Building Name: Great Seneca Creek Elementary School
Location: 13010 Dairymaid Drive, Germantown, Md.
Size: 82,511 ft²
Started: March 2005
Completed: September 2006
Use: Elementary school for 740 students
Cost: $18 million (includes 13.7 acre site)
Distinctions: LEED-NC Gold

Building Team

Owner: Montgomery County Public Schools
Project Manager: Joe Derosa, Montgomery County Public Schools
Architect: Grimm + Parker Architects
MEP Engineer: James Posey Associates, Inc.
Structural Engineer: Wolfram & Associates
Commissioner: Advanced Building Technologies
General Contractor: Hess Construction + Engineering Services
Landscape Architect: South Fork Studio Landscape Architecture
LEED Consultant: Sustainable Design Consulting, LLC
Before the county established high performance design mandates for all new schools, Great Seneca Creek Elementary School was the school system’s pilot project to test the benefits of a third-party certification for a new school. As a result, Great Seneca Creek became the first USGBC LEED® certified school in the 138,000-student Montgomery County Public Schools system and in Maryland. It earned a LEED for New Construction (NC) Gold rating. Earlier school construction projects featured high performance components but did not undergo third-party certification. Following the success of Great Seneca Creek, seven new Montgomery schools are registered for LEED certification and four are expected to follow.
Geoexchange System
The most energy efficient and costly feature of the 82,500 ft² school building is a ground-coupled heat pump (GCHP) system. Heat pumps, located in small mechanical closets between classrooms, are tied into a geoexchange system under the school’s athletic field. The system harvests the constant temperature of the earth for heating or cooling the building, depending on the season. The GCHP system, which eliminates the need for a boiler or cooling tower equipment, requires less maintenance and a smaller, central mechanical room.

The geoexchange field at Great Seneca Creek Elementary School features 10 circuits requiring 120 wells, each 515 ft deep. Together, these loops have approximately 130,000 ft or 24.6 miles of piping. Pumps transport 13,000 gallons of fluid through the system. The fluid is a mix of 80% water and 20% glycol. The biodegradable mix poses no danger of contaminating the groundwater if there were a leak. The system needs seven of the 10 circuits to work, creating a safety factor to keep the school operating at all times.

Even three years after opening, Montgomery County schools and other schools in the region with conventional HVAC systems run 12% to 50% more than Maryland’s 45,000 Btu/ft² per year energy intensity design target for new schools. However, new schools in Montgomery County with a GCHP system approach the desired design target, making this the system of choice for all new schools if the budget permits.

Maryland requires all projects to conduct a comprehensive life-cycle analysis of three different mechanical systems. Although GCHP systems usually outperform conventional systems over the life cycle of the building, they come with a significant first cost premium that needs to be accounted for early in the construction budget.
nevertheless, older montgomery county schools use about 60,000 Btu/ft² per year on average. this is in line with the national average for schools. energy use for montgomery county’s five new schools with GCHP in operation is below the 45,000 Btu/ft² per year benchmark by a projected average annual use of 36,500 Btu/ft² per year. by lowering energy use, the GCHP system provides significant savings in operations.

Calculating Costs
For the building and site, Great Seneca Creek Elementary School cost about $215/ft². This is similar to comparable school construction in the area at the time. The energy and water savings are expected to level out in compliance with the LEED modeling. Considering only utility savings, the payback of the premium is expected to take about eight to 10 years. Eventually, maintenance savings, health benefits and increased productivity need to be quantified and added to these calculations. However, this only makes sense after the school has been in operation for at least three years to allow the

<table>
<thead>
<tr>
<th>Project</th>
<th>Btu/ft²</th>
<th>Cost Per ft²</th>
<th>Savings Per ft²</th>
<th>Annual Savings</th>
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<tbody>
<tr>
<td>Great Seneca Creek Elementary School</td>
<td>31,310</td>
<td>$1.17</td>
<td>$0.73</td>
<td>$61,491.77</td>
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<tr>
<td>Average of Montgomery County Public Schools (Old and New)</td>
<td>60,000</td>
<td>$1.90</td>
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Based on data from January 2007 through May 2007 and extrapolated to 365 days.
dust of warranties, weather-related discrepancies and user behavior discrepancies to settle.

With Great Seneca Creek being the first LEED project for the school system, the cost of innovative technologies was difficult to predict. As a result, many of the sustainable features in the initial design were considered as alternates. The school system dropped some of the more ambitious technologies, such as a rainwater harvesting system, during the value engineering phase because the technology did not show a payback of less than seven years in utility savings.

**SUSTAINABLE FEATURES**

**Site**
- Native and noninvasive plantings
- Educational garden
- Wetland
- No-mow zones
- Preferred parking for carpools
- Light pollution control

**Water Efficiency**
- Low flow faucets and showerheads
- Flushless urinals
- Dual flush toilets
- No irrigation

**Energy Conservation**
- Low-e glazing
- Fiberglass window frames
- Interior and exterior lighting controls
- Vacancy sensors
- Ground-coupled heat pump system
- High efficiency boilers
- Plug load control
- Energy recovery
- Green power procurement
- ENERGY STAR® appliances and white roof
- User education program

**Materials**
- Use of local materials
- Recycled content materials
- Low VOC-emitting paints, sealants and adhesives
- Formaldehyde free insulation
- Formaldehyde free wood composites
- Use of wood from certified forest

**Operations**
- Integrated pest management
- Green cleaning equipment
- Systematic team cleaning
- Healthy, high performance cleaning initiative
- Tools for schools indoor air quality management
- Consumer recycling
- Construction waste recycling
- Conservation training

Above A comprehensive indoor air quality management plan prevented the polluting of the new structure.

