut portion of the study area, assuming an illustrative a scenario in which a behavior change campaign informs households that reductions in lawn fertilizer use will lead to a 30% reduction in lawn chemical exposure for children and pets.

Figure 4 illustrates corresponding N reductions by neighborhood for the combined New York and Connecticut study area. This figure is a screen shot from the Lawn Fertilizer Outreach Targeting Tool summarized under Objective 8 below.

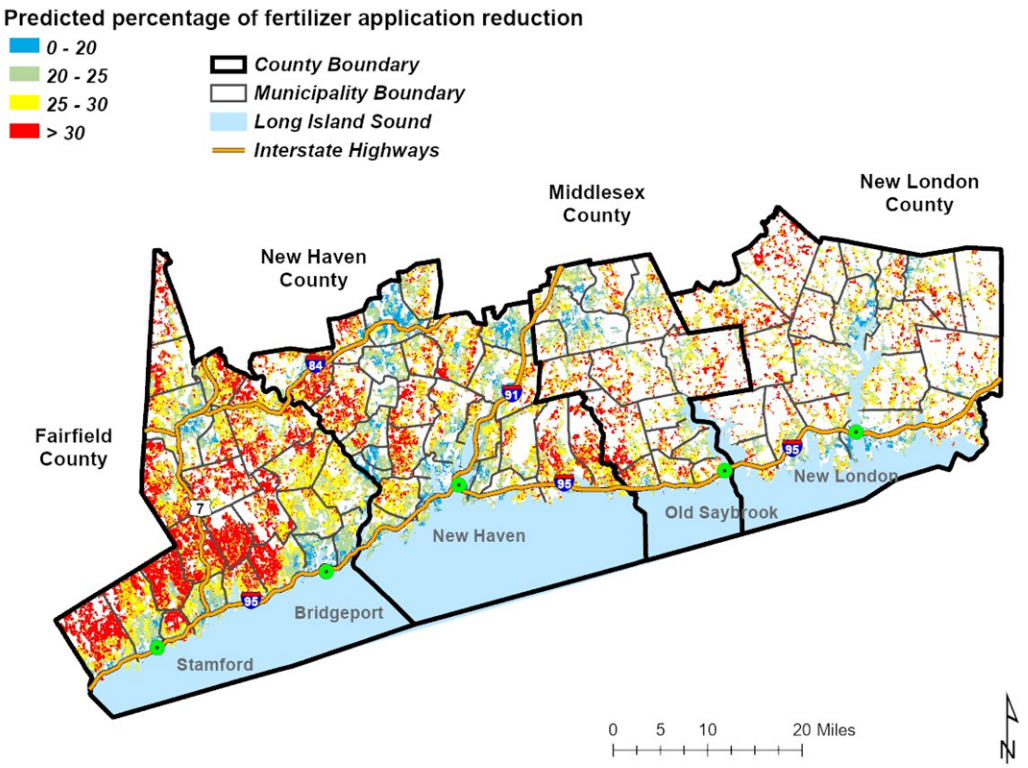


Figure 3. Spatial Distribution of Predicted Fertilizer Application Reductions: Behavior Changes Motivated by Information on Exposure Reductions to Children and Pets, Connecticut Case Study Area (Parcel-Level Results)

