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## EXECUTIVE SUMMARY

# Building Green Infrastructure

## *Land Conservation as a Watershed Protection Strategy*

The nation's waters have become progressively cleaner since the passage of the federal Clean Water Act in 1972. Today, the main threat to clean water is not industrial and sewage wastes, but nonpoint-source pollutants—often the byproduct of urban sprawl and development—that are washed by rainwater into sources of drinking water, or into streams that support recreation and fisheries. Nonpoint-source pollutants include oil washed off roadways and parking lots; pesticides and fertilizers from agriculture, lawns, and golf courses; and sewage from septic systems.

The U.S. Environmental Protection Agency's (EPA) 1998 Clean Water Action Plan estimated that about half the nation's 2,000-plus major watersheds experience de-

graded water quality—polluted runoff a primary cause. To address this problem, EPA has urged a watershed management approach, and proposed that 20 percent of its Clean Water State Revolving Fund (CWSRF) be set aside to provide communities with more flexibility to protect water.

The Trust for Public Land's 1997 report "Protecting the Source—Land Conservation and the Future of America's Drinking Water" found that communities across America are increasingly adopting watershed management plans as a way to ensure safe drinking water without having to resort to costly water filtration and treatment. Sometimes communities regulate the kinds of development and activities that can take place in a watershed. Another effective way to protect a watershed is to buy critical watershed lands or development rights, sometimes as a complement to regulation, as part of a holistic



Non-point source pollution is often the by-product of urban sprawl and development. © BARBIE ROKACH

approach to overall watershed management.

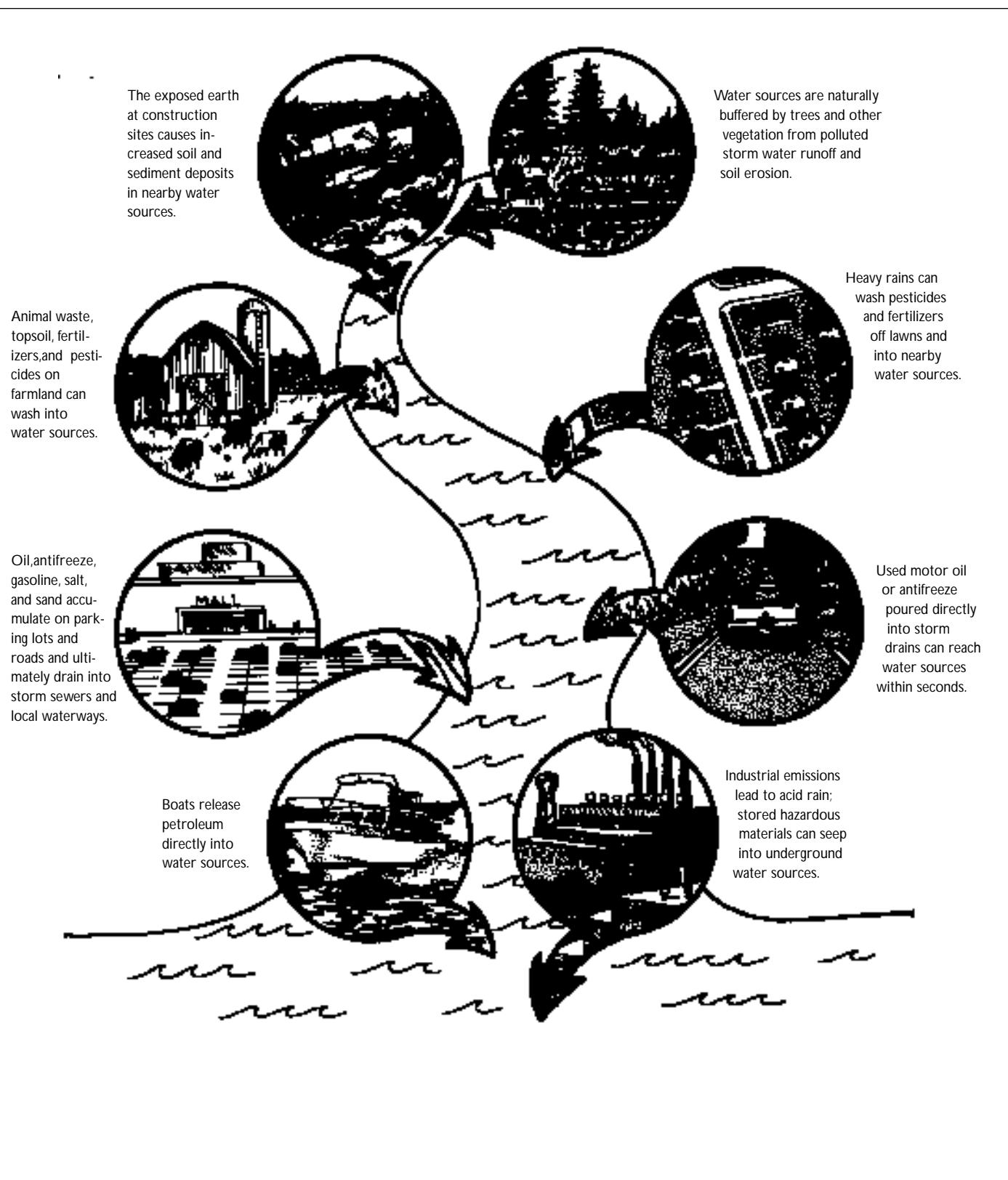
In many communities, buying land to protect water quality has become part of a broader "Smart Growth" effort. Smart Growth is the name for a nationwide movement that seeks to direct development in ways that preserve critical open space and natural resources.

Protected watershed lands become part of a community's "green infrastructure"—an infrastructure as important to community life and well-being as roads, schools, and utilities.

This report presents the cases of four watersheds where land conservation is helping preserve water quality.

- *Austin, Texas*, where nonpoint-source pollution due to rapid development is threatening the Barton Springs/Edwards Aquifer, a major drinking-water source.
- *Barnegat Bay*, a coastal estuary of more than 450 square miles along New Jersey's tidal shoreline. Rapid development in the area threatens local drinking water, water quality in the bay, and the region's important wildlife habitat.
- *Mountain Island Lake*, a pristine source of drinking water for Charlotte, North Carolina, and environs. Development along the lakeshore and tributary streams endangers water quality.
- *Indian River Lagoon*, a 155-mile-long estuary along Florida's east coast. Rich in habitat for both marine and shore species, the lagoon is threatened by ecological changes due to past ditching and draining of water courses, as well as by development within the watershed.

## POLLUTANTS FROM NONPOINT SOURCES



## LESSONS LEARNED

Taken together, the cases reveal the common elements that lead to success in watershed land conservation:

- Land conservation projects usually are driven by several motivations, in addition to the desire to protect watershed or marine waters. Water managers may need to look to diverse sources for funding and support. Supporters may also be motivated by the desire to preserve habitat, recreational opportunities, or the historic values of a landscape; or by the more general Smart Growth goal of preserving quality of life and curbing sprawl development.
- Decisions about land acquisition and public investment must be based on credible scientific or economic information. Such information might include data from water-quality monitoring; demographic projections; modeling of development scenarios using Geographical Information Systems (GIS); and cost analyses of alternatives to land acquisition, such as infrastructure and water treatment costs.
- In the absence of sophisticated information, land-use managers and water managers make decisions based on simpler models that show the cost-effectiveness and multiple benefits of land conservation. The more extensive data now being developed will help managers better target and prioritize parcels for conservation, and will help them make the argument for investment in watershed lands.
- For programs to win support and funding, the public must be educated on the multiple values of watershed protection. Grassroots efforts at public education may spring up around a specific incident of pollution. An independent convener, such as an environmental or civic group, may work to educate the public about water pollution problems and conservation solutions. In some areas, NEP has convened and helped educate local stakeholders through its citizens advisory committees, management committees, and scientific and technical advisory committees. In each of the case studies, public awareness has been reflected in voter approval for local land-protection funding.
- Complex land-protection programs require complex partnerships between jurisdictions and professional disciplines. Each of the case studies shows unique partnerships between water managers and land-use managers who share compatible goals. Public and private agencies together with independent nonprofits can help provide a collaborative conservation solution to water quality problems. In addition to generating public support, these organizations can promote sharing of information and help forge a cooperative effort—addressing both acquisition and management issues—among the many public and private partners. In two of the cases outlined, the National Estuary Program filled this organizational role.
- To be successful, land-acquisition programs require local funding, often generated through voter-approved bond sales or taxes. Beyond its fiscal contribution to land acquisition, local funding helps ensure community involvement and support. State funding often helps generate local funding, through incentives such as matching funds for land-protection programs.
- Successful land acquisition often takes place within a strong regulatory framework and alongside other water-quality protection tools. Land acquisition is not a replacement for regulation, but rather an alternative for communities and landowners in cases where regulation seems inadequate, or treatment prohibitively expensive, to protect the resource. For example, a successful program might combine a common regulatory technique—such as zoning—with the acquisition of land or easements to protect a wellhead or set aside wetlands in need of restoration.
- While the federal government played a small role in these watershed-protection examples, the potential for stronger state and federal support is important and growing. The National Estuary Program has shown that it can be a key coordinating partner in watershed-protection efforts. The EPA and USGS both generate data that can be used to link land-use and development patterns with changes in pollution levels. And while federal funding for watershed acquisition is still limited, EPA has proposed greater flexibility in the use of the Clean Water State Revolving Fund, which may make this money more available for land-acquisition projects.



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## Austin, Texas

### *Protecting the Edwards Aquifer*

**A**ustin is a handsome, historic city in a pleasant part of Texas, with rolling hill country to the west and the remains of the blackland prairie to the east. In the 19th century, the region supported immense herds of cattle. Now, the remains of ranches surround Austin, and a few ranchers still graze a scattering of cattle, goats, and sheep. The region has undergone tremendous development in recent decades—its beauty and culture lure new residents and industries, particularly high-tech companies in search of a high quality of life for their employees. The population of the greater Austin area has tripled since 1970, to over 540,000 in 1996.

The city of Austin—which owns the local water utility—draws its drinking water from three reservoirs on the Colorado River, which flows through the city. Lake Travis, Lake Austin, and Town Lake are part of a chain of reservoirs collectively known as the Highland Lakes, which in addition to providing drinking water, also are important recreational resources.

The Edwards Aquifer, an underground water source that contributes to the river, sits on the western side of the city and is the sole source of drinking water for over 1.5 million people, including residents of San Antonio and Austin. A thin layer of soil—providing habitat for over 50 species of plants and animals that live nowhere else—covers the aquifer. The Edwards is also the source of the largest spring in Texas, which feeds the Colorado River and

As rapid development threatens drinking-water sources, governments and residents are looking for ways to protect water quality through better land-use practices.

provides essential freshwater for riparian ecosystems downstream.

