WRI ISSUE BRIEF

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Southern Forests for the Future Incentives Series Issue Brief 2

Forests for Water: Exploring Payments for Watershed Services in the U.S. South

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SUMMARY

- The forested watersheds of the southern United States provide a number of benefits—including water flow regulation, flood control, water purification, erosion control, and freshwater supply—to the region's citizens, communities, and businesses.
- The loss and degradation of forests can reduce their ability to provide these watershed-related ecosystem services.
- Payments for watershed services provide landowners financial incentives to conserve, sustainably manage, and/or restore forests specifically to provide one or more watershed-related ecosystem services. Such payments typically involve downstream beneficiaries paying upstream forest owners or forest managers.
- There are three general types of payments for watershed services: (1) voluntary payments by downstream entities to upstream landowners to reduce the costs of doing business, (2) payments made to minimize an entity's cost of meeting a regulation, and (3) payments made to generate public benefits. A number of instances of each type of payment have been piloted in the United States, Latin America, and elsewhere.
- Many payments for watershed services share a common trait: they are investments in "green infrastructure" instead of "gray infrastructure." In other words, they are investments in forests and natural, open space instead of in human-engineered solutions to address water quantity or quality problems. In many instances, investments in green infrastructure can be more cost effective than investments in gray infrastructure.
- Entities that may have a business case for making a payment for watershed services include beverage companies, power companies with hydroelectric facilities, manufacturers that rely on clean freshwater supplies for processing, housing developers, public and private wastewater treatment plants, city and county governments, drinking water utilities, and public departments of transportation, among others.
- These entities can pursue a number of steps to capture the potential benefits of payments for watershed services, including identifying those forests most responsible for their clean water supplies, conducting economic analyses of green versus gray infrastructure, and exploring public/private financing partnerships.
- Upstream landowners can pursue a number of steps to advance---and ultimately benefit from---payments for watershed services, including developing an understanding of the watershed-related ecosystem services their forests provide, actively looking for emerging payment opportunities, and collaborating with other landowners to achieve economies of scale when engaging beneficiaries of the services their forests provide.
- This issue brief is intended as an introductory resource primarily for entities that depend upon stable supplies of clean freshwater in the southern United States and are looking for cost-effective approaches to sustain this supply. This brief also provides information to southern landowners interested in potential revenue streams generated by conservation and sustainable management of forests.

Recognizing the Watershed Value of Forests

The forested watersheds[1] of the southern United States provide a number of benefits to the region's citizens, communities, and businesses. For instance, they regulate the timing and magnitude of water runoff and water flows. They prevent impurities from entering streams, lakes, and groundwater. In addition, they hold soil in place, preventing it from eroding into nearby bodies of water.

However, as profiled in *Southern Forests for the Future* (Hanson et al. 2010), the forests of the southern United States

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face a number of threats to their extent and health, including permanent conversion of forests to suburban development. These threats, in turn, can impact water quantity and quality in affected watersheds.

One approach to address these threats is for landowners to receive payments for the role their forests play in improving water quality or quantity within a watershed. These payments may occur in purely voluntary transactions or as part of regulated water markets. In effect, this type of incentive recognizes the role forests play in providing watershed-related ecosystem services.

This issue brief is an introductory exploration of this type of incentive or payment for watershed services, with implications for the southern United States highlighted. In particular, it explores the following questions:

- What benefits do forested watersheds provide to people?
- How does forest loss or degradation affect these benefits?
- How can payments for watershed services encourage forest owners to conserve, sustainably manage, or restore forests in order to maintain these benefits?
- What steps would facilitate more payments for watershed services in the South?

As part of the World Resources Institute's (WRI) *Southern Forests for the Future Incentives Series* (Box 1), this brief is intended as a resource primarily for entities that depend upon stable supplies of clean freshwater in the South and are looking for cost-effective approaches to sustain this supply. Southern landowners will find this brief of value, as well, in that it profiles a potential new means of financing sustainable forest management or forest conservation.

Forests Provide Watershed Benefits

A clean and reliable water supply is one of the most important benefits of well-managed forests and is a resource that generates immense economic value for communities and businesses throughout the nation. This value is manifested in four types of watershed-related ecosystem services that forests anywhere can provide (Hanson et al. 2010):

- *Water flow regulation.* Forests and forested wetlands affect the timing and magnitude of water runoff and water flows. Some forest ecosystems act as sponges, intercepting rainfall and absorbing water through root systems. Water is stored in porous forest soil and debris and then slowly released into surface water and groundwater. Through these processes, forests recharge groundwater supplies, maintain base-flow stream levels, and lower peak flows during heavy rainfall or flood events.[2] Maintaining natural flow patterns is essential for preserving the integrity of riparian and in-stream habitats and the fish and wildlife populations that depend on them. Likewise, forests reduce stormwater runoff by intercepting and storing rainfall. According to one study,

Box 1 — About the Southern Forests for the Future Incentives Series

Over the coming decades, several direct drivers of change are expected to affect the forests of the southern United States and their ability to provide ecosystem services. These direct drivers include suburban encroachment, unsustainable forest management practices, climate change, surface mining, pest and pathogen outbreaks, invasive species, and wildfire. In light of these drivers of change, what types of incentives, markets, and practices—collectively called "measures"—could help ensure that southern United States forests continue to supply needed ecosystem services and the native biodiversity that underpins these services? The *Southern Forests for the Future Incentives Series* explores several such measures.

The series follows the U.S. Forest Service convention of defining "the South" as the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. Furthermore, the series is premised on the fact that southern United States forests provide a wide variety of benefits or "ecosystem services" to people, communities, and businesses. For example, they filter water, control soil erosion, help regulate climate by sequestering carbon, and offer outdoor recreation opportunities.

The series follows and builds upon *Southern Forests for the Future*, a publication that profiles the forests of the southern United States, providing data, maps, and other information about their distribution and makeup, condition, and trends. It explores questions such as: Why are southern forests important? What is their history? What factors are likely to impact the quantity and quality of these forests going forward? The publication also outlines a wide variety of measures for conserving and sustainably managing these forests. The *Southern Forests for the Future Incentives Series* delves deeper into some of these measures.

