

STREAM VELOCITY COMPARISON IN DOG RIVER WATERSHED

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The purpose of my project is to test and compare the stream velocity of Halls Mill Creek and Montlimar Canal. Halls Mill Creek is a natural stream that is able to access its flood plain. Montlimar Canal is a ditch that was dug to drain Wragg Swamp and does not have a flood plain. I tested the velocity of each waterway during roughly the same time and at varying rainfall intervals. I measured the distance of Halls Mill Creek from Halls Mill road to Demetropolis road. I then used this distance to measure an equal distance along Montlimar creek. I then used oranges to measure the velocity of the stream by throwing five oranges each creek at the same time to determine an average velocity of the stream. Based on my current research I have found that the natural stream has a faster base stream velocity but the canal has a faster post rain event velocity.

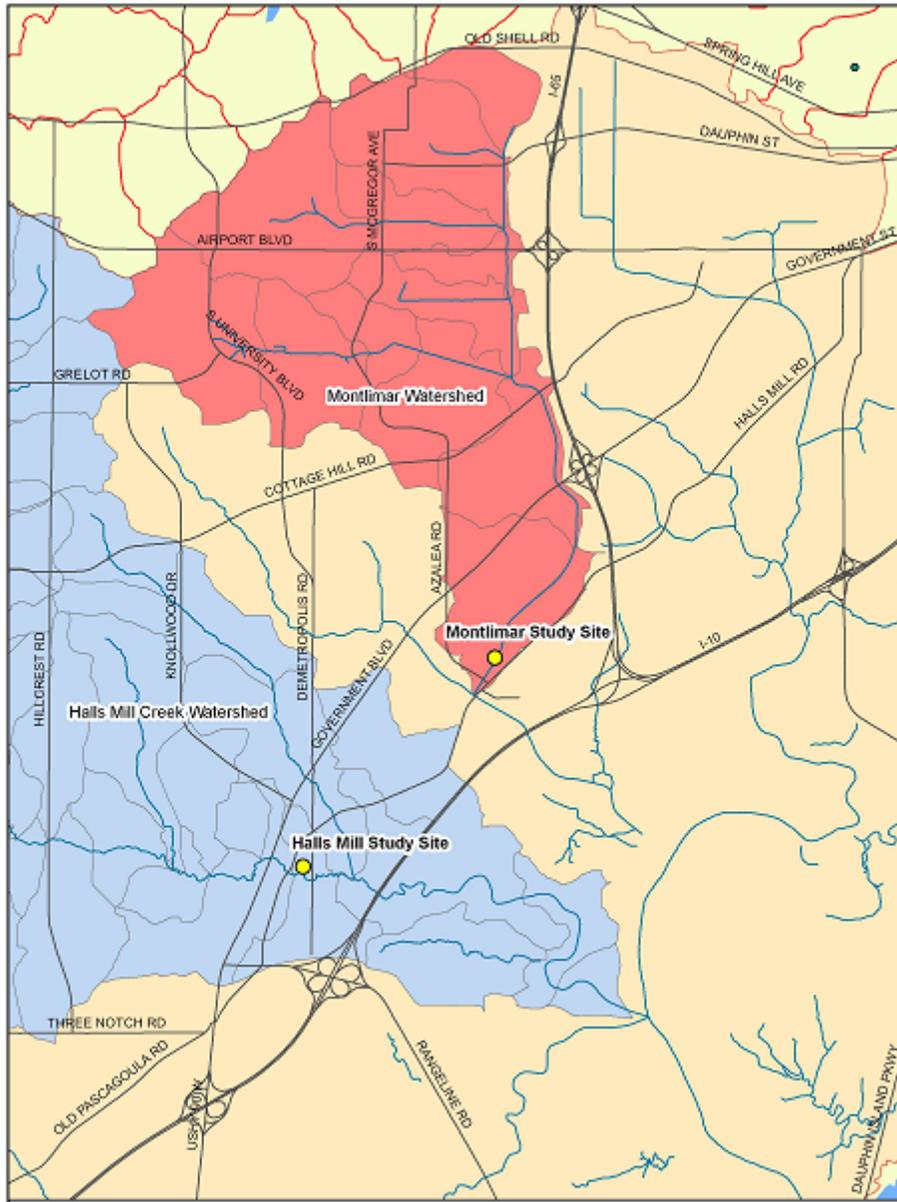
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Introduction