The Edwards Aquifer is composed of three very distinct hydrological segments: the Northern; Barton Springs; and the Southern, or San Antonio. Each of these segments is composed of three zones: the Recharge Zone, an area where the porous Edwards limestone is exposed to rainfall and stream flows; the Contributing Zone, the upstream area that contains the watershed of the streams that flow across the Recharge Zone; and the Artesian Zone, which makes up the aquifer's underground reservoirs.

#### AN ENDANGERED RESOURCE

The Barton Springs segment of the aquifer—the segment around Austin—has been identified as the most endangered aquifer in Texas, highly vulnerable to pollution due to its relatively small size, its high porosity, and the region's land-development boom. The segment discharges about 34 million gallons per day into the Colorado River, contributing significantly to the city's water supply. In 1988, EPA designated the Barton Springs segment a Sole Source Aquifer—the sole or principal source of drinking water for the area. (Federally funded projects require special review if they have the potential to pollute a Sole Source Aquifer.)

The segment is named for Barton Springs, which create Barton Pool, a natural "swimming hole" that is the popular centerpiece of Austin's regional park system and a major recreational resource for the community. For Austin residents, the condition of Barton Pool has served as a crude indicator of pollution within the watershed. More than 20 years ago, officials began to close the pool periodically due to the bacterial levels that contaminated the pool after storms.

Monitoring of lakes and creeks in the region began in the 1970s under the "Austin Tomorrow" program, and the city joined EPA's Nationwide Urban Runoff Program (NURP) study in 1981. Over the years, Austin has studied such factors as pollutant loads in stormwater runoff, groundwater quality, and the effects of impervious cover on water quality. The city has also modeled the effects of changing land-use and confirmed the deterioration of water quality that results when natural soils and vegetation are replaced with lawns, buildings, parking lots, and roadways.

The "Barton Creek Report," published in 1997 by the city's Watershed Protection Department, summarized many of these studies and recommended conservation through the purchase of land and development rights in areas of watershed under Austin's jurisdiction. It was hoped that this protection would offset the damage of development in areas beyond Austin's jurisdictional control. (The city's jurisdiction is limited to less than 25 percent of the total land area contributing to the Barton Springs aquifer. The remaining 75 percent is minimally protected by state rules.)

It's worth noting that from the late 1970s into the mid-1990s impervious cover in the watershed remained fairly constant at five to eight percent and water monitors found only limited pollution in the creeks and springs. But

the pollution found was largely attributable to nonpoint sources. Such pollution would increase substantially under current development plans, particularly at places such as Barton Pool.

#### ATTEMPTS AT REGULATION

In response to these studies, Austin passed five water-quality ordinances for local districts, beginning in 1979 with an ordinance to protect Barton Creek. In 1986, these ordinances were superseded by Austin's Comprehensive Watersheds Ordinance—now part of its land development code—which imposed restrictions on development throughout the city's jurisdiction. The ordinance specifies limits to impervious cover. It also requires natural buffers along stream channels, the treatment of stormwater runoff, and construction-phase erosion controls.

Despite these regulatory measures, residents remained concerned about the condition of the creeks—particularly those feeding Barton Springs—and about the large amount of continuing development. In the five years following passage of the Comprehensive Watersheds Ordinance, 86 percent of the development proceeded without complying with its provisions, largely due to zoning variances or grandfather clauses that exempted the developments from regulation.

The issue gained sharper focus in 1990, when developers proposed a 3,363-acre project along Barton Creek upstream of Barton Pool. As proposed, this development would have been on the edge of aquifer's crucial recharge zone—where exposed limestone allows rainfall and stream-flows (and any pollutants they carry) to plunge directly into the subsurface system of caves and channels. At a public hearing, hundreds of citizens expressed strong opposition to the development. The city council denied the permits and began working on new regulations to protect the Barton Springs watershed.

As it happened, Austin's Comprehensive Watersheds Ordinance regulations were also deemed inadequate by the local Save Our Springs Alliance (SOS), an organization of environmental groups dedicated to protecting the Edwards Aquifer. SOS soon developed an alternative nonpoint-source pollution ordinance designed to further limit impervious cover. Known as the "Save Our Springs Ordinance," this stronger measure was resoundingly adopted by Austin voters in August 1992.

The measure has since been challenged in court, with mixed results. In 1995, the Texas legislature passed one bill that removed some larger subdivisions from Austin's jurisdiction. Another bill allowed owners of more than 1,000 acres to create a "water quality protection zone" exempt from the SOS ordinance—however, the Texas Supreme Court ultimately declared such zones unconstitutional. Despite these challenges, the SOS Ordinance is still being enforced today.

The public debate over the ordinance greatly raised environmental consciousness in Austin, but the outcome made it clear that a regulatory approach alone was not enough to meet the challenges of managing growth and preserving clean water. "People could feel it," says Grant Godfrey, staff attorney for SOS. "There was a realization that if we didn't act, the opportunity would be lost."



Austin voters resoundingly adopted the Save Our Springs Ordinance in 1992, after grassroots efforts by environmental groups.

In 1995 and 1996, a Citizens' Planning Committee studied land use, transportation, and environmental concerns and from these studies developed the guiding principles for what in 1998 would become Austin's comprehensive Smart Growth Initiative. During that process, it was determined that the city's surface water—particularly the Barton Springs watershed—needed protection beyond current regulatory restrictions. Building on that recommendation, the city council designated the most sensitive third of the Austin region—land that drains into Barton Springs and the Highland Lakes—as a Drinking Water Protection Zone. The remaining two-thirds they designated a Desired Development Zone, which included the urban core, commercial corridors, and the central business district.

#### CONSERVATION FOR WATER QUALITY AND SMART GROWTH

*A 1991 poll revealed that Austin residents favored open space acquisition—particularly to protect water quality and secure recreation—and that they would approve increased property taxes to pay for the land*

Even as Austin voters were trying to strengthen development regulations, they were also moving to protect the watershed through land acquisition. Since 1980, six studies have recommended that Austin acquire undeveloped property. A 1991 poll jointly sponsored by the Trust for Public Land and Citizens for Open Space, a local environmental group, revealed that Austin residents favored open space acquisition—particularly to protect water quality and secure recreation—and that they would approve increased property taxes to pay for the land. In 1992, in the same election in which voters approved the SOS ordinance, they also approved a \$20-million bond act for a new Barton Creek Wilderness Park, which would protect the most critical areas around the springs.

In 1998, voters approved several other land-protection funding measures. Proposition 2, approved in May, authorized a \$65 million revenue bond to purchase land and easements within a 15,000-acre, hourglass-shaped buffer zone—an area almost entirely within the Drinking Water Protection Zone designated by Austin's Smart Growth Initiative. Funding for the measure comes through an increase in residential water rates that increases the average water bill by approximately \$1.20 per month. In November voters passed a second series of propositions to also generate funds for land protection. While the primary purpose of those purchases is to provide land for recreation and flood control, they also help protect the watershed.

SOS's Grant Godfrey believes that voters passed these measures because they appealed to both business people and environmentalists. "The business community and environmental groups found something to agree on," Godfrey says. "There was a growing understanding in our business community, particularly the high-tech sector, that quality of life—the fact that Austin is a pleasant place to live—is an important lure for their employees and helps keep the economy vibrant."

#### DEFINING LANDS FOR ACQUISITION

The goal of Austin's 15,000-acre watershed buffer is to protect both drinking water supplies and the cleanliness of the Barton Springs segment of the Edwards Aquifer. According to modeling projections, if the 15,000 acres were developed, the Barton Creek watershed could receive an additional 300 to 700 tons of sediment each year.

The exact limit and extent of the buffer was determined using a "combination of art and science," says Nancy McClintock of Austin's Water Protection Department—the "science" being information from water-quality studies, and the "art" consisting of logistical concerns such as development patterns, or the likely availability or contiguity of parcels. Weighing art and science, managers produced a map of the buffer zone in advance of the vote on Proposition 2, so voters could see the practical outcome of that measure.

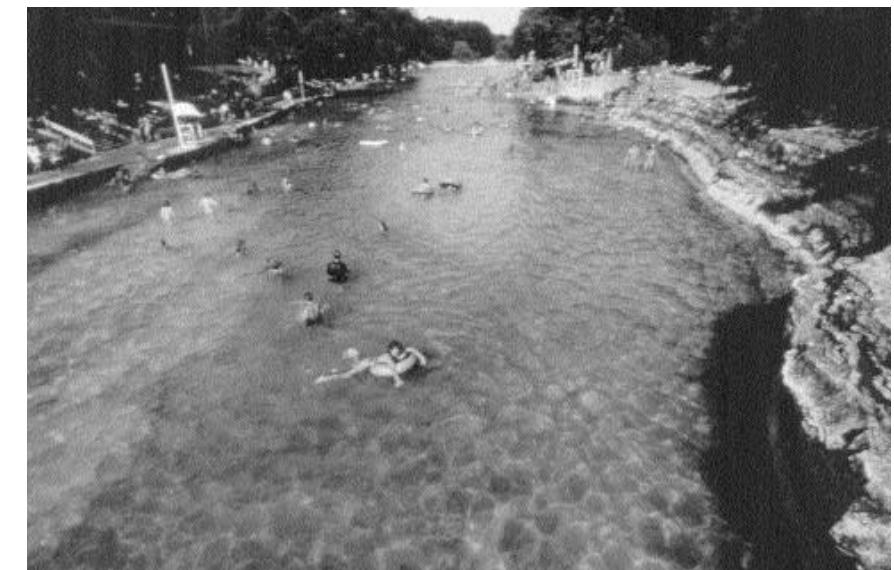
Once the parcels were identified, the department calculated for each of them the extra pollutants that would be generated under different development scenarios. In this way, staff were able to create a "pollution-avoidance figure" for each parcel, which was then incorporated into a land-acquisition prioritization matrix, along with information on topography (creeks, streams, etc.); whether the parcel was contiguous with other protected parcels; the expected cost of the parcel; and the willingness of the owner to sell. Relative value was assigned to several matrix factors: pollution avoidance (60 percent), base-flow protection (15 percent), recharge protection (15 percent), and contiguity (10 percent). Parcels acquired so far tend to have a high pollution-avoidance rating and a willing seller. (No condemnation of property is planned.)

#### FUTURE PLANS

What will Austin do with the lands it protects through acquisition or easement? City Manager Jesus Garza would like to see farming and ranching continue in the Austin area as part of Texas' heritage. Garza and his staff will be working with experts to develop management plans for protected lands that are appropriate to water-quality goals.

Plans call for reselling some of the acquired land, either to conservation organizations or to landowners who will accept conservation easements and strict development limits. Proceeds of these sales would be used to acquire more parcels. "Some developers are opposed to what they see as an expansion of the program," SOS's Godfrey points out, "and some public education is still required."

The issues surrounding the watershed protection program have been controversial, Garza notes, "but when we actually got into them, the community has been supportive, and business and environmental interests have worked together." In pursuit of its Smart Growth agenda, Austin is now studying new scenarios for development that will be less expensive and more sustainable, such as infill development. By reusing existing infrastructure, the city can continue to grow—without growing into critical watershed.