For additional information about southern United States forests, visit **www.SeeSouthernForests.org**. Developed by WRI, this interactive site provides a wide range of information about southern forests, including current and historic satellite images that allow users to zoom in on areas of interest, overlay maps that show selected forest features and drivers of change, historic forest photos, and case studies of innovative approaches for sustaining forests in the region.

less than 5 percent of rain falling on a forest is converted to runoff, while 95 percent of rain falling on impervious surfaces such as concrete is converted to runoff (Cappeilla, Schueler, and Wright 2005).

- *Water purification.* Two thirds of the nation's water originates from forested lands in the United States (National Resource Council 2008). This water comes from precipitation that is filtered through forests, and much of it ends up in streams (Smail and Lewis 2009). Forests help prevent impurities—mostly those from nonpoint source pollution[3]—from entering streams, lakes, and groundwater. Root systems of trees and other plants keep soils porous and allow water to filter through various layers of soil before entering groundwater. Through this process, toxics, excess nutrients, sediments, and other substances can be filtered from the water. Leaves and other debris on the forest floor play a role, too, by preventing soil loss due to wind and rain, thereby preventing siltation of waterways.
- *Erosion control.* Forests help keep soil intact and prevent it from eroding into nearby bodies of water in a number of ways. By intercepting rain, a forest canopy reduces the impact of heavy rainfall on the forest floor, reducing soil disturbance. Leaves and natural debris on the forest floor can slow the rate of water runoff and trap soil washing away from nearby fields. Tree roots can hold soil in place and stabilize stream banks. In addition, coastal forests and forested wetlands protect coastlines by absorbing some of the energy and impact of storm surges, thus reducing erosion, saltwater incursion, and other onshore impacts.
- *Freshwater supply.* The numerous streams and lakes found in forests provide freshwater for a variety of in-stream and off-stream uses. In-stream uses—those that occur within the water body itself—include electricity generation by hydroelectric plants, as well as recreation and wildlife habitat. Off-stream uses—those that occur outside the water body—include domestic and industrial water supplies and irrigation.

The economic value of these watershed-related ecosystem services supplied by southern United States forests can be substantial. The water flow regulation service limits water runoff during rainstorms, thereby reducing costs of downstream stormwater management and flood control. This service could be increasingly valuable as climate change intensifies and the South is potentially faced with an increase in the incidence and severity of extreme rainfall events (Seager, Tzanova, and Nakamura 2009; Cowell and Urban 2010).[4] The water purification service can reduce drinking water treatment costs. For instance, a study of 27 different water supply systems from around the country found that from 50 to 55 percent of the variation in operating water treatment costs can be explained by the percentage of forest cover in the water source area (Ernst 2004). The erosion control service reduces the deposition of sediment behind hydroelectric dams and thereby reduces the need for expensive dredging.

A nationwide study in 2000 concluded that clean water flowing from national forests in the southern and eastern United States generated $51.03 in benefits to in-stream uses and $10.21 in benefits to off-stream uses per acre foot[5] per year (Sedell et al. 2000). National forests and other protected landscapes often provide the cleanest water because these landscapes are sheltered from land use activities that can degrade water quality. If these values are extended to apply to other protected landscapes in the South, it suggests that clean water flowing from the 39.5 million acres of protected national forests, state forests, parks, and refuges in the region generates nearly $3 billion in economic benefits each year.[6] This estimate understates the value of clean water supplies from southern forests because it does not count the benefits of clean water flowing from other forests that are well managed but not formally protected.

Furthermore, this estimate does not include "passive benefits," such as water for wildlife habitat or other services such as waste dilution. The value of these benefits can be large as well. Although results vary between studies, one valuation study of taxpayers in the Catawba River Basin in North Carolina found passive use values (willingness to pay) of $139 per taxpayer and more than $75 million for all taxpayers in the Catawba River Basin counties for the protection of water quality (Kramer and Eisen-Hecht 2002; Eisen-Hecht and Kramer 2002).

Forest Loss and Degradation Adversely Impact Watershed-Related Ecosystem Services

Forest loss and degradation—decline in forest health and/or tree stocks due to poor management practices—can reduce a forest's ability to provide these watershed-related ecosystem services. For instance, the conversion of forests to urban and suburban landscapes reduces a watershed's capacity to regulate water flows (Hanson et al. 2010). Converting a forest (or farm) to impervious surfaces—coupled with urban drainage systems such as curbs, gutters, and drainpipes—alters a watershed's natural hydrology. This alteration can increase the volume of stormwater runoff and exacerbate flooding events. According to the U.S. Geological Survey, for example, urbanization increases the volume of water in peak flooding events by up to 200 percent in 100-year flood events, 300 percent in 10-year flood events, and 600 percent in 2-year flood events (Konrad 2003). Likewise, loss of live trees and loss of other forest structures, such as large logs on the forest floor, diminish how much water can be stored on a site.

Forest conversion or degradation can reduce a watershed's natural capacity to purify water (Hanson et al. 2010). One implication of this is that in many areas, excessive amounts of pathogens or nutrients, such as nitrogen and phosphorus, enter streams from nearby farmland, lawns, golf courses, and other converted landscapes. When this nutrient pollution arrives in rivers, lakes, estuaries, and marine environments, it can trigger algae blooms that block sunlight and deplete dissolved oxygen levels. The resulting "dead zones" can severely impact commercial oyster, crab, and other seafood industries, adversely affect tourism, and increase costs for fishing operations forced to find other areas in which to concentrate their efforts. In the Chesapeake Bay, the economic impact of shrinking crab harvests has cost Maryland and Virginia combined more than $640 million between 1998 and 2006 (Chesapeake Bay Foundation 2008).