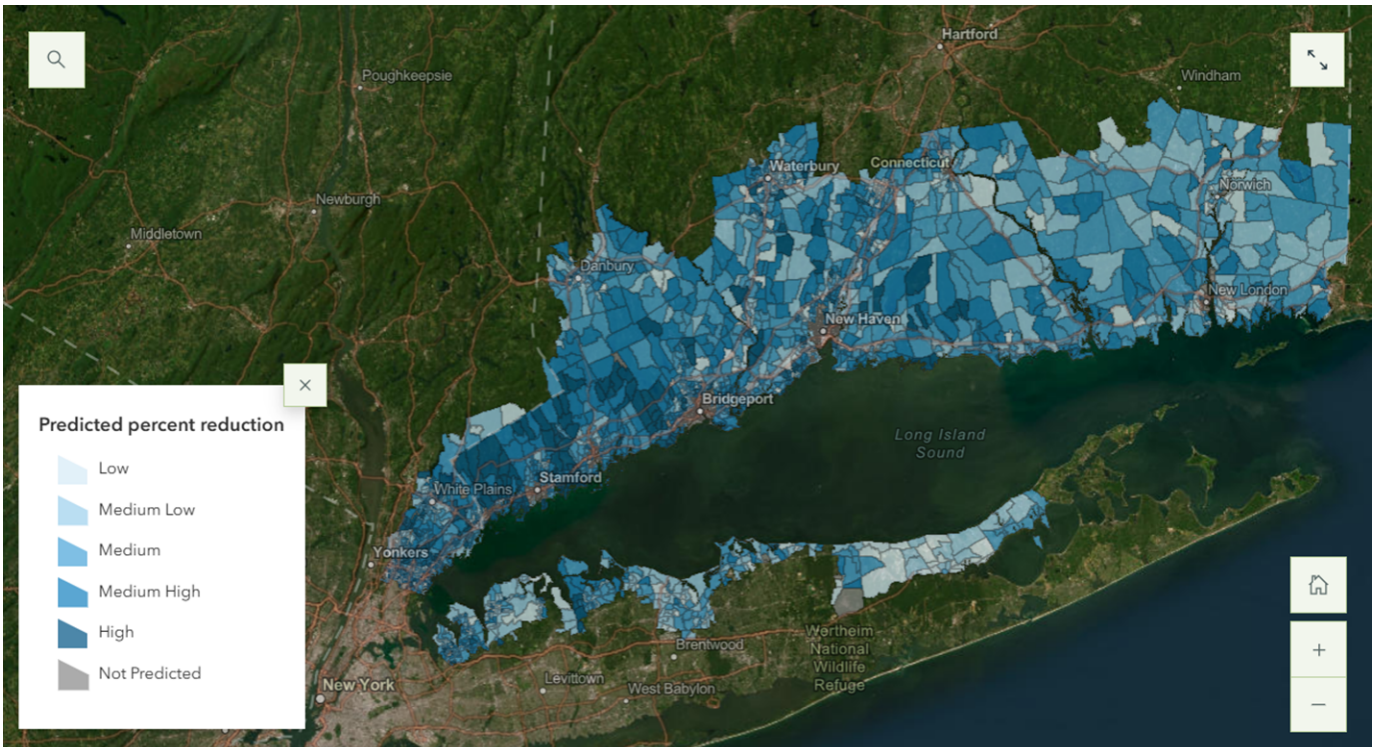


Figure 4. Spatial Distribution of Predicted Fertilizer Application Reductions: Behavior Changes Motivated by Information on Exposure Reductions to Children and Pets, New York and Connecticut Study Areas (Neighborhood-Level Results)

Objective 6: To integrate the tool in (3) with results from (5) to predict and test hypotheses on spatially explicit N-load impacts of behavior-change campaigns that reduce residential fertilizer use across different areas (e.g., municipalities, neighborhoods, embayment watersheds) and household types (e.g., larger parcels, newer homes), relative to baseline conditions.

This objective was completed as planned. The resulting landscape predictions of lawn fertilizer and nitrogen applications (Objective 4), combined with predicted behavior-change effects (Objective 5), were used to evaluate current spatial patterns of fertilizer use and associated N deposition, and to assess the effectiveness of alternative targeting and behavior-change strategies for programs intended to reduce fertilizer use. We find that the effects of behavior-change policies on fertilizer applications vary markedly depending both on policy design and on the type of households that are targeted, suggesting that some types of policies (e.g., those providing information on reduced chemical-exposure hazards and targeted at high-income households) are likely to be more effective at reducing fertilizer use. Interestingly, we find that monetary incentives of the type commonly advocated by economists (e.g., modest surcharges on lawn fertilizer products and services) are largely ineffective at motivating significant behavior change—perhaps because fertilizer is a small part of typical household budgets. Other interventions, such as the provision of information on lawn-chemical exposure for children and pets, are predicted to be more effective. Combined results provide the first integrated insight into sources of lawn-fertilizer related nutrient pollution to coastal US waters, together with guidance on how policies can be designed to reduce this pollution.

Among the most important findings from this objective is the relative importance of spatial targeting for behavior change campaigns. Due to large variations in factors such as household fertilizer use, lawn sizes, and N transport to LIS, interventions in some areas of the watershed are predicted to have much larger impacts on N loads to LIS than others, holding all else constant. For example, in the Connecticut study area, these “high impact” areas tend to cluster in the western portion of the coastal watersheds, targeting exurban neighborhoods with larger, newer homes and large lawns.

