Scaling Up Payment for Watershed Services Programs

In the Upper Neuse River Basin

A Feasibility Analysis and Guidance Framework

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Masters project submitted in partial fulfillment of the requirements for the
Master of Environmental Management degree in the Nicholas School of the Environment of Duke University

2012

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ABSTRACT

The Falls Lake Reservoir in the Upper Neuse River Basin (UNRB) of North Carolina is currently classified as "impaired," meaning that it fails to meet state water quality standards for its designated use for aquatic life. To retain its designated use and come into compliance with the Clean Water Act, the Falls Lake Rules stipulate specific goals for nitrogen and phosphorus load reductions in the watershed. Payments for Watershed Services (PWS) could provide a cost- and environmentally-effective approach to meeting the Falls Lake Rules goals. We examine successful PWS case studies across the United States to assess the feasibility of scaling up current PWS programs in the UNRB. We compile the relevant attributes, experiences, and lessons learned from these case studies to determine 1) the UNRB's general state of "readiness" for scaling up PWS programs in the basin, 2) which case studies can serve as model programs for the UNRB, 3) what a basin-wide PWS program might look like and steps UNRB stakeholders can take to better ready themselves for such a program, and 4) potential challenges, limitations, and benefits of basin-wide PWS program implementation. Results from this study suggest that the UNRB is well-positioned for scaling up a payment for watershed services program, as the basin already satisfies many of the designated preconditions for success. We provide five actionable recommendations for UNRB stakeholders and offer a guidance framework for program design and implementation moving forward.

EXECUTIVE SUMMARY

The Piedmont region of North Carolina is a vibrant community. A plethora of academic and research institutions, mild winters, and a high quality of life continue to attract families and professionals from around the country. As our social resources develop, we must take care to safeguard and protect our natural resources. Water is essential for our human health and for the health of our ecosystems. Nine reservoirs in the Upper Neuse River Basin, including Falls Lake, Little Michie, and Little River reservoirs, provide eight municipalities with clean drinking water and natural areas for recreation and wildlife habitat. As development increases the value of remaining green space in this watershed, economic options to incentivize conservation are being explored. Payment for watershed services (PWS) programs organize entities that impact water quality (sellers, typically landowners or point source polluters) and connect them to entities with an interest in protecting water quality (buyers, generally downstream users or utilities are beneficiaries). By connecting the buyers and sellers of water quality, PWS programs provide economic incentives to protect our natural resources. The spring of 2011 was an exciting time for the water utilities in Raleigh and Durham. Both cities introduced fees on their water bills that will fund land protection for water quality. These forward-thinking policies are the beginnings of what we hope will be a basin-wide payment for watershed services program.

The Conservation Trust for North Carolina (CTNC) acts as an umbrella agency for twenty-five land trusts in the state, many of which are involved in land conservation activities such as those funded by the Raleigh and Durham utility fees. CTNC commissioned this report to help shape the next steps of PWS development in the Upper Neuse River Basin. With this goal in mind, we used a case study approach to evaluate the feasibility of an expanded payment for watershed services program in the Upper Neuse River Basin (UNRB). This involved a systematic assessment of fifteen successful PWS case studies as well as an assessment of the UNRB. Case study 'score cards' were used as a structured tool for data collection. For each successful case study program assessed, the same basic program descriptors and key attributes were recorded to make comparisons and observe trends in these programs. We collected data through literature review and personal interviews. Next, we ranked attributes from the fifteen case studies according to their alignment to the UNRB and drew conclusions as to whether the UNRB meets the preconditions necessary for successful implementation of a watershed-scale PWS program. Attribute alignment was determined through a standardized scoring process; we compared attributes within each case study to the current UNRB context. These comparisons can be visualized in our alignment table, which is available in **Table 10.** Fifteen case studies provided ample takeaways in terms of PWS program development and structure. Our six primary findings in this area are identified and described below:

1. **Burlington and Tualatin provide strong program models.** These two case studies were the most aligned with the biophysical and political situation in the UNRB. PWS designers (government and non-profit representatives) should consider meeting with representatives from these programs to learn about effective infrastructure design, stakeholder engagement techniques, and potential funding mechanisms.
2. **UNRB has a unique watershed size and is well positioned for scaling up current PWS programs.** Case studies ranged in watershed size from 69 to 8,243 square miles. The Upper Neuse River Basin is safely nestled in the "Goldilocks Zone" in terms of its 770 square mile size, being neither too small nor too large for effective PWS program implementation.
3. **UNRB could have watershed level program administration or explore cooperative administration.** Although the watershed size varies considerably between case studies, the scale at which PWS programs are administered does not—the watershed level is the most common level of administration. We envision a watershed level PWS program in the UNRB, which will require expanding on current PWS efforts (water utility fees) in Durham and Raleigh to include the other six municipalities

in the watershed. Although all municipalities should be involved in the program, the diversity of administrative structures in the case studies shows that a watershed authority is not required for successful implementation—government cooperation with participation from non-profits and the public could be just as effective.

4. **Beneficiaries were similar across case studies and with the UNRB.** In twelve of the fifteen case studies, a government utility was the primary beneficiary of PWS program implementation. This suggests that the number of beneficiaries is not as important as the type. Government utilities align well with the UNRB; additionally, they are large and consistent beneficiaries. Private entities might take their place and also be able to support PWS programs, but this is not the case in the context of the UNRB.
5. **No payment mechanism arises as best aligned within the UNRB.** There are many payment mechanisms utilized across the case studies. While this attribute does not provide a clear model to build on, it does suggest flexibility in program design. Durham and Raleigh have successfully implemented volumetric fees through their water utilities, but smaller cities might better participate in a basin-wide PWS program through credits for BMP implementation or regular contributions of their legislature according to the annual budget.
6. **Drivers of PWS programs vary and with it, so do measurements of success.** Clear regulatory drivers can provide impetus for PWS development, but it is difficult to show 1:1 improvements in water quality in response to performance-based efforts such as changes in land use management. Instead, flexible regulation, like the nutrient management strategy outlined in Falls Lake Rules, provide an opportunity to improve water quality using economic levers like PWS before stringent performance based regulation goes into effect.

The alignment phase of our analysis leads naturally into a more descriptive and qualitative explanation of the lessons learned in each case study. We compiled the critical factors and recommendations from all case studies to arrive at a core set of recommendations for UNRB stakeholders to best position themselves for a successful future PWS program. For each recommendation, we describe three items: 1) evidence for that recommendation in the case studies, 2) the extent to which current and past activities in the UNRB satisfy that recommendation, and 3) next steps UNRB stakeholders can take to further act upon that recommendation. In order of importance, our core recommendations and suggested next steps are as follows:

1. **Encourage stakeholder engagement.** To engage stakeholders, we suggest designating a primary watershed-level organization for promoting and funding stakeholder engagement activities and increasing public outreach efforts that emphasize the nexus between water quality, water use costs, recreation, and land conservation.
2. **Leverage funding and diversify the funding portfolio.** We suggest that UNRB stakeholders leverage and diversify its funding sources by appealing to the private sector, instituting a fixed utility fee, and designating a watershed-level organization to apply a more systematic and targeted approach to finding and submitting grant applications.
3. **Utilize existing institutions.** To enhance the current utilization of existing institutions, we encourage UNRB watershed stakeholders to inventory the relative strengths and capacities of these institutions to reveal those that would be most ideal venues for implementation and management of a basin-wide PWS program.
4. **Design for adaptive management.** We suggest that program effectiveness be monitored and evaluated regularly at set intervals. The administration of surveys to participants and the public could also help gauge program satisfaction and further enhance program success.

5. **Capitalize on opportunities to realize co-benefits.** To maximize the potential realization of co-benefits in a basin-wide payment program, UNRB stakeholders could explore land acquisition, as opposed to easements, as the primary land conservation approach. Striving for higher public awareness of watershed conservation-generated recreational opportunities may also encourage public support of PWS activities.

Overall, our results suggest that the Upper Neuse River basin already possesses many of the needed characteristics, identified through our alignment analysis and core recommendations, for a successful PWS program. Given 1) our findings, 2) the fact that significant nonpoint source loading reductions will be required in the coming years, and 3) the multiple ancillary social benefits associated with green infrastructure approaches, we recommend that the Upper Neuse River Basin seriously consider scaling up to a basin-wide payments for watershed services program. We believe there is a role for both land conservation and agricultural best management practices in a basin-scale payment program, and that piloting of reverse auction and expanding upon the Upper Neuse Clean Water Initiative's (UNCWI) activities and funding could serve as substantial first steps. Quick action now will ensure that watershed stakeholders have sufficient opportunity to reduce nutrient loads and improve water quality for future generations in a low-cost, socially beneficial manner.

REPORT OVERVIEW

We were asked by our client, Lisa Creasman from the Conservation Trust for North Carolina, and our collaborators, Todd Gartner at the World Resources Institute and Lydia Olander at the Nicholas Institute, to assess the potential for a scaled up payment for watershed services (PWS) program in the Upper Neuse River Basin (UNRB). This report presents the findings from this work and comprises two primary components: 1) a feasibility analysis and 2) a preliminary guidance framework.

1. **Feasibility Analysis.** The feasibility analysis identifies and describes the relevant attributes of the UNRB and compares the UNRB's attributes to those of other successful PWS programs to determine the UNRB's general state of "readiness" for a PWS program.
2. **Guidance Framework.** We use information compiled from the case studies and in the feasibility analysis to arrive at a set of core recommendations for UNRB stakeholders to best position themselves for a successful future PWS program. For each recommendation, we describe three items: 1) evidence for the recommendation in the case studies, 2) the extent to which current and past activities in the UNRB satisfy the recommendation, and 3) opportunities available for acting upon the recommendation.

MOTIVATION FOR REPORT

A safe, clean, ample supply of freshwater is unquestionably necessary for the current and future health of Triangle area residents, visitors, and businesses. In 2008, the NC Division of Water Quality designated Falls Lake, the primary drinking water reservoir for Raleigh, "impaired" due to high levels of chlorophyll-*a*, and thus obligated to come into compliance for federal Clean Water Act water quality standards by 2041. Falls Lake lies within the Upper Neuse River Basin watershed (UNRB), and the cleanup, estimated at more than $1.5 billion, will not be easy. Because all counties and municipalities in the watershed contribute nonpoint source pollution to Falls Lake, it will require a concerted effort by all local governments within the UNRB to restore Falls Lake to its designated "fishable, swimmable, and drinkable" status.

Just as addressing the UNRB's water quality issues will require a concerted effort from a multitude of government and nongovernment actors within the watershed, so will it require a variety of policy and management approaches. These approaches come in two general flavors: "grey" infrastructure approaches, such as wastewater treatment facility upgrades, and "green" infrastructure approaches, such as installation of agricultural riparian buffers and conservation of land through easements or fee simple acquisition.

Land trusts such as the Conservation Trust for North Carolina (CTNC) have been working for decades to conserve socially and ecologically valuable lands in the Upper Neuse River Basin. Although not explicitly conserved for this purpose, these lands contribute substantially to essential ecological functions of the watershed, and thus provide a "green" infrastructure approach to water quality improvement. It is well understood that properly managed forestlands, wetlands, and grasslands filter surface water runoff from urban areas to improve water quality in downstream water bodies. As compared to traditional grey infrastructure water quality solutions, these green infrastructure solutions are often also less costly in the long run, appreciate in value over time, are not subject to mechanical failure, and provide important co-benefits such as recreational opportunities, aesthetic value, biodiversity, and carbon sequestration.

Despite the multitude of benefits provided by land conservation in the Upper Neuse River Basin, funding for these efforts have fallen drastically in recent years (CWMTF, 2012). Furthermore, with population growth in the region projected to increase urbanized land area in the basin, maintenance and enhancement of these vital ecological functions will be increasingly important for maintaining the watershed's water quality and meeting the water quality improvement goals for Falls Lake. It is imperative that an additional funding source is secured to ensure that land conservation activities continue in the future.

A payment for watershed services (PWS) approach to addressing the Upper Neuse River Basin's water quality issues would allow those who most value the cleanup of the watershed to pay private landowners and farmers to improve the water-filtering functions of their lands. This approach is attractive in many ways:

- ✓ It provides an additional funding source for vital land conservation efforts.
- ✓ It is often cheaper on a "per lb nitrogen" or "per lb phosphorus" basis to pay others to provide these watershed services on their lands than to make those reductions yourself.
- ✓ There are many grants and federal cost-share programs already available to further reduce the costs of these green infrastructure solutions.
- ✓ Providing financial incentives (a "carrot") is often more politically and socially favorable than introducing uniform regulatory requirements (a "stick" or "hammer").
- ✓ Money stays within the local economy, as costs of meeting water quality goals is diverted to local landowners as opposed to non-local grey infrastructure manufacturers and distributors.
- ✓ Green infrastructure water quality solutions provide additional social benefits, such as improved aesthetic value, air quality, biodiversity, recreation values, and carbon sequestration.

The above listed merits of a payment for watershed services approach have been demonstrated in cities and regions across the country, including successful programs in New York City, the Ohio River Valley, Boston, Oregon, and Georgia. Many general guidance documents are available which use characteristics and lessons learned from such case studies to guide PWS program feasibility assessment and design (Hanson, Talberth, & Yonavjak, 2011; Stanton, Echavarria, Hamilton, & Ott, 2010). No known study to date, however, has taken a place-based approach to this methodology – using case study examples to assess the feasibility and guide the design of a PWS program *for a specific watershed.* In this report, we tailor our feasibility assessment and guidance framework to the unique geographic, environmental, political, and social context of the UNRB. We use case study examples to:

- identify those model programs in the US which best align with the UNRB context and thus can best inform UNRB PWS program design,
- determine key "preconditions for success" for a PWS program and assess the extent to which the UNRB satisfies these preconditions, and
- arrive at recommendations and next steps for the UNRB to best position itself for a successful PWS program.

This report will serve as an integral step toward finding effective, low-cost solutions to the water quality issues in Falls Lake and the Upper Neuse River Basin. We hope this report will assist CTNC and other UNRB stakeholders by:

- providing an inventory and assessment of the information to-date on the payment for watershed services approach and UNRB watershed conservation-related activities,
- garnering support and enthusiasm around PWS among relevant stakeholders in the UNRB,
- facilitating communication among regional and local players involved in UNRB watershed conservation-related activities,
- guiding next steps to best position the UNRB for a successful PWS program, and
- setting the stage for the possible development and implementation of a successful payment for watershed services program in the Upper Neuse River Basin.

METHODOLOGY

This section overviews the methodology undertaken to conduct the feasibility analysis and develop the PWS guidance framework.

STEP 1. CASE STUDY SELECTION

To arrive at recommendations for a PWS program for the UNRB, we conducted a qualitative and quantitative assessment of fifteen PWS case studies in the United States. Table 1 depicts the criteria we used in choosing our case studies.

Table 1. Selection criteria used to arrive at the 15 case studies examined for this study.

Case Study Selection Criteria
Selected case studies satisfied all of the following criteria:
✓ Recommended by local experts as a successful program that would be relevant to the UNRB
✓ Highlighted in the literature as a successful program
✓ Successful, as demonstrated through: o Economic success – transactions have occurred and/or o Environmental success – resulted in additional environmental pollution reductions

STEP 2. ATTRIBUTE SELECTION

To assess which case studies could serve as ideal program models for a program in the UNRB, we identified a list of comparable program attributes. Attributes were chosen based on those which have been demonstrably influential to program success and may vary among programs (Brouwer, Tesfaye, & Pauw, 2011a).

STEP 3. UNRB CONTEXT

To assess the extent to which case study attributes align with those of the UNRB, we compiled information on the UNRB geographic, environmental, political, and social contexts based on the attributes on the score card. For each of the selected attributes from Step 2, we compiled an exhaustive description of that attribute in the context of the UNRB. For example, for the "Demand Driver" attribute, we collected information on all the potential demand drivers in a UNRB PWS program, to include regulatory drivers such as the Falls Lake Rules and cost drivers such as low-cost green vs. high-cost grey infrastructure options.

STEP 4. SCORE CARDS

We used score cards to summarize and assess each case study. We also used information gathered in Step 3 to compile a score card for the UNRB. The components of the score cards are detailed in Table 2.

Table 2: Score card components.

Score Card Component	Description	Alignment Rating?	Example(s)
Basic program characteristics	Characteristics of the program which may not necessarily influence program success, but may vary among programs	Yes – for those characteristics which are known for the UNRB	Program type, location, payment source, payment type
Key Attributes	Those attributes identified in Step 2 which have been documented to influence program success	Yes – for those characteristics which are known for the UNRB	Beneficiaries, demand drivers, biophysical characteristics
Success Indicators	If available, any statistics or descriptors that may indicate economic, political, or social success of the program	No	Pounds P/N reduced per acre or per dollar
Recommendations for the UNRB	Recommendations developed through application of critical factors and lessons learned to the UNRB context	No	Ensure a sustainable funding source, Subsidize slightly less than 100% of BMP costs, etc.

For relevant attributes, rankings were assigned that denote the extent to which the case study aligned with the UNRB for that attribute. Ranking criteria were standardized for each attribute from 1 (least aligned) to 5 (best aligned) and based on comparison to the UNRB score card. Much of this ranking process was subjective based on educated judgment, although each attribute ranking criteria was consistent with the general schema depicted in Table 3. Appendix B details the standardized rating criteria for each attribute.

Table 3. Ranking system for qualitative program alignment assessment.

Ranking	Description
1	Not similar to the UNRB at all.
2	Marginally similar.
3	Hard to tell or neither similar nor dissimilar.
4	Similar, but not a perfect match.
5	Replicates the UNRB's situation almost exactly.

After the attributes of case study programs were described and evaluated, we identified those program models and attributes that most closely aligned with those of the UNRB. Alignment rankings were summed for each program to arrive at a total "Alignment" score for each program. Alignment rankings were also summed for each attribute across case studies to arrive at a total "Alignment" score for that attribute.

STEP 5. PROGRAM MODEL, RECOMMENDATIONS, AND NEXT STEPS

Our recommended program models were those that best aligned with the UNRB, as predicted by the programs' "Alignment" ranking. All the recommendations from the case study score cards were examined to arrive at five key recommendations for a PWS program in the UNRB. We prioritized those recommendations which 1) were identified recommendations shared among a large number of case studies and 2) were identified recommendations from those programs that best align with the UNRB.

The attributes deemed as "important for program success" were identified during a qualitative assessment of the case study, which was informed by the literature and discussions with appropriate watershed program staff. These constituted the core components of our guidance framework developed for UNRB stakeholders.

INTRODUCTION TO THE PAYMENT FOR WATERSHED SERVICES APPROACH

The development of a basin-wide payment for watershed service program in the Upper Neuse River Basin provides an opportunity for economic gain for beneficiaries who participate in the program. The following sections describe payment for ecosystem services (PES) approaches, the necessary components of a payment for watershed services (PWS) program specifically, and the potential structures of a PWS program in the Upper Neuse River Basin.

THE ECOSYSTEM SERVICES APPROACH TO ENVIRONMENTAL PROBLEMS

Humans benefit from an array of services that healthy ecosystem functions and processes provide. Flood control, water purification, improved air quality, maintenance of biodiversity, and natural resource stocks are some essential examples of these services (Daily, 1997). Provisioning ecosystem services such as forest products are typically valued in market activity; however, despite their significant value to society, other services such as flood control, water supply regulation, and climate stabilization have not been recognized in terms of economic values. In a seminal paper, Robert Costanza et al. (1997) estimated the global ecosystem service value to be an average of $33 trillion dollars annually. Internalizing the positive externality of ecosystem services through market mechanisms provides incentives for better environmental policy development and contributes to the global economy (Costanza et al., 1997). As of 2007, in the US alone, PES programs had an estimated cumulative value of 1.9 billion dollars (Mercer, Cooley, & Hamilton, 2011).

Payment for ecosystem service (PES) programs provide a tool which can be used on a local, regional, or global scale to incorporate natural resources or stock for ecosystem services into the economy. For example, trees are the capital that provides the service of carbon sequestration (Hawken, Lovins, & Lovins, 1999). Formally, payments for ecosystem services are described as "a voluntary transaction where a well-defined environmental service is being 'bought' by a service buyer from a service provider if and only if the service provider secures service provision" (Wunder, 2005). Simply put, landowners and managers become ecosystem service providers as they choose to focus management practices to benefit the desired ecosystem service (Mercer et al., 2011).

The most common payments for ecosystem service programs are based around payments for carbon, biodiversity, or watershed services. Payment for watershed services (PWS) are the most frequently implemented of payment for ecosystem services programs (Stanton et al., 2010). All ecosystem services are undoubtedly important for societal wellbeing; this report focuses on those ecosystem services that ensure a sustainable, healthy, and clean supply of water from the surrounding watershed. As the global population continues to grow, fresh water will only become more precious. It is imperative that we act now to protect our freshwater sources in the future. There is evidence of movement in a positive direction by governments across the world that are planning for water quality and quantity and managing over half of the active PWS projects (Stanton et al., 2010).

WHAT ARE WATERSHED SERVICES?

Watershed services refer to the variety of benefits people receive from the normal functioning of hydrologic processes and the health of the surrounding ecosystem. Benefits are diverse and include everything from recreation, flood reduction, and habitat provision to the natural filtration of nutrients and chemicals. The range of services can be classified into five different types shown in Table 4 below (Brauman, Daily, Duarte, & Mooney, 2007).

Table 4. Watershed services (Brauman et al., 2007)**.**

Watershed Service	Description
1. Improvement of in-stream water supply	In situ uses include hydropower generation, water recreation, and transportation, as well as freshwater fish production and habitat provision for freshwater organisms.
2. Extractive water supply	Municipal, agricultural, commercial, industrial, and thermoelectric power generation all rely on water availability; generally, cleaner water is also cheaper for these uses as it does not have to be filtered before application in agriculture, for example.
3. Water Damage Mitigation	Intact ecosystems in and around water bodies provide mitigation for flood damage, sedimentation of water bodies, saltwater intrusion into groundwater, and dryland salinization.
4. Provision of water related cultural services	Cultural hydrologic services include spiritual uses, aesthetic appreciation, recreation, and tourism.
5. Water-associated supporting services	Clean and healthy water is essential for plant growth and as habitat for aquatic organisms.

These hydrological services can be linked to hydrologic attributes that directly affect the provision of the ecosystem service: quantity, quality, location, and timing of flow (Brauman et al., 2007). The link between environmental function, hydrologic attributes and ecosystem services is visible in **Table 5**. It is important to identify the water service of interest. Under some scenarios, tradeoffs can exist between two competing services. As we examine watershed services, we can see that the physical boundary of the watershed often creates boundaries outlining the beneficiaries of the service. However, this often means that PWS programs can be smaller in area and scope than other PES programs. Monitoring PWS programs can be difficult even in small watersheds given the frequent mismatch of biophysical and political boundaries.

Table 5. Overview of the most highly noted watershed services and the hydrologic attributes and ecohydrolic processes that underlie the production of those services (Brauman et al., 2007).

Ecohydrolic Process (what the ecosystem does)	Hydrologic Attribute (direct effect of the ecosystem)	Hydrologic Service (what the beneficiary gets)
Local interactions **Water use by plants** →	**Quantity** (surface and ground water storage and flow)	**Diverted water supply:** water for municipal, agricultural, commercial, industrial, or thermoelectric power generation uses **In situ water supply:** Water for hydropower, recreation, transportation, supply of fish & other freshwater products **Water damage mitigation:** Reduce flood damage, dryland salinization, saltwater intrusion, sedimentation **Spiritual & Aesthetic:** Provision of religious, educational, tourism values **Supporting:** Water and nutrients to support estuaries and other habitats, preservation of future use option
Environmental Filtration **Soil stabilization** **Chemical & biological additions/subtractions** →	**Quality** (nutrients, pathogens, sediment, salinity)	
Soil development **Ground surface modification** **Surface flow path alteration** **River bank development** →	**Location** (ground/surface, up/downstream, in/out of channel)	
Control of flow speed **Short and long-term water storage** **Seasonality of water use** →	**Timing** (peak flows, base flows, velocity)	

WHY WATERSHED SERVICES?

It is indisputable that 1) society needs an ample supply of clean water for its wellbeing and survival, 2) green infrastructure, such as forests, wetlands, buffers, and even rain gardens, provide watershed services which ensure the continued supply of clean water, and 3) human-built (or "grey") infrastructure, such as water treatment facilities, drains, and dams can provide services that ensure a continued supply of clean water. The users, or beneficiaries, of these clean and ample water supplies are faced with a key decision: in which infrastructure should we invest, green or grey, to ensure the continued supply of clean water? In addition, what are the tradeoffs associated with each type?

In the United States, emphasis has historically been on investment in grey (as opposed to green) infrastructure to ensure a continued supply of clean water. More recently, however, water managers, water-dependent industries, and conservation organizations have begun to acknowledge the benefits of green infrastructure investments. Green infrastructure can offer not only a cheaper alternative to grey infrastructure, but also offer significant, real co-benefits as compared to its brick-and-mortar counterpart (Table 6). Table 7 provides some specific examples of the cost savings available through green infrastructure development.

Table 5. The costs and benefits associated with grey vs. green infrastructure investments for the provision of watershed services.

Infrastructure	Costs	Benefits
Grey • **Dams, Retention Ponds** • **Treatment/Filtration Facilities**	- May damage fisheries	✓ Proven and understood ✓ Already budgeted for
Green • **Wetlands** • **Forest Cover** • **Riparian Buffers**	- Efficacy not yet proven - More difficult to determine land-service relationship (i.e., production function)	✓ Enhanced recreational and aesthetic values ✓ Achieve other conservation goals (enhanced biodiversity, carbon sequestration) ✓ Potential for additional ecosystem service revenue streams (carbon, wetland mitigation, biodiversity)

Table 7. Green vs. grey infrastructure cost savings examples. Adapted from (Center for Neighborhood Technology, 2010)**.**

Service Targeted	Green	Grey	Estimated Savings
Flood mitigation: Managing stormwater flooding in Milwaukee, Wisconsin.	Land purchased upstream holds 1.3 billion gallons of stormwater for \$0.017/ gallon.	Flood Management facility hold 315 million gallons of stormwater for \$0.31/gallons.	\$0.29/gallon (\$29,000 per million gallons)
Water quality: Protecting source water in New York City.	Maintaining lands conserved for water quality in the Catskills required an additional \$1.5 billion commitment.	Installing a filtration plant would cost an estimated \$10 billion.	\$8.5 billion
Water quality: Reducing temperature in Tualatin, Oregon.	Conserving land and installing riparian buffers to shade the river cost \$6 million.	Installing engineered cooling towers would cost an estimated \$60-\$150 million plus annual operating costs of \$2.5-\$6 million.	\$54-\$154 million

Generally, payments for watershed services are motivated through three primary drivers (Hanson et al., 2011):

1) **Costs**: Voluntary payments by downstream entities to upstream landowners to reduce the costs of doing business because oftentimes green infrastructure is cheaper than grey
2) **Regulations:** Payments made to minimize an entity's cost of meeting a regulation
3) **Social Benefits**: payments made to generate public benefits.

The example programs detailed in this report through the case study score cards demonstrate how these drivers can inform both the design and efficacy of PWS programs.

SUPPLY OR DEMAND DRIVEN PROGRAMS?

The perception of watershed service problems can affect the design of the PWS program, as Stanton et al. articulate so well.

When downstream users perceive water quality or quantity problems, the objective of the PWS program will be to incentivize upstream users to change their practices. This results in the watershed service buyers incentivizing the sellers to change their practices.

If the perception of the problem is supply side driven however, then payments will be disbursed to the benefit of the whole watershed protection program. In this case, all beneficiaries are likely paying in to a program to protect the health and function of the watershed.

In the Upper Neuse River Basin, the degraded downstream water quality in Falls Lake is the primary driver for regulation development and the beginnings of PWS programs. We expect to see incentives for upstream land conservation and wastewater management continue and expand in scope until the entire UNRB is incorporated into a basin wide-PWS program. The political challenge presented by such a program will undoubtedly be the most difficult piece of PWS design.

Box 1. Supply and demand drivers and implications for PWS frameworks.

BUILDING A WATERSHED SERVICES PAYMENT PROGRAM

Investment in green infrastructure can be manifested in the form of payments for watershed services (PWS) programs. A program simply organizes the supply and demand for watershed services into buyers, those who require clean drinking water, and sellers, those who impact the water supply (Majanen, Friedman, & Milder, 2011). Coordinating the efforts within a watershed for tracking and efficient allocation of effort re-forms scattered transactions into a PWS program. Majanen et al. (2011) define PWS transactions as those that satisfy the following criteria:

1. The market transaction is enacted voluntarily.
2. The transaction pertains to well-defined ecosystem services, or land use or management practices that are likely to produce such services.
3. The ecosystem services are being purchased by a willing buyer(s).
4. The ecosystem services are being sold by a willing seller(s).
5. The payment is contingent on the environmental benefits (or practices) actually being provided ("conditionality").
6. The payment secures ecosystem services that would not otherwise be provided through legal or regulatory requirements or customary practices ("additionality").

Any payment for watershed services program must be built upon two simple and necessary components: 1) the quantification of the payment and 2) the identification and delineation of the watershed service of interest. As clear as this dichotomy may seem, in practice the feel and flavor of these components can vary widely, and program developers may choose among a variety of options to design their payments for watershed services program. In this section, we lay out the primary payment frameworks in which PWS programs can operate and the specific watershed service providing activities that beneficiaries can purchase.

PAYMENT FRAMEWORKS

In a typical PWS program, landowners receive payments for the role their forests or management practices play in improving water quality or quantity. Many times, this entails an upstream-downstream transaction in which a downstream user such as a water utility uses government bonds to pay upstream landowners to institute watershed service-enhancing land management practices in order to improve or maintain downstream water quality (Majanen et al., 2011).

This section describes the major schemes, or frameworks, that are in use today to facilitate and implement payments for watershed services. For this report, we build upon the classification of PWS delineated by Stanton *et al.* (2010) (see **Error! Reference source not found.**). We build upon this classification by taking a hierarchical, nested approach, depicted in Figure 1, in which a payment framework is comprised of unique payment type, mechanism, and source.

PAYMENT TYPES

Payment types are often determined by the number and type of beneficiaries in a watershed. There is always room for adaptation within PWS design, however we expect that the recommended program model for the UNRB will show alignment in the beneficiaries attribute. Government buyers are important beneficiaries in the UNRB and in many other PWS programs. This report identified and assessed the following PWS payment types, also outlined in **Table 8**.

1) **Non-Market Payment Types:** In its broadest sense, payments for watershed services include private- or government-driven payments where those paying aim to protect or improve watershed services and those receiving payments engage in activities to ensure their continued provisioning above a business-as-usual scenario. Many payments for watershed services programs are not "markets" in the strictest sense of the word which is defined as transactions between parties voluntarily coming together and exchanging goods and services at a price that is determined freely by the market forces of supply and demand (Stanton et al., 2010). Gene, payments for watershed services include any transaction where there is a payment or exchange of credits between a buyer and seller to affect some improvement of a watershed service (Stanton et al., 2010). This section details the attributes of such "non-market" payments for watershed services programs.

   Most non-market programs focus on agricultural and stormwater BMPs and riparian buffers. The underlying theory is that pollution is minimized and slowed for natural filtration before it reaches a water body. If there are enough buyers and sellers within the watershed, a private market might be possible.

   - **Government** payments for watershed services: Money generated through public taxes or fees is used to protect the common good of the watershed service. Government programs use the beneficiaries of the service directly contribute to the protection of the service.
   - **Private sector** payments for watershed services: private companies.
   - **Hybrid** (public-private) payments for watershed services.

2) **Market Payment Types:** Traditional markets sell environmental services indirectly, as a good or quantity. This is easy to think about in terms of carbon sequestration or air quality; in a market framework, timber, fiber or a wood product is sold. Trees are obviously required to provide these goods, and therefore at some point, contributed to air quality, water quality or carbon sequestration. In addition to this indirect payment for ecosystem service market, some innovative frameworks allow direct market valuation of ecosystem services. These approaches are detailed below as they relate to PWS:

   - **Water quality trading regimes:** Legal limits are set for water quality (nutrient, temperature, or pollution levels). Credits are issued to stakeholders in order to limit the amount of pollution to a system. They are then be sold by those stakeholders who do not need the full allotment of credits to meet the required pollution levels and purchased by those who need more. Figure 2 shows the potential for nitrogen credit allocation by sector as an example.

Table 8. The three primary payment frameworks for PWS programs. Adapted from (Stanton et al., 2010)**.**

PWS Payment Types & Mechanisms		
Payment Type	**Description**	**Payment Mechanism**
Government PWS	Public funding (generated through taxes, government allocation) is used to make payments to private landowners for improving their land use practices or in exchange for title to the land.	Payments can take several forms: fee simple for acquisition, subsidy and cost-share for environmental management, direct transfer payments, or rental payments.
Private PWS	Private entities (industry, development, corporations) develop payment mechanism for protecting water quality/quantity in order to lower costs, improve image, or for philanthropic purposes.	Private entities can directly exchange payments between themselves or with land owners in exchange for development rights or land acquisition.
Water Quality Trading	Total pollution in a water body is limited through government regulation. Point source polluters are identified and equitably distributed credits to meet maximum allowable pollution levels.	Polluters trade credits to meet the environmental standards according to their needs (if reduction is cheaper, sell credits, if not, buy them).

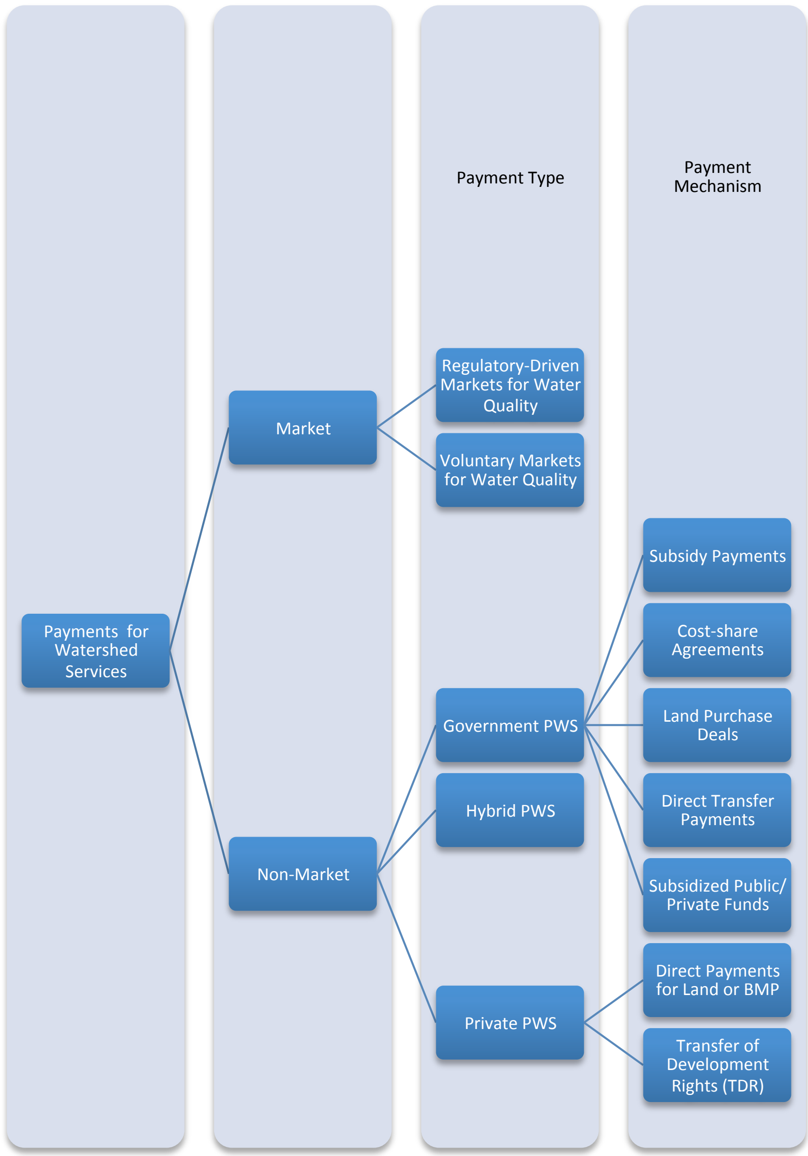

Figure 1. Classification of PWS payment frameworks. Adapted from (Stanton et al., 2010) **and** (Forest Trends & The Katoomba Group, 2008)**.**

PAYMENT MECHANISMS

Case studies examined for this report had a variety of payment mechanisms. It is important to differentiate the advantages and disadvantages of potential payment mechanisms in order to derive the recommended payment mechanism for the UNRB. It is also important to note that PWS programs require payment mechanisms for both the transactions themselves (increased water rates/user fees, bonds, credits, etc.) and the program infrastructure (monitoring, enforcement, trading platforms, etc.). In addition to the financing for program design and implementation, sustainable sources must be in place for post project monitoring and enforcement. Many PWS schemes are supported by state or federal grants, seed funding, or technical assistance that is channeled through local organizations. Apportioning percentages of taxes (sales or water utility) has been demonstrated in several projects to be a predictable and sustainable source of funding for all phases of PWS programs.

For each of the described payment frameworks, a variety of payment mechanisms can be utilized to carry out the transactions. For this report, a payment mechanism refers to the manner by which the payment is transacted. Below each of these payment mechanisms are briefly defined and described in further detail in the next sections.

SUBSIDY PAYMENTS

Most often, subsidy payments are funded by general taxes or user fees, they can be applied toward cost share programs such as federal programs outlined in the Farm Bill. Farm Bill programs assist landowners in financing best management practices and conservation easements. These programs are discussed in further detail on page 27.

LAND PURCHASE DEALS

Land purchase can take a variety of forms such as:

- ✓ **Conservation easements:** Landowners retain the rights to their property but receive tax benefits in exchange for giving up certain land use rights, most often these agreements are in perpetuity.
- ✓ **Direct Acquisition:** Land is purchased by a government body for the protection of water quality; it may be open to the public. Sometimes, land is purchased, conservation easements are implemented, and then it is resold. Land can also be held in perpetuity for its conservation value or for use as a public park.
- ✓ **Transfer/Purchase of Development Rights:** Developers buy rights to development from rural landowners to increase density in designated areas. The rural landowners cannot develop or parcel off the property which is under TDR contract, nor can any future owner of the property.
- ✓ **Revolving Funds:** This can provide much needed initial capital for land purchase deals. Loans can be extracted from revolving funds for project implementation and repaid through the mechanisms of the PWS program.

REVERSE AUCTIONS

Reverse auctions are competitive bidding systems in which sellers compete to supply buyers with a specified good or service, enabling buyers to locate the most competitive sellers (Greenhalgh, Guiling, Selman, & John, 2007).

PAYMENT SOURCES

Each of the payment mechanisms must in turn be funded from a sustainable source. For this report, we refer to this as the payment source. Be it from taxes, user fees, trust funds, or a company's working assets, it is crucial that any PWS program identifies and ensures a sustainable and dependable source to fund the program and its payments. A brief definition and description of payment sources are outlined below:

- **User Fees:** Base fees or volumetric fees can be attached to water use through the utility bill. Volumetric fees do not provide as much sustainability as base rate fees as they are subject to change with seasonality, water shortages, and water efficiency efforts.
- **Bonds:** Bonds often provide the base for revolving funds. They are available through State and Federal allocation. Bonds or debt securities are low interest loans purchased on the market to provide financing for projects. Monies generated by the projects then go towards re-paying the loan.
- **Grants:** While grants are not in themselves a stable funding source, they are usually part of a diversified portfolio. The US EPA has several programs that provide grant funding to protect water quality. For example, the Drinking Water State Revolving Fund was established by the Safe Drinking Water Act to provide financial assistance to states for protecting water quality (US Environmental Protection Agency, 2000).
- **State or Federal Funds:** There are federal funds available through grants and cost share as well as revolving funds. States can establish these same mechanisms. Pairing the two government funding sources can generate substantial funding for PWS programs.
- **Taxes:** Percentages of established taxes (like sales tax) can be allocated toward watershed protection or PWS programs. Alternatively, small, new taxes might be implemented to the same end if it is politically feasible.
- **Trust Fund:** Water trust funds are entities bound by a legal contract among founding members, generally institutions or companies representing key water users (Stanton et al., 2010). The trust fund usually involves a contract which designates an independent financial institution to manage the trust, including managing investment capital and ensuring that returns are spent on watershed protection activities in compliance with the Fund's contract or statutes (Stanton et al., 2010). An annual budget and operating plan is developed and overseen by a governing board, and a technical secretariat typically manages the project and spearheads strategic and business planning (Stanton et al., 2010).
- **Revenueshed:** This new concept was defined by the UNC Environmental Finance Center with the UNRB in mind; it defines the area in which revenue is generated through a policy instrument as a "revenueshed." In the case of watershed services, it is likely that the revenueshed will strongly resemble the watershed in its boundaries although, municipalities geographically distant from a watershed but dependent on its resources can be encompassed by the revenueshed concept (Hughes et al. (in press), n.d.).
- **Direct Private Investment**: Private companies or individuals might invest in PWS programs in response to regulations on their practices or voluntarily. Environmentally friendly practices can be marketed and touted for social capital and financial gain.

Diversified funding sources are ideal for PWS. There are opportunities to build on federal funding opportunities with local PWS development. The federal government supports cost share and grant programs through the Environmental Protection Agency as well as the Department of Agriculture.

Funders are often also beneficiaries. In the case of a watershed service fee, ratepayers contribute to programs protecting watershed services on their water bill. They in turn receive the benefit of cleaner, healthier water. Understanding the role of the watershed health in providing the watershed service is likely to increase the beneficiary support to act as a funder.

Later in this report, we examine the role and feasibility of these frameworks for addressing water quality issues in the Upper Neuse River Basin (UNRB) of North Carolina specifically.

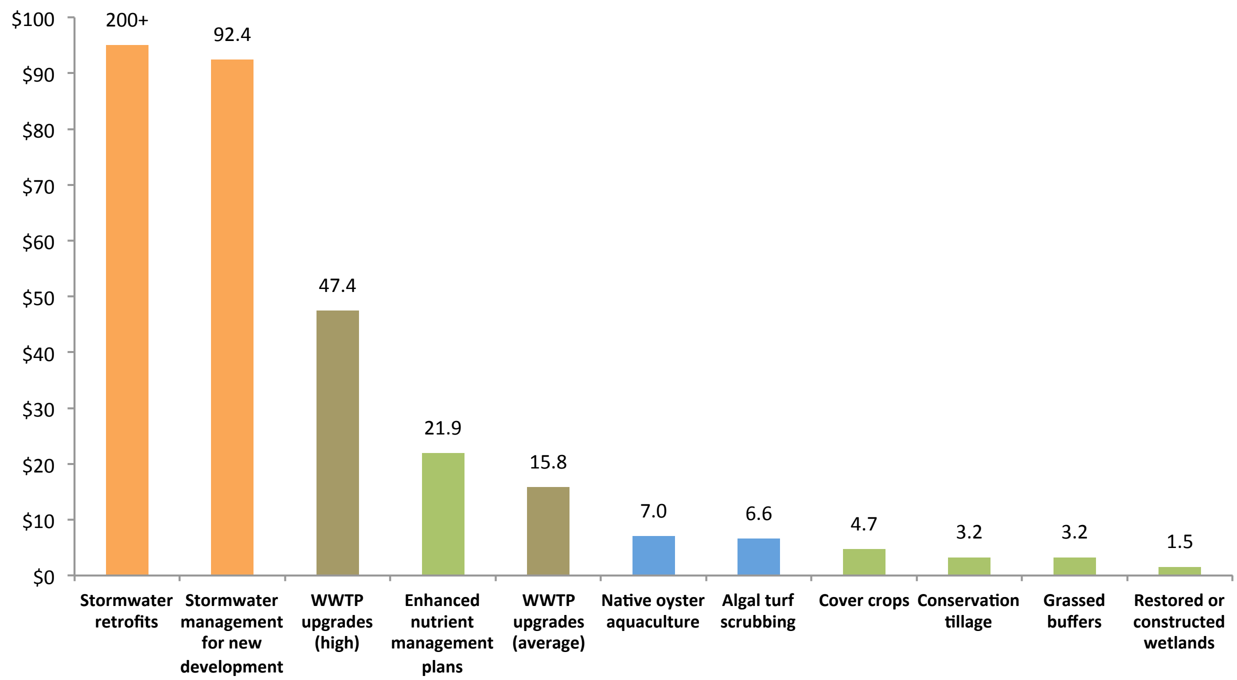

Figure 2. Costs per pound of annual nitrogen reduction for various management practices. Adapted from (Jones, Branosky, Selman, & Perez, 2010a).

ACTIVITIES FUNDED

The effectiveness and scientific underpinnings of Best Management Practices (BMPs) have been studied through experiment and practice for hundreds of years. Proving their efficacy would require another report and we will only touch on it here. PWS is not a new concept however, in the US, the Weeks Act protected 20 million acres of forest land for headwater rivers and watershed protection when it was signed in 1911 (Davis, 1983).

Best Management Practices are described by the US Environmental Protection Agency as "methods that have been determined to be the most effective and practical means of preventing or reducing pollution." They are based on observation, experimentation, and experience. Best Management Practices have concurrent goals of general stewardship and pollution mitigation practices, the EPA believes that BMPs achieve this dual purpose with equal efficiency (US EPA, 1993). BMPs can be implemented over the entire area of a site or applied to specific areas according to the management goals. BMPs have evolved as flexible guidelines that allow for different approaches to meet the same goal according to site context. They are meant to qualitatively address the practices of organizations, companies, and facilities in order to better their environmental impact. Many BMP practices evolved as a direct result of the 1987 Clean Water Act amendment that required states to reduce the contribution of non-point source pollution (NC Forest Service, 2006). In North Carolina, BMPs are not legally required in most areas, but serve as guidelines for landowners and managers. There are some exceptions however and the Neuse River basin is one area where the legislation prescribes the use of BMPs and in some cases defines exactly how they must be implemented.

There are a variety of actions that can be taken to enhance watershed service provision and facilitate the meeting of regulatory obligations in this arena. In many PWS schemes, beneficiaries do not pay for the verified delivery of watershed services themselves (e.g., a set g/L reduction in chlorophyll-a loads), but rather for best management practices (BMPs) that serve as a proxy for watershed services, based on pre-established causal relationships or assumptions (Majanen et al., 2011). Below is a list of the most common activities funded by PWS programs:

- **Best Management Practices on Land**
    - **Riparian buffers:** Streamside Management Zones (SMZ's) and riparian buffers are implemented to slow the flow of runoff and provide a natural filter for pollutants before they reach a water body. These areas also capture sediment and help to reduce erosion; vegetation serves to keep stream banks in place. Overhanging tree branches also provide shade to streams and rivers, reducing temperature and introducing more complexity to the in-stream habitat. Effective buffer widths are dependent on several interacting factors such as slope, soil type, precipitation regime, and water quality objectives (NC Division of Forest Resources, 2006).
    - **Reducing fertilizer use:** Fertilizer is a primary source of nitrogen and phosphorous, the two nutrients most threatening to global water quality (UN-Water, 2011). Minimizing its use and increasing the efficiency of its application is a simple way to ameliorate water quality issues.
    - **Managing manure:** Agricultural runoff is the greatest source of water pollution in the United States; managing manure, its containment and disposal, is just as important as reducing fertilizer use in addressing this problem. Locating animals away from stream banks and examining any irrigation practices can substantially reduce manure runoff.
    - **Fencing farm animals out of sensitive areas:** Fencing farm animals is a simple and effective way to reduce animal waste in water bodies. By limiting access to designated areas, there is a higher rate of filtration of waste (high in nitrogen) within the buffer zone. Additionally, bank erosion is limited to access points and can be planned for accordingly.

- **Cover crops:** Cover crops can provide increased soil moisture through increased infiltration. They also serve to slow runoff and reduce erosion. Cover crops can be planted in rotation with other crops in order to “rest” the soil; when selected for nitrogen-fixation, cover crops can also reduce the need for fertilizer inputs (Hamilton, 2005).
- **Agro-forestry practices:** Agro-forestry integrates crop and livestock cultivation with forestry practices (World Agroforestry Centre, 2012). This can provide additional economic benefits as well as increasing environmental services. Better soil fertility can reduce the need for inorganic fertilizer, habitat complexity increases as does biodiversity when trees are introduced to the landscape, fruit and nut trees can provide supplemental income and attract different pollinators.