The loss or poor management of forests can reduce erosion control services, too. Sedimentation caused by intensive timber harvests, roads, or lands disturbed by construction can affect river channels and reservoirs downstream and drive up the cost of water filtration for domestic and industrial water providers. A study in the Little Tennessee River Basin of North Carolina found that while closed canopy forests yield little or no sediment, alternative land uses such as development generate from 15 to 360 tons of sedimentation per acre per year (Hagerman 1992). The U.S. Department of Agriculture's Economic Research Service estimates that the water-related cost of erosion borne by downstream users in Appalachia is approximately $3.15 per ton of sediment (Hansen and Ribaudo 2008).[7] Applying these estimates to the Little Tennessee River basin suggests that downstream water users could face economic costs ranging from $47 to $1,134 per acre of upstream land per year due to erosion.

In the South, the watersheds with the greatest ability to produce clean water and with the most consumers tend to be the forested watersheds of the east (Figure 1, map on top). But these are often the same watersheds upon which development pressure is greatest (Figure 1, map on bottom).

Payments for Watershed Services Recognize These Values

Economic incentives could help entities avoid the water-related costs and damages associated with the loss or degradation of upstream forests. Payments for watershed services, a type of economic incentive, pay landowners to conserve, sustainably manage, and/or restore forests specifically to provide one or more watershed-related ecosystem services. Payments for watershed services typically involve downstream beneficiaries paying upstream landowners or land managers.

There are three generic types of payments for watershed services:

1. business-driven transactions that consist of voluntary payments by downstream entities to upstream landowners to reduce the former's cost of doing business or to enhance economic opportunities associated with improved water quantity, quality, or flow;
2. regulatory-driven transactions that consist of payments made to minimize an entity's cost of meeting a water quality regulation or offsetting future development impacts; and
3. payments made to generate public benefits associated with improved water quality, flow, or watershed condition.

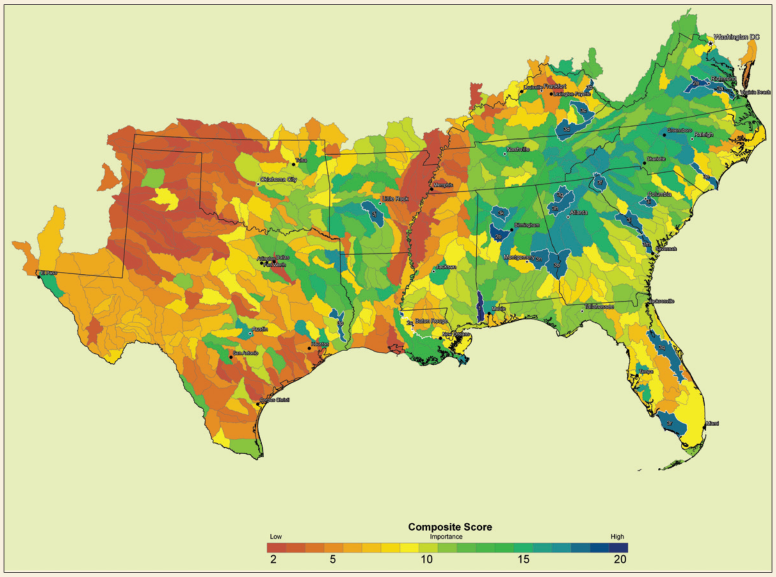
1. Voluntary transactions to enhance business opportunities

One type of payment for watershed services consists of voluntary payments made by one or more downstream water users to upstream landowners to maintain, sustainably manage, or restore forests in order to reduce or prevent negative impacts or "negative externalities" that would affect the downstream water user's operations or profitability (Box 2). Such payments are made to protect or improve water quality, flow, or watershed condition above and beyond conditions required by regulation.

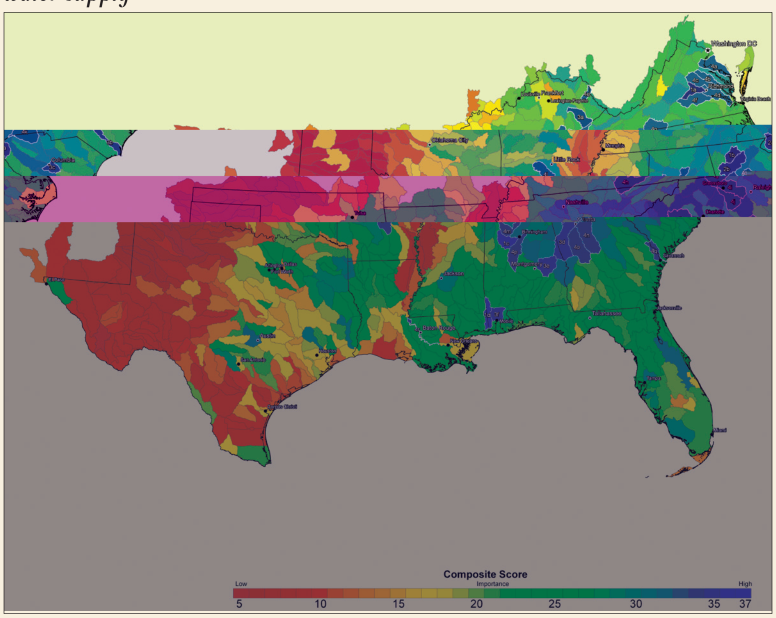
Such voluntary payments may reduce negative impacts more cost-effectively than investing in concrete and steel—"gray infrastructure"—to do what forests naturally do. To illustrate, consider a power company owning a hydroelectric dam and reservoir. The company could pay landowners upstream to restore forests along river edges and watershed slopes in order to reduce sedimentation of the reservoir above and beyond levels required by existing water quality regulations. This payment for watershed services could benefit the power company in many ways, because sedimentation reduces reservoir life, power generation capacity, and flood control efficacy, as well as increases sediment removal and dredging costs. For many reservoirs in the South, avoiding these negative impacts can be

FIGURE 1 **Watersheds of the South**

Inherent ability of watersheds to produce clean water upon which a large number of water consumers depend



Development pressure on private forests in watersheds important for drinking water supply



Source: Gregory and Barten, 2008.

worth as much as $2.29 per ton of sediment reduced (Hansen and Hellerstein 2004).

