WATER QUALITY OF A NEIGHBORHOOD RESERVOIR

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Optimist Lake is an integral part of the Dog River watershed located in Mobile, Alabama. The reservoir is part of Milkhouse Creek with the creek entering in from the north and exiting to the south before it continues on and joins Dog River. Reservoirs that are apart of this type of network normally act as a large settling pond for the stream, in effect giving the stream a place to lower its turbidity and decrease the amount of pollution which is in it. My paper is about the effectiveness of the reservoir in doing this important job. In terms of oxygen, pH, alkalinity, and hardness the lake does a good job at regulating the quality of water. However, because of how the water exits the lake the turbidity is much higher coming out than coming in.

Keyword: settling pond, turbidity, water quality

Introduction

Optimist Lake is a man made reservoir located in west Mobile, Alabama. The reservoir is part of Milkhouse Creek and part of the Dog River Watershed. The Lake is located in the middle of the Sheldon subdivision that is a densely populated area. With Milkhouse Creek entering the lake from the north and exiting at the southern end of the lake, this could potentially allow pollutants from the neighborhoods as well as roads to flow into the lake to directly enter the stream network and have some effect on the overall water quality of the creek and lake, as shown in Figure 1. This area is located in the western boundary of the watershed in an area that is being built up rapidly and where people may not even

Figure 1. Optimist Lake field sites

know what goes on there affects people who live on the other side of town. Because of this, I tested the water quality right before Milkhouse Creek enters Optimist Lake and right after it exited the lake to determine how effective Optimist Lake is at regulating the water quality.

The reservoir has an area of about 563 acres and is located in the Sheldon subdivision off Cody Road. The lake was man made in the 1970s and built during a time when few people lived out in this area of Mobile. The neighborhood has a population of 3,884 and with an area of 2.080 square miles gives it a population of 1,857 people per square miles (City Data 2010). Because of this, this large amount of people packed into this small area have the potential to directly affect the water quality of the lake that they live around. Milkhouse Creek enters the lake at the very edge of development in a wooded area, as shown in Figure 2 and then exits the lake through another residential area.

Figure 2. Milkhouse Creek entering the lake.

Small lakes and reservoirs such as Optimist Lake are very important in the water quality of stream networks and overall watersheds. These small reservoirs give the flowing water a place to slow down. Once the water has slowed down enough, sediment and other pollutants are than given the chance to finally settle out of the water and collect at the bottom of the reservoir Development such as

housing and building urban infrastructure have an adverse affect on these streams and lakes by causing increased erosion. Because of this it is important for the lakes and urban reservoirs to remain healthy and for it to be regularly maintained as it helps to regulate the conditions of the stream networks (Warren County 2007).

These urban lakes do have their problems. They can be easily contaminated by pollution from various places. The streets around them can draw surface runoff from streets and allow all of it to settle into the lake. Problems upstream can also bring in sediments from construction sites and other problems in. This can all lead to such nasty problems as algae blooms which can kill off all of the fish and wildlife contained in it (Hsiang-Te 1991) Because of this their health can fluctuate wildly and need to be looked at for them to work properly in the urban ecosystem.

The fact that this reservoir and stream are located in the middle of a fairly large neighborhood once can assume that it is in some way affected. Right off Cody Road a restaurant is undergoing renovation and has decided to expand their parking lot. To do this they have cleared away large quantities of trees and this alone directly affects the water quality. This has potentially allowed an increase in water runoff, soil permeability and erosion into the Milkhouse Creek right as the lake water also exits (Croke and Hairsine 2006). This is one example of conditions around the lake that could affect the entire stream.

Research Question

What is the difference in water quality of Milkhouse Creek upstream and downstream from Optimist Lake? This is the question that I was curious about as just looking visually at the water I noticed that there could in fact be a difference. In most cases, the outgoing water is cleaner than the ingoing in streams as the lake gives it a place for the particles to settle out. However, because of the various factors such as the neighborhoods and the conditions of the lake I believed that the exact opposite has happened here and that the water will be slightly worse exiting the lake or in fact have no

difference at all.

