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Chloride Levels in the Edgewood Retention Pond

Abstract

The city of Madison uses salt on the roads to break down ice and prevent slippery roads. However, when the snow and ice melts, the runoff has to go somewhere. That runoff goes into our lakes and streams, affecting the wildlife and vegetation. High concentrations of salt can sometimes be harmful to roadside vegetation. The degree of harm to vegetation relates to four factors: the amount of salt, type of soil, total precipitation and plant species (Salt and The Environment). The purpose of our study was to determine whether there was a correlation between the chloride levels in the Edgewood Retention Pond and the use of road salt as a deicer. We measured the amount of chloride at three sites within the Edgewood Retention Pond during the winter months. We used the Hach® Test to measure the chloride in the water and also monitored the conductivity of the water. Throughout the six months, the chloride concentrations greatly increased from about 8 mg/L to 6000 mg/L. Unlike previous years of testing, we did receive record breaking amounts of snow. This study has shown that there was a correlation between the chloride levels in the retention pond and road salt. We understand there is a liability issue regarding the safety of staff and students on the Edgewood campus. The goal is to find a balance between safety and ideal distribution of salt. The following are recommendations for reducing the amount of salt used on the Edgewood campus; monitoring the weather, knowing storm conditions, calibrating spreaders prior to winter, and using good spreading techniques (Salt and The Environment).

Introduction

Winter road maintenance in Madison is important, and the application of road salt is a necessary tool. However, the overuse of road salt can negatively impact the environment. Although road salt plays an important role in assuring transportation safety, it also poses a significant environmental health concern. Water from snow and ice melt carries dissolved road salt into lakes and streams. Because chloride ions from dissolved road salt are not removed from water by chemical or biological processes, all of the chloride applied as road salt eventually ends up in our streams and lakes. At sufficient concentrations, these chemicals may have toxic effects on plants and fish.

Salt is used as the principal road deicer because it is the most available and most cost-effective deicer to reduce hazardous road conditions. It is plentiful in the earth and the

sea (The Salt Institute). How much road salt is applied to an area depends generally on the amount of snowfall and harsh weather.

After World War II, as the expanding highway system became essential to the public and the national economy, road salt use began to soar. The bare-pavement concept, under which motorists could expect snow- and ice- free pavements shortly after storms, soon became a policy in most cities and their suburbs. As a result, salt use doubled every five years during the 1950's and 1960's, growing from 1 million tons in 1955 to nearly 10 million tons less than 15 years later (1991).

Our main focus was the Edgewood Retention Pond and the levels of chloride that enter it due to the winter weather and the amount of salt used. We know that when the water in the retention pond attains a specific amount of water, it will drain into Lake Wingra. The intention of this investigation and experimentation is to illustrate just how high the chloride levels reach.

We hypothesized that as road salt is applied to the city streets of Madison, and around the Edgewood schools, the salt concentration in the Edgewood Retention Pond will increase from October to March. As the snow and ice begin to melt, more chloride will be present in the retention pond. The contaminants in the retention pond will eventually end up in the lake.

Methods

Samples were collected based on various snowfalls this winter season, the distribution of road salt that was used after each snow fall, and the melting of the snow and ice that would drain the salt into the retention pond. We collected water samples from three different corners (Figure 1). We attempted to obtain samples after major snowfall events each month. Samples were collected before the snowfall to gain a better understanding of the chloride levels in the retention pond before the use of road salt. Water samples were sealed tightly and placed in a refrigerator until tests could be conducted. Each sample was tested twice with a Hach® chloride test (low test: model 8-P) to measure the chloride concentration of water. We used the low range procedure Hach® test only before it snowed, because the chloride levels were so low. We used a Hach® chloride test kit CD-51 for testing samples after it had snowed. With all of the salt that was used, we knew that chloride levels would be very high and the low Hach® test would not give us accurate results. Results were averaged and graphed.

Results

Our results showed that the chloride levels in the water were at a level of 5 mg/L in all three areas. After a record breaking amount of snowfall (approximately 90 inches), we took more samples to monitor the change in chloride levels of the water. As we expected, the amount of chloride dramatically increased. In the samples that we collected after a large snowfall, we found that in area 1 the levels increased to 6000 mg/L, area 2 increased to 4250 mg/L, and area 3 increased to 3650 mg/L (as shown in Figure 2).

