NERRS Science Collaborative Progress Report for the Period 9/1/2013 through 2/28/2014

Project Title: Nitrogen Sources and Transport Pathways: Science and Management Collaboration to Reduce Nitrogen Loads in the Great Bay Estuarine Ecosystem

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Project start date: 09/01/2010

Report compiled by: Michelle Daley, Chris Keeley, Steve Miller, Charlie French, and William H. McDowell

Contributing team members and their role in the project: William H. McDowell (oversees all project activities), Michelle Daley (manages field work, works collaboratively with stakeholders and is responsible for GIS analysis and data synthesis), Charlie French (science integration co-lead), Steve Miller (science integration co-lead), Chris Keeley (assists with science integration), Jody Potter (manages laboratory analyses and is responsible for caffeine and optical brightener analysis), John P. Bucci (responsible for mitochondrial (mt) DNA analysis) and Erik Hobbie (responsible for isotopic analysis of sediment)

Nitrogen Sources Collaborative-Science Advisory Board members: Members represent a diverse group of stakeholders from the Great Bay watershed including municipal planners and decision-makers, representatives of non-profit organizations, and local and regional businesses. All volunteer their time to meet, engage with the research team, learn about the research being conducted, and discuss how the research results can make a positive impact in the Great Bay watershed.

A. Progress overview: State the overall goal of your project, and briefly summarize in one or two paragraphs, what you planned to accomplish during this period and your progress on tasks for this reporting period. This overview will be made public for all reports, including confidential submissions.

Overall goal of the project: To detect non-point nitrogen sources and transport pathways in the Great Bay watershed while engaging decision makers in the science to ensure results are useful and will ultimately help reduce nitrogen loads in the Great Bay estuarine system.

Revised Project Objectives (based on stakeholder feedback described previously):

1. Integrate scientific investigations with stakeholders to ensure results are useful and accessible to environmental managers and other stakeholders
2. Identify, model and map N concentrations in surface waters throughout the Great Bay Watershed to identify "hot spots"
3. Identify non-point sources of N that reach surface waters and the delivery pathway (e.g. groundwater vs. stormwater) using tracers
4. Quantify N attenuation in large river reaches by modeling N inputs and outputs and inferring N attenuation

During this reporting period our goal was to work on objectives 1, 2, 3 and 4 and perform the activities designated under Q1 and Q2 of year 4 (Table 1). Objective 1 included continued collaboration with stakeholders through approximately quarterly NSCAB meetings and newsletter distribution focused on identifying the project products that will be most useful for stakeholders. Our plan for objective 2 was to continue to improve our Great Bay landscape models that predict N concentrations based on watershed characteristics using data from our 250 extensive sites and to improve our understanding of N "hot spots" and "cold spots". Objective 3 included continued sampling and analysis of some "hot spot" and "cold spot" sites to identify the sources of nitrogen or watershed characteristics that are associated with these intensive study sites. We distributed a "Nitrogen Sources Newsbytes" newsletter in October that solicited feedback from the readership on the proposed project products. In December, we held an NSCAB meeting where we focused on identifying which products the project team would focus on producing. We have improved some of the watershed boundaries for the extensive study sites and are in the process of updating the corresponding landscape characteristic information (human population density, land use/land cover and impervious surface) for further development of our Great Bay landscape models that predict N concentrations. Intensive sites were sampled in September, October and December for nutrients and isotopic analysis of nitrate (NO3) for a subset of the intensive samples. Unfortunately, the isotopic nitrate analysis (conducted by the UC Davis Stable Isotope Facility) cannot begin until May 2014. Work on objective 4 has been deferred.

B. Working with Intended Users:

- Describe the progress on tasks related to the integration of intended users into the project for this reporting period.

Our main mechanism for integrating intended users into the research project continues to be the Nitrogen Sources Collaborative Advisory Board (NSCAB) and electronic distribution of the Nitrogen Newsbytes Newsletter. NSCAB members include civic leaders, community decision-makers, business owners, and others who have a stake in Great Bay nitrogen issues and want to help ensure that good science leads to sound community decision-making. Typically quarterly NSCAB meetings are held to discuss project objectives, progress towards objectives, next steps, and final products.

Fall 2013:
Working with intended users during this reporting period was focused on conceptualizing useful products and means for delivering project results to the user community. Part of this involved soliciting input from the NSCAB via phone and email on products proposed by the project team, as well as collecting additional ideas from NSCAB members about what they felt would be useful products. We held one meeting with the NSCAB during this reporting period, summarized below.

