

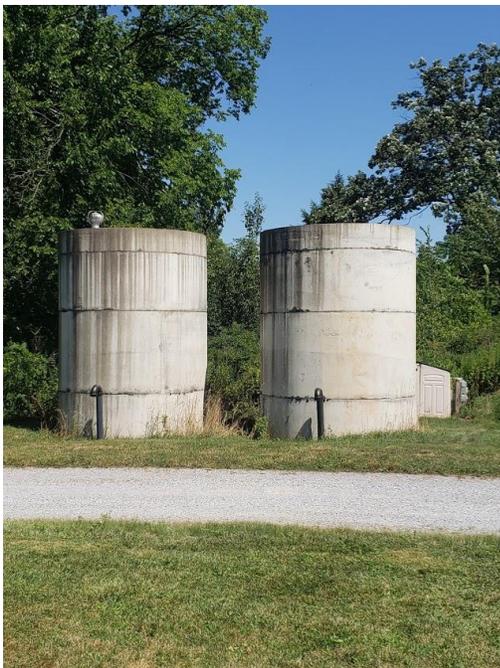
Sustainability September: Constructed Wastewater Wetlands

One of the most challenging problems to solve sustainably is the issue of human wastewater. Constructed wetlands are vegetation-based treatment systems that are engineered to tackle this monumental issue. In general, wetlands can be built to clean contaminated runoff from agriculture, storm water and human waste. At Duke Farms, constructed wetlands are designed to treat human wastewater, or effluent, from the Farm Barn Orientation Center and adjacent cottages. When Duke Farms is fully open, the constructed wetlands process thousands of gallons of wastewater per day. The daily amount varies a great deal depending on the number of visitors.



The constructed wetlands are located just to the east and south of the Orientation Center. Native wetland plants such as cattails and blue flag iris are intentionally grown in them to purify wastewater. These hardy plants not only withstand the flow of contaminated water, but they thrive in such an environment. Invasive or nonnative species that could become a problem in the habitat are not grown. Microorganisms in the soil and the plant roots cleanse the nutrient-charged waste, resulting in clean water that can be reintroduced safely into groundwater and used for non-potable purposes.

The constructed wetlands are a closed loop system, so only the waste that comes out of the bathrooms and kitchens gets into the treatment system. There are tanks before and after each part of the system



that hold the solid waste and liquid wastewater as needed. The liquid waste contains ammonia which is treated by trickling it through the tanks and adding oxygen. This converts ammonia to nitrates and water. The nitrates are taken up by the plants and are used as fertilizer. Most of the solids are also turned to liquid in the tanks, but some remain as solids and must be removed from the holding tanks periodically. Most of the remaining liquid is then cleansed by trickling through layers of sand and rock.

Human waste can contain volatile organic compounds (VOCs). These are organic chemical compounds that easily evaporate and can be toxic. Many VOCs are used to manufacture paints, cosmetics, pharmaceuticals, and petroleum products. Cattail roots harbor carbon digesting bacteria which convert complex carbons to simple carbons. Post conversion, the simple carbons gets stored back into soil or used by the plants.

Water that has been cleansed by the layers of rocks and sand is released into the wildflower field behind the Farm Barn where it trickles down to ground water (or the aquifer). This is called the drip field. This water is not used to irrigate the field, it is released about 10 inches below the surface of the ground. Control of outflow from the system must be carefully monitored to maintain appropriate water depths for the wetland vegetation and to ensure the entire system is not overloaded. The clean water is returned to the aquifer where it is available to be pumped up in wells all over the region. More than a million gallons of clean water are returned to the ground every year!

Wetlands are some of the most biologically diverse and productive natural ecosystems in the world and constructed wetlands provide important wildlife habitat. The wetlands at Duke Farms not only treat human waste in a sustainable way, they also improve water quality, conserve water, and support wildlife. Check them out next time you visit!

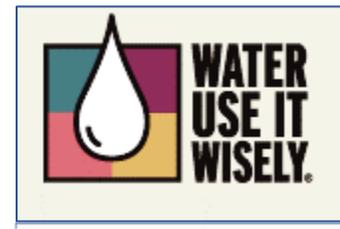
Home Activities for Conserving Water



Image: [Pikist](#)

The Earth might seem like it has unlimited water but in fact, less than one percent is available for human use. The rest is either salt water found in oceans, frozen in the polar ice caps, or too inaccessible for practical use. As the climate changes, droughts will become more frequent and water will become less abundant. We must find ways to save clean water! Although we can't build constructed wetlands in our backyards, they do make us think about how we can try to conserve water in our daily lives.

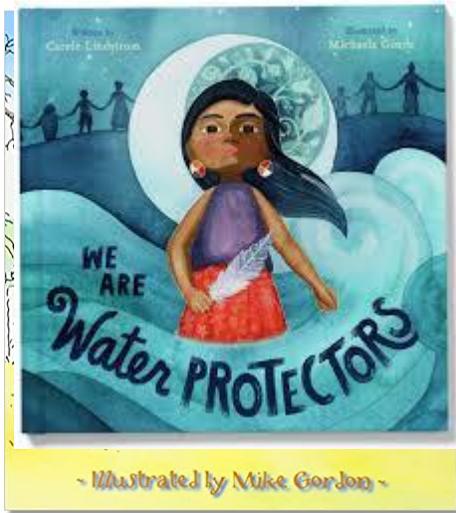
There are so many ways to conserve water; find 100 ways to conserve water right [here](#)! Do a home challenge to see how much water your household can save. Start by choosing 10 easy ways to save water and make a list of them for each member of the household. See how many you and each member of the household can perform for 10 days. Each time a member remembers to conserve water, have them record it or write it down and assign points to each task. At the end of 10 days, see who has the most points! Then add more tasks and do the challenge for two weeks, a month, a year... Before long, these tasks will become second nature. You will all be winners and so will the planet!



