Analysis of Water Quality in the Pike River

The overall state and quality of water in the Pike River

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Introduction:

Studying watersheds in a specific area gives knowledge and understanding on how humans impact the surrounding environment, urbanization along with the use of pesticides affect the hydrology of the watershed. Every place on earth is part of a watershed. Watersheds are specific to each region of earth and are can be defined by a place where all water drains to one common water-body. Constantly interacting with the watershed around them, humans have a heavy impact on their environment. It is important to study and monitor these actions to have a better understanding on the quality of our earth, and to realize the consequences of poor environmental actions. Focusing on one specific watershed can tell a lot about a region. In the pike river watershed, there are various contributing factors to the quality of water. Urbanization, an increase pesticide use and water extraction all play heavy roles in water quality. Water is a daily necessity and having a clean, abundant source of water determines the outcome of a society.

Urbanization along with the use of pesticides and other chemicals can be detrimental to fresh water. According to the article "Wisconsin WaterShed, Pike River Watershed, 2010 Water Quality Management Plan Update", "Decades of floodplain development and increases in impervious surfaces in urbanized watershed like the Pike have led to a historic stream channel lining, deepening, straightening, and relocating to move stormwater off the land and downstream more swiftly. Although these practices are now regulated, the rules came too late for the Puke River Watershed where decades of agricultural and urban development have left their mark." Considering that about 150 years ago the land virtually showed no signs of modern development, the land surrounding the Pike river has faced major changes in the past century. Forests and diverse wetlands used to surround the River, today approximately 20% of the land is highly developed. When roads and other man made surfaces are constructed, instead of soaking through the land and naturally entering the watershed everything that lands on the impervious

surfaces flows into the sewer systems which then run directly into the water-body. This has a heavy impact on freshwater. Modern farming techniques have also brought problems for freshwater, when farmers use pesticides to help grow their plants, runoff from their farms enters the water and creates problems like algae blooms which kill off other plants and animals living in the water. It has been proven that the impacts are negative to both humans and aquatic life but actions of the past cannot be reversed.

The total amount of water in the atmosphere doesn't change, but humans affect water placement and usage. The article "What is Hydrology and Why is it Important?" states "People don't make new water to sell, they simply take water from one place, such as a river or lake, clean it, and put it in a fancy bottle to sell." Because water is needed for life, people are constantly take water from one place and transporting it to another in order to survive and thrive. Humans do things to change water quality and this can impact the hydrologic cycle and environment around them.

Learning about watersheds is important because every place on earth is one. Using knowledge about watersheds, people can monitor and study a specific watershed. "Watersheds" from Schoolyard Hydrology-Ecology Teachers Hand Book, says "All of us living within a particular watershed have the ability to make changes to the environment which can intentionally or inadvertently affect aquatic ecosystems." Sometimes without knowing it humans impact their watershed. For example, an oil spill on a highway will flow in the sewer system, and then it will enter the water source (in this case the pike river). Pollution then occurs, most times, the person does not pollute the water on purpose. In the pike river, cases of "chronic aquatic toxicity", E.Coli, and habitat loss have all been spotted. Chronic aquatic toxicity is when an organism is exposed to something that might be harmful or detrimental to its health over a period of time. Having a basic understanding of watersheds will create general knowledge of these topics so that it can be avoided in the future.

The pike river is just one watershed out of the thousands in the world. Its qualities can be used to learn about the environment. Human activity and chemical use in the past century have helped to change the pike river watershed and have altered the way humans view the hydrologic cycle.

Methods:

September 25, 2014 from 12:00pm-1:30pm data was collected by Harborside Sophomores on the quality of the water in the Pike River. The weather was 24.3°C and partly cloudy. Multiple different tests were used to   determine the waters overall quality. The tests done included: streamflow , air and water temperature, dissolved oxygen, biotic index, Ph, turbidity and habitat.

Temperature tells alot about the quality of water. It is closely related with oxygen content. Lower temperatures indicate a higher amount of oxygen because there is more room for oxygen molecules to fit .Metabolisms of animals in cold water have to work harder because the water slows growth. Hotter water is generally an indicator of less oxygen. How water absorbs more minerals and leaves less room of oxygen particles. Hot water can be an indicator of thermal pollution as well because chemicals dumped from factories and industries reacts with the water causing the temperature to rise. In addition hot water is more likely to erode more soil. Warm water is better for plant growth but worse for animals because of the amount of available oxygen.   To measure temperature the process is quite simple. The bottom of a thermometer is inserted in the water for about 20-30 seconds about one foot deep into the water. After removing the thermometer the temperature is recorded. When reading temperature, the number recorded is observed at eye level and recorded in degrees celsius. To get an accurate reading ,   it is best to measure temperature in different sports of the river.

