



# Urban Stream Corridors and Forest Patches – The Connections: A Case Study of Bloomington, IN

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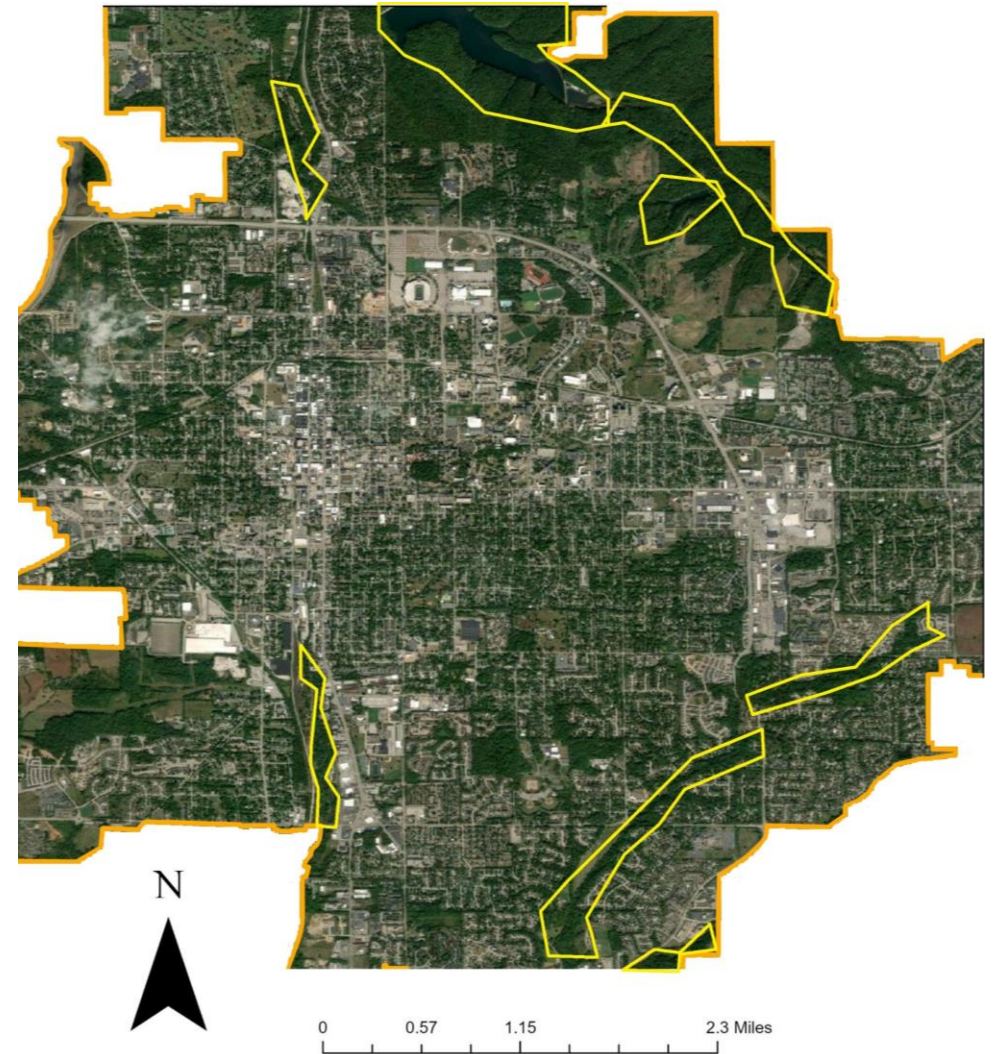


# Urban Stream Syndrome

- Regularly observed conditions found in and along stream corridors that drain urban environments (Walsh et. al 2005)
- “Symptoms” of Urban Stream Syndrome include: (Paul & Meyer 2001)
  - Flashier hydrology and altered geomorphology
  - Increased chemical and nutrient loading
  - Reduced species richness and increased numbers of tolerant species
  - Higher microbe densities
- Deforestation within the stream reach, especially in the riparian zone, is a major driver of Urban Stream Syndrome (Walsh et. al 2005)

