The influence of LANDSCAPE FACTORS on transportation systems

prepared by Iowa State University

Overview

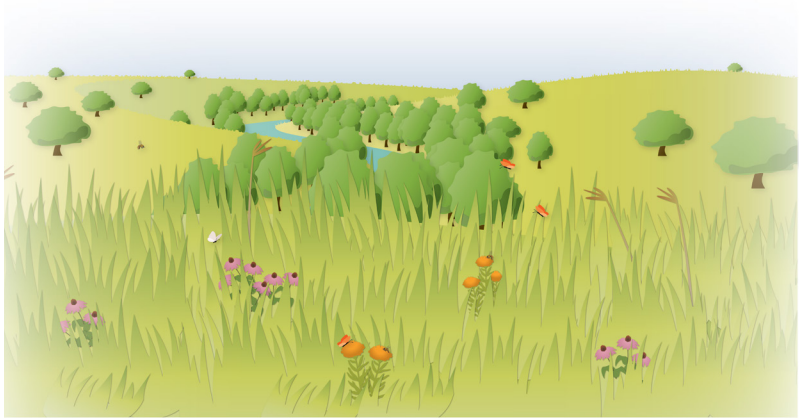
image credit: Jared Winkler - Wikepedia

This presentation explores the relationship between the landscape and built systems in your community. Specifically, we will examine:

- The development of transportation systems and community land use over time
- How surface water and topography affect where communities and transportation systems develop
- The impact of groundwater (when present) on transportation and land use
- Benefits of trees and other vegetation and how trees in towns fit with transportation networks, main streets, and neighborhoods

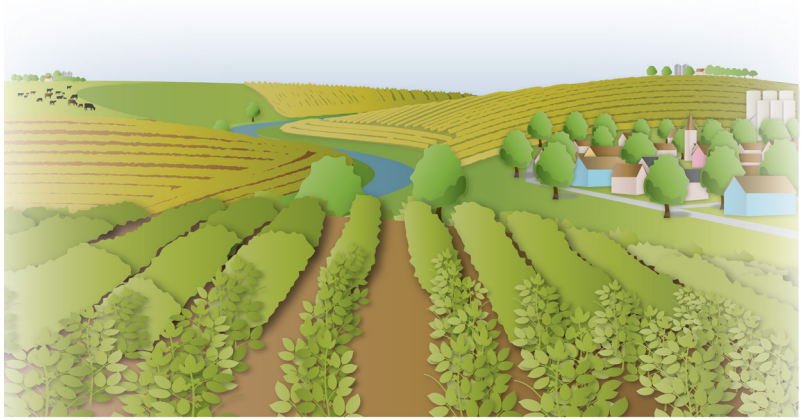
Imogene rests on a ridge in Southwest Iowa, just east of the rolling Loess Hills. Like many Iowa towns, Imogene sprung up along the railroad—specifically, the Wabash Trace Railroad that ran from Omaha, NE, to St. Louis, MO, and connected the town to surrounding cities such as Shenandoah and Omaha. Railroad Street became the commercial hub of Imogene, with businesses taking advantage of the proximity of arriving and departing railroad passengers. The number of visitors to Imogene dropped significantly starting in the early 1930s as area highways were updated, including Highway 59. In 1988, the Iowa Southern Railroad abandoned the 63-mile rail line between Council Bluffs and Blanchard, MO. In 2003, US Highway 184, which ran east-west through Imogene, was decommissioned, further reducing traffic through town. Today, the abandoned Wabash Trace Railroad is a 63-mile recreation trail that has contributed to revitalizing Imogene, because its location at the middle of the trail makes it a convenient rest stop for trail users.

Land Cover Changes Over Time



Historical Landscape

The historical landscape of Iowa was dominated by prairie and savannas. Tree canopy was typically found in valleys along river corridors adjacent to scattered savannas, because the fires that maintained the prairies could not spread as easily in those places. Native plants such as switchgrass, little bluestem, coneflower, and milkweed are some of the more recognizable plants found in the diverse prairie landscape.



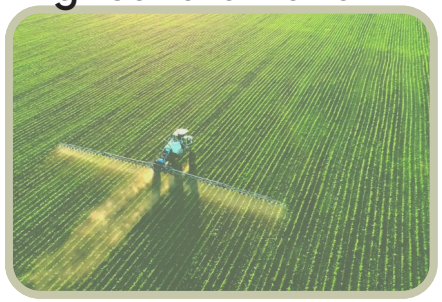
19th Century Landscape

The once-dominant prairie has been replaced by agricultural fields, pasture lands, and small towns in the post-settlement Iowa landscape. Fire suppression and development have allowed for greater growth of wooded areas among the rural landscape and in town. At the same time, many wooded river corridors have narrowed to make more room for cropland.