NSCAB Meeting December 5, 2013:

The goal of this meeting was to identify which products for the project team to move forward with producing. In recognition that resources allow us to only produce a subset from this list, we encouraged the NSCAB to consider which products would have the highest impact and the highest feasibility of being developed and delivered (process described below). Leading up to the meeting, the NSCAB and the project team identified six possible products:

1. **Maps**
    a) Interactive maps: Maps produced using google maps and google earth which allow users to click on a site and see the site metadata. Users could also look up sites in an accompanying table to find detailed information on watershed land use, population density, N concentrations and if source (tracer) data exist for that site.
    b) Static maps: Maps showing measured nitrogen concentration data and modeled current N conditions throughout the Great Bay watershed. These maps could be generated for each HUC 12 watershed and for each town and would be available as digital PDF maps. Need to investigate if GIS shapefiles (including attribute information) could be integrated into NH GRANIT.
    - Note NSCAB voiced that maps should have recommendations attached so that towns can reference them in applying for grants.
2. **Executive Summary**: Overview of project results (i.e., a 2 pg hard copy + a PDF download)
3. **Land Use Profiles**: Would identify what we know about each of our area’s common land uses, what the manageable sources of nitrogen are from this land use, what strategies are available for reducing nitrogen, and the co-benefits of those strategies.

4. **Presentations**: Project results for Town Boards and others. Possible options include a video that they could play, presentations to regional planning commissions as a 'train the trainer' presentation, recording audio to powerpoint presentations that have already been made for this project, partnering with NH Natural Resources Outreach Coalition or Southeast Watershed Alliance.
5. **Workshop(s):** One for town professional staff, and one that is more general for town boards. Workshops could be regional by subwatershed. NSCAB voiced that MS4 communities are already on board with doing something, so a focus should be on workshops for non-MS4 because they need information and motivation. Also, workshops could be recorded as a webinar or offered as Continuing Education credits.
6. **Article series**: Covering nitrogen sources and reduction strategies (possible topics include pet waste, fertilizer, septic maintenance), recognizing that will help towns comply with MS4 permits that will require outreach.

The meeting opened with Kalle Matso from the Science Collaborative giving an overview of Science Collaborative-funded projects and lessons learned from projects that have close integration with users from the beginning. Comments and questions from the NSCAB suggested that they felt appreciation for being included throughout the research project, and felt that this was a good approach overall. For example, one participant affirmed "the approach of getting users engaged upfront is good because they often are on the learning curve of how to use the end-products."

Michelle Daley reviewed what the project results tell us so far and what the limitations are based on spatial scale and causality of N sources in stream sites sampled. We then transitioned into how to convey that information through meaningful products.

We had an open discussion with the NSCAB about the perceived merits and limitations of each of the possible products. One consideration identified by the NSCAB was how products would tie into other efforts or could be leveraged/expanded upon by future projects. Also, NSCAB voiced that small towns without GIS capabilities will not be able to effectively access shapefiles, and so PDF maps or printed maps were more desirable.

In order to get a sense for the NSCAB's collective interest in these products, we created an Impact-Feasibility grid for each of the products. NSCAB members were given sticky dots and asked to place one dot on each product grid to show how impactful and how feasible they felt each product would be. The NSCAB and project team agreed that products with the greatest number of dots in the high impact/high feasibility quadrant would be prioritized highest. We explained that we would review the input and make a decision at a follow-up project team meeting and announce to the NSCAB which products we would be working on through the winter and spring, with a roll-out beginning in the summer.

The products with the greatest number of dots in the high impact-high feasibility quadrant were: workshops (5), summary of research results (4), interactive digital maps (4), static maps (4), land use profiles (3), series of articles (2), presentations on results (0).

The project team met in mid December to discuss the NSCAB input and decided to first focus on producing a 2 pg. summary report that will incorporate land use profiles (with maybe a picture for each one) and nitrogen management strategies (but not be prescriptive about the "right" strategy). The goal of this product will generally be to give people an understanding of land use dynamics. We communicated this decision back to the NSCAB via email, and that we will reengage with them in May.

Nitrogen Newsbytes Newsletter: The integration team worked with the scientists and local partners to issue the sixth Nitrogen Newsbytes newsletter in October 2013 which included a project update that captures the results of the August 2013 NSCAB meeting, explains the one-year extension of the project, and how the project team and NSCAB are working together to develop meaningful products for stakeholders to use in an effort to reduce non-point nitrogen inputs into Great Bay. The newsletter solicited feedback from the readership on the proposed project products. The newsletter continues to be a supplemental method for transferring information to stakeholders as well as collecting their input on questions that drive the activities of the project. The list of subscribers has grown to 150 people representing diverse interests, e.g. sewer districts, conservation and watershed organizations, taxpayers, businesses, national Senator staffers (Shaheen), etc.