# Connections Between Urban Streams and Forests

- Many Urban Forest Patches (UFPs) in Bloomington are found along stream corridors
- These UFPs reduce the physical and chemical effects of Urban Stream Syndrome
- However, they do not alter ecological effects (Roy et. al 2005)



Bloomington, IN - World Imagery

# Stream Corridor and UFP Changes Over Time

- As cities developed and increased in impervious surface cover, streams were channelized and buried
- Buried stream corridors lack connectivity with the surrounding environment due to being funneled through storm overflow pipes
- UFPs were removed as streams were modified to increase drainage
- But some new UFPs have regrown along stream corridors



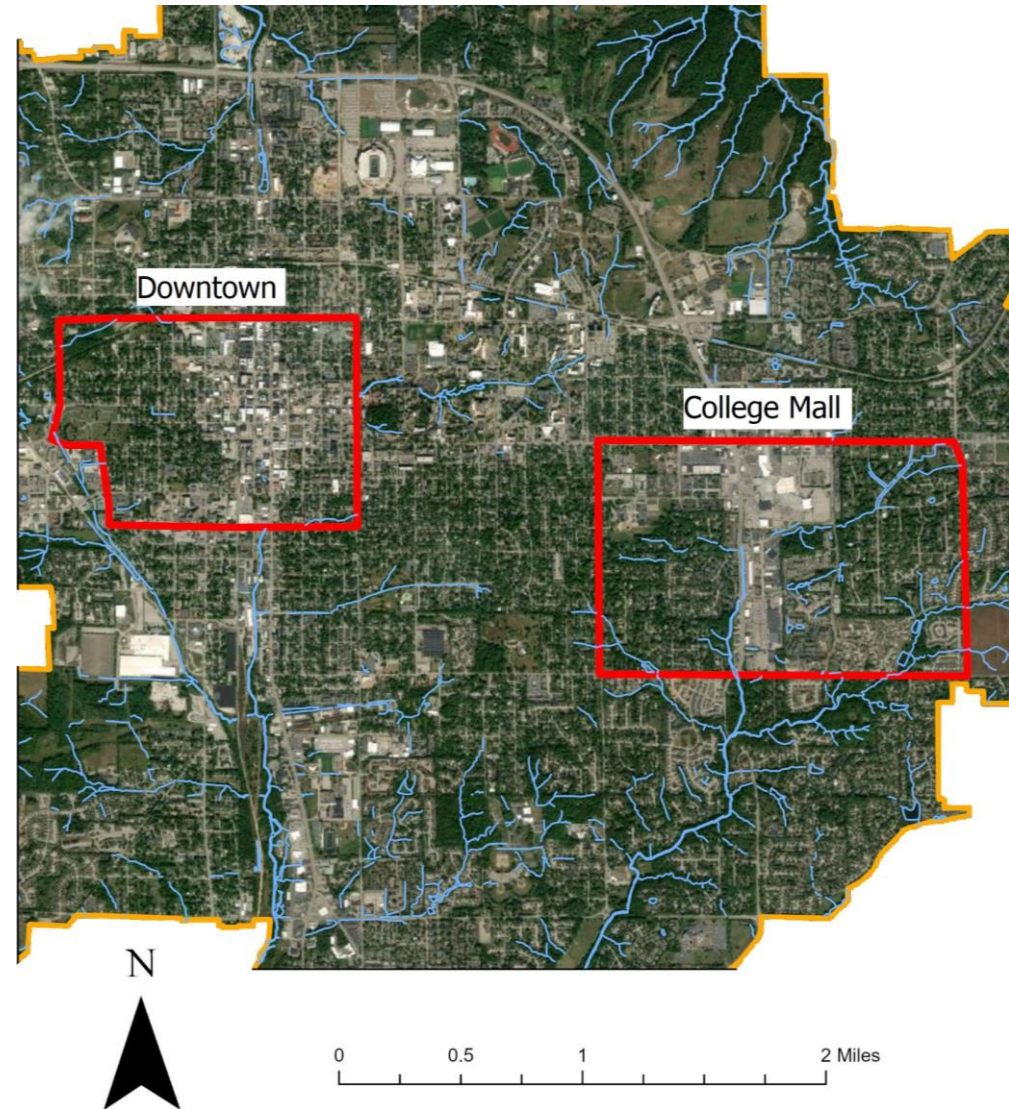
# Research Questions

- a. How have Bloomington streams moved and been buried over time altered their connectivity to nearby UFPs?