Current Land Cover

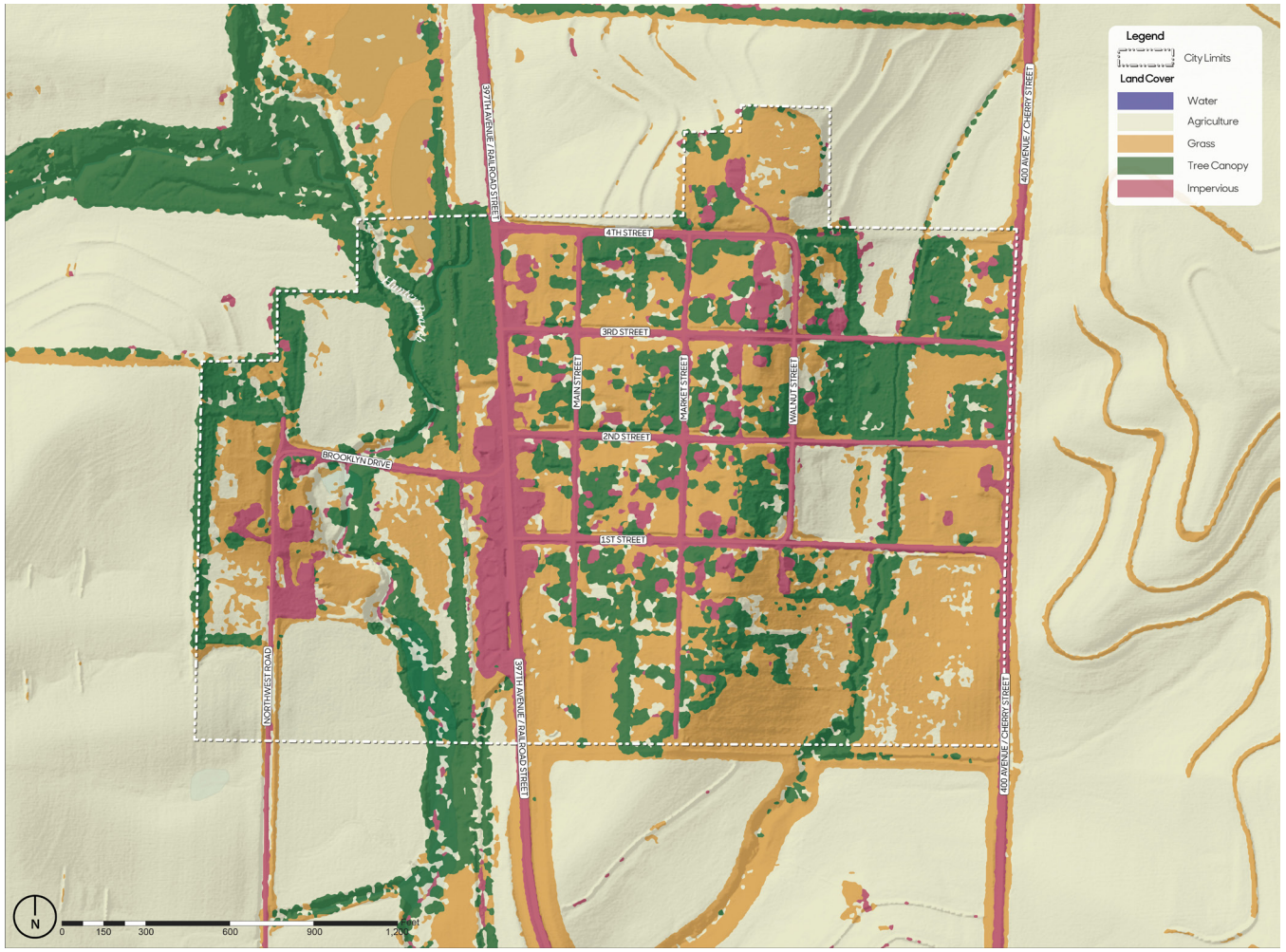
Impervious Surfaces

Agricultural Land



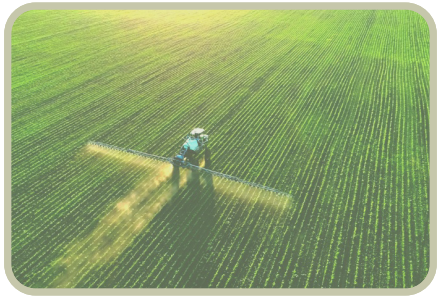
Grassland/Lawn

Tree Canopy



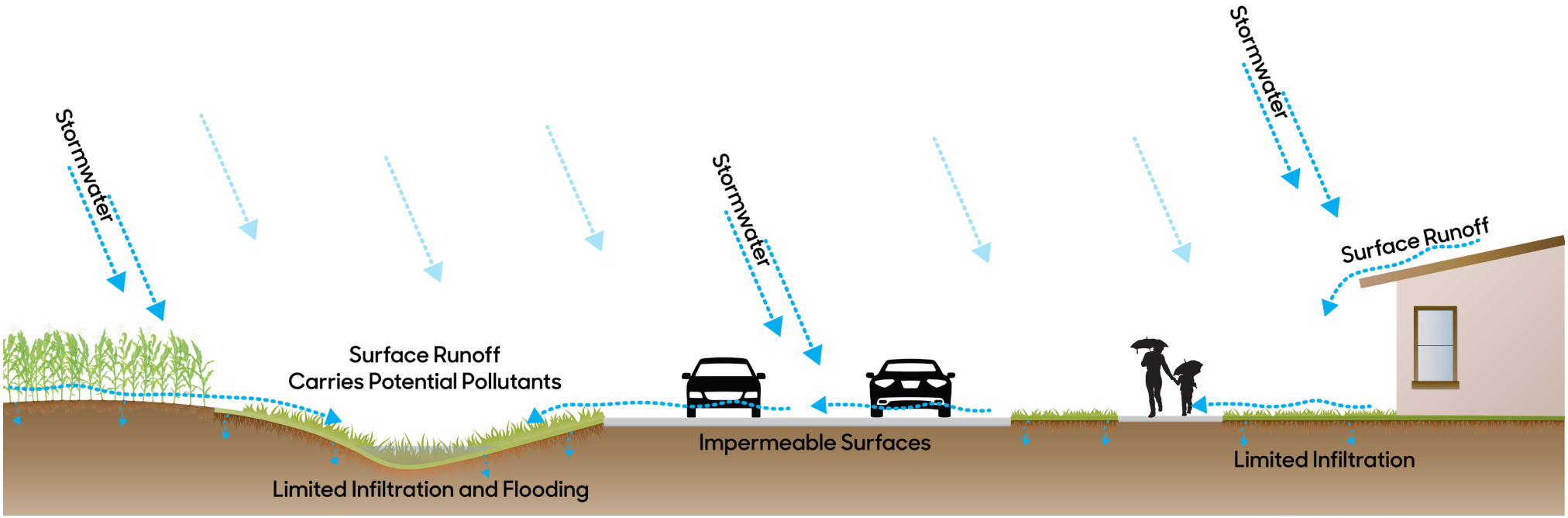
The land cover in most of Iowa's small towns today is a mix of residential lawns or neighborhood spaces dotted by trees. Streets and parking are paved and are sometimes flanked by sidewalks. Commercial and industrial zones are typically dominated by impervious surfaces.

