



FRESH WATER FOR ALL

An Anthology of Student Writing

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FRESH WATER FOR ALL: AN ANTHOLOGY OF STUDENT WRITING
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This anthology supports the inaugural SUNY Oswego Grand Challenge: Fresh Water for All and recognizes student work from all disciplines. From poetry and art intended to evoke the beauty of Lake Ontario, to analyses that seek solutions to water scarcity and pollution, these pieces represent the breadth of student writing done by the Oswego State community.

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Created and edited by School of Business Writing Fellow Melissa Webb

Edited by School of Communication, Media and the Arts Fellow Kenneth Nichols

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Alexandra Puccia

Embrace Waste

Lake Ontario is a hug between Canada and NY.
It's only a stretch of your imagination implanted as
Paradise pixels on your phone or as a dead limb
Wasteland in the blow of winter.

This shore is infected with plastic smiles and
Polluted personalities, spawned from beer bonfires
And the occasional cigarette. Go ahead, paint a new
Portrait and watch the waste wave in the foam.

Jenna Galeotti, Kyle Hollowell, and Aaron Shopland

A Nuclear Power Plant's Effect on Freshwater

Approximately seven miles northeast of Oswego, New York, the Nine Mile Point Nuclear Generating Stations, or better known as Exelon, is found in the town of Scriba. It contains two boiling-water nuclear reactors, Unit One, which began operating since 1970 and Unit Two which began in 1987 (Exelon, 2016). Exelon has become one of the largest competitive United States power generators and has been a part of Oswego, New York for almost forty years. Exelon works in every stage of the energy business such as power, generation, competitive energy sales, transmission and delivery (Exelon, 2016). Both reactors are powered by generators which are capable of supplying enough carbon-free electricity to power more than two million homes in the United States.

Today, Nine Mile Point Nuclear Station Unit One is the oldest operating commercial boiling water nuclear reactor in the nation. Due to continuous technological advancement and equipment, Unit One has been more reliable over the years and has been performing at drastic levels of efficiency (Exelon, 2016). Niagara Mohawk Power Corporation president James A. O'Neill expressed that "This nuclear plant, unlike fossil fuel plants, does not contribute to air pollution by emitting by products of combustion - an omen of things to come from nuclear energy in New York." Compared to most industrial power plants, the nuclear station is a clean operation using freshwater from Lake Ontario which does not cause any pollution to the environment. Nine Mile Point was designed to avoid any negative impacts on water quality in Lake Ontario or aquatic life (Reitz, 2018).

Due to economic conditions in 2016, the plant was on route to shut down by January 2017. Throughout 2016, former plant owner Entergy began discussing a deal with Exelon Generation, the owner of the largest nuclear energy fleet in the nation, to assume ownership of the plant to keep it operating. To help this transaction

Andrew Cuomo, the Governor of New York, pushed to adopt a Clean Energy Standard that would benefit the state's nuclear power plant. The Clean Energy Standard is "the most comprehensive and ambitious clean energy goal in the state's history. It is designed to fight climate change, reduce harmful air pollution, and ensure a diverse and reliable low carbon energy supply" (New York State Research and Development Authority, n.d.). The passing of the Clean Energy Standard allowed the plant to continue operating past January 2017.

Currently, Exelon's nuclear power plant at Nine Mile Point is doing the most to keep their fresh water use clean so it does not affect the ecosystems surrounding the lake. The two different reactors use the fresh water differently, but have precautions to ensure the safety and purity of the water and emissions.

Both reactors draw water in from the shores of Lake Ontario in Scriba, New York. Unit One of Nine Mile Point does not have a cooling tower. The water gets pulled in from the lake, cools off the equipment, and is then sent through a series of cooling chambers before returning to the lake. Nothing is added or removed to the water besides heat. This reactor has a series of screens throughout the intake portion that filter any substances from the fresh water before entering the system. This ensures that fish and wildlife, along with other debris, are not sucked into the pipe and heated with the water. Occasionally, an eel or small fish enters through one of the first screens, but the remaining filters get finer and finer, until the water is pure for the system.

Also, the water returning to the lake is closely monitored and the temperature is regulated, so it does not affect the ecosystems it is returned to. The United States Nuclear Regulatory Commission, or U.S.NRC, has set standards on the amount of heat that can be returned to the lake in this type of reactor (United States Nuclear Regulatory Commission, 2019). The returning water can be no more than thirty-five degrees Fahrenheit warmer than current lake temperature. Anything hotter than that may negatively affect the wildlife or plant life in the surrounding area. At Nine Mile Point, they have precautionary measures in place to guarantee the

compliance with that regulation. If the water returning reaches thirty-three degrees higher than current lake temperature, then the intake of water is slowed or stopped. This allows water more time in the cooling chambers and ensures conformity to the requirements.

Unit Two at Nine Mile Point does have a cooling tower that can be seen for miles around. At this reactor, the water is brought in from the lake with the same precautionary filters as Unit One. In this case, the water is used to cool the machines until it reaches its boiling point of 212 degrees Fahrenheit. At that point, the water turns to vapor and is emitted out through the cooling tower as a gas. As explained by one of the engineers, Unit Two is like a pot boiling on the stove. Nothing is added to the water as a liquid, so nothing travels into the clouds as a vapor. It is a sped up version of the water cycle.

Unit Two monitors the output as well, even though it does not reenter the lake. A threshold has been set for the amount of steam leaving the tower and cannot exceed a certain gallons per minute as set by the U.S.NRC. Currently, Nine Mile Point sends about 640,000 gal/min through their cooling tower (Hakan, 2016). This is a safe amount that can be diluted into the atmosphere, without causing excess precipitation to neighboring ecosystems.

Nuclear energy companies are heavily regulated, especially in New York State, and it is the opinion of an Excelon worker that regulations on this industry are strict. This same employee also claims that complying with all of these regulations costs companies a lot of money. Some of the regulations that companies like Excelon have to comply with are put into place by the United States Nuclear Regulatory Commission (U.S.NRC). The U.S.NRC is the Federal agency that is responsible for protecting the health and safety of the public and the environment by licensing and regulating the civilian use of certain radioactive materials (U.S.NRC, 2019). A significant regulation the NRC sets that greatly affects nuclear plants is their limit on the temperature of cooling water before it can be emptied into a body of water. As stated before, the maximum temperature the water can be is thirty-five degrees Fahrenheit. Some nuclear plants across the country have had to receive permission from the

NRC to increase the maximum temperature. They found this necessary because global warming is increasing the temperature of water, causing plants to hit the limit more often (Lydersen, 2016). Nuclear power plants are also required by federal regulation to have an emergency supply of water that can continue to cool the plant for at least thirty days (Union of Concerned Scientists, 2013).

Nuclear power plants saw dramatic changes in the safety standards and regulations after the Fukushima accident in Japan in 2011. In September of that year, the International Atomic Energy Agency (IAEA) Action Plan on Nuclear Safety was endorsed by IAEA Member States. This plan has resulted in international collaboration toward strengthening global nuclear safety. Changes implemented include the review of IAEA safety standards, the strengthening of IAEA safety peer review services, and an increase in the amount of safety peer reviews for operators and regulators. There have also been many measures taken that, “include carrying out ‘stress tests’ to reassess the design of nuclear power plants against site specific extreme natural hazards; installing additional backup sources of electrical power and supplies of water, and strengthening the protection of plants against extreme external events; and changes and reforms of organizational and regulatory systems” (Jawerth, 2016). Overall, the Nuclear Industry works together when it comes to safety and regulations. They are not really competitive, but cohesive in order to ensure the longevity of nuclear energy.

Exelon's nuclear power plant at Nine Mile Point is an efficient energy producer without any carbon emissions. The facilities are heavily dependent on the freshwater supply of Lake Ontario, but their operations try to reduce any effects they may have on the surrounding ecosystems. While in agreement with the Nuclear Regulatory Commission regulations, Nine Mile Point provides energy to thousands of people per year without having major effects on the lake or wildlife. This business is heavily monitored and regulated to ensure the continuation of those achievements.

Appendix

1. What is your business's background?

Nuclear energy

2. What is your business's environmental impact historically?

a. What is your business's impact on the environment now?

3. What laws and regulations does your business have to comply with?

NRC Regulations and NYS Regulations

4. How does that compliance impact your business?

It is heavily regulated, which is costly

5. Has your business ever violated any current laws or regulations?

6. How important is sustainability to your business?

7. Are there any recent changes in the law that challenged your business?

Fukushima in Japan, changed safety standards and regulations

8. What is your opinion about those that violate water laws and regulations?

9. Do you believe that there is a water crisis?

10. Do you have any concerns regarding the current amount of available fresh water?

11. Are you going beyond government regulations in efforts for clean water and air?

Yes, we take preemptive measures to ensure regulatory compliance

12. What is your company's mission with watershed management?

13. Do you adapt new and more efficient technology as it develops?

Yes

a. Are you creating new technology?

14. Do you think regulations on this industry are strict or loose?

The regulations are strict, especially in New York State

15. Is doing what's right for the environment optimal for your business? If not, what would you do differently?

16. Does your steam affect any other ecosystems or the water cycle?

No, just pure lake water. There are no other pollutants.

17. What are you doing now that is different than a year ago?
Not much
18. What differences are you making compared to other industries?
The industry works together for safety and regulations. It is not so competitive, but cohesive in order to ensure the longevity of nuclear energy.
19. Do you think what you are doing is more efficient than other industries?
Yes
20. What is the biggest achievement you guys have made in efforts for clean water?
21. What were some of your biggest challenges last year and what did you learn from it?

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Logan Rowe

Fountain of You

Josephine sits and talks with one of her good friends as they sit at home. A bottle of wine is between them.

JOSEPHINE
(laughing)

Listen....no, listen! I honestly felt like I was born to be in the water. You know, when I was about one, I was playing in a relatives pool in one of those little boats for kids. I was just floating there in this overly colorful boat. Suddenly, as my mother puts it, she looks over again to check on me after talking to my aunt and the bottom of that boat is the only thing sticking out of the water. I had somehow managed to flip myself over. My mother pushed herself forward as she began to run towards me, be it adrenaline or just that lioness quality in her that caused her to quickly dive in and snatch me from the bottom of the pool. As my small head reached the surface, I let out a lung-full of air and opened my eyes.

(beat)

I knew to hold my breath. I knew to close my eyes. I knew the rules of the water. This was only the beginning of my love affair with swimming. As I grew, all I heard was that my shoulders were built to be swimmers shoulders. You know, some of my favorite memories of childhood was being in the water. I used to count the days until we had the swimming portion of gym class. That was the only time I felt like I could be athletic and excel at something physical. It was almost as an escape from the real world to just feel yourself be submerged and intertwined under blankets of waves. Even in the bathtub, I used to put my head underwater, open my eyes and I was transported into this dream world.

(sighs)

Of course, I would be diagnosed with Sjogren's Syndrome.

(beat)

Huh? Oh! Yeah. S-J-O-G-R-E-N-S. All it means is that my immune system attacks my moisture cells, meaning I cannot store water properly. Weird, right?

(forced laugh)

I had just gone in for a yearly eye exam and suddenly I was in a hospital five hours away from my home being told by a specialist that my body lacked this basic function. I couldn't believe it. I didn't believe it. I woke up that day thinking I was just going to get some new glasses but instead, I was now aware of this monster who ravaged my body and took away the piece of nature I had felt so attached to.

(beat)

You bet your ass I've spent nights looking up how it can affect me as I continue to age and honestly? It terrifies me. Blindness, kidney failure, lymphoma, peripheral neuropathy and that's just naming a few. It was as if I was reading someone else's story and not the ending to mine. Hell, people don't even get diagnosed with this until middle age usually. And there I was, first hearing this word associated with my body when I was thirteen years old. The monster was supposed to lay dormant until later in my life, but fate was like a child who poked it until it awoke and angrily retaliated.

(beat)

I mean, it's gotten easier over the years. Not the diagnosis or thinking about the damage it can and probably will do, but I feel more prepared now. The first time I got a kidney infection, I was in so much agony. Now, they come so frequently from lack of moisture in my body that I have become an expert on taking care of them. I even taught myself to do self exams on my kidneys. All you do is make a fist and-

(pounds fist onto leg twice)

-just like that. Once on each kidney. If it hurts, you know something's wrong. And- Oh!

(pulls out a small bottle from her back pocket)

See these? Bottled tears. N-Not like I collected them or anything, but they're necessary for someone like me. Otherwise, my eyes get all scratchy and...it's not good.

(beat)

All I'm saying is you learn. You never overcome an auto immune disease. I will never wake up one day and be 'cured' of this. The only thing I can do is manage. It's all about managing.

