ABSTRACT

River baseflow is the river discharge supported predominantly by groundwater, and can be greatly increased by changes in land. Intuitively, the baseflow of a river would decrease with increased urbanization, as urbanization increases the amount of impervious surfaces, limiting the ability of precipitation to infiltrate into the ground and recharge the local groundwater. However, evidence suggests that the baseflow of rivers in urbanized areas can increase as a result of leaky subsurface water infrastructure that add water to groundwater and replenish baseflow. Another reason for the baseflow increase in urbanized watersheds is that water supply systems are over-pressurized by design to reduce the chances of contamination, providing extra water to the local system. Cities that have decreased in population over the last century may experience an even greater addition to baseflow as leaky water infrastructure may not be attentively maintained due to the fact that there are less people in the area to supply water to. Given these conflicting urban influences on baseflow, it is important to investigate this relationship further. The goal of this project is to empirically investigate how decreased population in urban areas has impacted baseflow in the Midwest region of the U.S. The project uses USGS gage data from streams within the Rust Belt, specifically from the states of MI, NY, PA, and OH. The results determined that there is a positive relationship between depopulation and baseflow in cities that lie within the geophysical province of the Central Lowlands.

BACKGROUND

As urban areas develop, the amount of impervious surfaces typically increases, producing a decrease in infiltration rate and an increase in runoff. The increased runoff produces a more “flashy” stream with quickly increasing and decreasing discharges, and intuitively less baseflow.

GAGE CRITERIA AND DISCHARGE METRICS

1) Continuous data, ≥ 40 years  
   -Not immediately downstream of large dams/impoundments  
   -Drainage area of less than 400 miles²  
2) Baseflow per unit drainage area (BF, m³/yr)  
3) Runoff (RO, m³/yr)  
4) Total flow (TF, m³/yr)  
5) A ratio of baseflow to peak over area (BF/PA, unitless)  
6) A ratio of runoff to peak over area (RO/PA, unitless)  
7) A ratio of total flow to peak over area (TF/PA, unitless)

RESULTS

<table>
<thead>
<tr>
<th>Geophysical Provinces of the Contiguous United States</th>
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<tr>
<td>Central Lowland</td>
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<td>Appalachian Plateaus</td>
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DISCUSSION

Depopulated cities of the “Rust Belt”, situated within the Central Lowlands physiographic province, experience urban karstification more intensely than other urban areas because of the underlying rock. The urban karstification process happens at a faster rate than it would naturally because the over-pressurization of the subsurface water infrastructure erodes the surrounding rock more quickly than naturally flowing waters in a typical karst system. Because of urban karstification, select cities are experiencing an increase in baseflow despite a decrease in population.

Urban Karstification
Leaks, by design, due to over-pressurization to decrease [water] contamination. Subsurface water infrastructure acting as a conduit for flow, increases secondary porosity and permeability characteristics.

Lifespan of water infrastructures are approaching, resulting in system failure.

REFERENCES