DEPARTMENT OF NATURAL RESOURCES

August 14, 2018

The Honorable Rick Hansen
State Representatives – District 52A
247 State Office Building
Saint Paul, Minnesota 55155

Dear Representative Hansen:

Thank you for your inquiry and concern about the potential impacts from diesel fuel that leaked into the Mississippi River at the Hoffman Bridge in South Saint Paul on Wednesday, August 8. The Minnesota Pollution Control Agency (PCA) Emergency Response is coordinating the response with the U.S. Environmental Protection Agency and representatives from Union Pacific. Reports from PCA are that 2,500 gallons of diesel fuel leaked from a 3,200 gallon capacity tank.

Attached please find a general scientific review of the impacts of diesel fuel and/or other petroleum products on aquatic life, and implications of the specific spill on August 8.

Sincerely,

Tom Landwehr
Commissioner

TJL/PJR/jls

Attachment

Effects of Diesel Fuel on Aquatic Life

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Contents of this Review

I used information related to diesel fuel spills, when available, but much of what I present here is related to spills of crude oil and/or other petroleum products. Studies of the effects of specific petroleum products are uncommon, since they are dependent on pre-spill data from another study in the waterbody. There are some studies that experimentally tested the effects of oil spills on freshwater ecosystems, but those are also rare.

Toxicity

In a controlled laboratory setting, the 24-hr lethal concentration (LC) of diesel fuel for *Daphnia magna* (a common freshwater zooplankton) was 1.78 mg/l and Rainbow Trout was 578 mg/l (Khan et al. 2007). The oil and petroleum-derived compounds can impair the ability of aquatic animals to extract oxygen from the water, impair physiological processes related to water balance and metabolism, and make them more susceptible to pathogens (Whitehead 2013). Experiments of diesel spills on plots of plants resulted in mortality in all but one species of plants in the Arctic (Walker et al 1978).

Changes to Dissolved Oxygen

Decomposition and oxidation of organic components in diesel fuel may decrease dissolved oxygen in surface waters, causing stress to aquatic organisms (Harrel 1985). The amount of decrease in dissolved oxygen is related to the amount of pollutant spilled in the water and the size of the waterbody. There can be immediate effects of effects of oil spills on dissolved oxygen (Whitehead 2013). There can also be secondary effects, as a pollutant plume is consumed by microbes, also decreasing dissolved oxygen.

Effects on Freshwater Communities

The effects of oil spills on freshwater organisms is variable. Effects may be immediate, with high mortality (snakes and waterfowl, Masnik et al 1976; insects Cushman and Goyert 1984; invertebrates Crunkilton and Duchrow 1990), delayed (invertebrates, Harrel 1985), or not apparent (fish and invertebrates, Masnik et al 1976). Oil spills can affect stream invertebrate communities by decreasing density and diversity (Harrel 1985, Crunkilton and Duchrow 1990, Lytle and Peckarsky 2001). Acute toxic effects and longer term genetic effects of diesel fuel have been observed on freshwater fish (Vanzella et al 2007). Changes in blood chemistry, physiological responses, and liver tissue have been observed in fish after exposure to diesel fuel (Simonato et al. 2008). Diesel fuel can have dramatic, toxic effects on plant communities, killing all but the most tolerant species, with little recovery following exposure (Walker et al 1978).

Many factors affect the amount of ecological disturbance caused by spills of oil products in freshwater ecosystems. The amount of damage due to oil spills in streams is related to waterbody size, with larger effects on smaller systems (Crunkilton and Duchrow 1990, Harrel 1985, Guiney et al. 1987, Masnik et al 1976). Effects of oil spills may be exacerbated by additional factors, such as low flows and warm water temperatures (Harrel 1985, Lytle and

Peckarsky 2001, Whitehead 2013). Dispersion of diesel by mechanical mixing (e.g., waves, aeration, water flow) can increase acute toxicity to aquatic animals, by increasing the bioavailability and exposure of toxins to animals (Schein et al 2009).

Recovery from Spills

Recovery from oil spills are also variable and dependent on multiple factors. High stream discharge (volume of water moving through a stream) and scouring stream flows may accelerate recovery from spills (Crunkilton and Duchrow 1990, Guiney et al. 1987). The timing of a spill within the year may impact the ability of a stream to recover from an oil spill. Many aquatic insect species have terrestrial adult life stages. If terrestrial adults are present during the spill, streams may recover more quickly (Harrel 1985, Lytle and Peckarsky 2001). Stream segments closest to spills may recover more slowly than downstream locations (Harrel 1985, Guiney et al. 1987).

Guiney et al (1987) identified four factors that promoted recolonization of fish and invertebrates in a watershed after an oil spill. Those factors included rapid response and clean-up, abundant water in the system, drift of invertebrates from upstream, and fish movement back into the affected stream reaches.

Implications: Diesel Spill in Mississippi River

Some fraction of the diesel spill in the river was likely dissolved in the water. Quantifying that amount is dependent on many factors, including the amount of diesel spilled into the river, the chemistry and temperature of the river water, the chemistry of the diesel, amount of water moving through the river, and other variables. Without samples, we don't know how much pollutant was dissolved in the water.

Given the volume of the spill relative to the volume of the Mississippi River in Saint Paul, the pollutant was highly diluted by river water. At the time of the spill, the discharge in the river was ~136,000 gal/s. The spill was 2500 gal. This means the spill was <2% of the river volume at that instant, at the location of the spill. Since the river is replenishing water at the location of the spill at the rate of ~136,000 gal/s, the plume was quickly diluted.

The impact to aquatic life was likely minimal from this spill, given the information about the size of the spill and the volume of the river. The spill is still concerning, however, as there are multiple stressors to aquatic life in the river (e.g., pollutants, warm temperatures, oxygen stress, pathogens). The effects of these multiple stressors are unknown and hard to quantify.

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