Methods

I tested the quality of water at two different parts of Milkhouse Creek. I tested the water quality of the creek right before it entered Optimist Lake and then right after the water exited the creek. The water entering the lake from Milkhouse Creek comes right out of a forested area. I tested this water right where the natural creek ends and before it gets channeled into the lake. The water coming out of the lake passes out of a pipe burred underneath the surface of the lake. The pipe itself is underneath an overflow dam which during heavy rains the water would come over. I tested the water coming immediately out of the pipe as it hit the stream network. For four weeks straight I performed the following tests at each site: turbidity, dissolved oxygen, pH, alkalinity, and hardness. After doing the tests I compared my results and was able to get a good idea of the overall health of the stream before and after the stream had left the lake. Turbidity is a measure of how dirty the water is and is affected by things such as sediment or dead biologic matter. Dissolved oxygen is a measure of how much oxygen is in the water. The pH is a measure of how acidic the water is. Alkalinity is a measure of the capacity of water to neutralize acids. Lastly, hardness is a measure of how the mineral content of water (EPA 2006). Each of these things is important because Optimist Lake should have some ability to clean them up.

Results

The results showed that that there was not much of a difference in water quality before and after it entered the lake as shown below in. As a whole the water quality in the stream before it enters the lake and after is for the most part fairly clean. The most noticeable thing is that the turbidity of the water downstream from Optimist Lake is much higher than it is when it enters the lake upstream. In fact, on average the turbidity was almost ten times higher downstream than it was upstream, as shown

in Figure 3.This could be caused by a number of different factors that will be discussed later on.

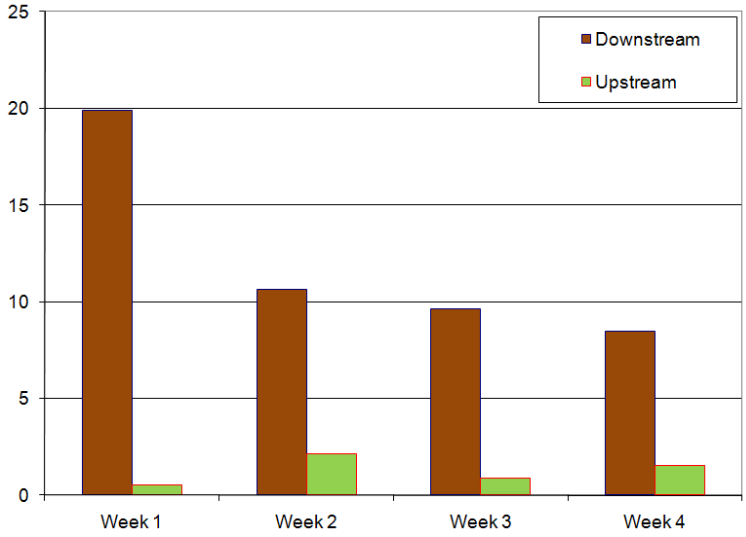

Figure 3. Turbidity in NTU at both sites

In terms of oxygen content in the water there was not much of a difference. On average the water temperature downstream was 16.75ºC and upstream was 16.5ºC. The dissolved oxygen on average was also not that different. However, when looking at the oxygen saturation between sites there is a noticeable difference between the two sites, as shown in Figure 4. The downstream site has an average of 71% oxygen saturation compared to the 61.75% upstream. This most likely has to do with the fact that the water coming out of the lake through the pipe is flowing out of a pipe and splashing into the stream where as the water coming in is just flows in. In terms of oxygen the both sites show a fairly healthy stream.