(beat)

Water used to be an escape for me. A sort of freedom I got to experience for a few hours. Now? Now with all of-

(gestures to body)

-this going on? Water is more of the unobtainable substance. I fight with water every day. I count the minutes until I can run and find a water fountain or just buy a drink to get rid of that ever present feeling of thirst. My body acts as if we live in a desert and we survive one drop of clean water at a time. No amount of liquid is ever enough when I take a drink. The sun is beating down on my overly sun sensitive skin and my mouth is in a permanently parched. I am forever trapped inside a survival situation and the helicopter is never coming for me. All I can do is keep trying to survive. Keep living from water source to water source. But one day, those sources aren't going to be enough anymore. This desert that is my body will eventually dry up. And I have to sit here as it dries up. I will have to watch every last drop evaporate.

(beat)

I used to think I was made to be in the water. Now? Well, now I know the truth.

Joe Carrasquillo

Fresh Water For All: A Business's Role in Managing Water Sustainability

Global awareness of our consumption of freshwater has become pivotal in a new wave of business ethics. The reasons stem from the simple fact that “accessible and usable freshwater sources are limited and unevenly distributed,” (link.springer.com), yet most businesses struggle with the moral and ethical problems of water sustainability in relation to their economic success. Water sustainability refers to the sufficient availability of freshwater for human and other living things’ use throughout the foreseeable future. On the one hand, the access to freshwater sources is a basic human right as officially recognized by the UN General Assembly on July 28th, 2010 through Resolution 64/292. On the other hand, water has always been a limited resource, therefore competition and conflict can be seen as some of the natural driving forces related to human development and economic growth (Heilig, pp 10). While some have argued that businesses should be more responsible in managing their water usage, others argue that the concept of sustainability may not be completely viable. This issue is important because the world is constantly changing, and as humans progress and continue to develop, so will the water needs of all living beings on this planet, making fresh water more scarce. One could think that all businesses would be involved in some way with increasing the efficiency of sustainable water management within their operations. Though I concede that businesses can be presented with complex challenges when faced with certain water sustainability policies, I still maintain that they have a moral and ethical obligation to do all that they can to help combat the water scarcity crisis rather than fuel it.

As businesses expand and grow, so does their water usage. Some businesses require water for production of their goods, but all businesses are responsible for some kind of water related footprint. Some of the problems involving freshwater that have been caused

by businesses involve pollution, climate change, and declining availability. Whether businesses have dumped chemical waste into surrounding freshwater ecosystems or emitted large quantities of toxic gas into the atmosphere, the prevailing understanding is that larger businesses are usually associated with higher risk, especially in regards to their effects on their local environments. Dumping waste and emitting toxic gas may save them some money now, but they are ultimately destroying the environment and future opportunities to access fresh water sources for everyone.

Some prevailing arguments against sustainability can be traced back to an Austrian economics professor Gerhard K. Heilig. His article called “Sustainable Development- Ten Arguments Against a Biological ‘Slow-Down’ Philosophy of Social and Economic Development” outlines ten arguments for why sustainability isn’t viable. In his article, Heilig advocates for a deeper understanding of human development and its relationship to sustainability. In Heilig’s view, “The Concept of Sustainability is Based (Without Saying so) on a Social Concept of Harmony and Altruism; This Ignores the Fact That Human Development is often Driven by Conflict and Fierce Competition.” (Heilig, pp 8) Essentially, he establishes a link between the driving factors of human development and the idea that sustainability disregards the importance of those factors. In other words, Heilig believes that the problem of managing sustainability occurs when we don’t take the natural processes of evolution and human development into account because we limit future growth.

Sustainability of freshwater can present more challenges for businesses when the idea of keeping track or measuring water usage arises. The argument prevails that it is difficult to use “quantitative measures to identify sustainability” (Heilig, pp 11). Businesses generally have to compute water usage in their expense reports to determine total liability in relation to their success, so how exactly do they manage that? The truth is that there are no easy ways to quantify sustainability, but measures to limit consumption are available. Every country has a governmental department dedicated to sustainability which provides outlines and templates for ways that

businesses can limit consumption. The Pacific Institute is but one website where businesses can research strategies such as “encouraging efficient water use across a catchment; and advancing public awareness of water resource issues,” (pacinst.org).

It is important for businesses to consider their role in managing their water-usage policies because there is a direct link between the way they affect water scarcity and the underlying factors of their economic success. To put it simply, people are healthier when they have access to freshwater, and healthy people have more time and energy to engage in their country’s economy. Therefore, it stands to reason that businesses would have a responsibility to do what they can to preserve the health, time and energy of their potential customers. By helping people within and outside of their communities, businesses can also gain popularity and financial incentives which could contribute to their economic success.

Within our ever-growing society, the challenge of managing water sustainability has demanded that our governments create innovative options for our businesses. One option for computing water consumption can be found in the sciencedirect.com article “Virtual water accounting for the globalized world economy: National water footprint and international virtual water trade,” which explains the use of virtual water. A study on the virtual water footprint of the world in 2004 found that “at the national scale, India, the United States, and mainland China are the world's largest virtual water consumers” (Chen, par. 1). This study refers to the unseen flow of water within the production of food and other commodities being traded between nations. In respect to virtual water, the article “John Anthony Allan’s “Virtual Water”: Natural Resources Management in the Wake of Neoliberalism” details the importance of finding an answer to the freshwater scarcity. The author, Kaitlin Stack Whitney, argued that international trade can improve the efficiency of global water use since people in water scarce regions usually meet their water needs through importing water-intensive goods. This was the first step in quantifying sustainability efforts because it made water-management a technical matter rather than a

political one (Whitney, par. 6). With this information, businesses have the opportunity to shift their focus from their bottom line to the effect they have on global water sustainability.

Fresh water is a basic human right, but the fact remains that people living in water-scarce regions are heavily reliant on the water imported from water-rich countries and their economies. Businesses have the moral obligation to implement water sustainability policies within their operations. Although some arguments may suggest that sustainability policies provide more problems than they do solutions, the prevailing argument that businesses are responsible for managing their water consumption has more support through philosophical and ethical discussion. The first step businesses can take to make water sustainability more efficient is by spreading awareness of the problems they face in relation to water consumption. The more we know and understand our role in the global ecosystem, the better prepared we will be in facing the challenges of this discussion.

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Koty Kurtz

The Threat of Depleting Aquifers in the United States from Unsustainable Practices

When my family moved to the small village of Barryville, New York, we lived in a house with many problems. One major problem was having both too much water and not enough water. The topsoil always had very saturated soil. The neighbor's yard was always so saturated with water that water-resistant shoes were required to walk across it to keep our feet dry. Even in winter, the audible crunch upon stepping on the soil could be heard not just from the frozen grasses, but from all the water frozen within the soil. Often times during rain, water had nowhere to go except into our basement. Despite living on the top of a hill, the basement often flooded. Our family items that were not on wooden pallets were often ruined.

You would not expect a lack of moisture in the water table here, but there was. Using too much water would cause the well to dry up. For the first six years we lived here, my mother would have to stay up late doing the dishes and laundry so that the water could build up enough for everyone to have a shower in the morning. She would use the water late at night for the washing machine and filling the sink, then she would leave it alone and this would allow the water to build up enough for us to have showers in the morning. We had to buy bottled water, as water was not something that was always available. It became normal to see my father wake me up for school most mornings because my mother was sleeping after staying up so late, and it also became normal to constantly buy bottled water. Yet, the question remained: what was the cause of the well drying up?

The reason the well was drying up was because the aquifer was too stressed to support our needs. Aquifers are stores of water in the soil. As water precipitates onto land, it percolates down into the soil, building up over time. We drill wells into the soil and obtain this water for our own domestic needs; however, throughout the

United States our current usage is not sustainable. The United States Geological Survey has a section dedicated to observing the country's groundwater status ("USGS Groundwater"). One map shows wells with low water levels that have been consistently low for at least ten years. These points indicate areas that must find another way to sustain themselves. Some of these areas with many depleted wells include: a majority of Nebraska, southeastern Idaho, western Utah, eastern Arkansas, southern California, central Maryland, and Nevada ("USGS Groundwater"). But as my family experienced firsthand, local aquifers in water rich areas like the northeast can also become depleted.

One region that has become synonymous with water controversies is Las Vegas, NV. The Las Vegas metropolitan area includes the city itself and the immediate area outside city limits. This extensive area encompasses over 2 million people ("Las Vegas"). Las Vegas has a few sources of water available to it. There is the water in the Colorado River basin ("Nevada Water Facts") and the large amount of water in Lake Mead, which is contained by the Hoover Dam. Due to increasing populations and drought, water levels have been decreasing. In just a couple years, Las Vegas may have to simultaneously deal with a lack of water and a lack of electricity, as there may soon not be enough water to power the hydroelectric dam ("Metropolitan Board"). In order to secure a supply of water, Las Vegas wants to build a 300-mile pipeline into another aquifer. This other aquifer is the home of Baker residents. Baker, NV, only has a population of 150 people. These residents fear that if the pipeline is approved, they will also lose their water supply ("Las Vegas Bets"). Calculations predict that without the pipeline the people of Las Vegas will run out of drinking water in 20 years ("Las Vegas Bets"). The easy solution would be to build the pipeline, but it is not the right solution.

The reason aquifers around the world are decreasing is because of the slow replenishment of the aquifers. While water is regarded as a renewable resource, it is not unlimited. In addition not all water resources are renewable. Due to their snow recharge, aquifers are considered nonrenewable resources (Gleick and

Palaniappan). This is due to their slow recharge as well as possible compaction from overuse. If all the water is removed from the aquifer, the soil can be compacted preventing any recharge from occurring. Similar to “peak oil,” there is also “peak water.” There is a limit to the water that can be obtained from a source (Gleick and Palaniappan). While aquifers can recharge, the rates are variable, and there are many factors that decide this. A study conducted observed the Gulf Coast aquifer recharge rate. Fourteen different wells were observed, and recorded rates ranged from 0.1 to 7.2 inches per year (Oden and Truini).

Aquifers take a long time to recharge, yet our actions are slowing recharge further. For example, as we lay down more concrete and other impermeable surfaces, water is prevented from even reaching the soil, preventing recharge. We can see these patterns on the SUNY Oswego campus. To the south of Lanigan Hall, there is a large section of concrete, commonly referred to as “The Sundial” that prevents water from reaching the soil. This is my third semester here, and I have seen it utilized by two events, and in both cases the amount of people utilizing the space does not justify the amount of concrete used. Not only is the concrete slowing the recharge rate, it is also carrying pollution directly into Lake Ontario. Another way to slow the recharge rate is through climate change. We are observing more intense rainstorms. If high volumes of water are dumped on land in short intervals of time, water doesn't have time to soak slowly into the soil. The water is forced to run downhill into local watersheds, and this rate of water flow increases with the amount of impermeable surfaces. This excess water never enters the soil and thus is also unable to recharge the aquifer (Rathay). Some areas with depleted aquifers may be able to use the groundwater efficiently and be able to recharge their aquifers. People in highly stressed areas like Las Vegas and other areas of the southwestern United States may have to move, as such an arid environment cannot support such a large population.

The first remedy to this problem would be to educate people on using their water in a more sustainable way. According to Ali et al, a majority residential water usage is used to irrigate their lawns

(169). These species require great amounts of water to thrive. A better usage would be using species that use less water. This would decrease the water usage and allow more people to live sustainably in a given area. If people want to continue to live in arid regions, water is essential -- green lawns are not.

The problem isn't just limited to arid areas though. It also affects the Great Lakes region. The Great Lakes hold 21% of the world's fresh water, and this is 84% of the United States' fresh water supply (Bianco). If arid regions continue to use up their water stored in aquifers, they will look towards the Great Lakes. In fact, it is already happening, and it is not just the people living near the lakes contributing. Nestlé is already threatening our aquifers. The US and Canada made an agreement to regulate the water usage within the Great Lakes watershed. This agreement is known as the Great Lakes Water Quality Agreement and limits the usage of water from the Great Lakes ("Great Lakes Water"). However, there is a loophole to this agreement. You are not allowed to remove water from the Great Lakes, unless it is in a container of 5.7 gallons or less. So as long as Nestlé drills a well into the watershed and bottles the water, they are allowed to ship it out of the watershed (Bianco). Even worse was that Nestlé was able to get a permit to increase the amount of water they can extract to 400 gal/min. Nestlé is making a short-term profit, but we will be in for a long-term suffering.