Before the development of Imogene, the landscape consisted of vast open prairie. As people settled in the community, the prairie was replaced by neighborhoods with substantial tree canopy growth surrounded farms that flourished in the nutrient-rich soil left behind by the erstwhile prairie.



Impervious Surfaces, Agricultural Land, & Lawns

Impervious surfaces limit or prevent stormwater from infiltrating the ground and, in expansive areas, can create heat-island effects through stored and reflected heat. Agricultural land that is in annual crops and tilled provides limited infiltration, which can contribute to local flooding. Lawns can also limit infiltration, especially over compacted soil. All of these factors contribute to stormwater runoff and localized flooding, especially during intense rainfall.



Groundwater Concerns

The depth to the water table refers to the distance from the surface that groundwater fully saturates soil. In places with a high water table (zero or only a few feet below the surface), groundwater can well up and cause localized flooding. Rivers and natural lakes are generally areas where the water table is above the ground. These rivers and lakes receive most of their water from groundwater with some surface-water runoff from rain or snowmelt. This is why rivers can still be seen even if it hasn't rained in a while.

High water tables can have effects beyond just surface pooling, such as in the case of "frost boils." Frost boils result from groundwater freezing during winter and forming bubbles of ice called "ice lenses" that expand and push up from the ground. When the ice thaws, the frost boils collapse, leaving a divot in the surface. With certain kinds of flexible pavement, such as asphalt or gravel, these frost boils form potholes.

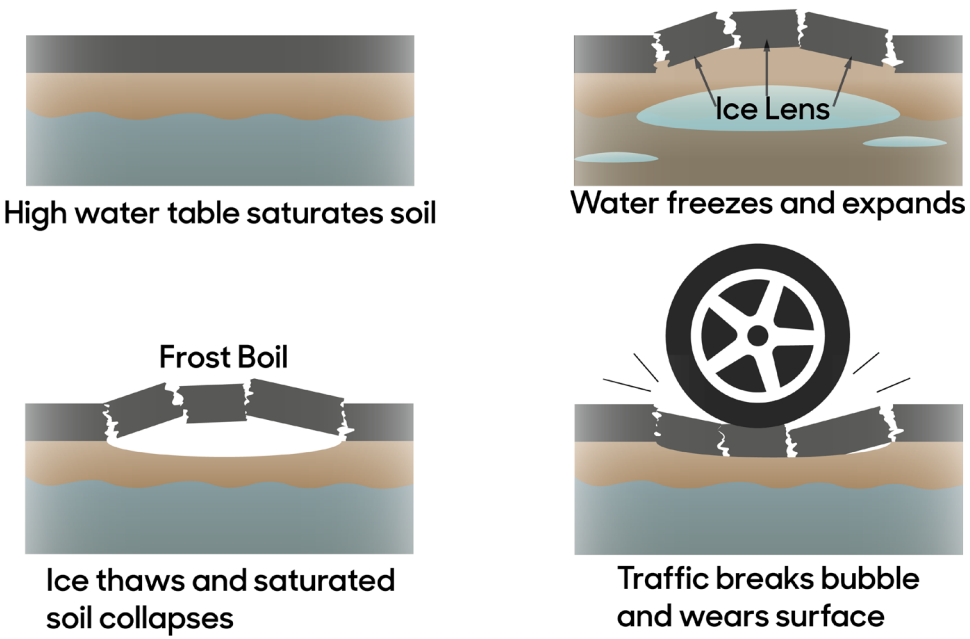


Diagram of the process by which frost boils affect roadways.