Additional Resources

- [More about constructed wetlands](#)
- [EPA fact sheet](#)
- [Water Conservation tips](#)

Books Students Might Enjoy About Clean Water and Water Conservation



An excerpt from the book that was created about North American indigenous people and their intent to protect clean water demonstrates its style:

“Water is the first medicine; it is where we all come from and nourishes us in the womb and on earth. There is talk of a black snake that will spoil the water, poisoning it. The black snake had been foretold for many years, and now it is here. Courage is the answer to it and the willingness to stand up and insist that water be protected. Nature cannot speak for itself, so we must speak and fight on its behalf. We can all be water protectors.”

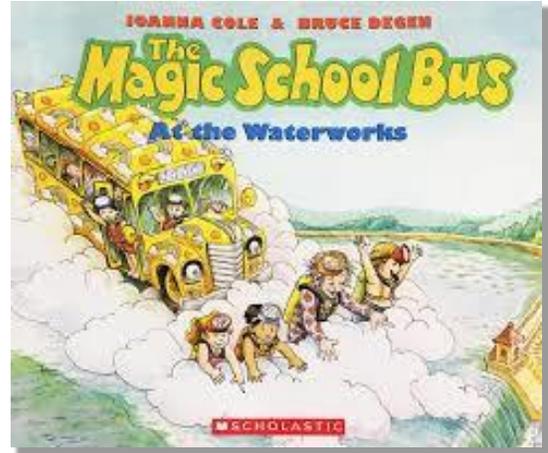
The author, Carole Lindstrom is Anishinaabe/Metis and tribally enrolled with the Turtle Mountain Band of Ojibwe. [Learn more about her and other works.](#)

Michaela Goade also illustrated “Encounter,” and “Shanyaak’utlaax: Salmon Boy,” winner of the 2018 American Indian Youth Literature Award for Best Picture Book. According to her website, she works with Indigenous authors and tribal organizations and is enrolled as a member of the Tlingit and Haida Tribes of Alaska. She writes, “I was raised in the rainforest and on the beaches of Southeast Alaska, traditional Lingít Aaní (Tlingit land). Today I live in Sheet’ká (Sitka), Alaska, a magical island on the edge of the world.”



Why Should I Save Water by Jen Green includes dozens of ways that children and their families can avoid wasting water. This book is part of a series that answers a common question that most children have, “Why Should I?”

The Magic School Bus At the Waterworks is a classic and follows water from clouds to homes and then to the waterworks. It explores the many trails of water and also explains a bit about water purification. [Click here to hear the book read aloud!](#)



The United States Environmental Protection Agency has teacher resources and games for kids about water conservation. Their site offers interesting facts in a fun format:

Thirsty for Knowledge? Let's Learn About Water!

Do you know how much water a family of four uses every day in the United States? Not 50 gallons, not 100 gallons, but 400 gallons! You could take up to 10 baths with that much water—but who would want to do that? Fortunately, there are many things we can do to save. [EPA Water Sense for Kids.](#)



Climate Change

There are so many water themes that span the curriculum and you can easily include, math (calculating water flow and volume) visual and performing art (pictures and photos about water and dancing out the water cycle) science (meteorology and weather patterns/storms) , technology (how do we measure rain) , engineering (what happens in a waste water treatment plant), geography global (clean water is a global crisis) , biology (microorganisms, salinity and other factors) Language Arts (poetry and literature - there is an enormous assortment) and much more. Importantly, for these reasons, water topics are directly aligned with Climate Change Curriculum. *For more information about how you may use this lesson in your classrooms, contact Kate Reilly, Manager of Education, Duke Farms kreilly@dukefarms.org*

Adopted 2020 New Jersey Student Learning Standards (NJSLS): *Climate Change*

New Jersey is the first state in the country to require climate change curriculum across all content areas and at a K-12 level. As stated by the NJDOE:



On June 3, 2020, the State Board of Education adopted the 2020 NJSLS in the following content areas:

- Career Readiness, Life Literacies, and Key Skills;
- Comprehensive Health and Physical Education;
- Computer Science & Design Thinking;
- Science;
- Social Studies;
- Visual and Performing Arts;
- World Languages.

These standards truly represent a foundation from which districts will build coherent curriculum and instruction that prepares each New Jersey student with the knowledge and skills to succeed in our rapidly changing world. They will put New Jersey again at the forefront of national education by including the following:

- Climate Change across all content areas, leveraging the passion students have shown for this critical issue and providing them opportunities to develop a deep understanding of the science behind the changes and to explore the solutions our world desperately needs.

*Photos of Duke Farms Constructed Wastewater Wetlands courtesy of Abby Schmid