

Nitrate Levels in the Big Muddy River

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Conclusions & Discussion

Upon further research several sources supported the test results. In its northern section near the origin, the Big Muddy River flows into Rend Lake near the upper section of the river and flows out over a spillway (Picture 4). This process plays a large role in filtering out nitrates by slowing the water and allowing materials in the water settle (EPA). After the river flows past Rend Lake and into more urban areas such as Carbondale and Murphysboro only 11% of the land in the Big Muddy River watershed is used for crop agriculture. This is much smaller than the amount of land that has forest and grassland which is 67%. This is significant because forest and grassland areas reduce the amounts of nitrates in the soil and along the shore (EPA). Not only are there large amounts of natural land use in the form of forests and grasslands, but there are also many wetlands in the area of the lower part of the Big Muddy Rivers watershed. Southern Illinois contains 57% of Illinois wetlands, most of which are located in the Big Muddy River basin (IDNR). Wetlands are an essential part of filtering runoff from agriculture lands and urban drainage systems because they allow the water to stand and then much the nitrates are lost through natural processes (IDNR). Soils around the watershed have low leaching capabilities which hinder the nitrates from mobilizing (IDNR). Figures 5 and 6 show nitrate leaching classes of soils in Illinois. In addition to having soils with low leaching capabilities, southern Illinois differs from northern and central Illinois in its farming practices. Farms north of the Big Muddy Watershed often use tile drainage, a method of removing excess water from fields via a network of pipes and tiles to guide water away from the field should the water reach a high enough level. Tile drainage allows water to collect nitrates and deposit them in nearby water sources. The water being drained carries agricultural chemicals with it and the tile drainage system provides no filtration as it swiftly carries water away from the field and towards a nearby water source. The reason for the lack of nitrates near the Carbondale Northwest Treatment Plant can be explained as well. The wastewater, which has already been treated but still contains chemicals, travels several miles from the plant to the Big Muddy River through a pipe. The pipe allows chemicals to further degrade because bacteria feed on them as the water travels through the pipe. The relatively clean wastewater mixes with the Big Muddy River and whatever waste content was originally in the water is extremely diluted. The combined factors preventing high nitrate levels account for the low nitrate readings in the Big Muddy River. Sustainable agriculture can be achieved if steps are taken to ensure that agricultural profitability and sustainability can coexist.

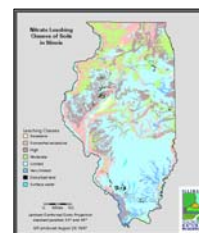


Figure 6 shows that the Big Muddy River has a watershed that consists of potentially low nitrogen leaching soils.



Figure 6 shows the distribution class ratios of nitrogen leaching class ratios.

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Results

The results from the nitrate tests were surprising. The first set of samples did not register any nitrate concentration which meant that the amount of nitrate present was less than 1 mg/L. These results, however, were unremarkable because spring fertilizer had yet to be applied. The second set of samples taken after many of the fields had been fertilized yielded the same results; all the samples indicated a level of nitrates below 1 mg/L when tested. The results of the second set of water samples were very surprising. We expected to find some amount of nitrate in at least one sample, however the levels were all still below 1mg/L. Before the third test the group took a water sample that had high nitrate levels to be sure that the test kit worked. The group then tested a third time, in hope that a large amount of rain from the few days prior to testing would change our results. However, the results were the same which lead us to conclude that there are low amounts of Nitrates in the Big Muddy River.

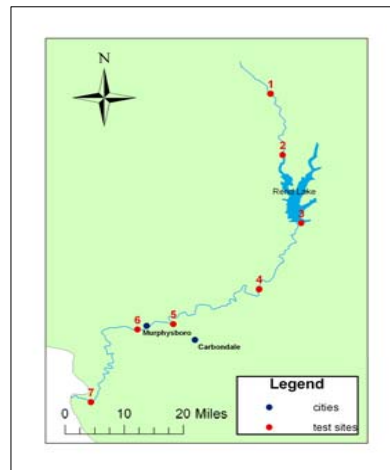


Figure 4 Map of the Big Muddy River and the test sites.



Picture 1 Boat Ramp before Rend Lake



Picture 3 Marcus directing the group to the next site.



Picture 2 Spillway before Rend Lake



Picture 5 Kevin walking back from taking a sample at site 7 (Right before the Mississippi River).



Picture 4 The spillway after Rend Lake



Picture 6 Kyle taking a water sample.

