Revealing the thriving ecosystem that exists below the water’s surface is the purpose of Indian Springs Metropark’s Environmental Discovery Center. An underwater viewing room, capped by an 18,000 lb acrylic dome, provides a window to the depths of a 1.7 acre pond. The first underwater pond-viewing room in Michigan helps the center to draw hundreds of visitors weekly to the restored wetlands and ecosystems of the 2,215 acre Huron-Clinton Metropolitan Park.
**Engaging Nature**

The 19,000 ft² center is located at the headwaters of the Huron River, nine miles northwest of Pontiac, Mich. Nestled among the low rolling hills of the surrounding metropark, the center’s simple standing seam copper gable roof is reminiscent of the local rural homesteads. Bents made of glued laminated timber (glulam) form the quasi-vertical member and the horizontal roof member supporting the wood roof deck. Canted to one side, the glulam bents create the opaque north elevation and the open southern façade. The exposed construction of the Discovery Center blends with the natural surroundings and enhances the educational function of the facility.

The building’s two-story main floor entrance descends into the lower floors and opens up to a discovery wing on the east and a multipurpose room on the west. The transparent southern façade of the structure offers a panorama of the outlying wetlands. A gently sloping edge of the building conceals the parking lot from the inside. Every room in the facility offers an unobstructed view of the surrounding wetlands.

**Viewing Levels**

The Discovery Center has three levels: above the water, at the water, and in the water. Each level provides a different view of the wetlands and educates visitors about the ecosystem. To meet the needs of the educational programs envisioned by the metroparks, the building required classrooms, laboratories and a multipurpose room.

The entry level, located above the water, offers an environmental interpretive studio on the east wing, with laboratory benches and equipment for performing experiments using information gathered on-site. The west wing holds a multipurpose room that seats 200 people and can be used for educational programs. After heating or cooling the building, geothermal by-product water fills the building's 1.7 acre wetland pond.

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**Building Name** The Environmental Discovery Center at Indian Springs Metropark  
**Location** 5200 Indian Trail, White Lake, Mich.  
**Size** 19,000 ft²  
**Started** 2002  
**Completed** 2005  
**Use** Metropark educational program center with classrooms, laboratories and a multipurpose room  
**Cost** $4.8 million  
**Distinctions** Second Place, 2008 ASHRAE Technology Awards

**Building Team**

- **Owner**: Huron-Clinton Metropolitan Authority  
- **Architect**: SmithGroup  
- **Engineer**: SmithGroup  
- **Construction Administration**: SmithGroup  
- **General Contractor**: JM Olson Corporation
Natural ventilation is used whenever possible. A manual override switch allows for a majority of the HVAC equipment to be turned off at once. Windows can be opened for natural ventilation and corresponding energy savings. Within the administration area, a control light tied to outdoor temperature and humidity turns from red to green when conditions are correct for natural ventilation, indicating to the staff to switch off the mechanical system and open the windows. Natural ventilation is supplemented with an exhaust fan positioned near the peak of the roof, providing added comfort when required without engaging the air-conditioning system. This effective use of resources results in a building with very low energy consumption.

Heating and cooling is provided by 30 ton and 10 ton water-to-water heat pumps. The heat pumps provide warm and chilled water to fan coil units located near each space. The heat pumps also use the well water on the way to the kettle pond or water sprayground as a heat sink. Because the well water is always 50°F–55°F, cooling is efficient. The energy efficiency rating is greater than 20. The heating mode is kept efficient by minimizing the hot water system temperatures. Multirow heating coils extract heat from the lower temperature (110–120°F) circulating water.

A 100% outdoor ventilation unit provides ventilation air to distributed fan coil units. The unit is equipped with free heating and cooling coils that precondition ventilation air using nearly constant 50°F well water (indirectly, through plate and frame heat exchangers) which is then directed either to the kettle pond or the water sprayground.

The free heating and cooling coils work in unison with a variable speed heat recovery wheel. Building exhaust/relief air is ducted through the wheel, recovering energy otherwise exhausted to the outside. Between the free heating and cooling coils and energy recovery wheel, the building ventilation air is almost entirely preconditioned without having to use mechanical heating or cooling. An additional cooling coil is provided in the unit for occasional building dehumidification.

Occupancy sensors minimize ventilation airflow rates and automatically set back the space setpoint temperatures when the associated room is unoccupied. Additionally, a variable speed supply fan in the ventilation unit minimizes the amount of fan energy required to deliver the ventilation air.
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used for a variety of functions from lectures to banquets. This room has two sides of glass and an expansive deck, which helps visitors engage with the outdoors.