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By early 1990s, Austin residents and officials realized regulatory tools were not enough to preserve water quality. 1992 voters approved a bond issue to protect popular Barton Springs pool.



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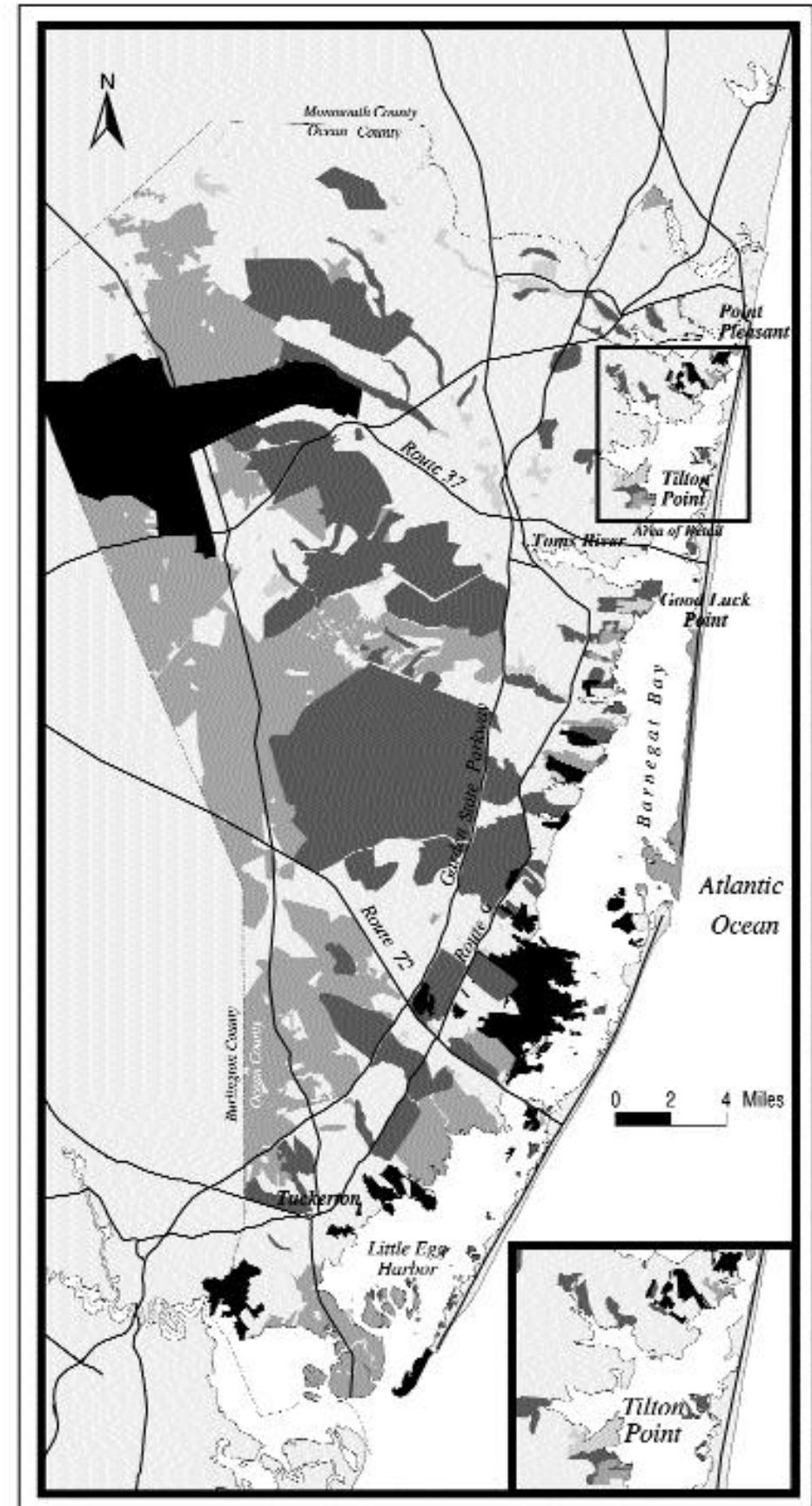
## Barnegat Bay *Protecting a Coastal Ecosystem*

The Century Plan described 100 high-priority conservation sites in the Barnegat Bay watershed. This early research on land-acquisition priorities later helped guide EPA's National Estuary Program at Barnegat Bay.

New Jersey is the most densely populated of all the states, and is also the one with the highest number of federal Superfund sites—a legacy of its chemical and petroleum industry. With large areas of sandy, porous soils, New Jersey leads the nation in the percentage of landmass classified as highly vulnerable to water pollution. According to EPA's Index of Watershed Indicators, more than two-thirds of the state falls into the most serious category for water-quality risk. The state depends heavily on groundwater for drinking, and New Jersey residents have demonstrated a high level of environmental awareness—state environmental policies have historically linked land use and water protection.

Covering more than 450 square miles of tidal shoreline, back-bay islands, marsh creeks, and pine and oak forests, the Barnegat Bay region exemplifies the conflict between development and natural resource conservation in New Jersey. With a resident population of 450,000, which doubles (and sometimes triples) during the summer, Barnegat Bay is a premier vacation destination for residents of New Jersey, Pennsylvania, and New York. The Barnegat Bay watershed is located almost entirely within Ocean County—with a small portion in Monmouth County—much of it within the Pinelands Preservation Area, an area established in 1978 by Congress.

Since 1950, Ocean County has been New Jersey's fastest-growing county, and this trend is expected to continue. Retirees in particular are attracted to the county. Thousands of new homes have been built in recent years—



Note: Protected Lands in Private Ownership Not Indicated

## Public Land in Ocean County



**TPL Century Plan Sites**  
**Federal Land**  
**State Land**  
**County/Municipal Land**

*The Trust For  
Public Land*

Map composed for The Trust for Public Land at the Center for Remote Sensing and Spatial Analysis (CRSSA), Rutgers University, 4/99

including 72 senior citizen communities with more than 52,000 units. The Rutgers University Center for Urban Policy Research estimates that by the year 2010, the county population will reach 575,000.

Development patterns vary tremendously, leading to varying types of nonpoint-source pollution. Development is heavy in the northeast and on the barrier islands; sparser in the southeast, where there are areas of critical habitat; and of very low density in the west, much of which is protected by the Pinelands Preservation Area.

Barnegat Bay itself is a coastal estuary (some scientists label it a lagoon) roughly forty miles long and one to four miles wide. In the bay, fresh- and saltwater combine to create a delicately balanced and productive aquatic environment—shallow enough for sunlight to reach the bay floor. About 75 percent of the bay is less than six feet deep at mean low tide, while overall depth varies from three to twenty feet. The bay is an important source of flounder, weakfish, bluefish, clams, and blue crab.

A nearly unbroken chain of barrier islands between the bay and the ocean creates an extraordinarily low rate of tidal exchange, with a complete turnover of water only about once in every 50 days. This prolongs the length of time pollutants remain in the bay.

Covering more than 450 square miles of tidal shoreline, back-bay islands, marsh creeks, and pine and oak forests, the Barnegat Bay region exemplifies the conflict between development and natural resource conservation in New Jersey

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#### THE THREAT FROM DEVELOPMENT

While wildlife waste and discharge from power boats contribute to the degradation of Barnegat Bay, the primary threat to water quality is development and associated activities: vehicle use, lawn and garden maintenance, and septic systems. This degradation is exacerbated by local zoning that encourages low-density development, so that the increase in pollution outpaces the rate of population growth.

Drinking water in Ocean County is drawn from underground. It is estimated that 66 percent of the population is served by developed water systems—either public or private—while the remaining 34 percent rely on domestic wells. Overpumping of freshwater is responsible for some shallower wells being contaminated by saltwater intrusion, and has been linked to the loss of wetland habitat for wildlife.

The state has determined that, in some areas, private wells less than 200 feet deep may be contaminated with mercury, believed to have come from pesticides, incinerator plumes, landfill runoff, and military bases. Some wells have been closed due to contamination from nearby Superfund sites, such as the huge site at the Ciba-Geigy chemical plant near Toms River, the county seat. There are more than 300 contaminated sites requiring cleanup in Ocean County including 13 federally designated Superfund sites.

The same polluted runoff that threatens drinking water in Ocean County also threatens the Barnegat Bay ecosystem, particularly in light of the bay's lengthy flushing cycle. According to the local Watershed Management Plan, nutrient runoff feeds excessive phytoplankton growth, with resulting turbidity. Bacterial pollution is also evident, as indicated by water-quality monitoring, and has led to

periodic restrictions on swimming and shellfish harvests.

The New Jersey Wetlands Act of 1970 protects, to some degree, the bay's salt marshes from alteration. Uplands and freshwater wetlands, however, suffer continuing assault from road construction, dredging, diking, filling, and lagoon construction. Proposed land conservation is expected to eventually integrate uplands, freshwater areas, and saltwater marshes into healthy ecosystems.

"Rapid urban sprawl is greatly affecting the watershed," says David Friedman, director of Ocean County's Soil Conservation Service. One study currently underway by the service demonstrates that rainwater is simply absorbed by the watershed's undisturbed wooded terrain. "But any kind of development—not just paved areas, but also lawns, golf courses, athletic fields, and the like—compacts this soil so that water cannot percolate through it," Friedman says. "We're seeing greatly increased flows in stormwater basins and saltwater intrusion in wells. At one time, our porous soils were a natural flood control."

In 1987, the New Jersey Legislature ordered a study of the environmental threat to the Barnegat Bay watershed. By 1993, this and other studies led to a Watershed Management Plan that addressed watershed management, sensitive area protection, water area and use, fisheries management, public access, public participation and education, and research and monitoring. The plan also led to the inclusion of Barnegat Bay in EPA's National Estuary Program (NEP), and a NEP Comprehensive Conservation and Management Plan is currently under development.

#### HOW LAND CONSERVATION FITS IN

The strong reliance on drinking-water wells, coupled with the need for clean water for wildlife habitat and protection of the bay ecosystem, means water treatment alone is an impractical solution to the problem of nonpoint-source pollution within the Barnegat Bay watershed.

The 1993 state Watershed Management Plan called for acquisition of sensitive areas by both public and private entities, in addition to the implementation of "best management practices" as buffer zones to protect waterways from human impact and reduce pollutants reaching the bay. The plan envisioned that buffer zones would be created through government regulation or the purchase of conservation easements. In practice, the purchase of easements—or of land in fee—has turned out to be the most effective way to create waterway buffers.