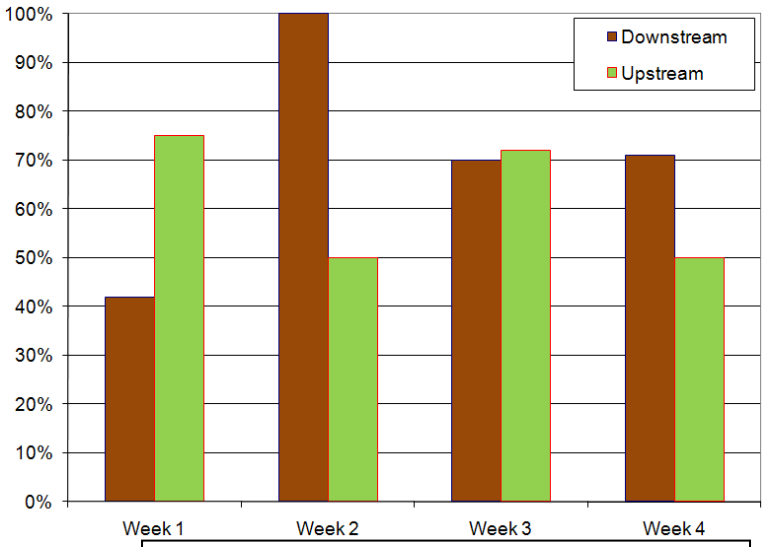

Figure 4. Percent Oxygen saturation.

The pH of the water is less acidic downstream than it is upstream. With an average pH of 6.38 over the four-week period the pH is in itself not bad. This lower acidity could easily be contributed by the fact that the alkalinity is also higher downstream which would help regulate it. The upstream pH was more acidic at an average of 5.63 and so was the alkalinity. The fact that the pH is around this

figure is not that surprising considering that it is passing through a forest that contains a lot of organic material. This makes sense as these correlate with each other. In both sites, pH was within a range that will not cause harm to wildlife . The alkalinity and hardness at both sites are not that different over the study period, as shown in Figure 5. In terms of hardness both sites water is quite soft which help reflect a lower mineral content.