- **Technical assistance, outreach, education:** In addition to funding the implementation of Best Management Practices, landowners can utilize funding to receive technical expertise. Learning about the different programs and practices that will be most appropriate on their properties can require substantial time and investment on the part of the supporting agency. Many grant programs and subsidies also support the key outreach component of conservation for water quality. See Box 2 for more examples.
- **Watershed management plan development:** Designing a good PWS program requires time, discussion, and expertise. The US EPA has provided and extended grants for the development of watershed management plans and PWS programs (State of Oregon Department of Environmental Quality, 2007a).
- **Enforcement of protected areas:** In densely populated or sensitive areas, water quality can be protected by restricting human access. If land use is restricted along the riparian area, annual monitoring must ensure that landowners are in compliance with the restriction.
- **Verification and monitoring:** While BMPs have proven their effectiveness, diminishing returns will result if they are not properly maintained and monitored. They are practice-based measures for the most part, meant to maintain flexibility; there is no definite width of a riparian buffer for example. In order to measure success, water quality must be monitored pre and post BMP implementation. Funding for verification and monitoring should be allocated explicitly in the design of a PWS program.

PUBLIC OUTREACH

In nine out of the fifteen case studies we examined, stakeholder engagement and public outreach were crucial to the success of PWS design and implementation. Some of the techniques used are listed below, however there is certainly room for more creativity in outreach strategy.

- ✓ **Landowner Engagement Meetings:** Landowners with high priority conservation parcels are identified and invited by land trust or local governments to learn about PWS programs.
- ✓ **Insets in Water Bills:** The beneficiaries of PWS programs can be engaged in their watershed and protection programs through their monthly water bill mailings.
- ✓ **Stakeholder Meetings:** Formal and informal group meetings bring together the beneficiaries, buyers, and sellers of watershed services. PWS program design, implementation, and monitoring plans can all benefit from stakeholder communication and engagement.

Box 2. Public Outreach Strategies.

PWS IN PRACTICE

There are a variety of schemes by which payments can be made to enhance or conserve watershed services. Of the hundreds of programs have been implemented worldwide (Majanen et al., 2011), there are 67 PWS specific program to date in the United States (Stanton et al., 2010). In the following pages, we will describe non-market and market payment programs in more details.

NON-MARKET PAYMENTS FOR WATERSHED SERVICES

Where market PWS programs involve the direct exchange of dollars for water quality (nutrient, temperature, or pollution levels are proxies), non-market PWS programs involve payments to landowners for protecting the watershed service targeted by the program. Payments to landowners can be funded by a government entity or a private buyer. These are briefly detailed below.

GOVERNMENT PAYMENTS FOR WATERSHED SERVICES

Payment for watershed services by government entities comprises the most predominant form of payment for watershed service projects (Stanton et al., 2010). There are federal funding opportunities uniformly available throughout the United States and county, state and city specific programs that vary. Ideally, regional (state, county, or city) programs should complement federal opportunities. City and county governments have a potential business case for making voluntary payments for watershed services because forests lower peak flows and reduce the costs of flooding during heavy rain events (Hanson et al., 2011).

FEDERAL PROGRAMS

Although many federal conservation programs provide watershed services, they are generally intended to provide other services as well (Mercer et al., 2011). In the United States, PWS activity is primarily driven by five key federally-funded conservation programs, one infrastructure grant program, and four local/municipal programs protecting drinking water sources (Stanton et al., 2010). Of the six federal government programs, five are funded through the Farm Bill and administered by the NRCS and Farm Service Agency, and one is funded through US EPA, Section 319 (of the Clean Water Act) Program (Stanton et al., 2010).

The US Congress passes Farm Bill legislation every five years, providing hundreds of billions of dollars in subsidy payments to farmers and foresters for watershed protection and conservation activities. PWS programs in the Farm Bill include the Environmental Quality Incentive Program (EQIP), Agricultural Management Assistance Program (AMA), Conservation Security Program (CSP), Conservation Reserve Program (CRP), and the Wetlands Reserve Program (WRP). The 2012 Farm Bill is still under review; the political atmosphere and economy will determine the future of these federal programs. It is possible that less funding will be available in the next cycle of the bill. Below, we have outlined the federal programs that are the most likely to be applied in the UNRB as part of a PWS program.

ENVIRONMENTAL QUALITY INCENTIVE PROGRAM (EQIP)

EQIP programs are funded through the Natural Resources Conservation Service and target agricultural and forest landowners. Professional expertise and financial assistance are available for the implementation of conservation and best management practices. The cost share agreement lasts for no more than 10 years; in this time, up to 75% of the cost of implementation can be covered through the program (Gray, 2009).

CONSERVATION RESERVE PROGRAM (CRP)

Annual rental payments incentivize landowners to retire their tilled working lands and reduce erosion. The program has begun cost-share for planting cover crops that support native wildlife as well. Landowners using CRP funding must agree to a 10 to 15 year time commitment before agricultural practices can begin again. Permanent easements are also covered under the program; there is a maximum annual payment of $50,000 (Gray, 2009).

WETLANDS RESERVE PROGRAM (WRP)

In July 2006, the USDA piloted a reverse auction in the Wetlands Reserve Program to reduce the acquisition costs of wetland easements (Greenhalgh et al., 2007). The reverse auction enrolled 3,500 acres into the program and reduced easement acquisition costs by 14% ($820,000) (Greenhalgh et al., 2007).

USGS COOPERATIVE WATER PROGRAM

U.S. Geological Survey Cooperative Water Program assists local and state agencies with water-quality and hydrologic investigations, including monitoring and quantifying the effectiveness of BMPs and restoration efforts (US Geological Survey, 2012).

USDA NRCS COST SHARE AND GRANT PROGRAMS

The USDA-Natural Resources Conservation Service (NRCS) administers cost share and grant programs for water quality restoration and protection (National Resources Conservation Service, 2012).They work in tandem with other local and government agencies to provide funding and expertise for land conservation, BMP implementation, and source water protection.

EPA SECTION 319 NONPOINT SOURCE GRANT PROGRAM

EPA's Section 319 program is a voluntary program that provides grants to states and tribes to implement non-point source projects and programs in accordance with section 319 of the Clean Water Act (CWA) specifically to protect source-water areas and the general quality of water resources in the watershed (Stanton et al., 2010). For example: Stream restoration planning, implementation and monitoring (US Environmental Protection Agency, 2012a)

NFWF AND NRCS MATCHING GRANTS PROGRAM

Conservation on Partners grants support and enhance the effectiveness of federal programs supported by the Farm Bill (CREP, EQIP, WRP). Private landowners can receive additional technical assistance from biologists and field technicians through the NFWF and NRCS to improve their land management for wildlife and habitat conservation (Curry, 2012)

REGIONAL/LOCAL PROGRAMS

State, county and city government PWS programs are flexible in their form and application. Tax mechanisms might be used, or as in the Tualatin, Oregon, a public utility might be the primary buyer of services. An example is the Northern Forests Watershed Pilot Projects in New Hampshire, Vermont, and Maine, which is discussed in further detail below.

The World Resources Institute (WRI) and the American Forest Foundation (AFF), the Manomet Center for Conservation Science, along with other key partners, have developed the Northern Forest Watershed Incentives project to provide economic incentives and technical assistance for family woodland owners to restore, enhance, and protect aquatic resources in two critical watersheds in the Northern Forest region – the Crooked River in Maine and the upper Connecticut River in New Hampshire and Vermont (Hubbard Brook Research Foundation, 2011). According to the Hubbard Brook Foundation's website, this project intended to 1) develop an "innovative, self-sustaining, and replicable, market-based model that facilitates transactions between ecosystem service buyers and sellers to protect and enhance watershed services and 2) create a partnership including landowners, foresters, conservation groups, policy makers, and other members of the public focused on the conservation and management of privately-owned forests using new market-based tools.

GOVERNMENT NON-MARKET PWS PROGRAM ATTRIBUTES AND CHALLENGES

In the United States, by 2008, federal cost share programs in the Farm Bill generated $1.35 in payments for land owners (Stanton et al., 2010). Water quality is not always the target of the cost share programs, but it is in the bundle of services that BMP implementation is meant to protect. Government funding specifically for PWS programs as in the EPA section 319 grants and drinking water protection programs generated $435 million in 2008 (Stanton et al., 2010). One of the benefits of government PWS programs is their demonstrated success; of the fifteen programs we analyzed, eleven had a public utility or government agency as the primary buyer of ecosystem services. These programs are implementable even when there are not many beneficiaries in the watershed.

Some challenges to government payment programs include:

1. **Instability of funding:** Government allocations are subject to approval on a rotating basis. New administrations and changing priorities can cut funding for these programs. The Farm Bill is likely to see deep cuts in its next cycle.
2. **Coordination:** Some watersheds cross multiple city, county or state boundaries. Determining the portion of government funding that should be contributed by each jurisdictional group can be a political challenge. We recommend allowing municipalities to contribute according to their impact on the watershed, and the capacity afforded by the size and budget of the municipality.
3. **Perception of Success:** People want to see tangible results for public money; the connection between ecosystem services and land management must be clearly articulated to the public. Monitoring before and after implementing PWS programs is essential to quantifying the benefit of the program. PWS programs do not necessarily result in a 1:1 tradeoff between the implementation of practice and improvement of water quality, for example. It is also therefore important to articulate the precautionary principle behind watershed protection and the additional public benefits it provides.

PRIVATE SECTOR PAYMENTS FOR WATERSHED SERVICES

Private PWS programs include instances in which a private entity develops its own payment mechanism in protection of a vital watershed service for either business or philanthropic interests (Stanton et al., 2010). Payment mechanisms can include the following (Stanton et al., 2010):

- Subsidy payments from private sources
- Privately funded transfers that take the form of direct payments from one private entity to another
- Required fees for watershed protection
- Purchase of land or development rights to land

While public or government participants in PWS are working to protect their drinking water resource, private buyers might participate for other reasons. Private buyers may be motivated by an environmental or conservation ethic. It is also possible to market their "green" brand or practices to a specific set of consumers providing them with financial incentive (Majanen et al., 2011). Additionally, private buyers could participate in order to protect the resources on which their industry or product is dependent (for their use value) although few buyers of this nature have actually been found (Majanen et al., 2011).

As compared to government payments, private sector payments for watershed services are less common in practice (Stanton et al., 2010). The 2010 State of Watershed Service Payments report identifies examples of private sector payments in France, Ecuador, and Tanzania, among others (Stanton et al., 2010). Specific examples of private PWS programs include:

- **Vittel in France.** The French bottled water company Vittel implemented payments for watershed services to protect the water they use in their product. Nestlé Waters, the parent company of Vittel, hired an environmental consulting firm to develop management plans for the 26 largest farms within their watershed. In exchange for new farming equipment, assistance in modernization (up 150,000 euros/farm), and an annual subsidy for the first five years of the plan implementation as well as waiving of landowner debt, Vittel simply required the farmers to follow the management plans throughout a 30 year contract. Not surprisingly, there was a high enrollment rate and after twelve years of the program, baseline nitrogen levels in the watershed were reduced. Agrivair , the environmental consulting firm hired by Vittel acted as a key intermediary in engaging the farmers and implementing the program. (Stanton et al., 2010)
- **Bonneville Water Restoration Certificate Program in WA.** The closest example to a voluntary private PWS program in the US, the Bonneville Water Resources Certificate Program does not invest directly in land management practices, but instead pays landowners to not use water rights and instead to keep the water in rivers (Mercer et al., 2011).

WATER QUALITY MARKETS

Similar to carbon and other pollution trading regimes, water quality trading (WQT) provides another effective financing mechanism for payments for watershed services. Water quality trading is traditionally defined by an offset framework where an overall limit is established for pollutant levels, and regulated entities (often point source polluters) may purchase offset credits to meet permitted obligations (Stanton et al., 2010). Water quality trading is an attractive option for PWS, as nonpoint sources are encouraged to reduce nutrient loading through a market mechanism rather than additional regulation, effectively allowing for a lower cost means of reducing nonpoint source pollution.

Pollution credit trading was officially recognized by the US EPA in 2003 when the Office of Water published it's In its Water Quality Trading Policy in 2003 for all dischargers within a watershed (Mercer et al., 2011). The policy's mandate is to:

> [e]ncourage states, interstate agencies and tribes to develop and implement water quality trading programs for nutrients, sediments and other pollutants where opportunities exist to achieve water quality improvements at reduced costs… [and] encourage voluntary trading programs that facilitate implementation of [Total Maximum Daily Loads], reduce the costs of compliance with Clean Water Act (CWA) regulations, establish incentives for voluntary reductions and promote watershed ‐ based initiatives (US Environmental Protection Agency, 2003).

Actions that can be taken to reduce nonpoint source pollution include implementation of best management practices (BMPs) by farmers on agricultural fields and by landowners on forested lands. Payments to farmers have been better quantified and tracked than the amount of funding towards tree planting or maintaining forest lands (Mercer et al., 2011). Mercer et al. (2011) note that in one of the most developed water quality trading programs in Pennsylvania, only one transaction involved the planting of a riparian buffer, and one transaction involved a stream restoration.

OVERVIEW OF PROGRAMS TO DATE

Carbon dioxide is ubiquitous in the atmosphere providing no natural boundary for carbon markets. Water quality trading markets are best implemented on a watershed scale and so are likely to be smaller in nature and within a naturally delineated region (Stanton et al., 2010). As of 2010, there were seventy-two trading schemes in four countries; sixty-six of these were in the United States (Stanton et al., 2010). Despite the relatively large number of trading schemes in the US, only eleven were actively exchanging funds as of 2008 (Stanton et al., 2010). Of the 236 point source facilities in the United States that are eligible to trade compliance permits, only about half (121) of the facilities have traded at least once over the life of the permit (Stanton et al., 2010).

Specific examples of water quality trading regimes currently in place include:

- **Long Island Sound Nitrogen Credit Exchange Program in Connecticut, USA.** In 2001, legislative action in the state of Connecticut created the Connecticut Nitrogen Credit Exchange (NCE). Seventy nine point source facilities are regulated in the Long Island Sound and are allocated Nitrogen General Permits (NGPs) that are renewed every five years (Gordon, 2010). Because a study found the costs of nonpoint/stormwater pollution reductions to exceed the costs of reductions by the point sources themselves, this trading program does not include nonpoint or stormwater sources – trading is only permitted among point sources. The 79 treatment plants involved in the trading scheme trade at different ratios depending on their location away from the Sound (known as Nitrogen Trading Zones). Throughout the first three years of the program, a low cap led to an excess of nutrient credits; however, between 2005 and 2009, because permit limits decreased faster than TMDL wasteload allocations, demand for credits exceeded supply (Gordon, 2010).
- **Tar-Pamlico nutrient trading program in North Carolina.** One of the first water quality trading programs in the US is located a few hours from the Upper Neuse River Basin – the Tar-Pamlico nutrient trading program in North Carolina (Gordon, 2010). Wastewater dischargers throughout the 5,400 square mile

basin are regulated through a shared NPDES permit, by which dischargers are allowed to allocate amongst themselves the lowest-cost actions to meet their regulated obligations (Gordon, 2010). In this trading program, point sources can pay a flat offset rate of $29/kg N to offset nutrient discharge, which can go toward one of three activities: 1) provide funding to the NC Agriculture Cost Share Program, which pays farmers to implements BMPs, 2) pay funds for the salary of a Soil and Water staff position helping to implement the nutrient strategy, or 3) pay the maintenance and operation of a gauging station (Gordon, 2010). Agricultural activities in the Tar-Pamlico basin are also regulated by a "pseudo-association," and obligated to meet baseline nutrient reduction targets in order to participate in the offset program. Overall, the program has effectively met its pollutant reduction targets – the association has been in over-compliance since the implementation of the program, and agriculture has always met its baseline nutrient reduction targets (Gordon, 2010).

- **Chesapeake Bay Nutrient Trading Program.** In May 2009, the Obama Administration released a Chesapeake Executive Order aiming to step up restoration of the Bay. The Clean Water Act Total Maximum Daily Load for the Bay is due for implementation in January 2011, and the Chesapeake Clean Water and Ecosystem Act of 2009 (H.R. 3852/S. 1816) promotes, among other things, the creation of a regional trading mechanism to further facilitate restoration (Stanton et al., 2010). The bay-wide nutrient trading program would allow credits to be exchanged across state lines and among the watershed's nine major river basins. An analysis by the World Resources Institute (Jones, Branosky, Selman, & Perez, 2010b) indicates that the economic benefits of a bay-wide nutrient trading market for nitrogen could be significant for the agricultural, wastewater, and municipal stormwater sectors in the Chesapeake Bay watershed.

PROGRAM ATTRIBUTES AND CHALLENGES

Of the 72 current trading schemes identified, only 14 recorded transactions occurred in 2008, totaling around $10.8 million dollars (Stanton et al., 2010). Challenges in making these markets effective include the following (Stanton et al., 2010):

1. **Lack of demand due to inadequate regulatory drivers**. Although the US accounts for more than 85% of the total water quality trading programs in the world, many programs are still awaiting implementation of water quality standards that set limits on nutrient loads (Stanton et al., 2010).
2. **Insufficient scale.** Because trades are generally limited to a single watershed and there are often not enough market actors within a watershed to encourage robust trading, successful implementation of water quality trading programs have been hindered by their small market size (Mercer et al., 2011).
3. **Conflicting programs.** To ensure additionality, many water quality trading programs explicitly exclude the use of nutrient reductions that are required by law or for which nonpoint sources have already been paid (Mercer et al., 2011). As such, government incentive programs like the Conservation Reserve Program (CRP) and the WRP can reduce the number of credits available in a water quality trading program and hinder market efficiency.
4. **Conflicting goals.** In the Tar-Pamlico nutrient trading program, land conversion from agriculture to development counts as a 100% reduction in agriculture nutrient loading from that property (Gordon 2010). Although nutrient loading may be reduced, the increase impervious surface may introduce other water pollutant discharges. Water quality trading schemes that focus solely on one pollutant without regard for its effects on other water quality pollutants may be shifting, rather than alleviating, water quality issues in these areas.

5. **Stakeholder Involvement.** Water quality markets are a new concept. Engaging and educating participating stakeholders as well as the general public is a step that should be taken before the design of the program.
6. **Reporting:** Transaction data are not a reporting priority. The trading market should be self-sufficient. However, extra funds for data collection, monitoring and evaluation are not generated by the program itself. These can and should be pursued separately.
7. **Measuring and Monitoring –** The ability to measure and monitor an ecosystem service is not always straightforward with public goods or resources. For example, individual behavior for implementing a BMP may not be observable. In addition, it is often costly to monitor and the effects of green infrastructure may not be readily observed.

FEASIBILITY ANALYSIS RESULTS: ATTRIBUTE AND CASE STUDY SELECTION

We identified 49 potential case studies (see Appendix A), 15 of which were selected based on program attributes and alignment with the UNRB. These case studies are displayed in Table 9.

Table 9. Case studies examined in this study.

Case Study	Location	Type – Primary Funding Source(s)
Boston	Massachusetts- Wachusett and Quabbin Reservoirs /watersheds	Government PWS – Utility Fee
Tualatin	Oregon-Tualatin River watershed level	Point-Non Point Water Quality Trading Market
San Antonio	Texas- Edwards Aquifer Watershed	Government PWS – Utility Fee and Sales Tax
New York City	Catskills- Cat-Del Watershed	Government PWS – General Fund
Conestoga	Pennsylvania- Conestoga River Watershed	Government PWS – Federal Grant
Syracuse	New York- Skaneateles Lake Watershed	Government PWS – General Fund/Federal Programs
Maryland	Baltimore, Maryland- 3 Watersheds	Government PWS – General Fund
Upper Tallapoosa	Georgia- Subwatershed in Carroll County	Government PWS – State Funding/Local Sales Tax
Great Miami	Ohio- Mississippi River Watershed	Market Trading Program- Point Source Credits
Pine Barrens	Long Island, New York-Kirkwood-Cohansey Aquifer	Market (Transfer of Development Rights)- Developer Funded
Burlington	Vermont- Lake Champlain Watershed	Government PWS-State Grants & Bonds
Portland	Maine- Sebago Lake Watershed	Government PWS- Utility Revenue (based on previous year)
Mountain Island Lake	North Carolina-Mountain Island Lake Watershed	Government PWS- State Grants, Local Bonds, Utility Fee
Salt Lake City	Utah- Wasath Canyons Watershed	Government PWS Utility Fee
Raritan	New Jersey	Government PWS-Utility Fee

PROGRAM ATTRIBUTES

To assess the case studies that best serve as program models for a PWS program in the UNRB, we identified a list of comparable program attributes. We selected attributes that have been suggested in the literature or by experts as necessary for program success or for program development as well as basic program attributes used as regular descriptors in the literature (Brouwer, Tesfaye, & Pauw, 2011b; Cochran & Logue, 2011). Attributes used in the case study score cards are listed in Table 10. The following section describes each of these attributes in detail and provides evidence for their importance from case study examples and the literature.

Table 10. Selected attributes for case study assessment.

Basic Program Attributes	Key Attributes
• Primary hydrologic service targeted • Co-benefits • Payment type • Payment mechanism • Payment source • Activities funded • Duration of program • Participants • Beneficiaries • Watershed size • Water source type • Scale • Government and utility coordination • Jurisdictional alignment • Biophysical characteristics • Drivers • Practice- or performance-based	• Transaction costs • Pricing and payment • Conflicting programs and goals • Opportunities for stacking • Adaptability/scaling up • Supporting organizations • Supporting laws and/or administrative rules • Competing investment options • Ample supply of sellers? • Ample supply of buyers/demand for service? • Potential supply of enhanced ecosystem services • Monitoring and evaluation • Permanence and sustainability • Program administration

PRIMARY HYDROLOGIC SERVICE OFFERED

PWS programs can target water quality, water quantity, or both. Recreation might be listed as a co-benefit or, in some cases, as a primary service offered in conjunction with watershed services. This is the case in Philadelphia's "Parks for People Program" which created green spaces for recreation in underserved areas- which the public wanted, in order to protect water quality- which the public needed (Trust for Public Land, 2008). It is important to identify the service targeted in order to monitor and gauge the success of a PWS program. If water quality does not improve for example, adaptive management should be implemented and alternative pathways to improving water quality might be explored.

CO-BENEFITS

Although watershed services are the focus of PWS programs, there are often co-benefits that result from their implementation. Other ecosystem services that might benefit from land conservation or riparian buffer implementation include biodiversity (increased available habitat and habitat connectivity) as well as recreation (conserved land might become public park, allow trail crossings, etc). Carbon sequestration might be another economic and ecological benefit derived through PWS activities. Many co-benefits are identified in case studies and valued in the watersheds of PWS programs: for example, in San Antonio, increasing the availability of public land helped to garner support for aquifer protection (S.O.S.A., 2011).

PAYMENT TYPE, MECHANISMS, SOURCE & ACTIVITIES FUNDED

The structure of PWS programs are discussed in detail in the Payment Framework section (Page 17).

PARTICIPANTS

Payments for watershed services program implementation is orchestrated by various sectors: governments, the private sector, non-governmental organizations (NGOs), and community groups (Stanton et al., 2010). The majority of PWS programs are managed by government (55%), while less are managed by private sector/NGOs (36%) and 9% are managed by a mix of the two (Stanton et al., 2010).

Participants needed for a PWS program include:

- **Buyers/Funders:** Governments, private interests, NGOs, individual users.
- **Sellers/Suppliers**: Private landowners or informal stewards, government reserves or land trusts, private reserves and NGOs who have title and management responsibility of protected areas.
- **Administrators:** Establish specifics of the transaction and facilitate buyer/seller negotiations.
- **Intermediaries**: General program facilitators.
- **Funders**: Any funds not invested by the buyers to help develop or maintain the watershed protection program.

BENEFICIARIES AND AMPLE SUPPLY OF BUYERS

The buyers/funders of watershed services often include entities that will benefit from conservation of the habitat surrounding their concerned catchment or water body including:

- Municipal governments responsible for protecting sources of drinking water
- Drinking water companies
- Hydroelectric generators (public and private)

In an ecosystem services framework, beneficiaries are defined as stakeholders that benefit directly from an ecosystem service, or simply put those individuals or groups that receive the ecosystem service (Harrington et al., 2010). Because beneficiaries depend on the delivery of an ecosystem service, they can decide what service landscape management should target (i.e. water quantity versus avoided flood damage) and what risks they are willing to take. This is naturally motivated what they want from the ecosystem (Brauman et al., 2007). The value of ecosystem services will depend on the views and needs from the perspective of beneficiaries (Hein, Vankoppen, Degroot, & Vanierland, 2006). This is important because the way in which beneficiaries value ecosystem services underlies the motivation for payment for ecosystem programs where beneficiaries pay producers of ecosystem services for continued delivery of the service provision. Valuation of ecosystem services by beneficiaries can occur through asking the willingness to pay for a service or willingness to accept compensation for loss of a service, through cost-benefit analysis, or other techniques (Hanson et al., 2011; Harrington et al., 2010).

In PWS schemes, beneficiaries can be buyers of the service or a third-party acting on behalf of the beneficiaries can be the buyer. For example, downstream beneficiaries pay upstream forest owners or forest managers to provide a watershed-related ecosystem service (Hanson et al., 2011). Beneficiaries can sometimes come together to pay for ecosystem service provisions to reduce transaction costs. This can be in the form of organizations, cooperatives, or fees that pay landowners providing the ecosystem service or pay for conservation projects (Defra & Eftec, 2005).

Finally, it is useful to identify beneficiaries of the ecosystem service(s) of interest to observe the tradeoffs among other services and the distribution of those services (Brauman et al., 2007; Defra & Eftec, 2005).

AMPLE SUPPLY OF SELLERS

The sellers, or suppliers of watershed services primarily consist of landowners who receive payments to implement management practices on their land which enhance the provision of watershed services from their land.

Landowners who provide watershed services typically have a multitude of reasons for participating in PWS schemes, but the most dominant include the financial benefits and a strong stewardship ethic (Majanen et al., 2011) . Many times cash payments alone are not sufficient to motivate behavioral change – especially since PWS payments are typically limited in size (Majanen et al., 2011). More often than not, payments serve as an "enabling factor" through which landowners can justify carrying out management practices that they had wished to carry out, but did not have the financial means to do so (Majanen et al., 2011).

DURATION OF PROGRAM

Some programs fulfill their mission in a short set amount of time while others are designed to continue actively trading for many years. The duration of the program can provide insight into the sustainability and public support of the program. This is especially useful for programs that are repeatedly supported through legislative allocation. While regular voting on program continuance might make the funding seem unstable, if the program has a record of support, the source can still be considered sustainable.

WATERSHED SIZE

This physical attribute is fairly straightforward data collection. However, it has been suggested through the literature that the "goldilocks principle" applies to PWS program design; that is that the watershed should not be too small (a single tributary) nor too large (thousands of square miles) for effective program implementation (Stanton et al., 2010).

WATERSHED SOURCE TYPE

The designation of upstream and downstream users is easier to delineate in a river system than in a closed system like a lake, or an isolated reservoir. We looked for alignment between the UNRB by identifying the kind of water body that the PWS program targeted. In addition, we identified whether or not the water body was used for drinking water as this affected comparability in the ultimate goals of maintaining swimmable, fishable, and drinkable water quality.

SCALE

Scale in the context of our attribute designation refers to the political or biophysical context of the PWS program. Cities and counties can implement PWS programs on their own without including the entire sub-watershed or watershed. Although this can solve point source pollution problems, for diffuse accumulated pollution like the one we find in the UNRB, a broad, watershed scale PWS program will most effectively address water quality.

GOVERNMENT & UTILITY COORDINATION

The management structure for a PWS program is somewhat dependent on the scale and scope of the program (Stanton et al., 2010). Government and utility coordination identifies the scope of administration responsibility. The number of municipalities or utilities involved in the PWS program will determine the most effective management structure of the PWS program. When the program is small and localized, a single land trust or non-profit might be able to administer the program effectively. For larger, watershed scale programs like we hope to see in the UNRB, a watershed authority would be preferable. This allows for centralized information gathering, planning, and decision making. High priority conservation parcels can be identified throughout the watershed and efforts can be coordinated. Funding for maintaining the administrative body should be earmarked by the PWS payment mechanism in order to ensure its continued ability to function.

If no centralized organization is designated, this can be done informally by bringing together all the players. Stakeholder meetings are an effective way to approach administration and were utilized effectively in the design of the Boston PWS program. The Upper Neuse River Basin Association served this function for some time in our region but the focus has shifted to a new group, the Falls Lake Management Association. It is essential that all local governments within the watershed come to the table for these meetings along with local policy makers and land trusts.

JURISDICTIONAL ALIGNMENT

Jurisdictional alignment refers to who the buyers and sellers are and where they are located. This is important when thinking about beneficiaries who have little or no jurisdiction to affect water quality upstream. Most beneficiaries of the UNRB are within the watershed, but not all. As the largest user of water from Falls Lake, Raleigh sits on the edge of the watershed (NC Division of Water Resources, 2010). Case study PWS programs will provide more useful models to UNRB program design if they also have some beneficiaries outside of the watershed.

BIOPHYSICAL CHARACTERISTICS

Biophysical characteristics focus on present and future land use. Current land use and land cover data show the percentages of area in the watershed of interest that are forested, used for agriculture, and developed. Agricultural runoff continues to be the largest source of nitrogen and phosphorous in the UNRB, watersheds with similar land use allotments will likely face similar water quality issues. Development pressure in this region is high, making the need for land conservation more urgent before impervious surface expands and exacerbates the problem (Triangle Land Conservancy & Tar River Land Conservancy, 2010).

DRIVERS

Regulatory drivers can provide strong incentive for PWS programs. Meeting the requirements using a flexible mechanism that utilizes green infrastructure is often preferable to expensive installment or upgrades of grey infrastructure. In addition to regulation, we delineated the geography of governments involved in the PWS program. The UNRB's situation is somewhat unique—not all of the municipalities within the watershed are dependent on water supplies within the watershed and some municipalities outside of the watershed are almost entirely dependent on its water supply. The combination of a similar regulatory driver and political context would suggest high alignment and comparability with the UNRB.

PRACTICE OR PERFORMANCE BASED

Best Management Practices are practice-based proxies for water quality. Through appropriate implementation, water quality should improve; there are tailored BMPs for nutrient loading, sedimentation, erosion, etc. Monitoring is obviously an important part of practice-based measures. If there is no implementation or maintenance, no change will occur.

Performance based measures also require monitoring; monitoring and data collection show that target benchmarks in nutrient reduction or reduced flow have been achieved. BMPs may or may not be used to achieve these reductions. Water quality trading programs might achieve performance through improvements in facilities or better timed wastewater releases rather than in upstream land use. Combinations of practice and performance based measures might also be utilized by a PWS program.

MONITORING AND EVALUATION

Many PWS programs use management practices as proxies for measured delivery of enhanced watershed services because the verified delivery of these services would be prohibitively costly, time consuming, and technically difficult. In a 2008 review of PWS in developing countries, all fifty of the programs in the study sample compensated individuals or communities under the premise that specific land management practices resulted in the enhancement or delivery of the targeted watershed service (Porras, Grieg-Gran, & Neves, 2008). The need for monitoring to verify the link between these BMPs and the level of enhanced service provided is immense, however, as these values form the basis by which these programs can be economically efficient and environmentally effective. Stanton et al. (2010) cited a “fairly uniform call for improving monitoring and evaluation of PWS programs in order to measure the performance of specific watershed protection activities and better understand the overall ecological results.”

Monitoring and evaluation is also important to ensure additionality. Initial evaluation of the national program in Mexico found that investments went to areas that were already under protection, leaving many of the most threatened and vulnerable areas unprotected (Stanton 2010). Had evaluation and monitoring not been a formalized part of the program in Mexico, project managers may not have been able to adjust project design and implementation specifications to allow investments to be redirected to cover those areas at greatest risk of deforestation (Stanton 2010).

PERMANENCE AND SUSTAINABILTY

Permanence and sustainability must be couched within the stated goals of the program. Some programs should be self-sufficient with regular, predictable funding available as in a base rate fee on a water bill. Programs like this should continue to implement BMPs along with the maintenance and pursuit of conserved land using the funds generated. Other programs may have a short life span of operation but a long lasting impact. Tualatin, Oregon’s temperature trading program provides an example of a program where trading lasted only five years, but effectively accomplished enough trading to reduce temperature in the watershed (State of Oregon Department of Environmental Quality, 2007a).

DEMAND DRIVERS

The most basic, yet essential component of a PWS program is the presence of a willing buyer. This can be challenging, as many beneficiaries are accustomed to enjoying ecological services for free (Majanen et al., 2011). It is expected that demand will grow as population growth and climate change introduce increasing pressure on our water resources. Expected increases in water rates as the future scenarios take form will incentivize beneficiaries to invest in actions that will reduce their risks and costs regarding water consumption.

Today, demand is primarily driven through regulations and incentives (Majanen et al., 2011). Continued implementation of PWS pilot programs is also expected to enhance demand, as buyers will gain confidence in the feasibility of PWS models (Majanen et al., 2011).

PROGRAM ADMINISTRATION

This attribute relates to government and utility coordination as well as jurisdictional alignment. The number of entities in the administration of the program suggests the level of difficulty introduced with more than one administering body. Unilateral administration, cooperative administration by multiple entities, and watershed level administration through an empowered authority are the categories we have defined within the attribute for ranking alignment with the UNRB. We hope a watershed level organization will be developed and designated to administer a PWS program that encompasses the scope of the UNRB.

PRICING AND PAYMENT

As mentioned earlier in this report, payment mechanisms can present a more cost-effective, politically feasible tool for conserving watershed services than traditional regulation-based approaches if the opportunity cost of providing the desired watershed service is higher than or equal to other alternatives (Stanton et al., 2010). The net monetary benefits to the beneficiary of investing in green infrastructure must therefore outweigh the net monetary benefits of the alternative: investing in grey infrastructure.

In our research, estimated costs for green infrastructure were often lower than for grey infrastructure (see

Table **7** for examples. In addition to a dollar for dollar comparison, green infrastructure offers several additional benefits. These include 1) long-term security and 2) potential for co-benefits. Natural systems increase in value as scarcity increases; as development and population grow in an area, green space will appreciate in value (Berry, 1987). The services provided by natural systems will also become more valuable; protecting the environment in the present provides a buffer or insurance against future development ensuring there will be a supply in the future. Recreational space and habitat for wildlife are co-benefits of green space that are also likely to increase in value with future development. Maintaining the surrounding green infrastructure for any one of these purposes (water quality, recreation, habitat) will provide a higher net benefit, incorporating the other co-benefits, than a targeted grey infrastructure investment; there are no co-benefits of a wastewater treatment plant.

CONFLICTING PROGRAMS & GOALS

It is important to identify any competing environmental goals or regulatory requirements with the services targeted by the PWS program. Direct conflict could create barriers to PWS program implementation and would suggest the need for adapting the structure of the scheme. By identifying these conflicts, their goals can be incorporated into the program.

OPPORTUNITIES FOR STACKING

PWS and carbon markets are the most commonly implemented types of payment for ecosystem service programs currently in the United States. If the markets continue to develop, there is the potential to stack additional PES services into existing programs. Riparian areas for PWS programs might provide an opportunity for credits in a biodiversity program for example.

ADAPTABILITY/SCALING UP

PWS programs tend to be smaller and more localized than other PES programs; they are applied on a watershed scale (Stanton et al., 2010). Local users will be more invested in protecting their own water supply quality and quantity. Political boundaries often create artificial subdivisions within a watershed but managing watershed services requires a watershed approach to protect the whole system. This is best done with regional cooperation among all political divisions or using a watershed authority approach.

PWS programs can be implemented in on a sub-watershed scale as a pilot project and then scaled up to encompass the whole watershed. Alternatively, different stakeholders might approach PWS differently. As long as there is communication and joint planning, this process should work as well. An example of this hybrid structure for scaling up is in the Edwards Aquifer in Texas (Aquifer Guardians in Urban Areas, 2003). There is a centralized watershed authority to coordinate protection of the aquifer. San Antonio uses a combination of sales taxes to protect land for water quality while Austin issues storm water drainage permits and has implemented a new watershed protection ordinance. Many other municipalities are also involved in the eleven county watershed protection effort.

SUPPORTING ORGANIZATIONS & LEGISLATION

These attributes identify the intermediary organizations and regulations that assist in PWS implementation or provide drivers for their implementation, respectively. For example, non-profits can effectively bring together landowners and provide education and support for a PWS program.

COMPETING INVESTMENT OPTIONS

In an area experiencing rapid development, for example, a landowner might weigh the decision to sell their land to a developer or incorporate it into a conservation easement. Other tradeoffs might include the cost difference between green and grey infrastructure. Understanding these tradeoffs in the region of the PWS program will help to incentivize participation in the program.

UPPER NEUSE RIVER BASIN SCORE CARD

This section provides details on the attributes of the Upper Neuse River Basin using the framework of the case study score card. These attributes inform the alignment score to the fifteen case studies assessed in order to gain an understanding the programs most similar and relevant to the UNRB context. This information guided our recommendations for a payment for watershed services program tailored to the needs of the UNRB.

BASIC WATERSHED OVERVIEW

PRIMARY HYDROLOGIC SERVICE TARGETED

In the Upper Neuse River Basin, the primarily hydrologic service targeted is water quality. This is because water quality degradation has been an issue for the watershed, especially for Falls Lake, which has failed state and federal water quality standards mandated by the Clean Water Act. Diffuse runoff is the primary cause of water quality concerns in the state of North Carolina and has been more specifically identified as the main contributor of nitrogen and phosphorus into Falls Lake (McNaught, Rukdek, & Spalt, 2003; NC DENR Resources Division of Water, 2012; UNRBA, 2003). In addition, water quality is expected to degrade due to land conversion from population growth and development especially in Falls Lake, where all areas in the basin drain.

Water quantity is a secondary hydrologic service targeted in the UNRB. Concerns over water supply were evident during the most recent drought in the region in 2008, which forced municipalities to impose consumer water conservation measures and negotiate inter-basin water transfer sale (Associated Press, 2008). While demand for water supply in the basin is expected to increase, it is not considered the primary threat to the UNRB.

CO-BENEFITS

Recreation can be a co-benefit or an additional benefit received from protecting land for water quality benefits. For example, Duke University owns about 1,500 forested acres in Hillsborough and Durham that is used for research and recreation (Hart, 2006). In addition, North Carolina Division of Parks and Recreation (NCDPR) manages 300,000 acres of conserved land the Eno River State Park, Occoneechee Mountain State Natural, Area, and Falls Lake State Recreation Area as well as numerous county and city parks (Hart, 2006).

In addition to recreation, there are other local benefits attained from watershed protection such as increasing property values, preserving ecological communities, water and nutrient cycling, avoided sedimentation, aesthetic and cultural values, and aquatic life benefits (NC Department of Environment and Natural Resources, 2011). There are also global benefits attained from forested areas such as climate change mitigation and the preservation of genetic material which can be used for future agricultural or medical purposes (FAO, 2012).

ACTIVITIES FUNDED

A variety of payment for watershed services programs exist in the Upper Neuse River Basin to fund green infrastructure activities that benefit water quality. These programs finance the implementation of BMPs or land conservation for water quality benefits or other co-benefits such as recreation. Below is a list of PWS type programs that are funded in the watershed:

- Land conservation (fee-simple acquisitions, conservation easements, etc.)

- Agricultural Best Management Practices
- Stormwater Best Management Practices

These activities are financed by various mechanisms, which have varying reliability. Federal dollars are available for cost-share programs to implement agricultural Best Management Practices (BMPs) or land conservation for eligible landowners. There are also EPA Section 319 grants available that have been used towards conserving land in the Upper Neuse. In addition, state funding is available for land protection and BMPs through the Clean Water Management Trust Fund, Natural Heritage Trust Fund, Agricultural Development and Farmland Preservation Trust, Parks and Recreation Trust Fund, North Carolina Agricultural Cost Share Program, State of North Carolina Conservation Tax Credit, North Carolina Ecosystem Enhancement Program (payment for offsetting nutrient loads) and Drinking Water State Revolving Loan Fund. However, federal and state sources are very competitive and unreliable. Many times funding availability is subject to the whims of political and economic influences.

Local funding is also available, and is often times recommended as the primary source of funding PWS type of programs because they are more reliable and provide more local buy-in. Local governments (municipalities and county governments) can provide funding through bonds or dedicated revenue streams such as water fees, property taxes, or other utility fees. For example, Raleigh has a dedicated revenue source for land conservation through a one cent per one hundred gallons charge to utility customers (Brice, 2011). Similarly, Durham has a fee in place that dedicates one cent per one hundred CCF to watershed protection (1 CCF = 100 cubic feet) (City of Durham Department of Water Management, 2009). Overall, the UNRB has limited reliable and dedicated funds for current PWS programs, although Durham and Raleigh's watershed fees are a substantial start.

BIOPHYSICAL CHARACTERISTICS

Forests cover 57% of the basin, while suburban and urban development cover 14% and cultivated lands cover 18% of the land in the UNRB (Table 11) (Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, 2011). In addition, grasslands, wetlands, and water bodies cover a smaller portion of the watershed at 6%, 2%, and 3% respectively. However, the percent development is expected to increase with populations projected to increase by 90% over next 30 years (Triangle Land Conservancy & Tar River Land Conservancy, 2010). In addition, Triassic soils are present in the Upper Neuse, most notably in the Ellerbe Creek watershed in Durham. These soils are characterized by poor porosity and low permeability, which complicates water drainage and quality in the basin (ECWA, 2003).

Table 11. Land Use and Land Cover Type (Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, 2011)**.**

Land Cover Type	Area (square miles)	% Cover
Suburban and Urban Development	106	14%
Forest	440	57%
Cultivated Lands	135	18%
Grassland and Shrub	50	6%
Wetlands	17	2%
Water	22	3%
Total	770	100%

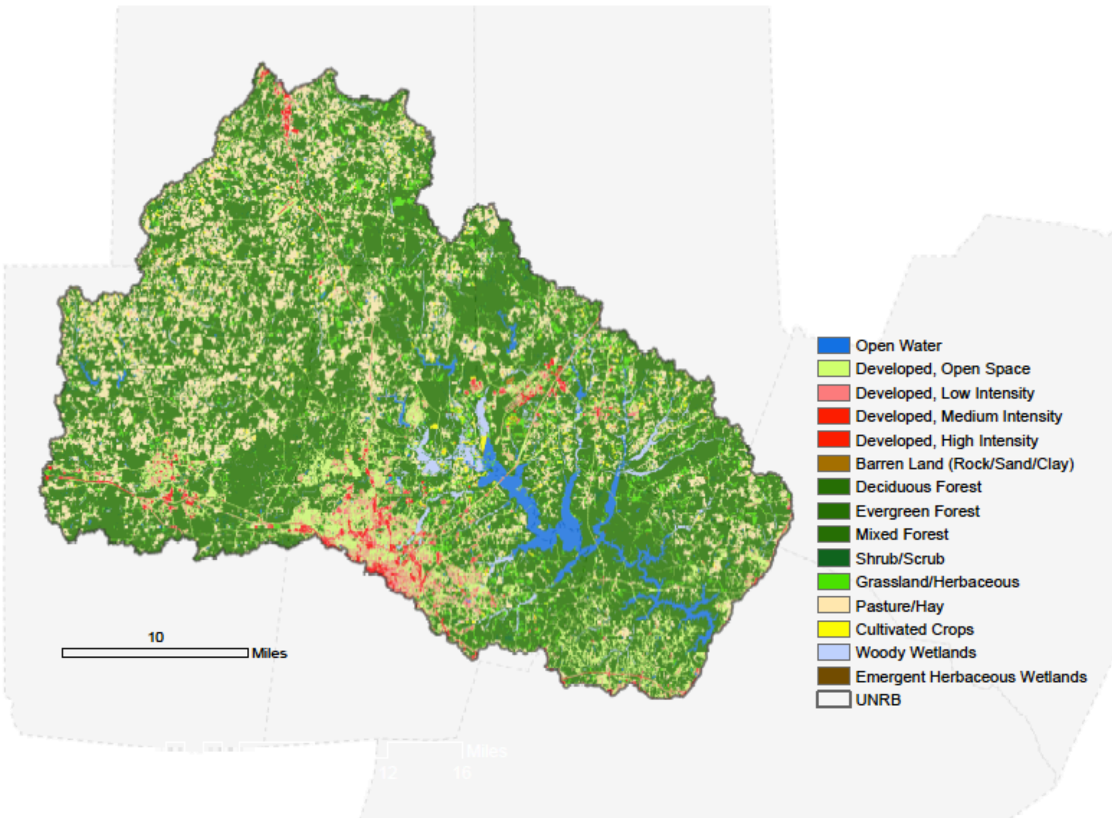

Figure 3. Land Use Land Cover Map for the Upper Neuse River Basin based on the 2006 National Land Cover Dataset.

POLLUTION FROM LAND USE

Pollution into Falls Lake comes from many different sources that are categorized as either non-point source pollution or point source pollution. Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources (US Environmental Protection Agency, 2012b). The EPA defines point source pollution as “any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack” (US Environmental Protection Agency, 2012b). There are basin-wide contributions of nutrients into the UNRB and the most monitored are nutrient and phosphorus. According to the US Environmental Protection Agency (EPA) excessive concentrations of these nutrients in the water and air of the United States is “one of America’s most widespread, costly and challenging environmental problems” (EPA, 2010).

The graphs in Figure 4 show the main nitrogen inputs into Falls Lake as 22% point sources and 88% non-point sources coming from agriculture (29%), forests (21%) (forestry contributes heavily to nitrogen because of the decomposing organic material which the ecosystem generates), developed areas (13%), septic systems (7%), shrubs/grass (3%), the NC Department of Transportation (1%) and other unidentifiable non-point sources (3%) (NC Division of Water Quality Planning Section, 2010). Similar figures follow for phosphorus where 30% of phosphorus loads are attributed to point sources and the remaining 70% are due to non-point sources such as agriculture (46%), septic systems (7%), developed areas (5%), forest areas (4%), sand filters (1%), and other unidentifiable non-point sources (4%) (NC Division of Water Quality Planning Section, 2010). Agriculture, stormwater runoff, wastewater deposition, and fossil fuel use are identified as primary sources of nutrient pollution in the UNRB.

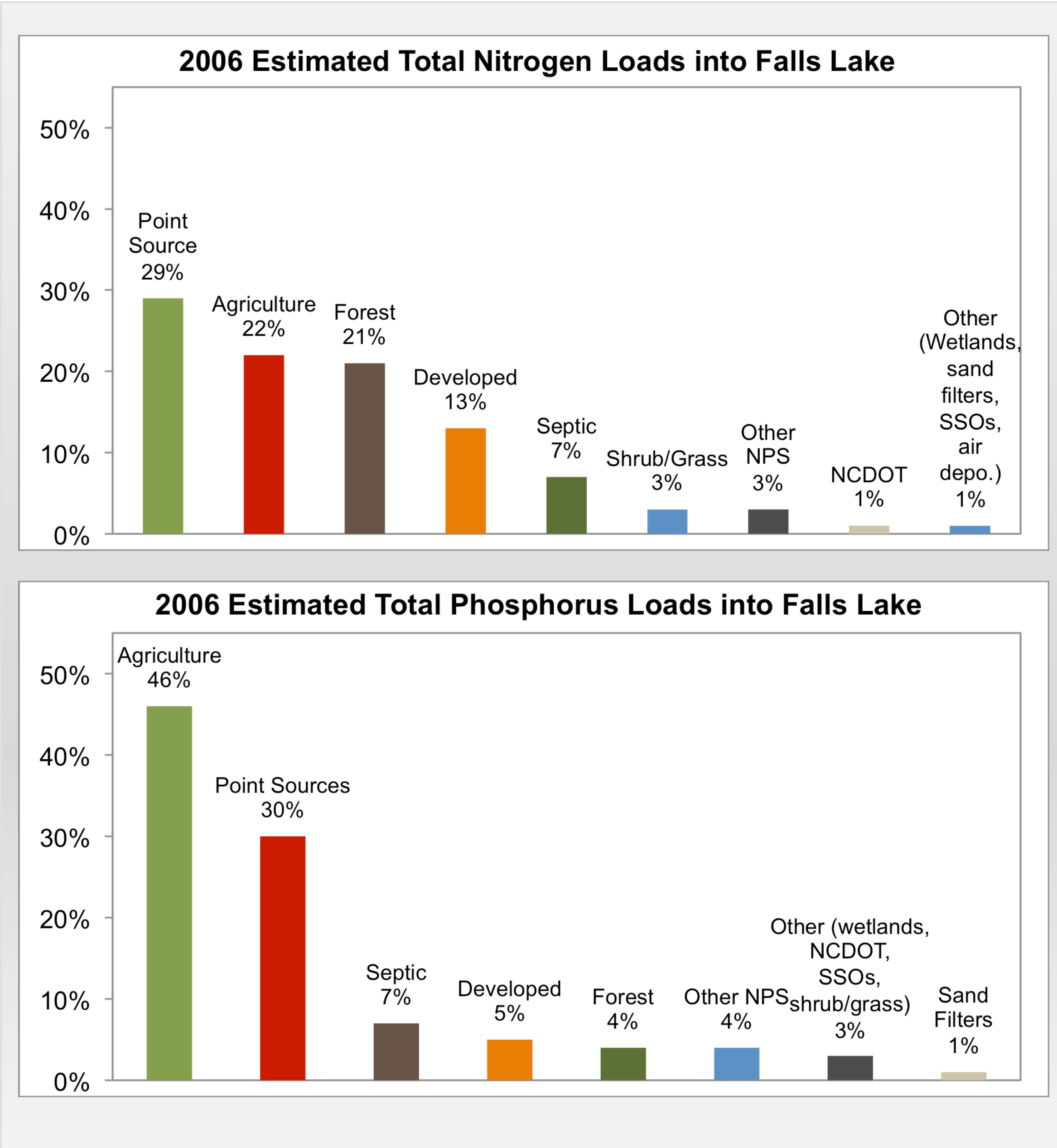

Figure 1. Estimated inputs into Falls Lake from phosphorus (NC Division of Water Quality Planning Section, 2010)**.**

PARTICIPANTS

The potential participants of an expanded payment for watershed services program are listed below. This is based on knowledge of beneficiaries, key actors in the watershed, and current payment programs (i.e. Raleigh's watershed fee and payments from the Clean Water Management Trust Fund).