Dissolved Oxygen indicates the amount of oxygen in the water. Plants and animals both depend on oxygen to live and grow. Different animals need different levels of oxygens to sustain healthy levels.

For example, trouts require lots of oxygen and often use of lots of the available oxygen in a stream. Other organisms have the ability to adapt to low oxygen levels and survive with low amount of it. An extreme lack in oxygen results in the dying off of organisms. Many times low oxygen levels occur due to an overpopulation of plants like algae. Algae rapidly grow and require lots of oxygen , often taking it from the rest of the aquatic population. Too much oxygen however can also have negative impacts. Animals can get bubbles disease, where too much oxygen gets into their system causing their blood to bubble eventually resulting in death. Even though this is rare it is possible and has occurred before. The first step in measuring DO is to collect the water. Collecting the water starts by taking the plug of the top of the bottle and submerging the bottle approximately one foot under the water. Slowly filling the bottle while allowing ALL air bubbles to filter out is necessary for accurate results. Make sure that there are no air bubbles in the water when putting the cap on, if there are still air bubbles remove all water from the bottle then try again. Once water is collected properly, follow all instructions on the standard hach model.

Ph measures the acidic or basic content in water. The ranges are from 0-14. Anything less than 7 means the water is too acidic. Any where more than 7 indicates there is more of a base in the water. Acidity is affected by the amount to hydrogen in the water.Low Ph readings indicate toxic elements may be able to come mobile and can cause harm when in contact by aquatic organisms. Too much acidity on the other hand can burn fish which is obviously negative. Ph is a an efficient way to show how water changes chemically because different chemicals in water affect the reading of Ph. There are two ways to read Ph the first is with a Ph reader and the other with strips. To measure Ph with strips, the strip is inserted face down into the water and swirl around for 20-30 seconds. Then looking at the color displayed on the strips and the bottle determine the Ph of the water and record on data sheets. Testing occurred on the Left, Right and Middle banks of the Pike River.

Turbidity is the clarity of the water and it has an impact on various other tests such as Dissolved oxygen, and temperature. If water is too cloudy, sunlight does not reach the entire body of water making the temperature colder and affecting the photosynthesis of plants. Starting the process fill the turbidity tube with water, keep removing water from the top of the tube until the bottom is visible. The more centimeters of water visible the better. Centimeters transfer into NTu's which are used to measure turbidity. The less NTu's the better. Less than 10 NTu's (more than 55cm) are healthy for fish. 5 NTu's are sustainable for recreational uses like swimming. Appropriate drinking water consists of 1-5 NTU's.

A macroinvertebrate is an organism that is visible to the naked eye and does not contain a backbone. Macroinvertebrates are good ways to assess stream quality because all chemical and physical features of the water affect them. Macroinvertebrates display impacts of habitat loss. Some are not tolerant of pollution, when even a little pollution gets into their systems they die. If pollutant intolerant specimens are not visible in a stream then it is possible that there is pollution in the water. To gather macroinvertebrates the materials used are a net, white plastic spoons. a white tray/basin, index key, white ice cube tray and recording sheet. Gathering macroinvertebrates starts with kicking up sediment in the bottom of the stream then scooping up particles with the net. Next, the net is emptied into the white basin. After moving all big pieces from the basin (rocks, leaves, and sticks) a spoon is used to scoop out all organisms that are visible. The macroinvertebrates are then put into separate ice-cube trays based on physicals features. Each different type of macroinvertebrates is then documented on a rubric. Each organism in group one is added up and multiplied by 4, the second gr is multiplied by 3, the third by 2, d the second by one.The total number from each group is then divided by the number of organisms found. This number is the total biotic index score. A n excellent score is anything above 3.5. Good scores range from 2.6-3.5, a fair score is 2.1-2.5 , and a poor score is anywhere in the 1.0-2.0 range.