Presentations to and discussions with local stakeholders and intended users on nitrogen issues in the Great Bay watershed

Daley, M.L. Oct 29, 2013 – Shared preliminary the Great Bay N sources and transport project results with Durham-UNH Integrated Permit and Planning Technical Advisory Committee (TAC).

Daley, M.L. Jan 17, 2014 - Met with Allison Watts and Paul Stacey to discuss how the Great Bay N sources and transport project might inform the NERRS Science Collaborative project: Water Integration for Squamscott-Exeter (WISE) and aid the project team in designing a water quality monitoring program.

Daley, M.L. Jan 31, 2014 – Met with Laura Byergo and Peter Wellenberger from Great Bay Stewards to discuss how the Great Bay N sources and transport project might inform site locations chosen for the "soak up the rain" effort.

Daley, M.L. Feb 26, 2014 – Met with Mark Zankel and Peter Steckler from The Nature Conservancy (TNC) to discuss the Great Bay N sources and transport project and how it can inform the next version of the TNC Land Conservation Plan for New Hampshire's Coastal Watershed.

- What did you learn? Have there been any unanticipated challenges or opportunities?

  Key lessons learned are:

  - NSCAB members are very interested in having products that they can bring to their communities, their towns and boards, and actually make decisions with.

- NSCAB members are very aware that MS4 and non-MS4 communities have different informational and motivational needs.
- We have developed a readership of approximately 150 people for the Nitrogen Sources Newsbites, but are challenged with finding a way to keep this readership engaged and connected to the issue beyond the project.
- Workshops, maps (both static and interactive) and a project summary were seen as having high impact-high feasibility. However, we are concerned that the remaining project resources will not be enough to develop all 3 products well and meet other project objectives at the same time.

- Who has been involved?

The NSCAB, Sewer District representatives, state environmental services staff, Lamprey River Watershed Association, Lamprey River Advisory Committee, Oyster River Watershed Association, Oyster River Local Advisory Committee, Trout Unlimited, Southeast Watershed Association, Newmarket Town Council and Conservation Commission, Marine Docents, US Senator Shaheen's office (via newsletter), state representatives (Spang, Borden, etc.).

- Has interaction with intended users brought about any changes to your methods for integration of intended users, the intended users involved, or your project objectives?

During this reporting period, interaction with intended users was primarily focused on shaping the products that will be developed. NSCAB provided the project team with a user perspective that informed the selection of products for development and dissemination.

- How do you anticipate working with intended users in the next six months?

We intend to reengage with the NSCAB in May or June when we have draft products for them to review. At that point we will host a "brown bag luncheon" meeting to review the products with the NSCAB and a range of stakeholders possibly including NH Dept. of Environmental Services, UNH Stormwater Center, Kalle Matso/NERRS Science Collaborative staff, and others. We intend to hold a final wrap-up meeting with the NSCAB in August/September.

Table 1. Project objectives and revised activity timeline.

List Project Objectives, Products, Activities	Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Objective 1:Integration of Science with End Users								
Engage stakeholders in framing the research questions	Completed							
Utilize NSCAB to guide the science objectives and desired products	x	x	x	x	x	x	x	x
Great Bay nitrogen sources newsletter: "Nitrogen Sources Newsbytes"	x	x	x	x	x	x	x	x
Adapt science in the field to address stakeholder input/needs	Completed							
Stakeholder analyses and review of findings	x	x	x	x	x	x	x	
Develop products that are useful for decision-makers		x	x	x	x	x	x	x
Explore publication products with stakeholders				x	x	x	x	x
Objective 2: Identify, model and map N concentrations to identify "hot spots" – Extensive sites								
Site Designation								
Assess catchment characteristics as delineated and described by NH Geological Survey (NHGS)	Completed							
Select ~250 study sites and generate maps necessary for initial sample collection	Completed							
Revise study site locations after site visit, sample collection and analyses	Completed							
Revise maps necessary for field collection	Completed							
Field sampling and Laboratory analyses								
Collect stream samples from extensive sites	Completed							
Process and analyze stream samples from extensive sites	Completed							
Compile data for analyses of N concentrations	Completed							
Create models and maps of N concentrations and "hot spots"								
Delineate watersheds for final extensive sites and characterize attributes (land use, population density, impervious cover etc.)	Completed							
Apply Lamprey DIN vs. population density model to extensive sites	Completed							
Develop Great Bay landscape model that predicts N concentrations	x	x	x	x	x	x	x	
Identify "hot spots" where N concentrations are higher than expected	x	x	x	x	x	x	x	
Map N concentrations and "hot spots"	x	x	x	x	x	x	x	