Stream velocity is an important factor involving channelized and non-channelized streams in the Dog River Watershed and all over the country. Channelized streams and canals are notoriously problematic when it comes to post rain event water velocity. Increased water velocity in these waterways cause bank erosion and stream bottom erosion. As water velocity increases so does its competency or the size of the largest piece of sediment that it can carry. Increased competency in a waterway leads to more sediment being picked up and carried downstream. When more sediment is carried downstream more sediment reaches Dog River. Increased sediment loads are also a problem when the faster moving Canal reaches a confluence with another slower moving canal or stream, this confluence cause's water velocity to slow and the competency of the water to fall. When the competency drops it causes much of the sediment that the faster moving waterway was carrying to fall out of the water column and settle on the bottom. The Dog River Watershed is facing this problem with sediment in many parts of its channelized streams and canals. Much of the sediment that is building up in these areas is sand.

These build ups cause waterway obstruction over time and forces the city to dredge these areas, which can be very costly. My project will address and compare the changes in stream velocity between a baseline with no rain and the velocity of the stream during different intervals and amounts of rainfall. I will compare two streams in the Dog River Watershed that share some characteristics but also are different in some ways. The streams will be alike in that the two streams I chose, Halls Mill Creek and Montlimar Canal are both within the Dog River Watershed. (Fig. 1) The streams will have contrasting characteristics also because Montlimar Canal is almost all engineered and Halls Mill is mostly still in its natural state. The community needs addressed in my topic are wide-ranging and diverse. Montlimar Canal is a ditch that was dug to drain Wragg Swamp and channel the headwaters of Bolton Branch and Eslava creek to the West of Interstate-65. It was common practice from the 1920's until the 1960's to dig ditches in order to drain swamps and wetlands. It was once thought that if the streams were straightened and cleaned out that they would work better at moving water. It was later realized that straightening streams from their natural state does more harm than good in the long run. Straightened and channelized streams flow much faster which can result in higher downstream velocity and increased erosion. (University of Illinois 4 March 2010) If it is determined that engineered streams have a higher velocity, data can be used to better understand the sediment build up in the engineered streams of the watershed. If a stream has increased velocity over what is normal for the slope and volume of a comparable natural stream the competency of the engineered stream would be much higher and it would carry more sediment downstream and into the river. Stream velocity measurements also can be important data when placing debris booms. If stream velocity is measured often enough so that velocity is predictable with known rainfall,

engineers will be able to determine what type of debris boom to use and the proper anchoring needed for the volume of water that will be expected..



(Figure. 1) Showing Montlimar Canal water shed in red and Halls Mill Creek Watershed in blue

Research Question

During equal amounts of rainfall, is stream velocity higher in a channelized stream than a natural stream? My research is significant because there is evidence that engineered streams do have a higher velocity than natural streams, the data could be used to help design better engineered streams that decrease velocity. If stream velocity is better understood the community will be able to understand the sediment flow of engineered streams and be able to better control the sediment build up in engineered streams.

Methods

The methods that I used to measure the velocity of flow of Montlimar Canal and Halls Mill Creek were simple and basic but used with the highest possible quality control during the test so that my data would be as accurate as possible. In order to measure stream velocity I used oranges as floating objects because of their buoyancy, high visibility and biodegradability. I then tested the time it took for the oranges to float from a set start and stop point. In order to compare the difference in velocity between Halls Mill Creek and Montlimar Canal I used an equal amount of floating distance for each stream. Through a couple of tests with both waterways to determine the time it would take to travel a given distance, I determined that a distance of 400 feet would work equally well for both streams. A distance of shorter than 400 feet would not allow the oranges to equalize to the speed of the water properly. I also found that for the sake of time and being able to attain measurements of both creeks during equal discharge levels a distance of much longer than 400 feet took much too long to complete. Once I determined the proper distance for measurement I then located the best stretch of each stream in which to conduct the velocity measurement. I wanted to insure that the data would be as accurate as possible so I

needed to find a section of each stream with the least amount of obstructions and confluences

that would slow or speed up the flow of the oranges and skew the data in any way. I determined that the best stretch of Montlimar Canal, which is channelized, would be the farthest spot from the metal weirs (Fig. 2) that are used