Habitat is used to evaluate the overall general quality of the river. It shows human impact on water. There are different factors that impact the habitat score. When assessing habitat presence of garbage/trash, amount of trees/vegetation, human treated lawn, impervious surfaces, stream flow, clarity of water, odor, presence of oil, presence of solids, and bank types are all taken into consideration. Any types of roads, or treated lawn/soil nearby a waterbody mean that humans have altered the land and this could impact water quality. For example, a presence of impervious surfaces means that precipitation and other liquids cannot naturally soak into the ground, instead they runoff into the water and can cause erosion and pollution into the water. The erosion from impervious surfaces and other chemicals can cause the bank of the river to become steeper, and can wash away the roots of aquatic plants. The closer roads are to the water the more likely erosion and pollution have occurred. The treatment of grass/lawn and the use of pesticides near a freshwater source is another major negative factor. Pesticides that runoff into the water create algae blooms, the algae takes up oxygen and blocks off sunlight this kills off other organisms, and can offset the food chain and life cycle of an entire ecosystem. The physical quality and appearance of water is also important when assessing habitat. Types of water appearance include clear, milky, cloudy, dark, oily, green, or orange. Some of these characteristics are natural and occur due to activities happening on or near the stream. Others however, like and orange color are not natural and are signs of pollution, chemicals, acids and other harmful materials that could be released into the water. Any types of unusual smells coming from the water are also not natural and can mean numerous things from sewage pollution to an overuse of chemicals from water treatment plants. It is important to understand and consider all of these features when assessing habitat because each characteristic can help indicate something different about the waterbody. To assess habitat the rubric from Water Action Volunteers was used. The highest score is a 54, and it is virtually what a "Perfect" stream would be. Lower scores mean poorer habitat.

Stream flow is another important aspect of water quality. Basically, streamflow is a measure of how fast water moves over a specific period of time. It helps to indicate the type of stream and type of life in/around the water source. Some bodies of water are naturally faster flowing and the plants and animals living in the water have to adapt to survive in those conditions. Others on the other hand have a much more gradual flow. There is no set ideal stream flow rate. However, stream flow should be constant. Spikes in streamflow can upset aquatic life, food availability, and the shape and size of the river. Often times, impervious surfaces are causes of streamflow spikes. There are also natural causes to rapid changes in streamflow like droughts, rainstorms, and dramatic temperature changes (melting and freezing of water). Materials used to measure stream flow are a stopwatch, a tennis ball, measuring tape, calculator and recording sheet. First, the width and depth are calculated. Then as one person stands in the water upstream, another waits downstream, as the person upstream released the tennis ball the time keeper records how long it takes the ball to float the specific distance. This is done a few time, and then the velocity is calculated.

Each water test has specific characteristics and tells something different about the water quality. The data taken by harborside sophomores was used to assess the quality of the water in the pike river based on each different test.

Results:

Harborside Academy sophomores traveled to Petrifying Springs in Kenosha Wisconsin to test the Pike River on September 25 2014. The weather was mostly sunny and the air temperature was 24.3 $^\circ$C, and the water temperature was 17.46°C. The first trial of turbidity was 26.5cm , the second was 33.4cm with an average of 29.95cm equaling an average of 17.3 NTU's.   For dissolved oxygen, 14 drops of thiosulfate equaled 7 mg/l and a 75% saturation. The total habitat score was 34. In group one for biotic index dobsonfly larva, Alderfly Larva, Watersnipe Fly Larva were found. In group 2, Dragonfly

larva, crawfish, freshwater mussel/fingernail clam, mayfly larva, damselfly Larva, and riffle beetle larva

were found. Im group three snails were found and nothing was recorded for group 4. The total biotic

index score was 3.36. The total stream flow was 7.663 cubic feet per second.

Test	Results
Water Temperature	17.46^{o}C
Air Temperature	24.3^{o}C
Dissolved Oxygen	7.0 mg/l (75%)
Habitat Score	34 out of 52
Biotic Index	*Group 1:* Dobsonfly Larva, Alderfly Larva, Watersnipe Fly Larva *Group 2:* Dragonfly Larva, Crawfish, Freshwater Mussel/Fingernail clam, Mayfly Larva, Damselfly Larva, Riffle beetle larva *Group 3:* Snail *Group 4:* None **Total Index Score: 3.36**
Streamflow	7.663 cubic feet/second
Ph	8
Turbidity	Trial 1: 26.5 cm Trial 2: 33.4 cm Average: 29.95 cm **Average NTU's: 17.3 NTU's**

The chart above shows each of the tests done and their results. Each test and result done

below was completed by Harborside Sophomores in Mr. Granseese's academic 2. at the Pike River.