List Project Objectives, Products, Activities	Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Apply N model to NHGS catchments (~3500) and identify those at risk for high N							x	x
Share available data with NHDES for accuracy assessment of nitrogen pollution source study	x	x	x	x	x	x	x	x
Objective 3: Identify N sources in surface waters and the delivery pathway – Intensive sites								
Select ~12 study sites that represent a single N source to test tracers	Completed							
Collect source water samples from tracer testing sites and analyze N fractions	x	x	x	x	x	x	x	
Isotopic analysis (^{15}N , ^{18}O) of nitrate source water	x	x	x	x	x	x	x	
Caffeine, optical brightener and mitochondrial DNA analysis of source water	Completed							
Sediment collection and ^{15}N analysis of tracer testing sites	Completed							
Select ~8 "hot spots" study sites to apply tracers	x	x	x	x	x	x	x	
Collect water and sediment samples from tracer application sites during baseflow and storms	x	x	x	x	x	x	x	
Analyses of tracers and N fractions at tracer application sites	x	x	x	x	x	x	x	
Data analyses	x	x	x	x	x	x	x	x
Prepare statistical (ongoing and final) analyses	x	x	x	x	x	x	x	x
Objective 4: Estimate N attenuation in large river reaches								
Model N inputs and outputs and infer N attenuation							x	x
Prepare Publications							x	x

C. Progress on project objectives for this reporting period:

- Describe progress on tasks related to project objectives for this reporting period.

Progress on **objective 1**: Integrate scientific investigations with stakeholders to ensure results are useful and accessible to environmental managers and other stakeholders

See section B

Progress on **objective 2**: Identify, model and map N concentrations in surface waters throughout the Great Bay Watershed to identify “hot spots”.

More than 1100 extensive samples have been analyzed to assess the range of nitrogen concentrations in streams throughout the watershed and to look for nitrogen “hot spots” and “cold spots”. We consider “hot spots” sites that have noticeably high N or higher N than we would expect given the watershed’s human population density and land use. Similarly, sites that have noticeably lower N than we would expect are considered “cold spots”. Data show that several sites exhibit median dissolved inorganic nitrogen (DIN; Figure 1), dissolved organic nitrogen (DON; Figure 2) concentrations well above the 0.45 mg/L total nitrogen (TN) threshold for assessing impairment of dissolved oxygen in tidal rivers and the Great Bay. Maximum DIN concentrations reached 3.9 mg N/L and maximum DON concentrations reached 1.2 mg N/L among individual samples suggesting that some of these sites are “hot spot” sites.

Through recent conversations with a member of our NSCAB we realized that the watershed boundaries for a few of our extensive stream sites as determined by NHGS using 10 m DEMs were not accurate. We have updated these watershed boundaries in question based on 2 ft contour intervals from NH GRANIT LiDAR data and are in the process of double checking other small streams to see if other discrepancies in watershed boundaries exist. Once this is completed, the watershed characteristic information (population density, land use/land cover and impervious cover) will be updated for these revised boundaries. We will then move forward with multivariate statistical approaches to better describe the spatial variability in DIN, DON and TDN concentrations (as compared to the simple linear regression analysis approach described in the last reporting period). We will also analyze each sampling campaign individually to minimize the error associated with any temporal variability in N concentrations.

To further assess “hot spot” and “cold spot” sites, we have looked more closely at the relationship between DIN concentrations and human population density and the relationship between DON and % wetland cover (Figure 1). As a first step, we consider sites with median DIN concentrations $\geq$ 0.90 mg/L (twice the TN threshold for assessing impairment of dissolved oxygen in tidal rivers and the Great Bay) to be “hot spot” sites (Figure 3). “Cold spot” sites were considered to be sites where median DIN concentrations were $\leq$ 0.3 mg/L and human population densities were $\geq$ 950 people/km^2 (Figure 4). Sites with DON concentrations > 0.60 mg/L are considered to be “hot spots” based on the relationship with wetland cover (Figure 2).