- **Potential Buyers:** Local governments (municipalities and county governments) and the Upper Neuse River Basin Association/Falls Lake Watershed Association.
- **Potential Sellers:** Farmers and landowners.
- **Intermediaries/Donors:** Land trusts, soil and water conservation districts, North Carolina State Cooperative Extension, environmental organizations, and private donors or foundations.

Local governments in the UNRB are targeted as potential major purchasers of watershed services. This is true of many payment for ecosystem service programs because the beneficiaries of watershed services are quite diffuse (FAO, 2012). In the UNRB, the utilities are public and are managed by local municipalities. This helps their potential as ecosystem service buyers if an offset market is created to comply with the Falls Lake Rules. For example, wastewater utilities may potentially buy offsets in order to comply with nutrient reduction targets if they cannot meet their reductions with in-house upgrades.

Sellers of watershed services are identified as landowners of priority areas that provide critical watershed services or areas that have the potential to protect or enhance specific environmental services through improved land management. In the UNRB, potential sellers are farmers, forest landowners, or urban landowners that protect land or install BMPs.

Intermediaries can help facilitate payment for watershed services program transactions by bringing buyers and sellers together, essentially reducing transaction costs. This is critical because PWS programs are based on voluntary participation of the landowner. Land trusts, soil and water conservation districts, North Carolina State Cooperative Extension, and environmental organizations can play a large role as intermediaries by building relationships with potential sellers. In addition, private donors or foundations can provide seed funding and the necessary capital for a payment program to get started. Intermediaries in the UNRB such as non-profit organizations are already actively conserving land in partnership with many landowners and local governments, including the Conservation Trust for North Carolina, Eno River Association, Ellerbe Creek Watershed Association, Triangle Green- ways Council, Tar River Land Conservancy, Triangle Land Conservancy, and The Trust for Public Land (Hart, 2006; NC Division of Water Resources, 2010).

BENEFICIARIES

In this analysis, the primary beneficiaries are the 500,000 people who rely on the drinking water reservoirs within the basin (Hart, 2006). Municipalities that draw water from water reservoir supplies are the City of Durham, the City of Raleigh, Town of Hillsborough, Orange County, Town of Hillsborough, Town of Butner, and City of Creedmoor (Hughes et al. (in press). Two municipalities, the Town of Stem and the Town of Roxboro do not rely on water reservoir supplies for drinking water.

Most of the 500,000 water utility customers or beneficiaries are located in the populated areas mid-downstream (Durham) and downstream (Raleigh) of the basin (Figure 8). Water utility customers can be broken down into major public and private water users, which is important to identify because they will have heightened interests in the cost, reliability, and quality of the water supplied. The World Resources Institute (WRI) conducted a beneficiary analysis of the Falls Lake Reservoir in the UNRB and identified major public and private water users, or beneficiaries (Talberth, Gray, Branosky, & Gartner, 2012). WRI's beneficiary list is expanded in Table 12. Understanding the major water users can provide an indication of the type of payment for watershed services program that is most appropriate in the basin. It is clear there are some major water users, for example, Duke University and the Hospital are the largest consumers of water in the City of Durham, and in fiscal year 2010 Duke used 449 million gallons of water (Sustainable Duke, 2012). However, these major water users are diffuse (Figure 5) and relatively small in number for larger payment for watershed services schemes such as water quality trading.

Table 6. Beneficiaries of clean water supplies in the UNRB (Talberth et al., 2012).

Type of Water Users	Entity
Public	North Carolina State University State of North Carolina Wake County City of Raleigh Raleigh Water Utility Durham Water Utility Orange-Alamance Water Utility Hillsborough Water Utility Creedmoor Water Utility South Granville Water and Sewer Authority
Pharmaceutical	Ajinomoto Mallinckrodt Glaxo Smith Kline
Healthcare products	Covidien
Food and beverage	Pepsi Bottling Ventures Cargill
Electronics/lighting and semiconductors	Suntronics Cree Industries
Textiles	Alsco
Other	Duke University Golf Courses

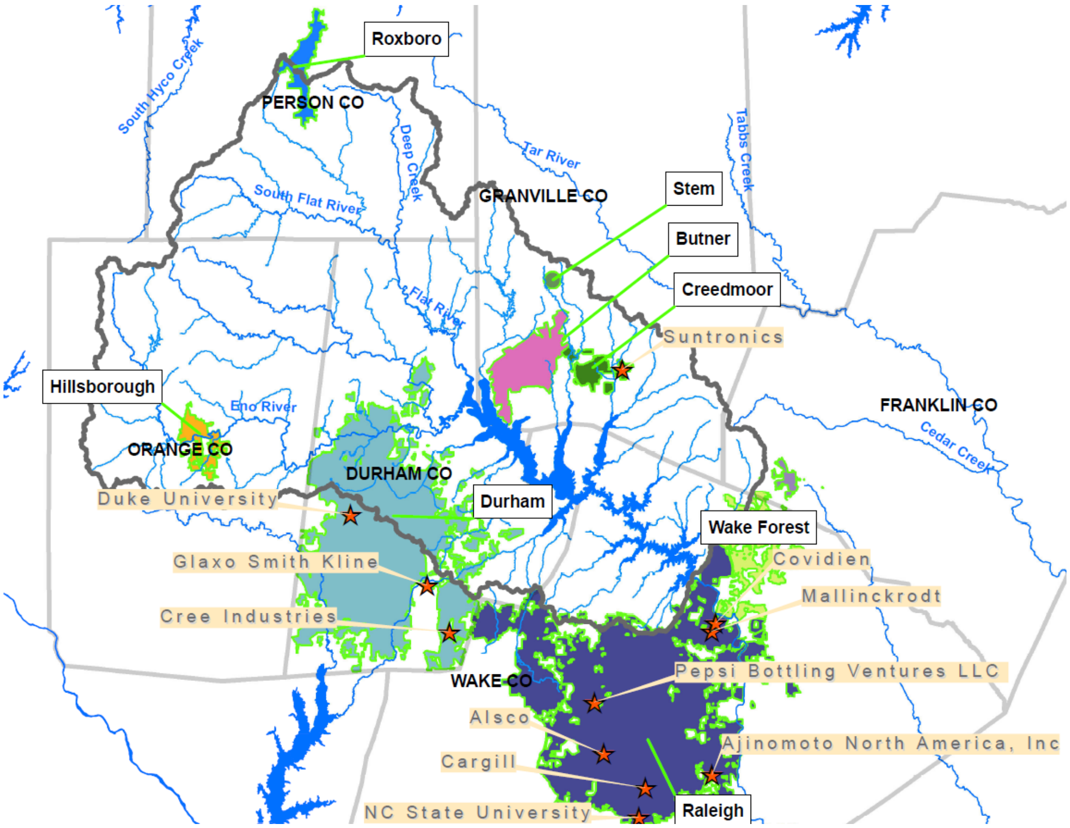

Figure 2. Major public and private beneficiaries in the UNRB.

Upstream landowners in the UNRB, such as those in Durham or Hillsborough, are thought to bear many of the costs of protecting water quality and receive little benefit because maintaining water quality downstream will require constraints on current and future land use or on the level of pollutants they can release. For landowners, the decisions of what can and cannot be done on land can affect the overall value of the land and can be a major concern for those living upstream. In addition, the Town of Roxboro and Town of Stem have lower incentives than do municipalities that rely on water supplies to participate in watershed protection because they do not draw water from the UNRB and receive little benefit from watershed protection. However, the Town of Stem and the Town of Roxboro obtain other benefits associated with the maintenance or enhancement of clean drinking water through BMPs and land protection although they do not rely on water supplies within the basin. These municipalities receive off-site benefits such as watershed, soil, and flood protection, maintenance or enhancement of aesthetic and cultural values, and recreation opportunities.

Overall, the costs of watershed protection and the benefits of clean water are unequally distributed. Areas where a local government may want to obtain water quality benefits for its constituents oftentimes are located in areas where they have no jurisdiction to do so. For example, Falls Lake, the drainage point in the basin and Raleigh's drinking water supply, receives pollution from the populated areas of Durham. Raleigh would benefit from green or gray infrastructure upstream, especially in Durham, but it has no jurisdiction in the area and ultimately receives little water quality benefits from upstream land use. This is important to keep in mind when designing a payment for watershed services program for watershed protection in order to properly incentivize landowners and other ecosystem service providers to maintain or enhance downstream watershed services.

WATERSHED SIZE

The Upper Neuse River basin covers 770 square miles in the Piedmont area of North Carolina.

WATER SOURCE

Nine drinking water reservoirs located within in the UNRB provide water to areas in and around the basin (Figure 6).

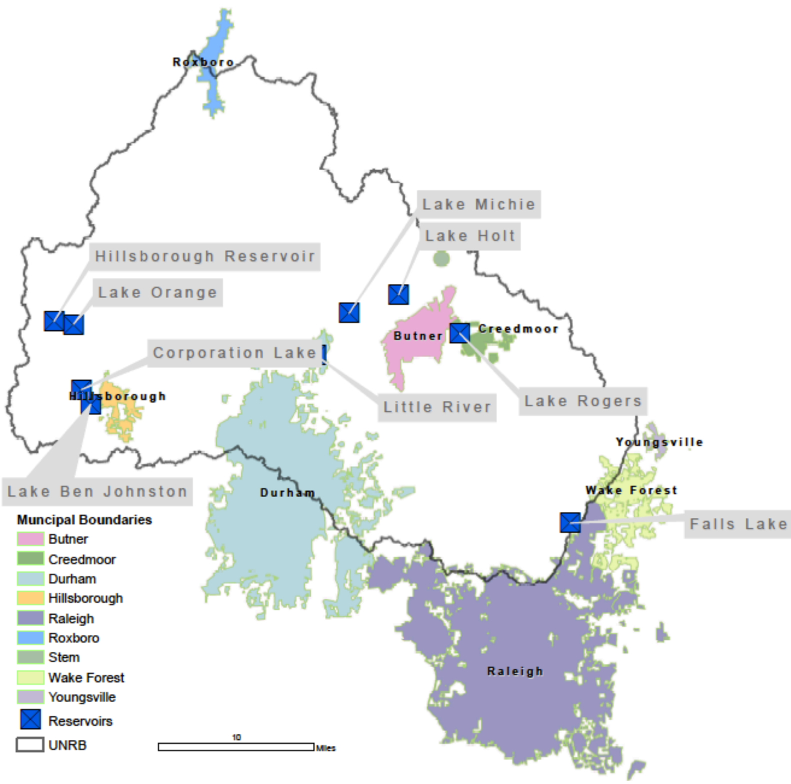

Figure 6. Reservoirs in the Upper Neuse River Basin.

WATER SCALE

About 200,000 people live in the UNRB and more than 500,000 people depend on water provided by its nine drinking water reservoirs (Hart, 2006; Hughes et al. (in press)).

GOVERNMENT AND WATER UTILITY COORDINATION

In total, 14 local government jurisdictions fall partially or fully within the Upper Neuse River Basin, which can be broken down into six counties and eight municipalities (Figure 3, Table 14). There are six water utilities throughout the basin providing water to customers inside and outside of the UNRB (Table 13).

Table 13. Water Utilities and Reservoirs in the Upper Neuse River Basin (NC DENR Resources Division of Water, 2012).

Reservoir	Stream	2010 Average Daily Withdrawal (MGD)	Water Utility
Lake Orange	Eno River	0	Hillsborough
West Fork of the Eno	Eno River	1.157	
Ben Johnston	Eno River	0	
Corporation Lake	Eno River	0.22	Orange Alamance (Non-profit)
Lake Rogers	Ledge Creek	0.718	Creedmoor
Lake Holt	Knapp of Reed's Creek	3.498	South Granville Water and Sewer Authority
Lake Michie	Flat River	17.986	Durham
Little River	Little River Lake	23.667	
Falls Lake	Neuse River	45	Raleigh

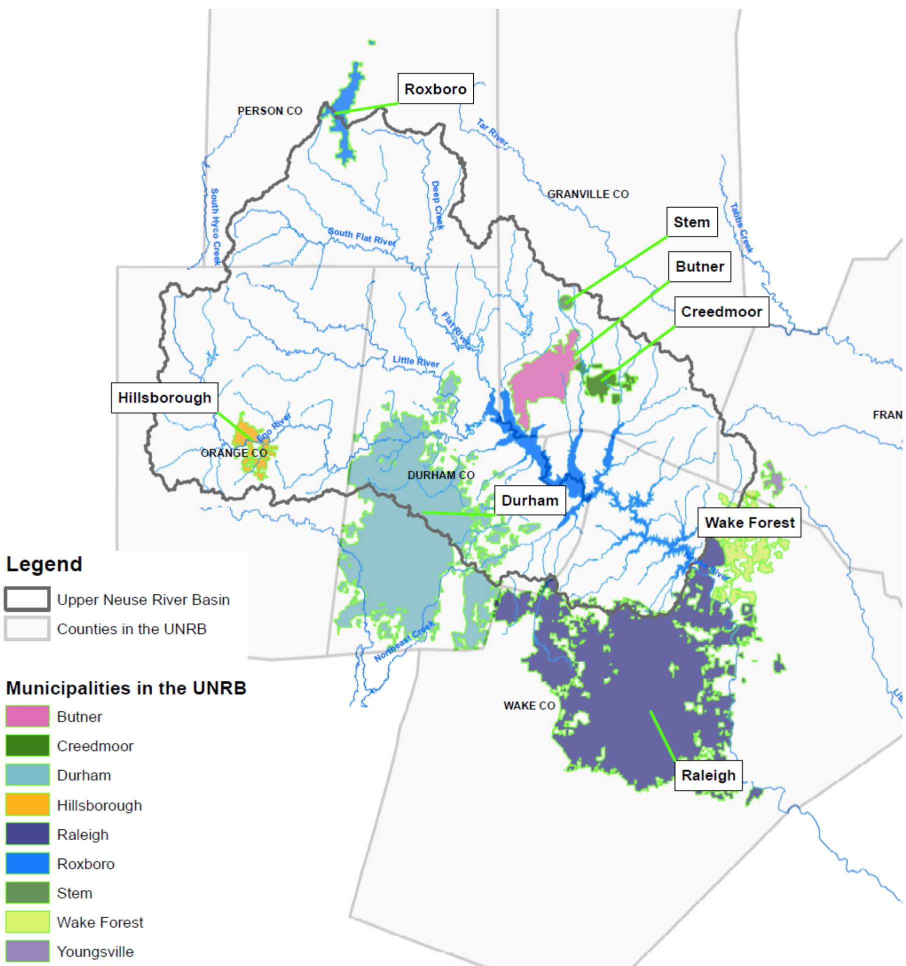

Figure 3. UNRB Municipalities and Counties.

LOCAL GOVERNMENTS

The Upper Neuse contains a collection of local government actors. Eight municipalities are fully within or partially within this watershed: Town of Creedmoor, City of Durham, Town of Hillsborough, City of Raleigh, Town of Roxboro, Town of Stem, Town of Wake Forest, and the Town of Butner (Figure 3). These municipalities vary in size with the City of Raleigh totaling to around 403,000 people and the Town of Stem totaling only 463 people (US Census Bureau, 2012) (Table 14).

Covering those municipalities are six counties: Person, Orange, Durham, Wake, Franklin, and Granville. The densest populations are located inside Durham, especially along that southern boundary from Raleigh to Durham. It is important to keep in mind the variation in sizes of the towns and cities in the UNRB, which effects their ability and capacity to respond to watershed initiatives. For the most part, a municipality finances and manages their own water infrastructure so there is little cost sharing of capital costs amongst parties, with the exception of intra-basin water transfers (Hughes et al. (in press)).

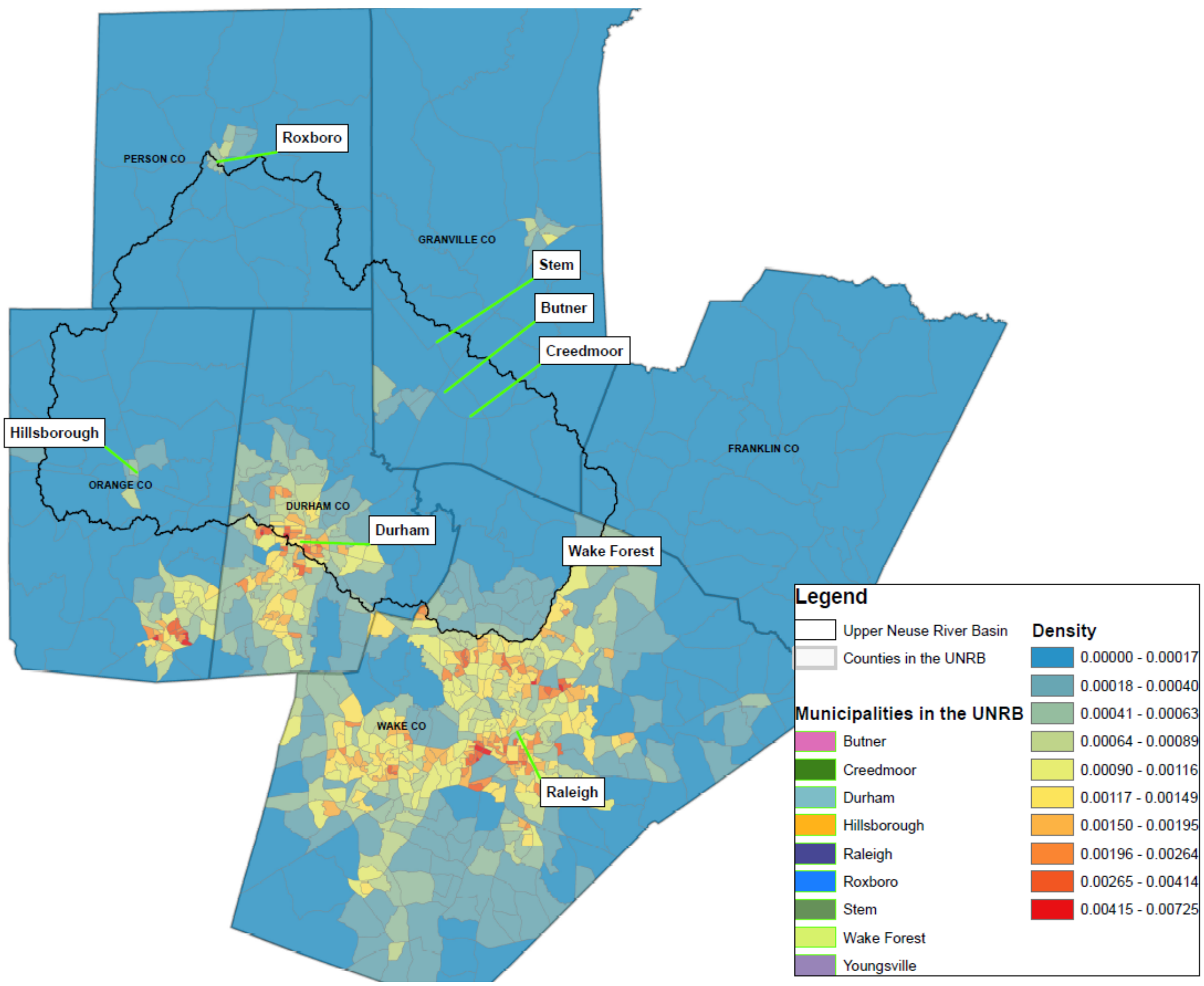

Figure 4. Population Density in the UNRB (US Census Bureau, 2012).

Table 14. Local Governments in the Upper Neuse River Basin (US Census Bureau, 2012).

	Total Area within UNRB		2000 population	2010 population	
Jurisdiction	Square Miles	%	# people	# people	% of watershed total
Durham County	205	26.50%	223,314	267,587	**21.6%**
Franklin County	8	1.10%	47,260	60,619	**0.6%**
Granville County	94	17.20%	48,498	59,916	**4.5%**
Orange County	209	25.40%	118,227	133,801	**13.3%**
Person County	130	16.80%	35,623	39,464	**4%**
Wake County	100	13.00%	627,846	900,993	**11.1%**
Town of Creedmoor	2	0.30%	2,232	4,124	**0.02%**
City of Durham	39	5.00%	187,035	228,330	**39.3%**
Town of Hillsborough	4	0.50%	5,446	6,087	**2.6%**
City of Raleigh	1	0.10%	276,093	403,892	**1.5%**
Town of Roxboro	1	0.10%	8,696	8,362	**0.3%**
Town of Stem	1	0.10%	229	463	**0.1%**
Town of Wake Forest	1	0.10%	12,588	30,117	**0.2%**
Town of Butner	7	0.90%	5,792	7,591	**0.7%**
TOTAL	**770**				**100%**

JURISDICTIONAL ALIGNMENT

As explained in the previous section, water quality benefits are not distributed equally throughout the UNRB's local government jurisdictions. Though water is sold locally in nearby regions and most buyers are located entirely inside the watershed, there is one significant buyer, the City of Raleigh, who straddles the watershed. Essentially, there are many jurisdictions within the UNRB that move water inside and outside of the basin.

Water withdrawn from the Town of Hillsborough, Town of Butner, and Town of Creedmoor reservoirs remain inside the UNRB. When Durham and Orange County withdraw water, it stays partially inside and outside the UNRB. More specifically, water withdrawn by Durham supplies its municipality in the UNRB and in the Cape Fear basin and water withdrawn by Orange County goes to areas within the UNRB as well as outside to Alamance County. In contrast to the rest of the municipalities within the UNRB who deliver water partially within the UNRB, the water withdrawn by the City of Raleigh leaves the basin.

DRIVERS

Currently, the biggest driver for watershed protection in the UNRB has been the listing of Falls Lake on the EPA's 303(d) impaired water body list in 2008 and the subsequent Falls Lake Nutrient Management Strategy that was drafted in response (General Assembly of North Carolina, 2009; NC DWQ, 2011) (Figure 9). Because the Falls Lake Rules requires coordination and action by all fourteen local governments in the watershed, it is the current main motivator for watershed protection in the basin.

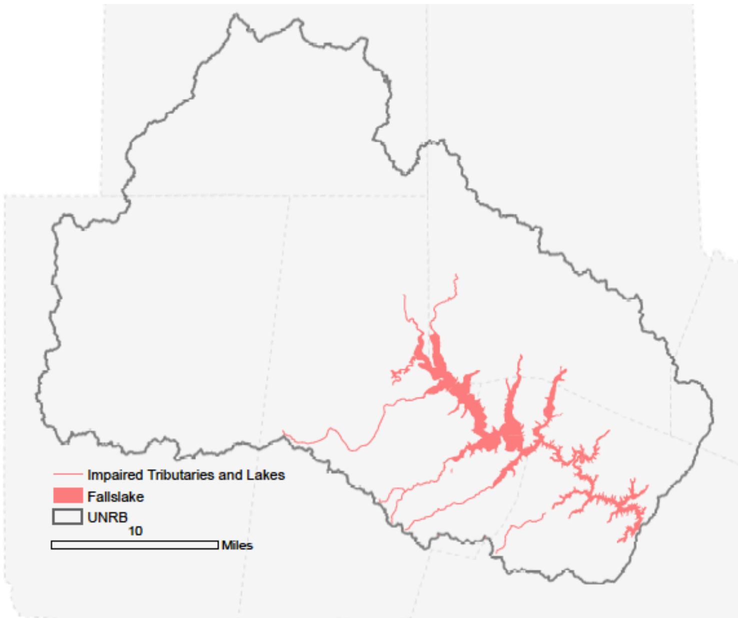

Figure 9. Falls Lake is an impaired water body listed on the EPA's 303(d) list.

Falls Lake was classified as impaired due to high loading of nitrogen and phosphorous (NC Division of Water Resources, 2010). The Falls Lake Nutrient Management Strategy, commonly known as the Falls Lake Rules, were drawn up as a response to its listing after more than a year of input from state and local agencies, conservation groups, elected officials, and concerned citizens. The rules are designed to bring Falls Lake into compliance with federal and state water quality standards by 2041. This means large reductions in nitrogen and phosphorus loads: 40% reduction in nitrogen and 77% reduction in phosphorus from a 2006 baseline. In addition, the Falls Lake Rules provide impetus for regional cooperation on the management of the UNRB by authorizing a 'Falls Lake Watershed Association,' which is charged with providing support for the implementation of the Falls Lake Rules (General Assembly of North Carolina, 2009).

The Falls Lake Rules are designed in two stages, which last for 10 and 15 years, respectively. The first stage (Stage I) of the rules is designed to improve the quality of the lower portion of Falls Lake. This is done by imposing rules on agricultural operations, new development, existing development, and wastewater treatment facilities across the basin (**Table 15**). The first stage was drawn up with the expectation that it will reduce nitrogen pollution by 20% and phosphorus pollution by 40% from the 2006 baseline. The objective of the second stage (Stage II) is to improve the quality of the upper portion of the lake and imposes additional rules to that portion of the lake. This stage involves more stringent requirements and possible mandatory actions or BMPs from the agricultural sector. Stage II is expected to be implemented in 2025 and result in reductions of 40% nitrogen and 77% phosphorus from the 2006 baseline. The rules allow the four primary pollution sources (new and existing development, wastewater treatment facilities, and agricultural operations) to buy offset to help meet reduction targets. However, it is important to note that land conservation (other than buffer restoration) is not considered a way to offset nutrient loads. This is probably due to difficulties in accounting the nutrient reductions of protected land.

Table 15. Falls Lake Rules Requirements (NC Environmental Management Commission, 2010).

Pollution Source	Responsible Party	Goal/Regulation	Approach
Agricultural Operations	Agricultural Operators	Reduce total N by 40% compared to 2006 Reduce total P by 77% compared to 2006 BMPs will be required in Stage II if goal N & P goals are not met	• Create buffer zones • Install exclusion fencing along streams
New Development	Developers	Stormwater management: At least 30%/50% reduction onsite for small/large projects Post-construction N&P rate targets: 2.2 lbs/ac/yr TN and .33 lbs/ac/yr TP Stage I load reduction from existing lands to 2006 baseline by 2021; Stage II requires local government imposed timeframes	• Land disturbance thresholds ½ acre residential; 12,000 sq/ft commercial
Existing Development	Local Governments	Stormwater management: Implement stormwater programs for new development activities that meets nutrient loading rate targets	• Installation of retrofits • Can meet remaining reductions through offset projects or purchase of reduction credits
Wastewater Treatment Facilities	Local Governments	Upper watershed waste water treatment plants will have mass allocations established based on 20% reduction in total N and 40% reduction in total P (Stage I) to be achieved by 2016 Stage II requires mass allocations based on a 40% total N reduction and 77% total P reduction to be achieved by 2036	• Wastewater treatment plant upgrades

Agriculture can play a large role in achieving reductions and can be an important player in a PWS program because Best management practices (BMPs) can provide watershed services and be thought of as green infrastructure. The opportunity to engage the agricultural sector is now, in Stage I of the Falls Lake Rules, before mandatory BMPs are required in Stage II of the Rules. By taking advantage of Stage I's 'collective compliance approach,' the agricultural community can take advantage of agricultural cost share programs to meet the requirements of the Falls Lake Rules before they are required. While evidence indicates buffering and fencing has already been accomplished in the UNRB, the Watershed Oversight Committee, who develops and assists the agricultural community to achieve reductions, is currently identifying other BMPs that could be used for compliance with the Rules (NC DWQ, 2011).

The Planning Section of the Division of Water Quality estimated the costs of Falls Lake Rules compliance and found that the majority of the costs will be paid by local governments. However, developers and those in the agricultural community will also see financial impacts (NC Environmental Management Commission, 2010). Despite its high price tag, the benefits of the Falls Lake Rules are not insignificant. The benefits of the Rules, which include avoided drinking water treatment costs, reduced drinking water treatment costs, recreational benefits, an increase in local economy and property values, upstream reservoir improvements, watershed stream improvements, aquatic life benefits, and Neuse Estuary improvement, has been estimated to surpass a total of $45 million (NC Environmental Management Commission, 2010).

Local governments in the UNRB are also subject to the Neuse Buffer Rules, also known as the Nutrient Sensitive Waters Management Strategy for the Neuse River. These rules also help to drive the current need for water quality protection activities. These rules established a goal of 30% reduction in nitrogen loads and were put in place as a response to the deaths of millions of fish in 1995 caused by large nitrogen loads. The Neuse rules set a baseline riparian buffer width of 50 feet as well as stormwater requirements. Specifically, the Neuse Rules requires jurisdictions to review development proposals to ensure that nitrogen exported from new and re-developments do not exceed 3.6 pounds per acre per year.

However, it is important to note that collaborative water quality protection has occurred in the past without a compliance driver. Coordination of local governments and stakeholders to form the Upper Neuse River Basin Association was driven by the recognition that additional growth and associated land conversion in the UNRB will occur. This spurred the need for coordinated planning efforts in order to ensure that water resources are protected for the long-term (UNRBA, 2003). This organization helped to facilitate cooperation for the Falls Lake Rules and generally, provides a forum for cooperation on water quality protection and water resource planning for the UNRB (UNRBA, 2003).

Though a regulatory driver exists to spur watershed protection in the UNRB to maintain a healthy supply of drinking water, we do not know whether we will be able to meet water quality regulations and targets for the UNRB. If we are unable to meet these goals, what are additional measures that can be adopted to ensure we can continue to have clean drinking water supplies and stream habitat? A payment for watershed services program can work within current regulatory drivers for the long-term benefit of water quality or it can work outside of a regulatory framework to meet the overall goal of high quality water for the future.

KEY ATTRIBUTES

The following key attributes are expected to serve as important points of reference of how well positioned the UNRB is to having a payment for watershed services program.

POTENTIAL SUPPLY OF ENHANCED OR CONTINUED ECOSYSTEM SERVICES

Opportunities for enhancement or maintenance of green infrastructure-based water quality services include land conservation (i.e., avoided conversion) and the implementation of agricultural and stormwater BMPs. According to the Upper Neuse Clean Water Initiative's prioritization of parcels, landowners, land trusts, and developers in Durham County have the highest potential to enhance the watershed services in the UNRB. This is due to Durham County having both the highest percentage of land already protected and the largest area of unprotected land in need of conservation (Hart, 2006). In contrast, Wake County has the second largest area conserved and is not a priority county for land protection. Models show that most of the projected population growth by 2025 will occur in Wake County and the City of Durham (UNRBA, 2003). This will have serious consequences on water quality due to land conversion and highlights the need to lessen adverse effects in the basin.

LAND CONSERVATION

Land conservation is a potential green infrastructure activity that can supply or enhance ecosystem service provision. Based on a collection of data that combined NC Conservation Tax Credit Properties, Land Trust Properties, State Parks, Preserved Farmland, Triangle Open Space, USFWS Wildlife Refuges, and Clean Water Management Trust Fund land acquisition projects, the UNRB has almost 76 square miles of dedicated land for conservation and open space (**Figure 10**). This translates into a little over 12% of protected lands in the UNRB and 88% unprotected. These figures are consistent with a report done by the Trust for Public Land and Tar River Land Conservancy who performed a prioritization analysis of land parcels in the UNRB, which will be discussed in more detail later (Triangle Land Conservancy & Tar River Land Conservancy, 2010).

shows the land use for the remaining unprotected land and shows that forested areas dominate the landscape at around 57%, which is followed by cultivated lands (Pasture/Hay and Cultivated Crops at 20%) and developed/urban areas (15%).

Table 7. Protected area totals in the Upper Neuse River Basin.

Area	Square Miles	% of the UNRB
Falls Lake	**20.6**	**2%**
Lands Managed for Conservation and Open Space (Protected Areas)	**75.9**	**9.8%**
Privately Owned Protected Areas (Land Trusts, Conservation Groups, and Other)	2.9	0.3%
Publicly Owned Protected Areas (Federal, County, Municipal, and State)	73	9.5%
Unprotected Lands	**673.5**	**87.4%**
Total UNRB	770	

Note: "Lands Managed for Conservation and Open Space" are a collection of data on lands that are permanently protected open space and farmland and other lands that are managed as "open space." Data was supplemented with 2011 data on Conservation Tax Credit Properties (NC DENR, 2011).

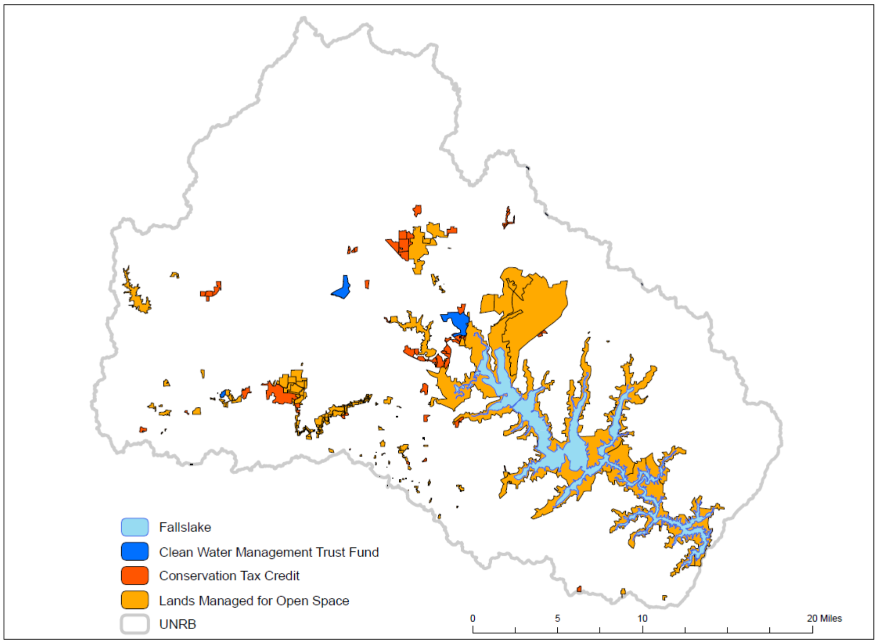

Figure 5. Protected area in the Upper Neuse River Basin.

Table 8. Land use land cover type of unprotected areas in the UNRB.

Land Cover Type	% of UNRB	Square miles
Forest	56.80%	384.5
Pasture/Hay	18.50%	125.1
Grassland/Herbaceous	5.50%	37.1
Shrub/Scrub	1.50%	9.9
Woody Wetlands	1.30%	8.7
Cultivated Crops	0.90%	5.9
Open Water	0.70%	4.4
Developed	14.80%	0.15

Notes: Pasture/Hay are areas defined as grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops. Cultivated crops are areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton—this includes all land being actively tilled (Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, 2011)

It is also important to mention two land prioritization studies that were performed in the UNRB with the goal of identifying lands that would provide benefit to water quality and other conservation values. These provide an assessment of the potential ecosystem services available in the Upper Neuse River Basin from land conservation based on GIS analysis. The first prioritization study was done by the Trust for Public Land (TPL) and the Triangle J Council of Governments (TCJOG) in 2006. The Triangle Land Conservancy and Tar River Land Conservancy prepared the second study in 2010. Both studies were carried out on behalf of the Upper Neuse Clean Water Initiative (UNCWI). While both reports look at critical areas for water quality, the two studies differed. The earlier study focused on general conservation objectives and modeled at a scale larger than parcels, while the most recent study emphasized working forest and included an updated dataset with tax parcels.

The first prioritization by TPL and TJCOG showed that the percent of unprotected land in the UNRB identified as high priority ranged from 3-6% for all counties in the UNRB (**Table 18**). Excluding lands already protected, the model identified 24,000 acres of the land as high priority for conservation to protect water quality in the UNRB. The more recent prioritization in 2010 built upon the 2006 prioritization scheme by modeling the entire watershed based on criteria such as the % of forest cover, % impervious surface, % wetland, drainage density, mean slope, drainage accumulation, the presence of significant natural heritage areas, and the size of core areas (Triangle Land Conservancy & Tar River Land Conservancy, 2010). Based on this analysis, 1,300 land parcels, which make up 57,800 acres or 15% of the UNRB, should be prioritized for conservation in the UNRB because they provide watershed benefits such as water filtration and avoided sedimentation (Triangle Land Conservancy & Tar River Land Conservancy, 2010).

Targeting the prioritized parcels for conservation to provide watershed benefits has potential to deliver a sizable amount of ecosystem services. However, this is not directly quantifiable. No quantitative estimates of nutrient reduction as a result of protecting lands exist. Thus, it is difficult to assess the magnitude of effect land conservation can have on meeting regulatory requirements or organizational goals toward water quality. However, it is clear that benefits can be attained from the conservation of land parcels in the Upper Neuse River Basin.

Table 18. TJCOG and TPL conservation prioritization for water quality benefits (adapted from Hart, 2006).

County	Total Area of County	Total protected area in UNRB	Total Unprotected high-priority land	% of Unprotected areas in the UNRB identified as high priority
Durham	191,360	22,151	6,862	5%
Franklin	316,160	0	157	3%
Granville	343,040	11,775	4,992	6%
Orange	254,720	5,762	5,454	4%
Person	251,072	0	2,585	3%
Wake	549,000	13,631	3,585	6%
TOTAL	1,905,352	53,319	23,635	100%

AGRICULTURAL BEST MANAGEMENT PRACTICES

Where and how BMPs are being implemented in the UNRB are important for assessing the potential supply of ecosystem service delivery available from these actions. It can provide information on whether BMPs would be adequate enough to meet water quality requirements or other grey infrastructure is needed. According to the NC Division of Water Quality, the majority of farms in the Upper Neuse have already voluntarily implemented the nutrient-reducing BMP of maintaining or restoring riparian buffers along waterways (NC Division of Water Quality Planning Section, 2010). This was accomplished in part by the Neuse Rules, which required 50-foot riparian buffers. A 2007 program analysis that assessed the effectiveness of the Neuse Rules, confirmed this notion by citing that when the Neuse Rules program began, 95.5% of the eligible lands in the counties within the UNRB (Durham, Franklin, Granville, Orange, Person, and Wake county) already implemented riparian buffers (Wittenborn & Moreau, 2007)). These eligible BMPs were implementing buffers (nitrogen removal credits depends on the size), water control structures, nutrient management (such as reducing nitrogen fertilizer), and use of cover crops. According to the authors, at the end of the program in 2003, the six counties had a regional average of 98% of farmland treated by riparian buffers and other BMPs deemed eligible the Neuse Rules in 2003 (Wittenborn &

Moreau, 2007)). In addition, all six counties reduced their average nitrogen application rates with an average reduction of 15%. (Note: the results of this analysis are presented on a county basis because these were the units of the analysis).

Various BMPs have been implemented in the UNRB to address the Neuse Rule and according to measurements using the Nitrogen Loss Estimation Worksheet provided by the state, the Neuse Rules have been very successful in achieving the 30% nitrogen loss reduction target for agricultural lands (Wittenborn & Moreau, 2007). Another result from this study is a survey, which showed that 35% of farmer respondents were 'somewhat likely' and 51% of farmer respondents were 'very likely' to use the same BMPs without the rules in place (Wittenborn & Moreau, 2007). This suggests that a payment for watershed services program should not include riparian buffers as a BMP to help meet water quality needs because it has already largely been accomplished. Currently, the Watershed Oversight Committee, which is authorized by the Falls Lake Rules to support the agricultural community's compliance to the rules, is working to identify other best management practices that may be eligible as a nutrient reduction credit to expand on opportunities. This would help address the diminishing BMP opportunities in Stage I of the rules.

AMPLE SUPPLY OF SELLERS

In total, the UNRB contains 119,000 parcels with an estimate of around 87,000 landowners (North Carolina Tax Parcel data). The exact number of farmers and landowners is unknown and requires a more detailed analysis. However, below are estimates of the number of farmers in the UNRB based on the counties that lie within the watershed (Table 19). Note that these values do not provide an indication of where this productive cropland is located. Overall, there is a sizable farmer population in counties that intersect the Upper Neuse watershed. However, there has been a trend towards decreasing numbers of farms and the amount of land in farms since 2005 as well as an increase in the average size of farms by two-fold since 2005 (NC Department of Agriculture and Consumer Services, 2007). These trends are important when planning a payment for watershed services program involving farmers because it can affect the additionality of BMPs used as offsets and may result in a higher potential for land conversion to impervious surface.

Table 9. Farmland in the UNRB by county (NC Department of Agriculture and Consumer Services, 2007).

County	Acres County	# Farms	Total Farm Acres	Average Farm Size	% in the basin
Durham	183,022	242	26,150	108	27%
Franklin	314,701	593	112,871	190	1%
Granville	339,838	673	128,366	191	17%
Orange	254,462	604	60,057	99	25%
Person	251,069	403	98,521	244	17%
Wake	532,415	827	84,956	103	13%

In addition, UNCWI identified that there are 1,300 land parcels that would provide water quality benefits if conserved, which makes up 57,800 acres or 15% of the watershed (Triangle Land Conservancy & Tar River Land Conservancy, 2010). Although it is unclear how many landowners own the 1,300 parcels, it is expected that intermediaries such as land trusts and the soil and water conservation districts can help facilitate and build relationships to educate landowners about 'selling' or donating the ecosystem services their land provides. Overall, the supply of sellers is relatively unclear in the UNRB. While land protection can provide critical water quality benefits, it is unclear whether an adequate supply of willing landowners exists.

AMPLE SUPPLY OF BUYERS/DEMAND FOR SERVICE

The demand for best management practices and land acquisition to obtain watershed benefits is currently driven by the Falls Lake Rules. Local governments and developers meeting the nitrogen and phosphorus reductions in the rules can buy offsets, which can be negotiated to be best management practices. In a payment for watershed services program, the expectation is that demand for ecosystem services will be driven in large part by local governments. This will be dependent on which BMPs are accounted for in nutrient reduction requirements or the overall strategies local governments design to meet their water quality goals.

However, there has also been increasing awareness of water quality benefits from land conservation and land trusts have been negotiating conservation easements for this purpose as well as for other benefits. Land trusts active in the UNRB include: the Conservation Trust for North Carolina, Eno River Association, Ellerbe Creek Watershed Association, Triangle Greenways Council, Triangle Land Conservancy, and Tar River Land Conservancy. These organizations make a small portion of the supply of buyers in the UNRB. In addition, Raleigh and Durham's watershed fees fund conservation and also share a small portion of the supply of buyers in the UNRB. Specifically, Raleigh has an annual budget of $1.8 million for land conservation, which it collaborates with land trusts to do, and Durham has an annual budget between $200,000 and $500,000 for land conservation. These efforts provide a picture of the current demand outside of a regulatory driver. Demand for green infrastructure from the non-profit sector and watershed fees have the potential to strengthen and increase through the long-term if they can be sustained by steady revenue streams.

MONITORING AND EVALUATION SYSTEMS IN PLACE

The final assessment of the Falls Lake Rules will be centered on a performance-based evaluation because ultimately, the nutrient management strategy should bring the lake back into compliance by 2041. The Falls Lake accounting tool was developed by North Carolina State University in coordination with NCDENR to be used as a monitoring and evaluation tool for existing and new development to be in compliance with the Falls Lake Rules. This accounting tool is identical to the tool being used in the Jordan Watershed, which is an updated version of the Tar-Pamlico tool. Currently, this tool is only useful for accounting for nutrient loads for new and existing development. Tracking and accounting methods for nitrogen and phosphorus loading for agriculture are planned for late spring 2012 (NC DWQ, 2012). Wastewater treatment plants nutrient loads will be accounted for through NPDES permits.

The Triangle Area Water Supply Monitoring Project was formed with the assistance of the TJCOG and the US Geological Survey (USGS & TJCOG, 2012). The Project has tracked water quality and quantity conditions and trends in many of the Triangle area's water supply reservoir. It is currently doing work to expand a water quality database for major ions, nutrients, sediments, and trace elements, collect water quality data at tributary sites; investigate mercury content in water and sediment; maintain current stream gages; and publish water quality trends for data collected in 2007. With monitoring sites along Little River, Eno River, Flat River as well as the upper and lower portions of Falls Lake, this project provides detailed water quality monitoring data for the UNRB.

However, there are no systematic monitoring programs in place for all programs in the watershed. For example, the North Carolina Ecosystem Enhancement Program does not monitor the effectiveness of individual BMPs and activities.

TRANSACTION COSTS

As intermediaries, land trusts, soil and water conservation districts, and environmental organizations can reduce transaction costs by bringing together buyers and sellers in a payment for watershed services program. However, on a basin-wide scale there are currently very little known tools specific to the UNRB to facilitate or encourage transactions for PWS programs. Future tools such as LandServer (landserver.org) may be useful in reducing the high upfront costs for enrolling in payment for ecosystem service programs.

CONFLICTING PROGRAMS AND GOALS

The Falls Lake Rules threaten compulsory agriculture BMPs should reductions not be met in Stage I of the rules. Compulsory BMPs would go into effect in Phase II and this would remove the possibility of cost-share programs because state and federal cost-share programs as well as other voluntary payment programs would not want to pay for BMPs mandated by regulations.

PROGRAM ADMINISTRATION

There have been steps towards regional cooperation to fix Falls Lake. For example, Durham, Hillsborough, and Raleigh already participate in water transfers with one another as they plan for future growth. In the section below, we highlight supporting organizations and initiatives in the Upper Neuse watershed that bring stakeholders together. As an already existing collaborative body, the Upper Neuse River Basin Association may be well positioned to implement a payment for watershed services program. However, only local governments are included in that initiative. Alternatively, the Triangle J Council of Governments can help facilitate a payment program. It already has experience in facilitating partnerships such as the Clean Water Education Program and is usually in favor of slower processes. However, it also has a local government focus although it has the ability to include supporting organizations such as land trusts and environmental organizations in its partnerships (CWEP, 2012).

SUPPORTING ORGANIZATIONS AND INITIATIVES

Upper Neuse Clean Water Initiative (UNCWI)

UNCWI was formed in 2005 as a response to growing development pressures on the region's water quality and quantity. This organization takes advantage of the opportunity to utilize land conservation as an effective practice in conserving the area's water supplies. UNCWI is a partnership effort to prioritize and protect those lands most critical for the long-term health of all drinking water supplies in the Basin. Partners include seven land trusts, watershed associations, local government, landowners, utilities, state agencies, elected officials and more (Triangle Land Conservancy & Tar River Land Conservancy, 2010).

Upper Neuse River Basin Association (UNRBA)

Formed in 1996, the UNRBA provided a forum for cooperation on water quality protection and water resource planning for the UNRBA. With the implementation of the Falls Lake Rules in 2011, its mandate was re-articulated and its name was changed to the Falls Lake Watershed Association, which is described below. The Town of Roxboro was the only local government in the UNRB that did not participate in this body (UNRBA, 2003; UNRBA Board of Directors, 2011).

Falls Lake Watershed Association

As of February 2011, the Upper Neuse River Basin also “operates under the assumed name of the Falls Lake Watershed Association” (UNRBA Board of Directors, 2011). This change signaled support for regional cooperation on the management of the Falls Lake watershed (or the Upper Neuse River Basin) and was authorized by the General Assembly under Session Law 2010-155. Subsequently, the UNRBA revised its bylaws to reflect this change and has started to consider the goals of the Falls Lake Rules especially those related to Stage II (Upper Neuse River Basin Association, 2011). The organization’s goals were re-articulated as a non-profit corporation that “assists its member local governments in their efforts to jointly address issues of concern to member local governments relating to water quality and waste water management in the Upper Neuse River Basin.” Overall, this body is authorized by North Carolina General Statutes. It provides a forum for sharing information pertaining to the UNRB, a mechanism for governments to coordinate and fund technical common resources, and a public forum to review and discuss innovative approaches to restoring, protecting, and maintaining water quality in the UNRB. However, non-profit and other advocacy groups are not included as members of the Falls Lake Watershed Association. It is unclear whether the Falls Lake Watershed Association is a clear transition from the UNRBA. Currently, the UNRBA exists as two names (UNRBA and Falls Lake Watershed Association). The UNRBA has modified its bylaws to incorporate the goals of the Falls Lake Watershed Association as specified by Session Law 2010-155, but has not itself dissolved as an organization (General Assembly of North Carolina, 2009).

