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Water Quality, Chemistry, and Hydrology of Salt Creek in Northeastern Illinois

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Abstract:
Salt Creek flows through the metropolitan area of Chicago and into the Des Plaines River. Its urban environment provides multiple sources of contamination, including storm runoff, combined sewer overflow, and wastewater treatment plant discharge. The purpose of this study is to determine how water chemistry changes downstream, whether the presence and levels of metals meet IPCB (Illinois Pollution Control Board) and EPA water quality standards, and how water chemistry changes during periods of storm flow and base flow. The study area consists of 10 sites along a 37 km stretch of Salt Creek. Water samples were taken every other week during June, July, and August of 2005. Six of these sites are located near USGS gaging stations, and corresponding hydrographs were collected to determine hydrological characteristics of the creek such as storm flow and base flow conditions. Hydrographs show Salt Creek as a "flashy" stream, a result of being in an urban area with a large amount of impervious space. Due to its "flashy" behavior, the frequency of flooding and the rate of erosion have increased. Analysis of water samples was done with an X-Ray Fluorescence spectrophotometer to determine concentrations of metals (Fe, Cu, Cr, Pb, Ni, Zn) and other ions (Ca, Mg, Na). Other measurements included total dissolved solids (TDS), temperature, and pH. Concentrations of As and Pb above IPCB limits were found throughout the study area and concentrations of Fe above IPCB standards were found in more downstream regions both during periods of storm flow and base flow. Fe was more often present during periods of storm flow. Concentrations of Ca, Ni, and Zn were generally below IPCB limits. Consistently high concentrations of As, Pb, and Fe were found in samples taken near the city of Elmhurst and several possible industrial point sources have been identified. Two upstream sites near Rolling Meadows and Elk Grove had TDS measurements above EPA standards set for the creek. Rolling Meadows also had consistently higher values for Ca, Mg, and Na.

Methods:
Bi-weekly water samples were collected during the summer of 2005 at 10 sites along a 26 mile stretch of the creek. A total of 48 samples were collected. Six of these sites are near USGS gaging stations. Hydrographs that show Salt Creek as a "flashy" stream, a result of being in an urban area with a large amount of impervious space. Due to its "flashy" behavior, the frequency of flooding and the rate of erosion have increased. Analysis of water samples was done with an X-Ray Fluorescence spectrophotometer to determine concentrations of metals (Fe, Cu, Cr, Pb, Ni, Zn) and other ions (Ca, Mg, Na). Other measurements included total dissolved solids (TDS), temperature, and pH. Concentrations of As and Pb above IPCB limits were found throughout the study area and concentrations of Fe above IPCB standards were found in more downstream regions both during periods of storm flow and base flow. Fe was more often present during periods of storm flow. Concentrations of Ca, Ni, and Zn were generally below IPCB limits. Consistently high concentrations of As, Pb, and Fe were found in samples taken near the city of Elmhurst and several possible industrial point sources have been identified. Two upstream sites near Rolling Meadows and Elk Grove had TDS measurements above EPA standards set for the creek. Rolling Meadows also had consistently higher values for Ca, Mg, and Na.

Results:
All metals analyzed were found in concentrations above water quality standards at some point during the sampling period and were found at every sample site. 6% of samples had concentrations of Cu above standards. Concentrations of Ni above standards were present in 21% of samples. 12.5% of samples had high concentration of Zn. Concentrations of As were above standards in 52% of samples and were present in every sample site. Concentrations of Pb were above standards in 27% of samples, most consistently in Elmhurst (river mile 18). Concentrations of Fe above standards were found in 21% of samples and were more common in the lower half of the study area. Concentrations of Ca, Mg, and Na, and total dissolved solids were higher at Rolling Meadows (river mile 33.9) than the rest of the sample area. Concentrations of total dissolved solids above EPA water quality standards were also present in Rolling Meadows.

Discussion:
During stormflow conditions, the primary source of contamination is from nonpoint sources, mainly from surface runoff. The metals analyzed are commonly found in gasoline, used motor oil, brake emissions, lubricating oil, pesticides and insecticides. Since the watershed is highly urbanized, these sources of metals are common. Pollution during baseflow conditions could be from retention water being discharged into the creek; waste-water treatment plants not being able to treat all of the metals present, or other unknown nonpoint sources nearby. A reason for Rolling Meadows to have different water chemistry than sites downstream could be due to Busse Lake (Figure 2), a 550 acre retention lake that is just downstream.

Conclusions:
Salt Creek is polluted during both baseflow and stormflow conditions at all sample sites. Metals were more common downstream. Higher concentrations of metals were found during stormflow conditions. Salt Creek north of Busse Lake appears to have different water chemistry than the rest of the creek.

References:

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