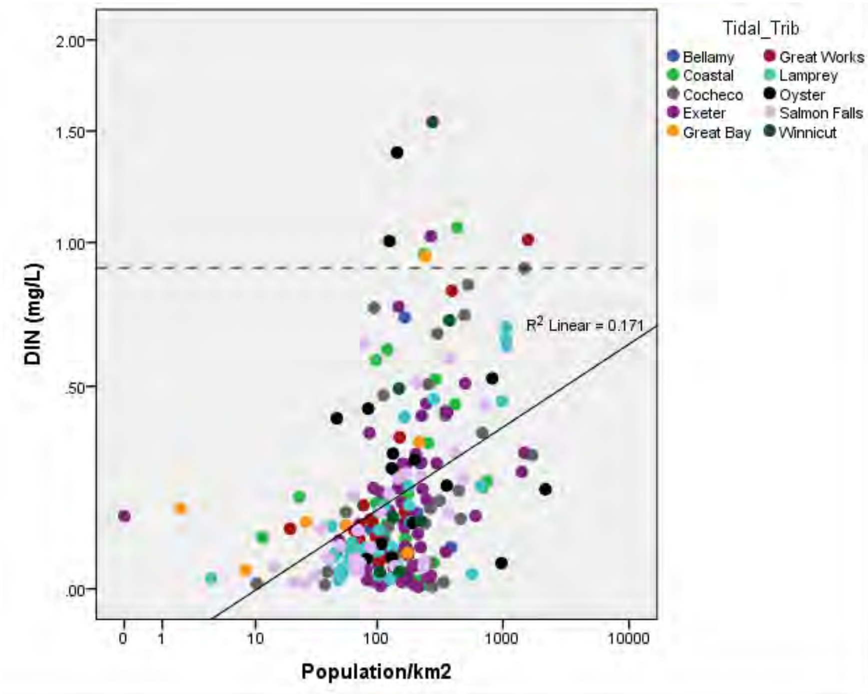

Figure 1. Median dissolved inorganic nitrogen (DIN) concentrations among Great Bay extensive sites vs. the watershed human population density. Sites are color coded by the tidal tributary location. Note log scale.

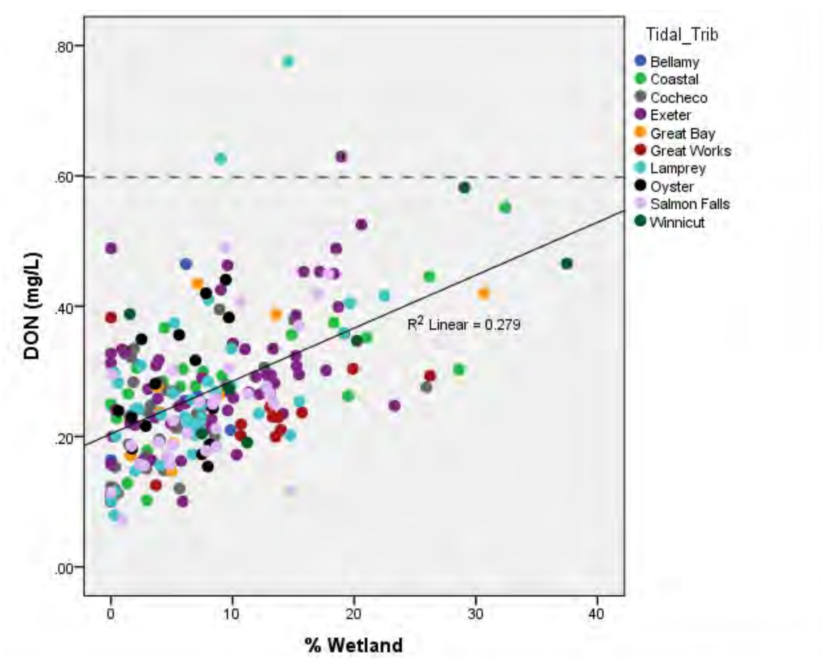

Figure 2. Median dissolved organic nitrogen (DON) concentrations among Great Bay extensive sites vs. the watershed human population density. Sites are color coded by the tidal tributary location. Note log scale.