Another catalyst for land conservation was publication of "The Century Plan—A Study of One Hundred Conservation Sites in the Barnegat Bay Watershed" in 1995. Published by the Trust for Public Land as part of a long-term protection effort, the Century Plan described 100 high-priority conservation and public-access sites in need of protection. A 1997 follow-up report, "Beyond the Century Plan—Biological Studies and Land Conservation of the Barnegat Bay Watershed," identified other vulnerable lands as determined by studies by Herpetological Associates, Inc., and the Rutgers University Institute of Marine and Coastal Sciences. These studies identified the top ten areas for priority protection on the basis of five criteria:

*"Rapid urban sprawl is greatly affecting the watershed. But any kind of development—not just paved areas, but also lawns, golf courses, athletic fields, and the like—compacts this soil so that water cannot percolate through it. We're seeing greatly increased flows in stormwater basins and saltwater intrusion in wells. At one time, our porous soils were a natural flood control."*

DAVID FRIEDMAN, director of  
Ocean County's Soil Conservation Service

## NEW JERSEY IS A LEADER IN LAND CONSERVATION

New Jersey enjoys a long history of land conservation to protect watersheds and meet other public goals. The state passed its first open-space bond act in 1961, and has passed nine additional bonds in the years since. The most recent of these—approved by voters in November 1998—is expected to generate \$1 billion to protect one million acres, half of the state's remaining open land. These funds are distributed through New Jersey's Green Acres land-protection program.

In 1989, the state legislature approved a mechanism whereby communities could create Open Space Trust Funds supported

by local property taxes, and in 1996 the legislature stipulated that these communities should receive preference for state Green Acres awards through a Green Acres Planning Incentive Program. The program provides grants to support up to 25 percent of approved land-conservation and outdoor-recreation projects and offers 2 percent financing for the balance. To date, 16 of 21 New Jersey counties and 91 of 566 municipalities have approved local funding for open space acquisition.

New Jersey has also been in the forefront of efforts to protect water. The

Pinelands National Reserve—which stretches 1.1 million acres across seven southern New Jersey counties—was created by a state-federal partnership in 1979. One purpose of the reserve is to protect the region's 17 trillion-gallon aquifer. Land and water are protected in part through public ownership, and in part through regulation of development. During the 1990s, the state developed a water supply master plan, "Water for the 21st Century," which calls for a comprehensive Watershed Management Plan for each of the state's 20 watershed management areas.

- importance to water quality;
- importance as wildlife habitat;
- level of disturbance, with preference to undisturbed properties;
- adjacency, or proximity to already protected properties; and
- size, with a preference for properties large enough to offer significant benefit.

Working with willing landowners and federal, state, county, and municipal authorities, to date TPL has protected 31 properties totaling over 5,500 acres within the watershed.

Some of the lands recommended for acquisition in the Century Plan have been protected with federal funds, and are now included in the Edwin B. Forsythe National Wildlife Refuge—established by the 1986 Emergency Wetlands Act. Designed to provide habitat for migratory fowl, this refuge now includes about 43,000 acres. Two sources of federal funds are used for acquisition of wetlands and adjoining uplands within its 52,000-acre authorized boundary: the Land and Water Conservation Fund and the Migratory Bird Conservation Fund. Another important source of funding was the settlement of a water-pollution lawsuit with a local pharmaceutical company, which generated \$1.2 million for land protection within the watershed.

"We buy land as it becomes available within our authorized boundary," says refuge director Steve Atzert. "And, while we have condemnation rights, we much prefer to work with willing sellers to avoid bad will in the community." With TPL's assistance, the refuge recently acquired a 350-acre site from AT&T for over \$1 million, and is negotiating with the state of New Jersey to buy a 500-acre game farm.

To date, using money from all sources, approximately 120,000 acres have been acquired within the Barnegat Bay watershed for state and federal protection.

## GENERATING LOCAL FUNDS

More recently, Ocean County has begun its own land-acquisition program. Because the county has not had a dedicated source of land-protection funding, it has not been eligible for grants from New Jersey's \$1.5-billion Green Acres program, first approved by New Jersey voters in 1961. Green Acres grants go to counties and municipalities that are able to match funds from a local Open Space Trust Fund. The creation of such funds is specifically authorized by the state legislature.

As part of its continuing effort to protect land in the Barnegat Bay watershed, TPL recommended that Ocean County create an Open Space Trust Fund—to acquire farmlands and natural open space and to make itself eligible for Green Acres grants. To overcome the reluctance of county officials to impose a new tax for land conservation, TPL engaged a local polling firm, which found that voters favored the concept—even those who had been expected to oppose any new property tax. However, the poll also showed that support dropped off for a tax much greater than one cent per \$100 property tax valuation.

At the same time, TPL helped form a citizens' advisory committee made up of leaders from diverse constituencies. The committee established the Ocean County Partnership for Natural Lands, which conducted a public education program in support of the Open Space Trust Fund. TPL and the committee worked with the county freeholders—New Jersey's county-level elected officials—to develop a funding measure for the November 1997 ballot. As a result of this work, 61 percent of Ocean County voters approved a Natural Lands Trust. Financed by a new property tax of 1.2 cents per \$100 of valuation, the measure is expected to raise nearly \$4 million annually to protect the region's watershed and agricultural lands.

According to Dave McKeon, Ocean County's assistant director of planning, "the new tax received broad support in large part because of TPL's Century Plan." He adds, "there was no vocal opposition, and the measure even received wide support from chambers of commerce across the county." The amount of the new tax was carefully set based on the results of public opinion surveys. "We're a rapidly growing county," McKeon observes, "but people realized we were shooting ourselves in the foot. The development was detracting from the qualities that drew people to live here in the first place."

The county and TPL are working to get the trust fund underway. The state was a partner in its first two acquisitions in late 1998, and the pace is picking up in 1999, with several new proposals to put through the county's selection matrix. The matrix stresses water supply—with an emphasis on the protection of wellhead and recharge zones—as well as the preservation of aesthetic values and the county's rural nature. Only natural lands, or easements on natural lands, will be purchased, and public access will be guaranteed. No development will be allowed on the purchased properties.

"Ocean County voters and their elected officials understand very well the need to preserve our lands, our ocean beaches, and our water supply," says former Ocean County freeholder John Bartlett. "The Natural Lands Trust Fund allows the county to take a leadership role in deciding how to do this,

*To overcome the reluctance of county officials to impose a new tax for land conservation, TPL engaged a local polling firm, which found that voters favored the concept—even those who had been expected to oppose any new property tax.*

Barnegat Bay residents have been successful in attracting and leveraging land conservation funds from federal, state, and local sources.

#### FUNDING FOR BARNEGAT BAY LAND ACQUISITION

Source	Program	Amount
Federal (USFWS)	Land and Water Conservation Fund	Ranges from \$0–\$4 million/yr.
	Migratory Bird Conservation Fund	Approximately \$200–\$400k/yr.
State-DEP	Green Acres Program	\$98 million annually
Ocean County	Open Space Trust Fund	\$3.8 million/yr.
Private	Ciba-Geigy Acquisition Fund	\$1,975,000
	Ciba-Geigy Grant Fund	\$525,000
	Individual Donors	\$60,000/yr. average
	Foundations	\$500,000/yr. average

working with private groups like TPL, and state and federal governments. For the public's support to continue, the fund's purchases must have a credible scientific basis and must represent a broad consensus of county interests."

#### DEFINING LANDS FOR ACQUISITION

The land-acquisition program in the Barnegat Bay watershed has been guided by an abundance of scientific studies that have helped prioritize parcels for acquisition. These include studies commissioned by TPL as well as studies by the U.S. Geological Survey, the New Jersey Department of Environmental Protection, the Pinelands Commission, and the National Estuary Program.

One early effort was launched by the Pinelands Commission, which in the mid-1990s obtained an EPA Wetlands Program Development Grant to develop a new tool for assessing the impact of development on wetlands within the watershed. Developed by Robert Zampella of the Pinelands Commission and Richard Lathrop of Rutgers University, the tool used a cumulative approach to assess the ecological integrity of wetland systems and the potential effects on them of future land use.

Some scientific data has come from volunteers who monitor ecological conditions in the bay and provide elected officials and resource managers with updates on the health of the bay. Volunteer monitoring programs include the Barnegat Bay Watch Monitoring Program (established under the state's Watershed Management Plan) and the Alliance for a Living Ocean. This data is useful to scientists investigating nonpoint-source pollution, nutrient enrichment and eutrophication, and the development and distribution of algal blooms within the bay. It is also used to help identify critical wildlife habitat. In addition to providing scientific data, volunteer programs heighten public awareness and understanding of the importance of Barnegat Bay, and the need for proper management.

#### THE IMPORTANCE OF THE NATIONAL ESTUARY PROGRAM

EPA's National Estuary Program (NEP) has provided important coordination for the diverse protection activities within the Barnegat Bay watershed. NEP plays the role of convener and facilitator, with NEP committees including all major players: politicians, appointed officials, scientists, environmentalists, and members of public interest groups. Together, they develop and implement the Comprehensive Conservation and Management Plan (CCMP), the goal of which is to restore and protect the bay.

"NEP brings people together in a very important way," says Bob Scro, director of the Barnegat Bay NEP. "It brings the issues to the table, and they are dealt with effectively." Because NEP is a national program, a NEP designation has helped validate the severity of the bay's problems and has enhanced the credibility of proposed solutions. "Another benefit," Scro adds, "is access to NEP's national network, which provides insight and guidance for problem-solving."

According to Bob Dieterich, coordinator of the Barnegat Bay study for EPA Region 2, "the NEP parallels and incorporates the land acquisition approach of TPL and other groups with three criteria—habitat loss, water quality and supply, and competing uses." Dieterich adds, "there is a strong interest in maintaining a clean water supply and a strong commercial fishing industry."

NEP's Science and Technology Advisory Committee has also gathered important data on the bay—including data from volunteer water-quality monitors—and has interpreted it through a GIS mechanism. NEP's CCMP will be in draft form in 1999, according to Scro. "Once complete, it will be a consensus document that guides water resource decisions and policy related to the bay for years to come."

Abandoned subdivisions reflect efforts to protect water quality and natural lands around Barnegat Bay.

*"The National Estuary Program brings people together in a very important way. It brings the issues to the table, and they are dealt with effectively."*

BOB SCRO, director of the Barnegat Bay NEP



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Efforts to protect watershed land at Mountain Island Lake go back to the 1970s. This 2,700-acre park protects land near the water intake for the city of Charlotte.

## Mountain Island Lake *Safeguarding a Pristine Reservoir*

The Catawba River rises in the rugged mountain country that provided the backdrop for the Civil War novel *Cold Mountain* and follows a course east and south through North Carolina. More than 1.5 million people depend on the river for drinking water, recreation, electrical power, and wastewater disposal. In North Carolina, Duke Power Company has created eleven dams and reservoirs along the Catawba.

Mountain Island Lake is the most downstream of these reservoirs: a meandering, wide area formed by the power dam at the river's southern end. More than a half-million people draw water from Mountain Island Lake, and by 2010 more than 700,000 are expected to do so. The Charlotte-Mecklenburg Utilities (CMU), which located its main intake on the lake in 1920, reports that water demand from its customers is currently growing at 5 to 7 percent per year.

Three counties border the lake. To the east is Mecklenburg County, home to the rapidly developing Charlotte metropolitan area; to the west, Gaston County—home to the smaller city of Gastonia—and rural Lincoln County. The lake and its environs also offer recreation and other public benefits to residents of these counties, and much of the lake's eastern side is managed by the Mecklenburg County Parks and Recreation Department as a natural and cultural preserve.