Objective 7: To integrate results of (4) and (6) with EJ mapping tools to predict N-load baselines and changes proximate to EJ communities, as affected by alternative behavior-change targeting.

This objective has been completed. We overlaid the nitrogen loading maps summarized by US census block group and environmental justice data layers. Initial results suggest that exurban communities, particularly wealthier households in newer and larger homes, represent a small proportion of the population but are the dominant source of nutrient pollution from lawn fertilizer. We also find that low-income EJ communities, frequently located in more densely populated urban areas, contribute a relatively small amount of the fertilizer N load to LIS. Low-income communities located along the coast are likely to be disproportionately affected by the effect of N pollution from lawn care practices of wealthier exurban communities, when considering N pollution and its impact on coastal water quality. These results suggest that patterns of lawn fertilization and associated environmental impact can exacerbate EJ concerns. To evaluate these general statements in a quantitative and more definitive manner, an assessment of impacts on water quality and ecosystem services among the affected communities would need to be considered. Such a comparison was beyond the scope of this study and thus not included as part of Objective 7 in the proposal.

Objective 8: To use results of prior objectives in close coordination with end users to provide actionable guidance on how behavior-change campaigns can be designed and targeted to produce measurable impacts on fertilizer use and N loads in particular areas.

This objective has been completed as planned. The results of Objectives 1 through 7 above were summarized by neighborhood (US Census block group) to provide guidance for behavior-change targeting focused on lawn fertilizer use. Results are presented via the **Lawn Fertilizer Outreach Targeting Tool**, which is publicly available via the UConn CLEAR web portal, at https://s.uconn.edu/nfert. An illustrative screen capture from the tool is shown in Figure 5. This web tool includes an ArcGIS StoryMap that explains the data and analyses used in the project, and an online viewer that provides relevant GIS data layers and research findings to help target fertilizer outreach campaigns for stakeholders and end-users. Input from end users was obtained during the design of the tool. The underlying project results and composite web tool have been presented both to individual end users and via webinars and presentations to multiple groups. These include presentations / engagements with the Long Island Sound Research Conference, the Long Island Sound Coastal Watershed Network, the Long Island Water Campaign, New York State Department of Environmental Conservation, Association of Environmental and Resource Economists, New England Interstate Water Pollution Control Commission (NEIWPCC), Coastal and Estuarine Research Federation, Long Island Sound Partnership workgroups and workshops, and many others. Follow-up engagements have also been scheduled to occur after the funding period ends (supported by other resources) to implement further outreach for the project. As of the date of this completion report, we have received multiple requests for additional presentations and engagements related to the project and the web tool. A webinar recording on this project and tool can be found at https://clear.uconn.edu/webinars/2026-webinar-library. Key project results have been published for the scientific and policy community in the highly cited *Journal of Environmental Management*, with the full citation, paper and additional details provided at: https://www.sciencedirect.com/science/article/pii/S030147972503631X.