Triangle J Council of Governments

TJCOG is a regional council of municipal and county governments in Chatham, Durham, Johnston, Lee, Moore, Orange, and Wake counties. Subprograms and projects are managed within this organization such as the Neuse River Basin Watershed Strategy. More recently, TJCOG was instrumental in the Falls Lake Stakeholder Project, which was the primary venue in which stakeholders were engaged in development of the Falls Lake nutrient strategy (NC Division of Water Quality, 2009).

Triangle Urban Long Term Research Area (ULTRA)

Triangle ULTRA is a collaborative project that is funded by the National Science Foundation and the USDA Forest Service. Its purpose is to bring together researchers from NC State University, UNC-Chapel Hill, Duke University, and the Triangle J Council of Governments in order to analyze the connections between people and the environment in the Triangle region of North Carolina. Most recently, Triangle ULTRA has brought stakeholders together to investigate effective ways to manage environmental resources such as water using an ecosystem services approach (Triangle ULTRA, 2012).

Conservation Trust for North Carolina

The Conservation Trust for North Carolina (CTNC) is a land trust that has the mission of protecting North Carolina’s land and water through direct efforts with willing landowners and in partnership with the state’s local and regional and trusts. CTNC works to protect land within the Upper Neuse River Basin and is part of the Upper Neuse Clean Water Initiative (CTNC, 2012).

Ellerbe Creek Watershed Association

The Ellerbe Creek Water Association is dedicated to restoring Ellerbe Creek in order to make it an asset for the citizens of Durham. It fulfills its mission through efforts such as restoration and land acquisition. ECWA involves volunteers in the monitoring of water quality in Ellerbe Creek through a Stream Watch Program. Overall, its efforts contribute to the watershed protection in its larger UNRB watershed (ECWA, 2003).

Eno River Association

The Eno River Association's mission is to conserve and protect the natural, cultural, and historic resources of the Eno River basin. As a land trust, the Association acquires lands and waters along the Eno River and its tributaries. Many of these tributaries are located in the UNRB and contribute to water quality in the basin (Eno River Association, 2012).

Triangle Land Conservancy

The Triangle Land Conservancy (TLC) is a land trust in the Triangle that has been protecting open space such as stream corridors, forests, wildlife habitat, farmland, and natural areas in Chatham, Durham, Johnston, Lee, Orange, and Wake counties. In the UNRB, TLC helps implement the Upper Neuse Clean Water Initiative (UNCWI) through land owner outreach and the conservation of priority lands for water quality (NC Division of Water Quality, 2009).

Triangle Greenways Council

The Triangle Greenways Council is an advocacy group that promotes greenways in the RTP area. The Council has been involved in efforts to design a riparian corridor in the UNRB. The goal of the design project is to prioritize and identify areas where preservation and restoration projects would have the greatest positive effect on water quality (Triangle Greenways Council, 2012).

Neuse Riverkeeper Foundation

The Neuse Riverkeeper Foundation is a nonprofit that protects, restores, and preserves the Neuse River basin through education, advocacy, and enforcement. Its vision is to develop innovative programs that foster and sustain education, stewardship and watershed initiatives and practices. Targeting the larger area of the Neuse River Basin, its efforts incorporate the UNRB (NC Division of Water Quality, 2009).

SUPPORTING LAWS/REGULATIONS/ADMINISTRATIVE RULES

Laws and regulations related to watershed protection usually include zoning overlays near water bodies with special development restrictions, soil erosion control permits for construction sites, prohibiting development within floodplains, stormwater BMPs for new and existing development, and finally, forbidding discharges into storm and sewer systems.

The list below provides a sample of local laws administered by different jurisdictions within the UNRB to provide a glimpse of how rules differ and the regulatory efforts taken by local governments toward the goal of watershed protection. It also includes two important laws that drove the cleanup of Falls Lake (Clean Lakes Act). The information was compiled from various assessments, local government websites, and a database of local regulations from NC Cooperative Extension (Dreps & Bearden, 2004; Hart, 2006; NC Cooperative Extension, 2012; TJCOG, 2011).

Stream Buffer Rules

Creedmoor, the City of Durham, Durham County, Franklin County, Granville County, Hillsborough, Orange County, Person County, Raleigh, and Wake County, all have stream buffer ordinances; the minimum buffer is a 50-foot wide riparian buffer adjacent to surface waters in the entire Neuse River Basin.

Person, Granville, and Wake Counties have a stream buffer minimum width of at least 75 feet.

Durham and Orange counties have stronger riparian buffer protection rules than surrounding counties in the Upper Neuse. In Orange County, all intermittent and perennial streams and flood plains must have a buffer of at least 65 feet on either side. Depending on the slope of the surrounding lands, the buffer can be up to 150 feet. In Durham County, streams must have buffers of 50 to 150 on either side and its reservoirs must have a buffer of 250 feet.

Creedmoor requires a minimum of 200 feet undisturbed vegetative buffer around new development activities in Lake Rogers (drinking water reservoir).

Falls Lake and the entire Neuse River Basin are bound to the Neuse Buffer Rule which was designed to protect and maintain existing riparian buffers for nutrient management (NC Department of Water Quality, 1997). 50-foot riparian buffers are prescribed and defined as having two distinct zones. Zone one must be at least thirty feet wide, vegetated and left undisturbed. Zone two must be at least twenty feet wide, but management for timber, grazing, and re-vegetation is allowed. This is consistent with the recommendations for SMZ width for maintaining water quality made by the NC Department of Forestry.

Soil Erosion Control

In Raleigh, all sites with a land-disturbing activity more than 12,000 square-feet must obtain a permit and meet with a soil conservation inspector if requested to do so; an inspector must inspect soil and erosion control devices before any grading activity can occur.

Durham also requires permits for any disturbance over 12,000 square feet.

In Wake County, permits are required for all sites that disturb more than one acre (43,560 square feet).

In Orange County, all building permits are required to undergo review by the Orange County Erosion Control; a permit is required if more than 20,000 square feet of land is disturbed, however, in the Upper Eno watershed, this threshold is smaller at 10,000 square feet.

Floodplain Protections

Wake County and the City of Durham do not allow new development in 100-year floodplains

Orange County restricts development in floodplains near its headwaters.

Hillsborough and Person County do not have floodplain management ordinances that restrict development in the 100-year floodplain.

Stormwater Rules

Orange County stipulates that flows must be diffused before entering a stream buffer and sometimes stormwater BMPs are required to prevent gullying.

Franklin County, Person County, and Wake County do not allow bioretention islands and other stormwater BMPs within landscaped areas or setbacks.

Only the City of Durham, Durham County, and Raleigh in the UNRB require that stormwater be treated before it is discharged.

Federal NPDES Phase II Rules

The National Pollutant Discharge Elimination System (NPDES) is a point source pollution permitting program designed as a part of the 1972 Clean Water Act. Municipalities in the Upper Neuse River Basin are subject to NPDES Phase II Rules, which require six minimum control measure: public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention (TJCOG, 2011).

NC Clean Lakes Act

In 2005, the North Carolina General Assembly enacted SL 2005-190 (SB 981), Clean Lakes Act, which directed the NC Environmental Management Commission (EMC) to develop and adopt a nutrient management strategy to reduce nitrogen and phosphorus pollution in Falls Lake by July 1, 2008 (later extended to July 1, 2009).

Improve Upper Neuse Water Quality

In 2009, the General Assembly enacted SL 2009-486 (SB 1020, Improve Upper Neuse Water Quality), which extended the deadline for the NC Clean Lakes Act until January 15, 2011 and also allowed for a system crediting early adoption of nutrient reductions and required stricter sedimentation and erosion control measures in the watershed.

WATERSHED PROTECTION PROGRAMS IN THE UNRB

There are a number of initiatives in the Upper Neuse with the goal of watershed protection. A few of these programs are highlighted below.

City of Durham Rain Catchers Project

In early 2012, the City of Durham launched a pilot program to provide free rain gardens and other backyard stormwater practices for the purpose of enhancing property values while at the same time improving water quality for nearby streams and lakes. These pilot projects are also hoped to aid the City in meeting its nutrient management requirements in the Falls and Jordan Lake Rules. These projects are funded by grants through the Clean Water Management Trust Fund and the North Carolina Division of Water Quality (City of Durham, 2012).

City of Raleigh Water Quality Cost Share Program

Raleigh offers a Water Quality Cost Share Program to homeowners, businesses, and public or government agencies that want to improve the quality of the stormwater runoff their party. Examples of projects that are funded and considered to improve the water quality of Raleigh's streams and lakes include cisterns, green roofs, rain gardens, bioretention devices, and permeable pavement (City of Raleigh, 2012).

Healthy Watersheds through Healthy Forests Initiative

The Conservation Trust for North Carolina (CTNC) was one of three partners selected by the US Endowment for Forest and Communities to participate in the Healthy Watersheds through Healthy Forests Initiative. As part of the initiative, CTNC is investing $6 million in three watersheds including the Upper Neuse River Basin to promote forest health and clean drinking water (Conservation Trust for North Carolina, 2010).

Orange County Lands Legacy Program

In April 2000, Orange County enacted an acquisition program to protect important natural and cultural resources called the "Lands Legacy Program." This program leverages local funds with state and federal dollars to acquire land through outright purchase, donation, or conservation easements. A priority for land acquisition is protecting watershed riparian buffers (Orange County DEAPR, 2010).

UNCWI: City of Creedmoor and City of Raleigh Fontaine Project

In early 2010, the Creedmoor along with Raleigh protected 165 acres adjoining the Neuse River. This project leveraged funding from the Clean Water Management Task Force, former property owners, Raleigh, Creedmoor, and the Upper Neuse Clean Water Initiative (City of Creedmoor, 2010).

Clean Water Education Partnership

The Clean Water Education Partnership is a cooperative effort between local governments, state agencies, and nonprofit organizations in the Tar-Pamlico, Neuse, and Cape Fear River Basins with the goal of protecting North Carolina's waterways from stormwater pollution through public education and outreach. This partnership provides information and education to those affecting water quality in the three basins on topics such as the sources of stormwater pollution and the effects of stormwater pollution. This is done through a variety of mediums such as television, radio, cinema, print, and website outreach.

FUNDING OPPORTUNITIES FOR WATERSHED PROTECTION IN THE UNRB

There are already a variety of funding opportunities in the UNRB for the purpose of watershed protection. This section begins by document local funding for watershed protection, such as watershed fees in the cities of Raleigh and Durham, and then moves on to state and federal funding dedicated for watershed protection. This information will be important for addressing the permanence and sustainability of funding mechanisms for water protection in the UNRB. Federal programs have already been discussed on page 27.

LOCAL FUNDING FOR WATERSHED PROTECTION

In the Triangle area of North Carolina, local governments have been discussing various scenarios for funding upstream land conservation through watershed protection fees. Currently, the main sources of watershed protection funding available locally are the watershed fees from the city of Raleigh and the city of Durham.

WATERSHED FEES

On May 3, 2011 the City of Raleigh voted to support a $0.01/100 gallon fee for watershed protection, a program modeled on the success of Rhode Island's watershed protection fee passed in 1994. The "Penny per Hundred program" requires that water suppliers spend at least 55% of the revenue generated by the fee on direct land conservation and acquisition. Alternative uses for the funds include facility upgrades, water main maintenance, non-point source pollution and run off prevention programs, and water conservation education. The RI program has generated $18,343,382 since its inception, protecting 2,410 acres in state watersheds. The Raleigh fee is expected to generate $1.8 million per year; individual households should not see more than a $0.40 increase in their monthly bill (Brice, 2011). The funds will go towards land protection and conservation managed by the Conservation Trust of North Carolina, and the Upper Neuse Clean Water Initiative. Durham has also instituted a similar fund, which generates an additional $100,000 per year to a total appropriation fund for watershed protection that total $200,000 to $500,000 per year (Correspondence with Vicki Westbrook, 2012).

STATE FUNDING OPPORTUNITIES FOR WATERSHED PROTECTION

The following section provides information on the major funding opportunities provided by the state of North Carolina.

NORTH CAROLINA TRUST FUNDS

North Carolina Clean Water Management Trust Fund

- The Clean Water Management Trust Fund (CWMTF) was stabled by the General Assembly in 1996 for the purpose of issuing grants to local governments, state agencies, and conservation non-profits to provide additional finance for water pollution problems. Projects should enhance or restore degraded waters, protect unpolluted waters, and/or contribute to a network of riparian buffers and greenways for environment, educational, and recreational benefits. However, this fund has gradually received fewer funds; for example, only $11.25 million was allocated to the trust fund in 2011, which was an $88.75 million reduction from its $100 million authorized budget. To date, grants have led to the protection of more than 454,375 acres of land protection in important watersheds and 4,863 miles of riparian buffers (CWMTF, 2012).

North Carolina Natural Heritage Trust Fund

- This trust fund provides additional funding for select state agencies to acquire and protect lands for important natural areas, preserve the state's ecological diversity and cultural heritage, and to inventory the natural heritage resources of the state. The trust fund acquires its allocation from 25% of the state's tax on real estate deed transfers and fees for personalized license plates, which amounts to about $12 million annually. Conservation of natural heritage lands provides water quality benefits in addition to wildlife habitat and recreational opportunities. The program has resulted in about 298,000 acres of land conservation (NC Natural Heritage Trust Fund, 2012).

North Carolina Parks and Recreation Trust Fund

- In 1994, the General Assembly established the Parks and Recreation Trust Fund (PARTF) for the purpose of funding improvements in North Carolina's park system such as operating expenses and capital improvements; funding grants for local governments for capital projects, repairs, renovation of facilities, creation of new parks, or land acquisition; and funding the Coastal and Estuarine Water Beach Access Program. It is a state grant program for local governments and is administered by the Division of Parks and Recreation. In 2011, PARTF awarded $8.7 million to 30 projects across the state (NC PARTF, 2012).

North Carolina Agricultural Development and Farmland Preservation Trust Fund

- The establishment of this trust fund in 2005 was driven by the loss of 1 million acres of forestland and 600,000 acres of farmland between 1990 and 2002. The purpose of the Agricultural Development and Farmland Preservation Trust Fund is to provide support to farming, forestry, and horticulture communities in North Carolina through supporting the purchase of agricultural conservation easements, funding public and private enterprises to promote profitable and sustainable family farms, and funding conservation agreements on active farm, forest, and horticulture lands. ADFP had an initial appropriation of $50,000 from the General Assembly. In 2008, this allocation increased to $8 million and then was decreased to half at $4 million dollars the next year. Since 2010, it has decreased to a steady allocation of $2 million. To date 34 easements have been funded and 6,204 acres of farms have been protected (NC ADFP Trust Fund, 2012).

COST-SHARE PROGRAMS

NC Agricultural Cost-Share Program

- Administered by the Division of Water Quality in the Dept. of Environment and Natural Resources. Provides cost-share assistance to farmers for the installation of BMPs on land that contributes to within three years of the contract being approved. Practice must be maintained for 10 years.

Partners for Fish and Wildlife in North Carolina

- The Partners for Fish and Wildlife in North Carolina is a program that provides technical assistance like habitat and enhancement recommendations and planning. It is geared towards improvements of habitats for threatened or endangered species, migratory birds, or other declining species, which can have peripheral, but important effects on watershed services. They also provide financial assistance for restoration efforts. Since the inception of this program in 1998, around 15,000 acres of upland and bottom land habitat and 30 miles of streams have been restored through North Carolina.

MITIGATION PROGRAMS

Tar-Pamlico Nutrient Trading

- For Phase III of this program, the parties agree to use the final Phase II end of pipe nitrogen cap of 426,782 kg TN and the final phosphorus cap of 73,694 kg TP. If loading exceeds either cap in any year of this Agreement, then the Association shall offset the amount exceeded by funding nonpoint source nutrient controls. Funds go to the Agricultural Cost Share Program for Nonpoint Source Pollution Control.

NC Ecosystem Enhancement Program (NCEEP)

- NCEEP is designed to restore, enhance, preserve, and protect the functions of wetlands, streams, and riparian areas required by the NC Wetlands Restoration Program Act. Funded by NC Dept. of

Transportation in return for compensatory mitigation credits, EEP functions in order to mitigate unavoidable functional losses to wetlands and riparian buffers from transportation improvements and other economic development activities. In this program, landowners can enroll their land, which should be a stream or wetland site, in a conservation easement for compensation, sell their land, or donate it. Usually site identification and mitigation procurement activities occur through full delivery providers, an NC EEP partner (like a conservation group), or a project manager.

NC Ecosystem Enhancement Program's Nutrient Offset Program

- NC EEP's Nutrient Offset Program was developed in order to assist developers in meeting their nutrient load requirements. Before receiving official site-plan approval from the local government, a developer must calculate the anticipated nutrient loading. If this total is over the allowable threshold, then the excess loading must be offset or mitigated through a mitigation bank. EEP uses an extensive planning process to secure mitigation through a full-delivery process and bidding process. Landowners are either contracted an EEP project manager, a full delivery provider, a partner, or would initiate the contact themselves. EEP doesn't typically purchase "credits" from landowners, but through a provider or partner such as a conservation group.

NORTH CAROLINA CONSERVATION TAX CREDIT

North Carolina registered the importance of land conservation partly through the NC Conservation Tax Credit Program, which provides landowners who donate their land for a conservation easement or fee simple deed a tax credit to apply against their state income taxes. Up to $250,000 can be credited for individuals and up to $500,000 can be credited to corporations. This value is determined by calculating 25% of the fair market value donated for conservation purposes (NCDENR, 2012).

MUNICIPAL BONDS

Wake County Open Space Program

- In November 2000, county voters approved a $15 million bond and four years later voters approved a second bond for $26 million to the Open Space Program. This program protects land as open space through direct land acquisition or matching funds to partnering organizations for easements or land acquisition in 11 identified acquisition corridors. The Upper Neuse River basin is in one of these corridors. To date, 11 of 12 municipal governments have received county grants (Wake County Government, 2012).

ALIGNMENT RESULTS AND DISCUSSION

Information compiled from the fifteen case studies were completed in their respective score cards and detailed in Appendix C of this report. Alignment scoring compares case studies to the UNRB context previously described. Table 20 below, which provides the relative alignment rankings (1 being least aligned to 5 being most aligned) as bars for each case study and its related attribute ranking in comparison with the UNRB. The most aligned case studies can be seen with the longest yellow 'Total' bar on the horizontal axis while the most aligned attributes can be seen in the yellow 'Total' bar on the vertical axis.

Table 10. Alignment results for examined case studies.

	Case Studies															
	Burlington	Tualatin	Boston	NYC	Raritan	San Antonio	Syracuse	Portland	Salt Lake City	Mountain Island Lake	Great Miami	Pine Barrens Credit	Maryland	Conestoga	Upper Tallapoosa	Total
Payment Type	Gov. PWS	Market	Gov. PWS	Gov. PWS	Gov. PWS	Gov. PWS	Gov. PWS	Gov. PWS	Gov. PWS	Gov. PWS	Market	Market (TDR)	Gov. PWS	Non-Gov. PWS	Gov. PWS	
Designated Payment Source	State Grants and Bonds	Point Sources	Utilty Fee	City General Fund	Utility Fee	Sales Tax	General Fund and Federal Programs	Utilitity Revenue	Utility Fee	State Grants, Local Bonds, Utility Fee	Point Sources	Developers	General Fund	Federal Grant	State Funding and Local Sales Tax	
Program Attributes																
Scale																
Beneficiaries																
Permanence and Sustainability																
Participants																
Water Source Type																
Government Utility Coord																
Monitoring and Evaluation																
Biophysical characteristics																
Program Administration																
Jurisdictional Alignment																
Watershed Size																
Drivers																
Practice or Performance																
Total																

Case study alignment rankings revealed six primary inferences relevant to the UNRB:

1. **Burlington and Tualatin provide strong program models.**
2. **UNRB has a unique watershed size and is well positioned for scaling up current PWS programs.**
3. **PWS programs can be administered at several levels; there is flexibility for the UNRB to structure administration as is most politically feasible Beneficiaries were similar across case studies and with the UNRB.**
4. **Beneficiaries and scale were similar across case studies and to the UNRB.**
5. **No payment mechanism arises as best aligned for the UNRB situation.**
6. **Drivers of PWS programs vary and with it, so do measurements of success.**

Each of these inferences, or "takeaways," are described in more detail below.

1. **Burlington, and Tualatin provide strong program models.** The case studies that best aligned with the UNRB context were Burlington and Tualatin with total alignment scores of 52 and 50 respectively (totals come from the sum of scored attributes, seen on the score cards). Burlington is an example of a PWS program that crosses state as well as country boundaries, Vermont, New York, and Quebec all work together to administer the watershed level PWS program. The Lake Champlain Basin Program is a formalized watershed organization that coordinates efforts between involved governments. Although Tualatin is a water temperature trading program model, it seems that the majority of examined attributes for this program align well with of the Upper Neuse River Basin, which focuses on water quality. The program relies on government utilities as the primary buyers, and local landowners as primary sellers. Additionally, the size of Tualatin's watershed is very similar to the UNRB suggesting its development could be modeled and built upon in the UNRB. These results suggest that the Burlington and Tualatin programs could provide strong models for an Upper Neuse River Basin program, whereby program designers in the UNRB could learn much from those programs' experiences. We suggest that UNRB program designers consult with representatives of these highly aligned programs for guidance before moving forward with PWS program development in the UNRB.

2. **UNRB has a unique watershed size**
   Many case studies' watershed sizes differ from that of the UNRB by an order of magnitude or more. The Syracuse and Upper Little Tallapoosa program areas are much smaller than the UNRB, while the New York City and San Antonio program areas are significantly larger. Should the UNRB's watershed size lie far outside the observed range (smaller than the smallest case study or larger than the largest); we may perhaps surmise that the exceedingly large or small size of the UNRB watershed could introduce challenges to the implementation of a successful PWS program. However, because the UNRB watershed size lies safely within the observed watershed size range, we conclude that, despite the lack of case studies that share UNRB's watershed size, the unique size of the UNRB watershed may not hinder the success of a PWS program.[1]

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[1] It should also be noted that the "watershed size" attribute was a "basic program characteristic," not a "key attribute"

Table 11. Watershed sizes and program administration characteristics of the examined case studies.

Area/Program	Program Size (sq miles)	Program Administration
UNRB	**770**	**Watershed-level governing body**
Mountain Island Lake, North Carolina	69	Cooperation between major players is represented by a watershed level organization that is not a governing body
Syracuse, New York	72	Unilateral administration*
U. Tallapoosa, Georgia	95	Unilateral administration*
Pine Barrens, New York	160	Cooperation among major players
Boston, Massachusetts	185	Watershed-level governing body
Salt Lake City, Utah	185	Cooperation between government utilities (primarily Salt Lake City Utility)
Portland, Maine	361	Cooperation among major players
MD Dept of Natural Resources	444	Cooperation between major players
Raritan, New Jersey	468	Cooperation among major players
Conestoga, Pennsylvania	475	Cooperation among major players
Tualatin, Oregon	712	Cooperation among major players
New York City, New York	1,900	Unilateral administration*
Greater Miami, Ohio	4,000	Watershed level governing body
San Antonio, Texas	5,400[2]	Cooperation among major players
Burlington, Vermont	8,243	Watershed level governing body

* If the watershed composes only one jurisdiction (city or county) and the program was administered by this one jurisdiction, then the program administration was assigned as "unilateral administration" not "watershed-level governing body."

3. **PWS programs can be administered at several levels; there is flexibility for the UNRB to structure administration that is most politically feasible.** The second attribute that varied greatly among the case studies and UNRB was the geopolitical level at which the program was administered. Table 21 details the program administration structure for each examined case study. Given the many county and municipal jurisdictions in the UNRB, we decided that a watershed-level governing body would be most appropriate for a UNRB PWS program. The only other observed case studies to display such a comprehensive level of program administration within a multi-jurisdictional watershed were the Burlington and Boston case studies. The other case studies either displayed unilateral administration, in which only one governmental or non-governmental entity administered the program, or cooperation among major players, in which each of many governmental or non-governmental entities played a role in administering the program, with no clear head administrator overseeing those entities. Implications of these results are twofold: 1) It is rare to see a situation in which one clear administrative body oversees an entire watershed, and 2) because programs have been successful without a watershed-level governing body, perhaps this administrative structure is not required for a successful UNRB PWS program. We suggest that UNRB stakeholders consult with representatives from the two most relevant programs, Burlington and Tualatin, to discuss the relative merits of the two administrative structures used in inter-jurisdictional programs.

[2] This area describes the size lands ultimately draining to the underlying aquifer.

4. **Beneficiaries and scale were similar across case studies and to the UNRB.** The most similar attribute to the UNRB across all case studies was the scale, shortly followed by the beneficiaries of a PWS program – those that will benefit monetarily from the increased provision of the watershed service. Scale was consistently at the watershed level while the size of the watershed was not as important (not well aligned), and there was much variation between case studies. We estimate the beneficiaries in the UNRB to be public water utilities and local city governments, as these entities will realize reduced Falls Lake Rules compliance costs. Public water utilities were also the primary beneficiaries in almost all of the case studies examined. This similarity suggests that the UNRB is well positioned in terms of its watershed services beneficiaries to develop a successful PWS program.

Table 12. Beneficiaries of the examined case studies.

Area/Program	Beneficiaries
UNRB	**Public water utilities**
Syracuse, New York	City of Syracuse and portions of towns around periphery along with their residents and businesses
U. Tallapoosa	Series of small public utilities; 30,000 residents
Boston, Massachusetts	2.2 million who live in Boston region and 5,500 industrial users
Conestoga, New York	55% public water suppliers and 22% unregistered water use points
Tualatin, Oregon	Clean Water Services public utility; 520,000 water customers and 12 cities
New York City, New York	New York City Water System; 9 million residents in NYC and 1 million in suburbs
San Antonio, Texas	San Antonio Water System (SAWS) serves 1.2 million drinking water customers
Maryland	Public water utilities serving 3 million residents
Burlington, Vermont	Water utilities in VT, NY and Quebec participate in the program- over 100 government utilities in all.
Raritan, New Jersey	NJ Water Supply Authority, NJ Environmental Infrastructure Trust, 1.3 drinking water customers
Salt Lake City, Utah	Salt Lake City Public Utility directly serves 500,000 county residents and sells to utilities in surrounding areas.
Great Miami, Ohio	Water quality in the Mississippi River (downstream) and the Gulf of Mexico is the targeted benefit of this landscape scale program
Pine Barrens, New York	1.4 million residents dependent on drinking water protected by transfer of development rights cooperation between 3 counties
Portland, Maine	Portland Water District serves over 190,000 customers in 11 communities
Mountain Island Lake, North Carolina	City of Charlotte Dept of Water & Sewer serves more than 720,000 water customers in 3 counties and 1 major city

5. **No payment mechanism arises as best aligned to the UNRB situation.** To assess which payment mechanism (taxes, utility fees, grants, markets, etc.) may be most appropriate for the UNRB, we examined the payment mechanisms of those case studies which best aligned with the UNRB. The top three case studies – Burlington, Tualatin, and Boston – each use a different payment mechanism – state grants and bonds, point-nonpoint trading, and a utility fee, respectively. We therefore were not able to arrive at a clear recommendation for the ideal payment structure for the UNRB. The lack of a clear frontrunner perhaps suggests that no payment structure choice is likely to be detrimental to program success – good news for UNRB program designers. This result illustrates the adaptability and flexibility of PWS programs

to be designed in response to the political needs of the watershed of implementation. It also suggests that municipalities of different sizes might be able to participate in funding PWS programs according to their capacity and political or budget constraints.

6. **Drivers of PWS programs vary and with it, so do measurements of success.** Regulatory drivers vary between programs suggesting no single type of regulation best incentivizes PWS programs. With nutrient management goals, there is more flexibility in implementation and measurement than in total maximum daily load limitations for nutrients. Regulation determines the way programs can be implemented and measured- we have captured this difference in the "practice or performance based?" metric which distinguishes between the implementation of BMPs, land conservation, *etc.* as a matter of good practices, and the measurement of changes in water quality due to the implementation of such practices. Showing actual reductions due to practice implementation can be complicated, and in the absence of measureable results, draw the programs into question. Many of the case studies we examined had practice based implementation and flexible regulations that allowed for improvement over time through land use management.

In summary, the case studies examined vary greatly in both their overall applicability to the UNRB and the relative alignment of their attributes. Although no clear and ideal watershed services payment structure could be identified from the case studies, we were able to decipher what ways the UNRB is unique, not so unique, and what implications these findings may carry for potential program success. The lessons learned from the case studies are discussed and applied to the UNRB in the following section.

CASE STUDY-BASED PROGRAM RECOMMENDATIONS

For each score card, we gathered qualitative information informally (phone interview, etc.) and formally (reports and white papers) on which factors were deemed critical or important to the success of the program. In this section of the score card, we also noted any additional aspects or activities that may have seemed innovative, interesting, or notable. Based on these data, we assessed how those aspects of the programs could apply to a potential UNRB PWS program and arrived at recommendations for such applications in the UNRB. These qualitative data can be found in the completed score cards in Appendix C.

We compiled the critical factors and recommendations from all case studies to arrive at a core set of recommendations. We prioritized those recommendations that 1) were shared among a large number of case studies and 2) were from those programs which best align with the UNRB. We arrived at five primary recommendations, depicted in **Table 13** and discussed in further detail in the sections below.

Table 13. Primary recommendations for a payment for watershed services program in the UNRB, as gleaned from representative case studies. Darkened cells represent case studies from which the recommendation was substantiated.

RECOMMENDATION	Burlington	Tualatin	Boston	NYC	Raritan	San Antonio	Syracuse	Portland	Salt Lake City	Mountain Island Lake	Pine Barnes	Maryland	Great Miami	Conestoga	U. Tallapoosa
Encourage Stakeholder Engagement	✔	✔	✔	✔	✔		✔	✔	✔		✔	✔	✔	✔	
Leverage Funds and Diversify the Financing Portfolio						✔	✔	✔		✔		✔			✔
Utilize Existing Institutions	✔				✔				✔	✔			✔		
Design for Adaptive Management	✔	✔	✔		✔		✔				✔			✔	
Capitalize on Opportunities to Realize Co-Benefits		✔	✔	✔	✔	✔		✔		✔					✔

For each recommendation, we identify 1) evidence for that recommendation in the case studies, 2) the extent to which current and past activities in the UNRB satisfy that recommendation, and 3) opportunities for UNRB stakeholders and decision makers to further act upon that recommendation.

RECOMMENDATION #1: ENCOURAGE STAKEHOLDER ENGAGEMENT

Above all other factors, experts and managers from programs across the country consistently noted that stakeholder engagement was critical or an important factor in the success of their programs.

CASE STUDY EVIDENCE

As evidenced in the examined case studies, a successful PWS program requires engagement of all relevant stakeholders; including farmers, local governments, regulators, landowners, watershed conservation organizations, non-governmental organizations, private sector beneficiaries, and most importantly, the public.

Whether through success stories or acknowledged program shortcomings, the program evaluators and managers we consulted consistently echoed the importance of engaging farmers in agricultural payment programs. Evaluators of the Conestoga reverse auction program, for example, noted that it is critical to "ensure that all [farmers] understand what the reverse auction is trying to achieve" and that the program should have conducted a "longer and more extensive stakeholder engagement process" (Mark & Greenhalgh, 2006). Both New York programs (Syracuse and NYC) demonstrated that the Whole Farm Plan approach can be a successful way of encouraging such farmer engagement and buy-in. In these programs, the development of a unique business plan for each farmer provided an increased sense of ownership and accountability for the success of his or her practice(s) (Lee Macbeth, personal communication, February 29, 2012). The Pine Barrens Credit Program also demonstrated a commitment to engaging program participants by dedicating staff time to seminars and workshops and encouraging attendance at the Clearinghouse Board of Advisors meetings (Central Pine Barrens Joint Planning and Policy Commission, 1995).

The public can also play a pivotal role in ensuring the success of a PWS program. Events that ensued in the Boston program demonstrate the weight of this role. Public misconception of active forest management in Boston resulted in a moratorium on this beneficial practice (MWRA (Massachussets Water Resources Authority), 2012). A representative from this program noted that "it was important to educate stakeholders about such actions taken for water quality management because misinformation such as occurred in this case can inhibit the progress of a program" (Thom Snowman, personal communication, March 2, 2012). The importance of public engagement was noted in the Burlington program as well, where the US EPA noted that "community involvement has been part and parcel of [their] source water protection program" (US Environmental Protection Agency, 2010). Citizens of Burlington engaged through "committees, surveys, and meetings at each juncture of the program's development" (US Environmental Protection Agency, 2010) and even provided input through a public ballot on proposed upgrades for their three wastewater treatment plants. The relevance of public outreach was also emphasized in Portland, Maine, where the US EPA commented that "public education significantly raised the public's interest and understanding of watershed protection and lake water quality and sparked a new lake association to foster protection activities" (US Environmental Protection Agency, 2012c).

Getting all relevant stakeholders to the table is only the first step of a successful stakeholder engagement process. Once all stakeholders are present, program managers benefit from providing an open and welcoming forum for communication. The Tualatin program provided such an environment, where their less formal approach included the institution of an "open" membership in which new members could join at any time, as well as the introduction of a more "fluid" group role in which the group acted as a sounding board for directions DEQ was considering or potential new directions (State of Oregon Department of Environmental Quality, 2007a). DEQ staff in Oregon also spoke at a variety of public venues, and the generally positive responses at these various meetings helped cement various ideas about how to design the trade (State of Oregon Department of Environmental Quality, 2007a). This engagement approach proved beneficial, as the Oregon Department of Environmental Quality noted that the assembled stakeholder group provided input that was “critical to the eventual success of the trade,“ proposing ideas that were “more expansive or flexible than what DEQ had been considering” (State of Oregon Department of Environmental Quality, 2007a). The executive director of a local environmental group substantiated Oregon DEQ’s observations, remarking that this setup helped the group avoid getting “locked into particular positions” that would hinder progress and productive (State of Oregon Department of Environmental Quality, 2007a). The Maryland program also provides an effective model for stakeholder engagement. In establishing the State of Maryland’s Forest Conservation Goals, the Forest Service organized a series of five meetings with representatives from the DNR, Department of Planning, Department of the Environment, Maryland Environmental Trust, The Nature Conservancy, The Chesapeake Bay Foundation, the EPA, private citizens, county governments and others to help evaluate and provide input on proposed goals for forest conservation and recommendations for reaching those goals. Maryland Department of Natural Resources found that this was necessary to support retention, expansion, and stewardship of forestlands of critical importance to water quality (Maryland DNR, 2007).

UNRB STATUS

Organizations and government agencies of the UNRB have already taken notable strides to engage watershed services stakeholders. The UNRBA and NC DWQ sponsor the Falls Lake Stakeholder Project, for example, which includes an online stakeholder platform and discussion forum (www.fallslakestakeholder.org). The NC DWQ also held nine stakeholder meetings during the development of the Falls Lake Rules (UNRBA and NC DWQ, 2009). The Upper Neuse Clean Water Initiative brings together local government and land trust stakeholders to inform water quality-enhancing land conservation activities. Local land trusts, such as the Conservation Trust for North Carolina, have also been conducting regular outreach and stakeholder meetings with governments, land managers, farmers, and conservation organizations for decades to carry out their conservation objectives.

UNRB NEXT STEPS

In addition to the aforementioned stakeholder engagement activities, we provide some preliminary opportunities for further engagement of UNRB stakeholders. We believe these opportunities may help heighten the potential success of a basin-wide PWS program. Note that we have not assessed these opportunities for viability or relevance, but rather provide a preliminary list of options for UNRB stakeholders to act upon this recommendation. Table 24 lists these opportunities in detail.

Table 24. Preliminary opportunities for further engaging watershed stakeholders in the UNRB.

Opportunity	Description
✓ **Designate a primary organization**	The UNRBA currently convenes government stakeholders around water quality issues, but does not include other important stakeholders, such as farmers, NGOs, and land trusts. UNCWI does bring land trusts and farmers to the table, but with a singular focus on land conservation approaches. Stakeholders with limited time and resources may not have the capacity to engage in both organizations. The basin could perhaps realize increased efficiency and stakeholder cooperation if these two entities combine their efforts and provide one common forum for discussion and planning. This organization, while primarily focusing on water quality issues at the onset, could provide the institutional capacity to be flexible and expand their focus to other watershed issues as needed, including water quantity.
✓ **Dedicate a funding source to support stakeholder engagement activities**	We recommend that the UNRBA, UNCWI, and/or TJCOG consistently allocate a proportion of its annual budget to increasing and sustaining stakeholder engagement activities.
✓ **Continue regular Falls Lake stakeholder meetings**	The Falls Lake Stakeholder Project convened nine meetings from 2008 to 2010 to solicit stakeholder input during the formulation of the Falls Lake Rules. We recommend that these meetings continue on a regular basis to help stakeholders and regulators coordinate and monitor implementation as the Rules go into effect.
✓ **Educate and engage the public through utility bill mailings**	The public is an important stakeholder and should not be overlooked. Currently, UNRB water utilities commit minimal efforts to communicate the "water quality - land conservation - water service cost" nexus to its water users, often due to fear of public backlash to rate increases. Currently, the penny-per-hundred-gallon surcharge program in Raleigh informs residents of watershed conservation efforts through a line item in its utility bills. The City of Raleigh, Durham, and other municipalities in the UNRB could consider providing informational packets in their utility bill mailings to raise awareness of this important link.
✓ **Increase publicity of watershed conservation successes**	Since its inception in 2005, UNCWI has completed 63 projects, protecting more than 63 miles of stream banks and 2,210 acres in the UNRB (Lisa Creasman, personal communication, April 25, 2012). To engage the public, UNCWI and UNRBA should work to increase the publicity of these conservation projects and use them as an opportunity to educate the public on the interconnection among land conservation, water quality, and water use costs.
✓ **Make sure everyone is at the table**	Because a payment for watershed services program would involve landowners, farmers, utilities, developers, and city and county governments, and NGOs, UNRB watershed organizations and governments should continually work to ensure that all potential stakeholders are at the table and engaged.

RECOMMENDATION #2: LEVERAGE FUNDS AND DIVERSIFY THE FINANCING PORTFOLIO

Prior to the 2008 economic recession, many local governments and watershed organizations relied largely on state and federal grants, trust funds, and cost share programs to fund watershed conservation activities. As funding allocations have decreased drastically for these federal and state programs, local entities will increasingly need to seek other, more dependable funding sources. Complementing the funding portfolio for watershed conservation activities with sustainable, local funding sources will help hedge against shortfalls in expected state and federal funding allocations and introduce a more sustainable approach to addressing water quality goals. The importance of this approach has been echoed across the United States as nearly half of the examined case studies noted that leveraging funds and diversifying the financing stream were critical or important factors in ensuring that program's success.

CASE STUDY EVIDENCE

Many case studies used federal or state seed funding as a base for leveraging funds from other additional revenue streams. In Upper Little Tallapoosa, program managers combined funds from state green space programs in conjunction with local sales tax revenues to boost funding. The Mountain Island Lake Clean Water Initiative in the Charlotte, NC area required a $6.5 million grant from the NC Clean Water Management Trust Fund to launch the program. Later the Initiative complemented this seed funding with revenue bonds, a utility watershed fee, and a Land Purchase Bond to fund land conservation activities (The Conservation Registry, 2012). A program evaluator noted that these additional funds "were necessary to sustain the program," and that "by leveraging multiple funding sources, residents and their local leaders were able to protect more than 6,000 acres of watershed land improving the quality of water in a reservoir serving approximately 8% of the state's population" (NC Dept. of Environmental and Natural Resources Public Supply Section).[3] A two-year Conservation Innovation Grant (CIG) funded the design and implementation of the Conestoga reverse auction program, which successfully demonstrated that the federal cost share program EQIP could increase its environmental effectiveness on a per-dollar basis sevenfold by using a reverse auction pricing mechanism as opposed to set price list (Selman, Greenhalgh, & Taylor, 2008). The Ohio Great Miami River water quality trading program also benefited from government seed funding, as it became operational in 2006 using a $1 million USDA NRCS grant that was later supplemented with $1.2 million in contributions from wastewater treatment facilities (Newburn & Woodward, 2012).

Despite its prevalence among our examined case studies, federal seed funding is not a prerequisite for success. Local funding sources such as sales taxes and utility fees provide the most reliable form of funding to achieve conservation objectives in the long term (Hart, 2006), and can also be complemented with separate, additional revenue sources to further boost the portfolio. San Antonio, for example, supplemented a 1/8 increase in local sales tax with a onetime 2% increase in state sales tax to generate a bond for conservation (National Conservation Easement Database, 2011). Syracuse complemented its City general fund contributions with federal cost share monies, a Conservation Innovation Grant, and other municipal government funding to implement their agricultural BMP payment program (Macbeth, 2011). In Portland, Maine, the primary source of funding is the previously year's revenues from utility fees, which is supplemented by Section 319 Grants and state legislature funding that is matched dollar-for-dollar with private funds (Maine State Planning Office, 2006; US Environmental Protection

[3] As referenced in http://www.efc.umd.edu/new/pdf/Charlotte-Mecklenburg%20Case%20Study.pdf (unknown author).

Agency, 1999, 2012c). Maryland DNR also leveraged funds for its program using funds from Maryland's Rural Legacy Program, Maryland's Environmental Trust, and Program Open Space funds, which are funded through a state real estate transfer tax (Maryland DNR, 2012).

Although the examined case studies clearly reveal that creating a diversified financial portfolio for funding watershed conservation activities can help provide critical supplemental funding and help hedge against unexpected funding lapses, case study evidence suggests that supplementation may not always produce synergistic benefits. Lee Macbeth, Watershed Control Coordinator for the City of Syracuse, noted that perhaps providing a 100% subsidy to farmers for BMP implementation was not the best approach; rather, reduction of the original 100% subsidy to 95% or so might have enhanced farmers' sense of ownership and increased their investments in successful BMP outcomes (Lee Macbeth, personal communication, February 29, 2012). Program managers from the Conestoga reverse auction also noted that competing funding sources for BMPs such as EQIP, state funds, and Chesapeake Bay Funds introduced a challenge to implementing the auction and resulted in less interest by the farmers in a new PWS program (Mark & Greenhalgh, 2006).

UNRB STATUS

The UNRB has already leveraged several funding sources for watershed conservation activities. For every $1 the City of Raleigh has invested in the Upper Neuse Clean Water Initiative since its inception, the City has been able to protect $13 of land value (Lisa Creasman, personal communication, April 25, 2012). The Upper Neuse Clean Water Initiative leveraged a Healthy Watersheds through Healthy Forests grant from the U.S. Endowment for Forestry and Communities with funding from the North Carolina Natural Resource Trust Fund; City of Raleigh; and Wake, Durham, and Orange counties to provide capital for designing and implementing a watershed-scale source water protection program. The Clean Water Management Trust Fund, the Natural Heritage Trust Fund, and cost share assistance provided by federal Farm Bill programs such as the Environmental Quality Incentive Program (EQIP) and the Agricultural Management Assistance Program (AMA) also provide significant watershed conservation funding.

UNRB NEXT STEPS

With federal, state, and local government funding sources drying up of recent, it is increasingly critical that the UNRB positions itself to maintain a sufficient and sustainable funding portfolio for a potential PWS program. Below we have identified some preliminary opportunities for the UNRB to further diversify and leverage its funding portfolio and thereby boost the probability that a future PWS program in the basin will succeed. Note that we did not assess these opportunities for viability or relevance, but rather present a preliminary list of options for UNRB stakeholders to act upon this recommendation. We detail these opportunities in Table 25.

Table 25. Preliminary opportunities for further diversifying and leveraging the PWS funding portfolio in the UNRB.

Opportunity	Description
✓ **Consider a fixed, as opposed to volumetric, watershed utility fee**	Currently, the watershed conservation utility fee for water consumers is volumetric, meaning that the amount consumed dictates the total fee amount. Although perhaps more favorably perceived by water users, this funding source is unsustainable, as it will necessarily vary with water consumption and result in decreased revenues during seasons of low consumption. Introduction of a fixed-rate component may ensure a more sustainable funding source. Salt Lake City introduced a fixed watershed fee in 1999 that has increased from \$0.25 to \$2.00 per household per month since its inception (Carpe Diem West, 2011). Fixed rates will inevitably increase at some point to cover increased capital costs. Perhaps introducing this fixed-rate watershed conservation fee as part of such an overall fixed rate increase would dampen the perceived price impact to water users.
✓ **Educate farmers on federal cost share opportunities**	Currently, many farmers in the UNRB take advantage of federal cost share opportunities. UNRB administrators should ensure that farmers continue to understand the suite of funding opportunities available to them for implementation of watershed conservation activities.
✓ **Designate a body charged with overseeing and crafting grant proposals**	Although the UNRBA and UNCWI have already benefited from federal and state grant funding opportunities, the process for finding and applying for grants could be improved. Currently, government and organizational entities apply for watershed conservation grants on an individual, case-by-case basis. Although politically challenging, collaboration among government and non-government entities to apply for and implement grants would arguably provide a more focused, consistent, and logical approach that would benefit the watershed.
✓ **Designate a sales tax earmark**	Many other programs across the country have earmarked a portion of the local sales tax toward watershed conservation objectives. Although politically challenging, the UNRB could examine the potential revenues associated with a sale tax, as opposed to water utility fee, approach. Currently, a large proportion of sales tax revenues fund education and transportation activities. Depending on the priorities of the populace, a simple back-of-the-envelope calculation may reveal that benefits from a half-cent appropriation to watershed conservation may outweigh the forgone benefits of using those same funds for transportation activities.
✓ **Explore additional federal and state grant opportunities**	While UNRB stakeholders have successfully received many state and federal grants to forward watershed protection efforts, other grant opportunities remain untapped. The Conestoga reverse auction pilot utilized a Conservation Innovation Grant (CIG) to catalyze the development and expansion of their payment for watershed services program (Selman et al., 2008). To hedge against risks associated with the development and implementation of a new PWS program, UNRB entities should consider applying for such grants, the targeted activities of which include more innovative approaches to conservation.
✓ **Work with NGOs to fundraise**	Many NGOs such as land conservancies have the experience and contacts necessary to fundraise significant revenues. The UNRB could benefit from further leveraging these organizations' fundraising base and expertise.
✓ **Continue exploring private sector marketing opportunities**	Private sector entities in the UNRB, such as Pepsi Co. and Duke University, may seek opportunities to market their sustainability values. The UNRB could benefit from pitching watershed conservation donations as a viable marketing tool for private sector companies. This effort would allow UNRB stakeholders to "piggyback" off these private sector marketing efforts in forwarding their own watershed protection public outreach campaigns. Bonneville Environmental Foundation in the Pacific Northwest exemplifies the potential success of such an approach. Private sector entities have voluntarily purchased Water Restoration Certificates™ to offset water usage and boost their sustainability marketing.

RECOMMENDATION #3: UTILIZE EXISTING INSTITUTIONS

Five of the fifteen case studies examined noted that utilizing existing institutions, such as land trusts and Soil and Water Conservation Districts (SWCD), provided critical support to the program.

CASE STUDY EVIDENCE

The development of a PWS program need not require reinvention of the wheel; existing institutions in the watershed have often already dedicated significant time and energy to building relationships and capacities. These institutions can serve as excellent venues for management and implementation of a PWS program. The Soil and Water Conservation District staff members, for example, are local community members that farmers and landowners know and trust. These District managers also have the experience and capacity needed to implement conservation programs, one of their key duties is management and implementation of federal cost share programs. Newburn and Woodward noted in their 2012 evaluation of Ohio's Great Miami water quality trading program that "reliance on the SWCD offices to recruit and advise farmers has been essential to achieve relatively high rates of farmer participation." These authors also assert that the use of SWCD agents reduces costs for the program by allowing the program to "free ride on the administrative costs that SWCD offices receive to assist in the federal conservation programs." Because SWCD offices already monitor practices funded by the larger federal conservation programs, they can also "easily monitor BMPs installed under the water quality trading program."

The use of existing government institutions was apparent in many other examined case studies as well. In the Conestoga reverse auction program, the NRCS Conservation Service of Conestoga served as the point organization for liaising with the farmers – among the Service's duties were to advertise the program, conduct farm visits, and help farmers to estimate their phosphorus loading reductions using the NutrientNet tool (Suzie Greenhalgh, personal communication, March 14, 2012). The Onondaga County Soil and Water Conservation District spearheaded and administers the Syracuse Skaneateles Lake Watershed Agricultural Program, which allowed the New York State Department of Health to grant the City of Syracuse an indefinite water filtration waiver with no expiration date in 2004 (Onondaga County Soil and Water Conservation District, 2012).