- b. How have UFPs near streams changed in size, or moved over time altered their impact on streams?



# Study Sites

- Two sites within Bloomington city limits were selected to observe changes in UFPs and stream corridors over time
- UFPs are at least 1 acre and have a mean width of 120'
- Stream corridors include permanent streams and ephemeral corridors



Bloomington, IN - World Imagery

# GIS Imagery

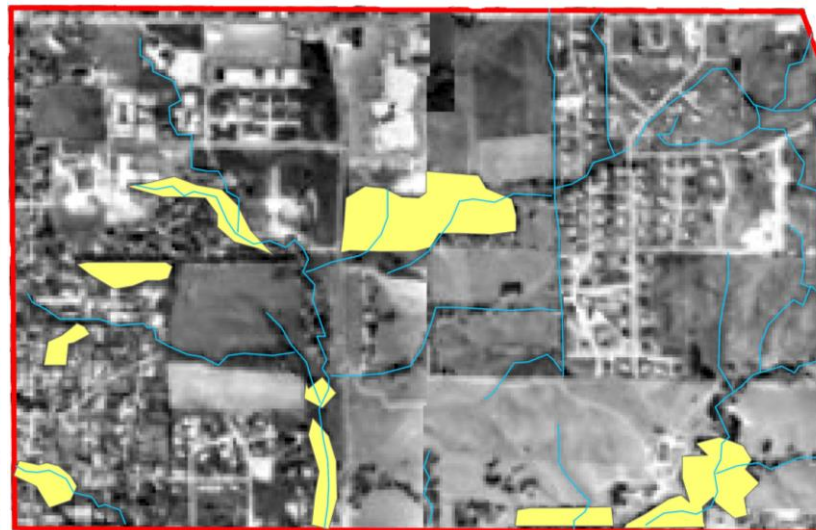
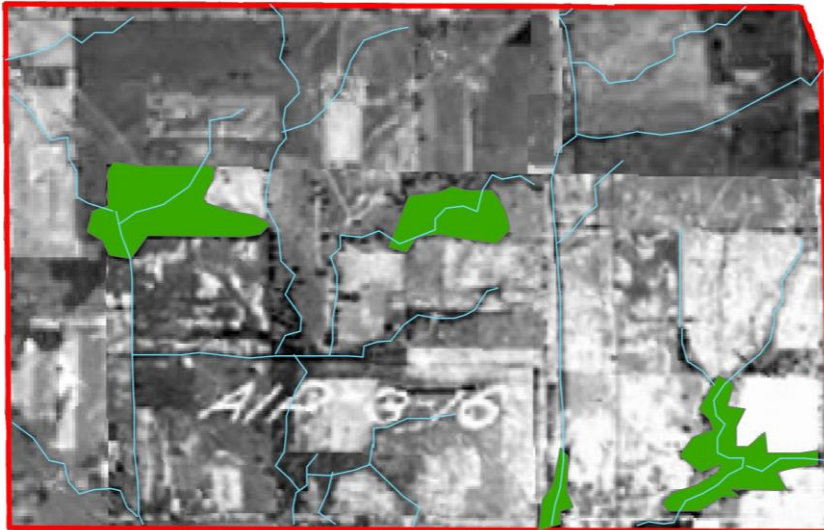
- GIS aerial imagery from 1939 and 1967 were used to draw UFPs and stream corridors for each respective year
- 2016 NLCD data was used to draw UFPs
- City of Bloomington's Creeks and Streams file was used for 2016 stream corridor data
- Buried streams are inferred using current Bloomington stormwater overflow maps and viewing missing parts of visible stream sections

