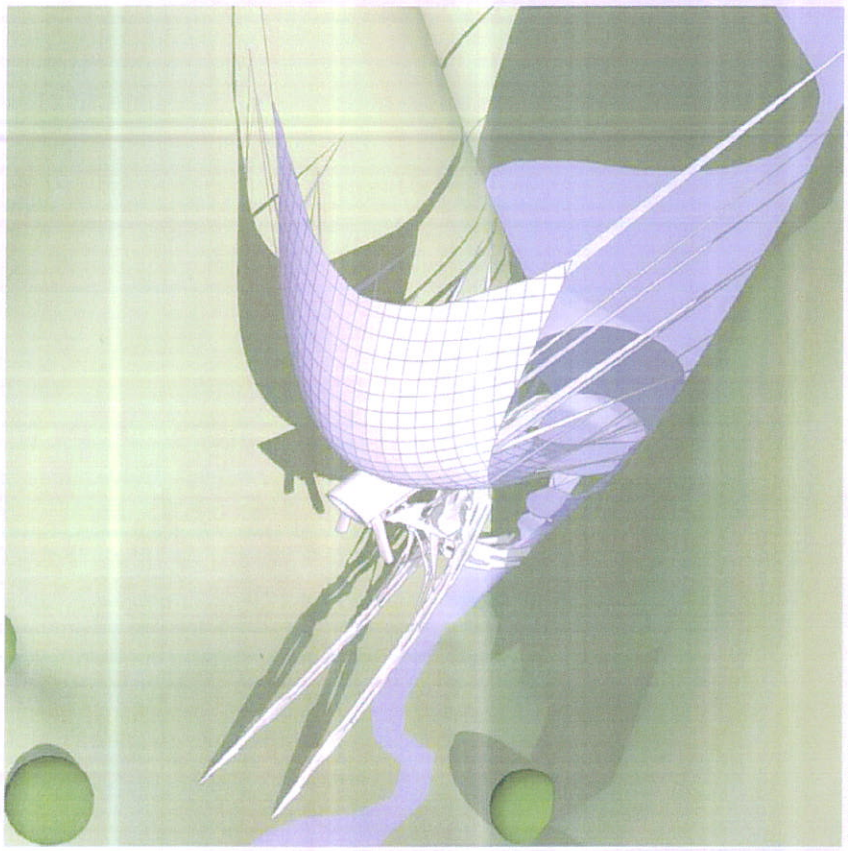
ENVIRONMENTAL ENGINEERING

Mitigation Bank Finances Major Stream Restoration in Northern Virginia

Demand for stream restoration typically far exceeds the funds available for such efforts. For this reason restoration projects are often piecemeal undertakings, focusing only on the most degraded stream sections rather than comprehensively addressing an entire waterway. An exception to this rule, however, can be found in Reston, a planned community of approximately 60,000 residents in Virginia's Fairfax County. Construction work recently began there in an effort to restore three of Reston's streams along their entire lengths—a total of 14 mi (23 km). Yet instead of draining the community's coffers, the project will cost Reston nothing, thanks to its innovative partnership with Virginia's first urban stream mitigation bank.

The Northern Virginia Stream Restoration Bank was formed in 2003 by Wetland Studies and Solutions, Inc. (WSSI)—a water and natural resources consulting firm headquartered in Gainesville, Virginia—and the Peterson Companies, a real estate developer based in Fairfax, Virginia, which provides financial and legal support. Approved by the U.S. Army Corps of Engineers and the Virginia Department of Environmental Quality (DEQ) in 2006, the bank has sold approximately 200,000 "stream condition units" (SCUs)—credits that WSSI uses to determine how much restoration work it will conduct—to public and private entities whose development projects have had a deleterious effect on streams in northern Virginia, explains Michael Rolband, P.E., M.ASCE, the president of WSSI.