Discussion:

This section explains the results of the data taken at the Pike River . It shows what they mean and why they mean what they do. The data was taken by harborside sophomores. Research is important because it helps analyze results.

The water temperature of the Pike River was 17.46°C. Some animals require hotter temperatures than others. Based on information provided by Water Action Volunteers , when the temperatures of a stream gradually increase species tolerant of colder waters will slowly die off as warm water ones take their place, in addition, a majority of aquatic organisms have the ability to adapt to a range of temperatures. In order for species to adapt, the temperature needs to be consistent, spikes (extreme highs and lows) in temperature are detrimental to the health of aquatic plants and animals. Brook trout for example require temperatures ranging from 12.8-18.3°C, a small mouth bass on the other hand can survive in waters as warm as 30°C. According to the article Petrifying Springs Park Pike River Fish Passage Dam Removal Design and Engineering Project. , along with many other species of fish in the Piker River one of them happens to be the Brook Trout. Therefore, 17.46°C is a sustainable temperature for that specific species, but because the data wasn't taken over a period of time only one piece of data is given, it is not accurate enough to say that the overall temperature of the Pike River is always good. But on the day the data was taken it happened to be.

For dissolved oxygen, 14 drops of sulfate equaled 7 mg/l with 75% saturation. Based on data given by watermonotoring.uwex.edu, good ranges of dissolved oxygen are 7-10 mg/l, and good percents are from 71-90% saturation.

Dissolved Oxygen Quality	Percent Saturation (%)
Excellent	91%-100%
Good	71%-90%
Fair	51%-70%

Dissolved Oxygen Quality	(Mg/l)
Healthy	7-10 mg/L
Good	5-7 mg/L
Bad	less than 5 mg/L

The two tables above show the ranges for dissolved oxygen, and are created based on information given by Water Action Volunteers and watermonotoring.uwex.edu. Using those sets of data, the dissolved oxygen in the Pike River would be good. Also, knowing that trout are one of the most oxygen consuming organisms and on average require at least 6 mg/L of dissolved oxygen, the dissolved oxygen in the pike river is sustainable for them. However, water action volunteers continues to state "You can assess the range of dissolved oxygen levels that aquatic plants and animals at your stream site must withstand by monitoring twice in one day- early in the morning just before sunrise, and later in the afternoon when plants have been exposed to the most direct sunlight for an extended period."

The ph was 8 logarithmic units. The range of ph is from 0-14 with 7 being neutral or pure water and anything less than 7 being acidic and greater than 7 being basic. If the water is too acidic it could burn fish but if its too basic (greater than 10) it can dissolve living matter. The visual representation of the Ph scale shown by water.usgs.gov shows that the ph of and average stream is anaywhere from 6-8. Bases on this information, the water in the pike river is in a good range for Ph.

Source: Environment Canada
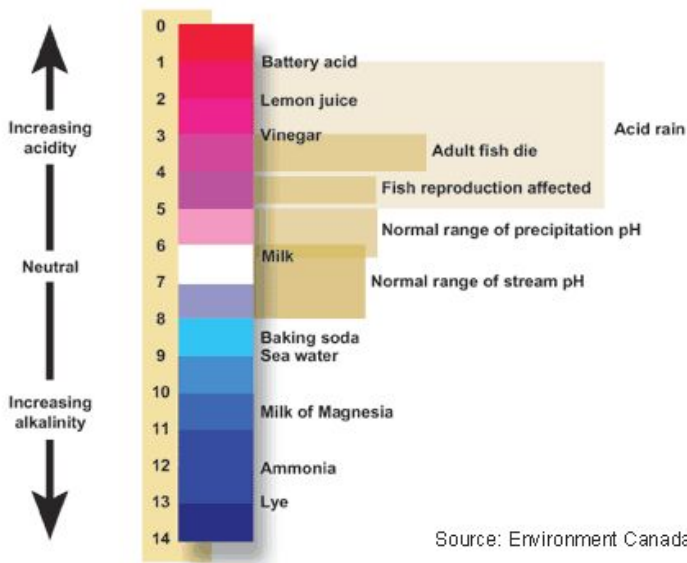
The first turbidity site resulted in an average of 26.5 cm, and the second with 33.4 cm with an an average of 29.95 cm or 17.3 NTu's. water used for recreation i recommended to have 5 NTu's, appropriate drinking water contains 1-5 NTU's. Even though the water at the pike river was not sustainable for drinking, that does not mean the results were necessarily bad, different aquatic organisms are able to adapt to different levels of turbidity, and some actual thrive better in murkier waters. watermonotoring.uwex.edu states "What causes problems in any stream or river are unuaual concentrations of suspended particles and how ling the water stays at a deactivated level. When you collect transparency samples, it is important to note and fluctuations in values which can help detect trends in water quality." They continue on to say, "The longer water remains at unusually high values the greater the effect it has on fish and other aquatic life." Because the tests done at the pike river only covered one day, the results are inconclusive due to a lack of data. In addition, while tests were being done at the first site, human activity upstream may have disrupted the sediment in the water causing the readings to become slightly inaccurate.