# Results – College Mall Area

1939








1967

2016



0 0.25 0.5 1 Miles

## Legend

- |  |   |
|--|---|
|  Modern_Streams |  2016_UFP    |
|  1967_Streams   |  1967_UFP    |
|  1939_Streams   |  1939_UFP    |
|  |  Study_Sites |

- As the College Mall area developed into a commercial/ residential area, many stream corridors were buried
- The number of UFPs increased, due to a combination of fragmentation and the maturation of younger forest patches, mostly along stream corridors



# Results – Downtown

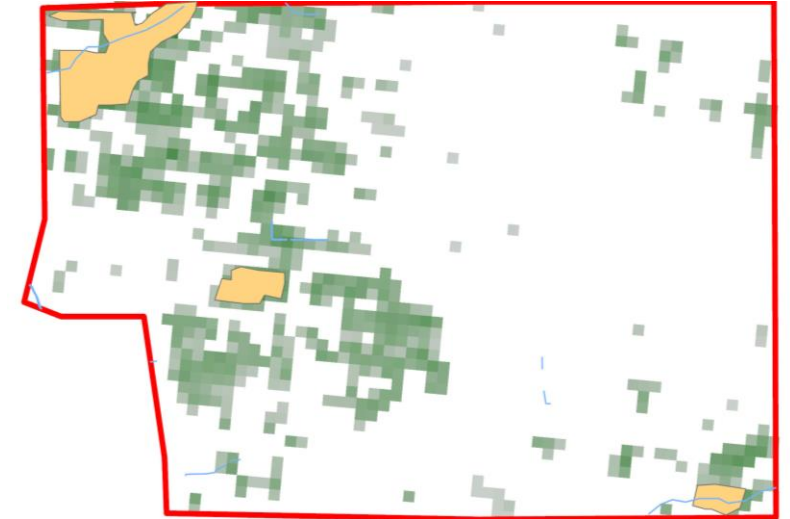
1939



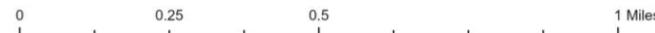
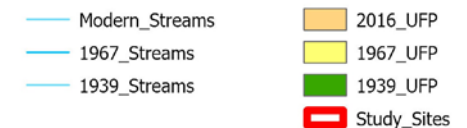
1967



2016



## Legend



- Most stream corridors were buried between 1939 and 1967
- Most UFPs in 1939 were removed to develop this area, with new UFPs growing in the western half of this site. The new UFP in the Northwest corner was established along a former railway that was converted in bike/pedestrian trail

# Summary of Results

- Overall, many stream corridors at both sites were buried due to infrastructure development, which reduced overall connectivity between most stream corridors and nearby UFPs
- New UFPs increases stream corridor/UFP connectivity at the sites of these UFPs
- Most UFPs changed over time
  - Most forest patches in 1939 were removed or reduced in size, especially in the Downtown site, mostly to build mix of residential and commercial sites
  - New UFPs appear in 1967 and 2016, mostly due to sites being undisturbed, allowing UFPs to grow



# Next Steps

- Analyze the entire City of Bloomington using the 1939,1967, and additional aerial imagery for presence of stream corridors and UFPs
- Utilizing field work to refine stream corridor and UFP data
- Estimate UFP value for ecosystem services regarding reduction of stormwater runoff
- Incorporate Impervious Surface Cover Imagery and Flood Zone data to rank UFPs based on their ability to reduce runoff and flooding