My mother had to endure six years of staying up late to use the water before a new well was finally built. But there is only so much water in the aquifer, if we cannot use water more sustainably then a lot more people will have to endure even worse conditions. My family had to use bottled water regularly as we had a water shortage on our property. However, this bottled water would be coming from someone else's aquifer. This demand would increase pressure on that aquifer increasing the water withdrawal to support people that need bottled water. If this demand is too great then the aquifer won't be able to support the local population that lives there. Companies like Nestlé will move on to another aquifer forcing the local populations with their depleted aquifer to either move or also buy bottled water continuing the cycle. This scenario can also be the

fate of the Great Lakes region. The Great Lakes are the largest source of freshwater in the United States, it creates a large target for companies like Nestlé. If the Great Lakes are not protected now, then in the future, residents of the Great Lakes may be forced to buy bottled water as well.

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Zachary Snow

Micro Size, Massive Problem: Plastics in the Great Lakes

Every time you find yourself knee deep in one of the fabulous Great Lakes of America, odds are you are within a stone's throw of some sort of plastic pollution. A water bottle little Timmy forgot after a day at Presque Isle, a toothbrush Margaret lost after camping on the world's largest freshwater lake island, Manitoulin Island, or even a grocery bag that blew away from Mrs. Crabtree on her weekly grocery run in Detroit -- these forgotten bits of plastic are easily found in any of the five Great Lakes, and it's a huge problem.

The Great Lakes are a natural gem. They hold roughly 20% of the world's surface freshwater supply and provide a booming economy with a GDP of USD \$6 trillion. A quarter of all Canadians, 8.5 million to be exact, live in the Great Lakes Basin and over 30 million US residents do (Burlakova et al. 536). With this many people in one concentrated area, it's easy to understand just how much pollution is making its way into the world's largest surface fresh water, much of which is unfortunately plastic pollution.

Plastic is a blessing and a curse. We all love plastic for its durability; however, it is this resiliency that is the problem. Single use plastics such a water bottles or grocery bags can often be broken down through a chemical and mechanical degradation, but complete breakdown can take hundreds of years. In some cases, complete breakdown is not even possible. And when complete breakdown does occur, it's not the end of the story for plastic. Chemicals with long complicated names are left behind, such as polychlorinated naphthalenes (PCNs), polybrominated diphenyl bisphenol A (BPA) and polychlorinated biphenyls (PCBs) to name a few (Gandhi et al. 482). These chemicals have negative health effects for humans and animals alike. Ingested microplastics can cause havoc on the digestion tract of a fish. On top of this, the

foreign diseases associated with plastics are a dime a dozen. It's basic knowledge that humans aren't supposed to eat plastics -- no one is chowing down on a garbage bag for lunch. But these plastics still find their way into us through the fish we eat and even the water we drink.

But where are all these plastics? The water bottle floating across Lake Michigan doesn't seem like the end of the world, and that's true...it isn't. Hopefully a weekend warrior stops and picks it up. But if every boater drops a water bottle and forgets to pick it up, it will add up rapidly. From the moment a piece of plastic enters the water, a thin layer of bacteria begins to form called a biofilm. Think of a biofilm as a tiny city of bacteria and a floating plastic bottle is free real estate. This biofilm builds and builds until the weight of the bacteria colony overcomes the buoyancy of the plastic bottle. And just like that the plastic eye sore vanishes from the surface and essentially vanishes from most people's mind. This plastic bag then either sinks to the bottom of the body of water and starts the slow process of chemical breakdown or it gets swept away by a wave, becoming someone else's problem (Chen et al. 858).

Another unseen issue of plastics in the Great Lakes are ever present microplastic concentration (Eriksen et al. 177). Microplastic arise from the breakdown of other plastics or, even worse, come from everyday activities. That beautiful new fleece you just washed is made from plastic. This plastic falls off constantly and doesn't seem to amount to much, but just like the compound effect found with the plastic water bottles, these microfibers and microplastics add up. Every time you wash your clothes the waste water from the washer finds itself in a water treatment plant and then into a lake. Over two thirds of the treatment plants that drain into Lake Ontario do not use advanced treatment methods to try and capture these microplastics.

These microplastics may pose a larger threat to the abiotic and biotic systems of the Great Lakes than that of visible plastic such as a Styrofoam container. Most of the fish of the Great Lakes do not have 20/20 vision and can't tell the difference between a

floating fiber of microplastic and a tasty piece of plant. These microplastics provide nothing of value to the fish. The fish has the sensation of being full but receives a stomach full of plastic with absolutely no nutritional value at all (Gewurtz et al. 501). These unseen microplastics affect humans as well. It's nearly impossible to go swimming in one of the Great Lakes and not get a mouthful of water or two. Just as you guessed it, these microplastics are then entering your system. And if it's unhealthy for the fish of the Great Lakes, it's easy to assume it's not all that great for humans.

But not all hope is lost. The recent rebirth of recycling and the push for more environmentally friendly policies is leading the way to rehabilitation of the Great Lakes. There are a number of local advocacies groups dotted all over the Great Lakes Basin that easily help the average Joe become involved in protecting one of America's most important resources.

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Fresh Water for All: An Anthology of Student Writing

MARITIME MUSEUM

Written by

Ty Berman-Scozzafava, Kelly Morency & Leslie Ann Velez

Fresh Water for All: An Anthology of Student Writing

FADE IN:

EXT. LIGHTHOUSE - DAY

A man, STEVE (30s), walks up to the lighthouse, arriving at his new job. Waiting outside for him is another man, EARL (50s), who is wearing a navy jacket with the lighthouse logo on it. Underneath it reads "lighthouse keeper." He also wears a wool sailor's hat.

EARL

I'm guessing you're Steve? I'm Earl. I'm going to be showing you around here.

Steve nods in acknowledgement and they're off.

INT. LIGHTHOUSE - DAY

Earl shows Steve the main area of the lighthouse, the kitchen, the living quarters, and the top of the lighthouse.

Steve goes back to his new living quarters and HANGS a PICTURE of his WIFE and NEWBORN on the wall.

Steve settles in. We see the passing of time through the peeling of months from a calendar accompanied with a time lapse of a day. Also show passing of time from the changing of light navy jackets to heavy winter navy jackets.

CUT TO:

EXT. TOP OF LIGHTHOUSE - DAY

Steve is standing at the top of the lighthouse with Earl. Earl looks in the other direction of Steve. He see's the darkening clouds. He points to them and turns to Steve.

EARL

It's going to be a rough one.

Steve and Earl climb down the stairs.

INT. CONTROL ROOM - DAY

Two crew members stand in front of the radio. In the background we hear people running and yelling commands.

Over the speaker we hear-

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2.

COMMAND RADIO

"All units, all units. Incoming storm from the West. Secure the lighthouse."

OVER BLACK

We hear men yelling, heavy rain fall, thunder, cracks of lightning, and huge gusts of winds. The last thing we hear is Steve's shouts.

EXT. HOUSE - DAY

We see the backs of two workers knocking on a door. The WIFE from the picture opens the door with a now 2 year old clinging to her leg. The look on her face tells us the news she's being given.

CUT TO:

EXT. MARITIME MUSEUM - DAY

70 years later a FAMILY of four is walking up to the maritime museum. In the parking lot behind them are all modern day cars. Show a sign that says the date of 2018.

KID

Ugh, Dad! Why did you drag us here?
I could be playing Fortnite with my friends!

DAD

Try and keep an open mind would you?

They meet with a TOUR GUIDE and make their way through the museum.

EXT. GREY TUG BOAT - DAY

They journey over to the grey tug boat. One of the kids goes up to the steering wheel and starts to play with it. The DAD turns to him and says.

DAD

You look just like my grandfather.

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3.

INT. MARITIME MUSEM

They go into the actual museum and see the artifacts and paintings. The same kid tries to touch the anchor hanging next to a clear "no touching" sign.

DAD

Don't touch that.

EXT. LIGHTHOUSE - DAY

The Tour Guide brings the Family finally over to the light house. The Tour Guide starts their spiel.

TOUR GUIDE

This lighthouse has been a guiding light in this Harbor since 1880. It has helped lead a massive amount of ships safely into port. There was, however, a tragedy that struck in 1942. During a record breaking storm, multiple crew members unfortunately lost their lives...

The Tour guide's voice fades out. The dad turns to his kids. He starts to choke up slightly, his eyes glistening from incoming tears.

DAD

Kids, you know that was my grandfather that died in the 1942 storm? Your Pappy was only 2 when it happened.

The annoyed kid from before turns to his dad with a new amazement and sincere smile.

KID

This place is really cool, dad.

CUT TO:

EXT. BREAK WALL - SUNSET

The family is standing on top of the break wall at sunset. They all stand together looking out at the lake. We go to a split of the family of four and Steve in the same location and positioning on the break wall at sunset. The parallel images end the scene.

CUT TO BLACK.

Michaela Kingston & Joshua Hernandez

Camden Group: Fresh Water and Wastewater Treatment

Water is essential to everyone and everything on this planet. Over the course of earth's long history, our bodies of freshwater have become polluted due to the activity of humans. In some cases, the water becomes undrinkable for those who live near it. Camden Group Inc., a water treatment company in Oswego NY, that follows regulations and abides by set laws, some of which are harder to comply with, making operations not always smooth. Water treatment companies work to sort plastics, garbage, and other non-compostable items from the water supply. There are people all over the state taking action to reduce the damage that has been done.

What Camden Group Does:

Camden Group Incorporated has been working to clean both freshwater and wastewater for the Oswego area. It consults other companies who have begun to lack the ability to preserve local freshwater and steer them in the right direction. Mr. Scherrieble, the President of said company, works to operate freshwater and wastewater facilities. According to Scherrieble (2019), the Camden Group "consult, as well as troubleshoot problems that other companies have" (Camden, 2013). The company also manages other companies, Camden Group steps in when other companies are sinking. "This company helps them stay afloat and get back to thriving" (Camden, 2013).

The company treats approximately forty million gallons of both water and wastewater company-wide, every single day. When asked about the company's accomplishments, or things that they are proud of, Mr. Scherrieble (2019) stated the accomplishments are "in the other companies that they have been able to help and fix" (Scherrieble, 2019). Camden group is called to help other companies when they are in an extremely rough place. Camden looks at everything about these companies from their daily schedules to their logged books. In some cases, companies don't keep track of them.

Camden works to then create daily schedules, to help make things more efficient and effective, which leads to better management (Camden, 2013). Scherrieble confirms that they “make a roadmap for each company and then break it up to set priorities and make it manageable for the companies” (Scherrieble, 2019). Camden Group helps other companies stay within the laws and regulations of freshwater to improve the impact of water operations.

Companies are always impacting the environment both positively and negatively. Camden group is always striving to stay on the positive scale of impact. There are a lot of new technologies out there today that is created to help clean fresh water. One of these new technologies is called Membrane Technology (Pall, 2018). This Membrane Technology is created by a group called PALL whose sole purpose is creating new machinery and technology for filtration and purification (Pall, 2018). This company’s products hold promise for reducing the cost and reducing the number of impurities that are in the water. Scherrieble said that Camden is very grateful to be working with this company that has created a new science to further filter water supply. After the water is filtered, strained, and cleaned, the water is then run through this Membrane, which is a very fine filtration system that is able to catch very tiny impurities that are still in the water. Once filtered again, the water is significantly cleaner (Scherrieble, 2019).

Unfortunately, groups can negatively impact the environment. The by-laws for companies, says that companies are supposed to maximize profits for their shareholders. So, some companies make maximizing profits as their priority instead of the regulations that are put in place to maximize cleanliness and effectiveness. Some companies can become greedy and ignorant, so they do not meet the parameters that are put in place when the two companies decide to work together (Scherrieble, 2019). These parameters are guidelines that are put in place to show what is acceptable and what is not, such as not being able to cut corners simply to cut costs and maximize profit. When Camden Group sees that a company not meeting the parameters, whether it was intentional or not, and they are partnered with them they take legal

actions. They then will no longer do business with the company (Scherrieble, 2019). Even though there are companies that can have a negative impact on the environment, Camden Group does its best at staying true to the environment, even if it means cutting ties with other companies that set priorities of money over the importance of the environment.

How Camden Complies with Federal Pollution Laws and Regulations:

There are an abundance of laws and regulations that these businesses need to comply with. One regulation in particular that Mr. Scherrieble says is hard to deal with is that every employee needs to be a fully certified operator to work at this business. To be a certified operator one would need to receive a degree in either science or engineering. Scherrieble expressed his troubles with this regulation because people don't naturally want to grow up to be in this field of business. Possible employees usually get to this type of business later in life, rather than being a part of their chosen career path. This proves to be difficult to follow because there is a lot of schooling, training and experience that an individual need to have before starting to work in the field. For an average employee, the person would need to go through two years of schooling and at least one full year starting work with Camden (Scherrieble, 2019). To be in a higher position like that of Mr. Scherrieble, one would need about ten years of schooling and ten years of experience before you can even be seen to be qualified in the position (Scherrieble, 2019).