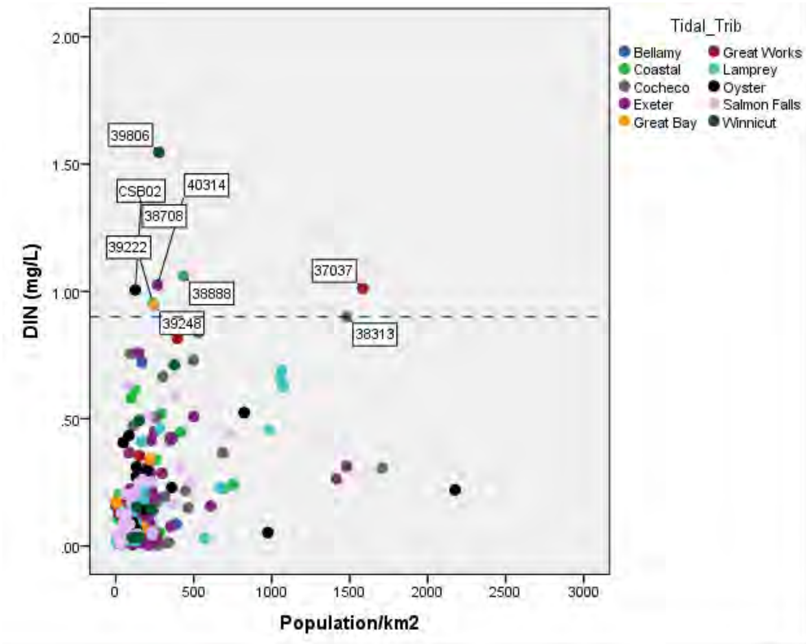

Figure 3. Median dissolved inorganic nitrogen (DIN) concentrations among Great Bay extensive sites vs. the watershed human population density. Sites with DIN concentrations > 0.90 mg/L (twice the TN threshold for assessing impairment of dissolved oxygen in tidal rivers and the Great Bay) are labeled. Note linear scale.

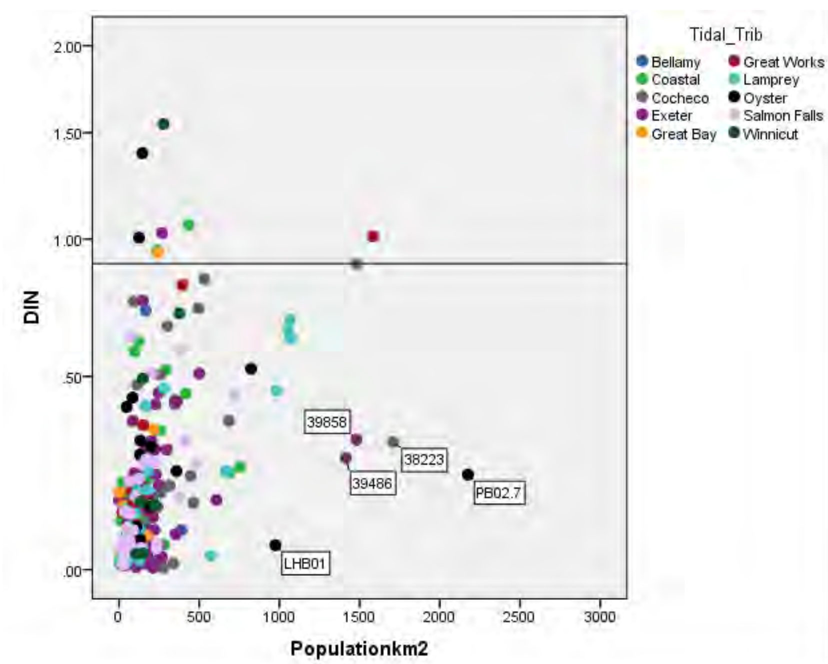

Figure 4. Median dissolved inorganic nitrogen (DIN) concentrations among Great Bay extensive sites vs. the watershed human population density. Sites where median DIN concentrations were ≤ 0.3 mg/L and human population densities were ≥ 950 people/km2are labeled. Note linear scale.

Table 2. Preliminary "hot spot" and "cold spot" stream sites. Median DIN and DON concentrations are given along with the corresponding watershed human population density (Pop/km2) and % land use/land cover (developed (Dev), agriculture (Ag) and wetland cover). Watersheds described as "Urban" rely predominately on centralized wastewater treatment facilities for treatment of human waste whereas "suburban" watersheds rely predominately on on-site septic systems for treatment of human waste.