Figure 2. Wier on the Montlimar Canal. Note rocks to repair bank erosion

to control the slope. If data was collected to close to the weirs it

would be skewed because in some places velocity increases and decreases because many of the weirs are damaged and water flows only across part of them in one spot which increases the velocity the closer you come to them.

I determined that the best start and finished spot along Halls Mill Creek would be at least 500 feet from the bridge where Hall Mill road crosses over Halls Mill Creek (Fig. 3). This distance would insure that the velocity would be not be affected by the

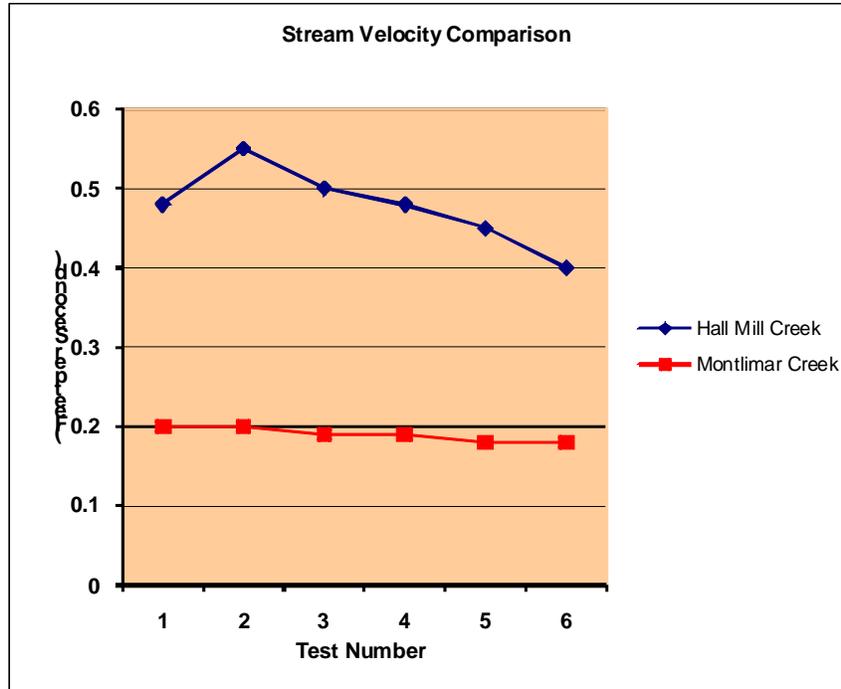


Figure 3. Halls Mill Creek at Demetropolis Road.

confluence of the bridge. In order to determine the distance of my measurement along the bank I used a GPS to measure out 400 feet and used landscaping stakes to mark my start and stop positions to insure that I used the same distance every time. When I tested the velocity of each stream I would use 3 oranges simultaneously. I would toss the oranges in the stream about 50 feet ahead of the start point so that they would equalize in speed before they got to the starting point. I made sure to mark each orange with a permanent marker and a 1,2,or 3 so that the number would be visible to me from the bank. I would then note the start time of each individual orange in my field notes and the individual finish time each of the oranges. Due to the slow water velocity of the waterways I was able to walk along the bank of the Montlimar Canal and Halls Mill Creek. This ensured that I got an accurate measurement of the start and finish point of each orange. I then took the average of each the three oranges to determine an accurate velocity.

Results

I tested both creeks within 1 and half hours of each other on 6 different occasions through the month of March and April. Almost every time my data showed that Hall Mill Creek which is the natural stream had a velocity of almost double the velocity of Montlimar Canal every time. (Fig. 4) These results conflict with my hypothesis that Montlimar Canal, which is the channelized stream, would have a much higher velocity than Hall Mill Creek. On average throughout the six measurements it took the oranges and average time of about 16 minutes to travel the 400-foot distance down Hall Mill Creek. Comparatively it took an average time of 36 minutes for the oranges to travel the 400 feet down Montlimar Canal. The six measurements were taken during time of almost equal discharge for each stream respectively, due to the lack of rain that Mobile experienced in March and April.