How Camden Views the Regulations:

When asked if the company has tried to change any of the regulations that have been put in place, Scherrieble said that they had not tried to change the laws because are constantly changing anyway. The regulations change and become stricter as time progresses, but these changes and strict structure only make these companies better. The regulations change and become stricter because as time goes by more knowledge unfolds about how water is being treated. These regulations can really help companies

improve as soon as they are put in place. It will make it easier for the company to move forward when newer regulations are added, because they will already be working towards improving themselves. The company is better able to maintain itself and create better water for the safety and health of the people (Scherrieble, 2019).

One of the regulations that are still followed by Camden and other groups today is the Clean Water Act of 1972. This established the basic structures for regulations about pollution discharged in the waters of the United States. The Act helps with the basic rules for controlling the pollution (Clean Water, 2017). The Safe Drinking Water Act of 1996 is used to protect the quality of the drinking water, it discusses the risks that come from low qualities of drinking water (Safe Drinking, 2017). It establishes rules for everyone to keep the same minimum, safe standard of any sort of impurities that are allowed in drinking water.

The regulations are always changing because of our knowledge and our society as a whole is always changing. Rules can be set in place for a period of time before realizing that it has negative impacts on the water or environment itself. These rules and regulations change to make things safer and healthier for the air, the water, even for the “fisheries” (Scherrieble, 2019). If there were no regulations that were enforced our own safety and health would plummet and could be devastating for the water and environment. Scherrieble stated that he had in recent years gone to Monterrey, Mexico and it was evident to tell that the drinking water was not to the standards that we in New York State have. Scherrieble looked into their regulations and found that the standards are not highly enforced and not quite as many are in Monterrey as there are in most places around the world (Scherrieble, 2019). The consequence for not staying up to date on the regulations or skipping steps to save costs for Mexico’s own water companies are that there is less clean drinking water for its people. It can also be more dangerous because if there are greater amounts of chemicals in Mexico’s waters, then there will be more fish and other animals that are eaten that then become dangerous to eat without people even realizing. There are

evident differences in water quality within United States; New York has very high and strict standards for its water. Camden takes the initiative to protect the water in this New York area because the company knows how important it is for everyone to have clean, safe drinking water. Protecting the quality of water is very important to this company and that is why it abides by all of the regulations to keep the water as safe as it can be for the people and animals who need the water to survive. Drinking water from New York and drinking water from California is very different even though they both in the United States. In California, people often don't drink it unless it is from a plastic bottle. The drinking water is not clean and in certain areas it is unsafe to drink because it is not as intently cleaned and filtered as other states like New York. The more regulations there are and the more strictly they are enforced, the healthier it is for our society as whole.

Changes in Regulations that Affect the Waters:

Many things have changed over the years, not just the regulations. People have started becoming more aware of their impact on the environment. The only people who are concerned about the water aren't just those who work with it, but those who simply want to make the world we live in healthier for every living thing on it. In recent years there have been many movements to clean our world's waters; one that has created an impact is the new movement to stop using plastic straws (Last Plastic Straw, 2018). People have started to catch onto this movement to stop using plastic straws because it was found that when they are in the oceans and can easily get stuck in the noses of sea turtles (Last Plastic Straw, 2018). This movement isn't a ban on straws; however, many places in the United States are adopting this and are now using biodegradable paper straws. These straws when in liquid for a certain period of time start to decompose. When asked about this movement and if he had seen any sort of impact, Scherrieble said that he has definitely seen an impact. Scherrieble stated that along with the movement to use paper straws, people are also simply choosing to go without straws. The machines that are used to filtrate the water often can get clogged. The plastic

straws don't decompose, so they just get caught and unless people go in and get them out there's damage done to these machines. When this happens, costs can increase due to the excessive number of times it needs to be fixed (Scherrieble, 2019). Even though the straws being used now, would very likely have the same effect of getting clogged in the machines like plastic straws, the difference is that the straws are able to decompose enough to the point where they will be able to unclog themselves as they decompose (Scherrieble, 2019). Plastic straws can also affect freshwater; most plastic straws break into smaller pieces which release chemicals that then get into the water that we drink and even in the fish and other animals which we eat (Vernon, 2018).

The Costs of the Regulations on Camden Group:

The costs of doing this work isn't exactly cheap. Scherrieble stated that it was roughly three dollars per thousand gallons of fresh water to be treated, and roughly ten dollars per thousand gallons of wastewater to be treated. The more water treated is more money spent, but Camden is working with other companies, like Pall Technology, which are trying to create new, more efficient machinery and technology. Pall Technology are also doing it so that the overall price can go down (Scherrieble, 2019). The companies are doing as much as they can to get costs down and still treat the same volume of water as they do now, or more. The impacts of the costs are not the only thing that Camden Group is trying to work and progress on.

What's in Store for Years to Come for Camden Group?

In the next five years, Scherrieble says that the company is looking to continue increasing the number of people who are certified operators because the more people to be certified, means there are more people to help treat these waters. Camden Group has an internal school which they would like more people to enroll. It is an intensive course, which takes the two years of schooling and compacts it into a six-week course (Scherrieble, 2019). It is hard and strenuous for the students and those teaching the courses. The

president of Camden Group believes it will be all worth it when it can see a growth of certified operators. Scherrieble likes to take technology to the next level. He would like to continue working with other companies to fix and refine the technology that they use so that they can keep costs down. Scherrieble has a passion for helping others and restoring these machines and technology to help others continue to meet their regulations. Scherrieble hopes in the next five years to show people a small version of what his company does. He wants to increase awareness of what is in our waters before treating the water to help allow people to realize the dangers that come from pollution.

Camden Group has been working towards cleaning local waters for years. Camden Group have complied with all regulations that have been thrown their way so that they are able to create a positive impact on freshwater. Camden is really taking the initiative to help the area have clean and safe waters so much that it has gone as far as helping other surrounding companies to follow their positive impact. Regardless of regulations, they strive to do what's best for the environment. The laws may be strict and plentiful, but the more regulations that are enforced, the better able we are to have knowledge about how to properly clean our waters. This knowledge leads to a safer and overall healthier impact of the way we live everyday life.

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Anna Maslowski

Another Day at the beach: Swimming with Your Sewage in the Great Lakes

Approximately 34 million people benefit from the common resource of the Great Lakes water and surrounding ecosystems, in addition to more than 3,500 species of plants and animals including over 250 species of fish that call the Great Lakes basin home (Tip of the Mitt Watershed Council). As an integral part of millions of Americans' lives, home to vast wildlife and ecological communities, a tourist attraction rich in geologic history, and 95% of America's freshwater supply, the Great Lakes are a resource in need of both protection and management. When swimming in the Great Lakes, most people don't consider they are enjoying water that also contains tens of billions of gallons of combined raw sewage, stormwater, and organic chemicals.

To address the overwhelming amount of sewage ending up in our freshwater supply, we must examine our fiscal priorities as a society and take a look at the sewage system infrastructure we rely on. There are two main types of sewer systems: separate sewer systems consisting of two pipes, one which carries stormwater and a second that carries domestic sewage, and combined sewer systems in which rainwater runoff, domestic sewage, and industrial wastewater are all collected in the same pipes (The United States Environmental Protection Agency). Most of the infrastructure in place in communities along the Great Lakes shoreline is more than a century old and uses combined sewer systems (Lyandres, Welch). During heavy rainfalls, the volume of water entering treatment facilities overwhelms capacity. Treatment facilities therefore dump excess water directly into nearby water bodies. High combined sewage overflows (CSOs) contribute to toxic algae blooms and high concentrations of bacteria such as *E. coli* in beaches and drinking water, which pose health hazards to the surrounding environments and communities.

Approximately 772 cities in the United States run on combined sewer systems, and it is estimated that up to 3.5 million people become ill each year from contaminated sewer overflows that contain organic material and waste, industrial waste, trash and hygiene products, and debris and chemicals from the street (Natural Resources Defense Council). According to Natural Resources Defense Council attorney Thomas Cmar, the Great Lakes beaches as of 2010 had experienced more CSOs than the rest of the United States, making the Great Lakes beaches the most polluted in the country (Hochanadel). Only a few weeks into the summer of 2018, 24 Michigan beaches had been closed or contaminated with stormwater runoff and sewage facility floodings (Zaniewski). Swimming hazards after storms are becoming more frequent in the Great Lakes due to the incapability of the sewage systems in place to process high volumes, so when will it be determined that it's finally time for a full upgrade?

Like many of the problems that face our society, we know the causes and the solutions. The National Resources Defense Council published in 2012 that until crumbling infrastructure is addressed, beachgoers will continue to suffer the health risks of swimming in polluted waters. The 2017 American Infrastructure Report Card grade for the nation's wastewater treatment was a "D+," defined as being poor to fair in condition, approaching the end of its service life, with large portions exhibiting significant deterioration. The American Water Works Association estimated at least \$1 trillion is needed to upgrade existing water systems to meet the needs of the growing population (American Society of Civil Engineers).

The problem is evident – funding is needed to upgrade our sewage infrastructure. Sewage certainly should be out of sight, but not necessarily out of mind. Sewage infrastructure is critical to our personal, economic, and ecological health and deserves to be engineered to the same modern standards we expect of other necessities in our lives.

Close to home, the Oswego River watershed contains hazardous waste sites, sewage discharges, CSOs, and municipal and

agricultural runoff and was once ranked among the most polluted sites in the Great Lakes. Hazardous waste has since been removed under Superfund programs, solid waste management facilities have begun to be maintained under the Resource Conservation and Recovery Act, and the city was removed from the Great Lakes Area of Concern designation in 2006 (Manadelia). Since then, the city has been more active in maintenance and has invested \$87 million to upgrade the Westside Water Treatment Plant to limit the number of sewer overflows (Office of Public Affairs). The combined sewer system was separated into stormwater and sanitary drains to alleviate stress on the combined system. Since 2016, there have still been 22 sewage discharges in the Westside Water Treatment Plant with the preventative long-term correction being on-going separations of the Westside Collection System (The City of Oswego). As of June 2018, the project was approximately two-thirds complete with about 50% of the city's sewer and stormwater systems separated (Reitz). These improvements are overdue, but welcome. However, Oswego is just one community, and local and national governments throughout the basin have to make a similar commitment to upgrade infrastructure as well.

Home to one-fifth of the world's fresh surface water and 95% of the United States' fresh surface water, the Great Lakes are not a resource to be taken for granted. What happens in the basin affects water for all species that share the landscape and its waters. The Great Lakes cannot support us if we cannot support them. Unlike many natural stresses the Great Lakes face, sewage discharges and overflows are preventable and can be solved by replacing antiquated infrastructure systems with the modern engineering the people and ecosystems of the Great Lakes deserve.