"There's tremendous diversity of wildlife—white-tailed deer, red-tailed hawks, rare and endangered flowers," says State Senator Fountain Odom, whose district encompasses the eastern side of the lake and who has been working to protect it for nearly 30 years. "The lake is the crown jewel of

the area," Odom says. "It is to us as Central Park is to Manhattan, only more so—it's not only our recreational oasis, but also the source of our drinking water."

### THE THREAT FROM DEVELOPMENT

Mountain Island Lake's water quality ranks in the state's highest category—unusual for its urban setting. The main reason for this purity is that the Catawba River's bright red sediment—derived from red Piedmont soils—settles out at Lake Norman, a much larger reservoir immediately upstream.

One illustration of the lake's purity—compared to that of the river—can be found in the experience of the city of Gastonia, which recently relocated its water intake from the river to the lake. Since then the city has saved \$250,000 annually in water-treatment costs. To help secure this long-term saving, Gastonia recently authorized \$9.5 million in revenue bonds to protect a key tract just 1,000 feet upstream of its water intake.

The greatest threat to the lake's water quality, however, comes from rising population and increasing development, which is spreading out from Charlotte through Mecklenburg County and, to a lesser extent, through Gaston and Lincoln counties. While some land has been protected on the lakeshore by conservation efforts dating from the '70s, other land remains unprotected. Development also poses a danger along 125 miles of streams that feed the lake. Development on these streams could dump tons of sediment, lawn chemicals, bacteria, and other nonpoint-source pollutants into the water supply. For example, McDowell Creek—one of the lake's main tributaries—already carries sewage nutrients from a Mecklenburg County treatment plant, along with large quantities of silt from subdivision development upstream.

But as development forces land values to rise, major landowners feel pressure to sell watershed land for housing, shopping centers, and golf courses. One landowner feeling such pressure is Crescent Resources, a development subsidiary of Duke Energy—which also owns Duke Power, and holds substantial acreage in the watershed.

Efforts to protect Mountain Island Lake began in the 1970s, when Mecklenburg County passed a \$20-million bond package to create parks and greenways, mostly on the lake's east side. In that same decade, CMU also launched a small land-acquisition program in the watershed. Each year \$50,000 from the utility's capital improvement budget goes to protection of land in the watershed, particularly on the eastern lakeshore where the CMU intake is located. This land—managed by the Mecklenburg County Parks and Recreation Department—now totals 2,700 acres. Regulations permit only low-impact recreation, such as canoeing, fishing, and hiking.

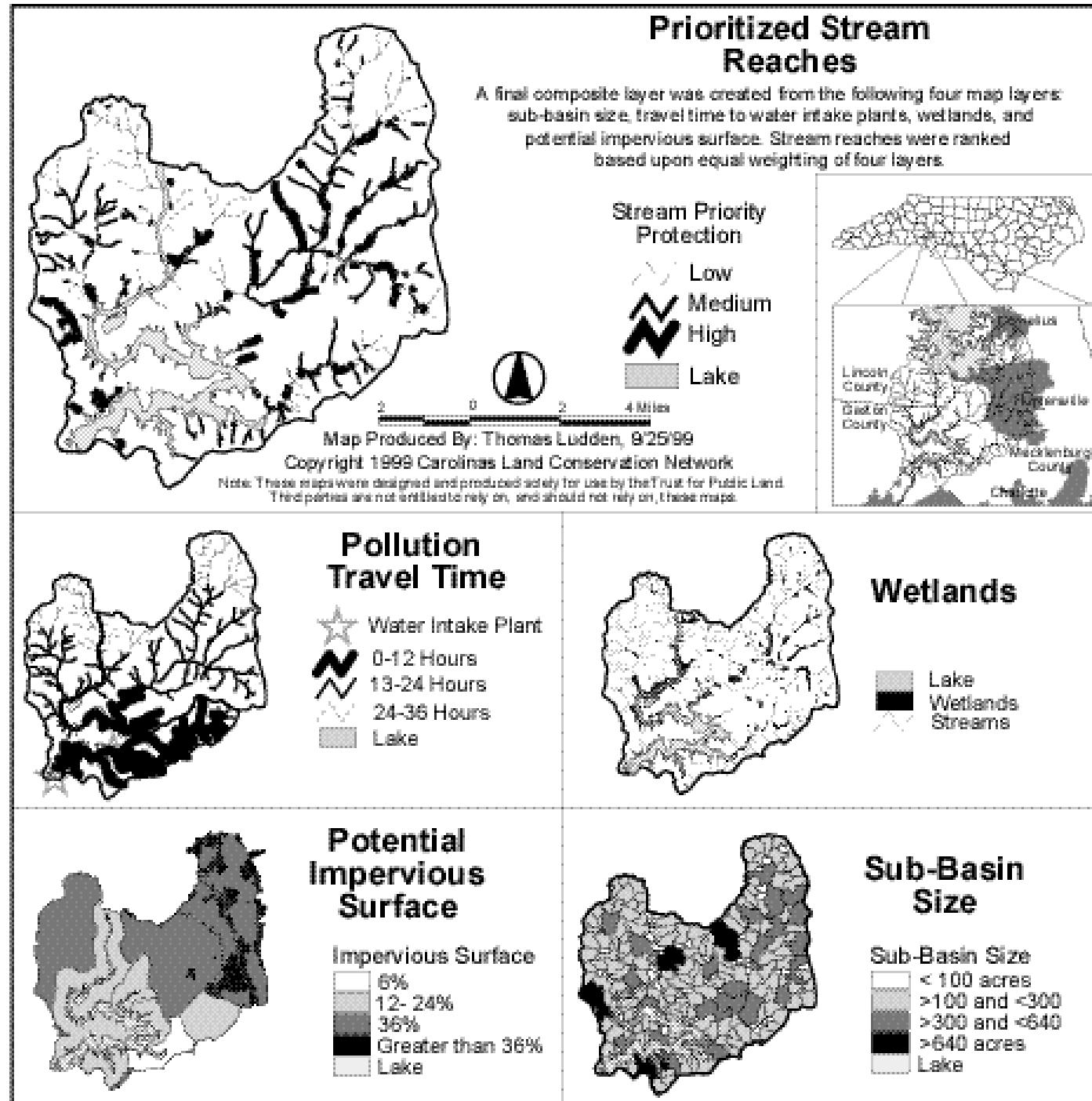
### A UNIQUE STATE FUNDING SOURCE

But while Mecklenburg County's expanding tax base has enabled a small land-acquisition program, Gaston and Lincoln counties have remained more rural, with fewer resources to buy land on the western side of the lake. One potential source of funds for these communities was created in 1996, when North Car-

*"There's tremendous diversity of wildlife—white-tailed deer, red-tailed hawks, rare and endangered flowers.*

*The lake is the crown jewel of the area. It is to us as Central Park is to Manhattan, only more so—it's not only our recreational oasis, but also the source of our drinking water."*

FOUNTAIN ODOM, state Senator



The Carolinas Land Conservation Network and the Centralina Council of Governments developed a model to identify priority lands for protection at Mountain Island Lake.

olina's General Assembly created the Clean Water Management Trust Fund, the nation's first state funding program dedicated exclusively to water-quality protection.

The fund—created in response to several high-profile water-pollution events in North Carolina—guarantees a minimum of \$30 million per year of general revenues to state agencies, local governments, and nonprofits for water-protection projects. Grants are made for the acquisition of land and easements for riparian buffers to protect urban drinking-water supplies, as well as for the repair or replacement of failing wastewater treatment and septic-tank systems. As of early 1999, grants from the fund totaled \$92.5 million—about 40 percent of this for land acquisition alone.

In 1998, Gaston and Lincoln counties, working with the Centralina Council of Governments and TPL, obtained full funding from the Clean Water Management Trust Fund to buy a key 1,231-acre Mountain Island Lake property from Crescent Resources for \$6.15 million. The acquisition of six miles of frontage on the lake's less-protected western shore increased public ownership of the shoreline to 53 percent.

#### COMMUNITY SUPPORT

Important support for this land acquisition came from the Initiative for Mountain Island Lake, a grassroots effort spearheaded by the Catawba Lands Conservancy, the Carolinas Land Conservation Network, the Community Foundation of Gaston County, the Foundation for the Carolinas, and the Trust for Public Land.

The initiative—which includes major public education and fundraising components—is focused on protecting critical watershed parcels through the acquisition of land or easements—either through donation, or by purchase from willing sellers. Organizers hope to pioneer a new model for cooperative management among the watershed's several jurisdictions. The ultimate goal, according to Senator Fountain Odom, is to more than double current public holdings—to 10,000 acres—and to institute strong land-use regulation to guide development on key private parcels.

The initiative's leadership council includes the former publisher of the Charlotte Observer, the chairmen of the Gaston and Lincoln county commissions, the director of the Charlotte/Mecklenburg County Utility District, the director of the Foundation for the Carolinas, and the director of the Catawba Lands Conservancy.

#### DEFINING LANDS FOR ACQUISITION

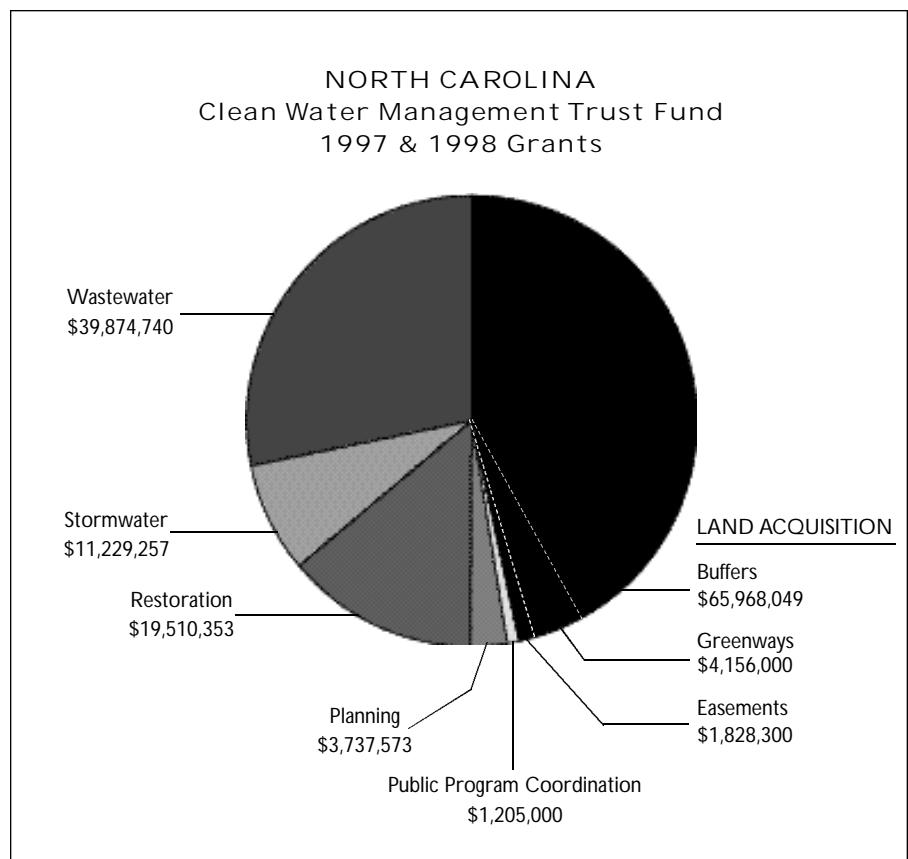
In 1998, the Carolinas Land Conservation Network (CLCN) and the Centralina Council of Governments developed a model to identify priority lands for protection. Developed with TPL's support, the computerized Geographical Information System (GIS) organizes detailed data from the entire watershed—including information on land ownership and development regulations. Developed with guidance from an 18-member scientific steering committee, the GIS prioritized stream segments within the watershed based



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In addition to protecting water quality, conserved land at Mountain Island Lake supports public recreation for the region's growing population.