Figure 1:

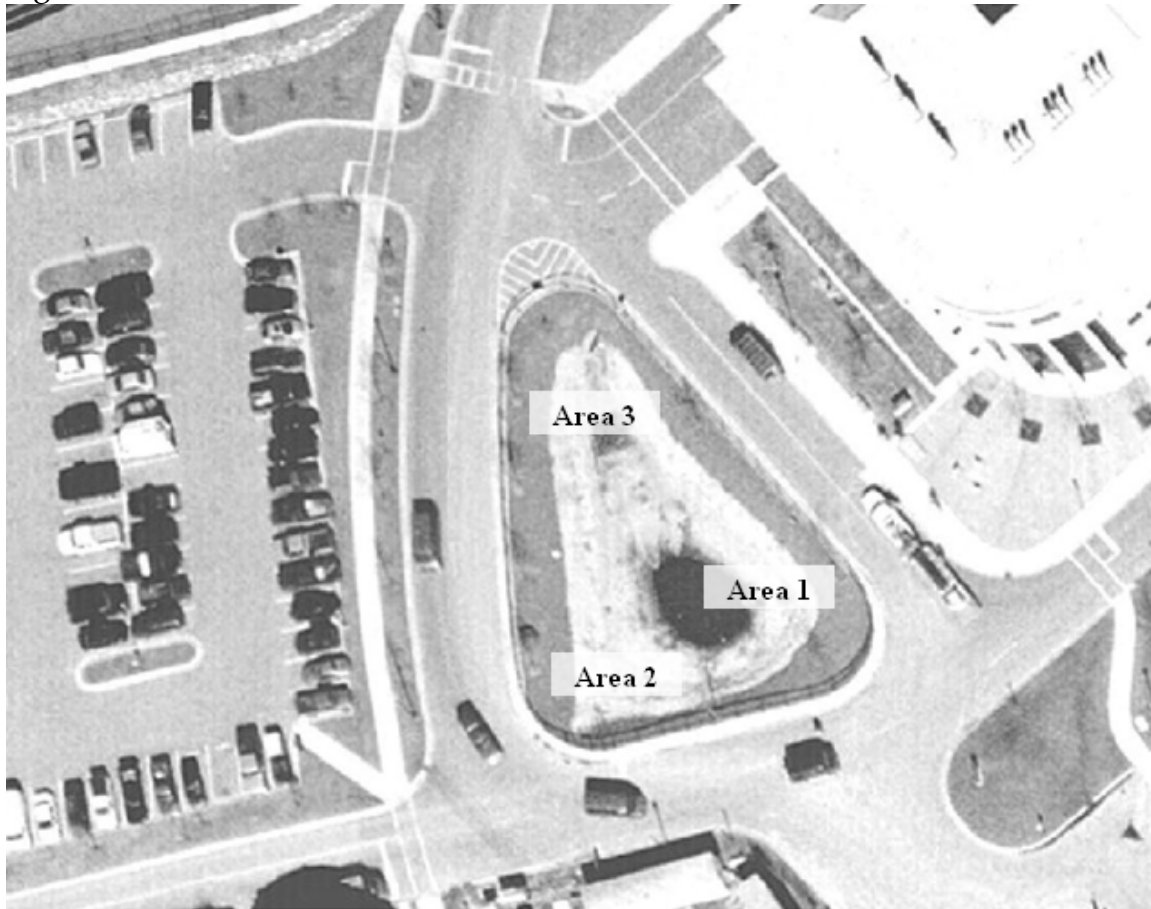
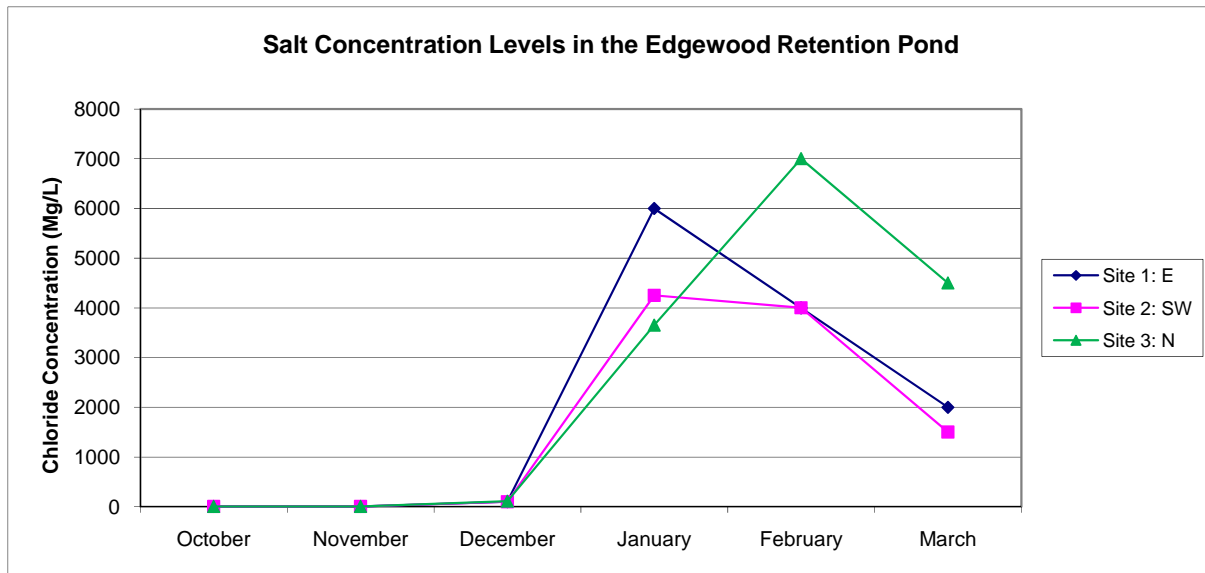