	Sample Name	Alternate Name	Description	Tidal Tributary	Town	DIN (mg/L)	DON (mg/L)	Pop/ km2	Dev	Ag	Forest	Wetland
DIN "Hot Spots"												
	37037		Urban	Great Works	Sanford	1.012	0.108	1583	78.1%	0.4%	18.5%	0.0%
	38313	Unnamed Brook Dover - upstream Henry Law Park	Urban	Cocheco	Dover	0.900	0.123	1481	88.0%	0.9%	9.9%	0.0%
	38708	Hamel Brook at Ffrost Dr.	Suburban	Oyster	Durham	1.395	0.188	144	12.3%	0.1%	70.0%	8.1%
	38888		Suburban	Coastal	Kittery	1.061	0.128	435	17.1%	0.7%	70.0%	1.3%
	39222		Suburban/Urban	Coastal	Rye	0.954	0.303	238	4.9%	2.7%	59.4%	28.6%
	39248		Suburban/Ag	Great Bay	Greenland	0.945	0.170	243	28.8%	24.2%	36.4%	1.6%
	39806		Suburban	Winnicut	North Hampton	1.546	0.191	276	41.6%	7.1%	31.5%	11.2%
	40314		Suburban	Exeter	Hampstead	1.025	0.109	268	23.0%	12.7%	61.4%	0.0%
	CSB02	Oys-2; 38595; Chelsey Brook at Packers Falls Rd.	Suburban/Ag	Oyster	Lee	1.006	0.154	125	5.1%	28.7%	53.3%	8.0%
DIN "Cold Spots"												
	38223	Berry Brook	Urban	Cocheco	Dover	0.307	0.154	1707	89.3%	1.6%	6.0%	0.3%
	39486		Suburban	Exeter	Raymond	0.264	0.327	1413	100.0%	0.0%	0.0%	0.0%
	39858		Urban	Exeter	Exeter	0.313	0.309	1481	64.2%	1.6%	30.5%	3.7%
	LHB01	Oys-5; 38525	Urban	Oyster	Durham	0.053	0.239	975	30.8%	1.6%	62.8%	0.6%
	PB02.7	38560	Urban	Oyster	Durham	0.220	0.349	2175	54.1%	3.4%	36.3%	2.5%
DON "Hot Spots"												
	40152		Agriculture	Exeter	East Kingston	0.038	0.629	82	3.7%	36.5%	40.4%	18.9%
	38900		Agriculture	Lamprey	Deerfield	0.033	0.626	50	3.3%	38.1%	42.8%	9.0%
	39724		Ag/Urban	Exeter	Exeter	0.077	0.489	353	1.2%	42.4%	49.4%	0.0%

Most of the preliminary DIN “hot spot” sites are suburban watersheds which rely predominately on on-site septic systems for treatment of human waste (Table 2). Conversely, most of the DIN “cold spot” sites are urban watersheds which rely predominately on centralized wastewater treatment facilities for treatment of human waste. All three DON “hot spot” sites have a high percentage of agricultural land use (36-42%) in the corresponding watersheds (Table 2).

Progress on **objective 3:** Identify non-point sources of N that reach surface waters and the delivery pathway (e.g. groundwater vs. stormwater) using tracers.

Intensive sites were sampled in September, October and December for nutrients and isotopic analysis of nitrate (NO_3) for a subset of the intensive samples. In December, isotopic analysis was scheduled with the UC Davis Stable Isotope Facility, but UC Davis could not schedule this sample analysis to begin until May 14, 2014.   This delay in sample analysis means that we will not receive the nitrate isotope tracer data until mid-July, which will make it impossible to include this information in the draft products by May or June for review at the “brown bag luncheon” meeting with the NSCAB and other stakeholders.

A graduate student, Marleigh Sullivan, has been conducting experiments on wells in the riparian zone of one suburban and one urban site to quantify N uptake and denitrification. Preliminary results from her work suggests that when nitrate is in excess (~32 mg/L), mean nitrate removal ranged from 2.45 to 2.55 mg/L*day among the two riparian urban wells and from 3.02 to 6.62 mg/L*day among the four riparian suburban wells (Figure 5). About half of the wells experienced increases in TDN even though there was a decrease in nitrate. This indicates that there is an additional source of N over the course of the experiment, perhaps from decomposition of soil organic matter.