*Developed with guidance from an 18-member scientific steering committee, the GIS prioritized stream segments within the watershed based on basin size, detention time, presence of adjoining wetlands, and maximum potential amount of impervious cover based on local zoning.*



North Carolina's Clean Water Management Trust fund is the nation's first state funding program dedicated exclusively to water quality protection. A substantial portion of funding has gone to watershed acquisition.

tion program. Under the state's Water Supply Watershed Protection Act, all local governments having land-use jurisdiction within a water-supply watershed must adopt a management plan for that watershed. "While the state can levy fines or other sanctions on localities that do not implement its 1992 watershed regulation, most have [implemented them] voluntarily," says Steve Zoufally, director of the North Carolina Department of Environment and Natural Resource's Water Supply/Watershed Protection Group. "Localities must adopt the state rules as a minimum," Zoufally notes, "but may develop more stringent ones of their own."

The situation in the town of Huntersville, in Mecklenburg County north of Charlotte, illustrates this program. The town—which has extraterritorial jurisdiction over a significant portion of the Mountain Island Lake watershed—developed zoning and subdivision ordinances that rank lands according to their sensitivity relative to watershed protection. "Development pressure is high in this area," confirms Ann Hammond, Huntersville's chief planner, "particularly in areas closer to the river and lake, and land-use regulations are not popular."

For this reason, Huntersville is seeking authorization from the legislature for a transfer-of-development-rights program. While this program is intended primarily to preserve the rural heritage lands, it would also produce significant water-quality benefits and would complement land-acquisition programs being carried out by CMU and other entities within the watershed.

on basin size, detention time, presence of adjoining wetlands, and maximum potential amount of impervious cover based on local zoning. Three maps were generated, based on differing degrees of future development. The maps suggested which parcels should be protected to guarantee maximum water quality in various stream segments.

According to Owen Furuseth, professor of geology at the University of North Carolina and director of the modeling project for CLCN, "With this information in hand, local governments can steer development away from areas with the greater water-quality risk, and conservation groups can focus on the most environmentally sensitive lands for conservation."

#### CONTINUING EFFORTS

Local efforts to protect Mountain Island Lake take place in the context of North Carolina's water-supply protec-



Rich in habitat for both marine and shore species, Indian River Lagoon is threatened by man-made changes to the region's hydrology and by pollution from development.

## Indian River Lagoon Restoring a Damaged Estuary

The Indian River Lagoon is actually a system of lagoons stretching for more than 150 miles down the east coast of Florida. The northern half of the system, roughly centered on Cape Canaveral, includes Mosquito Lagoon and the misnamed Banana and Indian Rivers—not rivers at all, but estuaries set off from the sea behind barrier islands. In its southern half, the system narrows to a slender continuation of the Indian River, which forms a portion of the intracoastal waterway to the point where the barrier islands disappear near Palm Beach.

Indian River Lagoon traverses six counties—Volusia, Brevard, Indian River, St. Lucie, Martin, and Palm Beach—and two of the state's five water-management districts. The total watershed includes 356 square miles of lagoon surface and 1,901 square miles of surrounding basin. The terrain comprises coastal ridges, barrier islands, natural and artificial inlets, impounded marshes, drainage canals, and seagrass habitat. Home to more than 4,300 species of plants and animals, the watershed also contains 20 percent of the remaining mangrove forest on the U.S. east coast.

The lagoon and its connecting uplands, marshes, and wetlands forms



In addition to offering irreplaceable wildlife habitat, Indian River Lagoon provides close-to-home recreation for 12 cities along its 150-mile length.

***Today most of the pollution within the watershed comes from upland development.***

***Nonpoint sources now make up more than 60 percent of pollutants found in the Indian River ecosystem.***

a functional ecological system that no longer functions in a completely natural way. Humans have drained wetlands to establish citrus groves and impounded saltwater marshes to control mosquitoes. In the first half of the 20th century, six districts ditched and drained the coastal landscape for flood control or to prepare the land for farming. In some places humans have also altered the western boundary of the watershed: surface waters that once flowed into other basins, such as the St. Johns River and Lake Okeechobee, are now diverted into the lagoon. Today, up to 60 percent of the Indian River Lagoon drainage basin consists of artificially extended watershed—which now contains two and a half times as much land as it did in 1916.

#### THE THREAT FROM DEVELOPMENT

Population in the vicinity of Indian River Lagoon increased by more than 124 percent between 1970 and 1990, and is expected to reach nearly one million inhabitants by the year 2010. The region's twelve major urban centers include two of the nation's fastest-growing cities—Palm Bay and Port St. Lucie—and development pressure is particularly strong for single family homes along waterways. The Kennedy Space Center, at Cape Canaveral in Brevard County, has attracted much of the area's development.

In 1990, Florida passed the Indian River Protection Act, which required that point-source pollution from municipal wastewater plants be eliminated by 1996. Today most of the pollution within the watershed comes from upland development—pollution exacerbated by the manipulated hydrology of the basin. Freshwater flow to the lagoon has been greatly increased by drainage projects, altering the salinity of the lagoon. Increased freshwater flows also have increased the flow of nutrients, metals, pesticides, suspended solids, and organic stains from developed areas in the basin. Nonpoint sources—stormwater and tributary discharges—now make up more than 60 percent of pollutants found in the Indian River ecosystem.

Degradation of the lagoon became apparent by the mid-1970s. In 1981, a symposium on the future of the ecosystem led to formation of the Marine Resources Council of East Central Florida, a coalition of residents working to set priorities for the estuary's protection. Council workshops between 1985 and 1990 helped raise public awareness of the lagoon's problems and generated recommendations for the government action. In response, Governor Bob Graham formed the Indian River Lagoon Field Committee, whose findings prompted passage of the state's Surface Waters Improvement and Management (SWIM) Act in 1987.

The goal of the SWIM program—authorized under the Act—is to upgrade water quality, improve or maintain existing natural conditions, and protect threatened and endangered species—not only in Indian River Lagoon but in five other aquatic ecosystems across the state. The program develops and directs a recovery plan for the ecosystems, including nonpoint pollution

## Indian River Lagoon Blueway Project





Efforts to protect Indian River Lagoon are focused on both marine and terrestrial ecosystems.

prevention and public education. In 1991, Indian River Lagoon was accepted into EPA's National Estuary Program; planning and management of the area is now coordinated jointly by SWIM and NEP.

#### A HISTORY OF LAND CONSERVATION

In the early 1960s the federal government began buying land in the northern section of Indian River Lagoon in

an effort to create a buffer around the Kennedy Space Center at Cape Canaveral. Eventually, more than 140,000 surrounding acres will be protected—an important nucleus of natural lands that includes the Merritt Island National Wildlife Refuge, one of Florida's top tourist destinations.

Acquisition of land by the state for conservation purposes goes back to the 1970s, with the establishment of a series of programs that extend to this day. The Conservation and Recreation Lands program (CARL), Save Our Rivers, and funding programs such as the Florida Preservation 2000 Act of 1990 (P-2000)—and its extension, the Florida Forever program, approved in May 1999—have all included the protection of water among their land-acquisition goals.

Originally formed as flood-control agencies, Florida's water management districts now play an important role in acquiring land to meet water-quality standards. The St. Johns River Water Management District, for example, has acquired over 100,000 acres of the Indian River Lagoon watershed with state CARL funds, including a 30,000-acre buffer along the St. Sebastian River, originally designed as a manatee protection program.

In addition, all six counties in the watershed have adopted locally funded land-acquisition programs of between \$20 million and \$100 million since the mid-1980s.

#### ONE LOCAL FUNDING EFFORT

One ambitious local funding program is that of Brevard County, home to the Kennedy Space Center and barrier island resort towns such as Cocoa Beach. In 1990, a citizens group, Preservation Brevard, spearheaded the local funding effort after the group became alarmed at the disappearance of the county's biological diversity. In September 1990, voters authorized a \$55-million limited-tax bond for the county's Environmentally Endangered Lands (EEL) program.

"Florida is wet," observes Nancy Higgs, a Brevard County commissioner. "People here are tied to the waterways—they love fishing, boating, and just sitting on the beach. They may not focus much on an individual endan-

gered species, but they draw the line at development that's going to harm their use of the waterways." This public awareness has enabled Florida to weather the anti-environmental backlash of the mid-1990s, Higgs believes. "Even the most extreme property rights advocates now recognize that protecting our waterways and the lands that affect them is a fundamental concern for our Florida public."

While some earlier land-acquisition efforts tended to focus on either wetlands or uplands, EEL's effort has tried to link marine and terrestrial ecosystems, according to Duane DeFreese, the program's former coordinator. "This is one of the first local land-acquisition programs to look at public land holdings as an integrated package," DeFreese says, "one that forms a conservation network, as opposed to a collection of individual parcels." The program—about 75 percent complete—has protected 15,000 acres, and while the tax has not produced as much money as was projected, those funds have been leveraged with support from the state's P-2000 program.

One key to the EEL program's success was the rigor with which its scientific experts chose the lands to be acquired, DeFreese believes. The group had sought a quantitative method to select target parcels, but was unable to do this because of the need to include such unquantifiable considerations as politics, local economic needs, and existing landownership. In the end, selection was based on qualitative criteria including the presence of endangered species, connection to other parcels, importance to native communities, and the parcel's role in the larger ecosystem. Many critical wetlands and mangrove marshes have been restored as a result of the program—including former mosquito impoundments that have become once again the nursery and refuge for important fish species.

#### A BLUEWAY FOR INDIAN RIVER LAGOON

In the early 1990s, Indian River Lagoon's six counties and two water management districts with the cooperation of the National Estuary Program (NEP), jointly developed a sweeping proposal for state CARL funding to create an Indian River Lagoon Blueway. Through acquisition of almost 9,000 acres of wetlands and uplands—626 parcels in 45 targeted areas—Blueway lands would connect with other public lands to form a natural buffer corridor along the lagoon. Completed in two phases, the acquisitions would cost a total of \$54.5 million.

