Impact of CoVID-19 Stay-at-Home Orders on Urban Stream Quality in Denver Metro Area with Application for Future Urban Living Scenarios

Extended Abstract

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Introduction

The COVID-19 pandemic has created an opportunity to research how urban water quality can improve if traffic were significantly reduced during normal societal conditions. Due to stay-at-home orders, many businesses, schools, and public spaces have closed resulting in much less traffic and more open parking lot spaces than usual. These recent conditions may have reduced carbon emissions and have prompted consideration of how changes in traffic conditions can benefit our urban infrastructure(City Lab, 2020). An additional and important perspective is the outlook on the improvement of urban water quality due to the decreased amount of vehicles.

The state of Colorado amongst others in the nation have experienced heavy shut down orders with only essential businesses continuing to stay open. The state's mandates signify citizens should only leave their homes under essential circumstances, which will likely cause reduced amounts of water pollution in areas along roadways and popular shopping centers. Literature reviews suggest motorized vehicles are primarily responsible for specific heavy metals such as copper, lead, and zinc as well as other pollutants such as polycyclic aromatic hydrocarbons(PAH) and BTEX (i.e, benzene, toluene ethylbenzene, xylenes)(Han, Y.et al, 2006). Sustainable improvements to our society such as working from home, online retail shopping, and the promotion of public transportation can help reduce these pollutants. Many of these improvements have been in place since March, and while research is in place to observe air emissions, little to none has occurred to understand urban stream quality.

Stay-at-home orders present an example of low level human activity that can impact water quality, which is an important factor for future sustainability efforts. Our hypothesis is urban water quality will be improved, where concentrations and pollutant fluxes will be reduced by an order or magnitude compared to historical and post-pandemic conditions, particularly for total dissolved solids, acidity, heavy metals, and selected organic pollutants.

Objectives and Methods

The objective of this research is to collect for later comparisons, sensitive data on urban water quality during the period of reduced traffic by COVID-19 restrictions. Our methodization for analyzing the impacts of normal and reduced traffic was by using historical data from the USGS, Colorado School of Mines field samples, and CoAgMet(Colorado State University weather software)in the Denver Metropolitan Region and comparing it to post-pandemic water quality. In addition, literature reviews were conducted on articles in relation to our topic for a better understanding of this research and future urban living and urban water quality.

Our primary study area is a north-south 130-mile corridor from Fort Collins to Colorado Springs(Figure1) . The

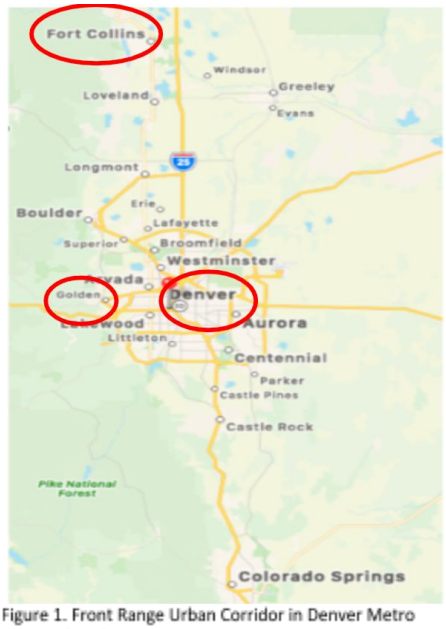

Figure 1. Front Range Urban Corridor in Denver Metro Area, Colorado

18 specific sampling sites are in Denver, Fort Collins, and Golden. Samples from these sites will be collected during dry(normal stream base flow conditions) and wet weather in storm sewers and other urban channels. We will be analyzing significant urban water pollutants that are products of vehicular traffic, which include heavy metals, PAHs, and BTEX. The sites chosen are streams that are adjacent to accessible roadways and large parking lots and are important to the local municipal areas. The sites also have a good source of historical data and represent the cities in the 130-mile corridor. There are some limitations to collecting this data because not all data is readily available due to COVID-19 shutdowns. Neighborhoods with high and lower imperviousness were selected, along with thoroughfares by the two major interstates in the Denver area(I-25,I-70).

Data and Results

Before gathering the research data, an in-depth review of literature articles written on the relationship between water quality and traffic was conducted. The literature reviews iterated to us, emissions from these sources deposit directly on land surfaces such as parking areas, streets, and highways, washing-off during storm events, especially in those impervious surfaces due to their rapid runoff response, even during small rainfall events(Muller et al, 2020). These reviews were also important in ensuring we maintained a global perspective in the application of our research. The data for precipitation in the Denver metropolitan area was collected remotely using the CoAgMet weather software. There were 18 sites in which precipitation data corresponding with the sampling events were collected in 5 minute increments. This data were then graphed on stormwater hydrographs along with corresponding water flow data(Figure2). The graphs show precipitation and the following trend of water flow data to allow the team to align their event sampling data including BTEX, PAH, and other pollutants in order to make analysis of water quality due to run-off. We hope to make stormwater hydrographs post-pandemic in order to compare them to traffic conditions and water quality during the pandemic.

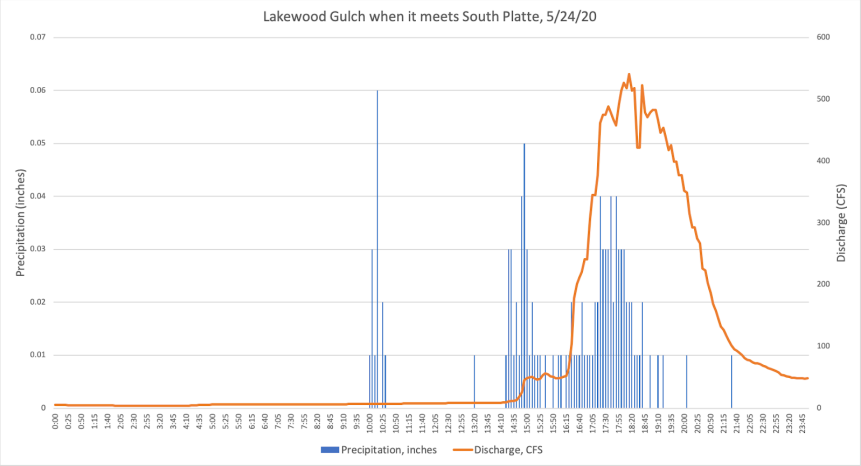

Figure 2. Storm hydrograph for Lakewood Gulch on 5/24/2020

Conclusions

Reducing pollutants can have significant benefits to our future sustainable living situations.

The COVID-19 pandemic has the potential to accelerate the conditions of working from home, online learning, and increased online retail shopping. This information will be useful to urban planners in regards to infrastructure that promotes healthier and more sustainable urban water systems.

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