Land trusts have also consistently played pivotal roles in ensuring PWS program success. The Mountain Island Lake Initiative continues to use the expertise and institutional capacities of The Catawba Lands Conservancy and the Trust for Public Land to secure and maintain new watershed conservation sites.[4] Watershed property acquisition efforts have been enhanced in Salt Lake City's watershed by collaborating with land trusts and other organizations in the area (Bear West Consulting, 1999; Carpe Diem West, 2011). In the Upper Little Tallapoosa PWS program, Carroll County's success attainment of SPLOST (Special Purpose Local Options Sales Tax) funds can be largely attributed to the Trust for Public Land's involvement (personal communication, Amy Goolsby, Caroll County Planner, March 15, 2012). To that end, the Trust provided technical assistance to map and model critical areas for water quality, create a report on funding options for land protection, and a strategic action plan for watershed protection (The Trust for Public Land, 2002; Trust for Public Land & University of Massachusetts Amherst, 2002a).

UNRB STATUS

The Upper Neuse Clean Water Initiative illustrates efforts by UNRB stakeholders to utilize existing institutions in order to forward watershed protection goals. The multiple local land trusts that compose the Initiative have the

[4] Source: http://www.efc.umd.edu/new/pdf/Charlotte-Mecklenburg%20Case%20Study.pdf.

necessary capacity and experience to design and implement successful land conservation activities. Utilization of these local land trusts provides UNRB stakeholders with an efficient means of meeting water quality goals and initiatives.

The Soil and Water Conservation Districts (SWCD) of the UNRB help farmers comply with the Falls Rules and find cost share assistance through federal and state cost share programs (Durham County Government, 2012). They also actively work with farmers on voluntary BMP programs such as Durham's voluntary nutrient reduction program (Durham Soil and Water Conservation District, n.d.). Although no UNRB SWCDs currently participate in local payments for watershed services programs, their demonstrated technical assistance capacity indicates a potential for UNRB stakeholders to benefit from their participation in such a program.

UNRB NEXT STEPS

Below we have identified some preliminary opportunities for the UNRB to utilize existing institutions in the development and ramping up of a basin-wide PWS program. Note that we have not assessed these opportunities for viability or relevance, but rather present a preliminary list of options for UNRB stakeholders to act upon this recommendation. We list these opportunities in Table 26 below.

Table 14. Preliminary opportunities for utilizing existing institutions in a UNRB-wide PWS program.

Opportunity	Description
✓ **Inventory relative strengths and capacities of current UNRB institutions**	Multiple conservation-oriented institutions and organizations exist in the UNRB. An inventory of the relative strengths and capacities of these institutions may reveal those that would be most ideal venues for implementation and management of a basin-wide PWS program.
✓ **Begin talks with SWCDs**	Expert evaluators of the Ohio Great Miami water quality trading program noted that "the prominent role of the SWCD offices in the institutional design of the trading program has enormous potential to be replicated in future water quality trading programs in other regions" (Newburn & Woodward, 2012). UNRB stakeholders should being talks with SWCDs to identify the capacities and suggestions SWCD staff may have for moving forward with the agricultural component of a basin-wide PWS program.
✓ **Begin talks with local land trusts**	Local land trusts such as the Conservation Trust for North Carolina (CTNC), Triangle Land Conservancy, and the Eno River Association are already heavily involved in conservation activities for enhanced water quality (Hart, 2006). UNRB stakeholders should begin talks with these entities about their potential to expand efforts and integrate a basin-wide, scaled-up PWS program into their operations.

RECOMMENDATION #4: DESIGN FOR ADAPTIVE MANAGEMENT

Seven of the fifteen examined case studies noted that the ability to adaptively manage the program was a critical or important factor in ensuring that programs' success.

CASE STUDY EVIDENCE

Flexibility and adaptability in program design was noted as important to the success of the many programs, including in Boston, Burlington, Tualatin, Raritan, and Syracuse. In Syracuse, the City administered surveys to participating farmers to gauge program progress and satisfaction and identify any needed amendments or improvements to the program. Results of the survey resulted in an amendment to the contract which encouraged improved BMP maintenance and farmer buy-in (EPA Office of Water, 2010). In Tualatin, program managers conducted regular revisions to their work plan and applied for grant extensions (Cochran & Logue, 2011; State of Oregon Department of Environmental Quality, 2007a). In Conestoga, program managers responded to low participation rates in the first bidding round by streamlining the auction process for the second round (Greenhalgh et al., 2007). In the Pine Barrens program, the Commission regularly updates its Land Use Comprehensive Plan in order to reflect upgraded standards and guidelines for development, incorporation of past Commission land use decisions and interpretations, and appropriate program feedback (Pine Barrens Credit Program, 2012; Tripp, 2009).

UNRB STATUS

Adaptive management is stipulated in the Falls Lake Rules explicitly, including required water quality monitoring by the Division of Water Quality and the ability to "request Commission approval to initiate additional rulemaking" should "acceptable progress … not been made towards achieving nutrient-related water quality standards throughout Falls Reservoir" (NC Department of Environment and Natural Resources, 2011). The Commission established a "staged and adaptive [Falls Rules] implementation plan" which includes a requirement that DWQ reports to the Commission and provides information to the public in January 2016 and every five years thereafter as necessary. If DWQ finds that acceptable progress has not been made towards achieving nutrient-related water quality standards throughout the Falls Reservoir, it may, at any time, evaluate compliance and request Commission approval to initiate additional rulemaking (NC Department of Environment and Natural Resources, 2011). Grant funding has been explicitly allocated for this purpose (Sarah Bruce, personal communication, March 3, 2012), but at this time there is no clear methodology or plan for monitoring and evaluation of progress in the agricultural sector (NC DWQ, 2012).

UNRB NEXT STEPS

Below we have identified some preliminary opportunities for the UNRB to further plan for adaptive program management and thereby boost the probability that a future PWS program in the basin will succeed. Note that we have not assessed these opportunities for viability or relevance, but rather present a preliminary list of options for UNRB stakeholders to act upon this recommendation. We list these opportunities in Table 27.

Table 27. Preliminary opportunities for designing for adaptive management in a UNRB PWS program plan.

Opportunity	Description
Provide a more detailed timeline for benchmarking and evaluation	If management strategies do not produce measurable changes in water quality, alternative approaches to the problem should be considered and pursued by program administrators, regulators, and regulated entities.
Outline a clear methodology for quantitative and qualitative evaluation of all participating parties and activities	In order to gauge effectiveness of management practices, pre- and post-program implementation data should be gathered by tasked entities at predetermined testing sites.
Plan for surveys to evaluate participant satisfaction	In addition to monitoring environmental effectiveness, evaluation of program perception, both by participants and the public, could reveal opportunities to further enhance the success a PWS program.

RECOMMENDATION #5: CAPITALIZE ON OPPORTUNITIES TO REALIZE CO-BENEFITS

Over half of the examined case studies noted that it was beneficial to take advantage of opportunities within the program to realize ancillary co-benefits, such as recreation and wildlife habitat, on sellers' lands. Benefit streams from these co-benefits can be substantial and, under future PES scenarios, could in turn contribute to leveraging and further diversifying the funding portfolio for a PWS program (Recommendation #2).

CASE STUDY EVIDENCE

Many of the examined case studies leveraged the ancillary co-benefits associated with watershed service enhancement activities. In San Antonio, public recreation was noted as an important incentive for justifying land conservation in the watershed (Trust for Public Land, 2003). A state park that lines the drinking water source in Portland, Maine "significantly" increased home values, demonstrating the real monetary benefits that accompany land protection activities (Michael, Boyle, & Bouchard, 1996; Portland Water District, 2012). The water source, Sebago Lake, is also an important recreational area for residents, as 90% of the land is public and recreation is encouraged (Portland Water District, 2012). The Mountain Island Lake source water protection program plans to create an Educational State Forest on property protected by the Initiative, and the public currently enjoys many recreational facilities on the lake, including two public accesses, one county park, and a waterfowl refuge (North Carolina Department of Environment and Natural Resources & North Carolina Wildlife Resources Commission, 2001). In a survey sent out to Carroll County residents for the Upper Little Tallapoosa program, green space was at the top of the list in terms of what people would like to see in their community. Carroll County voters were able to see the link between quality of life and acquiring and maintaining green space, which resulted in voters approving the SPLOST to fund water quality protection, green space preservation and recreation (Amy Goolsby, personal communication, Carroll County Planner, March 15, 2012; Rasmussen, 2007; Trust for Public Land & University of Massachusetts Amherst, 2002b).

UNRB STATUS

Falls Lake itself provides a multitude of co-benefits in addition to its primary purpose as a drinking water source. Recreation is highly valued in Falls Lake, where hiking, boating, fishing, and swimming are available to residents and visitors year round. In addition to the recreational benefits provided directly from Falls Lake, land protection activities throughout the watershed have realized significant recreational opportunities for watershed residents. The North Carolina Division of Parks and Recreation (NCDPR), manages the Eno River State Park, Occoneechee Mountain State Natural Area, and Falls Lake State Recreation area, for example, which collectively comprise about

30,000 acres of conserved land around the Upper Neuse River Basin (Hart, 2006). NCDPR is also working on a "Mountain-to-Sea Trail" that will run parallel to the Falls Lake shoreline for 25 miles (Hart, 2006). The City of Hillsborough has set aside money from its Capital Improvements Plan to acquire additional acreage for a river walk along the Eno River that will connect Occoneechee Mountain State Natural Area to the Orange County courthouse and river park complex in downtown Hillsborough (Hart, 2006). The City and County of Durham are also developing a greenway system that links riparian corridors (Hart, 2006).

UNRB NEXT STEPS

Below we have identified some preliminary opportunities for the UNRB to capitalize on valuable co-benefits when designing and funding a PWS program. Note that these opportunities have not been assessed for viability or relevance, but rather represent a preliminary list of options for UNRB stakeholders to act upon this recommendation. These opportunities are listed in Table 28 below.

Table 28. Preliminary opportunities for further diversifying and leveraging the PWS funding portfolio in the UNRB.

Opportunity	Description
✓ **Explore land acquisition, as opposed to easements, to realize recreational co-benefits of watershed conservation**	Easements are only open to the public if it is the explicit wish of the landowner. Because easements typically encompass part of a homestead, public access can be considered an intrusion. When the whole property is purchased fee simple by a PWS buyer, however, its use can be dedicated to the public. Despite the relatively higher costs of acquisition, UNRB PWS program administrators should consider the social co-benefits associated with land acquisition activities when deciding upon the most appropriate watershed protection approach.
✓ **Increase communication of watershed conservation co-benefits to recreational users**	Conservation successes are most appreciated by those who know about them. UNRB stakeholders should strive for higher public awareness of watershed conservation-generated recreational opportunities. For example, land acquired for public benefit could perhaps include signage explaining that the land was protected primarily to protect water quality.
✓ **Incorporate the option for realizing additional co-benefit revenue streams in a PWS program model**	A PWS program can greatly benefit from incorporation of additional co-benefit revenue streams. Realization of these benefit streams may "tip the scales" for sellers and boost participation in the program. We suggest that PWS program planners and administrators emphasize careful and creative land protection planning and prioritization. Such planning processes could allow for the development of beneficial recreational opportunities, such as the "Ohio's Great Corridor" trail, which was established by land protected through the Great Miami Basin water quality trading program (Kieser & McCarthy, 2012)

CAVEATS, GENERAL PROGRAM RECOMMENDATIONS AND NEXT STEPS

The feasibility analysis and guidance framework provided in this study can serve as an important next step for scaling up a payment for watershed services program in the Upper Neuse River Basin. As indicated in Figure 4 (see the Biophysical Characteristics section of the Upper Neuse River Basin Score Card), any real approach to improving water quality in the basin must address the nonpoint sources of pollution in the watershed. Providing payments to landowners and farmers for watershed services, be it through land acquisition, restoration, or best management practices, has been shown in programs across the country to be an effective way to address these nonpoint sources.

Given the demonstrated effectiveness of a PWS approach, we were pleased to find through our analysis that the Upper Neuse River Basin is well positioned for a scaled-up, basin-wide PWS program. As depicted in Table 10 (see the Alignment Results and Discussion section), many of the characteristics of the Upper Neuse River Basin align well with the attributes of other successful programs. Those UNRB attributes that do not align well with the case studies, such as demand driver type and commodity type (practice- or performance-based), also do not align *across* case studies. This cross-program variability indicates that perhaps there are no "one size fits all" parameters for those attributes, and that the UNRB may still be well positioned despite its relative uniqueness for those attributes.

Although our results suggest a considerable potential for a successful PWS program in the Upper Neuse River Basin, this feasibility study is not exhaustive and should not serve as the sole litmus test for whether PWS is the most cost-effective and/or environmentally-effective approach to improving water quality in the basin. PWS is not a panacea; payments for watershed services provide just one tool in the toolbox for reducing N and P loadings to the watershed. A PWS approach cannot address subsurface pollution sources, such septic tank leakage, for example. These sources will likely require engineered grey infrastructure improvements. A scaled-up PWS program in the UNRB should therefore serve as one many of other water quality enhancement approaches in the watershed.

We also did not assess the cost-effectiveness of a PWS approach as compared to other pollution-reducing approaches. Such an analysis was beyond the scope of this project. The outcomes from such an assessment would rely largely on the payment mechanism (e.g., reverse auction, bilateral trades, or set pricing) and extent to which the program resembles an open market. For example, determining the feasibility and cost-effectiveness of a market-based PWS program, such as water quality trading, would require an extensive analysis of potential pricing, supply, and demand for the traded commodity. An example of such an analysis from the Great Miami water quality trading program is depicted in Table 29.

Although there is not yet a UNRB-specific economic efficiency analysis, we can draw lessons from economic analyses conducted for other cities and watersheds. Studies have consistently found that green infrastructure approaches to reducing nutrient inputs can be far cheaper than alternative grey infrastructure approaches (see Table 7 for examples). Furthermore, these "grey vs. green infrastructure" analyses are likely underestimations of potential costs savings, as studies often do not incorporate the additional benefits realized from the many ancillary co-benefits associated with green infrastructure approaches, including improved habitat, recreational, flood attenuation, and aesthetic benefits. These benefits are real and can often "tip the scales" to make green infrastructure investments the clear choice for optimizing benefits to society. Table 30 shows the availability of these co-benefits in the Upper Neuse River Basin under various green infrastructure management scenarios.

Table 29. Economic feasibility analysis for potential water quality trading program. Adapted from (Kieser & Associates, 2004)**.**

Total Phosphorus				
Agricultural management practices	**Watershed Point Source Load Reduction Cost (million)**	**Watershed Point Source Unit Reduction Cost (/lb)**	**Non-Point Watershed BMP Cost (million)**	**Watershed Non-Point BMP Unit Cost (/lb)**
No-till on 50% ag, land			$37.8	$1.08
No-till and 50% fertilizer reductions			$108.5	$2.70
No-till, 50% fertilizer reductions, and hay-only in select sub-watersheds	$422.5	$23.37	$425.1	$8.48
Total Nitrogen				
Agricultural management practices	**Watershed Point Source Load Reduction Cost (million)**	**Watershed Point Source Unit Reduction Cost (/lb)**	**Non-Point Watershed BMP Cost (million)**	**Watershed Non-Point BMP Unit Cost (/lb)**
No-till on 50% ag, land			$37.8	$0.45
No-till and 50% fertilizer reductions			$108.5	$1.23
No-till, 50% fertilizer reductions, and hay-only in select sub-watersheds	$422.5	$4.72	$425.1	$3.99

Table 30. Green infrastructure options and benefits in the Upper Neuse River Basin. Adapted from (Talberth et al., 2012)**.**

Green Infrastructure Options and Benefits in the Upper Neuse River Basin						
	Improved Water Quality	**Reduced Nutrient Loading**	**Reduced Sedimentation/ Turbidity**	**Increased Water Supply**	**Lower Flood and Drought Risk**	**Habitat and Aesthetic Co-benefits**
Wetland Conservation	✔	✔	✔	✓	✔	✔
Forest Conservation	✔	✔	✔	✓	✔	✔
Green Agricultural Practices	✔	✔	✔	✓	✓	✓
Green Stormwater Management	✔	✔	✔	✓	✔	✓
✔ **= Yes** ✓ **= Under certain circumstances**						

Preliminary UNRB-specific economic analyses also demonstrate the relative advantages of green infrastructure investments. A 2010 News and Observer article noted that "if the lake quality doesn't improve by 2016, a $115 million upgrade of Raleigh's E.M. Johnson Water Treatment Plant, which handles all water for Raleigh's system, will be needed" and "as much as $200 million in other improvements may be necessary" (Ovaska, 2010). A fiscal analysis from the NC DWQ estimated high end implementation costs for Stage I of Falls Rules to be around $605 million (NC Division of Water Quality Planning Section, 2010). These reports suggest that a green infrastructure approach may present significant cost savings opportunities for the Upper Neuse River Basin.

Extensive economic feasibility analyses such as those mentioned above require significant investments of time and money. Evidence from the examined case studies suggests that perhaps such an investment is not required. We found very little evidence for other PWS programs conducting economic analyses; rather, many cities and programs simply worked off the "good faith" supposition that green infrastructure investments pay worthwhile societal dividends that justify the costs of program implementation. In the case of the UNRB, investments of time to conduct an economic feasibility analysis may be a luxury that the watershed cannot afford. Increasing development pressure in the watershed threatens to convert forested lands to development. As stated in the Upper Neuse Clean Water Initiative Conservation Plan, "land conservation is a cost-effective key to ensuring watershed protection, and it will only work while undeveloped sensitive lands remain" (Hart, 2006). As time progresses, the watershed will increasingly lose vital watershed services from these forests, and perhaps irreversibly so, underlying the urgent need to address these imminent losses now.

Significant nonpoint source loading reductions will be required in the coming years to comply with the Falls Rules and maintain current water uses in the watershed. Green infrastructure approaches address these nonpoint sources while also producing multiple additional social benefits. These facts, combined with the promising feasibility outcomes from our study, lead us to recommend that the Upper Neuse River Basin seriously consider the scaling up of its payments for watershed services programs. We believe there is a role for both land conservation and agricultural BMPs in a watershed-scale payment program. The Syracuse program could serve as an effective model for this approach, where parallel land conservation and agricultural BMP programs are housed in different institutions that work in tandem to meet water quality goals. Piloting of a reverse auction may serve as a useful first step toward development of an agricultural BMP payment program; Conestoga and the Great Miami River Basin both demonstrated reverse auctions to be a cost-effective approach to securing nonpoint load reductions (Kieser & McCarthy, 2012). Stakeholders in the basin could also work towards expanding UNCWI activities and funding. Although land conservation investments do not necessarily qualify as a nutrient reduction activity by the Falls Lake Rules, working toward their qualification under the Rules could be pursued, perhaps, through continued demonstration and quantification of its associated pollution reductions. Regardless of the approach taken, whether it is inside or outside the Falls Lake Rules regulatory framework, we emphasize that the time is ripe for action.

CONCLUSION

To meet the goals of the Falls Lake Rules and ensure a healthy, long-term supply of drinking water for the 190,000 residents of the Upper Neuse River Basin, it is critical that nonpoint sources of nutrient pollutants, such runoff from agricultural activities and urban stormwater, are addressed. Providing market-based financial incentives in the form of payments to private landowners and farmers to implement watershed conservation activities can provide a low-cost, environmentally effective, and politically- and socially- favorable approach to addressing these nonpoint pollution sources. Programs around the country have demonstrated that, given the presence of a few key preconditions, this approach can be effective and preferentially favored over traditional grey infrastructure approaches. This study provides a customized feasibility analysis for the potential development of such scaled-up payment for watershed services (PWS) program in the Upper Neuse River Basin. Results from this study demonstrate that the UNRB possesses many of the same attributes as other successful PWS programs, as well as many of the identified key preconditions for success, including an engaged stakeholder group and diversified financing portfolio. These results suggest that a PWS program in the UNRB will be not only feasible, but successful as well. From five overarching recommendations, we provide a list of opportunities the UNRB could explore to further position itself for success, including the designation of one stakeholder engagement organization with a dedicated funding source and the undertaking of additional publicity and public outreach efforts. With the official implementation of the Falls Lake Rules beginning for new development and the agricultural sector in 2013, it is imperative that actions are taken quickly to ready the UNRB for this cost- and environmentally-effective approach to improving water quality. Quick action will ensure that these sectors can meet their nutrient load reduction requirements in the lowest-cost and most expedient manner possible.

ACKNOWLEDGEMENTS

We would like to thank our client, Lisa Creasman from the Conservation Trust for North Carolina, for the opportunity to undertake this undoubtedly timely and important project. We would also like to thank our collaborators, Todd Gartner at the World Resources Institute and Lydia Olander at the Nicholas Institute for Environmental Policy Solutions, for their invaluable input throughout the project. We extend our deepest gratitude to our Masters Project advisor, Jim Salzman, for his guidance, insight, and careful review. Finally, we would like to note our appreciation to the many local and non-local professionals who offered their time and energy to meet with us and provide valuable information and insight. We are greatly appreciative of all those that helped make this project possible, and we hope that the contribution of this project to the water quality and conservation initiatives of the Upper Neuse River Basin is able to outweigh the tremendous contributions of the many who helped make it possible.

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APPENDIX A

ID	Case Study	Point Person	Resources/Where case was mentioned
1	Tualatin River Basin, Oregon	Kaola	Case studies utilized in Nicholas Institute report
2	Contra Costa Water District	June	Case studies utilized in Nicholas Institute report
3	Conestoga Watershed, Pennsylvania	Andrea	Case studies utilized in Nicholas Institute report.
4	NYC	June	Appleton paper on DurhamES drive, http://www.biodiversity.ru/programs/ecoservices/library/functions/water/doc/Postel_Thompson_2005.pdf, http://www.conservationregistry.org/projects/17166
6	Upper Little Tallapoosa River Watershed, Georgia	June	http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf
8	Raritan Basin, New Jersey	Kaola	http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf
5	Bull Run Watershed, Oregon	June	http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf
7	Portland Water Bureau (Portland, Gresham, and Fairview in Oregon)	June	http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf, http://www.biodiversity.ru/programs/ecoservices/library/functions/water/doc/Postel_Thompson_2005.pdf
9	Merrimack Village District Water Works, New Hampshire	June	http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf
10	Suffolk County and its Towns, New York	June	http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf
11	Waynesville, North Carolina	Andrea	http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf
12	Manchester, New Hampshire	June	http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf
13	Quabbin and Wachusett Reservoirs	June	http://www.epa.gov/enviroed/pdf/swpcases.pdf
14	Seattle Public Utilities, Cedar River Watershed and South Fork Tolt Watershed	Andrea	http://www.epa.gov/enviroed/pdf/swpcases.pdf
15	Salt Lake City Corporation, Department of Public Utilities (Wasatch Canyons)	June	http://www.epa.gov/enviroed/pdf/swpcases.pdf
16	Portland Water District (Portland, Maine – Sebago Lake)	Kaola	http://www.epa.gov/enviroed/pdf/swpcases.pdf, http://www.biodiversity.ru/programs/ecoservices/library/functions/water/doc/Postel_Thompson_2005.pdf
17	Hetch Hetchy and NPS	June	http://www.epa.gov/enviroed/pdf/swpcases.pdf
18	Raleigh, NC; penny per hundred gallons	Kaola	
19	Salem, Oregon	June	http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-OR-Salem.pdf

20	McKenzie River Watershed, City of Eugene	June	http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-OR-McKenzie-River-Agriculture.pdf
21	San Antonio, Texas; Edwards Aquifer Sensitive Lands Acquisition	Kaola	http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-TX-SanAntonio.pdf, http://www.conservationregistry.org/projects/17189
22	Philadelphia Water Department (Land acquisition grant and restoration)	Kaola	http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-PA-Philadelphia.pdf
23	Burlington, Vermont; watershed restoration and protection (near Lake Champlain)	Kaola	http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-VT-Burlington.pdf
24	Auburn, Maine	Kaola	http://www.biodiversity.ru/programs/ecoservices/library/functions/water/doc/Postel_Thompson_2005.pdf
25	Syracuse, NY	Andrea	http://www.biodiversity.ru/programs/ecoservices/library/functions/water/doc/Postel_Thompson_2005.pdf
26	Clean Water Management Trust Fund in North Carolina (CWMTF) as a state-wide effort to pay for water quality	Kaola	Cooley and Mercer, "Taking Stock"
27	Santa Fe, NM (forest protection for drinking water)	Kaola	Cooley and Mercer, "Taking Stock"; Stanton et al. 2010, http://www.conservationregistry.org/projects/17158
28	Denver, CO (forest protection for drinking water)	Kaola	Cooley and Mercer, "Taking Stock"; Stanton et al. 2010
29	Bonneville Water Restoration Certificate Program	Andrea	Cooley and Mercer, "Taking Stock", http://www.conservationregistry.org/projects/15801
30	Deschutes County, Oregon	Kaola	http://www.conservationregistry.org/projects/17171
31	Mokelumne Watershed Project in CA*(may be still in the planning phase)	Kaola	http://www.conservationregistry.org/projects/17170
32	Conserve to Enhance (Pima County, AZ)	Kaola	http://www.conservationregistry.org/projects/17168
33	Dubuque, Iowa (Mississippi River and Lake Champlain Basins)	Andrea	http://www.conservationregistry.org/projects/17162
34	Florida Ranchlands Environmental Services Project (FRESP) – then it was scaled up to : Dispersed Water Management Northern Everglades and Estuaries Payments for Ecosystem Services Program	Andrea	http://www.conservationregistry.org/projects/15813 (scaled up: http://www.conservationregistry.org/projects/17155)
35	Thermal Loading Offsets (Northwestern Oregon)	Andrea	http://www.conservationregistry.org/projects/15843
36	Virginia's Forests to Faucets Initiative (Abermale County, VA)	Andrea	http://www.conservationregistry.org/projects/15852
37	City of Tulsa Source Water	Andrea	http://www.conservationregistry.org/projects/15791

	Protection Program		
38	Denver Water Forest to Faucet Partnership	Andrea	http://www.conservationregistry.org/projects/15792
39	White River Partnership (Landscape Auction)	Andrea	http://www.conservationregistry.org/projects/15855
40	Flint River Basin (Miller County, GA)	Andrea	http://www.conservationregistry.org/projects/15817
41	Salmon-Safe Farm Certification Program	Andrea	http://www.conservationregistry.org/projects/15752
42	Chesapeake Bay Nutrient Trading Program	Andrea	http://www.chesapeakebay.net/content/publications/cbp_12203.pdf, also look at the bay bank
43	Conservation Reserve Program (as a national program)	Andrea	http://www.forest-trends.org/documents/files/doc_134.pdf
44	Republican River Project	Andrea	Majanen et al. 2011 (doc: "pws_agandlandowners.pdf"
45	Conservation Marketplace of Minnesota, City of Cold Spring's	Andrea	Majanen et al. 2011 (doc: "pws_agandlandowners.pdf"
46	Montana Water Project (aimed at ranchers)	Andrea	Majanen et al. 2011 (doc: "pws_agandlandowners.pdf"
47	Federal Recovery Credit System (used for credit trading on military bases)	Andrea	http://www.fws.gov/endangered/landowners/presentation-script.html
48	Edwards Aquifer in San Antonio & Austin (drinking water mgmt zone, water quality protection land)	Andrea	http://www.austintexas.gov/department/water-quality-protection-land
49	Baltimore	June	

PWS Program Score Card Template

Program Name/Loc.

Basic Program Overview:

Program Attribute	Description	Alignment Rating Criteria
Primary Hydrologic Service Targeted	• Water Quality • Recreation • Water Quantity	
Co-benefits	• Recreation • Water Quantity • Biodiversity/Wildlife Management • Tradeoffs • Write tradeoffs	
Payment Type	• *Go by paper • Non-Market Government PWS • Non-Market Private Sector PWS • Non-Market Hybrid PWS • Water Quality Trading Scheme	
Payment Mechanism	• Cash payment • Subsidy payments • Cost-share agreements • Land purchase deals, etc.	
Payment Source	• User fees • Bonds • State or Federal Funds • Trust Fund, etc.	
Activities Funded	• What BMPs • Land conservation • Educational and outreach programs?	
Duration of program	• How long program has been in place	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): • Sellers: • Intermediaries/Donors:	1: buyers and sellers don't match 2: one buyer or one seller match 3: 4: buyers and sellers match but not all 5: all buyers and sellers match
Beneficiaries (Type and Amount)	• Recipients of ES	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public

		4: primary beneficiary is public utility but others more significant than in UNRB 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• Square miles	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source Type	• Man-made Reservoir? • Natural lake? • Bay/natural water body not used for drinking water • Aquifer? • Rivers?	1: impaired water body (not for drinking) 2: 3: aquifer/river 4: Lake 5: Reservoir
Scale	• What area is covered? (also include if it's local, regional, national) • If covered area is not entire watershed, how big is the watershed? • How many people does it serve? • What kind of water body? Aquifer? Reservoir? River?	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: 5: watershed-scale
Government and Utility Coordination	• # of counties in a watershed • # of municipalities in a watershed • # of cities in a watershed	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• Who are the buyers and who are the sellers and where are they located?	1: buyers are non-local 2: local buyers outside the watershed 3: local buyers entirely inside the watershed 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in

		watershed
Biophysical characteristics	• Land use of the watershed or program area (breakdown of forests and agriculture, for example) • What are the contributions of the different nonpoint sources? (e.g., ag vs. urban runoff)	1: meets none of the criteria 2: meets 1 of the criteria 3: meets half criteria 4: meets 3 of four criteria 5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• Regulatory compliance? What kind? • Cost reduction? • Voluntary? Why?	1: no regulatory driver 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• Practice-based – paying for a practice not result • Performance-based—paying for an observed reduction of water quality results	1: practice-based (paying for a BMP, not load reduction per se) 3: both practice- and performance-based (paying for a BMP with an implied associated load reduction) 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment Ranking Criteria
Potential Supply of Enhanced Ecosystem Services	• Are there enough BMPs and targeted lands to justify a PWS program? In other words, are there ample opportunities for pollution reduction measures? • Has a study been done to assess this?	
Ample Supply of Sellers?	• Do the potential suppliers seem willing to participate? What is their perceived reception in terms of values, understanding, experience with similar programs, level of stakeholder involvement	
Ample Supply of Buyers/Demand for Service	• Has a supply/demand analysis been conducted? What were the outcomes?	
Monitoring and Evaluation	• Systems for monitoring and evaluation? • Specific performance benchmarks (criteria for evaluation)?	1:Program has no specific goals or performance benchmarks (criteria for evaluation)

	• Performance against a certain baseline?	2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• Sustainable funding mechanism and institutional structures? • Measures to ensure permanence/lasting environmental improvements?	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal 4: 5: Program activities has means to remain in place more than 10 years after implementation
Program Administration	• 3rd party, government, etc… • Any system of checks and balances or binary roles?	1: Unilateral sub-watershed administration 2: 3: Administered through cooperation between major players 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Tools to facilitate and encourage transactions? • Online transaction platforms where beneficiaries can find suppliers and conduct transactions, allowing an GO, government agency, etc.. to bring beneficiaries together • Institutions established to match buyers and sellers? • Seller collaboration or grouping?	
Pricing and Payment	• Will payments/pricing result in most economically efficient means of meeting environmental or cost reduction goals?	
Conflicting Programs and Goals	• Are there any	
Opportunities for Stacking	• Are there any	
Adaptability and Scaling Up	• Are institutional and financial mechanisms adaptable over time? • Able to link up with other programs? • Ability to expand and scale up?	
Supporting organizations	• Public support from community organizations • NGOs (land trusts, etc…)	

	• Sometimes NGOs can bring parties together for example, bringing landowners together to collaborate into a PWS arrangement	
Supporting laws, regulations, administrative rules	• Future rules • Local government mandate	
Competing Investment Options	• Do beneficiaries face options for substitution? • Are there tradeoffs to investment? • What are the competing opportunity costs? • If available, green versus grey costs	

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• Pounds N,P, sediment deposition avoided? per acre, per BMP, per $ invested? is this compared to a baseline or goal? • Acres conserved? • Percent increase in acres conserved • Whatever else may indicate progress toward meeting environmental goal.
Economic Efficiency	• Number of Transactions – fraction of potential sellers that have successfully been paid to implement something • Costs (including transaction costs) – cost per lb avoided? per BMP? per acre? per participant? • $ saved as compared to alternative – green vs. grey. – green/grey ratio cost
Synergies or Externalities	• What co-benefits? Presence of threatened/rare species? • What co-costs?
Political and Social Favorability	• Does the program seem politically and socially popular? • Are there clear winners/losers that may cause potential conflict?
Future Outlook	• General comments here on how it's looking, impressions on stability over time, etc.

Additional Comments:

More information:

- Key contacts?
- Relevant/informative website(s)?

Primary Recommendations for UNRB:

Citations and Resources:

Completed Score Cards

PWS Program Score Card

Program Name/Loc.	• Upper Neuse River Basin • Triangle Region of North Carolina

Basic Program Overview:

Program Attribute	Description	Alignment Ranking
Primary Hydrologic Service Targeted	• Water Quality Secondary: Water Quantity	
Co-benefits	• Recreation • Water Quantity • Biodiversity/Wildlife Management • Hydrologic Functioning	
Payment Type	• Not applicable.	
Payment Mechanism	• Not applicable.	
Payment Source	• Not Applicable.	
Activities Funded	• BMPs such as buffer restoration and fencing • Land conservation • Stormwater management	
Duration of program	• Not Applicable.	
Participants	• Potential Buyers: Local governments (municipalities and county governments) and the Upper Neuse River Basin Association/Falls Lake Watershed Association. • Potential Sellers: Farmers and landowners. • Intermediaries/Donors: Land trusts, soil and water conservation districts, North Carolina State Cooperative Extension, environmental organizations, and private donors or foundations. •	1: buyers and sellers don't match 2: one buyer or one seller match 3: 4: buyers and sellers match but not all 5: all buyers and sellers match

Beneficiaries (Type and Amount)	• 500,000 water utility customers that benefit from clean drinking water • Six public water utilities (municipalities that obtain water from UNRB reservoirs)	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public 4: primary beneficiary is public utility but others more significant than in UNRB 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• 770 square miles	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source Type	• 9 drinking water reservoirs	1: impaired water body (not for drinking) 2: 3: aquifer/river 4: 5: Reservoir
Scale	• A potential program would ideally cover the entire watershed	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: 5: watershed-scale
Government and Utility Coordination	• 6 counties (Durham, Wake, Franklin, Person, Orange, and Granville counties) • 8 municipalities (City of Durham, City of Raleigh, City of Creedmoor, Town of Stem, Town of Butner, Town of Roxboro, Town of Hillsborough, and Town of Wake Forest) • Raleigh is one of the fastest growing cities in the United States and Durham is one of the fastest growing counties in North Carolina	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed 5: multiple burgeoning cities within the watershed and dependent on water source thru

		multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• Water is sold locally in nearby regions and most buyers are located entirely inside the watershed, there is one significant buyer, the City of Raleigh, who straddles the watershed. Essentially, there are many jurisdictions within the UNRB that move water inside and outside of the basin. • Water withdrawn from the Town of Hillsborough, Town of Butner, and Town of Creedmoor reservoirs remain inside the UNRB. When Durham and Orange County withdraw water, it stays partially inside and outside the UNRB. • Water withdrawn by Durham supplies its municipality in the UNRB and in the Cape Fear basin and water withdrawn by Orange County goes to areas within the UNRB as well as outside to Alamance County. • Water withdrawn by the City of Raleigh leaves the basin	1: buyers are non-local 2: local buyers outside the watershed 3: local buyers entirely inside the watershed 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• Forests cover 57% of the basin, while suburban and urban development cover 14% and cultivated lands cover 18% of the land in the UNRB • Grasslands, wetlands, and water bodies cover a smaller portion of the watershed at 6%, 2%, and 3% respectively. • The percent development is expected to increase with populations projected to increase by 90% over next 30 years • Triassic soils are present in the Upper Neuse, most notably in the Ellerbe Creek watershed in Durham. These soils are characterized by poor porosity and low permeability, which complicates water drainage and quality in the basin • Agriculture, stormwater runoff, wastewater deposition, and fossil fuel use are typically identified as primary sources of nutrient pollution in the UNRB	1: meets none of the criteria 2: meets 1 of the criteria 3: meets half criteria 4: meets 3 of four criteria 5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• Falls Lake Rules is a nutrient management strategy that is the current regulatory driver. • Falls Lake was classified as impaired due to	1: no regulatory driver 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body

	high loading of nitrogen and phosphorous and put on the EPA's 303(d) list in 2008 • The Falls Lake Rules are designed to bring Falls Lake into compliance with federal and state water quality standards by 2041. Targets are for a 40% reduction in nitrogen and 77% reduction in phosphorus from a 2006 baseline.	(e.g., filtration waiver) 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• The Rules can be considered performance-based because final evaluation for compliance with the Falls Lake Rules depends on the actual reductions in Falls Lake and not efforts to address the pollution	1: practice-based (paying for a BMP, not load reduction per se) 3: both practice- and performance-based (paying for a BMP with an implied associated load reduction) 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem Services	• Only 12% of land is protected in the UNRB. • Two land parcel prioritization schemes have been run to pinpoint lands that are critical to water quality – the most current prioritization exercise identified 1,300 land parcels that would provide high water quality benefits. • According to the NC Division of Water Quality, the majority of farms in the Upper Neuse have already voluntarily implemented the nutrient-reducing BMP of maintaining or restoring riparian buffers along waterways. • The Falls Lake Rules' Watershed Oversight Committee is identifying other BMPs that the agricultural sector could use toward meeting its reduction goals. • Overall, little quantifiable knowledge exists on the potential supply of ecosystem services available on the landscape through land conservation or the implementation of BMPs	
Ample Supply	• In total, the UNRB contains 119,000 parcels	

of Sellers?	with an estimate of around 87,000 landowners. • Land trusts, soil and water conservation districts, and non profit organizations can help motivate the supply of sellers	
Ample Supply of Buyers/Demand for Service	• The demand for best management practices and land acquisition to obtain watershed benefits is currently being driven by the Falls Lake Rules. Local governments and developers meeting the nitrogen and phosphorus reductions in the rules can buy offsets, which can be negotiated to be best management practices. • There is an expectation is that demand for ecosystem services will be driven in large part by local governments. This will be dependent on which BMPs are accounted for in nutrient reduction requirements or the overall strategies local governments design to meet their water quality goals. • However, there has also been increasing awareness of water quality benefits from land conservation and land trusts have been negotiating conservation easements for this purpose as well as for other benefits.	
Monitoring and Evaluation	• The Falls Lake accounting tool was developed by North Carolina State University in coordination with NCDENR to be used as a monitoring and evaluation tool for existing and new development to be in compliance with the Falls Lake Rules. • This accounting tool is identical to the tool being used in the Jordan Watershed, which is an updated version of the Tar-Pamlico tool. • Currently, this tool is only useful for accounting for nutrient loads for new and existing development. Tracking and accounting methods for nitrogen and phosphorus loading for agriculture are planned for late spring 2012. • The TJCOG and USGS are part of the Triangle Area Water Supply Monitoring. The Project has tracked water quality and quantity conditions and trends in many of	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place

	the Triangle area's water supply reservoir. It is currently doing work to expand a water quality database for major ions, nutrients, sediments, and trace elements, collect water quality data at tributary sites; investigate mercury content in water and sediment; maintain current stream gages; and publish water quality trends for data collected in 2007. With monitoring sites along Little River, Eno River, Flat River as well as the upper and lower portions of Falls Lake, this project provides detailed water quality monitoring data for the UNRB.	
Permanence and Sustainability	• The only current revenue stream for watershed protection are Raleigh and Durham's watershed fees • The Falls Lake Rules is set to end in 2041 and its role as a driver will not be permanent	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal 4: 5: Program activities has means to remain in place more than 10 years after implementation
Program Administration	• The Upper Neuse River Basin Association also called the Falls Lake Watershed Association has the potential to facilitate or administer a payment for watershed services program. However, nonprofit organizations and other important stakeholders are not included in this body. • The Triangle J Council of Governments also has the potential to facilitate a watershed scale program especially with its experience in facilitation partnerships like the Clean Water Education Partnership. However, it ultimately has a 'local government' focus.	1: Unilateral sub-watershed administration 2: 3: Administered through cooperation between major players 4: 5: Administered by a watershed-level governing body
Transaction Costs	• As intermediaries, land trusts, soil and water conservation districts, and environmental organizations can reduce transaction costs by bringing together buyers and sellers in a payment for watershed services program. • There are currently no tools specific to the UNRB to facilitate or encourage transactions for PWS programs, however, supporting organizations detailed below	

	may play a role in helping cover project costs. In addition, future tools such as LandServer (landserver.org) may be useful in reducing the high upfront costs for enrolling in payment for ecosystem service programs.	
Pricing and Payment	• Information not available.	
Conflicting Programs and Goals	• The Falls Lake Rules threaten compulsory agriculture BMPs should reductions not be met in Stage I of the rules. Compulsory BMPs would go into effect in Phase II and this would remove the possibility of cost-share programs because state and federal cost-share programs as well as other voluntary payment programs would not want to pay for BMPs mandated by regulations.	
Opportunities for Stacking	• Information not available.	
Adaptability/Scaling Up	• Adaptive management is incorporated into Phase II of the Falls Lake Rules	
Supporting organizations	• Upper Neuse Clean Water Initiative • Falls Lake Watershed Association/Upper Neuse River Basin Association (UNRBA) • Triangle J Council of Governments • Triangle Urban Long Term Research Area • Conservation Trust for North Carolina • Ellerbe Creek Watershed Association • Eno River Association • Triangle Land Conservancy • Triangle Greenways Council • Neuse Riverkeeper Foundation	
Supporting laws/regulations/administrative rules	• Stream Buffer Rules (all local governments located in the UNRB have stream buffer ordinances- the minimum stream buffer mandated is 50-feet) • Soil Erosion Control (Raleigh, Durham, Wake County, and Orange County have soil erosion control measures that require permitting for land-disturbing activities) • Floodplain protections (Wake County and the City of Durham do not allow new development in 100-year floodplains; Orange County restricts development in floodplains near its headwaters) • Stormwater Rules (Orange County	

	stipulates that flows must be diffused before entering stream buffers; City of Durham, Durham County, and Raleigh require stormwater to be treated before it is discharged) • Federal NPDES Phase II Rules • Neuse Buffer Rule – requires a 50 foot buffer as part of compliance to Neuse Nutrient Sensitive Waters Rules • NC Clean Lakes Act – directed the NC Environmental Management Commission to adopt and develop a nutrient management strategy for N & P in Falls Lake • Improve Upper Neuse Water Quality (extended the deadline of the NC Cleans Lake Act)	
Competing Investment Options	• Ecosystem service suppliers face investment competition from developers in this rapidly growing area	
Other (indicate)		

Citations and Resources:

Hart, K. *The Upper Neuse Clean Water Initiative Conservation Plan: Protecting Land and Drinking Water for the Future*. (2006).

NC Department of Agriculture and Consumer Services Agricultural Statistics. (2007).at <http://www.ncagr.gov/stats/codata/index.htm>

NC Division of Water Resources *Neuse River Basin Water Resources Plan*. *Environmental Management* 132 (2010).

NC Division of Water Resources *2001 State Water Supply Plan*. *2010 State Water Supply Plan* (2001).

NC Division of Water Quality Planning Section *Fiscal Anlaysis for Proposed Nutrient Strategy for Falls of Neuse Reservoir*. *Analysis* (2010). Available from <http://portal.ncdenr.org/c/document_library/get_file?uuid=2a29f5a4-3db1-4c63-bd63-cad51a5ac385&groupId=38364>

NC DWQ NCDENR - Rules Implementation Information. (2012). Available from http://portal.ncdenr.org/web/fallslake/rules-implementation-information

NC Environmental Management Commission *Proposed Rules for Falls Lake Reservoir Water Supply Nutrient Strategy*. *Water* (2010).

Triangle Land Conservancy & Tar River Land Conservancy Upper Neuse Clean Water Initiative: Technical Report. (2010).

USGS & TJCOG Triangle Area Water Supply Monitoring. (2012).

UNRBA Board of Directors Upper Neuse River Basin Association, Inc. Bylaws. (2011). Available from <http://www.unrba.org/docs/bylaws.pdf>

UNRBA Upper Neuse Watershed Management Plan. (2003) available from http://www.unrba.org/docs/finlplan.pdf

UNRBA Support of Long-Term Planning and Regulatory Nutrient Management Activities in the Falls Lake Watershed. (2011) available from http://www.unrba.org/docs/pathforwardrfp2011.pdf

Wittenborn, A. & Moreau, D. *The Neuse River Basin Agricultural Nitrogen Reduction Strategy: A Programmatic Analysis*. (Chapel Hill, NC, 2007). Available from <http://repository.lib.ncsu.edu/dr/bitstream/1840.4/4111/1/NC-WRRI-381.pdf>

PWS Program Score Card

Program Name/Loc.	• Quabbin and Wachusetts Reservoirs • Boston, MA

Basic Program Overview:

Program Attribute	Description	Alignment Ranking
Primary Hydrologic Service Targeted	• Water quality (has a filtration waiver—chlorination and filtration occurs when there is pipe maintenance)	
Co-benefits	• Recreation – a game population is kept under control with hunting; 1200 ha belonging to DWSP (2% of watershed) is for public recreation • Research facilities—DWSP allows research permits • Forest management – provides $500,000 to $1 million in revenue annually	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Cash payment	
Payment Source	• PILOT is funded by a tax paid by the water consumer • PILOT payments are about $5 million a year • An additional $7 million annually is used to purchase lands	
Activities Funded	• Boston city owns 22,000 ha of the 48,000 ha watershed and still wants to acquire land • PILOT (land acquisition) • Conservation easements (10 so far on the watershed totaling to 300 ha with private owners) • DWSP encourages and partly finances private forest management plans • (forest management done with the main objective of forest management) • Bird harassment program	
Duration of program	• Managed since 1961 and continues to manage today	
Participants	• Buyers: DWSP (Department of Watershed Protection)	1: buyers and sellers don't match

	Sellers: landowners	2: one buyer or one seller match 3: **4: buyers and sellers match but not all** 5: all buyers and sellers match
Beneficiaries (Type and Amount)	• 2.2 million who live in the Boston region and 5,500 industrial users	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public **4: primary beneficiary is public utility but others more significant than in UNRB** 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• 48,000 ha or 119,940 acres (UNRB 492,800 acres)	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, **3: if order of mag larger,** 4: if twice as large, 5: if same size (UNRB is 770 square miles)
Water Source Type	• The Wachusett Reservoir receives water from the Quabbin Reservoir through the Quabbin Aqueduct	1: impaired water body (not for drinking) 2: 3: aquifer/river 4: **5: Reservoir**
Scale	• Local—city planning; Metropolitan Water District	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **5: watershed-scale**

Government and Utility Coordination	• Public ownership of water supply system
	• uses gravity mostly versus using pumps to get water to customers
	• 1 municipality
	• 117 square mile Wachusett Reservoir includes portions of the Cities:
	    • Boylston, Clinton, Holden, Hubbardston, Leominster, Paxton, Princeton, Rutland, Sterling, West Boylston, Westminster, and Worcester (12)
	    • Overall 51 communities and 2.2
		1: one city in watershed and using the water
		1: one city within watershed with its own utility
		2: one utility serving multiple cities inside (not outside) the watershed
		3: one utility serving multiple cities both inside and outside the watershed
		4: multiple cities within the watershed and dependent on

	million residents	**water source thru multiple utilities, not dependent cities outside the watershed** 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• Buyers are inside and outside the watershed and water travels downstream to users	1: buyers are non-local **2: local buyers outside the watershed** 3: local buyers entirely inside the watershed 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• 87% forested and 6% wetlands • Type of water catchment: catchments of rivers/streams (reservoir) • Well drained soils • Forest management: Uneven-aged stands, mixed species homes	1: meets none of the criteria 2: meets 1 of the criteria 3: meets half criteria 4: meets 3 of four criteria **5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)**
Drivers	• Legislation—The division's mandate is laid out in Laws and Regulations administered by the state of Massachusetts • This program is also looking to maintain its filtration waiver	1: no regulatory driver **2: non-TMDL regulatory driver for polluted drinking water body** 3: impaired drinking water body with pending TMDL and no associated rules 4: impaired drinking water body with established TMDL and no associated rules 5: impaired drinking water body with established TMDL and associated rules
Practice or Performance-based?	• Practice-based—The Filtration Avoidance Determination requires implementation of programs to reduce susceptibility of water sources to contamination including land acquisition, land management, etc… • Water quality testing is still done to test whether or not drinking water meets health	1: practice-based **3: both practice- and performance-based** 5: performance-based

	standards	

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem Services	• 90% forested • 22,000 ha controlled by the waterworks company • 3,300 ha belong to other governmental agencies and are under protection • The total area is 43,300 ha • 4800 ha do not have forest management	

Ample Supply of Sellers?	• 18,000 ha are privately owned
	  • 7,000 have protective management
	  • 11,000 do not have any restriction	

Ample Supply of Buyers/Demand for Service	• Yes because of government mandate; unknown for other land acquisitions	
Monitoring and Evaluation	• Both the DEP and EPA conduct strict oversight of DCR operations and watershed protection activities in the Wachusett Reservoir watershed. DEP conducts annual inspections of the system because DCR is a public water supplier. DEP uses four distinct criteria in its evaluation of DCR's watershed protection efforts: • Demonstration and implementation of watershed control. • On-site inspection of the water supply system. • Documented absence of waterborne disease outbreaks. • Compliance with the existing U.S. Safe Drinking Water Act's maximum contaminant levels. Each year that DEP has inspected DCR operations, it has found that DCR had demonstrated adequate control measure for water quality protection. The implementation of watershed plans, including the Wachusett Reservoir's Watershed Protection Plan, Public Access Plan, and Land Management Plan ensures that 2.2 million people and 5,500 industrial users continue	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results **5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place**

<table>
<tr><td></td><td>to enjoy an abundant and high-quality water supply.</td><td></td></tr>
<tr><td>Permanence and Sustainability</td><td>MWRA Ratepayers
Legislation provides agenda for management, but then there are some political risks (seem fine so far though)</td><td>1: One-time grants with no renewal in sight
2:
3: Not definite, but has potential and record of renewal
4:
<u>5: Program activities has means to remain in place more than 10 years after implementation</u></td></tr>
<tr><td>Program Administration</td><td>Massachusetts Water Resources Authority (MWRA) and the Massachusetts Department of Water Management
DWM—now the Department of Conservation and Recreation: responsible for reservoir watershed operation and management to supply a safe and sufficient supply of water to the MWRA – under the Office of Watershed Management within the Division of Water Supply Protection
Mission of the Office of Watershed Management: provide pure water through responsible land management
MWRA is responsible for the treatment and distribution of the water
MWRA is funded by ratepayers— this funds the entire budget, including land purchases (so both MWRA and OWM are funded by ratepayers)</td><td>1: Unilateral administration
2:
3: Administered through cooperation between major players
4:
<u>5: Administered by a watershed-level governing body</u></td></tr>
<tr><td>Transaction Costs</td><td>Programs like PILOT are in place to help reduce transaction costs</td><td></td></tr>
<tr><td>Pricing and Payment</td><td>Unknown</td><td></td></tr>
<tr><td>Conflicting Programs and Goals</td><td>Biggest threat is privately-owned watershed forests into housing developments</td><td></td></tr>
<tr><td>Opportunities for Stacking</td><td>Unknown</td><td></td></tr>
<tr><td>Adaptability/Scaling Up</td><td>Public institution, governed by mandates from legislation</td><td></td></tr>
</table>

Supporting organizations	• Local government entities	
Supporting laws/regulations/administrative rules	• Filtration Avoidance Waiver • Safe Drinking Water Act • Governor has a five-year capital spending plan that includes at least $50 million per year for land conservation (a 65% funding increase spent over the last four years)	
Competing Investment Options	• Wetlands Protection Act • Watershed Protection Act—limits development within 120 meter of our tributaries • Land disposition: when private and public owners have an incompatible use of their land with water protection, juridical tools exist to allow DWSP to buy the lands (additional conservation) • Legislation enhanced the Office of Watershed Management to maintain drinking water supply by establishing a **Water Supply Protection Trust**—this provides a more efficient mechanism for approving the Office of Watershed Management's annual work plan and budget • 2008 **Watershed Protection Plan** (for the Wachusett Reservoir, Quabbin Reservoir, Ware River, and Sudbury/Foss Reseroirs Watersheds)	
Other (indicate) Stakeholder Engagement	• Development pressures from unprotected land	

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• Water is not filtered, but measured doses of chlorine are added to disinfect the water as it enters the aqueduct • Since 2008, there has been 19,000 acres of land acquisition
Economic Efficiency	• 10 conservation easements, trust fund, funding from ratepayers, forest management
Synergies or Externalities	• Information unavailable.
Political and Social	• Somewhat, they are publicly owned and are dealing with criticism for forest management practices

Favorability	
Future Outlook	• The program looks as if it will continue for the long-term especially because it is financially stable and receives a steady allocation from the General Assembly for operation. It relies on very little external funding for its watershed protection program.