Likewise, payments could be made to enhance watershed-related ecosystem services in order to enhance downstream business opportunities. To illustrate, consider a sport fishing club. To increase opportunities for members, the club could make payments to one or more upstream landowners to restore habitat for highly desired fish species in streams where they are currently absent or have low populations.

A number of entities have a potential business case for making voluntary payments for watershed services, including:

- city and county governments, because forests lower peak flows and reduce the costs of flooding during heavy rain events;
- hydroelectric facilities, of which there are many in the South,[8] because upstream forests prevent sedimentation and thereby maintain reservoir life, power generation capacity, and flood control efficacy, as well as lower dredging costs;
- beverage companies, because upstream forests reduce sedimentation and help purify incoming water flows, thereby lowering costs companies incur further when filtering water; and
- manufacturing companies that require clean freshwater for their operations and may be able to avoid technological costs associated with water treatment if water quality is more cost- effectively managed upstream.

Although voluntary payments for watershed services have yet to arise at scale in the southern United States, examples are starting to emerge in a number of countries (Box 3). In each, recipients of payment are the upstream landowners or land managers. In each, those making payments are downstream water beneficiaries. Often, different beneficiaries join together to minimize the degree to which there are free riders—those that benefit from the improved water without paying for it. How payments are financed varies between these examples, but many include the creation of an endowment-style fund.

Box 2 — Negative Externalities, Property Rights, and Payments for Watershed Services

A "negative externality" is a cost not conveyed through prices that occurs when an entity that did not agree to an action incurs damages caused by others. With respect to watersheds, negative externalities occur when uncompensated costs are borne by downstream water users who have no control over the upstream land management decisions that led to the increased sedimentation or pollution. From the standpoint of economic efficiency, negative externalities lead to an overallocation of resources to activities that degrade watershed-related ecosystem services, because the costs of these activities are not borne by the entities that cause the degradation to occur.

How negative externalities can be corrected or "internalized" depends in part on the assignment of property rights. For example, if a downstream entity has an explicit or implicit property right to clean water, then correcting negative externalities would entail upstream entities paying the downstream water user to compensate the latter for the water pollution damages caused by the upstream entities. On the other hand, if upstream entities have an explicit or implicit right to pollute, then internalizing negative externalities would entail the downstream water user paying upstream entities to reduce their pollution.

The U.S. Clean Water Act regulates two basic types of pollution: pollution that emanates from "point sources," such as factories or wastewater treatment plants, and pollution that emanates from "non-point" sources, such as farms or suburban development. Typically, point sources are the only entities that face mandatory water quality standards under federal and state water laws (Taylor 2003). Therefore, there is an explicit assignment of rights to clean water for water users downstream of point source facilities.

With respect to nonpoint sources, the Clean Water Act contains no enforceable standards, an aspect reinforced by many state level "right to farm" laws that exempt farms and forest operations from nuisance claims. As such, the implicit assignment of property rights favors the rights of a nonpoint source to pollute. Therefore, in watersheds where farms, forests, and newly developed areas are concentrated in the upper reaches of watersheds, the majority of payment for watershed services designed to reduce negative impacts affecting downstream water users would involve payments from downstream water users to upstream landowners to change the latter's land management practices.

Despite the differences in geography, the business cases for establishing a payment for watershed services highlighted in these examples are likely to be applicable to circumstances in the southern United States. Thus, perhaps these examples can serve as inspiration for establishing such payment programs in the South.

2. Regulatory-driven payments to minimize costs of achieving water quality goals

A second type of payment for watershed services consists of payments made by an entity to landowners to maintain, sustainably manage, or restore forests in order to reduce the entity's cost of complying with a public policy goal or water quality standard. These could include payments made to help comply with existing standards as well as those made to reduce the risk of water quality violations in the future.

To illustrate, consider a point source, such as a wastewater treatment plant, that faces a regulatory limit on the amount of nitrogen it can release into a water body per year pursuant to the Clean Water Act. In some states, the plant may be allowed to purchase nitrogen reductions achieved by other entities in lieu of reducing some of its own nitrogen effluent. Thus, a landowner that plants trees near a stream may be able to generate nitrogen credits that could be sold to the wastewater treatment plant and used by that plant to comply with the nitrogen effluent limit. If the price of the nitrogen credit is less than the cost the wastewater treatment plant would have incurred to reduce the same amount of nitrogen from its own facility, then this payment for watershed services benefits the wastewater treatment plant by minimizing the cost of achieving the water quality regulation.

A number of entities have a potential business case for voluntarily entering into this kind of payment for watershed services, including:

- municipal governments that face stormwater runoff limits and are allowed to purchase credits to meet regulations;
- drinking water treatment facilities with the option of investing in forest conservation to obtain filtration waivers; and
- public and private wastewater treatment plants that face nitrogen or phosphorous effluent limits and are allowed to purchase credits to satisfy the regulation.

Examples of this type of payment for watershed services are beginning to emerge (Box 4).

Box 3 — Examples of Voluntary Transactions to Enhance Business Opportunities

Voluntary payments for watershed services exist in a number of locations around the world. Examples include:

- Costa Rican hydropower company Energia Global (now Enel Latin America) makes payments to a forest protection fund that pays landowners upstream of the company's dams to conserve or reestablish tree cover, thereby reducing river siltation and the need for reservoir dredging (Hanson et al. 2008). Energia Global pays $10 per hectare per year to the National Fund for Forest Financing, and the government of Costa Rica contributes an additional $30 per hectare, largely financed from fuel tax revenues. The fund makes cash payments to those owners of upstream private lands who agree to reforest their land, engage in sustainable forestry, and/or conserve existing forests. Landowners who have recently cleared their land or are planning to replace natural forests with plantations are not eligible for compensation. The financial compensation of $48 per hectare per year is based on the opportunity cost of forgone land development, in this case revenue from cattle ranching (Perrot-Maître and Davis 2001).
- Quito, Ecuador established a water fund in 2000 to protect upstream lands in order to maintain water flows and water quality. The fund's principal was raised by the city's water utility (via a levy), a local brewer, a bottler, and a hydroelectric company. The fund was established after being conceptualized and promoted by The Nature Conservancy. The principal was invested in stocks and other financial instruments and was allowed to grow before interest earnings were used to finance forest restoration projects. An independent governing body selects the conservation projects. By late 2010, more than 2 million trees have been planted and more than 5,000 acres of land have been restored (Whelan 2010).
- Bogotá, Colombia established a water fund in 2009 to finance conservation of forests, reforestation, and other conservation and regeneration of native vegetation in the watersheds that supply the city with water. Interest from the fund will become a perpetual source of financing for upstream forest and land conservation. Investors in the fund include Bavaria (Colombia's largest brewer) and the Bogotá city water utility, both of which have vested interests in a steady stream of clean freshwater, and the Inter-American Development Bank (Whelan 2010). The fund was established with the assistance of The Nature Conservancy.
- The Crooked River watershed is part of the larger Sebago Lake watershed, which supplies high-quality drinking water to 200,000 residents and many businesses in Portland, Maine. The heavily forested watershed naturally supplies water that surpasses standards set by the Safe Drinking Water Act (SDWA). As a result, the Portland Water District holds a Filtration Avoidance Determination from the U.S. Environmental Protection Agency, saving the water utility and its customers tens of millions of dollars in capital costs that would otherwise be needed to filter water to meet SDWA standards. The watershed's ability to indefinitely provide such clean water, however, would be diminished by forest conversion and degradation. To address this challenge, the American Forest Foundation, the World Resources Institute, Manomet Center for Conservation Sciences, Western Foothills Land Trust, and local partners are working to establish a payment for watershed services, recognizing that maintaining forests—and maintaining the waiver—can be a cost-effective alternative to filtration plant construction. The partners are identifying areas in the watershed most important for ensuring clean water supplies and then linking those forestland owners with investments from beneficiaries.

3. Payments to generate public benefits

A third type of payment for watershed services consists of payments made by an entity to landowners to maintain, sustainably manage, or restore forests in order to yield benefits for the public at large, or "public goods." Public goods are benefits that are enjoyed by all but not paid for by all and so are often under-provided relative to what an efficient market would achieve. Payments for watershed services can help to correct this problem of the underprovision of public goods by providing funding for landowners to construct forested wetlands, reforest denuded lands, or create riparian zones that would not otherwise be cost effective to undertake by private sector entities. As with the financing of most public goods, government bodies are the primary source of funding for this type of payment for watershed services.

One example is the U.S. Department of Agriculture's Conservation Reserve Program (CRP). The CRP was originally authorized by the 1985 Food Security Act with the primary goal of reducing soil erosion and sedimentation of surface waters. The program is designed to retire highly erodible lands from agricultural production by converting these fields to forests or grasslands and to stimulate restoration of wetlands and riparian zones. Landowners participating in the program typically receive an annual rental payment plus up to half the cost of establishing permanent vegetation.

Some states directly finance watershed restoration as well. The Florida Department of Environmental Protection, for instance, is engaged in an extensive watershed restoration program throughout the state. The Department finances a diverse portfolio of watershed restoration projects designed to ensure safe drinking water supplies and protect rivers and

Box 4	Examples of Regulatory-Driven Payments to Minimize Costs of Achieving Water Goals

Payments for watershed services to minimize costs of achieving regulatory goals are starting to emerge in response to policies such as the U.S. Clean Water Act. For example:

- In the 1990s, New York City pioneered payments for watershed protection when the city opted to finance watershed conservation upstream in the Catskills region in lieu of building additional drinking water treatment infrastructure to meet water quality standards. The city has spent or committed approximately $1.5 billion (averaging $167 million per year) to maintain nature's ability to supply clean freshwater. Payments fund conservation easements on the forests and open spaces around reservoirs, native habitat restoration, and related activities. Building a water filtration plant, on the other hand, would have cost from $8 billion to $10 billion: approximately $6 billion to build and another $250 million per year to maintain (Kenny 2006). Moreover, building a treatment plant would not have generated the wide array of ancillary ecosystem services provided by the green infrastructure alternative—forest and open space conservation—such as carbon sequestration and recreational opportunities.

- In February 2010, the U.S. Endowment for Forestry and Communities announced a "Healthy Watersheds through Healthy Forests Initiative," a 3-year, multimillion dollar initiative that seeks to advance the connection between forest management, water quality, and water quantity in the eastern United States. The three partner organizations include the Conservation Trust for North Carolina, working in the Upper Neuse River Basin in central North Carolina; Pinchot Institute for Conservation, working in the Upper Delaware River Basin located in Pennsylvania, New Jersey, and New York; and the Virginia Department of Forestry, working in the South Fork Rivanna Reservoir Watershed located in Albemarle County, Virginia. These three projects are designed to link landowners' financial interests and their forestland management practices to urban consumers of the municipal water supply to influence landowner behavior in a way that reduces the costs of both urban and rural users of the water resources. Landowners who participate will receive cash payments for increasing forest cover through afforestation on their property and one-time cash payments for conservation easements that protect working forests, stream restoration work done in conjunction with forest buffers, and stabilization of forest harvest sites.

- In 2004, one of the nation's first temperature trading initiatives began within the Tualatin watershed in Oregon. Clean Water Services, a water resources utility in Washington County, Oregon, was one of the first utilities in the nation to be issued an integrated, watershed-based National Pollution Discharge Elimination System permit that covers four treatment plants and allows for temperature trading within the watershed. Clean Water Services was considering investment in costly refrigeration units ($4.3 million by 2008) at its wastewater treatment facilities. A more cost-effective alternative, this permit allows the utility to address wastewater discharge temperature requirements by trading warm treatment plant effluent with shade provided by 35 miles of restored riparian forest and cool water provided by 30 cubic feet per second of additional water released from a headwaters reservoir. Under this trading approach, landowners enrolled in the program receive a rental payment in exchange for signing a 15-year contract with the U.S. Department of Agriculture's Farm Services Agency and the soil and water conservation district to allow revegetation of lands in the riparian corridor. Moreover, the watershed payments finance planting of more than 400,000 trees and shrubs annually within the watershed's 712 square miles. In addition to providing technical assistance to the soil and water conservation district, Clean Water Services finances the enhancements above what the standard U.S. Department of Agriculture Conservation Reserve Enhancement Program would finance (Roll and Cochran 2008).