Methods

The study consists of testing the water in the Big Muddy River for nitrates and using a GPS unit to transfer the coordinates of the test locations onto a GIS map of the Big Muddy River. The purpose of the research is not only to collect data on the nitrate concentrations of the water, but to integrate that information into a digital map (Figure 4).

The first step we undertook in our project was the testing of the Big Muddy River. First, quadrangle maps of the Big Muddy River were obtained. These maps were used to select key locations along the Big Muddy River where the results could provide the most significant information. A road map was used to find roads that provide access to the chosen test sites. We selected seven different sites.

- **Site 1** - near the origins of the river; selected as a base to gauge the changes downstream.
- **Site 2** - right before Rend Lake; chosen in order to determine what effect of the lake has on the river's nitrate concentration.
- **Site 3** - the point at which the Big Muddy River flows out of Rend Lake (Picture 4); chosen for comparison to Site 2.
- **Site 4** - is located after the middle fork at which point a tributary enters the river; to observe the changes caused by tributaries.
- **Site 5** - just before Murphysboro; allowing us to analyze the effects of an urban area.
- **Site 6** - after Murphysboro; chosen for comparison to site 6.
- **Site 7** - right before the Mississippi River; provided a final reading.

The next step was to collect the supplies for the fieldwork. These supplies included a nitrate test kit, GPS unit, a map, a camera, and water sample bottles. Three samples were taken at each site from the middle and both banks and were tested on site using the nitrate kit. A GPS waypoint and photograph were taken at each site. On March 24, April 1, and April 14 of 2007, sample sets were taken.

A map was made using GIS layer files and the GPS waypoints. The layers used were the Illinois state boundary, the Big Muddy River, Rend Lake, and the cities of Murphysboro and Carbondale. With the help of Microsoft Excel, we created a graph displaying the different land uses in the southern section of the river near Carbondale and Murphysboro.

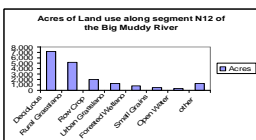


Figure 5 acres of land-use in segment N12 (source: EPA TMDL).



Figure 5 map of segment N12 of the Big Muddy River (red line) near Murphysboro (shown in red) and its watershed (outlined in purple)

Limitations

Certain limitations restricted the depth and scope of the project. Due to time constraints the tests could only be taken during the chosen test dates. A more thorough study would have to be conducted over a longer period of time. Additional test sites could have given more geographically detailed test results, as well.

Introduction

Sustainability can be defined as the continued use of resources over time without degrading the environment. In this project we examined nitrate levels in the Big Muddy River to determine if the river is seriously polluted. Nitrates are widely used in agricultural fertilizer and, as a result, rivers in agricultural areas often have high nitrate levels. Nitrate pollution causes environmental degradation and nowhere are the consequences more apparent than in the Gulf of Mexico near the mouth of the Mississippi River. The Gulf of Mexico has been experiencing an effect called eutrophication as a result of the high nitrate levels in the Mississippi River. Eutrophication is the biochemical process that lowers the level of dissolved oxygen in water to the extent that many aquatic organisms cannot survive. The Big Muddy River is a tributary to the Mississippi and flows through a largely agricultural region. In order to address the nitrate pollution problem and agricultural sustainability in the Mississippi River watershed, nitrate levels should be closely monitored along the Mississippi River as well as its tributaries including the Big Muddy River.



Figure 1 Map showing the location of the Big Muddy River in Illinois

Purpose

The purpose of this study is to measure the nitrate levels throughout the Big Muddy River and interpret the results. The nitrate pollution in the Mississippi River is widely attributed to non-point source pollution from agricultural fertilizers. The hydrological processes of surface runoff and leaching carry fertilizer from farm fields to nearby streams. The streams carrying nitrates connect to larger streams and so on until the nitrates reach a major river such as the Mississippi River. Nitrogen can be moved large distances in this manner and it is important to recognize that most nitrates in the Mississippi River did not originate from its own shores but from elsewhere in the Mississippi River Basin. The Big Muddy River accumulates water and the pollutants in it in the same way but on a smaller scale. The study results can be analyzed on two scales, as well. The larger scale result is the Big Muddy River's contribution to the nitrate content in the Mississippi River. The smaller scale results are the observation of nitrate level changes along the Big Muddy River and the determination of the factors responsible for the changes. The Big Muddy River is worth studying because the Big Muddy watershed is a largely agricultural area which could make it a source of nitrate pollution in the Mississippi River.