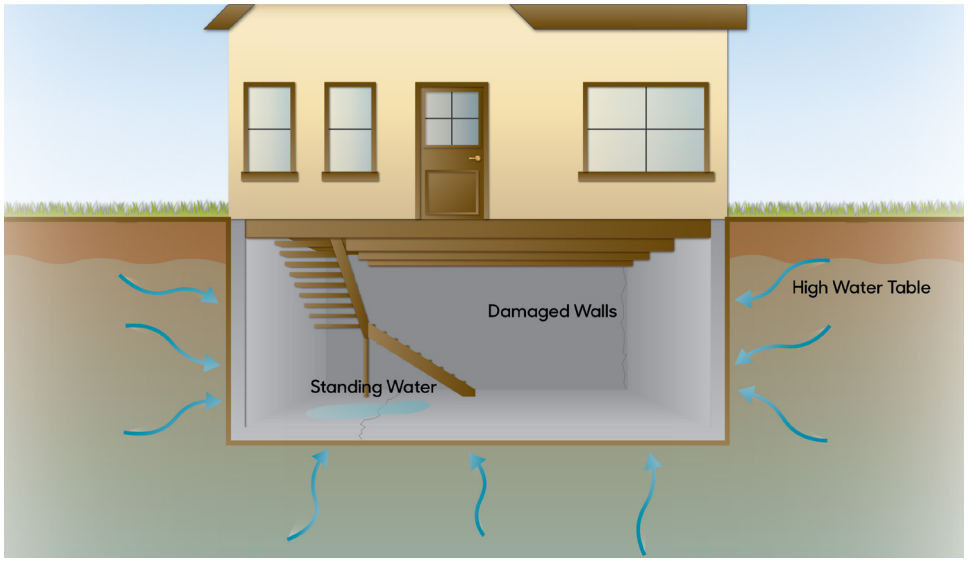


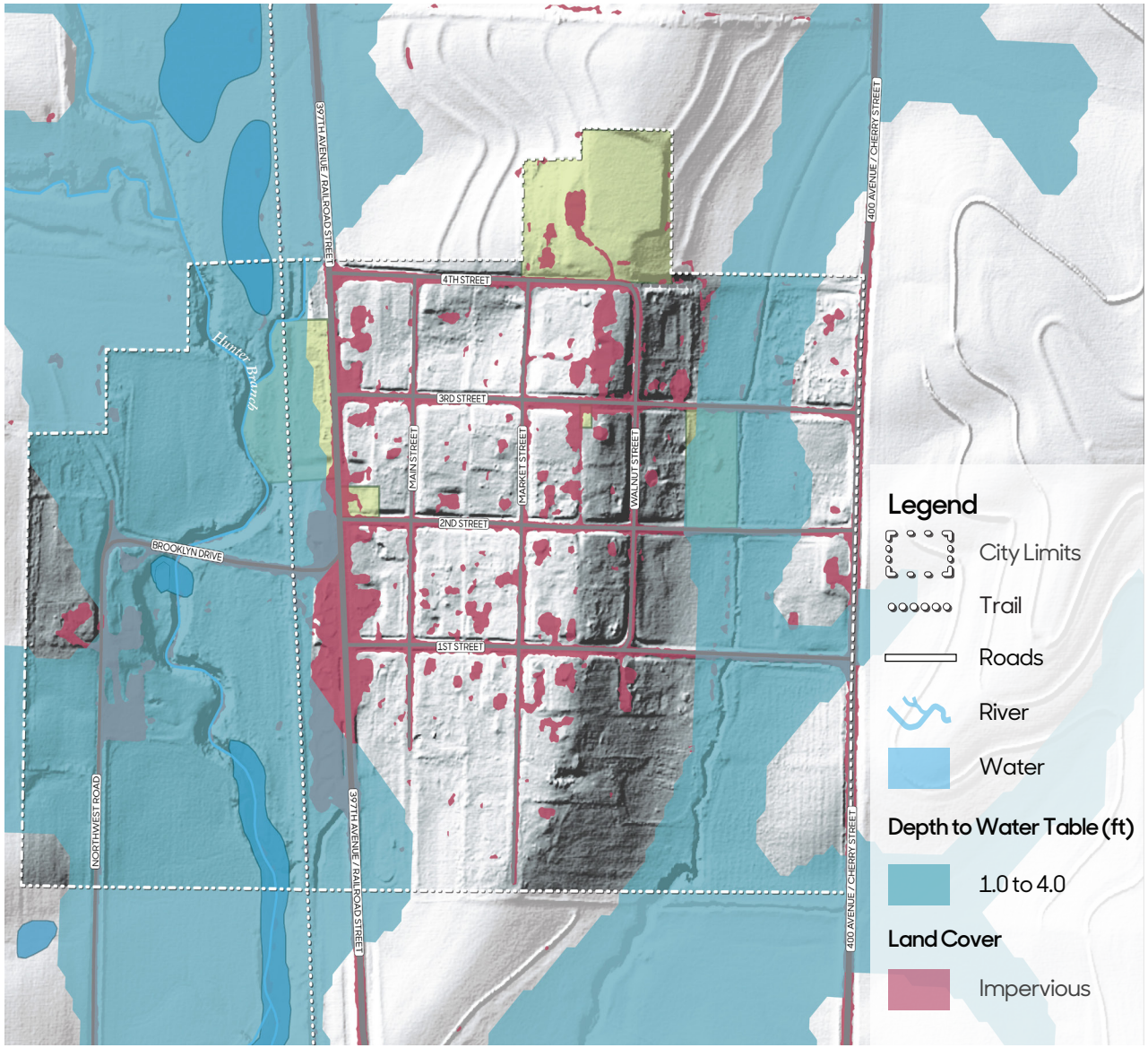
Diagram of the effects of a high water table on foundations and basements.

High groundwater tables can also have detrimental effects on one's home. Houses with basements surrounded by a high water table develop cracks or damaged walls due to water pressure. Typically a tile drain mitigates some of these effects, but wet foundations can require "dewatering," which can be expensive.

Developing landscapes with high water tables requires more expensive maintenance, construction, and paving. Creating public spaces or parks in these areas makes good sense.

Example Community

Emmetsburg's high water table has caused repeated damage on streets and even parking lots. The highway shows signs of continual repairs.