Figure 2:



Discussion

Results supported our hypothesis that chloride levels in the retention pond will greatly increased due to the use of road salt. With the ever changing weather this season, our test results were greatly impacted, due largely in part to the record amounts of snow, below freezing temperatures, and warm days with snow and ice melting. This winter season, the city used a majority of the salt, and was asked to conserve for further snowfalls. Because of the large amount of snow, more road salt was applied. However, the overuse of salt can negatively impact the environment. The following are examples of impacts:

- Vegetation
 - Inhibition of seed germination and root growth for grasses and wildflowers.
 - Competition to native species from salt-tolerant invasive species.
- Wildlife
 - Compromised health in birds ingesting salt at 266 mg/kg; median lethal dose in birds and mammals is 3,000 mg/kg.
- Aquatic life
 - Decreased dissolved oxygen and increased nutrient loading, promoting eutrophication.
 - Reduction of number and diversity of macroinvertebrates.
 - Median lethal does (7 days exposure to salt) for 17 species of fish, amphibians, crustaceans ranges from 1,440-6,031 mg/L (mean value of 3,345 mg/L) (2006).

This accounts to the high levels of chloride in our tests, higher than previous years. We believe that the levels at site three are higher because this is where runoff initially comes in contact with the retention pond. In previous studies, increased chloride levels were associated in our study with increased snowfall. In a similar study conducted last year,

the highest recorded chloride level in the Edgewood Retention Pond was 465 mg/L. Our highest record was 7000 mg/L. Our study differed in that we tested three sites in the pond, whereas this group took samples from the same spot. When comparing results, the first noticeable increase in chloride levels was observed in the month of December. Both studies also had a large increase in chloride levels during the months of January and February. One possible reason for the decrease in chloride levels at the end of February and into March for both studies could be due to an increase in temperature and/or less snowfall. Both of these factors can cause snow to melt, which dilutes the water in the pond. Even though our results for chloride levels were significantly higher than the results from last year, the overall trend of increasing and decreasing levels of chloride took place during the same months, and most likely happened due to salt application from a snowfall and then a period melting.

With this information and the data collected during our study, we hope to better inform individuals of the damaging effects of road salt not only to our lakes and streams, but the wildlife that depends on it for its survival. We have observed excessive amounts of salt on campus sidewalks and parking lots. We suggest Edgewood consider pre-wetting salt with a chemical such as calcium chloride and/or magnesium chloride. This technique reduces the amount of salt needed, and produces the intended results (Salt and The Environment).

References

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