The study of Toledo, Ohio, assessed the economic benefits of green infrastructure as a method for reducing flood impacts in the Silver Creek Watershed. Visit the different stations to learn about current and past flooding events that have impacted Toledo, how current precipitation and land use can create runoff during flood events and cause damages, how flooding and associated damages might increase in the future due to climate change, and how green infrastructure can be used to lessen those impacts. We also want to hear about the types of green infrastructure you would like to see in the Silver Creek Watershed to reduce flooding impacts as well as what you can do on your own property.

Stations:

- **Station 1**
  - **Flood Impacts**
  - What are the current and past flooding events that have impacted Toledo?

- **Station 2**
  - **Current Precipitation and Land Use**
  - What causes flooding in the Silver Creek Watershed and results in damages?

- **Station 3**
  - **Future Precipitation and Land Use**
  - How will climate change and development affect flooding in the future?

- **Station 4**
  - **Green Infrastructure Options**
  - How can we lessen flooding impacts using nature?

- **Station 5**
  - **Opportunities in Silver Creek**
  - What green infrastructure opportunities should be implemented in the Silver Creek Watershed to lessen flooding?
HEAVY RAINS = FLOODING

TOLEDO FLOODS

Toledo’s Chronic Urban Flooding

Toledo’s More Memorable Floods

- 1913: 6-8 inches
- 1969: 10-14 inches of rain
- 2006: 5-7 inches of rain.
  - 3 floods in 3 weeks!

WHY IT FLOODS

Toledo – Once the Great Black Swamp

- Swampy, flat land does not drain well
- Lots of paved surfaces
- Creek reaches peak fullness
- Too much water, too fast for stormwater pipes

BIG STORMS: WHAT ARE THE CHANCES?

Our project is identifying the impacts from a big storm known as a “100-year” storm. This storm has a 1% chance of occurring every year. Extreme events such as the 100-year storm do not happen very often, but when they do, they cause major damages.
Average 5* or more inches in 24 hours (for 100-year storm). Toledo has traditionally had bigger storms in the summer months of June through August.

* Source: NOAA Precipitation Frequency Data for Toledo

9,370 acres or 92% of the watershed is covered in paved materials. This is a problem because rooftops and streets do not absorb rainwater which runs off into nearby streams, ditches, and storm drains. If there is too much water too fast, then these systems become overwhelmed and flooding happens.

Keep your storm ditches clean and open to reduce flooding potential. Those storm ditches help water flow to the larger stormwater system and take water out of your neighborhood.

This information will help us identify when flooding could occur:

- Amount of rain from the 100-year storm
- Information about what is on the land

These two pieces of information give us the peak discharge estimate, which is the maximum amount of water moving through Silver Creek at a certain time and location.

In our current flood scenario, a 100-year flood could damage about 20% of the structure on this property.
Big storms and flooding have increased over the last century and are expected to further increase. Climate models are projecting an increase in big storm events. Our project looked at heavy rain in the year 2035. The climate data from our study show a projected 0.58% increase in the frequency of 100-year storms.

The Silver Creek Watershed is about already 92% covered by paved surfaces, so there is not much room for more development. However, there is a major need for more floodwater storage.

In the future, with the climate changing, the chances of a damaging peak discharge from the 100-year storm event could go from a 1% annual chance to a 1.45% annual chance. The community’s chances of a damaging storm increase, making impacts more likely to happen.

In our future flood scenario, a 100-year flood could damage 35% of the structure on this property, compared to 20% in the current flood scenario.
INCREASED GREEN INFRASTRUCTURE = DECREASED FLOODING

CREATE NEW NATURAL AREAS TO ABSORB FLOOD WATERS

Benefits:
- Reduces peak discharges
- Captures and reduces a variety of pollutants like sediment, nutrients, and bacteria
- Reduces temperature
- Reduces runoff quantity during storm events
- Can be designed for public access and enjoyment
- Improves water quality
GREEN INFRASTRUCTURE NEEDED TO REDUCE FLOODING FROM BIG STORMS

To reduce the damaging 100-year storm peak discharge by 10%, we need to store this amount of storm water:

- **31 acre-feet** needed under current rainfall and land use
  - That’s 448 swimming pools*

- **33 acre-feet** needed under future rainfall and land use
  - That’s 477 swimming pools*

How can we reach this goal?
The City of Toledo, its homeowners, and businesses can work together to implement different green infrastructure techniques.