The lower level, located at the water, offers two seminar rooms separated by a movable wall that can open up and create one larger expansive room. A distance education classroom and building support spaces fill the remainder of this floor.

The pond level, located in the water, enables visitors to interact with the man-made kettle pond, modeled after ancient glacier kettle ponds from the region, and view the interworkings and complexities of the wetland ecosystem.

**Underwater Classroom**

The pond level is best experienced in the pond room, an underwater classroom that allows an incredible 360 degree view of the kettle pond. A series of windows in the environmental hall leading to the pond room allows students and visitors to look into the pond from its base and witness flora and fauna.

The underwater classroom encompasses a 20 ft diameter acrylic dome set at the bottom of a 12 ft deep kettle pond. The classroom...
places students within the wetland environment to observe activities below the water. This observation room is in a wetland environment with unfiltered water. To maintain a continuous flow of water through the pond, staff regularly separates the iron minerals from the groundwater by adding an air bubbler to inject air into the water, causing the iron within the water to oxidize and sink to the bottom of the pond.

**Lighting**

Throughout the building, lighting enhances the architectural forms and materials while meeting functional needs. Lighting addresses specific tasks in individual spaces. It also allows the building to read as a cohesive whole through the extensively glazed south façade.

At the entry level, indirect lighting was applied to accent the beauty of the wood decking that covers the walls and ceilings. The multipurpose room’s layers of light coupled with a multiscene lighting control give flexibility to event settings.

In the classrooms, fluorescent pendants on daylight sensors provide energy-efficient light and reduce glare. Halogen indirect fixtures accent the warmth of the wood ceiling and provide dimmable ambient light with extended life. Clusters of energy-efficient compact fluorescent pendants symbolize bubbles, creating a connection to the adjacent pond. To minimize visual clutter within the open architecture, these fixtures, customized with integral battery backup ballasts, double as emergency lighting.

At the pond level, lighting design enhances the underwater level experience. Grazing light from efficient metal halide sources accentuates the texture of the lobby’s stone wall. The pond viewing corridor is illuminated to reinforce the notion of being under water. Simple halogen downlights were modified with a metal mesh trim and blue color filter to immerse the visitor in colored light. This cost-effective and maintenance-friendly solution also gives the effect of water rippling above the surface.

**Water Stewardship**

A theme of the Discovery Center is water stewardship and the relation of water to natural systems. During the project design, the mechanical engineers worked closely with aquatic biologists, ecologists, the Michigan Department of Environmental Quality, landscape architects and civil engineers to gain maximum use of the well water.

The man-made kettle pond and associated wetland areas require a nearly continuous water flow at a minimum of 50 gallons per minute to support the aquatic organisms, fish and plants. In addition, an adjacent children’s water sprayground requires 75 gallons per minute during summer operating hours for automated water spray toys and ground sprays. Water used at the sprayground is recaptured for irrigation and pumped to the metropark’s nearby golf course irrigation system. Ultimately, water is directed to adjacent wetlands or seepage beds, returning to the ground and the aquifer from which the water originated.

Additionally, the mechanical system
forms the hub of a water system that serves several purposes. An on-site well capable of producing 1,500 gallons per minute provides water for geothermal heating and cooling of the building while also supporting the building’s domestic use and fire protection. Geothermal by-product water fills the 1.7 acre wetland pond in the front of the building, as well as the series of ponds and wetlands downstream.

Water Treatment
The well water on-site is quite hard and contains high levels of iron and manganese. Without water treatment, the iron and manganese would quickly stain the building’s plumbing fixtures. Various types of filtration systems were discussed during the design phase. With a number of fairly remote parks surrounding Detroit, the Metropolitan Park Authority had extensive experience with well water treatment systems. They guided the design team to a treatment system that uses sodium hypochlorite pellets to oxidize the iron and manganese so that they can be filtered out.

Similar to the building plumbing fixtures, the water sprayground also required well water treatment to prevent staining of the various water toys and surfaces. Therefore, a second substantially larger treatment system was installed parallel to the building’s domestic water system. This system is used only in the summer months when the sprayground is operating. In the domestic hot water system, a traditional water softener is used for scale prevention.

Materials and Resources
Building materials were selected for energy efficiency and resource effectiveness. Oriented southwest toward the view, major windows are protected by overhangs, sun screens and adjustable interior shades. Fenestration is minimal on the other elevations, thereby limiting exposure. Clear glazing was selected to avoid disruption of views. High-efficiency argon gas filled insulated-type was selected with a low-e coating. The roof and walls also are well insulated.
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Benchmarks
The project was evaluated against the USGBC LEED® criteria during the design process. LEED was used as a benchmark, as opposed to a scorecard, for reaching sustainability goals. The owner determined that LEED, with its associated process, added costs and paperwork, was not as essential as creating a sustainable building. A commissioning procedure, a prerequisite for LEED, also was evaluated and deemed too costly by the owner, becoming another determining factor not to target LEED certification. Although not formally pursued, the center was designed to meet a Silver rating, through the use of various energy-efficient systems.