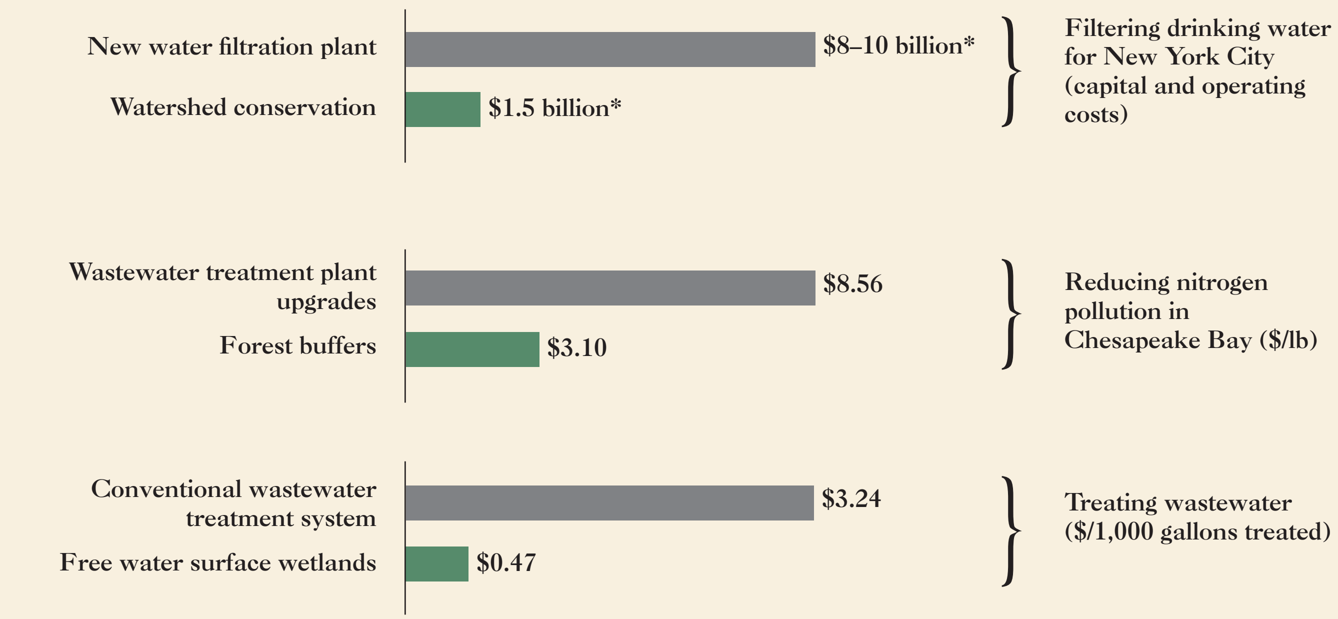
lakes from pollutants in stormwater runoff.[9] The state's Clean Water State Revolving Fund is a major source of funding for these efforts.

Gray versus Green Infrastructure

Many of these payments for watershed services share a common trait: they are investments in "green infrastructure" instead of "gray infrastructure." In other words, they are investments in forests instead of human-engineered solutions, concrete, and other technologies to maintain the ongoing provision of watershed services over time. For example, to meet drinking water quality standards implemented since the late 1980s, researchers expect that treatment plants across the United States will have to invest hundreds of billions in infrastructure (Dissmeyer 2000; Maxwell 2005). Green infrastructure investments could obviate the need for at least a portion of these expenditures. New York City, Bogotá, and other cities are using investments in forest conservation and restoration as a way to avoid the building of new water filtration plants to maintain clean water flows to the cities' residents. In the Boston area, three watersheds received a filtration waiver, avoiding costs of about $200 million due to commitments to maintain upstream forest conditions (Barten et al. 1998). In a water quality trading program, a wastewater treatment plant could finance a landowner to restore riparian forests instead of investing in plant upgrades.

These investments in green infrastructure are designed to save money relative to investments in gray infrastructure (Figure

FIGURE 2 Green Infrastructure Can Be Less Expensive than Gray Infrastructure



* Figures represent 2006 U.S. dollars.

Source: Kenny 2006; Wieland et al. 2009; Chesapeake Bay Commission 2004; Corps of Engineers 2003.

2). Note, however, that Figure 2 estimates do not include the economic values of other, nonwatershed-related ecosystem services provided by green investments or the natural resource damages caused by gray infrastructure, such as the loss of fisheries associated with dams. For example, restoring forests near streams can be a cost-effective means of not only controlling nutrient runoff but also increasing carbon sequestration and providing recreational and hunting opportunities. It represents a more cost-effective means of reducing pollution than a filtration plant, even more so when the costs associated with clearing undeveloped land to make room for the new plant are taken into account. The economics of green infrastructure would be even more financially attractive to landowners if they were to receive compensation for other ecosystem services provided or a "stacking" of payments for ecosystem services (Stanton et al. 2010; Bianco 2009).[10]

Building Payments for Watershed Services in the South

In the years ahead, making payments for watershed services an important source of revenue for southern landowners will require (1) sufficient demand, (2) adequate supply, and (3) good infrastructure—that which makes transactions possible and efficient. With regard to each of these three elements, there are a number of actions that the public sector, private sector, landowners, and others can take to encourage the spread of payments for watershed services in the South (Figure 3). Several of these actions are outlined below.