Groundwater and impervious surface map of Imogene, IA

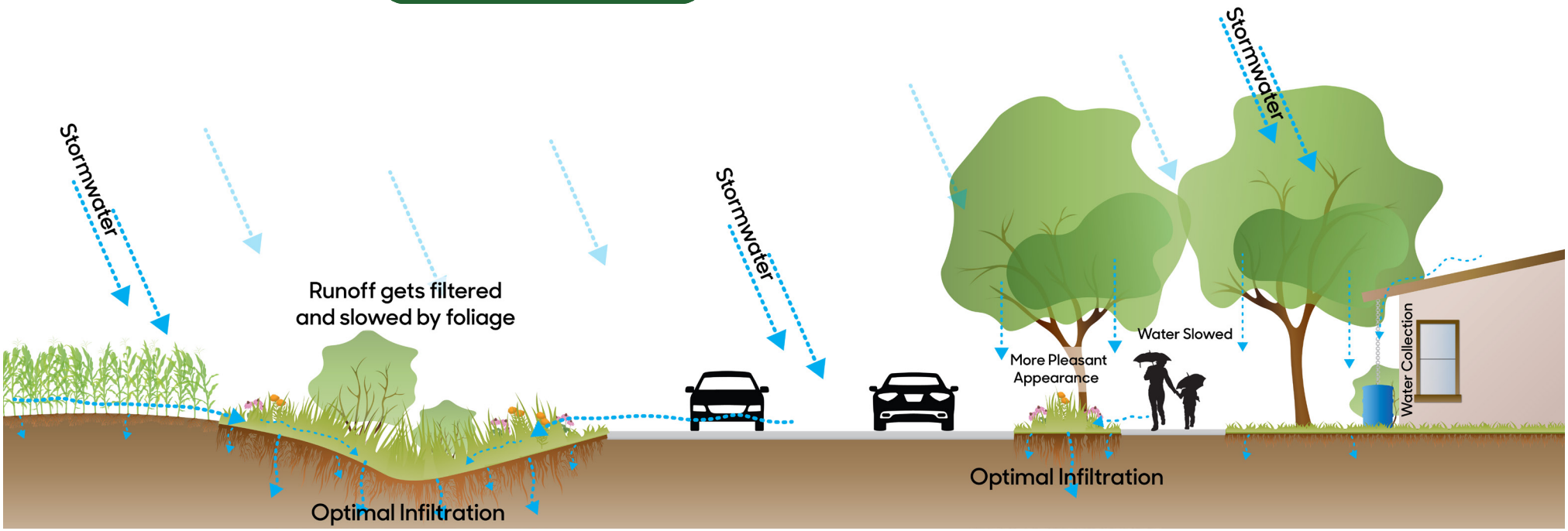
Looking at your town map, are there areas where the high water table and impervious surfaces overlap? Next time you are in this part of town, note local pavement conditions. Do you see signs of cracks or buckling? Has the surface been patched multiple times?

Vegetation Benefits

Grasslands & Tree Canopy

Native grasslands with deep-rooted plants aid in infiltrating stormwater, while dense foliage slows and filters stormwater from other areas. Practices such as bioswales and natural roadsides capitalize on these benefits to improve water quality.

Trees offer many advantages. They clean the air, create shade, and cool the atmosphere. They intercept rainfall, which helps mitigate stormwater runoff and flooding. They consume groundwater, which lowers the water table and makes space for water storage below ground. Carefully chosen and placed trees create community identity and make spaces comfortable for residents. Grasslands and trees provide habitat for pollinators and birds, which provides enjoyment for residents.



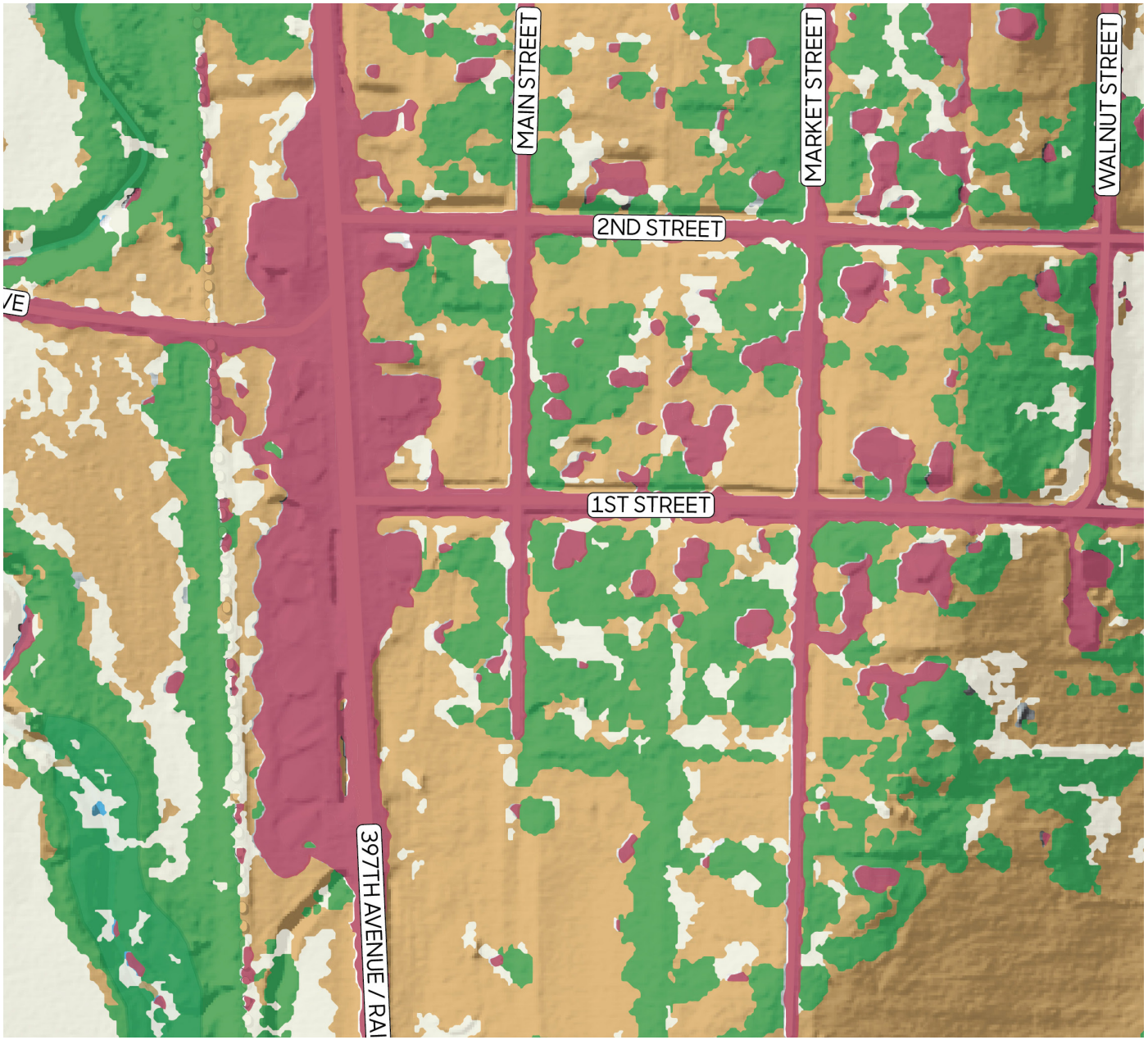
Example Streetscapes with Minimal Vegetation

Lack of street trees creates uncomfortable spaces that feel unwelcoming and exposed to the elements.