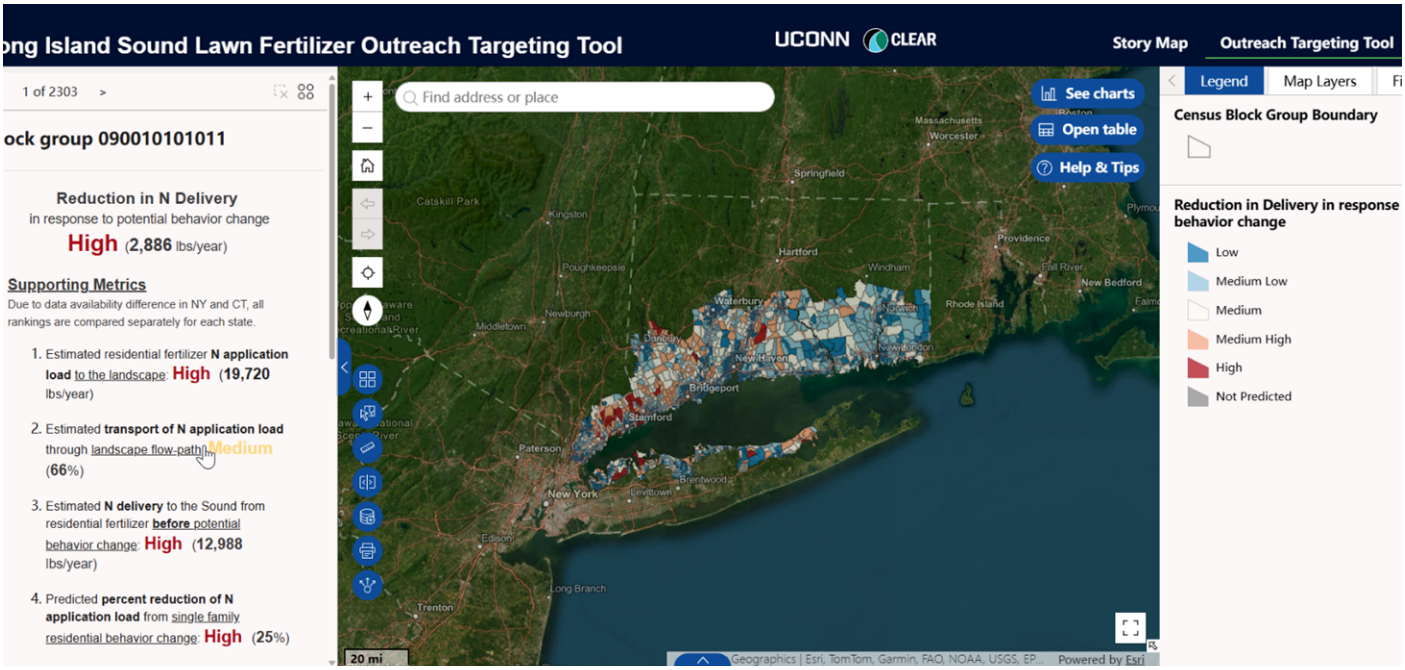


Figure 5. Illustrative Screen from the Online Lawn Fertilizer Outreach Targeting Tool, Available at https://s.uconn.edu/nfert.

C2. Scientific Abstract: Describe your entire project's results as if intended for a scientific meeting or publication.

Attainment of nutrient-reduction goals in Long Island Sound (LIS) and similar waterbodies requires policies or programs able to address household behaviors such as lawn fertilizer use that are linked to nonpoint emissions. Nutrient impacts from residential lawns are a growing concern as urban populations increase and limited progress has been made to change household behaviors. While the impacts of excessive fertilization are well known, little attention has been paid to understanding behaviors by residential households, including how to effectively implement behavior change campaigns and implications for attaining nutrient-reduction goals. This project develops and implements a novel, integrated economic-hydrologic model that first predicts high fertilizer-impact areas based on household characteristics combined with spatially explicit nitrogen-load and transport estimates to LIS coastal waters. The model then simulates subsequent impacts of prospective behavior-change campaigns on fertilizer use and associated nitrogen delivery. The model is implemented for a case study area that includes Connecticut coastal counties within LIS watershed and municipalities of Suffolk, Nassau, and Westchester Counties (NY) that overlap the LIS watershed. The approach integrates multiple models within the LIS coastal boundary including: (1) econometric modeling using household survey data to predict parcel-level residential fertilizer decisions, (2) landscape predictions for fertilizer use across single-family households in coastal Connecticut, coupled with a nutrient transport model to predict LIS nitrogen loads, and (3) contingent behavior modeling to examine willingness to reduce fertilizer use in response to prospective policy interventions. This is the first integrated economic-nitrogen transport simulation model to examine residential fertilizer behaviors coupled with an assessment of the potential for nutrient-reduction programs to target areas for mitigating nutrient impacts. Results are presented in a novel GIS viewer / web tool and set of story maps that allow users to explore: (1) predicted lawn fertilizer use across coastal areas of the LIS watershed, illustrated at the neighborhood scale, (2) hot and cold spots for lawn fertilizer use, (3) the implications of this spatially explicit fertilizer use for LIS nitrogen loads, and (4) predicted impacts of alternative targeting for behavior-change campaigns on these lawn fertilizer applications and corresponding nitrogen loads. Integrated findings enable more effective targeting and design of behavior change campaigns to reduce lawn fertilizer use and nutrient loads to LIS.

C3. Problems Encountered: Describe difficulties encountered during the project, e.g., problems with experimental protocols, and how they were resolved.