1. Sufficient demand

To build demand, beneficiaries—entities that may find it in their interest to pay others to ensure the supply of needed watershed-related ecosystem services—can pursue a number of steps, including the following:

- *Avoid overlooking the potential for watershed payments.* This first step is the most obvious. Public and private sector entities that depend upon or impact freshwater quantity or quality should at the very least explore payments for watershed services as a viable option for achieving their economic or public interest goals. Too often, the default approach is to invest in gray infrastructure, such as a water filtration plant upgrade, without consideration of green infrastructure options. Entities for whom payments for watershed services might be of interest include:
  - beverage companies,
  - power companies with hydroelectric facilities,

FIGURE 3 **Actions to Build Payments for Watershed Services in the South** *NOT EXHAUSTIVE*

Demand ↔ ***Infrastructure*** ↔ ***Supply***

Demand

- Avoid overlooking watershed payments
- Identify which forests are relevant
- Conduct economic assessments
- Build the business case
- Develop a long-term financing model
- Explore public/private partnerships

Infrastructure

- Lower transaction costs
- Strengthen quantification
- Improve performance monitoring

Supply

- Develop understanding of watershed-related ecosystem services provided
- Actively look for emerging opportunities
- Collaborate with other landowners

  – manufacturers that rely on clean freshwater supplies for processing,
  – housing developers,
  – public and private wastewater treatment plants,
  – city and county governments,
  – drinking water treatment facilities, and
  – public departments of transportation.

- *Identify which forests are relevant.* For successful payments for watershed services, public or private sector managers will need to identify which forests—or tracts of land to be reforested—provide the freshwater benefits enjoyed by the public or private sector entity. In addition, managers will need to identify the threats to these lands and opportunities for payments to reduce or eliminate such threats. Not all forests in a watershed may be equal contributors to the target water-related ecosystem service. Even if the science in understanding the "flows" of ecosystem services is inexact, scientists and modelers from universities and nongovernmental organizations, government or state extension agencies, or private consultants could help hone the identification of forestlands and the quantification of the amount of forest needed to maintain or restore desired watershed benefits.
- *Conduct economic assessments.* When building the business case for entering into a payment for watershed services, managers should conduct comparative cost-benefit economic analyses of green versus gray infrastructure options. These analyses will compare the relative, discounted costs of financing, constructing, and operating gray infrastructure with making periodic payments for watershed services over time. In addition, it is important to document and estimate the cost of the negative impacts associated with sedimentation, decreased water flows, and water pollution and who bears the cost of these impacts. Likewise, where possible, it is important to estimate the cobenefits that forest-based solutions can provide. Such benefits are not often prevalent in gray infrastructure solutions. While the data needed to conduct such analyses may not always be available, one can at least scope out what the analysis would entail so that these data needs can be identified and prioritized.
- *Build the business case.* If the economic analyses are favorable, managers can outline a business case for entering into a payment for watershed services in order to garner corporate, agency, or public approval. Among other things, the business case should articulate the underlying rationale—to enhance business opportunities for downstream water users, minimize an entity's cost of meeting a regulation, or generate public benefits—and the comparative economics. Where possible, it can be helpful to glean lessons learned and best practices from previous payment for watershed services experiences (Boxes 3 and 4).

- *Develop a long-term financing model.* Sustainable, long-term financing of payments to upstream landowners is critical to the success of the payment program. Sources of funds could include levies on water beneficiaries, pollution fees or pollution avoidance payments, endowment grants, and others. One approach that appears to be taking root in Latin America is the endowment-style fund, where payments to landowners are financed through the interest earned by the fund, thereby preserving capital in perpetuity (Box 3).
- *Explore public/private partnerships.* Both companies and government agencies can have a business case for engaging in payments for watershed services. But they need not operate in isolation. In fact, many payments for watershed service programs involve the combined financial contributions from both the public and private sector. For instance, the principal for the watershed payment endowment fund in Quito, Ecuador was raised by a levy on the city's water utility, a local brewer, a bottler, and a hydroelectric company (Box 3).

2. Adequate supply

Upstream landowners can pursue a number of steps to advance—and ultimately benefit from—payments for watershed services. In particular, they can do the following:

- *Develop an understanding of watershed-related ecosystem services provided.* It is incumbent upon forest owners to understand what demonstrable watershed benefits their forests currently provide or could provide in greater quantity through changes in forest management or forest restoration. In addition, forest owners can learn which downstream entities benefit from these services. Armed with this knowledge, forest owners are in a good position to identify payment for watershed services opportunities when they arise.
- *Actively look for emerging opportunities.* Forest owners should keep abreast of potential payment for watershed services pilot programs under consideration. Likewise, owners should watch out for emerging state or federal government cost-share programs or incentives that reward landowners for taking steps to improve a forest's ability to provide watershed benefits. Many cost-share programs, such as those offered by the Natural Resource Conservation Service, may be precursors to more formal watershed service payment programs, so gaining a familiarity with these existing programs could help prime landowners for more lucrative opportunities in the future.
- *Collaborate with other landowners.* Family forests comprise about 57 percent of total southern forest acreage (Hanson et al. 2010). Most family forests are small tracts, with 4 million owners each holding less than 50 acres in 2006 (Butler et al. 2008). Therefore, for any given watershed, there is a high likelihood that there will be many forestland owners (or landowners who could reforest property). Implementing forest management practices at a scale that yields the desired downstream water benefits becomes more challenging the more landowners there are. Likewise, if a hydroelectric facility or other beneficiary needs to engage a large number of suppliers, then transactions become more complex and costs tend to rise (Johnson, White, and Perrot-Maître 2001). One approach for addressing these challenges is for landowners to collaborate when participating in a payment for watershed services arrangement. For instance, suppliers could voluntarily aggregate themselves into a forest landowner association or cooperative, coordinating forest management approaches, sharing best practices, and enabling beneficiaries to interact with just one entity.