By purchasing SCUs from the restoration bank, developers obviate the need to implement mitigation measures on streams harmed by their work. The number of SCUs that a developer must purchase depends on the quality of the affected stream and the extent to which the developer's project will affect it. Using an assessment technique approved by the Corps and the Virginia



A 'WIND DAM' capable of generating power via three wind turbines is being developed by Laurie Chetwood, the founder of London-based Chetwoods Architects, and the Helsinki-based engineering firm WSP Finland. The dam is essentially a "sail" that will be strategically tethered to either side of a narrow valley so as to receive the mass of air funneled into the valley. The air captured by the sail will then be directed through three 15 to 20 kW turbines. The funneling action of the valley and the position of the turbines—one directly behind the other—will optimize the ability of the dam to generate power even when there is little wind or when speeds are as low as 10 m/s. The three turbines will each have a blade diameter of approximately 10 m, and their combined output is expected to be 100 to 120 MWh per year, enough for 28 to 35 homes based on United Kingdom averages. The design team is currently overseeing finite-element modeling simulation, wind tunnel testing, and vibration analysis for a number of locations in Russia near Lake Ladoga, which is just northeast of St. Petersburg. The €3.5 million (U.S.$5.4 million) project is expected to be complete by 2010.

DEQ, WSSI assigns a score to a stream that will be affected by a development project. High-quality streams, that is, streams in a relatively pristine condition, receive high scores while streams in poor condition receive low scores. In turn, the score dictates how many SCUs a developer must purchase per lineal foot of stream to be affected. In short, developers whose projects affect high-scoring streams must purchase more SCUs than those affecting low-scoring streams.

For every SCU sold, WSSI carries out restoration work on streams within the region. The more intensive its restoration effort, the more SCUs the company can claim. "Based on what we're doing, we get a different number of credits per foot," Rolband says. For example, total reconstruction of a stream—similar to what the company is doing in Reston—provides the most SCUs per foot of restored stream, he says. By contrast, simply planting trees beside a stream would confer a "minimal number of SCUs per foot," Rolband says.

Approximately 65 percent of the SCUs sold thus far have been purchased by a handful of large public entities, Rolband says. For example, roughly half of the total SCUs sold so far went to Washington Dulles International Airport, which needed to offset harm to the environment caused by the construction of a new runway. The remaining 35 percent of the SCUs have been purchased mainly to provide mitigation for numerous private developments.

WSSI decided to restore streams in Reston, Rolband says, because most of the land through which the streams flow is owned by the Reston Association, the community's homeowners' association. This arrangement vastly simplifies efforts related to such issues as right-of-way. However, Reston also benefited from the existence of a watershed management plan developed for the Reston Association by GKY and Associates, Inc., of Chantilly, Virginia. "We had the plan in hand," says Larry Butler, the association's director of parks and recreation, when WSSI and the Reston Association began discussions regarding a partnership.

WSSI ultimately hopes to restore all 26 mi (42 km) of Reston's streams, Rolband says. Thus far, however, the firm has received regulatory approval to repair only 14 mi (23 km). The work will entail restoring the entire lengths of the three streams—Snakeden Branch, the Glade, and Colvin Run—named in the watershed management plan as the ones most in need of restoration.

Established in the 1960s, Reston was developed with a "fantastic vision" that included the use of significant natural buffer areas around the community's streams, Rolband says. Unfortunately for its streams, however, Reston was constructed with little regard for storm-water management, except for the construction of four large lakes. Traditional curb and gutter systems, designed to remove storm water from developed areas as quickly as possible, were connected to pipes or open concrete flumes that convey storm water directly to the nearest stream's floodplain, essentially bypassing the buffers along the waterways. "Since there was no detention or infiltration, there is a huge increase in the volume of water, plus a huge increase in velocity," Rolband says. "That water has way more energy now."

The resulting erosion has converted large stretches of the streambeds into vertical "canyons" devoid of vegetation, Rolband says. Compounding the problem, the heavily incised streambeds prevent all but the highest flows from overtopping the banks, which would dissipate some of their energy. As the large and fast flows from the streams erode the banks, sediment washes downstream, accumulating in Reston's lakes and degrading the water quality there. The Reston Association, which currently must dredge its lakes every few years, expects to see its dredging costs decrease "significantly" once the restoration projects are complete, Butler says.

Three years ago WSSI installed flow gauges and rain gauges along the three streams to accumulate data for use in designing the restoration projects. Because most of the data are associated with small storms, WSSI is using actual flow data to determine a stream's appropriate channel size during periods of low flow. To determine the appropriate channel sizes to accommodate an event that would fill the rivers to their banks, the firm is relying on published data on streams in the Piedmont Physiographic Province, data that WSSI adjusts to account for the levels of imperviousness in each stream's watershed.