Additional Comments:

- The MWRA's forest management program has halted due to a public organization's opposition to forest management.

More information:

Massachusetts Water Resources Authority Website. Retrieved April 19, 2012, from http://www.mwra.state.ma.us/

Primary Recommendations for UNRB:

- Local government regulations played a big role in establishing permanence and sustainability, the UNRB should expand upon opportunities in common regulations such as the Falls Lake Rules to continue to build local capacity.
- Co-benefits of recreation, forest management, and a research facility were realized and important for stakeholder engagement; outreach to stakeholders on other benefits can help build public support

Citations and Resources:

US EPA *Protecting Sources of Drinking Water: Selected Case Studies in Watershed Management*. (1999).

Massachusetts Water Resources Authority Massachusetts Water Resources Authority Website. at <http://www.mwra.state.ma.us/>

Massachusetts Department of Conservation and Recreation. (2011). *Wachusett Reservoir Watershed 2011 Public Access Plan Update*. Retrieved from http://www.mass.gov/dcr/watersupply/watershed/documents/2011wachusettaccessplan.pdf

Massachusetts Water Resources Authority. (2012). Source Water Assessment and Protection Program. Retrieved April 19, 2012, from http://www.mwra.state.ma.us/sourcewater.htm

Barten, P.., Kyker-Snowman, T., Lyons, P.J., Mahlstedt, T. & O'Connor, R. Massachusetts: managing a watershed protection forest. *Journal of Forestry* **96**, 10-15 (1998).

PWS Program Score Card

Program Name/Loc.	• Maryland Forest Watershed Managment Program • Maryland Department of Natural Resources

Basic Program Overview:

Program Attribute	Description	Alignment Ranking
Primary Hydrologic Service Targeted	• Water Quality (ensure the quality of the untreated water in Baltimore's three reservoirs)	
Co-benefits	• Recreation • Water Quantity	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Land purchase deals, etc. • BMPs • Development of Forest Management Plans	
Payment Source	• State Funds	
Activities Funded	• Riparian forest buffers • Forest management to protect drinking water reservoirs • Watershed partnerships • Forest harvesting BMP assessments	
Duration of program	Land conservation for protection of water quality has occurred since 1880	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): Baltimore City Department of Public Works • Sellers: Landowners	**1: buyers and sellers don't match** 2: one buyer or one seller match 3: 4: buyers and sellers match but not all 5: all buyers and sellers match
Beneficiaries (Type and Amount)	• 5 million people in Maryland – fifth most densely populated state in nation—60% of the population rely on surface reservoirs for drinking water • Baltimore and Washington DC draw from surface water reservoirs for drinking water	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public **4: primary beneficiary is public utility but others more significant than in UNRB**

		5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• 444 square miles is the total surface of the reservoir watersheds (Loch Raven, Prettyboy and Liberty)	1: if order of magnitude smaller, **2: if smaller by a factor of 2 or more,** 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source Type	• Three reservoirs: Liberty Reservoir, Loch Raven Reservoir, and Prettyboy Reservoir (Across 2 watersheds—Loch Raven and Prettyboy reservoirs are in the Gunpowder watershed and Liberty is in the upper Patapsco watershed)	1: impaired water body (not for drinking) 2: 3: aquifer/river 4: **5: Reservoir**
Scale	• The program is statewide (USDA Forest Service and State of Maryland)	**1: city- or county-wide** 2: 3: sub-watershed but not a particular jurisdiction 4: 5: watershed-scale
Government and Utility Coordination	• Maryland administers the program, however, there are many jurisdictions within the state; a lot of focus and cooperation is in the more populated areas such as Baltimore • There are two main reservoir watersheds span four counties (Baltimore, Carroll, Harford, and York, PA) with most of the Loch Raven in Baltimore, Prettyboy in Baltimore and Carroll, and Liberty mostly in Carroll and some in Baltimore • In 1984, a comprehensive agreement was signed by Baltimore City, Baltimore County, Carroll County, the two counties' soil conservation districts, two Maryland state agencies, and the Baltimore Regional Planning Council to establish the Baltimore Reservoir Watershed Management Program • This Program was intended to reverse the negative water quality trends in the three reservoirs. (Resigned in 2003)	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed **3: one utility serving multiple cities both inside and outside the watershed** 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• Buyer is the Maryland DNR Forest Service who supports the four management action (see activities funded) and seller are those within the three reservoir watersheds • For Acquisition programs they can be	1: buyers are non-local **2: local buyers outside the watershed** 3: local buyers entirely inside the watershed

	through various DNR programs, CREP, Land Conservancies or other	4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• 41% forest cover in Maryland • Between 1880 and 1955, Baltimore city acquired more than 7,100 ha of land around the reservoirs to protect watersheds	1: meets no of the criteria 2: meets 1 of the criteria 3: meets half criteria **4: meets 3 of four criteria** 5: naturally forested, and 50%-70% forested, with significant development pressure and 16% use (2001 – from MP)
Drivers	• Watershed protection, however, the Maryland Forest Watershed Management Program helps contribute to the Chesapeake Bay goal of nutrient reduction proposed in April 30, 2007	**1: no regulatory driver** 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver

Practice or Performance-based?	• Practice and performance-based	1: practice-based (paying for a BMP, not load reduction per se) **3: both practice- and performance-based (paying for a BMP with an implied associated load reduction)** 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem Services	• Watershed-wide analysis of land critical to reforest or conserve was completed and funded by the USDA Forest Service	
Ample Supply of Sellers?	• The state of Maryland suggests that there are appropriate areas to place long-term easements—to meet its goal to protect 20% of land from development 1,250,000 acres need to protected and so far 700,000 are estimated to be already protected	
Ample Supply of Buyers/Demand for Service	• Maryland has 202 Forest Conservation Goals—one being to protect an additional 250,000 acres of forest by 2020 through legal mechanisms with more than half in areas of high value to water quality	
Monitoring and Evaluation	• Monitoring is done for four of the key areas worked in (see activities funded), but not systematically for all	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit **3:Program goals are qualitative** 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program

		goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• Sustainable—funding provided by Maryland DNR and Federal programs (i.e. CREP)	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal 4: **5: Program activities has means to remain in place more than 10 years after implementation**
Program Administration	• Maryland Department of Natural Resource Forest Service • Also works cooperatively with the USDA Forest Service and Private Forestry	1: Unilateral administration 2: **3: Administered through cooperation between major players** 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Maryland DNR website helps provide information about their programs including forms and processes to apply	
Pricing and Payment	• Information unavailable	
Conflicting Programs and Goals	• Development threats	
Opportunities for Stacking	• Information unavailable	
Adaptability/Scaling Up	• Information unavailble	
Supporting organizations	• Reservoir Watershed Management Agreement of 2005 authorized continuation of the watershed management program • 2005 Action Strategy for the Reservoir Watersheds are 93 different commitments under seven major categories • Involved in regional programs to reduce nutrients and improve living resources in the Chesapeake • Also involved in the Chesapeake Bay Program, Potomac Watershed Partnership	

Supporting laws/regulations/administrative rules	• Riparian forest buffers became a focus in 1996 when the Chesapeake Bay goal of 2010 miles of new buffers created by the year 2010 was adopted • A directive was signed by the Chesapeake Executive Council in 2006 where the Governor of Maryland committed state resources to "conserving those forest lands in the Bay watershed where conservation to protect water quality is most needed"	
Competing Investment Options	• Development of high quality watershed lands	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• 1722 kilometers of riparian buffers have been restored since 1987.
Is still running to date?	• Yes
Water affordability	• Not applicable, not a water utility or municipality.
Meeting projected demand for drinking water?	• Not applicable, not a water utility or municipality.
Economic Efficiency	• Information unavailable.
Synergies or Externalities	• Co-benefits of public recreation; forest management benefits.
Political and Social Favorability	• Yes, this is part of the state of Maryland's Department of Natural Resources, which has forest conservation goals established for the long-term. • The Governor or Maryland in 2006 agreed to commit state resources towards "conserving those forest lands in the Bay watershed where conservation to protect water quality is most needed"
Future Outlook	• The future outlook for this program seems promising due to the strong positive impacts of Maryland's Forest Conservation Goal for 2020, which commits the state to time-specific goals and milestones. These provide strong targets for addressing future development impacts.

Additional Comments:

This is a state program that engages in forest management and conservation in order to protect watersheds. The forest service department of Maryland developed this watershed forest management program with the USDA and private forest associations, which looks to protect watersheds by riparian forests restoration, water reservoirs management, and related Best Management Practices.

More information:

Maryland Department of Natural Resources. (2012). Maryland Watersheds and Forest Management Program. Retrieved from http://www.dnr.state.md.us/forests/programapps/dwprotection.asp

Primary Recommendations for UNRB:

- The UNRB should consider how it fits into the goals of the state of North Carolina in order to provide synergistic forest conservation outcomes for water quality benefits. For example, Maryland's Forest Conservation Goal for 2020 commits the state to time-specific quantitative goals and milestones.
- The UNRB should also consider lobbying for a long-term forest conservation goal in the state of North Carolina in order to provide long-term impetus for forest conservation especially as one of the fastest growing states in the country. For example, Maryland's long-term forest conservation goal provides general qualitative and quantitative goals for accomplishing forest conservation including addressing urban canopy cover goals in Maryland to focus on areas developed before stormwater management requirements are mandatory.

Citations and Resources:

Baltimore Reservoir Watershed Management Program: Reservoir Technical Group. (2004). Reservoir Program Technical Report: Water Quality Assessment, Targeted Studies and Ongoing Water Quality Issues in the Baltimore Metropolitan Water Supply Reservoirs and Their Watersheds. Baltimore. from http://www.baltometro.org/RWP/ResProgTechRept.pdf

Maryland Department of Natural Resources. (2012). Maryland Watersheds and Forest Management Program. Retrieved from http://www.dnr.state.md.us/forests/programapps/dwprotection.asp

Maryland Department of Natural Resources. (2007). Current Forest Conservation Efforts in Maryland. Retrieved April 19, 2012, from http://www.dnr.state.md.us/forests/conservationgoal.asp

Hairston-Strang, A. (2007). Cooperative Forest Watershed Management in Maryland: Watershed Restoration Across Land Ownerships. Annapolis. from http://stream.fs.fed.us/afsc/pdfs/Hairston-Strang.pdf

PWS Program Score Card

Program Name/Loc.	• Cat-Del Watershed • New York City, NY

Basic Program Overview:

Program Attribute	Description	Alignment Rating
Primary Hydrologic Service Targeted	• Water Quality	
Co-benefits	• Economic benefits to farmers to avoid urbanization/development • Recreation	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Whole Farm Program: City paid staff and capital costs and a small stipend for a farmer's time	
Payment Source	• NYC Department of Environmental Protection	

Activities Funded	• Whole Farm Program (BMPS and to serve business interests)
	    • Each farm provided with a technical team that would custom design pollution control measures for each farm, to maximize effectiveness and minimize cost.
	    • Purposefully did not do a top-down BMP approach
	    • Caveat of program was needed 85% farmers within 5 years or will have to revert to traditional water regulations (93% of all farms participated on outset)
	• Land Acquisition and management for recreation in the watershed (In 2010, NYC protected 12,000 acres—since 1997, DEP has purchased 116,000 acres of land or easements adding to the 45,000 acres the City owned in 1997)
	• Partnership Programs to address failing septic systems and authorized the	

	construction of more than 70 stormwater control measures to address runoff • Waste Water Treatment Plant Upgrades • Watershed Agricultural Council, which is a private-public partnership (works with farm and forest landowners – for Whole Farm Plans, Forest Management Plans, and Conservation Easements)	
Duration of program	• Since 1997	
Participants	• Buyers: NYC DEP, USDA, USFS (the latter two help fund plans) • Sellers: Landowners (farm owners and forest land owners)	1: buyers and sellers don't match 2: one buyer or one seller match 3: **<u>4: buyers and sellers match but not all</u>** 5: all buyers and sellers match
Beneficiaries (Type and Amount)	• (NY City Water System) • 9 million people in NYC and 1 million in the suburbs of NYC • 600,000 residential and 200,000 commercial buildings, 2 dozen local water systems in NY's northern suburbs	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public **<u>4: primary beneficiary is public utility but others more significant than in UNRB</u>** 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• Water system gathers water from three watersheds, covering an area of 2,000 square miles of 830,000 hectares • 3 watersheds: Croton River watershed (10% water supply), Catskill-Delaware watershed (90% water supply)	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, **<u>3: if order of mag larger,</u>** 4: if twice as large, 5: if same size
Water Source Type	• Network of 19 reservoirs and three controlled lakes	1: impaired water body (not for drinking) 2: 3: aquifer/river 4: **<u>5: Reservoir</u>**

Scale	• Three watersheds with a 19 reservoir network and 3 controlled lakes	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **5: watershed-scale**
Government and Utility Coordination	• At time of the program Croton supply: 3 counties (Putnam, Wetchester, Dutchess counties) – now 100% (2010) is from Cat-Del • Catskills-Delaware watersheds: 5 counties (Delaware, Greene, Schoharie, Sullivan, and Ulster counties) and 6 reservoirs • 4 cities located in the Cat-Del watershed • Water supplied by the NYC Department of Environmental Protection • However, most of the beneficiaries are in NYC (8 million versus 1 million in upstate counties) • Treats 1.3 billion gallons of wastewater per day • Distributes more than 1 billion gallons of drinking water each day	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed **4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed** 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• Buyers are inside and outside the watershed and water travels downstream to users • Water is also delivered to upstream counties: Westchester, Putnam, Ulster, and Orange • 55 municipalities	1: buyers are non-local 2: local buyers outside the watershed 3: local buyers entirely inside the watershed **4: local buyers are both inside and outside the watershed** 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• Croton River watershed was originally rural, but since WWII it is increasingly suburban • The Catskill-Delaware watershed encompasses most of the Catskill Mountains, a rural area of farms, forests, small towns, and a growing number of vacation homes	1: meets no of the criteria 2: meets 1 of the criteria 3: meets half criteria **4: meets 3 of four criteria** 5: naturally forested, and 50%-70% forested, with significant development pressure and 16% use (2001 – from MP)
Drivers	• Filtration waiver	1: no regulatory driver

	Previously failed to maintain compliance on the Croton Watershed, filtration plant was built for that watershed • Inability of low-income in NYC to afford costs of filtration plant	**2: non-TMDL regulatory driver for polluted drinking water body** 3: impaired drinking water body with pending TMDL and no associated rules 4: impaired drinking water body with established TMDL and no associated rules 5: impaired drinking water body with established TMDL and associated rules
Practice or Performance-based?	• Practice-based—The Filtration Avoidance Determination requires implementation of programs to reduce susceptibility of water sources to contamination including land acquisition, land management, etc… (see activities funded) • Water quality testing is still done to test whether or not drinking water meets health standards	1: practice-based **3: both practice- and performance-based** 5: performance-based

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem Services	• Yes, only 30% of the total land in the Cat-Del watershed was in public ownership and protected from development—the rest of the watershed was for family farm agriculture, woodlot forestry, and outdoor recreation based tourism (land acquisition and BMP supply) • In addition, by the end of the 1980s vacation home builders got lots of money for homes close to streams, which produced lots of pollution; adding to this were non-farm rural residents and residents of small local villages that promoted developments that increased road construction and road salting	
Ample Supply of Sellers?	• 91% of farmers were in the Whole Farm Program (stakeholder involvement big for this – included meetings and conditionality caveat for 85% of farmers within 5 years) • Land acquisitions have been occurring	

	since 1997 and has gone from 24% of protected land to 34% today (2010)	
Ample Supply of Buyers/Demand for Service	• DEP has renewed funding for watershed protection programs driven by Filtration Avoidance Determination	
Monitoring and Evaluation	• DEP has a Distribution System Monitoring Program, which is more extensive than required by law, to demonstrate meeting of health-related state and federal drinking water standards • In FAD Annual Report, program goals are assessed for all programs (i.e. large farm program, small farm program, etc…); report also tracks the number of projects initiated, land conserved, number of BMPs used, etc…	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results **5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place**
Permanence and Sustainability	• Permanence is helped by tradition of Filtration Avoidance Determination • Largest municipal water and wastewater utility in the country • NYC Water Board sets water and sewer rates for NYC – these members are appointed by the Mayor • (Strategic Plan 2011)	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal 4: **5: Program activities has means to remain in place more than 10 years after implementation**
Program Administration	• The NYC DEP administers the watershed programs and is a City agency and is in charge of distributing clean water and collecting and treating wastewater • Watershed Agricultural Council (WAC), however, is a 16-member Council of Directors that represents the interests of farm and forest landowners within the NYC water supply region—they are in charge of fiscal oversight and policy making	**1: Unilateral administration** 2: 3: Administered through cooperation between major players 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Nycwatershed.org website and resources to get those interested enrolled in programs	
Pricing and Payment	• Unsure, it is "cheaper" than a filtration plant, however, as regulations evolve and population grows, filtration may be needed	

Conflicting Programs and Goals	• Development threats	
Opportunities for Stacking	• Unknown, Farm Bill programs and funding, however, are used to meet some of WAC goals	
Adaptability/Scaling Up	• Unknown if institutions can be adaptable over time	
Supporting organizations	• WAC Advisory Committee • State Partners, Federal Partners, Nonprofits, and local governments	
Supporting laws/regulations/administrative rules	• Filtration Avoidance Waiver • Safe Drinking Water Act	
Competing Investment Options	• \$4 to \$6 billion dollars for filtration plant and \$250 million annually	
Other (indicate) Stakeholder Engagement	• Leading up to Whole Farm Program, there was a program of four half day sessions (Education Sessions) with City presenting and then the Farmers presenting	

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• Permanently protected land in the Cat-Del Watershed has gone from 24% in 1997 to 34% today • Has become one of the biggest landowners in the area and land management practices allow increased acreage for recreation every year (approximately 74,000 acres to date) • 10-year Filtration Avoidance Determination from EPA issued by the EPA for NYC in July of 2007 • Acres conserved? • Percent increase in acres conserved • Whatever else may indicate progress toward meeting environmental goal.
Is still running to date?	• Yes
Water affordability	• Annual water and sewer costs are \$877 per year (~\$0.0109/ gallon) • Water affordability is also part of its 2011 Strategy Plan
Meeting projected demand for drinking water?	• (for all cities using that reservoir/drawing from the watershed) • Expected to meet projected demand for drinking water • Incorporated into their 2011 Strategy Plan

Economic Efficiency	• \$4 to \$6 billion dollars and \$250 million annual operating cost for filtration plant • \$241 million allocated for land acquisition to be spent over 10 year period (beginning 1997) • To-date \$319 million spent on land acquisition • \$54.6 million to funding septic rehabilitation and replacement program • \$21 million for stormwater retrofit program • To-date a total of 783 BMPs have been implemented on small farms at a cost of more than \$2.7 million • Overall investment is thought to total at about \$500 million, entire program is cited as costing \$1.5 billion • (see below)
Synergies or Externalities	• Unavailable.
Political and Social Favorability	• NY State issued a new 15-year water supply permit that allows NYC to continue acquisition of sensitive watershed land to protect the water supply
Future Outlook	• Outlook is strong especially as shown in the 2011 Strategic Plan

Additional Comments:

"Finally, as the New York City experience has drawn steadily more attention, some have raised the issue of whether or not the financial savings for New York City were so great that the New York City experience is unique and not particularly applicable to other ecosystem service situations. This author suggests that puts the matter exactly backward. The financial savings for New York were so great because it was receiving such a high level of ecosystem service, and because it had created water institutions that had the flexibility and financial resources to move quickly to seize the economic and environmental opportunities using ecosystem services offered." (Appleton 2002)

"But the key to the program was how the pollution control was designed. Instead of selecting a top down menu of best management practices to be applied to each farm-- the typical non-point source pollution regulatory approach--the Whole Farm program would provide each farm with a technical team that, with the full participation of each farmer, would custom design pollution control measures for each farm, to maximize their effectiveness and minimize their cost. A particularly important feature of this custom design was that the measures would be selected not only for their pollution control benefits, but they would also be designed into and integrated with the farmer's business plan and management practices for his farm." (Appleton 2002)

More information:

NYC Department of Environmental Protection website:
http://www.nyc.gov/html/dep/html/watershed_protection/index.shtml

Watershed Agricultural Council website:

http://www.nycwatershed.org/aw_description.html

Primary Recommendations for UNRB:

- Instead of selecting a top-down menu of BMPs to be applied to each farm, their Whole Farm program provided each farm with a technical team that would help them custom design their measures; farmers also benefited by business leading to a participation rate of 91% of farmers—the UNRB would benefit by integrating program participants into the design of how to meet water quality goals for nonpoint source pollution
- NYC had water institutions that had the flexibility and financial opportunities to seize the opportunity to protect the ecosystem services offered in their watershed. While the UNRB has many local government and water institutions, they would benefit from coordinating together flexibly in order to take advantage of opportunities as they come
- The program funded land acquisition, addressed failing septic systems, performed waste water treatment plant upgrades, and founded a watershed agricultural council (private-public partnership of farm, forestland owners, and local governments) that works on easements and forest management plans; the UNRB would particularly benefit from a reliable source of funding for a multi-faceted program to address water quality threats

Citations and Resources:

Appleton, A. F. (2002). How New York City Used an Ecosystem Services Strategy Carried Out through an Urban-Rural Partnership to Preserve the Pristine Quality of its Drinking Water and Save Billions of Dollars. *Environmental Protection*.

EPA. (2011). History of the New York City Watershed Filtration Avoidance Determination. Retrieved April 19, 2012, from http://www.epa.gov/region2/water/nycshed/

NYC Department of Environmental Protection. (2010). New York City 2010 Drinking Water Supply and Quality Report. 2010. Retrieved from http://www.nyc.gov/html/dep/pdf/wsstate10.pdf

NYC Department of Environmental Protection. (2012). Exteneded New York City Watershed Land Acquisition Program. Retrieved April 19, 2012, from http://www.nyc.gov/html/dep/html/environmental_reviews/lap.shtml

NYC Department of Environmental Protection. (2011). New York City Strategy 2011-2014. Retrieved April 19, 2012, from http://www.nyc.gov/html/dep/pdf/strategic_plan/dep_strategy_2011.pdf

Watershed Agricultural Council. (2012). Watershed Agricultural Council Home Page. Retrieved April 19, 2012, from http://www.nycwatershed.org/aw_description.html

PWS Program Score Card

Program Name/Loc.	• Pine Barrens Credit Program • Long Island, New York

Basic Program Overview:

Program Attribute	Description	Alignment Ranking
Primary Hydrologic Service Targeted	• Water Quality	
Co-benefits	• Recreation • Protection of rare, threatened, and endangered species	
Payment Type	• Government Market PWS (voluntary)	
Payment Mechanism	• Pine Barrens Credit/Transfer of Development Rights	
Payment Source	• Pine Barrens Credits (PBCs are allocated to landowners in the Core Preservation Areas or sending areas based on parcel size, the underlying zoning of the parcel as of 1995, and whether there was any prior parcel development) • Received seed funding from NY state • As of 2011, the average credit value is $85,000	
Activities Funded	• Conservation easements	
Duration of program	• 1995 to current	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): Developers or the Pine Barrens Credit Clearinghouse (bank) • Sellers: Landowners • Intermediaries/Donors: Pine Barrens Credit Clearinghouse	1: buyers and sellers don't match **2: one buyer or one seller match** 3: 4: buyers and sellers match but not all 5: all buyers and sellers match
Beneficiaries (Type and Amount)	• 1.4 million residents in Suffolk County that use this drinking water source	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not

		necessarily public **<u>4: primary beneficiary is public utility but others more significant than in UNRB</u>** 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• 194 square miles—the area is estimated to have 60 trillion gallons of high quality drinking water	1: if order of magnitude smaller, **<u>2: if smaller by a factor of 2 or more,</u>** 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source Type	• Aquifer	1: impaired water body (not for drinking) 2: **<u>3: aquifer/river</u>** 4: 5: Reservoir
Scale	• Program covered 160 square miles, mostly a portion of Suffolk County where the Central Pine Barrens is located	1: city- or county-wide 2: **<u>3: sub-watershed but not a particular jurisdiction</u>** 4: 5: watershed-scale
Government and Utility Coordination	• TDR program created by the State of New York, Suffolk County, and three municipalities: Southampton, Brookhaven, and Riverhead Towns • The Central Pine Barrens overlies a significant portion of a Sole Source Aquifer designated by the US EPA • Not run by a Utility, however, it is for the benefit of drinking water quality for the area	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed **<u>3: one utility serving multiple cities both inside and outside the watershed</u>** 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• Buyers are developers who want to increase density into Compatible Growth	1: buyers are non-local 2: local buyers outside the

	Areas, while sellers are those who own property in the Core Preservation Areas; all are within the Central Pine Barrens—the area meant for ground water quality protection	watershed **3: local buyers entirely inside the watershed** 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• Land use of the watershed or program area (breakdown of forests and agriculture, for ex.) • What are the contributions of the different nonpoint sources? (e.g., ag vs. urban runoff vs. mining)	1: meets none of the criteria 2: meets 1 of the criteria 3: meets half criteria **4: meets 3 of four criteria** 5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• NY State Legislature passed the Long Island Pine Barrens Protection Act in order to protect the ground, surface, and drinking water for 1.8 million residents in the area and protect a threatened landscape (program established because of this law's requirement)	**1: no regulatory driver** 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• The TDR program is practice-based and is implementing the Central Pine Barrens Comprehensive Land Use Plan, which recommends the establishment of the program	**1: practice-based** 3: both practice- and performance-based 5: performance-based

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem	• There are 55,000 acres designated as 'Core Preservation Area' that may be eligible for a transferable development	

Services	right in exchange for a permanent conservation easement in order to reduce development	
Ample Supply of Sellers?	• 55,000 acres designated as 'Core Preservation Areas and currently only 12% of PBC have been redeemed (larger supply than demand)	

Ample Supply of Buyers/Demand for Service	• Receiving areas or Compatible Growth Areas are located throughout the three towns: Brookhaven, Southampton, and Riverhead. For all receiving areas, a single credit can increase the intensity of development up to three hundred gallons per day per acre
	• In addition, each town has certain rules for increasing development with these credits:
	  • Brookhaven allows additional increases in residential development density of up to 20% with the Credits
	  • Southampton allows an increase in density from one unit per five acres to one unit per one acre in residential zones; for areas already zoned for one dwelling unit per acre, you can increase this to one unit per half acre
	  • Riverhead allows increases in commercial and industrial floor area through the use of Credits based on the County Health Department's guidelines	

Monitoring and Evaluation	• Credits are documented through "Credit Certificates," which contain the owner's name and serial numbers so that sales of Credits can be monitored and tracked by the Commission • The Commission inspects and enforces the parcels under conservation easements • Testing is not quantitative, rather an evaluation of the program working on the assumption that conservation easements will lead to maintenance of ground water quality	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit **3:Program goals are qualitative** 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress

		in place
Permanence and Sustainability	• Seed funding from the State of NY, the program was established through a state law and seems somewhat permanent until most/all of the land is protected or so long as there is a demand for credits	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal 4: **5: Program activities has means to remain in place more than 10 years after implementation**
Program Administration	• Pine Barrens Commission: A five-member Commission consisting of the State, Suffolk County, and the Towns of Brookhaven, Riverhead, and Southampton is charged with operating the transferable development rights and conservation easement program (as well as joint land use review, permitting, and enforcement authority along with local municipalities and coordination of regional public lands stewardship and management) under the NY Environmental Conservation Law Article 57 • Pine Barrens Credit Clearinghouse: The Pine Barren Credit program created a bank called the Pine Barrens Credit Clearinghouse, which (1) records easements on sending area properties and notifies applicant property owners how many credits they would be allocated—proposals from property owners are then received and they are approved or denied by the bank; (2) buys pine barren credits directly, if property owners don't sell to the Clearinghouse they can sell their credits through a real estate broker or buyers on lists from the Clearinghouse.	1: Unilateral administration 2: **3: Administered through cooperation between major players** 4: 5: Administered by a watershed-level governing body
Transaction Costs	• The Pine Barrens Credit Clearinghouse acts as a bank to help reduce transaction costs – it actively assists the market through buying and selling of Credits and publishing a monthly Registry of buyers and sellers	
Pricing and Payment	• The value of credits are negotiated privately by developers and landowners	

	(or intermediate owners of the credits) and overall, are established on the open real estate market	
Conflicting Programs and Goals	• Unknown	
Opportunities for Stacking	• Unknown	
Adaptability/Scaling Up	• The Commission and Clearinghouse are institutional mechanisms that can be made adaptable over time to include annexation of more Core Preservation areas or Compatible Growth Areas	
Supporting organizations	• Daily operation of the program requires cooperation and communication between many agencies: Commission, Towns, County Health, County Treasurer, State Department of Environmental Conservation, County Real Estate, for example are all involved	
Supporting laws/regulations/administrative rules	• In 1993, the NY State Legislature passed the "Long Island Pine Barrens Protection Act" with the goal of protecting the largest, "central" remaining Long Island Pine Barrens region • Central Pine Barrens Comprehensive Land Use Plan established the plans for the TDR program, Clearinghouse, and Commission	
Competing Investment Options	• Development projects within the Core Development Areas, however, projects that are not grandfathered or exempt is prohibited without a hardship permit from the Commission	
Other (indicate): Outreach	• Outreach is performed via: o Pine Barrens Credit Registry – a monthly listing of Credit holders, sellers, Letter of Interpretation holders, and potential buyers o Regular reports—certificates and credits issued, conveyed, redeemed o The Clearinghouse Board of Advisors meetings are open to the public o Website: ww.pb.state.ny.us	

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• As of January 1, 2008, this program had protected 657 parcels consisting of 1,345 acres • There have been 772.20 Credits generated overall with 476 unredeemed Credits • The sum of all sales and re-sales to date exceed $25 million
Is still running to date?	• The Pine Barrens Credit Program still exists as of 2012 and is active. As of April 1, 2012, there were at least four times more sellers than potential purchasers. However, there were more than 35 potential purchasers in the program that may turn into transactions.
Water affordability	• Not applicable.
Meeting projected demand for drinking water?	• Yes
Economic Efficiency	• Unknown, however the Pine Barrens Bank and registry is thought to greatly reduce transaction costs.
Synergies or Externalities	• Information not available.
Political and Social Favorability	• The Pine Barrens Credit Program was created by NY law and has legislative support for its mandate. However, its social favorability is unknown.
Future Outlook	• Active transactions are occurring and there is also active management in terms of education and bringing buyers and seller together through the Pine Barrens Credit Registry. This seems to indicate long-term stability for this program, which is in its 17^{th} year.

Additional Comments:

Summary: The Central Pine Barrens is divided into a Core Preservation Area that is designed for preservation and a Compatible Growth Area that is designated for controlled growth. In this program, "Pine Barrens Credits" can be transferred from the Core Areas into either the Compatible Growth Area or the non Pine Barrens areas within the three Towns.

More information:

Main website containing Registry and other information:

http://pb.state.ny.us/

Primary Recommendations for UNRB:

- Local government coordination is important for TDR programs to work especially because coordination of receiving and sending areas to achieve watershed-wide goals is a key element in attracting buyers and sellers of TDRs.
- Seed funding was important for starting this program, may need such investment to have a similar program in the UNRB.
- A TDR program requires a lot of planning; for example, two years were taken to plan the Pine Barrens Credit Program. Such time should be set aside to assess whether a program would suit the UNRB.

Citations and Resources:

Central Pine Barrens Joint Planning and Policy Commission. (2010). The Pine Barrens Credit Program: Transferable Development Rights in Central Suffolk, NY. Retrieved 2012, from http://pb.state.ny.us/pbc/pbc_overview.pdf

The Central Pine Barrens and Suffolk County's Watershed Fact Sheet. (2006). Retrieved 2012, from http://pb.state.ny.us/pbc/pbc_program_fact_sheet.pdf

New Jersey Highlands Council. (2008). *Transfer of Development Rights Technical Report*. Retrieved from http://www.highlands.state.nj.us/njhighlands/master/tr_tdr.pdf

Central Pine Barrens Joint Planning and Policy Commission. (1995). Pine Barrens Credit Program Handbook: A User's Guide to the Central Pine Barrens Transferable Development Rights Program.

Tripp, J. The Pine Barrens Credit Program: Transferable Development Rights in Central Suffolk County, New York. (2009). from <http://www.highlands.state.nj.us/njhighlands/hdcbank/pbcp_pres_030509.pdf>

PWS Program Score Card

Program Name/Loc.	• Salt Lake City Public Utilities • Salt Lake City, Utah

Basic Program Overview:

Program Attribute	Description	Alignment Ranking
Primary Hydrologic Service Targeted	• Water Quality	
Co-benefits	• Recreation (skiing, camping, picnicking, hiking, and hunting)	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Land purchase deals or water rights purchase	
Payment Source	• Ratepayer surcharge ($1.50 per month per customer), generates roughly $1.5 million per year for watershed water rights and property acquisition	
Activities Funded	• Land conservation	
Duration of program	Formal program started in 1991, continues today	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): Salt Lake City Public Utilities • Sellers: Landowners in watershed • Intermediaries: non-profits, businesses	1: buyers and sellers don't match 2: one buyer or one seller match 3: 4: buyers and sellers match but not all **5: all buyers and sellers match**
Beneficiaries (Type and Amount)	• 500,000 county residents in Salt Lake City and eastern bench of Salt Lake County as well as Sandy City	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public **4: primary beneficiary is public utility but others more significant than in UNRB** 5: primary beneficiary is public utility with little ag/industrial

Watershed Size	• 185 square miles	**<u>1: if order of magnitude smaller,</u>** 2: if smaller by a factor of 2 or more, 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source Type	• City Creek, Parleys Creek, Big and Little Cottonwood Creeks, Deer Creek, Deep wells, and Jordanelle Reservoir	**<u>1: impaired water body (not for drinking)</u>** 2: 3: aquifer/river 4: 5: Reservoir
Scale	• Watershed scale – Wasatch canyons	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **<u>5: watershed-scale</u>**
Government and Utility Coordination	• Water is provided to Salt Lake City, Salt Lake County, and Sandy City (part of the Metropolitan Water District of Salt Lake City) by the Salt Lake City Public Utilities	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed **<u>3: one utility serving multiple cities both inside and outside the watershed</u>** 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• The Salt Lake City Public Utility has a Water Rights and Watershed Purchase fund to fund purchase of critical watershed property and are downstream for the canyons • The sellers are private property owners who sell their land for a conservation	1: buyers are non-local 2: local buyers outside the watershed 3: local buyers entirely inside the watershed **<u>4: local buyers are both inside and outside the watershed</u>**

	easement or sell their water rights—many times they are those benefitting from ski tourism in the area	5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• The watershed is made up of the Wasatch Canyons—threats to this are from recreation development and other land uses • National Forest makes up 61% of the watershed	1: meets none of the criteria 2: meets 1 of the criteria 3: meets half criteria **4: meets 3 of four criteria** 5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• Unprecedented growth and the development of the Salt Lake City Protection Plan • Recreation development, climate change, and other developmental pressures	**1: no regulatory driver** 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• Both, drinking water quality is performance-based, however, land acquisition is practice-based and demonstration of water 'proves' the necessity of doing this	1: practice-based **3: both practice- and performance-based** 5: performance-based

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem Services	• Currently, the City owns 18.6% of the watershed lands in the seven Wasatch canyons • Salt Lake City owns all or the largest percentage of water rights in each of the Wasatch Canyons • Wasatch-Cache National Forest is the largest land manager in the plan area • Land Ownership: Forest Service (65%--mainly in the southern canyons), Private (19%), Salt Lake City (19% -- mainly in the	

	northern canyons) • In addition, 2,708 acres are developed parcels and 11,989 acres are undeveloped parcels	
Ample Supply of Sellers?	• Do the potential suppliers seem willing to participate? What is their perceived reception in terms of values, understanding, experience with similar programs, level of stakeholder involvement	
Ample Supply of Buyers/Demand for Service	• Program is looking to chip away at the private landownership that will cause an increase in development – will continue to have funds available in the Watershed Lands Acquisition fund program to acquire critical watershed lands	
Monitoring and Evaluation	• Salt Lake City Public Utilities monitors water quality in accordance with regulations • Salt Lake Valley Health Department samples drinking water on a regular and random basis to ensure Safe Drinking Water Act compliance • Routine monitoring of groundwater occurs • Watershed protection efforts are not monitored, but are demonstrated through the maintenance of water quality in the canyon streams	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit **3:Program goals are qualitative** 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• Fund has sustained since 1991 and continues today—in 1999, the fund was increased from $0.25 to $0.50 to help meet its goals for land protection; later it was increased to $1.00, and as of 2012, the cost is $1.50 per account per month	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal 4: **5: Program activities has means to remain in place more than 10 years after implementation**
Program Administration	• Salt Lake City Public Utilities administers the payment for watershed services program—the utility coincidentally is in charge of most of the watershed, but through cooperation with smaller adjacent jurisdictions	1: Unilateral administration 2: 3: Administered through cooperation between major players **4:** 5: Administered by a watershed-

		level governing body
Transaction Costs	• NGOs and businesses sometimes work collaboratively with the Salt Lake City Public Utilities for land acquisition purposes—this can help reduce transaction costs of bringing buyers and sellers together	
Pricing and Payment	• Unknown	
Conflicting Programs and Goals	• Unknown	
Opportunities for Stacking	• Unknown	
Adaptability/Scaling Up	• Adaptability mechanism is available through the Watershed Management Plan. For example, when the Watershed Management Plan was updated in 1999, a recommendation was made to increase the surcharge. This was needed to provide adequate funding to purchase private property and subsequently the fee was increased from \$0.25 to \$0.50; then in 2008 it was increased to \$1.00, and in 2012 to \$1.50 per account per person	
Supporting organizations	• Watershed property acquisition efforts have also been enhanced by partnering with businesses and private/non-profit organizations that have worked together to purchase land collaboratively (For ex. Utah Open Lands and US Forest Service)	
Supporting laws/regulations/administrative rules	• Private landowners do not automatically own their rights to water on their land – most of these are owned by Salt Lake City. In order to develop, developers interested in watershed property must obtain water rights to build and are subject to restrictions • Under State law, Salt Lake City has extraterritorial jurisdiction over its extended watershed – this along with the Federal authority granted by Public Law 101, or 1914 and 1934, allows for the establishment of regulations and ordinances to protect water supply – non municipally owned watershed lands are	

	subject to ordinance. For example, land use in surrounding canyons are regulated where hiking and camping are allowed, but campers must stay 200 feet from any water source; in addition, there are no dogs, horses, grazing, or septic systems allowed. • Anyone caught polluting the city's drinking water supply despite land ownership can be fined • In 1993, the State Department of Environmental Quality, Division of Drinking Water established a "Drinking Water Source Protection Rule," in order to help protect land surfaces that contribute to water recharging the aquifer that feeds a well or spring source • Forest Service and Salt Lake City has entered into formal agreements that restrict the use of Forest Service land that are important for protection of water supplies • Salt Lake County has a Sensitive Lands Ordinance that extends the stream set-back for new buildings 50 to 100 feet. In addition, a standard called "limits of disturbance," specifies an area in which construction and development activity must be contained. This decreases the amount of lands that are disturbed through accidental or unregulated construction practices.	
Competing Investment Options	• Development is growing in the area and there are growing pressures from this, for example, there are ski resorts which allow in thousands of cars and people to travel in the canyon each winter day	
Other (indicate)	Education campaign: "Keep it Pure" by the Public Utilities provides new signage in the watershed, curriculums for education for students to understand and appreciate the watershed	

Success Indicators:

Success Indicator	Description

Environmental Performance Benchmarks To-Date	• Practice-based—protected lands are assumed to maintain water quality and this quality is maintained today
Is still running to date?	• Yes.
Water affordability	• Information unavailable.
Meeting projected demand for drinking water?	• Meeting the water resource needs for a growing population is one of the biggest challenges the public utility will face in the future. To cope with growth effectively, master plans for the three utilities and the canyon watersheds have been adopted for water conservation. In addition, this area is susceptible to drought. Overall, much of the future demand will be met through water conservation and efficient use of existing resources. (Salt Lake City Department of Public Utilities 2001)
Economic Efficiency	• Information is unavailable.
Synergies or Externalities	• Co-benefits include limited recreational opportunities.
Political and Social Favorability	• Yes, all proposed increases in the watershed fee rates have been supported by the City Council.
Future Outlook	• Not available.

More information:

- Salt Lake City Public Utilities Watershed Protection Program, www.slcgov.com/utilities/watershed.htm

Primary Recommendations for UNRB:

- The UNRB could also benefit from a fixed surcharge fee for municipalities in order to have dedicated and reliable funding for watershed protection and flexibility should be built in where raising the fees over time can be discussed in the right venues every three to five years.

Citations and Resources:

Salt Lake County Government. (2010). *Wasatch Canyons Tomorrow*.

US EPA. (1999). *Protecting Sources of Drinking Water: Selected Case Studies in Watershed Management*.

Salt Lake City Policy and Budget Division. (2011). *Capital and Operating Budget: Fiscal Year 2011-2012*.

Salt Lake City Department of Public Utilities. (2001) Annual Report. From http://www.slcclassic.com/utilities/PDF%20Files/Annual%20Reports/2001%20Annual%20Report.pdf

Bear West Consulting. (1999). *Salt Lake City Watershed Management Plan*.