Example of Vegetated Streetscapes

Street trees, shrubs, and planters along a roadway offer shade and protection from the elements, while also enhancing the experience of the street.

Vegetation Benefits



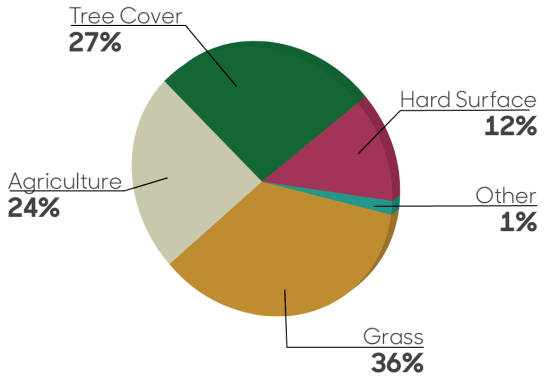
Land Use Map of Imogene, IA
The main transportation corridor through Imogene consists mostly of impervious surfaces, with lawn and tree canopy in the adjacent neighborhoods and a wooded riparian corridor. Impervious surfaces are most dense on the lower elevation, and will contribute the majority of runoff toward the adjacent creek during and after precipitation.

Looking at the heart of your community, does your downtown core have trees?

How does this change as you move from the downtown into residential areas of town?

Reflecting on your own experiences, where do you feel most comfortable on a hot summer day?

How do you think visitors see this space?



Aerial photograph of Imogene, IA
Nearly 30% of land cover in Imogene consists of tree canopy, compared to 12% impervious surfaces. This substantial canopy helps reduce surface heat and provides natural buffers. The trees lining the creek also provide a solid natural edge on the west side of town.

Next time you are out in town, note what it feels like to be in areas where there are more trees and vegetated areas.

How does it feel to be in areas mostly dominated by impervious surfaces with minimal vegetation?

Do you notice a difference in how many people pause or gather in those spaces?

Surface Water Conditions

A watershed is an area defined by elevated boundaries that separate water flowing toward different rivers and creeks. These basins show the extent of a drainage area flowing to a single outlet point.

Where a community is located within its watershed(s) determines how much water flows into or through it. Location also influences the town's capacity to manage flooding issues. For example, a community located near the end of a watershed (close to the outlet point) will have little capacity for reducing the amount of water draining toward it from upland areas, and will receive greater volumes of water during flooding seasons than other communities located higher in the same watershed.

Development of channelized waterways, drainage tiles, and impervious surfaces also leads to increased quantities and speed of the water headed downstream; while a community located near the top of its watershed may not experience flooding, managing water will have a greater effect on neighboring communities downstream.

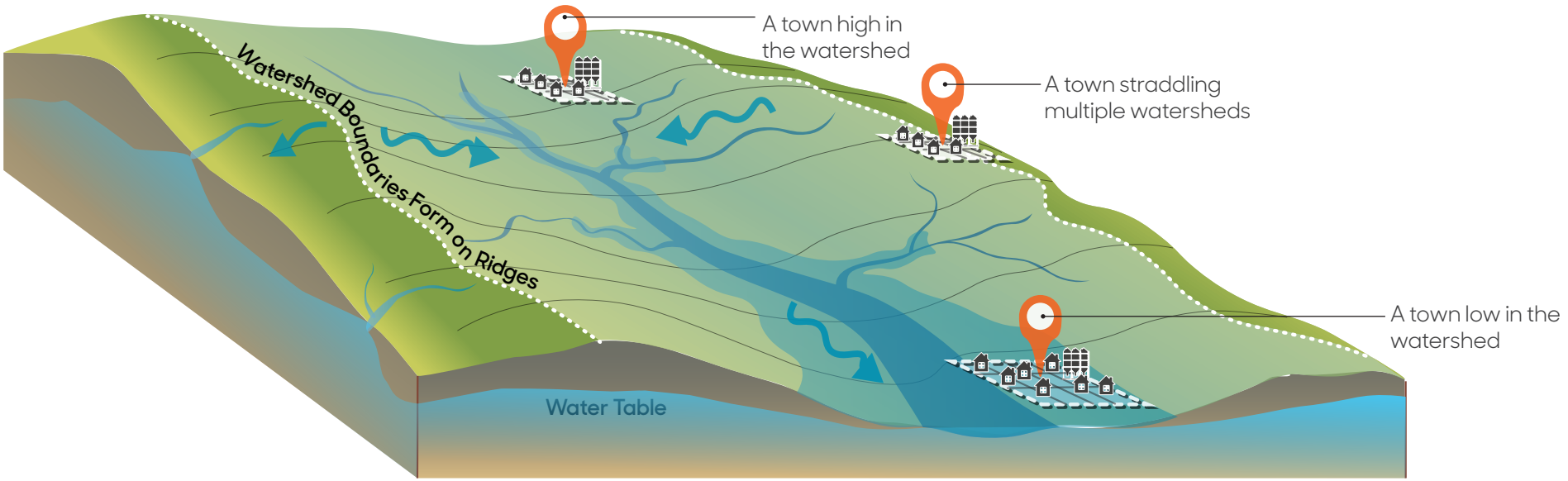
The map on the following page highlights your community within its surrounding watershed(s).

Where is your community located within the watershed(s)? Is water flowing to your community or away from it?