"NEP provided an umbrella for the counties and the districts to wrap up all their efforts and pool their resources so that we can acquire the most desirable lands remaining along the lagoon," says Blueway project manager Ken Berk. Berk works with the land acquisition division of the St. Johns River Water Management District.

The NEP's Comprehensive Conservation and Management Plan for Indian River Lagoon notes that such a program "will be a critical step toward protection, preservation, and restoration of the integrity, produc-

#### INDIAN RIVER LAGOON BLUEWAY PROJECT Local Funding and Summary of Parcels Proposed for Acquisition

County	Amount	Acres	Tax Assessed Value
Volusia	\$20 Million	1,743.87	\$11,627,487
Brevard	\$55 Million	4,256.67	\$18,841,090
Indian River	\$26 Million	1,603.41	\$12,220,000
St.Lucie	\$20 Million	793.19	\$6,891,450
Martin	\$20 Million	459.90	\$9,775,010

To protect the economic value and delicate ecology of Indian River Lagoon, each of its five bordering counties has dedicated funds to land acquisition.

## FLORIDA IS STRONG IN LAND ACQUISITION

Florida Preservation 2000 Act of 1990 will raise \$3 billion by the end of the century to buy natural lands throughout the state. Funding was achieved through the sale of revenue bonds backed by a documentary stamp tax on real-estate transfers. Since 1990, about one million natural area acres have been preserved.

Florida Forever is a ten year, \$3-billion program passed in May of 1999 to succeed P-2000. It helps fund over half a dozen state land-protection programs, including:

- Conservation and Recreation Lands (CARL): To conserve and protect unique natural areas, endangered species, wetlands, and recreational lands, CARL receives one third of the annual Florida Forever funds. CARL also benefits from a trust fund that receives about \$40- to \$45-million each year from earmarked taxes.
- Save Our Rivers: Created in 1981 to buy land for conservation and water quality purposes, the state's five water-management districts handle acquisitions under this program, in cooperation with the Department of Environmental Protection. Expected to have acquired over 1.5 million acres by the year 2000.
- Local Level Programs: Many counties, including the six on Indian River Lagoon, acquire land for conservation, as do Florida's five water management districts. The county programs rely on locally based finance measures, usually through voter-approved property taxes.

tivity, and biodiversity of the Indian River Lagoon's resources for this and future generations."

Developing the Blueway proposal was a complicated effort that grew out of the Brevard County EEL program. The six counties then formed the Indian River Lagoon Land Acquisition Working Group, which spent several years inventorying private parcels along the lagoon's waterways. This list—cataloging thousands of properties worth a total of \$300 million—was prioritized by a seven-member committee of scientists and local experts, using a qualitative ranking system similar to that used by the EEL program. Criteria included size of parcel, natural resource value, quality of the land, presence of endangered species, ease of connection to public land, and manageability. Each parcel was evaluated using a three-tier analysis based on its value to individual endangered species, the local biological community, and the larger ecosystem.

The St. Johns River Water Management District—with funding from NEP and the district's SWIM program—is currently developing a Pollutant Load Reduction Model as a more quantitative tool for land-acquisition decisions in the Indian River Lagoon watershed. "It will take five years to establish, calibrate, and verify the model, which is based on data collected by the district, the counties, and the U.S. Geological Survey," says Joel Steward, technical program manager for the district's Division of Environmental Sciences. Data collection is expected to be completed by the end of 1999 and by 2002 the data will validate the model. "The model will provide a powerful tool for land-acquisition programs such as Blueway by allowing a more specific targeting of stream segments and land parcels according to their contribution to pollutant load," Steward says.

Former EEL coordinator Duane DeFreese believes such models are becoming important tools to show the relative costs and benefits of land acquisition, and he sees the failure to develop basic modeling tools as a weakness in land-acquisition programs nationwide. "We have to be able to show we didn't just pull parcel selections out of our pocket," DeFreese points out. "We must show that our decisions make basic economic sense. We put huge dollars into buying land, and huge dollars into managing it once bought, but we put very little into the kind of fundamental economic research needed to show the value of these programs."

"CARL funding for the Blueway acquisitions is by no means secure," DeFreese notes. The Blueway concept of linking a large number of parcels to protect a single natural system is a relatively new and complicated one. Blueway proponents have had to push for recognition of the intangible ecological relationships that are the basis of their proposal. In addition, Florida's P-2000 program is being replaced by the new Florida Forever funding program as the source of CARL funds, and the counties must push to maintain the project's ranking through the transition. Fortunately, the Blueway project enjoys strong public and political support and has been able to make a strong economic case for land protection. A recent NEP study estimates Indian River Lagoon's annual value to local economies at \$700 million.

In the meantime, the Blueway partners are pushing ahead with acquisitions while the land can still be acquired at reasonable cost. For exam-

## INDIAN RIVER LAGOON

Primary Problems	Impacts
Watershed Alteration	Increased freshwater loading Increased nutrient loading Increased sediment loading Increased toxicant loading Altered hydrologic balance Decreased water quality Chronic physiological stress to organisms
	Acute ecological impacts and associated physiological stress to organisms during isolated storm events
Habitat Modification and Destruction	Direct loss of critical emergent and submergent habitats of structural and functional importance Habitat fragmentation
	Functional isolation of marshes (i.e. mosquito impoundments)
	Decreased habitat heterogeneity
Sewage Discharge	Increased nutrient loading Increased toxicant loading Acute and chronic physiological stress to organisms
Bridge/Causeway Construction	Alteration of water circulation and flow Decreased water quality in isolated lagoon basins
	Isolation and fragmentation of habitats
	Potential genetic isolation
Human Population Growth	Increased shoreline development Over-use impacts Habitat destruction for coastal construction
Over-Exploitation	Population declines of commercially valuable species
Global Change	Climatic impacts on ecotonal characteristics Rise in sea level

DUANE E. DEFRESE, HUBBS-SEAWORLD RESEARCH INSTITUTE

Human activity has profoundly altered the Indian River Lagoon ecosystem. Cooperating partners are seeking to mitigate these changes through strategic land conservation.

ple, the St. Johns Water Management District has already bought more than 1,000 acres in Blueway parcels. "We have to act quickly when properties are available," DeFreese points out. "If we don't, we may lose our chance forever."

NEP director Martin Smithson agrees that time is of the essence. "We need to accelerate our land-acquisition programs today," he says. "Florida's population projections are startling. We have to accomplish our work over the next 10 to 15 years if we are going to outpace development and growth."

## Discussion and Conclusions

**S**ince the federal Clean Water Act of 1972, the nation has significantly limited industrial and municipal wastewater discharges. In recent years, non-point-source pollution has been recognized as the most important remaining source of U.S. water pollution, with clear links to agriculture and development—particularly sprawl development. EPA's 1998 Clean Water Action Plan calls polluted runoff the worst water-quality problem in the United States today.

One way to clean up water pollution from nonpoint sources is to build costly filtration and water-treatment plants. But for many communities, a better way is to protect water at its source. Source protection can be achieved through "best-management" practices for farmers and industries, or through regulation of development—such as limits on impervious cover, or restrictions on the size and type of developments in critical watersheds. However, a 1991 study by the American Water Works Research Foundation concluded that land ownership offers the most effective long-term protection.

The case studies show that land acquisition can be an effective tool for controlling nonpoint-source pollution while meeting other goals and that the case for land acquisition can be clarified and strengthened with specific data that shows how land-conservation programs reduce pollution loading.

The case studies reveal common features that spell success for watershed-acquisition programs

### MULTIPLE MOTIVATIONS FOR LAND ACQUISITION

In some instances land acquisition to protect water supplies is part of the larger effort to "grow smart." Smart Growth is a national movement that seeks to direct development in ways that preserve critical open space and natural resources. The Smart Growth program in Austin, Texas, for example, was given strong impetus by the desire to protect the city's watershed lands. At the federal level, this Smart Growth role for watershed protection is embodied in the Administration's "Better America Bonds" proposal, which cites water-quality protection as one use for the new funding. It is also recognized in EPA's proposal to create greater flexibility in the use of the Clean Water State Revolving Fund, which might make more federal funds available for land-acquisition projects.

In the case studies, decisions to move forward with a land-acquisition strategy were made on the basis of cost-effectiveness, long-term protection, and multiple benefits of land conservation. In Austin, for example, part of the motivation for acquiring land was to preserve the remnants of the Texas ranching culture; in Charlotte, maintaining the purity of Mountain Island Lake has reduced water treatment costs for the surrounding municipalities; for Barnegat Bay and Indian River Lagoon, an added benefit was the preservation of the fragile coastal ecology. In the case of Indian River Lagoon, planners tried to combine public recreational use on some tracts with strictly limited access on more ecologically sensitive tracts.

Beyond these case studies, in other parts of the country, land acquisition

is being used as an economical alternative to advanced water treatment as a way of meeting or maintaining EPA water-quality standards. For example, the EPA gave New York City the option of, among other actions, buying up large portions of its watershed instead of building a filtration system at a cost estimated as high as \$8 billion. Similarly, EPA offered the Massachusetts Metropolitan District Commission the option of acquiring 25 percent of its watershed land as an alternative to a \$200-million filtration plant.

### THE CASE FOR COST-EFFECTIVENESS

Determining cost-effectiveness of land acquisition can be a complex challenge. In some cases, the benefits are clear: New York City hopes to avoid building a huge \$8-billion filtration facility by buying its watershed land; Austin will avoid the cost of extending infrastructure to areas where it bans development; and Gastonia, North Carolina, claims annual water treatment savings of \$250,000 by using pristine Mountain Island Lake as a source.

Of course, the benefits of such purchases must be balanced with the cost of protecting the land, with the loss of property tax revenue to the community and, some might argue, with jobs lost due to lack of development. Still, treatment for nonpoint-source pollution becomes increasingly complex and expensive as development increases in a watershed. Control over the land through acquisition often offers the best opportunity to restore land and protect water quality. For this reason, water managers cited in this report are turning to land conservation when a funding program can be found to match their needs.

Other benefits of land acquisition, while tangible, are more difficult to quantify. In addition to protecting water quality, land conservation offers multiple benefits to the public, including recreation, flood control, and the preservation of wetland and forest habitats. Less tangible are the "quality of life" values fostered by the Smart Growth movement. In Austin, for example, one "plus" of land acquisition for voters—and for the high-tech industries that have been attracted to the area—was the opportunity to retain open space around the city and to preserve an element of the Texas ranching heritage. In Ocean County, New Jersey, voters who supported the creation of the Natural Lands Trust were partly motivated by a desire to preserve the rural character of their county.

Land acquisition also affords public agencies full access to, and control of, land for restoration and other site manipulation—an issue key to Indian River Lagoon managers in their effort to restore historic hydrologic patterns and remove exotic species.



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Town Lake, Austin, Texas. Of the several ways of protecting watershed land, acquisition offers the best opportunity to open the land for recreation.