No significant problems were encountered.

C4. New Research Directions: Identify any additional, new research directions pursued during the project and reasons for adding them to the original research plan.

No additional, new research directions were pursued during the project.

C5. Outreach & Interactions: Describe activities and results of the project's Extension and Outreach Plan. What audiences were reached, and what products were produced? Describe any other interactions with industry, agency, or other stakeholder representatives.

As described under Objective 8, there have been significant interactions with end-user groups. These include engagements at/with the Long Island Sound Research Conference, the Long Island Sound Coastal Watershed Network, the Long Island Water Campaign, New York State Department of Environmental Conservation, Association of Environmental and Resource Economists, Social Cost of Water Pollution Workshop, the Long Island Sound Partnership, New England Interstate Water Pollution Control Commission (NEIWPCC), and others. The team

worked with Robert Burg from the Long Island Sound Partnership on an article entitled, Study on Residential Fertilizer Use Helps to Identify Nitrogen "Hot Spots," published on the LISS website: https://longislandsoundstudy.net/2024/05/study-on-residential-fertilizer-use-helps-to-identify-nitrogen-hot-spots/. Multiple webinars and presentations for scientific and end-user groups have occurred over the project, as listed below. We recently met with Quinn Burkhart of the Long Island Sound Partnership to discuss further post-project engagement and outreach to additional partners. Additional meetings will be held with Jimena Perez-Viscasillas, the Long Island Sound Partnership Outreach Coordinator. Results are also available publicly via the **Lawn Fertilizer Outreach Targeting Tool**, through the UConn CLEAR web portal, at https://s.uconn.edu/nfert.

C6. Presentations and Publications: Describe efforts to disseminate information about this research not previously reported (e.g., conferences, journal articles, presentations, books/book chapters, proceedings, invited papers or seminars, workshops, symposia, fact sheets, bulletins, brochures, student theses, unpublished reports, responses to inquiries, news releases, newspaper coverage, web articles, newsletters, television or radio appearances, governmental testimony, or interviews with the media). Either attach or send when available one copy of each publication/product (PDF preferred or web link). Please list as outlined below:

Publications: List publications here in standard citation format (please do not include publications submitted or in review, only list in-press and published publications). Include the abstract if possible.

Newburn, D.A., H. Wang, R.J. Johnston, K. Chang and T. Ndebele. 2025. High-Resolution Spatial Modeling of Household Lawn Fertilizer Behavior: Implications for Targeting Nitrogen-Reduction Programs. Journal of Environmental Management 395, 127655.

Abstract: Residential lawns cover a substantial area within urbanized regions and household fertilizer applications represent a major nonpoint source of nitrogen pollution. This paper develops a novel methodology for an integrated model that produces parcel-level, large-scale predictions of residential lawn fertilizer use and corresponding nitrogen applications. An illustrative application of this methodology is provided for Connecticut coastal counties within the Long Island Sound watershed to allow the comparison of targeting strategies for nitrogen fertilizer-reduction programs. A two-part hurdle regression model of household lawn fertilizer behavior is estimated using household survey data. Hurdle model estimation results are then used to predict lawn-fertilizer behavior for all single-family households in the region (N = 431,349) based on observable property characteristics and household demographics. Predictions integrate model results with high-resolution land cover data to identify lawn footprints and a simulation procedure to incorporate demographic information for households that were not in the survey sample, thereby producing parcel-level estimates of nitrogen applied to lawns. The effectiveness of nitrogen-reduction scenarios is compared for the optimal, simple rule-based, and municipal-level targeting strategies. Large variations in fertilizer and nitrogen applications exist over household types and municipalities. The majority of predicted nitrogen application is due to a small subpopulation of households, primarily parcels with newer, larger homes on large exurban lots. Results demonstrate that targeting strategies play a key role in the potential effectiveness of nitrogen-reduction programs. Findings such as these illustrate the insights for policy guidance that can be provided through integrated approaches that predict household-level fertilizer use across the landscape.

Presentations: List presentations here, include the name of the conference or meeting and indicate if oral or poster presentation, and if it was invited. Include abstract(s) if available. For posters, include a PDF copy if possible.