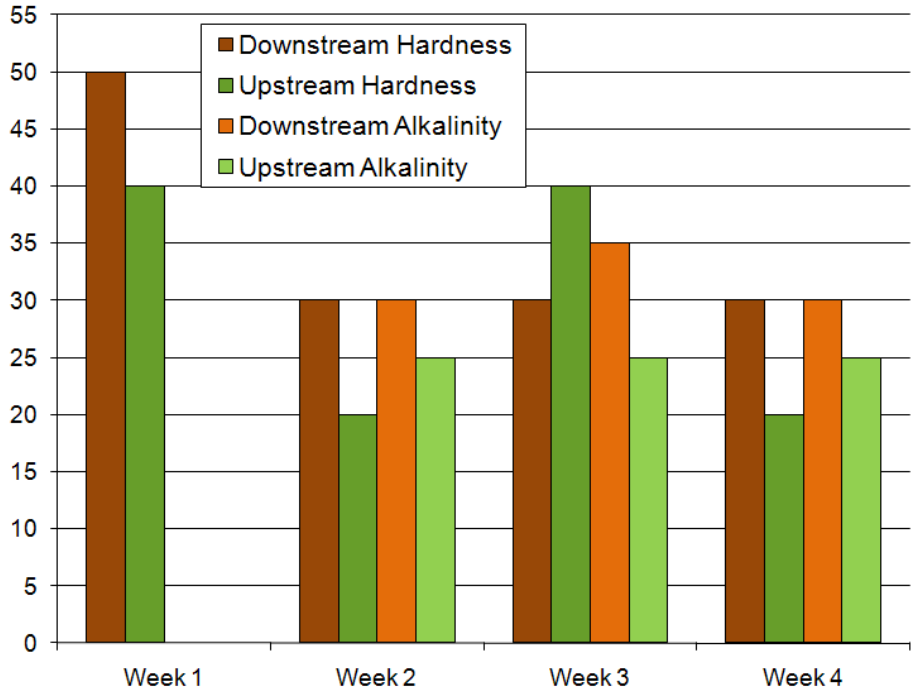

Figure 5. Alkalinity and Hardness in mg/l

Discussion

In terms of water quality the biggest differences between Milkhouse Creek as it runs through Optimist Lake is that of turbidity. As stated previously, the water is visibly murkier at the downstream locations where you cannot even see the bottom and at the upstream field site before the creek enters the lake you can. This helps one visually notice that there is in fact a difference between the two sites There could be many different causes for this. Knowing that only a portion of material can be trapped by the lake, many different factors can determine how exactly much does get trapped. Water discharge conditions, sediment characteristics, the volume of the lake, and the overall water quality of the lake are very important when determining how much material gets trapped (Sunborg 1992). The amount of material that has already settled at the bottom of the reservoir can also have something to do with this.

The length of retention in Optimist Lake can also have an effect on how well the lake is it cleaning up the turbidity. If the water flows through it quickly it will be unable to let any of the particles settle out (Hsiang-Te 1991). The most likely culprit is the location of the pipe underneath the allows water to leave the lake and enter Milkhouse Creek. Being that it is located underneath the surface of the water it could be at the bottom of the lake and simply sucking out the sediment already located there and forcing it into the stream.

Having this lake clean is very important for the neighborhood that surrounds it as well as the rest of the Dog River watershed.. This neighborhood reservoir is important because it is supposed to help clean up pollutants, regulate flood waters during heavy rains, replenish underground water, and help with the development with the area by providing a recreational atmosphere (Qiao 2009). Even though the lake is fairly clean it is important to note that children play in it as well as people fish. While conducting research and just talking to inhabitants I learned that residents do not eat the fish located here because of fear of health reasons.

To help Optimist Lake clean up the water there are a number of things that could be done. The most obvious is changing how the water exits the lake. The pipe containing the outflow if water is more than likely sucking out much more sediment than it should be. One of the simplest is to use excavation equipment and remove some of the sediment in the reservoir. This could be quite costly but it is effective. Another thing that could be done is to find a way to slow down the speed of the water as it passes throug the lake that would allow the particles to settle out of it. This is done at the entrance of the creek to the lake with concrete blocks which do help slow the flow of the creek. The most efficient would be to help cleanup the problems that occur upstream from the lake and thus help stop the amount of sediment flowing into the lake in the first place.

Conclusion

Optimist Lake is an integral part of Milkhouse Creek and the western portions of the Dog River

watershed. This lake allows sediment and particles to settle out of the water that thus helps clean up part of the watershed. The lake does help to curtail the chemical makeup of Milkhouse Creek but because of various factors it is not doing a good job in lowering the turbidity of the creek, with the water being vastly murkier coming out than coming in. This could easily be improved by changing the position of the pipe or installing a filtering system. The way water leaves Optimist Lake is one single spot that could be targeted for cleanup and then regularly maintained that would vastly help the overall watershed.

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Appendix 1. Raw data

Site 1 - Downstream							
	Water Temp C	Oxygen in water (mg/l)	% Oxygen Saturation	Hardness (mg/l)	Alkalinity (M mg/L)	pH	Turbidity (NTU)
Week 1	14	4.3	42%	50	N/A	6.5	19.9
Week 2	22	7.95	100%	30	30	7	10.65
Week 3	15	6.8	70%	30	35	6	9.63
Week 4	16	6.9	71%	30	30	6	8.47
Avg	**16.8**	**6.5**	**71%**	**35.0**	**31.7**	**6.4**	**12.2**

Site 2 - Upstream							
	Water Temp C	Oxygen in water (mg/l)	% Oxygen Saturation	Hardness (mg/l)	Alkalinity (M mg/L)	pH	Turbidity (NTU)
Week 1	15	7.3	75%	40	N/A	6	0.51
Week 2	19	4.1	50%	20	25	5.5	2.12
Week 3	13	7.3	72%	40	25	5.5	0.89
Week 4	19	6	50%	20	25	5.5	1.54
Avg	**16.5**	**6.2**	**62%**	**30.0**	**25.0**	**5.6**	**1.3**