Carpe Diem West. (2011). Salt Lake City, Utah-- Remembering Our Relationship with Our Watershed. Retrieved from http://www.carpediemwest.org/sites/carpediemwest.org/files/Salt%20Lake%20City%20Success%20Story_0.pdf

PWS Program Score Card

Program Name/Loc.	• Upper Little Tallapoosa River Watershed • Carroll County, Georgia

Basic Program Overview:

Program Attribute	Description	Alignment Ranking
Primary Hydrologic Service Targeted	• Water Quality	
Co-benefits	• Preservation of scenic views and working landscapes • Recreation	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Land purchase deals (fee simple acquisition and easements)	
Payment Source	• Local sales tax that directs about $20 million toward land acquisition (Special Purpose Local Option Sales Tax (SPLOST)) • Received $400,000 from the Georgia Department of Natural Resources' Georgia Greenspace Program to fund purchase of land (initial seed funding)	
Activities Funded	• Land conservation • Recreation management	
Duration of program	• Began in 2003, funding unknown	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): Carroll County Government • Sellers: landowners • Intermediaries/Donors: Trust for Public Land and EPA (source water protection program)	1: buyers and sellers don't match 2: one buyer or one seller match 3: **4: buyers and sellers match but not all** 5: all buyers and sellers match
Beneficiaries (Type and Amount)	• 30,000 people who draw water from a series of small reservoirs on the Little Tallapoosa River	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public **4: primary beneficiary is public**

		<u>utility but others more significant than in UNRB</u> 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• 95 square miles lies almost entirely within Carroll County, Georgia	**<u>1: if order of magnitude smaller,</u>** 2: if smaller by a factor of 2 or more, 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source Type	• Rivers with small reservoirs to draw water • The Little Tallapoosa, which is the main tributary to the Upper Tallapoosa originates in Carroll County, Georgia	1: impaired water body (not for drinking) 2: **<u>3: aquifer/river</u>** 4: 5: Reservoir
Scale	• Carroll County is covered, which contains most of the subwatershed (ULTR)-- • The larger Tallapossa Watershed also covers Haralson County and parts of Paulding County • The watershed itself is 605 square miles and incorporates Alabama and Georgia	**<u>1: city- or county-wide</u>** 2: 3: sub-watershed but not a particular jurisdiction 4: 5: watershed-scale
Government and Utility Coordination	• 3 counties in the larger watershed • 1 Utility—Carroll County Water Authority for the Little Upper Tallapoosa River • 19 municipalities in the larger watershed	**<u>1: one city in watershed and using the water</u>** 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• Buyers are the local county government and the sellers are landowners who are	1: buyers are non-local 2: local buyers outside the

	located in the watershed; however, Carroll County also funds projects that are outside its immediate watershed for broader water quality benefits	watershed **<u>3: local buyers entirely inside the watershed</u>** 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• Located in the Piedmont region of the southern Appalachians • River is currently used for drinking water, recreation, and wildlife habitat • Land uses in the watershed are traditional farming, forestry, and low-density housing • Since 1990, forest land in the watershed has decreased from 66 to 53%, while developed land has increased by 7% • Currently, 19% of county land is in ag, 24% is in conservation, and 35% is considered vacant—although 20% of land is residential, much of the vacant land is zoned for residential use—ag land is also being converted to residential use • Water is from the Little Tallapoosa River for Carroll County • Primarily rural and agricultural	1: meets no of the criteria 2: meets 1 of the criteria 3: meets half criteria **<u>4: meets 3 of four criteria</u>** 5: naturally forested, and 50%-70% forested, with significant development pressure and 16% use (2001 – from MP)
Drivers	• Want to decrease the amount of disinfection that has to be done to reduce costs (following a filtration that was built due to Cryptosporidium outbreak in 1987). – not cost effective to have sewers in the county • Threats: development from Atlanta is encroaching on agricultural lands and no public sewer exists in much of the county, an individual on-site septic systems are proliferating • Set a goal to preserve 20% of the county's total area in greenspace focusing on funding and acquiring greenspace, preserving farmland, protecting natural resource, and developing passive recreation areas • 14 miles of the Little Tallapoosa River is listed as impaired due to fecal coliform bacteria	**<u>1: no regulatory driver</u>** 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver

Practice or Performance-based?	• Practice-based with some performance/monitoring and evaluation	1: practice-based **3: both practice- and performance-based** 5: performance-based

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem Services	• TPL identified that agricultural and waste management could provide ES to reduce pollutants throughout many subwatersheds • With the Community Greenspace Plan, Carroll County will need to have a total of 64,000 acres to be protected to meet their 20% goal • There is minimal protection of wetlands and there is almost no public protected forestland in the watershed—most is owned by private landowners of forest product companies	
Ample Supply of Sellers?	• Most of the land in the watershed (~70%) is privately owned • (see biophysical characteristics)	
Ample Supply of Buyers/Demand for Service	• Government is mostly doing the buying with grants or SPLOST funding • Also opportunities for state (Georgia Greenspace Program) and federal funding (Farm Bill programs)	
Monitoring and Evaluation	• Funding available through Section 319 to hire a watershed inspector to enforce soil and sediment control regulations • Water quality monitoring is conducted by the State University of West Georgia Geoscience Department as part of the West Georgia Watershed Service	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit **3:Program goals are qualitative** 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and	• In November 2003, votes approved new funding through a local sales tax that	1: One-time grants with no renewal in sight

Sustainability	directed about $20 million toward land acquisition for water source protection and recreation • In 2002, Carroll County was approved as a demonstration site for the Trust for Public and and US EPA to study whether water source protection activities could result in cleaner water	2: **3: Not definite, but has potential and record of renewal** 4: 5: Program activities has means to remain in place more than 10 years after implementation
Program Administration	• Carroll County, however, in the Community Greenspace Program with five other municipalities	**1: Unilateral administration** 2: 3: Administered through cooperation between major players 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Transaction costs are not as high because they're handled at the governmental level, inclusion in Greenspace Program helps reduce costs (toolkit available)	
Pricing and Payment	• Unknown	
Conflicting Programs and Goals	• Unknown	
Opportunities for Stacking	• Unknown, however, Carroll County has utilized different grants to obtain funding for their projects (recreation, greenspace, etc…)	
Adaptability/Scaling Up	• Unknown	
Supporting organizations	• Public support in Carroll county votes to approve earmarking funds for protection	
Supporting laws/regulations/administrative rules	• Community Greenspace Plan, Carroll County and five municipalities pledged to work towards protecting 20% of the county's land as greenspace with water quality protection as a primary goal over the next 10 years • Carroll County votes approved the SPLOST, which earmarked $19 million (36% of the total SPLOST) to fund water quality protection, greenspace preservation and recreation • These SPLOST funds were matched by the Federal Farm Bill	
Competing	• Want to reduce the costs of filtration—	

Investment Options	largest competing investment costs is development	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• $2 million used to lock up development rights to farm and ranching land • County purchased more than 1,250 acres of undeveloped land • Ranchland and farmland preservation: 1,726 acres of farm land have been protected • Secured funding for a watershed inspector to enforce soil and sediment control regulations
Is still running to date?	• Yes
Water affordability	• Not applicable, program not administered by utility.
Meeting projected demand for drinking water?	• Information not available.
Economic Efficiency	• Information not available.
Synergies or Externalities	• Information not available.
Political and Social Favorability	• Yes, a quality of life questionnaire implemented by the county showed that residents clearly value the protection of forests and natural lands and would like to have additional public parks and recreation areas. Around 74 percent of respondents indicated that they highly value Carroll County's natural surroundings, trees and forests, and about 78 percent indicated that the creation of additional public parks and recreation areas would enhance quality of life. Additionally, 77 percent of respondents said they would support using a portion of the S.P.L.O.S.T. for the protection of land.
Future Outlook	• This program is dependent on local grants for watershed protection, SPLOST funds were a positive indicator of public perception of land conservation

Additional Comments:

Most of this program's success was attributed to the Trust for Public Land's involvement and the backing of the county's leadership in its source water protection program for agriculture and other land easements. Carroll County is looking into Transfer of Development Right programs.

More information:

See citations and resources below.

Primary Recommendations for UNRB:

- Local funding and partnering with a state program helped Carroll County to address the threat of degrading water quality; in the UNRB funding for watershed protection should utilize existing opportunities for leveraging water quality as a secondary benefit
- In Carroll County a quality of life survey was done and residents valued protected areas and would like to have more recreation and public parks; the UNRB could benefit by addressing resident and stakeholder values in order to provide co-benefits

Citations and Resources:

Barten, P., Zhang, Y., & de la Cretaz, A. L. (2002). *Land Conservation, Restoration, and Stormwater Management Priorities for the Upper Little Tallapoosa River, Georgia*. from http://cloud.tpl.org/pubs/landwater-tallapoosa-umass-mapping.pdf

Georgia Department of Natural Resources. (1998). *Tallapoosa Basin Plan: River Basin Characteristics*. Retrieved from http://www.gaepd.org/Files_PDF/plans/tallapoosa/chapt-2.pdf

Rasmussen, P. (2007, March). Carroll County: Adding Greenspace. *Georgia Trend Magazine*. Retrieved from http://www.georgiatrend.com/March-2007/Carroll-County-Adding-Greenspace/

Trust for Public Land, & University of Massachusetts Amherst. (2002). *Upper Little Tallapoosa River Watershed: Source Water Issues Report*. Retrieved from http://cloud.tpl.org/pubs/landwater-tallapoosa-sourcewaterissues-rpt.pdf

The Trust for Public Land. (2002). *Upper Little Tallapoosa Watershed: Land Conservation Funding Options*. Retrieved from http://cloud.tpl.org/pubs/landwater-tallapoosa-funding-options.pdf

PWS Program Score Card

Program Name/Loc.	• Lake Champlain Basin Program • Burlington, Vermont

Basic Program Overview:

Program Attribute	Description	Alignment Rating Criteria
Primary Hydrologic Service Targeted	• Water Quality (Source Water Protection Program SWPP)	
Co-benefits	• Recreation • Water Quantity • Biodiversity/Wildlife Management	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Grants for source water protection programs	
Payment Source	• Federal and State funding for SWPP through the Drinking Water State Revolving Fund (Water Supply Division, 2011)	
Activities Funded	• Education • SWPP • BMP implementation with federal cost share programs	
Duration of program	SWPP instituted in 1994	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): State of VT, NY • Sellers: Land owners • Intermediaries/Donors: US EPA, Lake Champlain Basin Program	1: buyers and sellers don't match 2: one buyer or one seller match 3: **4: buyers and sellers match but not all** 5: all buyers and sellers match
Beneficiaries (Type and Amount)	There are 100 state regulated water supply facilities on the lake. Vermont has 73, NY has 26, and Quebec has 1 (Ballinger, 2004)	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public 4: primary beneficiary is public utility but others more

		significant than in UNRB **<u>5: primary beneficiary is public utility with little ag/industrial</u>**
Watershed Size	• Lake Champlain basin is 8,243 square miles. (Ballinger, 2004) • The lake itself is 120 miles long and 12 miles wide at its maximum width.	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, **<u>3: if order of mag larger,</u>** 4: if twice as large, 5: if same size
Water Source Type	• Natural lake serves as the drinking water source as well as the wastewater discharge site. Incentive to protect water quality is extremely high.	1: impaired water body (not for drinking) 2: 3: aquifer/river **<u>4: Lake</u>** 5: Reservoir
Scale	• Lake Champlain is a very large lake extending between state and country boundaries. There is coordination between these governments to implement a comprehensive, watershed scale PWS program.	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **<u>5: watershed-scale</u>**
Government and Utility Coordination	• 40,000 people in the city of Burlington dependent on Lake Champlain water supply (US Environmental Protection Agency, 2010) • 200,000 people within the Lake Champlain basin dependent on it for water suuply (68% live in VT, 27% in NY, 5% in Quebec)(Ballinger, 2004)	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed **<u>5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed</u>**
Jurisdictional Alignment	• Lake Champlain Basin Program is administered in partnership between US EPA, NY Department of Environmental Conservation, Vermont Agency of Natural Resources, Quebec Ministry of	1: buyers are non-local 2: local buyers outside the watershed 3: local buyers entirely inside the watershed

	Environment, & New England Interstate Water Pollution control (Ballinger, 2004)	4: local buyers are both inside and outside the watershed **<u>5: local buyers entirely inside and one or more straddling in watershed</u>**
Biophysical characteristics	• 2004 LULC maps shows 64.3% forested land, 16% agriculture, 5.6% developed areas, and 3.8% wetland (10.3% is open water) (Ballinger, 2004) • Phosphorous is of primary concern in the basin. Nonpoint sources account for 90% of nutrient loading. Agricultural runoff is 38% of nonpoint source contribution, urban and developed land is 46% , forest land is 15% (Program, 2008)	1: meets none of the criteria 2: meets 1 of the criteria **<u>3: meets half criteria</u>** 4: meets 3 of four criteria 5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• SWPP developed in concert with the State of Vermont Act 250. This act governed land use within the watershed for the city of Burlington and areas outside of its jurisdiction- a permitting process was included that accounted for timber management, impervious surface, and sewer system development (US Environmental Protection Agency, 2010)	1: no regulatory driver **<u>2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver)</u>** 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• Practice & performance	1: practice-based (paying for a BMP, not load reduction per se) **<u>3: both practice- and performance-based (paying for a BMP with an implied</u>** associated load reduction) 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment Ranking Criteria
Potential Supply of Enhanced	• There is potential to scale up the program to address land use above the two	

Ecosystem Services	intakes of the lake.	
Ample Supply of Sellers?	• Stakeholder engagement and education was a focus in the development of the SWPP. Outreach efforts to landowners and farmers included education about BMP's and incorporation of equitable and achievable standards. Implementing BMP's had measureable effect on phosphorous loading. (Program, 2008; US Environmental Protection Agency, 2010)	
Ample Supply of Buyers/Demand for Service	• Largest buyers are the municipal water suppliers: The Champlain Water District and the City of Burlington (Ballinger, 2004)	
Monitoring and Evaluation	• Program monitoring includes continuous water quality testing and comparison to baseline data. Results are reported to the State in a monthly report. Customer satisfaction is also a measure of success. (US Environmental Protection Agency, 2010)	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results **5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place**
Permanence and Sustainability	• The Revolving Fund should continue to be adequate for the SWPP. State and Federal budgets could affect annual availability. So far, annual renewal has not been an issue.	1: One-time grants with no renewal in sight 2: **3: Not definite, but has potential and record of renewal** 4: 5: Program activities has means to remain in place more than 10 years after implementation
Program Administration	• Intended Use Plan for the budget must be approved by US EPA, State of Vermont Water Supply Division and Dept of Environmental Conservation. The public is invited to attended meetings and comment on IUP. (Water Supply Division, 2011) • Lake Champlain Basin Program is funded	1: Unilateral sub-watershed administration 2: 3: Administered through cooperation between major players 4: **5: Administered by a**

	by the EPA and partners from VT, NY, and Quebec work with the program to protect water quality in Lake champlain (Ballinger, 2004)	**watershed-level governing body**
Transaction Costs	•	
Pricing and Payment	• Will payments/pricing result in most economically efficient means of meeting environmental or cost reduction goals?	
Conflicting Programs and Goals	• Are there any	
Opportunities for Stacking	Federal Cost share programs are already in use. Carbon, biodiversity or habitat credits could complement the work that has already been done.	
Adaptability/Scaling Up	• The Fund complements other efforts. State and Federal funding could be increased using a tax, even a temporary increase, if there were need for additional capital for a larger scale project.	
Supporting organizations	• Education has been a focus of the SWPP . Public support and investment in the watershed is high- much of the monitoring is performed by lay people who volunteer(Sutkoski, 2012)	
Supporting laws/regulations/administrative rules	• The "Opportunities for Action: An Evolving Plan for the Lake Champlain Basin" was endorsed in 1996 with a call for updates. Updates were made in 2003 and 2010- goals are to reduce nutrient loading, prevent toxic contamination, manage invasive species, and conduct outreach & education. Mandate to continue some form SWPP is implicit. (Ballinger, 2004) • State of Vermont Act 250 provides guidance for protecting water quality inside and outside of Burlington's jurisdiction. (US Environmental Protection Agency, 2010)	
Competing Investment Options	• Do beneficiaries face options for substitution? • Are there tradeoffs to investment? • What are the competing opportunity costs?	

	• If available, green versus gray infrastructure costs	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• Agricultural BMP implementation avoid 16.1 metric tons of phosphorous per year from non-point sources (Raunecker & Holowell, 2006)
Is still running to date?	• Yes
Water affordability	• $3.17 per 100 cubic feet
Meeting projected demand for drinking water?	• (for all cities using that reservoir/drawing from the watershed)
Economic Efficiency	• Number of Transactions – fraction of potential sellers that have successfully been paid to implement something • Costs (including transaction costs) – cost per lb avoided? per BMP? per acre? per participant? • $ saved as compared to alternative – green vs. grey. – green/grey ratio cost
Synergies or Externalities	• What co-benefits? Presence of threatened/rare species? • What co-costs?
Political and Social Favorability	• The public was integral to the development and implementation of SWPP. See additional comments for quotations.
Future Outlook	• General comments here on how it's looking, impressions on stability over time, etc.

Additional Comments:

" Community involvement has been part and parcel of Burlington's source water protection program(US Environmental Protection Agency, 2010)."
The lake is the only water supply in the region. Wastewater is deposited in the same place that drinking water is sourced. (US Environmental Protection Agency, 2010)

More information:

- Laurie Adams, Assistant Director Burlington Public Works (802) 863-450
- US EPA Case Study on Burlington
  http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-VT-Burlington.pdf
- Lake Champlain Basin Program
  www.lcbp.org

Primary Recommendations for UNRB:

Burlington's program provides a strong model of the way a watershed authority might be developed and structured for a comprehensive watershed scale PWS program. The Lake Champlain Basin Program that administers the PWS program is made of government representatives and influenced by the public as well as non-profits and partnerships with the US EPA. Public support proved to be extremely important in the development and implementation of the program. Like the UNRB, Burlington has focused on BMP implementation and relies on pre and post project monitoring to gauge success; Burlington's monitoring plans might also provide useful frameworks for the UNRB.

Citations and Resources:

Ballinger, N. (2004). Lake Champlain Basin Program. Retrieved January 3, 2012, from http://www.lcbp.org/

Program, L. C. B. (2008). Phosphorous- Nonpoint Sources. *Lake Champlain Basin Atlas*. Retrieved January 3, 2012, from http://www.lcbp.org/Atlas/HTML/is_pnps.htm

Raunecker, S., & Holowell, L. (2006). *Fact Sheet Series: Nonpoint Source Pollution*. *Cities*. Retrieved from http://www.lcbp.org/factsht/npsfactsheet2006.pdf

Sutkoski, M. (2012, February 25). Lakeshore residents tackle water quality monitoring. *Burlington Free Press*. Burlington. Retrieved from http://www.burlingtonfreepress.com/article/20120226/GREEN01/120225013/Lakeshore-residents-tackle-water-quality-monitoring

US Environmental Protection Agency. (2010). Vermont�: Burlington - Public Interest Drives SWP in Vermont. *Source Water Case Study*. Retrieved from http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-VT-Burlington.pdf

Water Supply Division, D. of E. C. (2011). *State of Vermont Intended Use Plan for the Drinking Water State Revolving Fund, Federal Fiscal Year 2010*. *Main*.

PWS Program At-A-Glance Score Card

Program Name/Loc.	• Conestoga Reverse Auction • Conestoga, PA

Basic Program Overview:

Program Attribute	Description	Alignment with UNRB
Primary Hydrologic Service Targeted	• Water purification, as measured through water quality	
Co-benefits	• Ag BMPs, so not as many as forest BMPs or land conservations	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Reverse auction	
Payment Source	• Conservation Innovation Grant funds • Total budget for two auctions = $490,000	
Activities Funded	• Farmers awarded to implement BMPs • For first auction, entered bids to implement specific EQIP standard BMPs • Nutrient Management Plans, all listed on (Greenhalgh, Guiling, Selman, & John, 2007)	
Duration of program	• 2 year CIG	
Participants	• Buyers: NGO – Pennsylvania Environmental Council • Sellers: Farmers; Landowners • Sellers match, but not buyer	1: buyers and sellers don't match **2: one buyer or one seller match** 3: 4: buyers and sellers match but not all 5: all buyers and sellers match
Beneficiaries	• Majority of withdrawals from public water suppliers (55%) and unregistrered water use points (22%) • Populations (and water use) expected to increase by 11% in 2010, 22% in 2020, and 22% in 2030.	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public **4: primary beneficiary is public utility but others more**

		<u>significant than in UNRB</u> 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• The Conestoga River Watershed encompasses 475 square miles in Lancaster County, with small portions in 3 other counties	1: if order of magnitude smaller, **<u>2: if smaller by a factor of 2 or more,</u>** 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source	• River	1: impaired water body (not for drinking) 2: **<u>3: aquifer/river</u>** 4: 5: Reservoir
Scale	• Entire watershed	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **<u>5: watershed-scale</u>**
Government and Utility Coordination	• 475 square miles in Lancaster County, with "small portions" in Chester, Lebanon, and Berks counties • Lancaster, PA – primarily one city	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed **<u>4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed</u>** 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed
Jurisdictional Alignment	• Buyers encompass area larger than watershed itself	1: buyers are non-local **<u>2: local buyers outside the watershed</u>** 3: local buyers entirely inside the watershed

		4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics (sources of pollution problem – urban runoff, ag, etc.)	• While the area's population continues to grow, agriculture remains the dominant land use activity at 60% -70% (TEEBcase by S. Greenhalgh, 2010). Very high dairy cow. • Primary source of nutrients include ag and urban runoff, construction activities, wastewater, septic systems, industrial discharges, and soil (streambank) erosion (TEEBcase by S. Greenhalgh, 2010) • 13% of the watershed is developed. Only 8% is forested.	1: meets none of the criteria 2: meets 1 of the criteria **<u>3: meets half criteria</u>** 4: meets 3 of four criteria 5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• Regulatory compliance sort of – 330 miles of the river and tributaries listed as impaired for N and P – need reductions to abide by TMDL – though "ag rarely has to do anything anyways" • Wanted to more efficiently allocate funds that were already being given out through the EQIP program	1: no regulatory driver **<u>2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver)</u>** 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-Based?	• Choose practices based on most "load reduction bang for your buck." No post-monitoring to ensure performance-based.	1: practice-based (paying for a BMP, not load reduction per se) **<u>3: both practice- and performance-based (paying for a BMP with an implied associated load reduction)</u>** 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment with UNRB
Potential Supply of Enhanced Ecosystem	• One of the "main" contributors of P is the agricultural sector (Greenhalgh et al., 2007).	

Services	• Highest contributions by far from point sources (have a graph of nonpoint vs. point sources in (Hintz, 2008))	
Ample Supply of Sellers?	• Supply outweighed demand. • First auction: 6 accepted, 8 received --> did not exhaust allocated funding budget as participation was low • Second auction: 13 accepted, 23 received • One noted lesson was to invest the time to carefully explain the aims of a reverse auction to all stakeholders (e.g., explain what commodity or environmental outcome is being purchased)	
Ample Supply of Buyers?	• Yes - because from one body (government) • Development pressure, so demand will likely increase • No current availability for offsets from development	
Monitoring and Evaluation	• Technicians from the County Conservation District worked with farmers to estimate the P reductions associated with the BMPs. Estimated using WRI's NutrientNet tool. • No specific goals or performance benchmarks (other than economic efficiency)	**1:Program has no specific goals or performance benchmarks (criteria for evaluation)** 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• One time CIG grant	**1: One-time grants with no renewal in sight** 2: 3: Not definite, but has potential and record of renewal 4: 5: Program activities has means to remain in place more than 10 years after implementation
Program Administration	• The NRCS Conservation Service in Conestoga was the point organization for the auction as they were the key folks who liaised with the farmers – they were	**1: Unilateral sub-watershed administration** 2: 3: Administered through

	also the ones who did most of the advertising, farm visits, and helped them estimate their P reductions using Nutrient Net tool.	cooperation between major players 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Used NutrientNet to quantify P reductions associated with BMPs • Another lesson: invest time to streamline the initial auction rules and process to reduced confusion and any potential lack of participation because of perceived or real over-complication • Noted lesson learned: make any tools used user-friendly	
Pricing and Payment	• For first auction, used EQIP standard BMP costs and cost-share amounts • For second auction, farmers bid price WTA to implement BMP (could exceed EQIP BMP costs) • Bids then ranked within NutrientNet based on the cost of each P reduction ($/lb P reduced) • This ranking informed the cut-off price at which the budget was exhausted (any bid lower than price was successful and funded) • Average bid price = $10.32 in first auction, $5.06 in second auction • Noted lesson learned: Invest the time to identify appropriate methods to calculate environmental outcomes achieved through implementing BMPs	
Conflicting Programs and Goals	• None identified	
Opportunities for Stacking	• None explicitly noted	
Adaptability and Scaling Up	• Information not available	
Supporting organizations	• Support from Lancaster Land Conservancy	
Supporting laws, regulations, administrative rules	• Already had ag buffer rule	
Competing	• None identified.	

Investment Options		
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• 19 BMPs were estimated to result in over 92,000 lbs of P reductions • 4,600 lbs P reduced per BMP/contract • Average price was $10.32/lb P for first auction and $5.06/lb P for second auction.
Is still running to date?	• No
Water affordability	• N/A
Meeting projected demand for drinking water?	• N/A
Economic Efficiency	• Number of Transactions: Two reverse auctions were performed. First auction (6 bids) did not exhaust the budget. Second auction (13 accepted, 23 receieved) met the budget cap. • Costs: Total budget for the two auctions was $490,000. • $ saved as compared to alternative - unknown, no benchmark. • Actual accepted bids ranged from 2.85 to $54.33 per lb P ($54.33 was cutoff price beyond which would exhaust budget) • Average price was $10.32/lb P for first auction and $5.06/lb P for second auction.
Synergies or Externalities	• Information not available
Political and Social Favorability	• Information not available
Future Outlook	• BMPs have 10-15 year lifetimes. No indication of plan to maintain BMPs after end of lifespan.

More information:

Emailed with Suzie Greenhalgh

Preliminary Recommendations for UNRB:

- Ideal for the UNRB as a precursor for transitioning to a more comprehensive nutrient trading program. Conestoga will likely be transitioning into the Chesapeake Bay Trading Platform. Although this reverse auction project is not a source of sustainable,

permanent N and P reductions in and of itself, it serves as a good base for eventual expansion to the Chesapeake program by:
    - Engaging farmers, introducing them to a local PWS program and program admins, familiarizing them with ag BMPs and their associated costs
    - Revealing lowest-cost BMPs and approximate prices farmers are WTP for them (beneficial for estimating program costs, conducting cost/benefit and supply analysis later)
    - Conducting baseline analyses of reduction potential and estimated loading rates from individual private ag sources
    - Testing out accounting tools (in this case ,Nutrient Net) and trading platforms
    - Making the case for market-based programs for meeting watershed water quality goals
- In the future, UNRB will likely experience decreased ag inputs and increased urban-derived inputs. This model may have to be expanded to stormwater BMPs for UNRB.
- Make accounting tools clear and easy to use

Citations and Resources:

Greenhalgh, S., Guiling, J., Selman, M., & John, J. S. T. (2007). *Paying for Environmental Performance: Using Reverse Auctions to Allocate Funding for Conservation*.

Hintz, D. (2008). *Conestoga River Watershed Total Maximum Daily Loads Development - An Interim Data Report*. *Sites The Journal Of 20Th Century Contemporary French Studies*. Retrieved from http://www.srbc.net/pubinfo/techdocs/publication_257/techreport257.pdf

TEEBcase by S. Greenhalgh. (2010). *Reverse auctions help farmers to reduce phosphorus content in local waterways* (pp. 2007-2009). Retrieved from TEEBweb.org

PWS Program Score Card

Program Name/Loc.	• Mountain Island Lake • Charlotte, North Carolina

Basic Program Overview:

Program Attribute	Description	Alignment Score
Primary Hydrologic Service Targeted	• Water Quality •	
Co-benefits	• Recreation (significant recreational facilities on MIL, including two public accesses, one county park, a waterfowl refuge, and plans to enhance these resources) • Plan to create an Educational State Forest on property owned by Gaston County at the lake • Biodiversity/Wildlife Management	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Land acquisition payments	
Payment Source	• Clean Water Management Trust Fund provided funding to launch the Initiative ($6.5 million grant) • Later land acquisition funded by revenue bond, utility watershed fee, Land Purchase Bond	
Activities Funded	• Land acquisition and easements (land conservation)	
Duration of program	Initiative started in 1998	
Participants	• Buyers: Local City and County governments • Sellers: Landowners • Intermediaries/Donors: State funding, foundations	1: buyers and sellers don't match 2: one buyer or one seller match 3: **4: buyers and sellers match but not all** 5: all buyers and sellers match
Beneficiaries (Type and Amount)	• Serves as a water supply for more than 720,000 people in Mecklenburg, Lincoln, and Gaston Counties as well as the City of Charlotte	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix

	• Public utilities	3: primary is utility, but not necessarily public 4: primary beneficiary is public utility but others more significant than in UNRB **<u>5: primary beneficiary is public utility with little ag/industrial</u>**
Watershed Size	• 69 square miles	**<u>1: if order of magnitude smaller,</u>** 2: if smaller by a factor of 2 or more, 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source Type	• Man-made reservoir for water and power	1: impaired water body (not for drinking) 2: 3: aquifer/river 4: **<u>5: Reservoir</u>**
Scale	• Regional, watershed-scale	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **<u>5: watershed-scale</u>**
Government and Utility Coordination	• Mecklenburg, Gaston, Lincoln counties • City of Charlotte, City of Gastonia • Not sure if any dependent cities that are outside the watershed – don't believe so	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed **<u>4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed</u>** 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed

Jurisdictional Alignment	• Buyers are the Initiative, but ultimately City and County governments • Sellers are private landowners	1: buyers are non-local 2: local buyers outside the watershed **3: local buyers entirely inside the watershed** 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• Much of the eastern side has been protected as a County Nature Preserve, but "unchecked development on the western side of the lake and its impact on water quality became a growing concern to area's residents" • 23% of shoreline is developed • Land use of the watershed or program area (breakdown of forests and agriculture, for ex.) • What are the contributions of the different nonpoint sources? (e.g., ag vs. urban runoff vs. mining)	1: meets none of the criteria 2: meets 1 of the criteria **3: meets half criteria** 4: meets 3 of four criteria 5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• "Although the project was not required under Clean Water Act regulation, it was largely driven by fear that MIL would soon no longer be in compliance with CWA requirements due to increased development in the watershed." • Local leaders feared that clean water was threatened by increasing sediment and fecal coliform from new development." • The entire length of McDowell Creek is on the state's 303(d) list (not yet EPA approved) in this subbasin. A management strategy is being developed in conjunction with local stakeholders.	**1: no regulatory driver** 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• All land conservation, so practice-based	**1: practice-based (paying for a BMP, not load reduction per se)** 3: both practice- and performance-based (paying for a BMP with an implied associated load reduction) 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem Services	• Used a prioritization scheme to highlight priority conservation parcels • Still have not met goals for acres of land protection	
Ample Supply of Sellers?	• Not sure – assuming that the prioritization scheme took into account folks potential willingness to participate	
Ample Supply of Buyers/Demand for Service	• Demand will likely increase over time due to increased development pressure • Only local governments will demand – no offset-type provisions in place	
Monitoring and Evaluation	• No/Unknown whether success of project's actions are being monitored • Monitoring acres conserved to date • Have land acquisition goals but no clear water quality benchmarks	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit **3:Program goals are qualitative** 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• No real sustainable funding mechanism – reliant on one-time grants and bonds • Have been able to acquire multiple funding sources and leverage initial funds	1: One-time grants with no renewal in sight 2: **3: Not definite, but has potential and record of renewal** 4: 5: Program activities has means to remain in place more than 10 years after implementation
Program Administration	• Mountain Island Lake Initiative – created by Catawba Lands Conservancy, the Community Foundation of Gaston County, the Foundation for the Carolinas, the Trust for Public Land, and Gaston, Lincoln, and Mecklenburg Counties. • Now a broad coalition of local governments, funders, non-profits	1: Unilateral sub-watershed administration 2: 3: Administered through cooperation between major players **4:** 5: Administered by a watershed-

		level governing body
Transaction Costs	• No indication of tools to facilitate and encourage transactions • All activities funneled through the Initiative, perhaps reducing transactions costs as compared to individual governments transacting • No indication of seller collaboration or grouping	
Pricing and Payment	• No clear	
Conflicting Programs and Goals	• No identifiable conflicting programs and/or goals	
Opportunities for Stacking		
Adaptability/Scaling Up	• Are institutional and financial mechanisms adaptable over time? • Able to link up with other programs? • Ability to expand and scale up?	
Supporting organizations	• Public support from community organizations • NGOs (land trusts, etc…) • Sometimes NGOs can bring parties together for example, bringing landowners together to collaborate into a PWS arrangement	
Supporting laws/regulations/administrative rules	• Future rules • Local government mandate	
Competing Investment Options	• Do beneficiaries face options for substitution? • Are there tradeoffs to investment? • What are the competing opportunity costs? • If available, green versus gray infrastructure costs	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks	• Explicit goal of the initiative was to protect both 80% of the lakeshore and 80% of its tributaries. • As of 2004, 74% of the lakeshore, 20% of the tributaries, and over 6,000 acres

To-Date	of the watershed were protected • Noted that "since the MIL Initiative, water quality has measurably improved through the MIL watershed, including a 70% reduction of fecal coliform."
Is still running to date?	• Yes
Water affordability	
Meeting projected demand for drinking water?	• (for all cities using that reservoir/drawing from the watershed)
Economic Efficiency	• Information not available.
Synergies or Externalities	• Information not available.
Political and Social Favorability	• Information not available.
Future Outlook	• Information not available.

Citations and Resources:

http://www.efc.umd.edu/new/pdf/Charlotte-Mecklenburg%20Case%20Study.pdf

http://ncwrc.conservationregistry.org/projects/15809?printable=true#fulldescr

http://www.nalgep.org/localinnovations/index.cfm?LinkAdvID=43005

http://www.ncwater.org/Reports_and_Publications/Catawba_River_Basin/CRBNRPfinal.pdf

PWS Program Score Card

Program Name/Loc.	• Ohio River Valley - Miami River Watershed • Water Quality Trading - Reverse Auction Program

Basic Program Overview:

Program Attribute	Description	Alignment Ranking
Primary Hydrologic Service Targeted	• Water Quality (reduced TP and TN loads)	
Co-benefits	• Habitat Improvement • Stream shading/temp benefits • Streambank stabilization • flow velocity stabilization • floodplain preservation • Recreation – trails called "Ohio's Great Corridor" • Ancillary benefits are only considered in funding decisions in the event of a tie bid.	
Payment Type	• Point-nonpoint source water quality trading • WWTPs buy ag BMPs to offset their load reduction requirements	
Payment Mechanism	• Reverse Auction – MCD asks the farmers and SWCDs to state their requested bid amount and then sets the maximum acceptable bid after the round of bidding is finished.	
Payment Source	• WWTPs contributions to the program by 2010 exceeded $1.2 million. Over half of the plants' contributions have been allocated to funding load reduction projects, with the balance used to support administrative and water quality monitoring costs. • The MCD used funding from the $1 million USDA-NRCS grant – a portion of which was used to support administrative expenses and a portion was used to fund projects and generate credits from ag sources which are held in the insurance pool (Newburn & Woodward, 2012).	

Activities Funded	• Ag BMPs (no till was used for economic analysis). "Unprecendented success in the diversity of ag BMPs funded" (Newburn & Woodward, 2012) citing Ribaudo and Gottlieb 2011) • Livestock management (e.g., manure storage ponds or structures) represent 58% of total funded nutrient reductions (Newburn & Woodward, 2012).	
Duration of program		
Participants	• Multiple point source buyers (many WWTPs) • Multiple nonpoint source sellers (all farmers)	1: buyers and sellers don't match 2: one buyer or one seller match 3: **<u>4: buyers and sellers match but not all</u>** 5: all buyers and sellers match
Beneficiaries (Type and Amount)	• The condition of the Great Miami River Watershed also affects receiving water bodies downstream, including the Ohio and Mississippi Rivers and the Gulf of Mexico •	**<u>1: beneficiaries don't match at all</u>** 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public 4: primary beneficiary is public utility but others more significant than in UNRB 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• 4,000 square miles (640 acres)	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, **<u>3: if order of mag larger,</u>** 4: if twice as large, 5: if same size
Water Source Type	• Rivers • No known reservoir or lake • Talk of TMDLs for watersheds as a whole, although I'm not sure how that works exactly (Newburn & Woodward, 2012)	**<u>1: impaired water body (not for drinking)</u>** 2: 3: aquifer/river 4: 5: Reservoir
Scale	• What area is covered? (also include if it's local, regional, national) • If covered area is not entire watershed, how big is the watershed? • How many people does it serve? • What kind of water body? Aquifer?	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **<u>5: watershed-scale</u>**

	Reservoir? River?	
Government and Utility Coordination	• Area includes 15 counties • Watershed includes cities of Dayton, Troy, Hamilton, and upper portion of Cincinnati	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed **<u>5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed</u>**
Jurisdictional Alignment	• Both buyers and sellers are inside the watershed (altho Cincinnati is straddled – not sure what this means for them)	1: buyers are non-local 2: local buyers outside the watershed **<u>3: local buyers entirely inside the watershed</u>** 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• Agriculture is "predominant land use in the watershed" (Kieser & McCarthy, 2012) (70% of land area), particularly for row crop production (Newburn & Woodward, 2012) • Unknown what loadings are from different nonpoint sources (only have land use info)	1: meets none of the criteria 2: meets 1 of the criteria 3: meets half criteria **<u>4: meets 3 of four criteria</u>** 5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• "It was expected that the nutrient criteria and TMDLs would act as a driver for demand from WWTPs for credits; however, as is true nationally, finalization of the nutrient criteria and TMDLs in Ohio has been delayed for a range of scientific	1: no regulatory driver 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) **<u>3: impaired water body with</u>**

	reasons and legal challenges" (Newburn & Woodward, 2012). This delay has "eliminated the direct demand for credits" (Newburn & Woodward, 2012) citing Selman et al. 2009) • Regulatory – WWTPs will soon face more stringent effluent limits as a result of impending numeric nutrient standards for receiving rivers and streams • Pre-compliance incentives to encourage early participation prior to issuance of more stringent limits (favorable trading ratios for early actors) • Watershed includes over 1,000 stream miles and over 40% of these do not meet federal standards for attaining aquatic life (Newburn & Woodward, 2012)	**established regulatory/cost driver (currently allocated certain amount per year)** 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• performance-based in the sense that getting credits for modeled reductions, practice-based in the sense that nutrient reductions are modeled based on practices and not ultimate effect on water quality	1: practice-based (paying for a BMP, not load reduction per se) **3: both practice- and performance-based (paying for a BMP with an implied associated load reduction)** 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment Ranking
Potential Supply of Enhanced Ecosystem Services	• Analysis indicated adequate supply of agricultural nonpoint source reductions in TP to meet all WWTP demand and most TN demand (K&A 2004) • Out of 160 bids submitted as of the 6th round of bidding in 2009, 100 were approved, indicated ample supply of available nutrient reductions. • Are there enough BMPs and targeted lands to justify a PWS program? In other words, are there ample opportunities for pollution reduction measures? • Has a study been done to assess this?	
Ample Supply of Sellers?	• In 2002, watershed included over 1,000 farmers. • Do the potential suppliers seem willing to participate? What is their perceived	

	reception in terms of values, understanding, experience with similar programs, level of stakeholder involvement	
Ample Supply of Buyers/Demand for Service	• Watershed has total population of 1.5 million people and more than 75% reside in urban areas • There are 314 point sources in the watershed. The large municipal WWTPs are the dominant dischargers, including 7 point sources with over 10 million gallons per day (from (Newburn & Woodward, 2012), who cited Kieser and Associates, 2004)	
Monitoring and Evaluation	• Annual monitoring of the practices by the SWCD offices is required to document the "generation and status of water quality credits" (Newburn & Woodward, 2012) citing MCD, 2005). • Program was designed to "improve locally impaired waterways and provide a cost-effective alternative for WWTP compliance under forthcoming N and P standards" (Kieser & McCarthy, 2012) • Annual monitoring by SWCD is more to make sure BMPs are in place and haven't failed. Not actually conducting in-stream measurements (altho this is being done by a third party as well, I believe, but don't have a clear source for this)	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• Used a one-time $1 million USDA-NRCS grant to get program up and running • Administrative and monitoring costs have largely been incurred by offsetting parties (WWTPs) • Not sure if will continue to incorporate administrative and monitoring costs into the price	1: One-time grants with no renewal in sight 2: **3: Not definite, but has potential and record of renewal** 4: 5: Program activities has means to remain in place more than 10 years after implementation
Program Administration	• Miami Conservancy District (MCD) – a watershed-based flood district with taxing authority • They are authorized and founded by the State of Ohio	1: Unilateral sub-watershed administration 2: 3: Administered through cooperation between major players 4: **5: Administered by a**

		watershed-level governing body
Transaction Costs	• MCD served as a clearinghouse for all transactions – noted to reduce transaction costs • Used standardized Spreadsheet Tool for Estimating Pollutant Load (STEPL) to determine nutrient reductions based on practice type and biophysical characteristics. • SWCD offices work with individual farmers, as opposed to the MCD themselves.	
Pricing and Payment	• In round 1, reverse auction approach provided an average 32% savings relative to a fixed price (Newburn & Woodward, 2012). This decreased in latter rounds of bidding, was only 14% in round 6. • Use trading ratios – 2:1 if discharging into impaired waters, 1:1 if discharging into attaining waters. Increases to 3:1 and 2:1, respectively, after regulations are in place.	
Conflicting Programs and Goals	• Farmers who had already participated in federal cost share programs were not eligible to participate	
Opportunities for Stacking	• Several cities in the watershed have begun working collaboratively with landowners and producers to develop recreational trails • No explicit work towards stacking payments or supplies.	
Adaptability/Scaling Up	• Currently working to scale up to the entire Ohio River Basin. • ODNR has reacted to pressure from farmers and SWCD agents to develop new STEPL modules to estimate load reductions (b/c most popular and effective BMPs were not previously in the module) (Newburn & Woodward, 2012).	
Supporting organizations	• Public support from community organizations • NGOs (land trusts, etc…) • Sometimes NGOs can bring parties together for example, bringing landowners together to collaborate into a PWS arrangement	
Supporting	• No known supportive rules other than	

laws/regulation s/administrative rules	the primary demand drive (nutrient standards and TMDL)	
Competing Investment Options	• Economic analysis conducted – found substantial cost differentials b/w WWTP upgrades and trading of credits ($422.5 million vs. $37.8 million) (Kieser & McCarthy, 2012)	
Potential for Innovation	• Altho the variety of projects available suggest a potential for innovation, this is stifled by the constraints of the STEPL module used to estimate load reductions. Now the tool has incorporated new STEPL module.s	

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• Noted goal was to "improve locally impaired waterways" • Has the "greatest number of credits being generated compared to similar trading programs in the US" (Kieser & McCarthy, 2012) • Over $1.3 million (2/3 of which came from WWTPs either directly or with matching support from EPA/USDA), has been allocated to the funded practices providing an estimated 808,845 lbs of nutrient reductions (Newburn & Woodward, 2012). This is averages to $1.61/lb nutrient reduced, $13,000 per project/BMP
Is still running to date?	• Yes
Water affordability	• N/A
Meeting projected demand for drinking water?	• N/A
Economic Efficiency	• Stated goal of program was to provide a cost-effective alternative for WWTP compliance under forthcoming N and P standards (as compared to "expensive wastewater treatment plant upgrades") (Kieser & McCarthy, 2012) • Ten rounds of reverse auction bidding to date • 7 point source buyers representing 9 permitted outfalls (out of 300 in the watershed) participated in pre-compliance market • A total of 160 eligible applications were submitted as of the 6th round of bidding in 2009, and the MCD funded 100 projects for ag BMPs (63% acceptance rate) – meaning ample supply of willing seller • Noted that fact that GMTP has been an unprecedented success in the diversity of ag BMPs indicates that other cost-effective opportunities may be left

	• unexploited in other programs that have focused on only one BMP type (Newburn & Woodward, 2012). • In round 1, reverse auction approach provided an average 32% savings relative to a fixed price (Newburn & Woodward, 2012). This decreased in latter rounds of bidding, was only 14% in round 6.
Synergies or Externalities	• What co-benefits? Presence of threatened/rare species? • What co-costs?
Political and Social Favorability	• Does the program seem politically and socially popular? • Are there clear winners/losers that may cause potential conflict?
Future Outlook	• General comments here on how it's looking, impressions on stability over time, etc.

Additional Comments:

- Those dischargers who participated early on represented larger communities that recognized that expensive WWTP upgrades would be associated with nutrient standards.
- The economic analysis of the cost differential for WWTP to comply with future instream nutrient criteria/TMDLs through their own actions vs. ag BMPs "served as a major impetus for demand from WWTPs for the trading program" (Newburn & Woodward, 2012).
- "Two institutions have played critical roles in the functioning of the GMTP… leadership of MCD managers… and the SWCD offices" (Newburn & Woodward, 2012).
- Organizing over 100 meetings with stakeholders… "led to widespread support from diverse stakeholders including agricultural producers, the Ohio Farm Bureau, municipalities, SWCD offices, regulatory agencies, and local watershed groups" (Newburn & Woodward, 2012).
- "Transaction costs were greatly reduced, which can improve program efficiency, by the MCD serving as a clearinghouse for all transactions between participating WWTPs, SWCDs, and farmers" (Newburn & Woodward, 2012).
- Transactions were facilitated by using SWCDs to interact directly with farmers, as they already have similar responsibilities in the federal conservation programs and are "socially embedded" agents with existing networks of relationships that can reduce the historic mistrust between farmers and urban groups (Newburn & Woodward, 2012) citing Breetz et a. 2005 and Mariola 2009).
- A "major reason for the decline in effectiveness of the reverse auction is that MCD did not vary the maximum price paid between rounds. The effectiveness of the reverse auction relies on some degree of uncertainty about the threshold price to create an incentive for lower bids." Similar behavior has been observed for CRP auction. (Newburn & Woodward, 2012)

- "SWCD agents keep monitoring and enforcement costs relatively low. As the agents have ongoing relationships with the farmers and monitor practices funded by the larger federal conservation programs, it allows them to easily monitor the BMPs installed under the GMTP as well."
- "Reliance on SWCD offices to recruit and advise farmers has been essential to achieve relatively high rates of farmer participation" … due to… established relationships with farmers, expertise on which farmers and practice types are likely to be competitive, and SWCD can "partly free ride on the administrative costs that SWCD offices receive to assist in the federal conservation programs" (Newburn & Woodward, 2012).
- "We believe that the prominent role of the SWCD offices in the institutional design of the GMTP has enormous potential to be replicated in future WQT programs in other regions" (Newburn & Woodward, 2012).
- However, it's important that SWCD offices are on board, or "the SWCD office does not reduce transaction costs, but rather imposes a barrier to trading because farmers are unlikely to be aware of the program without SWCD promotion even though some farmers may be competitive" (Newburn & Woodward, 2012).

More information:

- Talked with Mark Kieser of Kieser and Associates

Primary Recommendations for UNRB:

- **Because early participants were larger dischargers that would require upgrades to abide with new standards, should focus on getting the largest point source dischargers on board**

Citations and Resources:

Kieser, M. S., & McCarthy, J. L. (2012). *Great Miami River Watershed Water Quality Trading Program: Review Report*. *Environment*.

Newburn, D. a., & Woodward, R. T. (2012). An Ex Post Evaluation of Ohio's Great Miami Water Quality Trading Program1. *JAWRA Journal of the American Water Resources Association*, *48*(1), 156-169. doi:10.1111/j.1752-1688.2011.00601.x

PWS Program Score Card

Program Name/Loc.	• Sebago Lake • Portland, ME

Basic Program Overview:

Program Attribute	Description	Alignment Ranking
Primary Hydrologic Service Targeted	• Water Quality has been the focus since the drinking water supply portion of the lake was made into a reserve in 1913 • Water Quantity	
Co-benefits	• 90% of the land is public and recreation is encouraged, however there is a 2 mile 3000 ft buffer that is not accessible to the public intended to protect WQ at the southern intake(Portland Water District, 2012).	
Payment Type	• Non-Market, Government: Watershed Service fee	
Payment Mechanism	• Land purchases, conservation easements, BMP implementation	
Payment Source	• 1993 legislation allowing water utilities to set aside up to 5 percent of the prior year's revenues for drinking water source protection. (US Environmental Protection Agency, 1999a) • Land for Maine's Future Fund: funded by the legislature for conservation in the state and matched dollar for dollar by private funds (Maine State Planning Office, 2006) • Section 319 WQ Grants through State Non Point Source Pollution (US Environmental Protection Agency, 2012)	
Activities Funded	• Land conservation, easements • BMP implementation includes erosion control, technical assistance for road & ditch maintenance, shoreline audit program, and education. Heavy emphasis on education for landowners and local schools.(US Environmental Protection Agency, 2012)	
Duration of	• Efforts to preserve land along the lake	

program	periphery have been in place since 1913. The legislature passed a law to protect Portland's drinking water supply.	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): Portland Water District (24mgd demanded (Portland Water District, 2012) • Sellers: Land owners, family forests • Intermediaries/Donors: Land trusts manage different portions of the lake, Sebago Lake State Park	• 1: buyers and sellers don't match • 2: one buyer or one seller match • 3: • **<u>4: buyers and sellers match but not all</u>** • 5: all buyers and sellers match
Beneficiaries	• Residents of Portland and the 24 towns within the watershed, tourists, homeowners on lake periphery • Portland Water District (over 190,000 customers) • 6.9% Residential, 2.2% agriculture, 0.2% commercial, 2.5% timber, 81.5% undeveloped vegetated areas, 2.2% other	• 1: beneficiaries don't match at all • 2: primary is not a utility, but share similar beneficiary mix • 3: primary is utility, but not necessarily public • 4: primary beneficiary is public utility but others more significant than in UNRB • **<u>5: primary beneficiary is public utility with little ag/industrial</u>**
Watershed Size	• Total watershed area=361 sq miles (171 direct, 190 indirect) • Lake is 12 miles long, 995 billion gallon capacity	• 1: if order of magnitude smaller, • **<u>2: if smaller by a factor of 2 or more,</u>** • 3: if order of mag larger, • 4: if twice as large, • 5: if same size
Water Source Type	• Natural lake used for drinking, fishing, swimming	• 1: impaired water body (not for drinking) • 2: • **<u>3: aquifer/river/lake</u>** • 4: • 5: Reservoir
Scale	• Whole watershed is involved in lake protection.	• 1: city- or county-wide • 2: • 3: sub-watershed but not a particular jurisdiction • 4: • **<u>5: watershed-scale</u>**

Government and Utility Coordination	• 23 towns • 11 cities of Greater Portland directly dependent on Sebago lake for drinking water- most of these are downstream from the lake and not necessarily in the same watershed.	• 1: one city in watershed and using the water • 1: one city within watershed with its own utility • 2: one utility serving multiple cities inside (not outside) the watershed • 3: one utility serving multiple cities both inside and outside the watershed • 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed • **<u>5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed</u>**
Jurisdictional Alignment	• PWD is primary buyer	1: buyers are non-local 2: local buyers outside the watershed **<u>3: local buyers entirely inside the watershed</u>** 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• 6.9% Residential, 2.2% agriculture, 0.2% commercial, 2.5% timber, 81.5% undeveloped vegetated areas, 2.2% other • (Portland Water District, 2012)What are the contributions of the different nonpoint sources? (e.g., ag vs. urban runoff vs. mining)	**<u>1: meets none of the criteria</u>** 2: meets 1 of the criteria 3: meets half criteria 4: meets 3 of four criteria 5: meets all criteria (naturally forested, 50%-70% forested, with significant development

		pressure and 10-20% ag)
Drivers	• Regulatory compliance required by legislation • Public support/demand for clean water (result of progressive legislation and education)	1: no regulatory driver **2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver)** 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance Based	• BMP's and land conservation to meet drinking water standards. It's practice based but must meet performance standards.	1: practice-based (paying for a BMP, not load reduction per se) **3: both practice- and performance-based (paying for a BMP with an implied associated load reduction)** 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment Ranking
Ample Supply of Ecosystem Services	• The pollution reduction to date has been impressive, however PWD is threatened with losing its waiver and may need to invest in a water treatment facility-protecting more forested land could delay this possibility and to this end WRI is working in the Crooked River to establish PWS. (Gartner, 2011)	
Ample Supply of Players/Seller s?	• Do the potential suppliers seem willing to participate? What is their perceived reception in terms of values, understanding, experience with similar programs, level of stakeholder involvement? ○ This is an unknown. It seems likely that there is still an understanding of the need to protect WQ higher	

	up in the watershed.	
Ample Supply of Buyers?	• Portland Water Supply would be the primary buyer. Historical connection to land for water quality, pride in lack of filtration.	
Monitoring and Evaluation	• 10 monitoring systems in place around the watershed, monitoring takes place regularly (1x/month). Secchi disk, phosphorous, and chlorophyll a are measured • Reporting is regular and transparent	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results **5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place**
Permanence and Sustainability	• Much of the protection around the lake is now permanent as it is in State Park or easement.	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal 4: **5: Program activities has means to remain in place more than 10 years after implementation**
Program Administration	• Government funded program • Legislature provides funding and supports water district purchases	1: Unilateral sub-watershed administration 2: **3: Administered through cooperation between major players** 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Land purchase deals and conservation easements require relationship building and time.	
Pricing and Payment	• Will payments/pricing result in most economically efficient means of meeting environmental or cost reduction goals?	
Conflicting Programs and Goals	• Losing federal waiver might affect investment in the watershed. Sebago Lake would remain a tourist destination nd	

	continue to be protected. • Protecting the Crooked River Watershed is the next step	
Opportunities for Stacking	• Crooked River has critical salmon habitat and is threatened by dam development (Maine Rivers Staff, 2012)	
Adaptability/Scaling Up	• If land along the Crooked River is purchased for WQ, opportunities to partner with federal cost share programs exist • Potential for Sebago Lake users to pay upstream landowners in market?	
Supporting organizations	• Noted in "Participants"	
Supporting laws/regulations/administrative rules	• None explicitly noted	
Competing Investment Options	• 73% of the watershed is privately owned forest land. Development pressures in this area ranked **first** in a study of Maine's watersheds- There is need for land protection and certainly competition from development. (USDA Forest Service Northeastern Area, 2009) • Income from development might compete with ethic to protect water quality • Substitute grey infrastructure for green? Still looking for cost data.	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• State of the watershed report 2012 shows consistent clarity and safe levels of minerals/contaminants. Avoided N&P do not appear to be on the list of concerns so much as maintaining overall swimmable, fishable, drinkable standards. (Portland Water District, 2012) • 1997: $600,000 spent to purchase buffer zone within 1,000 feet of shoreline (US Environmental Protection Agency, 1999b)
Economic Efficiency	• Information not available
Synergies or	• Sport Fishing industry is lucrative and dependent on lake clarity, increases

Externalities		tourism
	•	Development on lakefront, property values are higher because of the clean water and landscape (Portland Water District, 2012)
Political and Social Favorability	•	Public support for the program seems strong overall
	•	Incentives to continue protecting lake water quality even if the filtration waiver were denied
Future Outlook	•	Interested to find out more about Crooked River Land protection

Additional Comments:

This study is a good example of the efficacy of watershed protection. It's a small watershed with 11 cities and 23 towns served. There is a legacy of land protection and in spite of increasing development pressure, water quality remains high. Federal filtration waivers are a primary driver for continued land protection, however the ethic of protecting water quality would likely continue even if a treatment plant were installed. Portland has the potential to extend current PWS efforts upstream of Sebago Lake in the same way, attention in the UNRB should look upstream of Falls Lake to best protect water quality.