3. Good infrastructure

Payments for watershed services will not be possible at a large scale until adequate infrastructure is created to facilitate transactions. At least three actions are needed:

- *Lower transaction costs.* Setting up a payment for watershed services agreement incurs transaction costs. For example, the flow of watershed-related ecosystem services from forest to beneficiary needs to be identified. Beneficiaries and forestland owners need to find each other, negotiate contracts, and develop long-term funding mechanisms. Although these and other expenses will vary by watershed, ensuring low transaction costs is important for overall economic efficiency. Approaches for lowering transaction costs include:
  - utilizing online transaction platforms where beneficiaries can find suppliers and conduct transactions, such as www.NutrientNet.org or www.thebaybank.org for water quality trading;
  - allowing a nongovernmental organization, government agency, aggregator, or broker to serve as a third-party intermediary, bridging beneficiaries and suppliers of watershed-related ecosystem services; and
  - educating landowners and property managers about assessment tools such as www.landserver.org that generate property reports on the ecosystem services that private

lands provide and determine eligibility for payments and other conservation funding opportunities.

- *Strengthen quantification.* Improving the underlying data and quantification of the link between upstream forest management practices and downstream water quantity and quality would further strengthen the efficacy of payments for watershed protection by helping to define with more precision the actual commodity (i.e., cubic meter of water, nutrient credit) generated by such practices. Several projects in the United States have already made substantial headway performing this type of detailed analysis, by examining landscape characteristics such as land use, distance to streams, distance to wetlands, slope, and permeability and their relationship to water quantity and quality. These types of analyses are critical for aggregators and other investors seeking to purchase water quality credits for resale to downstream beneficiaries. Knowing which lands are most productive in generating watershed-related ecosystem services will help target investments to high-yield opportunities.
- *Improve performance monitoring.* The long-term credibility and efficacy of payments for watershed services will depend in part upon the ability of beneficiaries to see improvements in water quantity or quality and the ability of suppliers to demonstrate that their forest management practices are generating these improvements. Therefore, market participants or third parties such as nongovernmental organizations, government agencies, or universities need to ensure that performance monitoring systems are in place and are continually improved.

Going Forward

Payments for watershed services are a promising means of incentivizing landowners to conserve, sustainably manage, and/or restore forests specifically to provide one or more watershed-related ecosystem services, such as water flow regulation, flood control, water purification, erosion control, and freshwater supply. Watershed payments are beginning to emerge in the United States and elsewhere, providing case examples for the South to draw from and apply. With its combination of forests and freshwater challenges, the South is ripe for using this new incentive approach.

However, to make payments for watershed services more ubiquitous in the South, demand, supply, and infrastructure to facilitate transactions all need to be substantially scaled up. What is also needed is a proliferation of new pilot projects to blaze a trail for others to follow in the region. To date, only a few payments for watershed services projects have begun in the United States (Box 3 and 4). While these pilot projects will serve a critical role in demonstrating the most effective program structure, more pilots— especially in the southern United States—are needed in order to demonstrate the promise these programs hold for bringing forest-based, watershed-related ecosystem services to scale going forward.

If you are interested in exploring payments for watershed services in more detail, please contact Todd Gartner, WRI's Conservation Incentives and Markets Manager, at Tgartner@wri.org.

Notes

1. A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place. Source: U.S. Environmental Protection Agency, "What is a Watershed?" U.S. Environmental Protection Agency. Online at: <<http://water.epa.gov/type/watersheds/whatis.cfm>>.
2. The presence of forests, however, typically results in lower surface flows to nearby waterways because of infiltration and the transpiration of water into the atmosphere through leaves. Therefore, reducing forest cover and density generally increases surface water yield from watersheds, although these changes can be short-lived and depend on climate, soil characteristics, and the percentage and type of vegetation removal. For instance, streamflows increased 28 percent following a clear-cutting experiment in a southern Appalachian watershed. Source: Kevin McGuire, *Water and Forest Cover Literature Review.* (Blacksburg, VA: Virginia Water Resources Research Center & Dept. of Forest Resources & Environmental Conservation, Virginia Tech, 2009). Citation in literature review from: T. W. Swank, J.M. Vose, and K.J. Elliott, "Long-Term Hydrologic and Water Quality Responses Following Commercial Clearcutting of Mixed Hardwoods on a Southern Appalachian Catchment," *Forest Ecology and Management* 143, no. 1–3 (2001): 163–178.
3. According to the U.S. Environmental Protection Agency, non-point source pollution from agriculture, urban development, and suburban development accounts for more than 60 percent of impairment in U.S. waterways, including many drinking water sources. Source: P.K. Barten and C.E. Ernst, "Land Conservation and Watershed Management for Source Protection," *Journal AWWA* April 96 (2004): 4, 2009.
4. According to Seager et al., "Models project that in the near-future precipitation will increase year-round in the Southeast north of southern Florida."
5. The volume of water—43,560 cubic feet—that will cover an area of 1 acre to a depth of 1 foot.
6. The equivalent per-acre values reported in the Sedell et al. 2000 study are $73.10 for in-stream and $2.75 for off-stream uses in 2010 dollars. Extending these values to the 39.5 million acres of protected forests in the South yields $2,887,450,000 in annual in-stream benefits and $108,625,000 in annual off-stream benefits. Extending the benefit estimates to all protected lands assumes that management practices on national forests and other protected lands are similar.
7. Updated to 2010 dollars. To be precise, these figures were expressed in terms of the "avoided cost" benefit of reducing 1 ton of sediment. Regardless, they represent the magnitude of externalized costs to downstream water users.
8. The Tennessee Valley Authority alone has 30 dams. Tennessee Valley Authority *Dams and Hydro Plants,* 2003. Online at: <<http://www.tva.com/power/pdf/hydro.pdf>>.
9. See: <<http://www.protectingourwater.org/protecting/restoring/>>.
10. Stacking of payments for ecosystem services is an option that has received increasing attention in the United States. Stacking holds a lot of promise (Stanton 2010), with the development of programs such as the Electric Power Research Institute's stacking initiative in the Ohio River Valley. But stacking also faces a number of challenges to ensure the environmental integrity of the payment programs (Bianco 2009).

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