The total biotic index score was 3.36. Group one had 3 species found, group 2 with 6, group 3 with 1, and group 4 with 0. Because macroinvertebrates don't move very fast and they are existent in almost every body of water worldwide, it is generally easy to collect and compare samples of macroinvertebrates. Because many of the macroinvertebrates found are pollutant intolerant (based on the rubric from Water Action Volunteers),there is a small chance that there is little if any pollution in the pike river. One thing to take into consideration however, is human error. Because all of the students collecting data had never sampled macroinvertebrates before, it is likely that some may have been documented wrong. But according to the overall score, if done correctly, the water quality in the pike river based on macroinvertebrates is good. The table below is based on information given by watermonotoring.uwex.edu and shows how the stream quaily of macroinvertebrates cooresponds with the biotic index score.

Stream Quality Based on Biotic Index Value

Excellent	3.6 and above
Good	2.6-3.5
Fair	2.1-2.5
Poor	1.0-2.0

The overall score for habitat was 34 out of a possible 52. Each category has a maximum score of 4, and the totals are added up to get the final result. Parts of the assessment were stronger and showed more positive results than others. Using information given by the Water Action Volunteers, and based on the Water Action Volunteers Habitat Assessment Check-List, the following results and reasonings were made. The riparian vegetation was strong scoring 4's on both the left and right bank , this means that there were no signs of human activity within 50 feet of both sides of the river, parking lots, treated

lawns, roads, and cleared areas were all out of the range. The left bank was over 90% covered by natural plants, and other vegetation scoring a 4. The right bank however, scored a 1 because vegetation was present in less than 50%, this leaves the land more vulnerable to erosion and indicates that human activity could have been present. Both banks were fairly unstable, meaning that many spots along the banks were bare, showed or were very likely to be damaged by erosion, and areas that lack vegetation. The overall condition of the channel was decent, although the river was changed through human activity by the construction of a dam, and the water was shallow throughout, the natural bends in the river give it extra length and habitat life. The combination of pools; areas created at the bottom of the river in places where stream flow is slow in sediment collects, and spreads out, their composition was primarily of mud or other substances, underwater plants or fish covers were not present and the large amount of pools means that the river may be constantly changing or unstable which is not good for aquatic life and can offset balances in many other areas of the stream quality. Habitat is not just one specific test, it is a lot of mini assessments that combined create a general indicator of the streams quality, it is hard to determine weather the water quality is "good" or "bad". There are parts of the habitat that are very strong while others could become improved. To get the best understanding of the habitat of the Pike River, it should be assessed periodically, at least twice a year, and in different seasons to see the affect climate changes and other natural aspects have on the habitat.