**The case for land conservation can be best made when good data provides direction for targeting and monitoring land acquisition.**

Protection of Mountain Island Lake has received broad public support.



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And, finally, land conservation is a permanent solution to water quality problems, offering continued source protection through land management.

#### NEEDED: A BASIS FOR DECISION-MAKING

The case for land conservation can be best made when good data provides direction for targeting and monitoring land acquisition. The planners and policymakers in the four cases relied for the most part on simple models or matrices to make land-acquisition decisions. At Mountain Island Lake, for example, stream segments within the watershed were prioritized based on four factors: basin size, detention time, presence of adjoining wetlands, and maximum potential amount of impervious cover based on local zoning. Landownership data was also considered in planning acquisitions. Ocean County, New Jersey, has developed a land-acquisition matrix that stresses water supply issues, with an emphasis on wellhead and recharge zone protection, as well as preservation of rural values.

Water resource managers are also working to link land-acquisition decisions to more sophisticated databases such as those of EPA, USGS, and their own state water agencies. New Jersey, for example, is a leader in developing GIS for environmental protection—including its Watershed Management Program—and the state's Office of Planning is developing a GIS-based development-planning program. At the federal level, data being developed by USGS under its National Water Quality Assessment (NAWQA) program could lead to better targeting of land purchases by showing the link between nutrient and pesticide loads in the sub-basins of its study areas.

The NAWQA program, which stresses the benefits of "whole-watershed assessment," has been monitoring water quality since 1992 in more than 50 large river-basin and aquifer areas, which collectively cover more than half of the U.S., and account for drinking water sources for about 70 percent of the population. A primary objective is to describe relationships among natural factors—human activities, stream ecology, water quality, and to define the factors that most affect water quality. This linkage of water quality to environmental processes and land-use is of fundamental importance to water resource managers, planners, and policymakers. Preliminary NAWQA findings confirm that land-use practices are key to nonpoint-source pollutants, particularly nutrients and pesticides.

"We are finding water-quality patterns are repeating themselves over space and time," says Tim Miller, chief of the NAWQA program. "By placing basin findings in a larger regional or national context, it then becomes easier to see where, when, and why water-quality changes occur and to anticipate future conditions."

#### PLANNING TOOLS FOR LOCAL OFFICIALS

Many land-use decisions spring from local considerations about quality of life, including the value of clean water as it compares with the possible benefits of development. Municipal officials and others involved in making these decisions need a clear road map for understanding nonpoint-source

pollution and how it affects their communities. One effort to develop such a road map is the Nonpoint Education for Municipal Officials (NEMO) program, a joint venture of the University of Connecticut Cooperative Extension System, with the university's Department of Natural Resources Management and Engineering, and the Connecticut Sea Grant College.

At the heart of the NEMO approach is a natural resource/watershed inventory and an analysis of impervious cover that compares current levels with projected levels estimated from zoning-based "build-out" analysis. "We need to plan our open space areas, not just our developments," says Jim Gibbon, NEMO's land-acquisition specialist. "Such planning lets people see that not all public lands can be playgrounds—if, for example, they're critical to the watershed or an endangered species. It lets them see that avoiding impervious cover in certain areas is vital to their water supply."

Gibbon also notes that, while GIS and other modeling techniques can be valuable educational tools, they are not always essential. "You can do an adequate inventory with pencil and paper," he says.

#### PUBLIC EDUCATION AND OUTREACH

The land-acquisition programs in this report include a strong element of community-based planning, as well as public outreach and education. Without public understanding and support for the link between water quality protection and land conservation, development will prevail in the planning process. And even if public officials are committed to land acquisition, voters, who are often asked to fund acquisitions, must also be educated.

A local or national conservation group can be an effective vehicle for public education. In Austin, for example, Save Our Springs—a coalition of local environmental groups—lobbied the city for a strong nonpoint-source ordinance and went on to support two successful land-acquisition bond measures. In New Jersey, TPL's Century Plan focused public attention on Barnegat Bay's disappearing habitat. At Indian River Lagoon, Florida, workshops organized by the Marine Resources Council raised public awareness of ecosystem degradation and led to Florida's Surface Waters Improvement and Management (SWIM) Act and to a nomination of the watershed to EPA's National Estuary Program. And in North Carolina, the Mountain Island Lake Initiative is actively supporting efforts to protect the lake's pristine water quality.

#### LEVERAGING LOCAL FUNDING

In each of the four case studies, bonds or property tax surcharges were used to protect watershed lands. These local funds were often leveraged with state conservation funds through such programs as New Jersey's Green Acres program, Florida Forever (and its precursor, P-2000), and North Carolina's Clean Water Management Trust Fund.

State programs of this kind are on the rise—in part because of increasing public desire to protect water quality. In New Hampshire, for example, the governor has proposed a two-year, \$3-million Water Supply Land Conservation Grant program, administered by the Department of Environ-

#### DRINKING WATER STATE REVOLVING FUND

Set-aside for a planned land or easement acquisition

MARYLAND		
FY 1997		
\$450,045		
MAINE		
FY 1997	FY 1998	
\$475,000	\$656,750	
VIRGINIA		
FY 1997	FY 1998	FY 1999
\$573,696	\$1,300,000	\$675,000

Up to 10 percent of federal Drinking Water State Revolving Funds may be loaned to communities to purchase land or conservation easements.

*Without public understanding and support for the link between water quality protection and land conservation, development will prevail in the planning process.*

### LAND CONSERVATION FOR WATER QUALITY:

#### What's going on in other communities

- California senators introduced legislation providing a ten-year, \$300-million program to preserve land around Lake Tahoe. State and local sources would provide \$600 million in matching funds.
- The U.S. Department of Agriculture and the state of Maryland jointly developed a \$200-million incentive program for landowners to preserve and protect forested riparian buffer zones in the Chesapeake Bay watershed.
- Oklahoma and Arkansas counties are working together, with the help of TPL, to develop a program for acquiring riparian and other conservation easements in the Lake Eucha watershed. The city of Tulsa already purchased land surrounding its Eucha reservoir.
- New York City acquired more than 5,000 acres in its upstate watershed, with 7,000 more in contract, as part of its filtration-avoidance agreement with EPA.
- The Massachusetts Metropolitan District Commission, with authorization from EPA, is acquiring 25 percent of its watershed land as an alternative to building a \$200-million filtration plant.

mental Services, which will allow municipalities to acquire watershed land or easements. The proposal is based on a 1998 EPA-funded study by the Society for the Protection of New Hampshire Forests, which found very little ownership of critical watershed by local water systems. And in Connecticut, in 1998 the Legislature pledged \$166 million in funding over 5 years to protect watersheds.

The cases in this report clearly show the benefit of flexibility in land-acquisition funding. For example, because each of the six counties bordering Florida's Indian River Lagoon has established a local conservation fund, the Blueway program has been able to make purchases quickly, in response to market conditions, without waiting for state matching funds.

For the most part, federal funding in the cases has come only under special circumstances, as in buying land in the New Jersey Pinelands, and for federally funded nature preserves such as Forsythe National Wildlife Refuge in New Jersey and Merritt Island National Wildlife Refuge at Cape Canaveral, Florida. Federal grant and loan programs for clean water have traditionally emphasized infrastructure construction or land management education.

The 1996 amendments to the Safe Drinking Water Act allow states to use up to 10 percent of their Drinking Water State Revolving Funds grants to make loans for communities to purchase land or conservation easements to protect public drinking-water sources. Maine, Maryland and Virginia set aside funds for this purpose in 1997 and 1998.

EPA also has moved to make its \$28-billion Clean Water State Revolving Fund (CWSRF) available to provide loans for virtually any type of water-quality project, including projects to mitigate nonpoint-source pollution, or to protect wetlands, estuaries, and watersheds. The aim is to provide increased flexibility to meet the complex challenges of nonpoint-source pollution. For FY 2000, EPA has proposed even more flexibility by requesting that some CWSRF funds be available as grants, not just loans (see box).

#### WILLING SELLERS, BUT WITH A REGULATORY BACKUP

For a long time, regulation was the sole means available to water managers and communities seeking to ensure water quality by protecting watershed lands. Today, such regulatory programs are proving more effective where there is also the flexible backup of a land-acquisition program.

In the opinion of the local officials interviewed in the case studies, the most effective land-acquisition programs are willing-seller, market-value programs. In such programs, landowners have the alternative of selling land or easements if regulatory restrictions prove onerous. In Austin, a long fight by community activists led to a strong ordinance that regulated development, but addition of the acquisition component has given the program more flexibility—for both the landowners and local program managers.

### SETTING PRIORITIES FOR LAND ACQUISITION

Different water-quality programs consider different factors when prioritizing parcels for conservation acquisition. Here are a few of the factors considered in each case study:

#### Austin, Texas:

- Avoidance of nonpoint-source pollution, calculated for various development scenarios.
- Base flow and recharge flow protection.
- Contiguity of a parcel with other acquired parcels.
- Existing development patterns.
- Willingness of the landowner to sell (no condemnation).

- Importance to preserving historical resources or quality of life.

#### Barnegat Bay

- Avoidance of nonpoint-source pollution through buffer zones.
- Preservation of critical habitat and wetlands.
- Protection of wellhead and recharge zones.
- Preservation of the rural aesthetic.

#### Mountain Island Lake

- Protection of surface drinking-water sources.
- Protection of stream segments based on basin size, detention time, adjoining wetlands, potential for impervious cover under existing zoning regulations.

- Protection of sensitive habitat.
- Protection of historic and cultural resources.
- Importance of land for recreation.

#### Indian River Lagoon

- Avoidance of nonpoint-source pollution.
- Restoration of natural hydrology and upland/wetland linkages.
- Protection of threatened and endangered species based on biological inventories.
- Contiguity and linkage with other publicly-owned parcels.
- Importance for other management goals, such as removal of ditches or exotic species.

### EMERGING SUPPORT FOR LOCAL PROGRAM

EPA's National Estuary Program (NEP), with its sophisticated data collection and modeling tools, has proven to be an invaluable resource. The Comprehensive Conservation and Management Plan (CCMP) that results from the NEP process can clarify the role of land acquisition as a protection strategy—as it did in the case of the Indian River Lagoon and is expected to do for Barnegat Bay. The CCMP can also serve as a blueprint for acquisition decisions.

Just as importantly, NEP's broad-based overlapping committee structure—management, scientific, technical, and citizens' advisory committees—forges links among stakeholders to catalyze progress in land-use planning, watershed protection, public education, and land acquisition.

Other data is emerging from water quality programs in North Carolina, New Jersey, Connecticut, Massachusetts, and New Hampshire. These states also support demonstration projects and educate decision-makers on the role of land conservation in protecting water quality.

Nonprofit land conservation and watershed protection organizations are playing an important role in disseminating data developed for EPA-mandated state restoration plans. Such data can help land-use planners and water managers decide where to expend limited land-conservation funds as they help communities protect water-quality and establish a "greenprint" for rational development, and link land-use and water-protection goals.

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