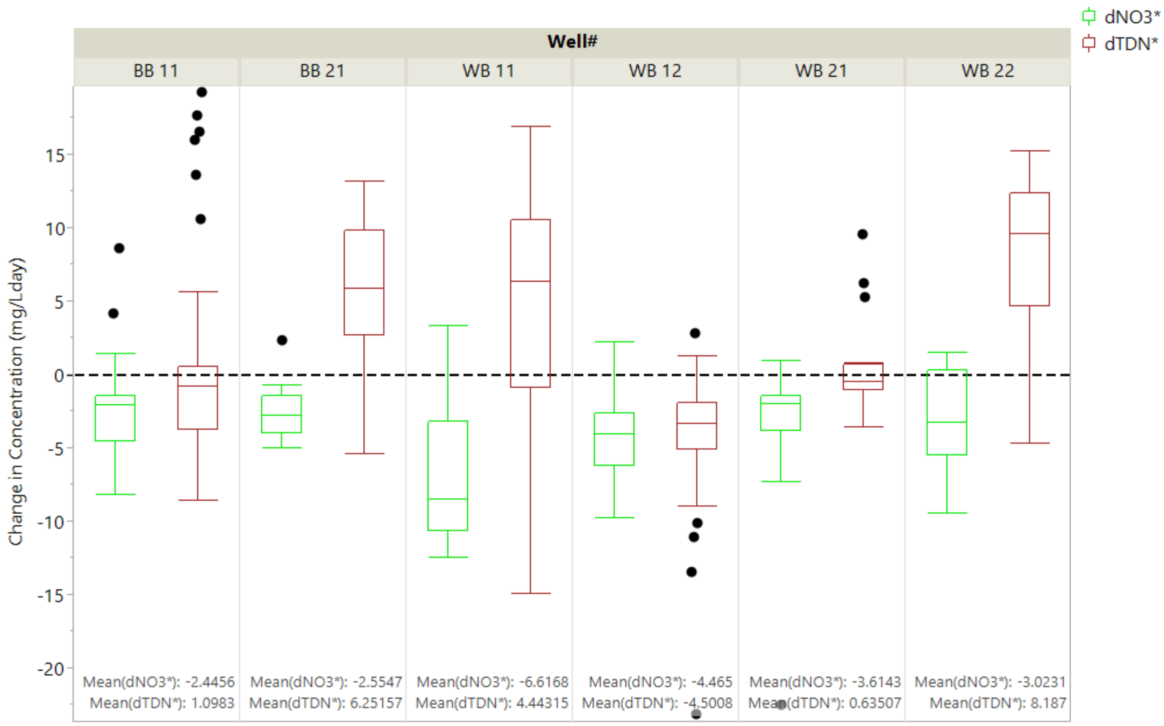

Figure 5. Nitrogen removal among riparian urban wells (BB11 and BB21) and among suburban wells (WB12, WB21 and WB22).

Progress on **objective 4:** Quantify N attenuation in large river reaches by modeling N inputs and outputs and inferring N attenuation.

Progress on this objective has been deferred.

- What data did you collect?

As described previously, we collected feedback from intended users on project products and collected samples and field data from intensive sites.

- Has your progress in this period brought about any changes to your methods, the integration of intended users, the intended users involved or the project objectives?

In the next couple months, we will need to consider whether or not we can produce the three types of products (workshops, project summary and maps) that the NSCAB valued as having high impact and high feasibility with the remaining project resources and time. One option is to omit objective 4 (Quantify N attenuation in large river reaches by modeling N inputs and outputs and inferring N attenuation) to free up personnel time to develop NSCAB desired project products. The NSCAB seems to be more interested in nitrogen conditions in their respective town or sub-watershed rather than the in-stream attenuation of nitrogen along the flow path to Great Bay. Additionally, the NH EPSCoR Ecosystem & Society project (http://www.epscor.unh.edu/ecosystemsandsociety) is well poised to model in stream and wetland processing of N in response to climate and land use variability using a much more sophisticated modeling approach (FrAMES: Framework for Aquatic Modeling of the Earth System) than we proposed in this project.

- Have there been any unanticipated challenges, opportunities, or lessons learned?

As with most research projects, developing the final dataset for both landscape characteristics and nutrient concentrations has been an iterative process and has taken longer than initially anticipated. The significant delay in the ability of the UC Davis Stable Isotope Facility to analyze intensive samples for nitrate isotopes is another unanticipated challenge to our timeline for project completion.

- What are your plans for meeting project objectives for the next six months?

In the next six months we plan to work on objectives 1, 2, and 3 and decide whether or not to proceed with objective 4. Specifically, we plan to perform the activities designated under Q3 and Q4 of year 4 (Table 1). This includes continued collaboration with stakeholders to finalize project products. We will finalize our Great Bay landscape models that predict N concentrations based on watershed characteristics. We will also continue to improve our understanding of “hot spot” and “cold spot” sites and the sources of nitrogen or watershed characteristics that are associated with these sites. Intensive sites will be sampled regularly for N concentrations and a couple times for isotopic analysis of nitrate. All finalized N concentration data will be shared with NHDES as it becomes useful for assessing the accuracy of the GBNPSS.

D. Benefit to NERRS and NOAA: List any project-related products, accomplishments, or discoveries that may be of interest to scientists or managers working on similar issues, your peers in the NERRS, or to NOAA. These may include, but are not limited to, workshops, trainings, or webinars; expert speakers; new publications; and new partnerships or key findings related to collaboration or applied science.

Publications:

Hope, A.J., W.H. McDowell, W.M. Wollheim. 2013. Ecosystem metabolism and nutrient uptake in an urban, piped headwater stream. Biogeochemistry. September 2013. DOI 10.1007/s10533-013-9900-y

E. Describe any activities, products, accomplishments, or obstacles not addressed in other sections of this report that you feel are important for the Science Collaborative to know.