(Fig. 4) Graph to display oranges travel in feet per second

Discussion

When I first began my project I fully expected that it would be cut and dry. I assumed that Montlimar Canal would have a consistently higher velocity than Halls Mill creek. I believed that because of the straightness of Montlimar Canal the velocity would always be greater. When I began testing I found that the data was showing the opposite of what I expected it to show. I then researched these two streams to better understand why this data was ending with these results. I determined that because Mobile has been in a rainfall deficit over the past 6 weeks I was unable to acquire data for these streams during a large rainfall event. This deficient and lack of a major rainfall event resulted in the majority of my tests being taken during sunny days and when the streams were at their base line.

I realized that because one stream is natural and the other channelized they have different fluctuating and constant variables of the discharge continuity equation. The discharge continuity equation is $Q=A*V$ meaning discharge equals stream cross-section area times stream velocity. I used this to explain why Halls Mill creek's stream velocity was higher than Montlimar's water velocity. Halls Mill Creek's stream velocity was higher than Montlimars because Hall Mill creek is still mostly a natural stream with access to its flood plain. It uses its flood plain to increase or decrease the cross sectional area to balance out velocity during fluctuations in discharge. Halls Mill Creek also has a higher elevation than Montlimar Canal, which makes the hydraulic head of Halls Mill Creek higher than Montlimar Canal. Halls Mill Creek also has a much larger watershed than Montlimar Canal, which helps Hall Mill Creek have a more consistent discharge than Montlimar Canal. During a large rain event Halls Mill creek would keep a fairly consistent velocity with the velocity that it had during my measurements but its cross sectional area would increase greatly to accommodate the increased discharge. Montlimar Canal however would greatly surpass Halls Mill in velocity because its cross sectional area would not change much from the time that I acquired my data so it's only solution to balance discharge would be to increase velocity. Montlimar Canal velocity was less than Halls Mill the days that I measured because during a non-rain event or a deficit the opposite occurs with discharge and velocity as does during a significant rainfall event. Hall Mill creek will shrink its cross sectional area during less discharge to maintain a natural velocity. Montlimar Canal is at a mostly set cross sectional area so during less discharge the stream velocity decreases consistently until discharge begins to increase again. Ground water recharge of streams also played a factor in my results. Halls Mill Creek is a natural steam so during a non-rain event most of its discharge is from ground water recharge, which keeps a steady flow during these times of small amounts of rainfall. Conversely

Montlimar Canal has little to no ground water recharge in its head waters so during these times of little to no rain fall velocity is lowered even more.

Conclusion

In conclusion, although my results did not show the effect of stream velocity during a significant rainfall event they did prove that velocity is different among natural and channelized streams. During a large rainfall event I would expect Montlimar Canal to have a much higher velocity than Halls Mills creek. I will continue to measure water velocity of these two over a larger span of time than 6 weeks. This project would be continued to acquire definitive results and data to prove my hypothesis during the summer season when rainfall is much higher. The continuation of this project would be helpful in proving that during a large rainfall event Montlimar Canal does in fact flow at a significant velocity and the amount of sediment that it carries into Moore Creek is greatly increased. The definitive results of this velocity study could be used to help the City of Mobile and DRCWR to better manage to bank erosion and sediment flow into Montlimar Canal during a large rainfall event.

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Appendix 1: Raw Data						
Test Number						
	1	2	3	4	5	6
Minutes to travel 400 feet						
Hall Mill Creek	14	12	13.2	14	14.8	16
Montlimar Creek	32.4	32	33.6	33.6	35.2	36
Test Number						
	1	2	3	4	5	6
Feet per Second						
Hall Mill Creek	0.48	0.55	0.5	0.48	0.45	0.4
Montlimar Creek	0.2	0.2	0.19	0.19	0.18	0.18