Below Bathroom partitions are made of recycled plastic from soda bottles and laundry detergent containers.
Advertisement formerly in this space.
Teaching Technology
Great Seneca Creek Elementary School also is a pilot project for new teaching technologies. Each classroom has a minimum of three computer stations, a digital projector, a teaching station with a wireless laptop tablet and a voice amplification system. Future technology upgrades include Promethean interactive whiteboards in every classroom. With this much technology in the classroom, daylighting, energy-efficient lighting and energy conservation are priorities.

National data shows that a building’s energy use can be reduced by more than 15% when occupants turn off lights and computers when not in use. These savings are significant for Montgomery County Public Schools, with an annual utility budget of more than $40 million. A 5% conservation mandate was established in 2004 for all Montgomery County schools. Each school’s current energy use is compared to its previous energy use. Schools with quantifiable results are given money to reinvest into their school-based conservation programs.

To create a hands-on connection between the building and its users, signs and tours educate students, staff and visitors about the sustainable building features, teaching them about a building’s effect on the environment and benefits of high performance buildings.

Low Flow Benefits
The school was expected to save 43% more water than required by the Energy Policy Act of 1992. After the first 18 months in operation, the water savings are closer to 50%. The school’s water use is 6.5 gallons/ft\(^2\) per year, which is below the school system’s average of 14.1 gallons/ft\(^2\).

<table>
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<tr>
<th>Project</th>
<th>Gallons/ft(^2) Per Year</th>
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<tr>
<td>Great Seneca Creek Elementary School</td>
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<tr>
<td>Average of Montgomery County Public Schools (Old and New)</td>
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Based on data from April 2006 through March 2007.
per year for elementary schools. Great Seneca Creek’s water savings add up to about 410,000 gallons per year.

To achieve these savings, the building’s plumbing uses dual flush technology in the kindergarten classrooms, as well as flushless urinals and low flow faucets throughout the school. After the building opened, the disposable cartridges of the flushless urinals were retrofitted with a permanent model. The permanent model is expected to show additional savings in maintenance and replacement costs.

PERFORMANCE DATA

The project team designed Great Seneca Creek Elementary School to use 35% less energy than required by ANSI/ASHRAE/IESNA Standard 90.1-1999, Energy Standard for Buildings Except Low-Rise Residential Buildings, and save at least $80,000 in utility costs per year when compared to an average Montgomery County Public School.

Data collected in the past from schools throughout the county indicated that energy use in the first year of operation in a new Montgomery County facility is between 20% and 40% higher than in the third year. During the first year, new systems are running under warranty, setpoints have not been established and calibrated, and users, energy management and service personnel have not been trained to run the new building efficiently. This trend holds true for Great Seneca Creek. So far, the energy use, although still in compliance with Standard 90.1-1999 and the LEED prerequisite, is higher than the 35% savings target.

Because the building recently reached the milestone of the first 18 months of operation, the school system’s energy analyst began the benchmarking of the actual energy use for the school. When a year’s worth of data has been collected, the benchmarking will be in place and actual energy use of the school will be shared regularly, about every four months, with maintenance and school staff. At other Montgomery schools, this feedback helped establish a culture of conservation among building users. In 2007, the conservation culture saved the school system $1 million in utility costs.
Building Components
During the school’s construction, 86% of the material packaging and construction waste were recycled. Most building materials came from local sources within 500 miles of the site. Some of the building components even feature 100% post-consumer recycled materials. For example, bathroom partitions are made of recycled plastic from soda bottles and laundry detergent containers. The casework of the school is made of wheatboard, a rapidly renewable material that is an environment-friendly alternative to particleboard.

A comprehensive indoor air quality management plan prevented the polluting of the new structure from construction dust and required that all finishes were low VOC-emitting. Furthermore, Great Seneca Creek was the pilot school for the school system’s green cleaning program. Healthier, multipurpose alternatives replaced several cleaning products. After the program’s success at Great Seneca Creek, the program, which has won national awards, was installed throughout the Montgomery County school system.

User Feedback
In addition to providing a first-class learning and teaching environment, Great Seneca Creek Elementary School provides a three-dimensional textbook and teaching tool that advocates environmental stewardship. Performance and perception of the school has exceeded expectations, with zero teacher turnover and high user satisfaction. A post-occupancy session revealed an exceptionally high level of user acceptance of the building and its green features and few complaints.

First Cost
Separating operation and capital budgets makes it difficult to justify first costs. Instead, first cost should be considered a small part of the overall lifetime cost of a building. Putting in money now saves more money down the road. For example, Great Seneca Creek’s choice to install a GCHP system has a higher first cost but usually outperforms conventional systems. Over the life cycle of the building, the GCHP system will save the school money in energy and operation costs.

Identifying LEED
High performance design standards had been incorporated into the school system’s design guidelines before LEED was available as a benchmarking tool. This made it difficult to identify purely LEED-related premiums for the school during the trial certification process.

Fulfill Function
Environment-friendly and low maintenance electrical hand driers replaced paper towels in the school’s restrooms. Unfortunately, the energy-efficient model installed at Great Seneca Creek Elementary School was too noisy for younger students and the adjacent classrooms. The school will replace the installed hand driers with a less noisy, energy-efficient model.

Lessons Learned

The GCHP system lowers energy use and provides significant savings in operations.

About the Author
Anja S. Caldwell, an architect, has managed the Green Building Program for Montgomery County Public Schools for the past five years. She served on the USGBC core committee that developed the LEED rating system for schools.