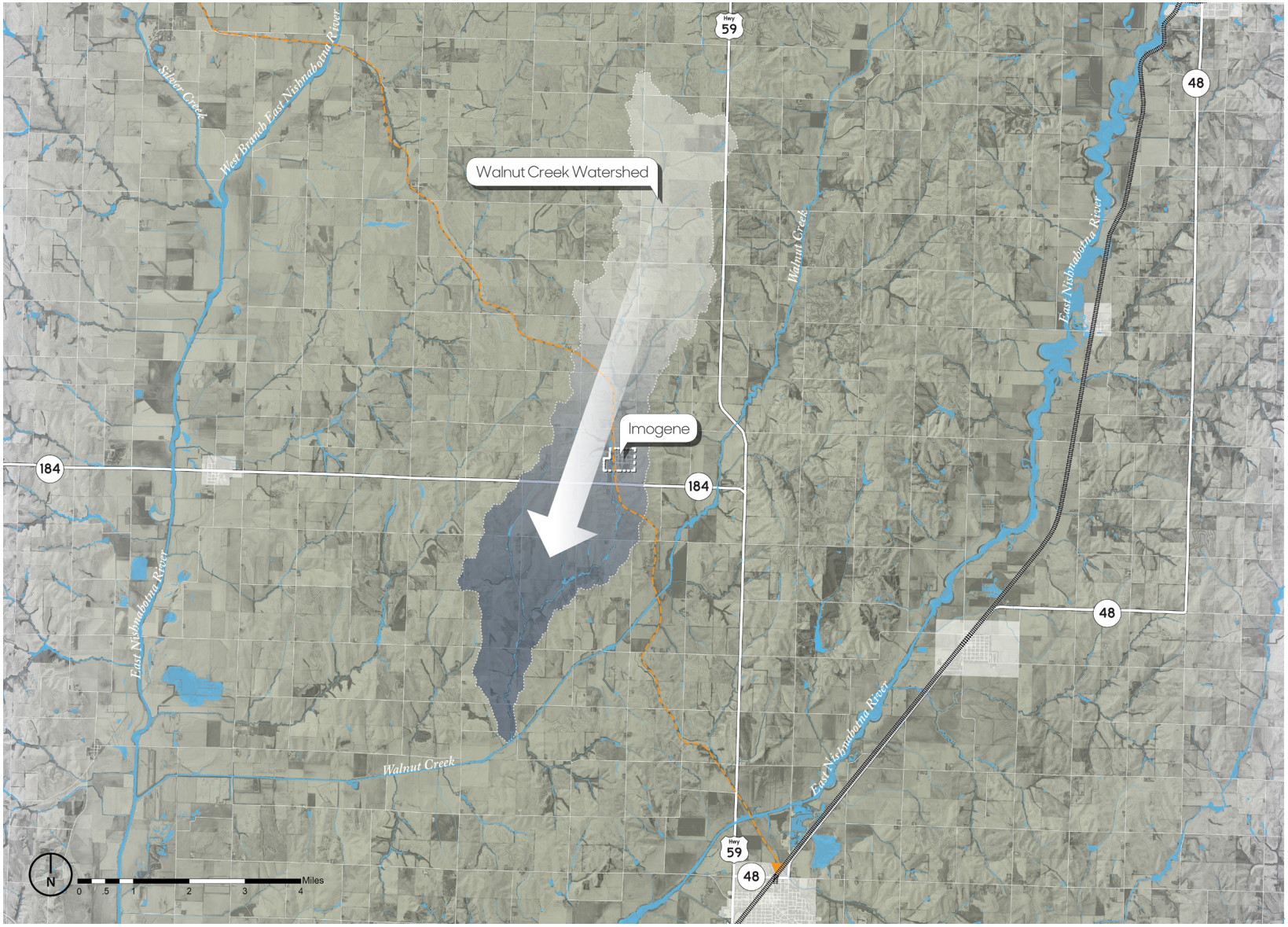
Is flooding an issue in your community?

How big is the watershed above your town? What conditions might increase or reduce flooding?

Are there conditions or practices happening in your community that could be creating risk for communities downstream from you?



Axonometric diagram of the physical characteristics of a watershed.



Legend

- River
- Highway
- City Limits
- Water
- Watershed
- Watershed Flow

Watershed map of Imogene, IA
Imogene is in the middle of Walnut Creek's narrow watershed, which consists of many creeks surrounding the town and eventually connects to the greater East Nishnabotna River. Despite the town's small scale and slope, any landscape alterations can affect what happens downstream.

Surface Water Conditions

The elevation and flow map displays differences in elevation. A combination of contour lines and the color gradient depicted in the legend show which areas are highest and which are lowest in the landscape.

If your community lies within or near a floodplain or floodway, the map on the following page reflects these features. Not all communities will have all of these elements; if they are absent on this map, none are present.

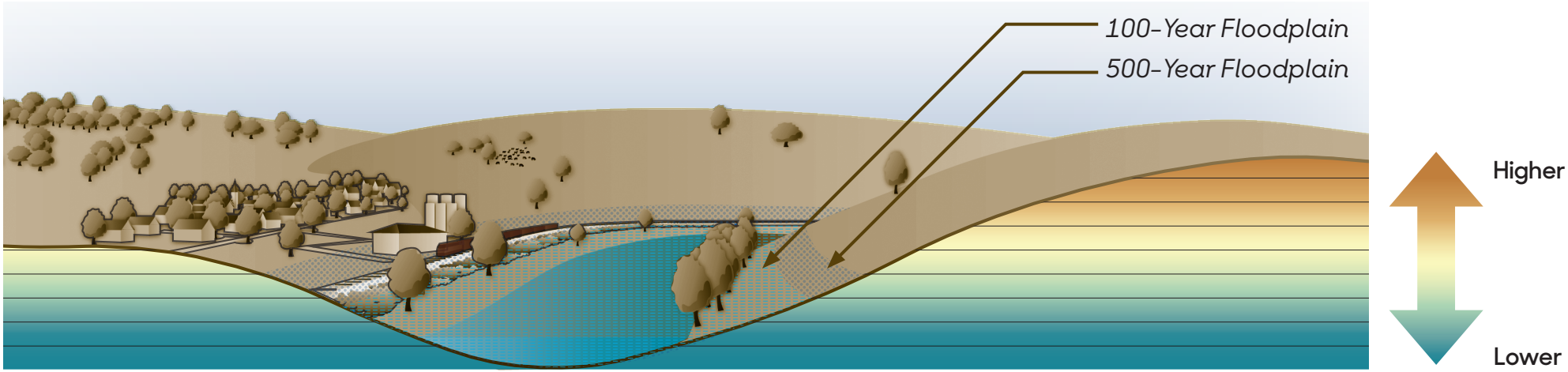
Flood risk is correlated to low-lying land. This map shows your community's 100- and 500-year flood risk as defined by the Federal Emergency Management Agency (FEMA) Flood Map Service Center. A floodway may also be shown, which signifies the greatest flow during a flood and is a zone that cannot be developed.