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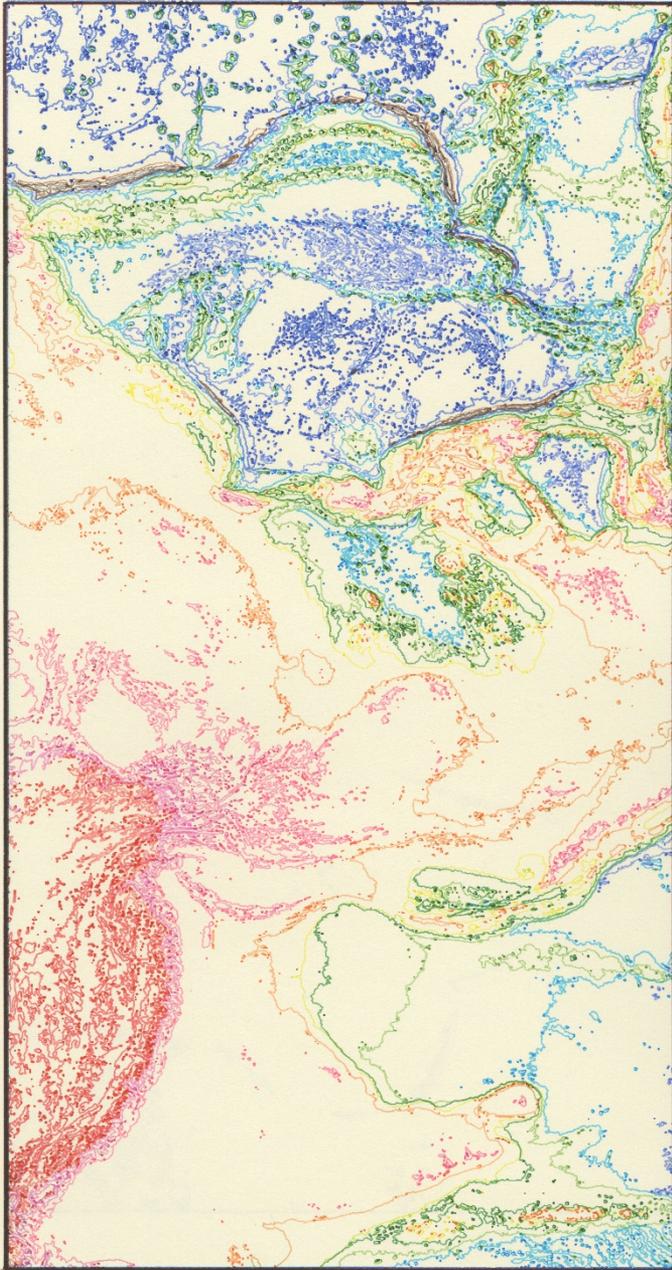
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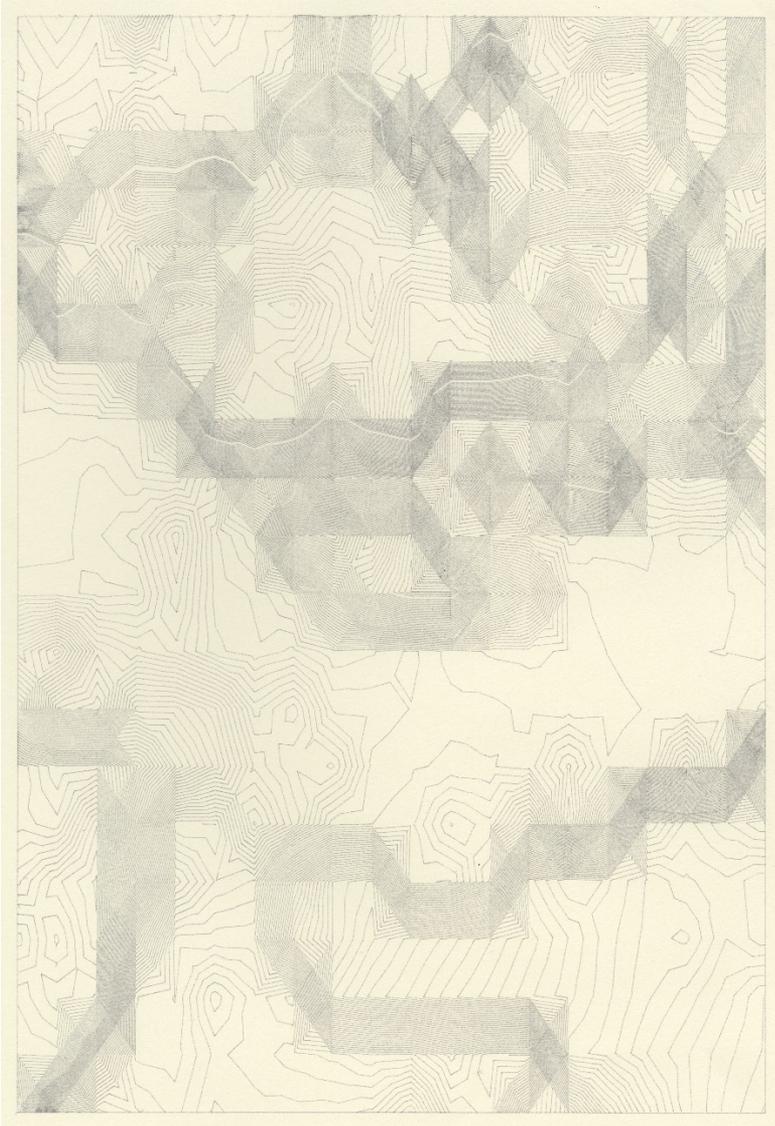
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The following images are part of an independent study project in the Art Department overseen by Associate Professor Cara Thompson that utilized cutting-edge technology such as the AxiDraw (Drawing Robot) and the HTC Vive and Google Tilt Brush (virtual reality drawing tools). Students were asked to create pieces focused on visualizing clean water. These pieces are the first created in this exploratory process, which continued throughout the semester.



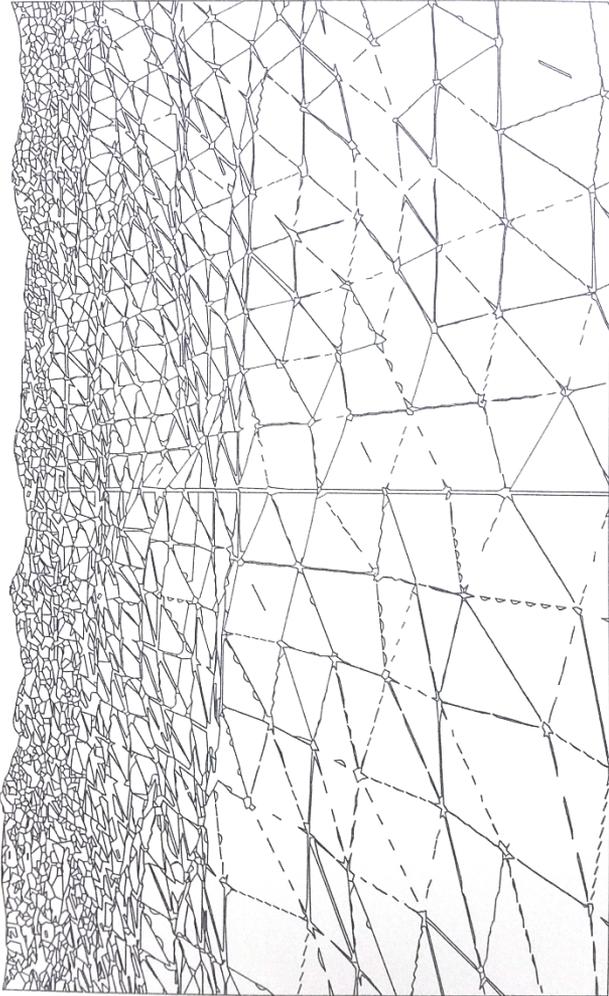
Abhishek Thapa: Aridraw drawing with ballpoint pen



Abhishek Thapa: AxiDraw drawing with ballpoint pen (2)



Bradley Holen: “Underwater” (VR drawing)



Zack Jocz: Axidraw drawing with ballpoint pen



Pragya Pahari: “Clean Water” (VR drawing)

We Are Lake Ontario

- A closer look at the litter on our lakeshore -



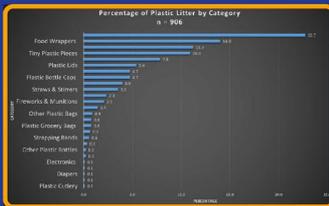
THE PROBLEM



In a recent clean-up event, more than 1,000 pieces of litter were found on the Lake Ontario shore ranging from fireworks to cigarettes. An estimated 22 million pounds of litter enter the Great Lakes yearly! Named "Lake of Shining Waters" by the Huron people because of its beauty, our lake is being dulled by mass amounts of litter.

Plastics

Of the 1,085 pieces of litter gathered from the shores of beautiful Lake Ontario, 83.5% consisted of plastic. Globally, an estimated 18 billion pounds of plastic enter the worlds' oceans and lakes each year.



Food and Drink Packaging

Of the 1,085 pieces of litter gathered from the shores of beautiful Lake Ontario, 40% consisted of items related to eating and drinking. The biggest contributors were food wrappers, plastic drink bottles, metal beverage cans, and plastic lids and bottle caps. Globally, over one million sea birds and mammals die yearly from consumption of food packaging products.

Items that are used by us once, likely stay in the ecosystem and impact our environment **FOREVER!**

Single-Use Items

Of the litter found, 81% is categorized of single use. The most frequently found single-use items include packaging, wrappers and beverage cans and bottles.



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How Little Actions Make a BIG Difference

The Solution  

- **REDUCE YOUR USE**

Dining out? Reducing your plastic waste is as easy as saying, "no straw, please", when ordering your drink. Consider bringing your own container to take home leftovers.

Life can get busy sometimes and it feels easier to grab a single-use beverage bottle on your way out the door. Instead, consider using a reusable water bottle you can refill yourself. You will save money, the planet, and your health. Frequently drinking sugary drinks is associated with a range of effects on health including weight gain, heart disease and tooth decay.

DRINK TAP WATER

CHOOSE TO REUSE

Remember to bring your reusable shopping bag when you make a trip to the grocery store. Some stores will give you a few cents back for doing so.

Can't seem to give up your plastic straw? No worries! Start sipping through a reusable straw made from glass, stainless steel or bamboo.

Getting a cup of coffee? Bring your own cup! Styrofoam (polystyrene) is known to be carcinogenic to animals and is a probable human carcinogen. Yuck. Bonus: many cafés will give you a discount for bringing your own cup.

It's important that we all take care of Lake Ontario to ensure that it can be enjoyed by future generations.

BE A GOOD STEWARD OF THE LAKE

When visiting the lake, be sure to use 'carry-in, carry-out' practices and if you see litter left behind, pick it up and put it in the proper receptacle.

Litter was collected as part of a Math Camp group activity in August 2018. The litter was organized and summarized by Casey Towne and Kate Spector of the Office of Learning Services and first presented during a 2019 January Break Out session. Organizational methods were adapted from the Alliances for the Great Lakes Adopt-A-Beach Litter Monitoring Form. <http://www.greatlakesadopt.org/Home/Links>

Source: Zuckowski, Dan. "22 Million Pounds of Plastic Enters the Great Lakes Each Year." Eco Watch. 2016. 2019 <<https://www.ecowatch.com/plastic-great-lakes-2157466316.html>>.

Riley Bolton



Joe Gray, Khushboo Panchal, Bharati Mahajan: Nero, a water use monitoring app



Summary

Water is the world's most important resource and the mission of Nero is to conserve this precious resource while saving consumers money.

Problem

Water prices are on the rise. Nero offers an easy way to reduce usage. According to Circle of Blue (a nonprofit network of journalists and scientists covering water issues), water prices have been increasing year over year since at least 2010. Federal spending on water infrastructure spending has decreased significantly since its peak in the 1970s. Water prices have steadily increased over the past decade and experts expect the trend to continue. Increased urban populations have further accelerated the problem. According to researchers from MSU, the problem is serious and getting worse with one-third of Americans are at risk of losing affordable drinking water by 2020.

Solution

With virtually no upfront expense or effort to implement, consumers can lower their water bills with Nero. A dual incentive structure will provide consumers with lower monthly bills as well as discounted access to products they already buy. Nero removes the upfront cost and ongoing investment required by current hardware solutions and offers a practical effortless monitoring solution.

Derek Kuhn

BIO 363 Photo Essay: Interacting with Lake Ontario and its Watershed



(Lake Ontario, Chaumont Bay NY; 02/23/19. Picture 1 shows a typical retaining wall among cottages in the area. Picture 2 represents one of the many watersheds that feed water and pollutants into Lake Ontario.)

The Great Lakes of North America are a natural wonder, created by powerful continental-scale glaciers. For 10,000 years, the lakes have served as a source of freshwater for all the local plants and animals; however, since Europeans landed on the Americas, the lakes have taken a turn for the worse, especially in the last 300 years (Egan 14). The Great Lakes are the largest network of fresh surface water on Earth. They hold 84 percent of North America's surface fresh water and about 21 percent of the world's supply (Guarino).

The Great Lake that has the biggest effect on my life is Lake Ontario. I live and go to school in Lake Ontario's watershed, so what happens in it affects me, my family and my neighbors. In addition, since all the Great Lakes are connected and flow into Lake Ontario, what happens in any one of the Great Lakes affects Lake Ontario. The photos above were taken in Chaumont, New York, where my grandfather built my family's cottage on Lake Ontario many year ago, before my dad was even born. My dad has been going to our cottage and this area of the lake since he was a child with all his siblings, especially during the summer.

Throughout my childhood my dad has done the same for me, and for every summer since I can remember, my life has revolved around going to the lake and enjoying everything it has to offer. However, the lake where my Father spent his summers is not the same reservoir where I spent my days off. Much has changed in the last 50 years. When my dad was younger, he used to be able to fish off the dock and catch tons of fish, but due to invasive fish such as gobies, many native fish populations have declined over the years and have become harder to catch. In addition, when my grandfather built our cottage, there were no zebra mussels covering the shore, but now every rock is covered with them. Over the years, zebra mussels have become a prevalent invasive species that entered the Great Lakes through the bottom of boats, changing the entire ecosystem. Many of the differences between the lake my father knew and the lake I know are due to "stressors." These stressors are usually man-made impacts that degrade the ecology of the lake and must be corrected in order for the lake to be healthy.