Vaudrey, J. (presenter), D. Dickson, Q.R. Lei-Parent, D., R. Johnston, T. Ndebele, H. Wang, D. Newburn, D. Wietelman, K. Chang. 2026. Targeting nitrogen reduction: Behavioral science and spatial modeling for home lawn fertilizer reduction programs. 2026 Hypoxia Workshop: Improving Outreach and Communications Around Hypoxia in Long Island Sound, hosted by the Long Island Sound Partnership. March 10.

Dickson, D. (presenter), Q. Lei-Parent (presenter), D. Newburn (presenter), J. Vaudrey, R.J. Johnston, H. Wang, D. Wietelman, K. Chang, and T. Ndebele. 2026. Focusing on Fertilizer: A New Tool to Help Target Lawn Fertilizer Outreach. University of Connecticut CLEAR Webinar, February 26. Recording available at https://clear.uconn.edu/webinars/2026-webinar-library.

Vaudrey, J. (presenter) "Social Science in the CTNERR." Presentation to the NOAA National Estuarine Research Reserve's Research Sector. Port Aransas, TX. Nov 1-4, 2025.

Vaudrey, J. (presenter), D. Dickson, Q.R. Lei-Parent, D., R. Johnston, T. Ndebele, H. Wang, D. Newburn, D. Wietelman, K. Chang. 2025. Targeting nitrogen reduction: Behavioral science and spatial modeling for home lawn fertilizer reduction programs. oral presentation. Coastal and Estuarine Research Federation biannual conference. Richmond, VA. November 9-13.

Vaudrey, J. (presenter). 2025. Building Connections – Bringing Research Results to Communities. Invited presenter and panel participant, Food Systems and Smallholder Communities Workshop 2025, Yale School of the Environment. September 25.

Lei-Parent, Q. (presenter), D. Dickson, J. Vaudrey, R.J. Johnston, D. Newburn, H. Wang, D. Wietelman, K. Chang, and T. Ndebele. 2025. *Integrating Behavioral Science with Spatial Modeling to Target Fertilizer Reduction Campaigns*. Big Ten GIS Conference, April 11.

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Dickson, D. (presenter), Q. Lei-Parent, D. Newburn, R.J. Johnston, H. Wang, J. Vaudrey, D. Wietelman, K. Chang, and T. Ndebele. 2025. Integrating Behavioral Science with Spatial Modeling to Target Nitrogen Fertilizer Reduction Programs. Coastal GeoTools, Wilmington, NC, January 27-30.

Newburn, D. (presenter), D. Wietelman, K. Chang, R.J. Johnston, T. Ndebele, H. Wang, D. Dickson, Q. Lei-Parent and J. Vaudrey. 2024. Integrated Assessment Modeling of Household Fertilizer Behavior: Implications for Nonpoint Nutrient-Reduction Programs and Coastal Water Quality. Seventh Annual Social Cost of Water Pollution Workshop, Washington, DC, October 2-4.

Newburn, D. (presenter), Johnston, R.J., T. Ndebele, D. Wietelman, H. Wang, D. Dickson, Q. Lei-Parent and J. Vaudrey. 2024. Spatial Modeling of Household Fertilizer Behavior: Implications for Nonpoint Nutrient-Reduction Programs and Coastal Water Quality. Association of Environmental and Resource Economists Summer Conference, Washington, DC, May 29 – 31.

Vaudrey, J. (presenter), D. Dickson, Q. Lei-Parent, R.J. Johnston, T. Ndebele, D. Newburn, D. Wietelman, H. Wang. 2024. Integrating Spatial Modeling of Household Fertilizer Behavior with Nitrogen Transport Models to Inform Nonpoint Nutrient-Reduction Programs. Long Island Sound Research Conf., Port Jefferson, NY. May 15.

Vaudrey, J. (presenter), D. Newburn, D. Wietelman, Johnston, R.J., H. Wang, D. Dickson, Q. Lei-Parent, T. Ndebele. 2024. A Nitrogen Pollution Solution: Reducing Fertilizer in Our Communities. Long Island Water Campaign, webinar, February 22.

Vaudrey, J. (presenter), D. Newburn, D. Wietelman, Johnston, R.J., H. Wang, D. Dickson, Q. Lei-Parent, T. Ndebele. 2024. Tackling Local Nitrogen Pollution: Reducing Fertilizer in Our Communities. Long Island Sound Coastal Watershed Network, webinar, January 11.