These techniques will vary in the amount of water storage they provide, but it all adds up to contribute to the goal!

**What is an acre-foot?**

1 acre-foot = 1 acre of water 1 foot deep OR 326,000 gallons of water.

**Risk Reduction**

- With **31 acre-feet** of storage, the annual chances of the damaging peak discharge goes down to 0.50% from 1%.
- With **33 acre-feet** of storage, the annual chances of the damaging peak discharge goes down to 0.71% from 1.45%.

Could reduce what’s spent on building damages

How do we know that installing effective green infrastructure saves money? We can find out by analyzing the expense of flood-related building damages. That figure helps us see what “green infrastructure” communities will **not** have to spend fixing flood-related damage. Of course, this figure does not include all flooding impacts, such as extensive cleanup or the filing of insurance claims. But it can give us valuable information.

By choosing to install more green infrastructure throughout the Silver Creek watershed, the City of Toledo and its residents would avoid $40,000 in building-related flood damage each year. This estimate only looks at building damages within the Silver Creek watershed and does not account for all the possible damages that do occur from flooding.
WHAT’S HAPPENING NOW TO REDUCE FLOODING?

CURRENT PROJECTS UNDERWAY

EPA and City of Toledo Fund Bioswale Project to Reduce Flooding

• U.S. Environmental Protection Agency (EPA) grant is being used to build bioswales in portions of the Silver Creek Watershed area to reduce flooding. This study helped provide results on the benefits of using green infrastructure. Contact Patekka Bannister (patekka.bannister@toledo.oh.gov) to learn more.

  • Benefits: Federal money is being leveraged, less stormwater flooding, potential for increase property value

County, City, and Business Partnership to Reduce Stormwater Flooding

• A Green Stormwater Infrastructure Task Force is meeting monthly to work on stormwater issues. Their goal is to improve water quality and flooding issues by using green stormwater infrastructure. They have several pilot projects underway. Contact Katie Rousseau (krousseau@americanrivers.org) to learn more.

  • Benefits: Region-wide coordination and less stormwater flooding

Reducing Flooding and Adding Parks in Urban Neighborhoods

• Toledo Metropolitan Area Council of Governments is using a recent grant to help urban parts of the region improve stormwater flooding using green infrastructure. Working with the Ohio Lake Erie Commission and the Lucas County Land Reutilization Corporation (the Land Bank) foreclosed and vacant properties will be put to use. There is a potential to install modern stormwater management in older neighborhoods where structures are being demolished. This could results in increasing green space and recreational areas for residents. Contact Kari Gerwin (gerwin@tmacog.org) to learn more.

  • Benefits: Less stormwater flooding, possibly increase property values, parks and open space
**WHAT GREEN INFRASTRUCTURE WOULD YOU BE INTERESTED IN PUTTING ON YOUR PROPERTY?**

Put a ✓ next to the green infrastructure practices you could do on your property.

<table>
<thead>
<tr>
<th><strong>Plant Trees</strong></th>
<th><strong>Divert Downspouts to Permeable Area</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Plant Trees" /></td>
<td><img src="image2.png" alt="Divert Downspouts" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Replace Lawn with Native or Perennial Plants</strong></th>
<th><strong>Install Permeable Sidewalk, Patio, or Driveway</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Replace Lawn" /></td>
<td><img src="image4.png" alt="Install Permeable" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Install a Rain Barrel</strong></th>
<th><strong>Install a Green Roof</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5.png" alt="Install a Rain Barrel" /></td>
<td><img src="image6.png" alt="Install a Green Roof" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Install a Rain Garden</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7.png" alt="Install a Rain Garden" /></td>
</tr>
<tr>
<td>Green Infrastructure Choice</td>
</tr>
<tr>
<td>----------------------------------------------------------------</td>
</tr>
<tr>
<td>Conservation of Natural Areas</td>
</tr>
<tr>
<td>Rainwater Cisterns</td>
</tr>
<tr>
<td>Rain Gardens and Bioswales</td>
</tr>
<tr>
<td>Permeable Sidewalks, Pavement</td>
</tr>
<tr>
<td>Stormwater Tree Trenches</td>
</tr>
<tr>
<td>Plant More Trees</td>
</tr>
<tr>
<td>Underground Storage</td>
</tr>
</tbody>
</table>

Put a ☑️ next to your top 3 green infrastructure choices.