Note the position of your community in this landscape: is it located in a valley, on high ground, or between the two?

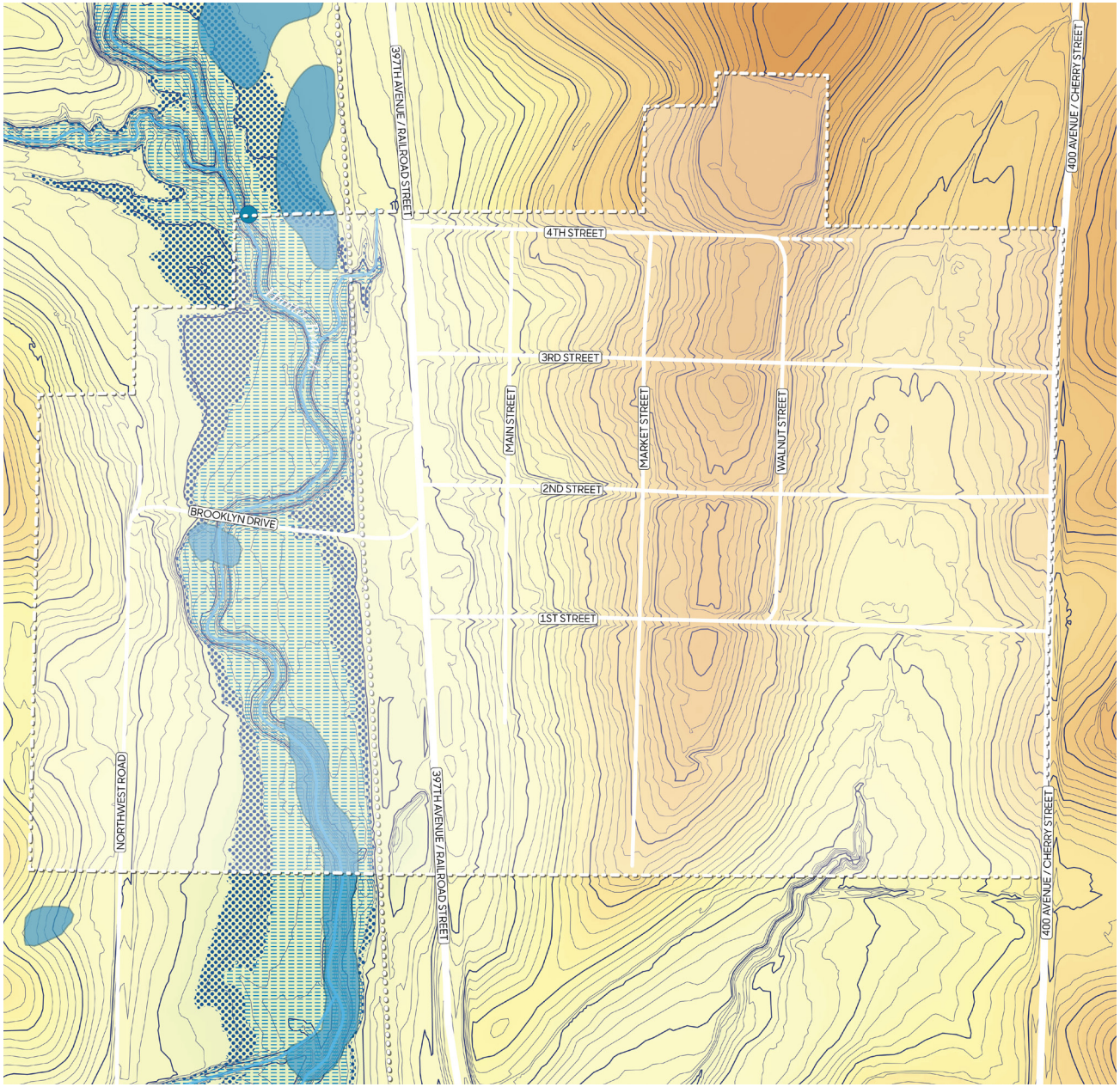
What parts of the community are in the floodplain or are at risk of flooding?

Why do you think these areas have developed in this location?

As the town grew historically, at what elevation did development happen? Has this changed over time?



Sectional diagram depicting the scale of elevation in relation to topographic features and development patterns.



Legend

- Trail
- River
- City Limits
- Road
- Water
- 2ft Contours
- 100 -Year Flood
- 500 -Year Flood
- Water Well
- Higher Elevation
- Lower Elevation

Elevation and flow map of Imogene, IA
Imogene was settled along Hunter Branch Creek, primarily above both the 100- and 500-year floodplains. A ridge in the center of the town allows for drainage to flow away from homes. The construction of the elevated railroad along the creek created a barrier for the floodplain, helping mitigate flooding.