D. ACCOMPLISHMENTS:

D1. Impacts & Effects:

This project provides guidance on how behavior-change campaigns for residential lawn care can be targeted to have intended effects on N loads to LIS coastal waters, integrating methods/data from social and biophysical science. It provides a heretofore unavailable capacity for end users to target behavior-change campaigns in ways that produce the greatest N-load reductions. The project supports efforts to promote sustainable behaviors across the watershed, addressing CCMP targets, strategies, and actions. To support these impact objectives, we have produced story maps, GIS data layers, and guidance depicting areas of the watershed and household types that can be targeted to produce desired N-load reductions (the Lawn Fertilizer Outreach Targeting Tool), including information on how efforts can be designed to reduce N loads in particular areas of concern. Webinars and other public presentations have presented this information to end-users, in addition to permanent posting at https://clear.uconn.edu/projects/fertilizer/. This project was designed at the request of end users seeking information on how to better design and target N-reduction efforts.

From a concrete perspective, project results demonstrate that targeting strategies play a key role in the potential effectiveness of nitrogen-reduction programs focused on lawn care. Moreover, results suggest that some of the most common approaches to behavior-change targeting (e.g., focusing on urban and densely populated suburban areas) may be relatively ineffective at reducing N loads to LIS, compared to strategies that systematically target the areas responsible for the largest N delivery to the Sound due to residential fertilizer (i.e., exurban lots with newer, larger homes and lawns). These results provide end-users with the information needed to develop more effective behavior change campaigns.

D2. Patents: Describe patents awarded or pending, including number, date, and licenses granted.

None

D3. Leveraged Funding: List and describe any funding or grants (e.g. from NSF, etc.) you received with the help of the work or results from this project. Provide project title, project dates, funding amount, and funding source.

Title	Start Date	End Date	Funded Amount	Funding Source

E. Stakeholder Summary: Provide a summary of your project as if you were selling or describing your project to a potential "stakeholder" (a non-peer audience). Focus on the major issues and their importance, your results, and what impact they have. Be sure to include "take-home messages" from your project.

Nitrogen (N) from residential lawn fertilizer is one of the most challenging and persistent problems impacting the health of Long Island Sound (LIS). Attainment of nutrient-reduction goals in LIS and similar waterbodies thus requires policies or programs able to address household behaviors such as lawn fertilizer use that are directly linked to nonpoint source N loads. While the impacts of excessive fertilization are well known, little attention has been paid to understanding behaviors by residential households, including how to effectively implement behavior change campaigns and implications for attaining nutrient-reduction goals. To address this unresolved problem, an interdisciplinary team of researchers from Clark University, the University of Connecticut, the University of Maryland, and the University of Miami collaborated on an effort to better target education and outreach campaigns to reduce the use of lawn fertilizer in areas of greatest impact. The study was implemented for a case study area that includes Connecticut coastal counties within LIS watershed and municipalities of Suffolk, Nassau, and Westchester Counties (NY) that overlap the LIS watershed. We applied social science data and modeling to predict households' likelihood to apply lawn fertilizer, their frequency of applications, and their likelihood to curb future fertilizer use. These predictions were combined with geospatial data on areas of large N loads from fertilizer and areas that are more likely to deliver N to waterways to develop a Lawn Fertilizer Outreach Targeting Tool, available at https://s.uconn.edu/nfert. This tool identifies areas of the watershed for which interventions to reduce lawn fertilizer may have greater impacts. Results are presented in a novel GIS viewer / web tool and set of story maps that allow users to explore: (1) predicted lawn fertilizer use across coastal areas of the LIS watershed, illustrated at the neighborhood scale, (2) hot and cold spots for lawn fertilizer use, (3) the implications of this spatially explicit fertilizer use for LIS nitrogen loads, and (4) predicted impacts of alternative targeting for behavior-change campaigns on these lawn fertilizer applications and nitrogen loads. The project provides information to support more effective targeting and design of behavior change campaigns to reduce lawn fertilizer use and nutrient loads to LIS. Results are available via the Lawn Fertilizer Outreach Targeting Tool, available at https://s.uconn.edu/nfert.

F. Pictorial:

The Lawn Fertilizer Outreach Targeting Tool and Story Map is available at https://s.uconn.edu/nfert. Additional images from the project are found in the figures above.

K. OTHER:

Provide other relevant information that you would like to include. This section is optional.

N/A