There are many stressors that can affect the health and water quality of Lake Ontario. In the photos above, there are a few examples of contributing factors that end up stressing the lake. In my first picture, we see the types of shorelines my cottage neighbors have constructed over the years. Unfortunately, this type of shoreline has become typical for this area in order to prevent erosion. When my grandfather built our cottage many years ago, he knew that erosion would pose a problem. Luckily, he did his research (he read many books about erosion, which still remain at my family's cottage to this day) before just walling off the shore. Instead, he left a gentle incline from the water and then placed a retaining wall to hold up the soil further back from the water. On the shorelines of most cottages in the area, big cement walls are prevalent and do their job to stop erosion of the shore. However, most of these cement walls don't last more than five years due to the power and size of the ice that breaks up and have to constantly be repaired and replaced.

At first, these erosion barriers might not seem like they would really affect the lake that much; however, they have a huge impact. Natural shorelines are important because they allow the lake to clean and heal itself. A natural shoreline usually consists of a slight incline of plants and microbes that can break down some of the harmful pollutants that humans dump into the lake (Essick). Shoreline barriers impact ecosystems across the Great Lakes region. Homeowners on the lake struggle to choose to either protect infrastructure and land from erosion or protect the ecosystem and its functions. Most homeowners choose to protect their land over the ecosystem and set up barriers that destroy the habitat of insects, crustacea, worms and more. Barriers placed low on the shore and into the water are more likely to affect a wider variety of ecosystem functions, including fish spawning grounds. Luckily, in some places across the United States, walls and barriers have been banned due to their detrimental effects on the local biota. An alternative that could solve both problems would be an approach that utilizes vegetation. Vegetation can be planted to reduce erosion and not upset the present ecosystem. These "living shorelines," which use nature

based approaches like native dune grasses or seaweed, help reduce erosion and improve ecosystem functions. To reduce erosion further, logs can be anchored into the upper shore to absorb wave energy. Overall, living shorelines provide a compromise that would improve the overall health of the Great Lakes and its residents (Dethier).

One of the best kinds of shorelines that acts as the kidneys of the lake are wetlands. Wetlands shelter not only a diverse group of plants and animals, but also a massive amount of microbes which work to break down chemicals that harm humans (Essick). Wetlands are usually flat, low-lying land with unique soil conditions that provide habitat for specialized plants and bacteria that break down pollutants, which in turn help give us clean drinking water. However, many wetlands have been destroyed and replaced by cities. For example, on Lake Erie, the Great Black Swamp was drained, and cities and farmlands replaced it. A massive, natural cleaning habitat was replaced by a massive dumping machine in the form of concentrated human agriculture and urbanization (Egan 214).

One city that is built over the Great Black Swamp is Toledo, Ohio. Toledo has recently been feeling the effects of an ecologically stressed lake. An algal toxin in Lake Erie contaminated the drinking water used by Toledo and many of its suburbs in August, 2014. Toxic algae is an indicator of a stressed and polluted lake. This type of toxic algae thrives on nitrogen rich warm water, which has become more and more common over the years. When the Black Swamp ecosystem equipped to filter out pollutants was replaced with a human driven ecosystem, which continues to dump pollutants Lake Erie faced a great loss for the health of it lake. The present of this once-grand collection of wetlands could have helped remove and cushion, the effects of human introduced pollutants on Lake Erie which have been disastrous in recent years. Overall, I would like to spare Lake Ontario the same fate as Lake Erie by educating local shoreline property owners with alternative ways to develop and protect the ecosystems present around them. Every citizen who

lives in the Great Lakes region would benefit from reformed management of these rare and fragile freshwater coasts.

Stressors can be seen throughout all the Great Lakes watersheds, not just on the lakes themselves. In my second picture, which is part of the village I've spent nearly all my summers in and around, a few different stressors can be identified. Only recently did I notice all the things we do on a daily basis, and that are all around us, that put the Great Lakes at risk. I've probably driven by this exact spot 1000 times without ever giving it a second thought; however, now I can't believe I've never taken notice of a few problems that are present. For one, the creek in the picture empties into Lake Ontario, which is no more than 100 feet away. To the left of the creek is a small parking lot for a local hardware store. When plowing the parking lot, all the snow is pushed right into the creek.

There's more than snow being pushed into the creek. Sand, salt and any trash left in the parking lot are also pushed into this tributary that leads to the lake. In addition, there's little to no buffer between the creek and the parking lot to stop salt and oil running off the pavement into the creek when it rains. All parking lots are salted and sanded, and cars occasionally leak oils and fluids onto the blacktop until they get pushed into the creek. Similarly, in the photo a white oil tank is very close to the edge of the creek allowing a spill or leak to enter Lake Ontario with ease. Over the years, since salt was discovered to be a useful product for keeping the roads clear, the Great Lakes have had elevated sodium levels caused by winter surface runoff (Guarino). Impervious surfaces, such as roads and sidewalks, allow massive amounts of dissolved salt to enter into lakes rather than soaking into the soil. The highest levels of sodium chloride are found where human population are highest, usually closer to shore. Lake Erie and Lake Ontario have the highest salinity reported, while Lake Superior is lowest with only 1 or 2 mg of salt per liter of water. In areas where the highest concentrations have been found, such as the mouth of the Saginaw River on Lake Michigan, the salinity levels are about one-tenth that of ordinary sea water (Guarino). If this continues the Great Lakes water quality could further degrade with implications for ecosystem function and

human water use (Zerbisias). It's important as citizens of the Great Lakes region to identify problems that are hurting the lakes and bring them to attention.

The lakes have changed tremendously over the years. Personally, I never knew you could catch big fish right from the shore until my dad told me that all his siblings used to do it when they were kids. It's hard for me to imagine a lake that abundant with fish, because it wasn't like that when I was a kid. My dad used to tell me my grandfather used to feed them fish right from the lake in the summer. He wouldn't dare feed my brother and me these fish because of the pollutants they hold. It's like a completely different lake.

In conclusion, there are many things that are stressing our watershed and surrounding lakes; however, it's important to learn what we're doing to degrade our water network and act accordingly to restore it. The Great Lakes, especially Lake Ontario, have always been a huge part of my life and my childhood, and I'd like them to be around for others to enjoy as well. Finally, unless we teach conservation across the country then nothing will change. Everyone has the ability to make his or her watersheds better than how they found them.

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Fresh Water for All: An Anthology of Student Writing

THE WATER REMEMBERS

Written by

Matt Hughes & Josh Sauve

Fresh Water for All: An Anthology of Student Writing

FADE IN:

EXT. MARITIME MUSEUM - LAKE SHORE - DAY

We begin with the waves of Lake Ontario crashing onto the shore. The water passes over rocks. It rises and falls along the sides of boats. It is peaceful and serene.

Jean (20, idyllic) speaks to us.

JEAN (V.O.)
My father once told me that the
water is alive.

YOUNG JEAN (11) and her FATHER collect pebbles from the shore. The wind animates flags and sails.

JEAN (V.O.)
That when you touch the waves, you
touch history.

Young Jean's hand skims across the water.

INT. DERRICK BOAT - BOILER ROOM - DAY

The boiler room is still, motionless, and covered in dust and webs. The Father points something out to Young Jean.

We hear the engine RUMBLING with life and sound of SHOVELING echoing from the past.

JEAN (V.O.)
The water remembers me just as it
remembers those who came before.

INT. DERRICK BOAT - MAIN ROOM - DAY

There is an empty bunk bed in the corner of the room. A small stove sits against the wall on the opposite side. Various artifacts of history lay in display cases. Young Jean leans closely over the glass, seeing her reflection.

JEAN (V.O.)
And it will remember you too.

INT. MUSEUM BUILDING - DAY

The walls of all of the rooms are lined with historical artifacts and artwork.

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Old furniture and other odds and ends are carefully placed throughout. Young Jean turns to her father and points out a cool piece with a smile.

JEAN (V.O.)
The relics of our past have many
stories to tell.

The SOUNDS of the past echo as she examines it.

EXT. LIGHTHOUSE - DAY

JEAN (V.O.)
Stories written in water and wind.

Young Jean looks up at the lighthouse from her father's arms as it stands in silent vigil amidst the water's endless war of attrition.

JEAN (V.O.)
From peaceful voyages to the
thunder of war.

EXT. LT-5 - DAY

The vessel of war stands fearless in the water. On the port side near the top, a German plane and swastika are painted.

The SOUNDS of GUNFIRE and a plane FALLING from the sky echo from the past.

Young Jean tugs on her father's sleeve to go inside.

JEAN (V.O.)
It has seen what we are capable of.

INT. LT-5 - BRIDGE - DAY

Young Jean runs her hands along the ship's controls. Through the windows, the lake is visible in the distance.

JEAN (V.O.)
Not only what we can destroy, but
what we can create.

INT. LT-5 - HALLWAYS - DAY

The hallways look rustic and solid. Spiderwebs line the corners of the ceilings and bulkheads.

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While her Father is busy, Young Jean wanders down the hall. She runs her hand along the walls until coming to an office.

JEAN (V.O.)
How we stand the test of time.

INT. LT-5 - OFFICE

A desk sits on the far end of the room. All sorts of military tools, odds, and ends litter the room. Two green army helmets rest on the desktop.

Young Jean walks up to the desk, eyes alight with imagination, and picks up one of the helmets.

JEAN (V.O.)
The water remembers.

She turns around and puts it on her head. It's too big, but she pretends she's a soldier. She salutes.

Two SOLDIERS, presumably from 1944, slowly appear behind her in full fatigues and salute too.

JEAN (V.O.)
All you have to do...

Soldier 1 reaches out and lays a hand on her shoulder. Young Jean turns around to catch them fading away.

JEAN (V.O.)
...is reach out and touch it.

Young Jean smiles to herself. Her Father comes in, puts the helmet back on the desk, and ruffles her hair.

EXT. MARITIME MUSEUM - DAY

All of the premises is visible and the museum logo overlays onto the image.

JEAN (V.O.)
H. Lee White Maritime Museum. Visit us today.

FADE TO BLACK.

Molly McLaughlin

Worldwide Water Shortages Could Lead to Civil War

Considering the numerous bodies of fresh water on this planet, there is now an important question on whether there is enough for all those inhabit the Earth. When discussing the topic of the availability of fresh water it is necessary to discuss the dangers associated with a lack of clean water. There are possibilities of extreme conflict and violence in which civilians feel as though they do not have the water needed to provide for all. The threat of civil war within regions that struggle with enough water is very real and very imminent in today's society. Several countries located in areas that are more prone to a drought or a period of time where rain is more uncommon are suffering from extreme government regulation and policies regarding the use of water. These regions on the planet, which are struggling with the availability of water, need to be acknowledged as well as the real threat of war.

When discussing the topic of lessening amounts of fresh water leading to possible civil war, we must discuss the reasons behind the issue. A few reasons listed by Suzanne Goldenberg of *The Guardian* are, "watering crops, slaking thirst in expanding cities, cooling power plants, fracking oil and gas wells-all take water from the same diminishing supply." These factors resulting in less water, as well as the drastic effects of climate change, have had detrimental results on many countries. Goldenberg emphasizes the rapid loss of water sources: "The losses of water reserves are staggering. In seven years, beginning in 2003, parts of Turkey, Syria, Iraq and Iran along the Tigris and Euphrates rivers lost 144 cubic kilometres of stored fresh water..."(Goldenberg). The statistic given on how much water is truly lost to factors such as fracking oil and power plants has caused such a massive loss in available drinking water in many Middle Eastern countries. Not only are these factors to be considered in the discussion of too little water, but droughts are to also be considered for the effect they have. During these droughts, bodies of freshwater evaporate and dry up which

leads to a significantly low supply of water. For reasons such as these, many governments take it upon themselves to place regulations over the use of freshwater. However, these regulations usually are followed by significant resistance, which in turn can lead to uproar.

The true threat of war in many Middle Eastern regions in response to the lessening amounts of fresh water must be discussed with more importance and urgency. It is hypothesized that war is not a fantasy by Dr. Peter Engelke, a senior fellow at Washington-based think tank Atlantic council hypothesizes that, "Between 2007 and 2010, Syria experienced of the worst droughts in recorded history, the effect of which was to decimate rural communities and drive hundreds of thousands off the land and into Syria's cities," (Smedley). Engelke asserts that these droughts will result in little to no readily available natural resources as well as reduced amounts of valuable land. The great shortage of freshwater in these regions will cause for smaller communities to be a target as they rely on the water for a livelihood of agriculture. Those who rely solely on the freshwater will be forced into the cities, where there is little room for them (Smedley). The concept that a lack of a basic human necessity could result in war and death is not too radical when considered seriously. For those around the world who do not see any possibility of regaining a source of freshwater, what do they have to lose?