Primary takeaways for the UNRB include:

- **Public awareness and investment in watershed**
- **Multiple funding sources**
- **Public land available for recreation increases stakeholder support of PWS**

"The watershed program produced many lasting achievements. Public education significantly raised the public's interest and understanding of watershed protection and lake water quality and sparked a new lake association to foster protection activities (US Environmental Protection Agency, 2012)."

Citations and Resources:

Gartner, T. (2011). Using Economic Incentives to Connect US Forests, Water, Communities. Washington, DC: World Resources Institute. Retrieved from http://www.wri.org/stories/2011/01/using-economic-incentives-connect-us-forests-water-and-communities#fn:1

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Portland Water District. (2012). Portland Water District. *Website*. Retrieved from http://www.pwd.org/home.php

US Environmental Protection Agency. (1999a). Protecting Sources of Drinking Water Selected Case Studies in Watershed Management Drinking Water Source Protection□: A New National Focus.

US Environmental Protection Agency. (1999b). Protecting Sources of Drinking Water Selected Case Studies in Watershed Management Drinking Water Source Protection□: A New National Focus.

US Environmental Protection Agency. (2012). Water: Nonpoint Success Stories, Maine. *Water*. Retrieved October 2, 2012, from http://water.epa.gov/polwaste/nps/success319/ME.cfm

USDA Forest Service Northeastern Area. (2009). Forests , Water and People Drinking water supply and forest lands in Maine. Retrieved from http://www.na.fs.fed.us/watershed/factsheets/fwap/FWAP_state_sheet_ME.pdf

PWS Program Score Card

Program Name/Loc.	• Raritan Basin • Raritan, New Jersey

Basic Program Overview:

Program Attribute	Description	Alignment Rating Criteria
Primary Hydrologic Service Targeted	• Water Quality & Quantity	
Co-benefits	• Recreation (over 50,000 acres) & Habitat for biodiversity are main co-benefits mentioned. (Shallcross, 2002)	
Payment Type	• Non-Market Government PWS Source Water Protection Rate component instituted by the NJ WSA in in 2002- goes to fund the NJ Environmental Infrastructure Trust (NJ Water Supply Authority Watershed Protection Programs Division, 2009)	
Payment Mechanism	• Cash payment • Subsidy payments • Cost-share agreements: Agricultural Water Enhancement Program (AWEP) funds conservation and cons. planning • Land purchase deals • Stormwater mgmt BMPs • Pays for the development of Nutrient Management Plans for farmers.	
Payment Source	• Source Water Protection rate on water bill is the primary source of funding • Federal funding through grants and cost share add to the available monies • (NJ WSA, 2009; The Trust for Public Land, 2005) • Current charge is $15 for every $241 per million gallons sold • (Personal communication Ken Klipstein, Director of Watershed Protection Programs, NJ WSA, 3/7/12)	
Activities Funded	• Land conservation • Project implementation	
Duration of	• Funding from Source Water Protection rate	

program	began in 2002. • Raritan Basin Management plan developed in 2003. • Addresses non-point source pollution, storm water, WWTPs, development and open space.	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): NJ WSA, NJ Resource Conservation & Development Council • Sellers: Private Landowners, commercial development landowners • Intermediaries/Donors: Acquisitions are done as partnerships between government and/or non-profits. • Over 35 partners including municipal, county, agency, and non-profits complete list available at http://www.raritanbasin.org/Projects/acquisition/about.html • NJ Dept of Environmental Protection, NJ Water Supply Authority (The Trust for Public Land, 2005)	1: buyers and sellers don't match 2: one buyer or one seller match 3: 4: buyers and sellers match but not all **5: all buyers and sellers match**
Beneficiaries (Type and Amount)	• 1.3 million people receive drinking water provided by the basin (The Trust for Public Land, 2005)	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public **4: primary beneficiary is public utility but others more significant than in UNRB** 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• Three watershed management areas (WMAs) are included in the Raritan Basin. There are 5 watershed planning regions and 20 WMAs designated by the NJ State Dept of Env. Protection. (Shallcross, 2002) • 468 square miles across 3 counties encompass the North & South branches of the Raritan River • The Lower Raritan is 352 sq miles over 4 counties • The Millstone River Watershed is 285 square miles and includes 4 counties	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, 3: if order of mag larger, 4: if twice as large, **5: if same size: (combining all the WMA's is about the same size as UNRB)**

Water Source Type	• 3 reservoirs are managed along the rivers by NJWSA. Also a canal. • Groundwater is also a supply for 18% of the population using wells. • Lawrence Brook Chain of Lakes also provides surface water. (Shallcross, 2002)	1: impaired water body (not for drinking) 2: 3: aquifer/river 4: **5: Reservoir**
Scale	• Raritan Basin covers 3 WMA areas. The • Rivers, lakes and reservoirs are all contained within the basin. • 1.2 million people are dependent on water from the basin.	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **5: watershed-scale**
Government and Utility Coordination	• 100 municipalities • 7 counties • 1100 square miles • 11 major water suppliers within the basin distribute water to municipalities inside and outside of the basin (Shallcross, 2002)	1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed **5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed**
Jurisdictional Alignment	• Sellers are the landowners • Buyers include NJ WSA, Land trusts	1: buyers are non-local 2: local buyers outside the watershed **3: local buyers entirely inside the watershed** 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• This data is from **1995** (Newcomb & Stanuikynas, 2002) • Agriculture: 19.2% • Forest: 26.6% • Urban: 35.7%	1: meets none of the criteria 2: meets 1 of the criteria **3: meets half criteria** 4: meets 3 of four criteria 5: meets all criteria (naturally

	• Wetland: 15.2% • Water: 1.2% • Barren: 1.4% • Impervious surface covers approximately 11% of the basin • 50% of basin land is within 1 mile of the highway network, 77% is within 2 miles suggesting the importance of non-point source pollution in the water bodies (Newcomb & Stanuikyanas, 2002) • Non point sources are primary contributor to water pollution, some development pressure, less forest, similar agricultural use	forested, 50%-70% forested, with significant development pressure and 10-20% ag)
Drivers	• NJ WSA was formed in 1981 by the New Jersey Water Supply Act where in all water supply facilities were transferred to the authority http://www.njwsa.org/html/about_us.html • The Authority instituted the source water protection programs, apparently in absence of legislation	**1: no regulatory driver** 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• BMPs for agriculture and stormwater are supported by the program. • Plans for farmers and land use • Outreach & education	**1: practice-based** 3: both practice- and performance-based 5: performance-based

Key Attributes:

Program Attribute	Description	Alignment Ranking Criteria
Potential Supply of Enhanced Ecosystem Services	• Are there enough BMPs and targeted lands to justify a PWS program? In other words, are there ample opportunities for pollution reduction measures? • Has a study been done to assess this?	
Ample Supply of Sellers?	• Do the potential suppliers seem willing to participate? What is their perceived reception in terms of values, understanding, experience with similar programs, level of stakeholder	

	involvement	
Ample Supply of Buyers/Demand for Service	• NJ WSA partners with at least two other agencies- land trusts or other state agencies in land purchase deals.	
Monitoring and Evaluation	• Water quality monitored and asssed using a network of 152 ambient water quality monitoring stations. Bioassessment is also done at these stations (Shallcross, 2002)	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit **3:Program goals are qualitative** 4: Clear program goals but related to something other than explicit load reductions or water quality results 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• The rate increase is regulated by the board of commissioners who oversee NJWSA. They are appointed by the Governor; any changes must be approved by public process. (Personal communication Julie Hajdusek 3/7/12)	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal 4: **5: Program activities has means to remain in place more than 10 years after implementation**
Program Administration	• NJ WSA administers the program directly or through partner agencies	1: Unilateral sub-watershed administration 2: **3: Administered through cooperation between major players** 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Tools to facilitate and encourage transactions? • Online transaction platforms where beneficiaries can find suppliers and conduct transactions, allowing an GO, government agency, etc.. to bring beneficiaries together • Institutions established to match buyers and sellers?	

	• Seller collaboration or grouping?	
Pricing and Payment	• Will payments/pricing result in most economically efficient means of meeting environmental or cost reduction goals?	
Conflicting Programs and Goals	• Are there any	
Opportunities for Stacking		
Adaptability/Scaling Up	• Are institutional and financial mechanisms adaptable over time? • Able to link up with other programs? • Ability to expand and scale up?	
Supporting organizations	• Public support from community organizations • NGOs (land trusts, etc…) • Sometimes NGOs can bring parties together for example, bringing landowners together to collaborate into a PWS arrangement	
Supporting laws/regulations/administrative rules	• Future rules • Local government mandate	
Competing Investment Options	• Do beneficiaries face options for substitution? • Are there tradeoffs to investment? • What are the competing opportunity costs? • If available, green versus gray infrastructure costs	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• To date, 3,500 acres conserved valued at $76,000,000 • Conservation Easements held on 316 acres and valued at approximately $2,600,000 • (NJ Water Supply Authority Watershed Protection Programs Division, 2009)
Is still running to date?	• Yes
Water affordability	• $241 per million gallons
Meeting projected demand for drinking	• (for all cities using that reservoir/drawing from the watershed)

water?	
Economic Efficiency	• Number of Transactions – fraction of potential sellers that have successfully been paid to implement something • Costs (including transaction costs) – cost per lb avoided? per BMP? per acre? per participant? • $ saved as compared to alternative – green vs. grey. – green/grey ratio cost
Synergies or Externalities	• What co-benefits? Presence of threatened/rare species? • What co-costs?
Political and Social Favorability	• Raritanbasin.org has a goal to generate greater awareness of the watershed and it's importance; goal to have 50% of population familiar with the concepts by 2012. •
Future Outlook	• General comments here on how it's looking, impressions on stability over time, etc.

More information:

- Ken Klipstein, NJ WSA- Cell 908.812.6837
- www.raritanbasin.org

Primary Recommendations for UNRB:

This source water protection program provides a good model for blending watershed authority that is spread across several governments into one entity. The watershed as a whole is broken into sub-watershed management areas (WMA) for ease of implementation, and coordination. Funding can be applied to a diversity of tasks in order to meet the needs of each WMA. The sum of the WMA areas is very close to the size of the UNRB, the political overlap is also striking as there are cities served by the watershed that are not entirely within the watershed (like Raleigh in the UNRB). There are additionally similar development pressures in the Raritan Basin, and the Source Water Protection Plan provides direct pathways to protect the water supply in the face of these challeneges (The Trust for Public Land, 2005). UNRB policy makers should consider speaking with the NJ Water Supply Authorty as they work to expand PWS in North Carolina

- **Raritan Basin Water Management Plan was characterized by strong partnerships with existing organizations as well as public outreach.**
    - Two phases of public education involving targeting the general public as well as more specific groups that might participate in water management.
    - Surveys of NJ residents found that "central New Jersey residents rank the importance of water resource protection higher than reducing taxes, unemployment, and road congestion (The Trust for Public Land, 2005)."
    - "Great progress has been made in the area of protection and preservation thanks to strong partnerships among municipalities and the Stony Brook–Millstone Watershed Association (SBMWA) within the Millstone River region(The Trust for Public Land, 2005)."

Citations and Resources:

Deborah Newcomb & Tom Stanuikynas. (2002). *LANDSCAPE OF THE RARITAN RIVER BASIN A Technical Report for the Raritan Basin Watershed Management Project*. *Water Supply*.

NJ Water Supply Authority Watershed Protection Programs Division. (2009). Watershed Protection Programs. Retrieved from http://www.raritanbasin.org/index.html

Shallcross, A. et al. (2002). *Raritan Basin Portrait of a Watershed*. *Raritan A Quarterly Review*.

The Trust for Public Land. (2005). *The Source Protection Handbook*. *Water Protection Series*. Retrieved from http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf

PWS Program Score Card

Program Name/Loc.	• Edwards Aquifer • San Antonio, Texas

Basic Program Overview:

Program Attribute	Description	Alignment Rating Criteria
Primary Hydrologic Service Targeted	• Water Quality: Maintain high WQ, drinking water standards • Water Quantity: preserve the sustainability of the aquifer	
Co-benefits	• Recreation: This is a real priority as there is little public land available (Trust for Public Land, 2003) • Biodiversity- aquifer recharge zone and aquifer house many rare and endangered species (plants, salamanders birds), karst limestone is a unique environment (S.O.S.A., 2011)	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• Land Acquisition and Conservation Program	
Payment Source	• User fees: Watershed Service Fee: City of San Antonio 1/8 increase on sales tax approved in 2000, 2005, 2010 for land protection and water quality (National Conservation Easement Database, 2011) • Proposition 2: Bond generated by 2% service fee on sales tax in the State of Texas	
Activities Funded	• Fee simple acquisition • Conservation Easements • BMP's (groundwater conservation plan (Edwards Aquifer Authority, 2012a) • Water conservation (stop leaky faucets, water use reduction, etc)	
Duration of program	• In place since 2000	
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): City of San Antonio (SAWS), Landtrusts • Sellers: Land owners • Intermediaries/Donors: Bexar Land Trust,	1: buyers and sellers don't match 2: one buyer or one seller match 3: **4: buyers and sellers match but**

	TPL, Nature Conservancy of TX, Edwards Aquifer Authority, Texas Cave Management	**<u>not all</u>** 5: all buyers and sellers match
Beneficiaries	• 1.2 million drinking water customers served by San Antonio Water System (SAWS), other municipalities include Kyle, Austin, San Marcos which have their own water utilities but collaborate in managing the resource (SAWS, 2012) • Agricultural demand for water is very high, up to 90% of withdrawal.	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public **<u>4: primary beneficiary is public utility but others more significant than in UNRB</u>** 5: primary beneficiary is public utility with little ag/industrial
Watershed Size	• Contributing zone is 5,400 sq miles in TX Hill Country. Recharge zone covers 1,250 sq miles. . • San Antonio segment is 160 miles long and between 5 and 40 miles wide at the surface (Eckhardt, 2012) • Other sources are currently used and alternatives, including building new reservoirs are being explored(San Antonio Economic Development Foundation, 2012)	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, **<u>3: if order of mag larger,</u>** 4: if twice as large, 5: if same size
Water Source Type	• Edwards Aquifer	1: impaired water body (not for drinking) 2: **<u>3: aquifer/river</u>** 4: 5: Reservoir
Scale	• Watershed scale- the recharge zones (ground and surface) are targeted for land conservation and BMPs however this has not yet been achieved throughout the entire watershed- for this reason, it is listed as a 3 and not a 5.	1: city- or county-wide 2: **<u>3: sub-watershed but not a particular jurisdiction</u>** 4: 5: watershed-scale
Government and Utility Coordination	• The aquifer covers 11 counties (4,350 miles), majority in Medina, Bexar, Goliad, Karnes, and Wilson (Guadalupe, San Antonio, Mission and Aransas Rivers and Mission, Copano, Aransas, 2011) • 1.7 million people reliant on Edwards for drinking supply • (Texas Commission on Environmental Quality, 2011) • City of San Antonio, Austin, Barton Springs,	1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed 3: one utility serving multiple cities both inside and outside the watershed 4: multiple cities within the watershed and dependent on

	Kyle, San Marcos • SAWS also provides collection and treatment services by contract to developments outside its defined service area, to avoid unnecessary proliferation of state wastewater discharge permits (SAWS, 2012)	water source thru multiple utilities, no dependent cities outside the watershed **5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least one city dependent that is outside the watershed**
Jurisdictional Alignment	• Not all buyers are within the Edwards Aquifer watershed or within the jurisdiction of the water utilities.	1: buyers are non-local 2: local buyers outside the watershed 3: local buyers entirely inside the watershed 4: local buyers are both inside and outside the watershed **5: local buyers entirely inside and one or more straddling in watershed**
Biophysical characteristics	• Land use of the watershed or program area (breakdown of forests and agriculture, for ex.) • 99% of water withdrawals in aquifer are for agricultural irrigation (Schaible, Mccarl, & Lacewell, 1999)	non point sources are primary contributor to water pollution, some development pressure, less forest, similar agricultural use
Drivers	• Regulatory: Aquifer Protection Ordinance and 33 Mandates (SAWS, 2012) • "At present, there is simply no institutional or regulatory framework that can effectively protect Edwards water quality" (Eckhardt, 2012). • Development pressure in San Antonio has rapidly increased impervious surface and runoff (Eckhardt, 2012) Edwards Authority Rules adopted in 1993 through Feb 2012 outline procedures & policies for protecting the ground and surface water quantity and quality for the health of the aquifer (Eckhardt, 2012)(Edwards Aquifer Authority, 2012b)	4- Similar development pressure and distributed efforts. Could use cohesive organization and protection plan.
Practice or Performance Based	• See Activities Funded	**1: practice-based (paying for a BMP, not load reduction per se)** 3: both practice- and performance-based (paying for a BMP with an implied associated load reduction)

		5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment to UNRB
Ample Supply of Ecosystem Services	• Are there enough BMPs and targeted lands to justify a PWS program? In other words, are there ample opportunities for pollution reduction measures? Yes, the watershed fee can continue to be used for land purchase and conservation easements. There is unprotected land around contributing surface and ground water that would benefit from BMPs and conservation practices.	
Ample Supply of Players/Sellers?	• Do the potential suppliers seem willing to participate? What is their perceived reception in terms of values, understanding, experience with similar programs? Attitude toward private property in TX could be a barrier to implementing easements and BMP's "stay off my land" ethic. However, there is a lot of land and likely a diversity of potential sellers (Eckhardt, 2012)	
Ample Supply of Buyers?	• San Antonio. Other municipalities protect land, but not within the same program.	
Monitoring and Evaluation	• Monitoring of easements for compliance had not been adequately enforced or documented as of 2010 (City of San Antonio, 2010)	**<u>1:Program has no specific goals or performance benchmarks (criteria for evaluation)</u>** 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results

		5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• There has been a strong record of renewal and the program has been in place for 12 years- this puts the SAWS program in between the scores of 3 and 5.	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal **4:** 5: Program activities has means to remain in place more than 10 years after implementation
Program Administration	• Government administered program, SAWS, works with other organizations and cannot function unilaterally in the Edwards Aquifer watershed.	1: Unilateral sub-watershed administration 2: **3: Administered through cooperation between major players** 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Tools to facilitate and encourage transactions? • Online transaction platforms where beneficiaries can find suppliers and conduct transactions, allowing an GO, government agency, etc.. to bring beneficiaries together • Institutions established to match buyers and sellers? • Seller collaboration or grouping?	
Pricing and Payment	• Will payments/pricing result in most economically efficient means of meeting environmental or cost reduction goals?	

	Tax has been renewed at three separate legislative sessions. $90 million annually seems adequate for funding existing programs.	
Conflicting Programs and Goals	• Risks to longterm sustainability- aquifer demand might exceed the recharge rate (supply) • Nitrogen loads increasing in spite of permitting process (Brodnax, 2011) • Conflict could arise due to the "common law rule of capture" which gives land owners access to their groundwater as well as surface water. Scarcity could drive competition for water (EAA rules).	
Opportunities for Stacking		
Adaptability/Scaling Up	• Potential to expand into other counties which (as far as I know) do not have a fee. There is a lot of land involved, and upstream surface water has yet to be targeted as a part of the Edwards Aquifer Protection.	
Supporting organizations	• There are landtrusts involved in the outreach and implementation of the program.	
Supporting laws/regulations/administrative rules	• Future rules- The fee maintains a revenue stream, another ¼ tax was introduced in 2011 but was not passed by the legislature. (EAA- rules)	
Competing Investment Options	• Agriculture demand and human demand threaten the health of the aquifer • Rapidly increasing population in the area puts development pressure on land & increases property value	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• None of these numbers are readily available.
Economic Efficiency	• Number of Transactions • In 2000, 6,500 acres purchased for $38 million ($45 million collected) (Capital Improvements Management Services, 2012) • In 2005, $90 million collected for land purchases within the county and beyond it. (Capital Improvements Management Services, 2012) • American Forests calculated that, in San Antonio alone, the benefit of tree cover is a staggering $1 billion dollars in storm water management value, $22 million in air pollution removal value, and further value for tons of carbon stored (Bexar Land Trust, 2012)
Synergies or Externalities	• What co-benefits? Potential for surface water protection to complement aquifer protection. • What co-costs? Reliance on the aquifer could compromise long-term health of the water supply as demand outstrips recharge, repercussions would cover a lot of ground. May have to invest in alternative water supply even with investment in land protection.
Political and Social Favorability	• There does not seem to be a lot of public awareness about the program. It's not being touted as an example of watershed protection/forward thinking/PES etc. Seems like it would go over well as the population feels water shortages acutely.
Future Outlook	• Need monitoring in place, expansion to source water, public outreach!

Recommendations:

San Antonio provides an excellent example of how multiple funding sources can be utilized for PWS program implementation. The watershed fee is a successful funding model in several case studies, increasing revenue through a percentage of state wide sales tax provides an additional source of revenue that is not dependent on the volume of water sold. The watershed service fees currently in place in Durham and Raleigh should be evaluated to ensure that they are appropriate- charging a higher fee could allow the scope of the PWS program application to be widened. Conflicting programs and goals show that San Antonio and the UNRB face similar long-term challenges. Finally, monitoring of effectiveness remains a gap in San Antonio as in the UNRB.

Additional Comments:

The Federally-listed aquatic species include two fish – San Marcos gambusia and fountain darter; one plant -- Texas wild-rice; and two salamanders --Texas blind salamander and San Marcos salamander. http://agecon2.tamu.edu/people/faculty/mccarl-bruce/papers/291.pdf

From the 33 Mandates (SAWS, 2012):

- Aquifer Protection Ordinance No. 81491 appendix II, "Recharge Zone Protection - establish a program for permanent protection of Recharge Zone in undeveloped state, through purchase, donation, or conservation easement."
- Water Resource Plan, Section 5.2.2, Recharge Zone Property Acquisition: "This program is to identify, acquire and protect those areas on the recharge zone that are the most sensitive in relation to available recharge. It provides funds to acquire land in order to protect recharge water quality. The main objectives of the program are to protect water quality and to reduce detrimental impact of certain land uses by achieving a balance between economic growth and environmental protection. SAWS anticipates multi-agency cooperation and encourages funding contributions from other entities."

More information:

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PWS Program Score Card

Program Name/Loc.	• Skaneateles Lake Watershed Program • Syracuse, NY

Basic Program Overview:

Program Attribute	Description	Alignment with UNRB
Primary Hydrologic Service Targeted	• Water Quality	
Co-benefits	• Cited high recreation value • Biodiversity • Lake is also used for fishery spawning areas and storage for seasonal runoff	
Payment Type	• Non-Market Government PWS	
Payment Mechanism	• BMP implementation is paid for through the SLWAP with principal funding provided by the City of Syracuse • No financial incentive – only free implementation	
Payment Source	• City of Syracuse • Other funding sources as well	
Activities Funded	• Primarily erosion and sediment control ag BMPs • Land conservation – thru purchase of conservation easements by the City • Development of Whole Farm Plans	
Duration of program	• Program was established in 1994 (Onondaga County Soil and Water Conservation District, 2012)	
Participants	• Buyers: City of Syracuse • Sellers :Farmers (SLWAP) and landowners (Skaneateles Lake Land Protection Program) • Intermediaries/Donors: Funding by the City for easements has sometimes been matched by NRCS Federal Farm and Ranch Lands Protection Program	1: buyers and sellers don't match 2: one buyer or one seller match 3: **4: buyers and sellers match but not all** 5: all buyers and sellers match
Beneficiaries	• City of Syracuse and portions of towns around its periphery, Village of Skaneateles, and various water districts in Town of Skaneateles and Villages of Elbridge and	1: beneficiaries don't match at all 2: primary is not a utility, but share similar beneficiary mix

	Jordan all obtain water for their public water supplies from Skaneateles Lake from pipe belonging to City of Syracuse. Also 1,000 lakefront residents have private intakes. • Only commercial use is for irrigation of Skaneateles Country Club.	3: primary is utility, but not necessarily public 4: primary beneficiary is public utility but others more significant than in UNRB **5: primary beneficiary is public utility with little ag/industrial**
Watershed Size	• Skaneateles Lake watershed – 72.54 sq miles •	**1: if order of magnitude smaller,** 2: if smaller by a factor of 2 or more, 3: if order of mag larger, 4: if twice as large, 5: if same size
Water Source Type	• Natural Lake (used for drinking water) – with a dam- most similar to a reservoir	1: impaired water body (not for drinking) 2: 3: aquifer/river 4: **5: Reservoir**
Scale	• Entire watershed	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **5: watershed-scale**
Local Governments and Utilities in Watershed or Program Area[5]	• 3 counties - serves portions of Onondaga, Cortland, and Cayuga counties (Onondaga County Soil and Water Conservation District, 2012) • Encompasses 1 village and 7 towns (EPA Office of Water, 2010) • Established by the City of Syracuse, but City is not within the watershed • Syracuse Water Department utilizes about 16 billion gallons per year for water supply to the City. The Village and Town of Skaneateles use approximately 0.30 billion gallons. • Villages and towns are quite small compared to UNRB with less development pressure	1: one city in watershed and using the water 1: one city within watershed with its own utility 2: one utility serving multiple cities inside (not outside) the watershed **3: one utility serving multiple cities both inside and outside the watershed** 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least

[5] (gets at institutional coordination issue)

		one city dependent that is outside the watershed
Jurisdictional Alignment	• Buyer is outside of watershed • Are the buyers and sellers in the same watershed? • Are main beneficiaries in the watershed? • Do they conflict?	1: other 2: local buyers entirely inside the watershed 3: local buyers entirely inside and one or more straddling in watershed **4: local buyers outside the watershed** 5: local buyers are both inside and outside the watershed
Biophysical characteristics and Loading Sources	• 48% ag, 40% forest, 5.4% residential, 0.2% commercial, other • No point source discharges are allowed within the watershed	1: meets none of the criteria 2: meets 1 of the criteria **3: meets half criteria** 4: meets 3 of four criteria 5: naturally forested, and 50%-70% forested, with significant development pressure and 16% use (2001 – from MP)
Drivers	• Regulatory and Cost Reduction - Program was developed as an alternative to a costly filtration system ($60-70 million for Syracuse and $4-6 million for Town of Skaneateles) required by the 1986 Amendments to the Safe Drinking Water Act and filtration avoidance criteria established by the NY State Dept. of Health. Allows the City to maintain its filtration waiver. • A voluntary program	1: no regulatory driver **2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver)** 3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year) 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• Practice-based (don't model or measure performance in determining which BMPs to implement – no "credits" being granted) • BMPs are planned and implemented according to Natural Resource Conservation Service (NRCS) standards and specifications (Onondaga County Soil and Water Conservation District, 2012)	**1: practice-based (paying for a BMP, not load reduction per se)** 3: both practice- and performance-based (paying for a BMP with an implied associated load reduction) 5: performance-based (paying for an observed reduction)

Key Attributes:

Program	Description	Alignment Ranking

Attribute		
Ample Supply of Additional Ecosystem Services	• As almost half the land is in ag, would assume enough BMPs and targeted lands to justify a PWS program. No clear evidence of a feasibility study done, however.	
Ample Supply of Players/Sellers?	• Seem willing to participate - Over ten year period (1994-2004), 54 of 60 identified farms voluntarily enrolled in program, with 44 Whole Farm Plans completed to date. • What is their perceived reception in terms of values, understanding, experience with similar programs, level of stakeholder involvement	
Ample Supply of Buyers?	• City of Syracuse – yes.	
Monitoring and Evaluation	• A tiered approach where farmer works with team to determine potential for reduction, develop a plan, implement, and evaluate/revise/repair if necessary • No specific performance benchmarks – only motivated by filtration avoidance waiver • Currently working with SUNY College of Environmental Science and Forestry to monitor the effectiveness of BMPs such as barn yards, milk house waste treatment, nutrient management, and pasture management on parameters such as turbidity, BOD, and bacteria against a pre-installation baseline. • City conducted an evaluation of SLWAP in 2000 by interviewing farmers and evaluating their experience. From evaluation City added a line in contract to revisit farms and correct BMPs that weren't functioning as intended or add new ones.	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative **4: Clear program goals but related to something other than explicit load reductions or water quality results** 5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place
Permanence and Sustainability	• Doesn't seem to be a sustainable funding mechanism – principal funding provided by City of Syracuse. • Funding for the Land Protection Program has been matched by NRCS Federal Farm and Range Lands Protection Program. • Sustainable in the sense that assistance was given not just for BMP, but for plan	1: One-time grants with no renewal in sight 2: **3: Not definite, but has potential and record of renewal** 4: 5: Program activities has means to remain in place more than 10

	as a whole. • Institutional structures seems stable b/c largely government. • Long-term interests b/c need filtration waiver. • much from City budget – not sure if sustainable funding for City funds.	years after implementation y funds)
Program Administration	• SLWAP is spearheaded/administered by the Onondaga County Soil and Water Conservation District (Onondaga County Soil and Water Conservation District, 2012) • OCSWCD entered into an agreement with conservation partners to implement the program. • Watershed level review committee, but administered thru OCSWCD in partnership with other SWCDs and organizations. • Also a Watershed Agricultural Program Review Committee (WAPRC) consisting of seven watershed farmers and two representatives of the City of Syracuse • Program was established by the City of Syracuse • Land Protection Program administered by City of Syracuse	1: Unilateral sub-watershed administration 2: 3: Administered through cooperation between major players **4:** 5: Administered by a watershed-level governing body
Transaction Costs	• Went through land trust to draft easement plan for land protection program – reducing transaction costs b/c they're already working in this arena •	
Pricing and Payment	• Provide a rental program for soil conservation tools (funded by the City)	
Conflicting Programs and Goals (programs that may compromise the additionality of a PWS program or provide incentives for opposing behaviors)	• Already zoning and land use regulations in place for Town of Skaneateles (Watershed Overlay district, Floodplain Overlay District, performance standards, size limitations, Conservation Density Subdivisions), but not for other towns in the watershed • Unknown if other BMP provisions for ag???	
Opportunities for Stacking	• No other payment programs highlighted that would stack up (assuming easements	

	and BMPs wouldn't occur on same lands)	
Adaptability/Scaling Up	• Farmers' "Whole Farm Plan" is evaluated in Tier V and revised/repaired if necessary (after how many years??) (Onondaga County Soil and Water Conservation District, 2012) • Are institutional and financial mechanisms adaptable over time? • Able to link up with other programs? • Ability to expand and scale up? • The project served as a pilot for the Agricultural Environmental Management program (AEM) statewide by producing the Whole Farm Plan (Onondaga County Soil and Water Conservation District, 2012)	
Supporting organizations	• It's a cooperative effort between the Soil and Water Conservation Districts and Cornell Cooperative Extension Associations of Onondaga, Cortland, and Cayuga counties, the NRCS, City of Syracuse.	
Supporting laws/regulations/administrative rules (those that do not compromise additionality but support a payment program)	• Other efforts include several educational and outreach initiatives, municipal regulations that govern zoning, proper use of chemicals, wastewater disposal, and agricultural activities (EPA Office of Water, 2010) • NY State Environmental Conservation Law 17-1709 prohibits point source discharges within the watershed (so no WWTFs) (EPA Office of Water, 2010) – this makes addressing nonpoint sources crucial for maintaining water quality	
Competing Investment Options	• Water filtration plan that would be required if they didn't receive the filtration waiver. • Not sure what opportunity costs would be for farmers and landowners…	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• Currently working with SUNY College of Environmental Science and Forestry to monitor the effectiveness of BMPs such as barn yards, milk house waste treatment, nutrient management, and pasture management on parameters such as turbidity, BOD, and bacteria against a pre-installation baseline. • Watershed Land Protection Program has protected 650 acres. (percent increase in acres conserved??) • Given indefinite water filtration waiver from New York State Dept. of Health for its "high-level, cost-effective" water quality protection (Onondaga County Soil and Water Conservation District, 2012)
Is still running to date?	• Yes?
Water Affordability	• $/gallon? expected to stay?
Economic Efficiency	• As of Oct. 2006, 42 of 46 farms were enrolled in program (91% participation rate). 26 of these had implemented (56%). (Onondaga County Soil and Water Conservation District, 2012) • $10 million watershed plan (ECONorthwest, 2004) - $217k/farm • A filtration facility would cost Syracuse $60-70 million and Town of Skaneateles $4-6 million (EPA Office of Water, 2010) • So, net cost savings of $35 to $50 milllion??
Synergies or Externalities	• Biodiversity for easements and possibly some BMPs • Not sure what opportunity costs are for farmers or landowners??
Political and Social Favorability	• Politically popular – Mayor supported the program without interruption in 2005 • Socially popular - 91% participation rate • No clear "losers" that may be upset from the program
Future Outlook	• Seems will continue based on past success. In 2005, mayor signed a letter supporting without interruption the Phase II continuation of the program, and the Task Force recommended keeping its format the same as it has been for past 10 years. • First program sign-up was for ten years (EPA Office of Water, 2010). After that period, farmers may sign up to continue the process a year at a time, but may sign up for a longer period, if desired. No one who implemented a plan has dropped out yet.

Additional Comments:

- The key differences between this case study and the UNRB are 1) low development pressure and currently very low levels of pollutant, and 2) they are driven by the need to maintain a filtration waiver. These differences are key because they mean that the UNRB is performance-driven and Skaneateles is practice-driven. This has huge implications for the program's drive (or lack thereof) to be economically efficient and environmentally effective.

Primary Recommendations for UNRB:

- Have a rental program for soil conservation tools – the City provided SLWAP with funds to purchase a John Deere conservation planter, a Great Plains no-till drill, and an Aerway minimal tillage system (Macbeth, 2011).
- Also has a phased approached to meeting program goals.
- This program had a very high participation rate. Should investigate further what they did to make the participation rate so high.
- The idea of developing "Whole Farm Plans" may be beneficial for the UNRB – tailoring each project to unique farm can likely increase the effectiveness of chosen BMPs, allow for more detailed assessment of BMP environmental outcomes, and increase farmer accountability and buy-in.
- Conducted surveys of farmers for program evaluation and are teaming with university to assess effectiveness of BMPs against a baseline. UNRB could benefit from a similar evaluation approach (especially utilizing partners such as a university)

Citations and Resources:

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PWS Program Score Card

Program Name/Loc.	• Water Quality Trading (Temperature) • Tualatin, Oregon

Basic Program Overview:

Program Attribute	Description	Alignment Rating Criteria
Primary Hydrologic Service Targeted	• Water Quality • Recreation	
Co-benefits	• Biodiversity	
Payment Type	• Water Quality Trading Scheme (thermal and dissolved oxygen)	
Payment Mechanism	• Cost share agreements • Shade-a-Lator Trading model • Policy development & information sharing	
Payment Source	• Federal funding through three large EPA grants • Oregon DEQ • Willamette Partnership established for longterm sustainability(State of Oregon Department of Environmental Quality, 2007a) •	
Activities Funded	• BMPs: riparian buffer, tree plantings, shade corridors • Land conservation & purchase	
Duration of program		
Participants	• Buyers (those knowingly and voluntarily participating in the transaction): Clean Water Services manages 4 WWTP in the area • Sellers: Landowners, Farmers • Intermediaries: Stakeholder groups facilitated the design of the trading market. (Selman, Greenhalgh, Branosky, Jones, & Guiling, 2009; State of Oregon Department of Environmental Quality, 2007a)	1: buyers and sellers don't match 2: one buyer or one seller match 3: **<u>4: buyers and sellers match but not all</u>** 5: all buyers and sellers match
Beneficiaries (Type and	• Clean water services water utility • 520,000 water customers in Tualatin River	1: beneficiaries don't match at all

Amount)	Watershed (Services, n.d.) • 12 Cities served by CWS	2: primary is not a utility, but share similar beneficiary mix 3: primary is utility, but not necessarily public 4: primary beneficiary is public utility but others more significant than in UNRB **<u>5: primary beneficiary is public utility with little ag/industrial</u>**
Watershed Size	• 712 square miles • The Tualatin River is 80 miles long	1: if order of magnitude smaller, 2: if smaller by a factor of 2 or more, 3: if order of mag larger, 4: if twice as large, **<u>5: if same size</u>**
Water Source Type	• The river is 80 miles long as and flows into the Willamette River. Two WWTP discharge into the Tualatin River at miles 40 and 10- the impact is small relative to non-point sources such as runoff, non-native plants, and degraded streams or altered channels.	1: impaired water body (not for drinking) 2: **<u>3: aquifer/river</u>** 4: 5: Reservoir
Scale	• Watershed scale: nutrient requirements must be met at every point in the watershed (Clean Water Services, 2006) • • Tualatin River basin is included in the program	1: city- or county-wide 2: 3: sub-watershed but not a particular jurisdiction 4: **<u>5: watershed-scale</u>**
Government and Utility Coordination	• CWS Utility • 11 cities within CWS service area	1: one city in watershed and using the water 1: one city within watershed with its own utility **<u>2: one utility serving multiple cities inside (not outside) the watershed</u>** 3: one utility serving multiple cities both inside and outside the watershed 4: multiple cities within the watershed and dependent on water source thru multiple utilities, no dependent cities outside the watershed 5: multiple burgeoning cities within the watershed and dependent on water source thru multiple utilities, with at least

		one city dependent that is outside the watershed
Jurisdictional Alignment	• Buyers: Water utilities/wastewater treatment plants	1: buyers are non-local 2: local buyers outside the watershed **<u>3: local buyers entirely inside the watershed</u>** 4: local buyers are both inside and outside the watershed 5: local buyers entirely inside and one or more straddling in watershed
Biophysical characteristics	• 39% agriculture, 49% forest, 12% urban and suburban (State of Oregon Department of Environmental Quality, 2007a) •	1: meets none of the criteria 2: meets 1 of the criteria 3: meets half criteria 4: meets 3 of four criteria **<u>5: meets all criteria (naturally forested, 50%-70% forested, with significant development pressure and 10-20% ag)</u>**
Drivers	• Regulatory compliance: TMDL, temperature requirements (95% reduction in the temperature impacts of WWTPs was a strong incentive for participation)(State of Oregon Department of Environmental Quality, 2007a). • Voluntary- all trading must be done in addition to meeting the minimum legal requirements	1: no regulatory driver 2: non-TMDL, nutrient standards, or drinking water cost driver for polluted water body (e.g., filtration waiver) **<u>3: impaired water body with established regulatory/cost driver (currently allocated certain amount per year)</u>** 4: impaired water body with pending TMDL/nutrient standards/cost driver (but no current reduction goals) 5: impaired water body with imminent regulatory/cost driver
Practice or Performance-based?	• Performance	1: practice-based (paying for a BMP, not load reduction per se) **<u>3: both practice- and performance-based (paying for a BMP with an implied</u>** associated load reduction) 5: performance-based (paying for an observed reduction)

Key Attributes:

Program Attribute	Description	Alignment Ranking Criteria
Potential Supply of Enhanced Ecosystem Services	• There were ample sellers, and enough buyer to begin the program. Due to the length of the contracts and the limited players; trading ended shortly after it began.	
Ample Supply of Sellers?	• 25 different farmers participated in the program to generate sellable credits (installed riparian buffers). Since buffers generate credit for 35 years, there will not be a need for more until 2035 (Selman et al., 2009)	
Ample Supply of Buyers/Demand for Service	• 94% of the land in the watershed is privately owned (Clean Water Services, 2006)	
Monitoring and Evaluation	• This was a new program and evaluation criteria had to be developed- rubric for evaluation is available starting on page 26 of the DEQ Case Study (State of Oregon Department of Environmental Quality, 2007b) • A 2:1 offset ratio must be met after 20 years. • Annual reporting is required •	1:Program has no specific goals or performance benchmarks (criteria for evaluation) 2: Program goals are fuzzy or not explicit 3:Program goals are qualitative 4: Clear program goals but related to something other than explicit load reductions or water quality results **<u>5: Clear quantitative program goals and performance benchmarks are in place and systems for monitoring progress in place</u>**
Permanence and Sustainability	• CWS provided a "cumulative impact bonus" for landowners who enrolled at least 50% of their stream into the program or who enrolled next to their neighbors for a total of 50% to ensure the environmental benefit of projects (State of Oregon Department of Environmental Quality, 2007a) • Trading has ceased but the impacts should continue for the 30 terms of agreement.	1: One-time grants with no renewal in sight 2: 3: Not definite, but has potential and record of renewal **<u>4: Current phase of implementation should last more than 10 years- hard to determine how the PWS will develop in the next phases</u>** 5: Program activities has means to remain in place more than 10

		years after implementation
Program Administration	• Department of Environmental Quality & Clean Water Services were primary administrators/designers • EPA support through the grant "could not be overstated" (State of Oregon Department of Environmental Quality, 2007a). There were regular revisions to the workplan and grant extensions that enabled the success of the program.	1: Unilateral sub-watershed administration 2: **3: Administered through cooperation between major players** 4: 5: Administered by a watershed-level governing body
Transaction Costs	• Tools to facilitate and encourage transactions? • Online transaction platforms where beneficiaries can find suppliers and conduct transactions, allowing an GO, government agency, etc.. to bring beneficiaries together • Institutions established to match buyers and sellers? • Seller collaboration or grouping?	
Pricing and Payment	• A lot went into developing this program. There was an understanding that the trading would lead to tangible results and improved water quality in the river basin.	
Conflicting Programs and Goals	• Trading must be in addition to meeting regulations, new regulations could change the market. • Trading agreements last 30 years, limited players in the market make it a short lived market- agreements made through permitting must be monitored.	
Opportunities for Stacking	• Temperature became the main focus of the trading permits. Permits for ammonia, BOD, nutrients could also be traded.	
Adaptability/Scaling Up	• Potential for expansion as a model for other rivers in the region. The Willamette River used the Willamette Partnership to incentivize watershed health using a market.	
Supporting organizations	• US Environmental Protection Agency • Oregon Dept of Agriculture • Oregon Dept of Fish and Wildlife	
Supporting laws/regulations/administrative	• CWS will not need additional credits unless regulations change in the next 30 years (term of credit agreement).	

rules		
Competing Investment Options	• Do beneficiaries face options for substitution? • Are there tradeoffs to investment? • What are the competing opportunity costs? • If available, green versus gray infrastructure costs	
Other (indicate)		

Success Indicators:

Success Indicator	Description
Environmental Performance Benchmarks To-Date	• Pounds N,P, sediment deposition avoided? per acre, per BMP, per $ invested? is this compared to a baseline or goal? • Acres conserved? • Percent increase in acres conserved • Whatever else may indicate progress toward meeting environmental goal.
Is still running to date?	• 1977-2001
Water affordability	• $/gallon – average and range
Meeting projected demand for drinking water?	• Demand in the basin is expected to double in the next 45 years requiring an extra 50,000 acre feet of water. (Services, n.d.)
Economic Efficiency	• Ecosystem Service approach to shading the stream using buffers: estimated $6 million versus engineered cooling towers at an estimated $60-$150 million investment plus annual operating costs of between $2.5-$6 million. Total cost savings of between $54-$154 million(State of Oregon Department of Environmental Quality, 2007a)
Synergies or Externalities	• What co-benefits? Presence of threatened/rare species? • What co-costs?
Political and Social Favorability	• Does the program seem politically and socially popular? • Are there clear winners/losers that may cause potential conflict?
Future Outlook	• General comments here on how it's looking, impressions on stability over time, etc.

Additional Comments:

Tualatin is an excellent case study for the UNRB as it is similar in its biophysical and regulatory attributes. There are several key takeaways:

- **US EPA support was crucial to the development and successful implementation of the program.**
- **Multiple funding sources: Federal grants and enhancement on federal cost-share programs.**

- **Outreach and education was a primary focus; stakeholders helped to structure the nutrient trading program. Landowners were not familiar with Farm Bill cost share programs until the outreach effort.**
- **Cost driver: Significant difference in the estimated costs for green ($6 million) infrastructure and grey ($60-150 million)**

Primary Recommendations for UNRB:

If Oregon's experience is any indication, it appears that the existence of a source with a strong interest in trading is more important in launching trading than having a manual on trading developed specifically for that state (State of Oregon Department of Environmental Quality, 2007b)

Despite the challenges described above, the stakeholder group gave DEQ input that was critical to the eventual success of the trade. In addition, although members of the stakeholder group regularly expressed skepticism regarding trading, in several cases the stakeholder group proposed ideas that were more expansive or flexible than what DEQ had been considering (State of Oregon Department of Environmental Quality, 2007b)

Citations and Resources:

Clean Water Services. (2006). Tualatin River Watershed-based Permit: Meeting the goals of clean water and healthy habitat. Retrieved from http://www.cleanwaterservices.org/Content/Documents/Permit/Watershed-based Permit Fact Sheet.pdf

Selman, M., Greenhalgh, S., Branosky, E., Jones, C. Y., & Guiling, J. (2009). Water Quality Trading Programs: An International Overview. *WRI Issue Brief*, (1), 1-16.

Services, C. W. (n.d.). Clean Water Services. Retrieved from http://www.cleanwaterservices.org/default.aspx

State of Oregon Department of Environmental Quality. (2007a). *Water Quality Credit Trading in Oregon: A Case Study*. Retrieved from http://www.oregondeq.com/WQ/trading/docs/wqtradingcasestudy.pdf

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