The stream flow in the Pike River was 7.663 cubic feet per second. Streamflow measures how fast the water is moving at a constant rate. Because many different factors affect streamflow, it is hard to determine whether a streamflow reading is necessarily "good" or "bad". The EPA states "It (streamflow) also changes during different seasons of the year, decreasing during the summer months when evaporation rates are high and shoreline vegetation is actively growing and removing water from the ground. August and September are usually the months of lowest flow for most streams and rivers in most of the country." Basically, depending on when streamflow is taken, the outcome of the results will

vary. Data given by the USGS below shows a graph of streamflow rates in the Pike River for the month of

September in 2014. The data also shows the averages of all data from the month of September since

1972. The spikes in the data are common, and are most likely due to unusual or inconsistent weather

patterns, however they could possible mean that there are other things impacting the water such as in

increase of human activity around the area. It is best to observe the streamflow for a longer period of

time to get the best estimate of what is effecting the streamflow, also keeping in mind weather

patterns, and the season of the year will help get the best idea of the water quality and streamflow in

the pike river. Because aquatic life adapt to certain stream flows, if rates stay consistently high or

consistently low it could offset the natural balance of the aquatic organisms, and they could be more

likely to die off, especially those who require more specific results.
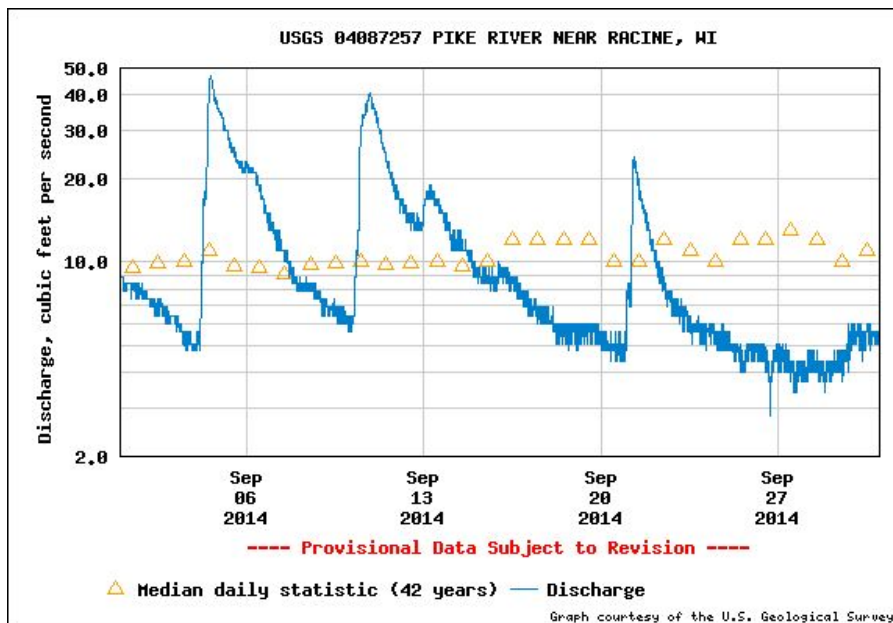
Conclusion:

Testing water quality is important because it gives insight on the overall life of the

stream . It builds knowledge on the way plants and animals live, and any factors that might be off

setting the ecosystem. Each test gave specific information on a certain part of the stream they are important in their own ways because without them, it wouldn't be possible to understand a watershed to the extent possible today. By knowing the goods and the bads of an ecosystem, humans can help try to preserve and restore that place. It is important to have a healthy stream because not only are plants and animals reliable on it for life, but humans are as well. In general, the pike river has good water quality. The macroinvertebrates for example had a very good reading.There are still some things however, that have room for improvement. For example, parts of the habitat were significantly degraded. Now, making a difference in an ecosystem doesn't always call for a huge, life-altering service project but it certainly doesn't happen overnight either. There are some simple things that can be done within the household to create a cleaner, safer ecosystem. One of the simplest solutions, is using reusable water bottles.. This way, there is less of a chance   of   it ending up alongside a river or stream bank and water use will be conserved as well, saving lots of money. Another simple solution is to reduce the amount of pesticides used on lawn and crops. Pesticides run off into the water source and create algae, the algae then reproduces and causes whats called and algae bloom. Large amount of algae infect a water source and take up materials needed to survive like oxygen and sunlight leaving less available for other aquatic species causing them to die. Joining organizations like the Water Action Volunteers in Wisconsin is another way to help water quality not only in the Pike River but other freshwater sources across the state of Wisconsin. One other thing that can be done to help is to help restore natural vegetation especially near the Pike River. Areas along the Pike had been cut down, or changed from their natural state. Areas along the banks of the river had little to no plant vegetation. Replanting vegetation can help improve wildlife, and the plants also help create natural shade which blocks extra sunlight from reaching deep into the water. Shade is good because too much sunlight results in a rise in temperatures which decreases oxygen levels.

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