The danger of civil uproar and even war within a country due to the lack of available drinking water is further supported by writer Suzanne Goldenberg. Goldenberg discusses the threat of war in certain countries: "Water, on its own, was unlikely to bring down governments. But the report warned that shortages could threaten food production and energy supply and put additional stress on governments struggling with poverty and social tensions." She emphasizes this point by referencing a report written in 2012 in which the US Director of National Intelligence was concerned that constant usage of a city's water supply could lead to conflict and was a threat to the national security of the United States (Goldenberg). The 2012 report is quoted stating, "During the next

ten years, many countries will experience water problems—shortages, poor water quality, or floods—that will risk instability and state failure, increase regional tensions, and distract them from working with the United States” (Goldenberg). The efforts being made to conserve the amounts of water available in certain parts of the world are met with resistance as water rationing and plans to limit water use are not viewed as helpful to the public.

The efforts that are visibly being made by world authorities in order to reduce the use of water have made great impacts but it is not enough. Goldenberg reports that countries in the Middle East are in the process of rationing the water for the 22 million people who live in Tehran in an attempt to conserve water, and Egypt is reaching out to Ethiopia to quit the construction of mega-dam on the Nile with the hopes to determine whether this would possibly restrict the flow of the river and fresh water it provides. Goldenberg notes that a problem presenting itself is the influx of Syrian refugees who seek sanctuary in countries such as Jordan. The appearance of refugees have led to an extreme water shortage for the entire country, which already was struggling to provide for those who call Jordan home. Goldenberg reports that in an effort to combat this issue of overpopulation affecting the availability of limited resources, the United Arab Emirates has, “invested in desalination projects and is harvesting rainwater.” The emergence of these factors that are first hand in the fight of less fresh water available and a greater discussion needs to be had in terms of how to solve the issue. According to a national intelligence report, the threat of war brought on by water shortages is clear: “As water shortages become more acute beyond the next 10 years, water in shared basins will increasingly be used as leverage; the use of water as a weapon or to further terrorist objectives will become more likely beyond 10 years” (qtd. in Goldenberg). Ten years may sound as if it is far in the future, but if we as human beings treat it as that then it will be here sooner rather than later. If the crisis of global water shortage is not resolved through collaboration between these countries, a consensus on how to preserve water will not be met and citizens will grow tired of constant rationing.

The discussion on the limited fresh water reserves on Earth has led to the possibility of civil war and uproar in many regions in the world. The use of less resources to scare the public into succumbing to government policies and restrictions is already occurring across the globe. Environmental stressors such as droughts are not entirely under our control but the tools we utilize to combat it is. The imminent danger of conflict in oppressed countries worldwide will affect not just those who live there. As a planet, our natural resources that are necessary for our survival are dwindling and the responsibility is no one else's to provide a globally accepted solution. We must support those who face oppression today so that in ten years' time we will not have to reverse the effects of a freshwater crisis.

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Kolton DuBray & Luigi Villani

Onondaga Lake Water Quality

Onondaga Lake is located in Central New York and is immediately northwest of Syracuse, New York. Although this body of water is located in the Finger Lakes region, it is not considered to be one of the Finger Lakes. The area around Onondaga Lake was settled on throughout the 17th and 18th century. This area was a hot spot for European immigrants' due to the presence of salt rich springs that surround the lake. The salt industry was a booming industry in Syracuse at the time and immigrants flocked there for economic opportunity (Central New York, n.d). By the 19th century, the area was a popular tourist attraction due to Onondaga Lake being located there. People came from all over to visit the beaches, amusement parks and resorts that surround the lake. Unfortunately, due to the mass number of people and rapid industrialization surrounding the lake, by the 20th century the lake had become heavily polluted. Once people realized how bad the pollution in the lake actually was, they began to take initiative. There were many laws and actions made to protect and clean up this once beautiful lake so it could be utilized once again.

By the mid-1900s, Onondaga Lake had become noticeably polluted. By 1940, swimming in the lake had become prohibited because it simply was too harmful for humans to swim in, and by 1972 the condition of the lake had gotten so bad that they even banned any fishing in the lake. Swimming was also banned in 1940 (New York State Department, n.d). It came to a point where the smell was so bad that families passing by on the roads would have to close the windows in their cars (Chanatry, D. 2012, July 31). The use of the lake changed drastically when the water and lake bottom sediments had become polluted with industrial pollution and even sewage waste that was being dumped into the lake. Some companies that were sued by the state over this toxic dumping include Allied-Signal Inc. and its corporate successor Honeywell International and Onondaga County's sewage treatment plant, Metro (Central New

York, n.d). The company dumped very large quantities of waste into the lake, causing the oxygen levels in the water to lower drastically. The pollution created higher levels of nutrients and organisms that were harmful to the lake and the people who were swimming in it; toxic contaminants and disease-causing bacteria were making people sick.

By the mid-1900s, the Western side of the lake had become completely industrialized, which brought heavy levels of pollution. Due to this, the fishing and resort industry began to drastically decline. The destruction of Onondaga Lake was caused by over 125 years of constant industrial and chemical operation pollution being dumped into the once beautiful lake. At one point, there was over 20 pounds of mercury being dumped into the lake each day. The company that is mostly responsible for the massive amounts of mercury is called Allied Chemical (Chanatry, D. 2012, July 31). Mercury is a liquid metal that is very harmful to humans, even when exposed to it in small amounts. Often, when exposed to mercury, humans experience toxic effects on the nervous, digestive and immune systems. In most cases, mercury has negative effects on the kidneys, lungs, skin and eyes. The excessive amount of mercury that was being dumped into the lake caused the surface water to become toxic with extremely high levels of mercury. The sediments in the lake had become rich in Polychlorinated biphenyl or (PCBs), which is an organic compound found in chlorine, also harmful to humans. The sediments were also contaminated with pesticides, creosotes, heavy metals and numerous volatile organic compounds (Mercury and Health, 2017, March 31). The amount of pollution was so rich within the lake that even the groundwater at numerous upland sites surrounding the lake had become polluted. At this point, by the 1970s the lake had been deemed completely unusable and unsafe to be utilized at all.

There has been an immense amount of pollution that has been dumped into Onondaga Lake throughout many generations, and even though there has been an intense cleanup effort over the past 50 years, the lake is still negatively impacted to this day. Although there have been multiple laws enacted and programs

created, the lake is still not very clean. Obviously, it has improved since being hailed as the “most polluted lake in the United States”. However, the past century of industrial pollution has definitely impacted the lake for generations to come. With the help of new laws, programs, and general appreciation of the lake by pedestrians, there is hope that the lake will soon be completely rid of pollutants.

Being that people have grown more aware of the issues of pollution around the Onondaga Lake area, there have been many efforts to restore the lake to healthy, flourishing standards. These efforts have been made through enacting several laws and creating amendments to improve the treatment of our nation’s bodies of water. One of the acts that became the most influential on Onondaga Lake is the Federal Clean Water act of 1972. The EPA was given the authority to implement pollution control programs like setting wastewater standards for industry. Also, the act made it unlawful for any person to dump any pollutant from a point source into navigable water, unless a permit was obtained (EPA, 2019, March 11). This in itself is very important as it attacks the issue of pollution head on. Another law that was very effective in setting standards for water pollution was the Resource Conservation and Recovery act of 1976. This act gave the EPA authority to monitor and control hazardous waste “from the cradle to the grave”. This means that the EPA has the right to monitor the transportation, treatment, storage, and disposal of hazardous wastes (EPA, 2018, August 15). Obviously, this is very important, companies are not able to hide their dumping from the EPA anymore and the EPA can keep a strict hold on companies that may be dumping pollutants.

Since the enactment of these laws, Onondaga Lake and many other lakes throughout the United States have been cleaned up and restored to livable conditions. Onondaga County has also made numerous strides to clean up the lake. They have created multiple programs, for example, the Save the Rain (STR) program. The STR program is focused on “implementing green and gray infrastructure for removal of storm water from the combined sewer system through green infrastructure projects, CSO storage with conveyance to metro, and elimination of CSO discharge points” (Onondaga County

Department, n.d). Another important part of Onondaga Lake's history of pollution was the Amended Consent Judgment act of 1998. This federal court order mandated that Onondaga County take steps to reduce the amount of pollution that enters Onondaga Lake and its tributaries (Onondaga County Department, n.d). All this attention that the lake received for its polluted waters has resulted in much cleaner conditions today.

It is now considered safe to swim in again and safe to fish. Although this is true, it is not exactly a hot spot for tourists' due to its troubled history. Being that there has been so much pollution in the water, the area may never be enjoyed how it should be. People are hesitant to want to swim in it, and being that there is no beach for people to stand on and sunbathe, there is not many people who use the lake. One thing that people do often on Onondaga Lake is fishing. The largemouth bass is very prominent in those waters. This can attract more people to the area, and the economy can benefit. This would be great for small town businesses that are selling baits and tackle. Everything is connected, and it is important not to take advantage of the ecosystem because although it may not affect us short term visibly, it more than likely will affect people in the long term.

In conclusion, Onondaga Lake has been an area directly affected by pollutants which has sparked a lot of controversy over the last century. There have been laws enacted, federal court mandated changes, and programs created to try to save Onondaga Lake and the 50+ species of fish that live there. It is very important to take a look at this situation as to help set examples for the future. The Onondaga community has made strides to reduce all pollution and come together to help save an important landmark. It is truly great to see that people are beginning to become more aware of the environment and how all their decisions affect the world around them. As of now, the Onondaga Lake revitalization project is currently ahead of schedule, making great progress with their work.

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Jack Geddes, John Sarkis, Daniel Frawley

The Importance, Issues, and Regulations of Freshwater

The stakes have never been higher. With a growing population coupled with a limited supply, freshwater became a concerning topic over the past handful of years. Beyond scarcity, poor efficiency of freshwater systems, and ever-changing cyanotoxins provide an alarming future. The city of Oswego hired the Camden Group, after realizing the lack of infrastructure. As a society, we are largely looking to address the issue. While there are many laws and regulations in place to ensure water is treated properly; however when these are not carried out, the effects can be unnerving.

The most notable situation of something going wrong recently is in Flint, Michigan. The Flint City Council decided in 2014 that the city of Flint would move its drinking water supply from Detroit to the Flint River in an attempt to save on costs. Flint did not run proper tests before making the switch, and lead from the old pipes contaminated the water supply. The lead poisoning resulted in foul-smelling, discolored, and off-tasting water used in Flint homes. In severe cases, health issues included skin rashes, hair loss, and itchy skin. The Flint River had been contaminated by local industries for more than a century. The waste was from car factories, paper mills, lumber yards, meatpacking plants and more. Without properly treating this water, the lead-filled water was piped throughout the city of Flint, and the problems soon ensued (Denchark, 2018).

The switch to the Flint River water supply brought an outbreak of Legionnaires disease, which is described as a severe case of pneumonia, killing twelve people and affecting 87 people between 2014 and 2015. The city did not take proper action in an attempt to treat the water; instead, they added more and more chlorine. This also backfired as it raised levels of “total

trihalomethanes,” which are chemicals that can cause cancer (Denchark, 2018).

Regulations are in place to keep such things from happening. The Clean Water Act of 1972 attempts to regulate wastewater from industries as well as any possible pollutants. The Act gives the United States Environmental Protection Agency (EPA) the authority to set minimum standards to protect the water (Environmental Protection Agency, August 2017). The Great Lakes, Superior, Michigan, Huron, Erie, and Ontario, are responsible for much of the world’s freshwater. The EPA says the Great Lakes are responsible for 84% of North America’s surface fresh water, as well as 21% of the world’s fresh water. In Oswego, New York, the water is pumped from Lake Ontario, treated, and sent throughout the city of Oswego.

In the city of Oswego, treatment is handled by the Camden company at Oswego Eastside and Westside Water Treatment Plants, which provide treatment to all sludge water generated in Oswego and surrounding areas. These facilities treat 40 million gallons of water between both facilities (Scherrible, 2019). The Eastside Facility is used to treat all contaminated water in Oswego, including SUNY Oswego. The Westside Facility treats all lake water, which goes right into the water supply. The sludge removal process is achieved by dewatering using a centrifuge, a process that separates wastewater solids from the liquid. Once that’s finished, the sludge is hauled to a landfill for disposal. The Plant received a complete upgrade in 2013 to increase the wet weather capacity, along with upgrades to the pump station (City of Oswego, 2019).