Energy Cost Savings
An early concern to the client was saving on energy costs. Table 1 provides actual electric meter readings. The building is equipped with a single meter. However, the data does not include remotely located and separately metered well pumps which serve other buildings and site areas in addition to the center.

The building’s total energy consumption is approximately 41,000 Btu/ft² per year. The energy consumed on-site is significantly lower than averages for various building types published in the U.S. Department of Energy’s 2006 Buildings Energy Data Book: 119,700 Btu/ft² per year for public assembly; 80,600 Btu/ft² per year for education; and 88,000 Btu/ft² per year for office.

Table 1

<table>
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<th>Month</th>
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</table>

Total Energy Consumption 228,320 kWh or approximately 41,000 Btu/ft² per year
Interpreting Nature
The building owner’s desire to showcase a large ecosystem restoration, including man-made wetlands and ponds, was accomplished with the design team’s goal to develop a building that embodies the metroparks’ commitment to the natural environment. Developing multipurpose uses for spaces within the building and outfitting them with specific equipment helped create a flexible multipurpose facility with ecologically minded features.

The facility supports environmental education and nature interpretation, showcases water resource management and incorporates sustainable design practices. In the Discovery Center, visitors can explore below the surface of the water’s edge and experience the mysteriously rich and diverse worlds of wetlands and natural habitats.

LESSONS LEARNED

Underwater Structure Challenges. Originally, the pond room floor was designed to be level with the adjacent pond level viewing corridor. However, the floor was lowered prior to construction when the acrylic glazing manufacturer informed the client that there were hefty additional costs for a custom-sized enclosure. All agreed to accept the standard-size enclosure, subsequently lowering the pond room well below the building, pond level finish floor and building sump system.

Faulty construction of a concrete knee-high sill wall around the base of the dome caused leakage, requiring the replacement of the entire concrete wall and complete drainage and refill of the pond’s water. During reinstallation of the membrane waterproofing system and reglazing of the acrylic structure, a dry sump was provided in the center of the domed room to further protect the dome’s perimeter from overflow risk in case of a broken seal. A supplemental exterior drainage pipe-portable sump system also was provided around the underwater pond structure late in the construction phase.

Cost Modifications. The metropark’s fiduciary responsibility to meet the original budget without cutting corners in terms of performance required the evaluation of cost modifications versus performance. After thorough evaluation, the owner decided to lower the overall project cost. Significant cost modifications, which largely impacted the performance of integral building systems, led to extended time spent by the project team troubleshooting foreseeable construction issues.

Central Control System. When the project was being designed, a computer, software, and custom front-end central control system were initially included, due to the project’s complexity and HVAC systems. However, with the project over budget at the time, these features were removed to save on costs. Following the building’s construction, the client began receiving temperature complaints. Other than setting up some type of data monitoring system, no way existed to determine what was causing temperature fluctuations. Every time an issue arose, another trip to the distant project site was required. If the planned front-end computer system with communication capabilities was installed as originally planned, and more accurate estimates were provided, much of the troubleshooting could have been accomplished and, in some cases, avoided, without having to visit the building. Once on-site, all that was available was a small keypad/screen to view the setpoints and operating state of the equipment, making it difficult to see how the system was controlling the equipment.

Commissioning. An additional casualty of cost modification was a commissioning process that was anticipated but later removed. Initially, some mechanical equipment did not operate as expected. While programming to meet the designed sequence of operation, some assumptions were made that were not clearly defined in the sequence. These assumptions caused the makeup air-handling unit to operate differently than intended. The problematic units were not discovered until the seasons changed and user complaints were received months later. A commissioning process would have benefited the architect, engineer and builder by preventing this situation and other unforeseen issues. It also would have saved the design and construction team valuable time and money. The weighted benefits of commissioning would have been of particular use due to the project’s remote location.

ABOUT THE AUTHOR

Camille Sylvain Thompson is a senior communications specialist for SmithGroup and a freelance writer. Contributors to the article include Paul Urbanek, AIA, project lead designer and vice president of SmithGroup; David Kistler, P.E., project lead mechanical engineer and principal of SmithGroup; and Michael Arens, chief engineer of Huron-Clinton Metropolitan Authority.