The designs for each stream must contend with "a lot of constraints," Rolband says, including sewer lines, pedestrian bridges, and numerous trees. Before beginning design work, WSSI surveyed the streams and their accompanying features. Reston required that WSSI include in its surveys all trees with a diameter greater than 4 in. (102 mm) located within a certain distance from the

streams. Thus far the firm has included more than 30,000 trees in its surveys.

To reconnect the streams to their floodplains, the vertical stream banks will be graded to flatten their slopes. The graded material will then be mixed with rock, gravel, and sand to form "constructed riffles" in the stream. These riffles are designed to have enough shear strength to resist erosion, Rolband says. To minimize shear stress on the stream banks, such structures as cross-vanes and J-hook vanes made of rock or wood will be used to deflect water from the banks and direct it toward the center of the stream. The graded slopes and the structures facilitate the reestablishment of vegetation. Native shrubs will be planted along the stream edges, while trees will be planted higher up on the banks and in the floodplain. Biodegradable coir fabric will be placed along the banks to prevent erosion until vegetation takes hold.

To address problems resulting from the existing system for conveying runoff to the floodplains, WSSI is removing portions of the flumes in certain locations. In places where the structures will remain, Rolband says, a series of rock-lined step pools will be built to absorb the water's energy before the water enters the stream.

Construction work on the three uppermost reaches of Snakeden Branch began in February and is scheduled to be completed this month. The next eight reaches will be restored this summer, followed by the remaining six reaches in the fall. The design work on the restoration of the Glade is under way, and construction is slated to begin in early 2009; the design work on Colvin Run will begin this fall, with construction scheduled to start one year later.

All told, WSSI has budgeted $70 million to restore the three streams, a figure that includes a plan to monitor and maintain the streams for 10 years after construction. To cover any problems that might arise after the monitoring period, the Reston Association will receive 5 percent of the mitigation bank's sales revenue. What is more, the Friends of Reston—a nonprofit organization that works with the Reston Association—will receive approximately $800,000, says Charles Veatch, an officer of the group and the president of the Reston-based Charles A. Veatch Company, a real estate and development firm. Aside from the many benefits it is conferring on Reston, the Northern Virginia Stream Restoration Bank will improve water quality in downstream waterways, including the Potomac River and the Chesapeake Bay, Veatch notes. "It's an outstanding example of what can be done elsewhere in the country," he says.

—Jay Landers

ENVIRONMENTAL ENGINEERING

Settlement Offers Way Forward for Restoration of Montana's Clark Fork River

In 1908 extensive flooding in western Montana destroyed a number of impoundments that had been constructed to hold tailings from copper mines in Butte. Washed downstream by the floodwaters, massive amounts of tailings were deposited along the banks of the Clark Fork River for miles, precipitating an environmental calamity that persists to this day. One century later, however, prospects for improvement appear promising, thanks to a recently announced $187-million settlement that clears the way for major cleanup and restoration work along approximately 60 mi (97 km) of the Clark Fork.

Much of the contamination entering the river from the earlier mining operations upstream has ended up in the sediment that has accumulated behind the Milltown Dam, which is located in Milltown at the confluence of the Clark Fork and Blackfoot rivers. After it was discovered that a plume of arsenic originating from the sediment beneath the dam's reservoir was contaminating Milltown's groundwater, the U.S. Environmental Protection Agency (EPA) added the reservoir to its National Priority List of Superfund sites in 1983. In 1992 the EPA designated a 120 mi (193 km) long stretch of the Clark Fork River as a distinct operable unit within the Milltown Reservoir Superfund site. Known as the Clark Fork River Operable Unit, the designation applies to the section of the river between Warm Springs and the Milltown Reservoir.

The settlement, which was spelled out in a consent decree that was lodged with the U.S. District Court of Montana by the U.S. Department of Justice on February 7, applies only to the Clark Fork River Operable Unit. The decree, which concludes litigation that began in 1983, involves the State of Montana, the EPA, and the Atlantic Richfield Company (ARCO). A subsidiary of U.K.-based BP p.l.c., ARCO was designated the party responsible under Superfund law for cleaning up the Clark Fork River Operable Unit because in 1977 it merged with the Anaconda Mining Company, which conducted the upstream mining operations.

In addition to arsenic, contaminants of concern associated with the remnants of earlier mining and smelting processes include cadmium, copper, lead, and zinc. In places where significant quantities of tailings were deposited along the river's floodplain, so-called slickens areas persist. Devoid of vegetation, these areas continue to release contaminants from the tailings into the river. As the fine-grained tailings