According to Westside Water Treatment Facility manager Ken Scherrible, Camden group became involved with the city of Oswego due to “deferred maintenance” at the city’s water and sewage facilities that involved inadequate process control management and generally poorly managed operations: “we never get called in because everything’s wonderful; we have [been] called in because everything’s gone to hell” (Scherrible, 2019).

The treatment plants are forced to abide by laws and regulations set forth by the EPA and the Department of Environmental Conservation (DEC). Regulations from the 1972

Clean Water Act include those that establish a maximum contaminant level of bacteria, viruses, and other pathogens that can find its way into water sources. The EPA also requires stringent regulation on drinking water. It attempts to limit chemical contaminants such as lead, copper, chlorine, and other synthetic products that could affect our water. Limits are also placed on microbial contaminants. These contaminants must be filtered out of all water coming from lakes, rivers, reservoirs, and ground aquifers (EPA, September 2017). Oswego Westside Water Treatment Facility Manager Ken Scherrible believes these regulations have changed his company for the better: “The regulations have changed and got much more stringent, so as a result of that it's made us a much better company than when we started” (Scherrible, 2019). Over the past three years, the EPA increased the number of substances they put on their Contaminant Candidate List, which, in turn, requires treatment facilities to filter out a growing number of substances (EPA, 2018).

The Clean Water Act instilled a program to regulate the discharge of pollutants into US waters through the National Pollutant Discharge Elimination System (NPDES). The NPDES program regulates multiple aspects of water treatment, including Discharge Monitoring Reports, minimizing industrial discharges during overflow events, along with on-site compliance evaluation from compliance and enforcing permits. The objective of the program is to make sure treatment facilities follow the steps to manage common problems among wastewater practices. (EPA, September 2017). Camden group shows evidence of following these regulations and good practices with the availability of Discharge Notification Reports, as public records found on the Oswego government website, with the most reports as recent as February 6th, 2019 (City of Oswego, 2019). According to Westside Facilities manager Ken Scherrible, officials from the EPA and other regulatory bodies inspect Camden’s facilities annually, unless they discover an issue where they feel the need to come back at a future time (Scherrible, 2019).

Wastewater facilities deal with Significant Industrial Users (SIU) that have permits that determine the parameters of how much wastewater they can safely dispatch to the facility. Sometimes, SIU's are businesses that aim to maximize profit at the expense of loosely following regulations and normal operating practices. Ken Scherrible points out, there have been industrial users in the past have applied new processes without notifying the westside waste facility, which could interrupt normal operations at the treatment plant (2019). Wastewater facility officials tour SIUs biannually to make sure their water processes meet the requirements of their facility. If these industrial user's fail to meet their permit requirements, the treatment facility can work with them or take actions against them, depending on their compliance with regulatory provisions. Some regulatory processes by the EPA make sure every SIU can comply with its wastewater facilities capacity parameters through "pretreatment programs," such as mechanisms at the business site to test the water before it's released into the sewers. Sewer Use Ordinance determines what a business's pretreatment process will be and how it will be handled and regulated (Scherrible, 2019).

The main problem Westside Facilities manager Ken Scherrible sees is getting certified operators: "I'll tell you the regulation right now, which is kicking everybody's butt in water and wastewater, is getting certified operators. Nobody grows up to say they want to be a sewer plant operator a water plant operator." It takes three years if you have no advanced schooling to acquire a certification and two and a half years if you have a bachelor's in science. Sherrible (2019) says, "there just are not enough people coming through the pipe or qualify to run these plants."

In the near future, freshwater issues will only increase, as a growing population will require more water. Issues include poor piping infrastructure, treatment plants not receiving enough funding or workers, and scarcity. However, Camden Group is working on technology that they say might up the game of all water treatment plants: "One of these things were working on is called cavitation... If you harness that energy and use it to destroy cells, then you can

destroy the cyanotoxins and these other emerging contaminants,” Sherrible (2019) claimed. The future of water is important and unsure, but companies like Camden group are working to create a more efficient water system.

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Matthew Gorman

Preservation of Lake Sturgeon Throughout the Great Lakes

Picture yourself in the late 1800s. You're a fisherman making a livelihood out in the vast expanse of Lake Ontario. Your ship has been trawling for hours as you attempt to catch fish to sell at the local market. When the net is pulled up, it's filled with a mass of prehistoric monsters: lake sturgeon. Your crew tosses them overboard or kills them on the spot; these fish cause more damage than they're worth by destroying equipment with their rugged bodies. Fast forward to 2019. Today, when lake sturgeon are caught in Lake Ontario, they are still thrown back, but not because they are unwanted. It's the exact opposite. Today, lake sturgeon are threatened in New York State and around the Great Lakes basin. Decades of reckless slaughter have pushed this species that dates back hundreds of millions of years to near extinction in mere decades.

The lake sturgeon, a mighty fish once so common in the Lake Ontario watershed, is now reduced to a threatened species. Its story is heard time and time again with various species in the Great Lakes and across the globe. Sturgeon are an ancient group fish whose body plan has remained virtually unchanged for nearly 200 million years (Krieger and Fuerst). The lake sturgeon, specifically, is the largest fish in the Great Lakes region, growing to a size of over 7 feet, and if the conditions are favorable, they have the potential to live over 150 years (NYS DEC). Lake sturgeon are very unique looking and have bony scutes on the outside of their body that act as protection. They also have long barbels growing underneath the snout in front of the mouth to sense benthic prey hiding in the substrate.

What makes these fish so special is that they are the only species of sturgeon consistently found throughout the Great Lakes. This species is a bottom dweller and typically eats invertebrates

living on the bottom of the lake such as shellfish (Warren & Burr, 2014). Because they are near shore fish, on a rare occasion they can be spotted below docks and harbors searching for food. Catching a glimpse of one of these magnificent beasts is absolutely breathtaking.

Around the early 20th century, lake sturgeon were commonly killed for their eggs to be used as caviar and for their meat (Warren and Burr). Around this time, fishing in the Great Lakes was a lifestyle and common job for many. Every day, fisherman would be out on the lake catching fish, specifically the lake sturgeon. Unfortunately, this constant pressure of being caught and killed was detrimental to the species. Over four million pounds of sturgeon were caught per year between 1879 and 1900 in the Great Lakes alone (“Lake Sturgeon”). However, overharvesting was only half the problem.

Perhaps the biggest detriment to the lake sturgeon was and still is their decline in habitat (Pollock, et al.). When laying their eggs, lake sturgeon tend to swim upstream and release the fertilized eggs on rocky river beds, which help protect them from harmful predation and environmental effects (Warren and Brooks). In the past, lumber was a commodity obtained through logging, which affected the local environments, specifically the water ways. While this collection of lumber wasn’t harmful to the lakes themselves, it did have an impact on various waterways and tributaries leading out of the great lakes. Garman and Moring observed a riverbed before and after deforestation. Researchers found that as more grounds were exposed and unprotected by trees, more erosion could occur because there would be no roots to anchor the soil, and as rainfall accumulated, more water and sediments were washed into nearby waterways. This sedimentation could fragment habitat and alter substrate conditions. As the substrate composition changes on the bottom of these water systems and habitats were fragmented, less space would become available to leave the eggs, causing them to be laid in locations that may lead to their destruction. (Flaspohler, et al.). Today with hydroelectric power and dams being used more frequently to generate electricity, these same river systems are

affected. This process has the potential to change the shape of the river beds from water flowing out of the dams, cause water level fluctuations, and prevent sturgeon from being able to reach proper nesting sites (McKinley, et al. and Barth and Anderson).

Reproductive success is a very worrisome issue within populations of the lake sturgeon. The age at which they can reproduce varies between sex, but is staggering nonetheless. According to Warren and Burr, males reach sexual maturity between the ages of 15 and 20 years while the females reach sexual maturity between 22 and 33 years of age. These numbers mean once a sturgeon is born, at least a decade and a half must pass before the individual can reproduce. As juveniles, sturgeon have many predators including muskellunge, northern pike and walleye (Smith and King). The presence of these predators among others lead to a low survival rate of young sturgeon.

While the outlook of sturgeon may seem grim, there are many conservation efforts aiding in attempts to increase their population. One widely used method is hatching and releasing juveniles into the wild. Pregnant females are caught in a stream where it is known sturgeons lay their eggs. The eggs are removed from the female and placed into a bucket and mixed with sperm. After the eggs are fertilized, they are incubated and eventually hatched. The juveniles are then allowed to grow to a large enough size where predation will be lessened and they can be promptly released (Ćeskleba). The former Department of Natural Resources fisheries manager, Ron Bruch, would commonly use this method of reintroduction to increase local lake sturgeon populations in Lake Winnebago, Wisconsin (Bruch, et al.). Various methods such as this have potential to increase population size within the great lakes and connected water bodies such as Oneida Lake (Reitz).

The lake sturgeon is a marvel of the Great Lakes and deserves respect. They have an exceptional body plan that has remained virtually unchanged since the cretaceous period and are truly a living fossil. The conservation of this species should be a priority, and citizens living around the great lake basin would likely rally around the conservation of this amazing fish if they knew more

about its unique place in the great lakes and its evolutionary history. With the lake sturgeon representing a fish of ecological and symbolic importance, residents of the Great Lakes will also be conserving other biota that share our Great Lakes ecosystems. Thankfully, conservation work on this species in and around the Great Lakes basin continues today, and we have more information regarding their life habits than ever before to help with the effort.

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Rasheed Shabazz

The Pond

As a child, most of my summer afternoons were spent at the Central Park pond with my late grandmother and cousins. Growing up in East Harlem, New York meant that the lovely Central Park was within a walking distance. On days that were too humid to stay inside my grandmother would take us down to the pond. On our way there, she would buy us all jumbo popsicles that dripped down our wrists as we ate them. My grandmother was a sweet woman, one who always put her grandchildren first. Our days at the pond were spent feeding ducks and fishing. We would all toss pieces of bread at ducks calmly sitting on the surface of the pond. I watched as they swiftly snatched the bread pieces out of the water. Dragonflies hovered amongst cattail plants as the faint sound ice cream truck music played in the background. Seeing the ducks enjoy the bread brought me enjoyment, I often wondered how the bread tasted to them. On occasion, the aggressive ducks would chase us, seeking more bread. We ran around the pond, full of excitement and terror as the greedy ducks pursued. Besides the frequent chases, our time spent feeding ducks was the peaceful break that we all needed. Out of curiosity I decided to ask my grandmother one afternoon why we fed the ducks.

“We do it as an act of kindness,” she said.

“What did the ducks do for us?”

“Being kind doesn’t require a reason. We do kind things simply because it’s right.”

Her statement was short and simple, but it is a statement that has resonated with me since. It was a simple enough statement for a seven-year-old me to comprehend, and it remains the mindset that I have at nineteen years old.

When fishing, my cousins and I eagerly placed tiny pieces of hot dog on each of our hooks. We would beg our grandmother to let us dig in the dirt for worms to use as bait, she never let us. My summer afternoons spent fishing at the pond taught me the art of

patience and anticipation. I still remember the day I caught my first fish on my own. I was able to cast my fishing line out to a respectable distance, as I waited. I kept my eyes focused on the bobber, ready for even the slightest tug. After about 15 seconds, I felt a slight tug on my rod, then a strong tension. My cousins shifted their focus to me as I froze with bewilderment.

“You’ve caught one. Reel it in!” shouted my cousin as she gripped my shoulder.

I bent my knees and braced myself as I furiously reeled it out of the water.

It felt great to finally catch my one on my own; I let out a sigh of relief as I cracked a cheeky smile. My grandmother helped me unhook the fish as we tossed it back into the pond. My cousins and I still fish at the pond on occasion. My grandmother has passed since then, but I shall never forget our beautiful summer days spent by the pond.

Victoria Armet

Backroad Crossing

The road that always floods when it rains
because it curves through a pond

(it's not a pond due to size
and connections slowly shifting the water back to the lake
to keep things moving
but it's not a lake due to the green of the ecosystem
and how it grows unruly without deep expanses of water
to break up its designs as it caters to the small creatures
who don't fear land despite the pain and guts
from the black unmoving lake and its hulking inhabitants
who fight without mercy and insist on photos)

where there once was a beaver slapping its tail
and turtles randomly appear as they make their way into our grass
to snap at our helping hands
that still holds frogs despite their lack of self preservation
as rain coaxes them from their mud homes to be crushed
beneath the tires that spin on the asphalt because the road is flooding.