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MISSION

The committee's mission, as commissioned by the Board of Trustees:

"To learn about the causes and extent of the August 20, 2018, flash flood that impacted over 80 Village homes, numerous Village businesses, many Village assets and the railroad, and to recommend actionable steps the Village could take to prevent the extent of any future such flash flood events. To offer public input sessions, perhaps at the start of its work and then towards the end of its work when its draft recommendations to the Village Board are being finalized. The goal for the Committee will be to make two reports to the Village Board: a status report and any initial recommendations by no later than May 1, 2019, followed by a final report and final recommendations by no later than November 1, 2019. The term of this Committee will be one year, subject to potential extension by the Board."

MEMBERS

Dave Benforado, Chair
Gloria Beach
Carolyn Benforado
Greg Brauer
Peter Hans
Mark Mandel
Eric Riedner

SCOPE

This report is intended to provide the Board of Trustees with a baseline understanding of the issues that contributed to recent flooding within the Village and to present a focused range of actions for consideration. While several technical experts were consulted in the process of preparing this document, the concepts, interpretations and recommendations included below are those of citizen members of the Stormwater Committee, most of us not being experts in flood control planning and stormwater infrastructure design. The Committee assumes the Board will ultimately use this document to guide the solicitation of expertise necessary to obtain a higher level of certainty and expand on the findings and recommendations herein.

INTERIM RECOMMENDATIONS

Educational

Explain the flooding problem for the June and August 2018 flooding.
Explain the history of flooding and proposed solutions.
Explain the planned University Avenue reconstruction project.
Explain recent improvements to flood protection.
Explain obstacles for water not moving as desired through the system.

Challenges/Constraints

Few undeveloped lots in Village and in west Madison (the Willow Creek drainage basin); urban built out area, not much available real estate for creative flood control measures..

85% of the Willow Creek drainage basin is not in Village.

Railroad tracks are at a critical point, but the railroad has not been able to be enlisted as a partner in this process.

University Avenue reconstruction ~ 2021. What will that project include from a stormwater improvement perspective? Tight timeline for getting preliminary studies in place (environmental, archaeological, etc.). This project has a significant Federal cost share.

- Note, this will provide an important outflow from the swale North of the railroad tracks by the pool (currently there is no connection from there to University Ave stormwater conduits).

Monetary sources for Village infrastructure costs given current Village debt.

Objective

Solve the 100 year flood.

- Yes, though technical constraints may require a modification of this objective.
- Want to build “resilience” into the system to ensure emergency vehicles can travel on University Ave and Shorewood Blvd into the Village.
- This will improve, but not solve, the August 2018 flood.
- Floodwater should not exceed XXX feet above sea level at 3 critical intersections.

Threshold Questions

Does Village support a stormwater conduit under Blackhawk CC?

- Yes if the modeling suggests it is required and could be filled effectively by rainwater. The technical aspects of this possibility should be pursued as soon as possible to coordinate with planning of the University Avenue reconstruction project.

Is it acceptable to use Garden Homes as a detention area?

- Not if it requires sacrificing current homes, but a small amount of detention may be possible.
- What are potential storage locations in Garden Homes and in the surrounding areas?

Establish an inter-governmental agreement with City of Madison that reflects Village priorities.

- Stormwater conduit system improvements needed.
- Cost-sharing on agreed projects.
- Water storage.

Technical Recommendations

- Contract with AE2S for modeling of various stormwater situations along the University Avenue corridor, developing model runs in consultation with and sharing model results with City of Madison Engineering.
- Consider engaging with the railroad and seeking to riprap the railroad ballast.
- Direct Village Engineer Brian Berquist to scope increasing height of Garden Homes floodwall in terms of effectiveness and cost.
- Explore the feasibility and cost to elevate homes above the floodplain, perhaps with a Village cost share.
- Make sure that stormwater ditch on north side of railroad tracks by Village Pool is connected to stormwater system during reconstruction of University Ave. (2021-2022).

Steps that can be implemented immediately

Village Crew must keep stormwater inlets clear & regularly inspect/maintain Garden Homes check valve.

Obtain cost estimate for a warning system (horn; perhaps text messaging) if the check valve at Garden Homes closes. Brian Berquist: $15,000 - $20,000 cost.

Annual education for Village residents and businesses about the National Flood Insurance Program (e.g., article in Village Bulletin).

Fix retaining wall on West of Janet's/UWCU property.

UNDERSTANDING OF RECENT EVENTS

June 16, 2018 event

The June 16, 2018 storm event resulted in isolated flood impacts to the Village focused primarily along the University Avenue corridor with notable areas of flooding highlighted on the attached Figure 1. Total damages resulting from the flood event are estimated to be on the order of $100,000 (estimate is unsubstantiated).

Rainfall that caused the flooding is best characterized using the US Geological Survey (USGS) rain gage in Middleton (USGS 05427948), located approximately 4 miles northwest of Village Hall. The total depth of rainfall that occurred during the June 16 event was measured at 2.5 inches with most of that falling within a 3-hour period as shown on the cumulative rainfall plot included as Figure 2. A comparison of the gaged rainfall against NOAA Atlas 14 recurrence interval data is included on Figure 3 and indicates this was a 5- to 10-year recurrence interval storm event across the 2- to 3-hour durations. However, daily rainfall totals measured at the National Weather Service (NWS) Charmany Farm gage (located 2 miles southwest of Village Hall) and the NWS Arboretum gage (located 3 miles southeast of Village Hall) suggest that rainfall totals were locally higher than those recorded at the USGS Middleton gage and that June 16 may have been closer to a 20-year recurrence interval storm event[1].

[1] A 20-year flood is also referred to as a 5% flood, since its probability of occurring each year is 5%.

In addition to the brief period of heavy rainfall, flooding impacts were also driven by relatively saturated soil conditions. Cumulative rainfall at the USGS Middleton gage over Water Year 2018 (October 1, 2017 through October 1, 2018) is plotted on Figure 4 and indicates that over 18 inches of rainfall was measured over the 46 days preceding the June 16 storm event, compared to an average rainfall of approximately 6 inches over that period.

Detailed estimate of damages to homes, businesses, and government buildings: [Village staff: please add]

August 20, 2018 event

The August 20, 2018 storm event produced record levels of flooding across the Village with significantly impacted areas including the Garden Homes neighborhood, the University Avenue corridor, and the low-lying residential area north of the railroad tracks. The extent of inundation from the August 20 event estimated by Town and Country Engineering is mapped on Figure 5. Total damages in the Village resulting from the flood event are estimated to be on the order of $10,000,000 (estimate is unsubstantiated).

At the USGS Middleton gage, the total depth of rainfall that occurred during the August 20 event was measured at 10.6 inches with most of that total occurring over a 12-hour period as shown on Figure 2. Using the NOAA Atlas 14 recurrence interval data included on Figure 3, this event was estimated to be well above a 100-year recurrence interval storm event for durations between 1 and 24 hours. An analysis of nearby rain gages and radar data completed by UW Madison estimates that the total storm depth was more likely between 7 and 8 inches closer to Shorewood Hills, but still well above a 100-year recurrence interval storm event[2].

Similar to the June 16 event, soil conditions were relatively saturated prior the August 20 storm with 3 inches of rain falling in a storm three days earlier and approximately 37 inches of rain falling over the preceding 16 weeks as shown on Figure 4. A comparison of long-term annual rainfall totals across several gages surrounding the Village is included as Figure 6 to demonstrate how much rainfall occurred over Water Year 2018 relative to previous years.

Detailed estimate of damages to homes, businesses, and government buildings: [Village staff: please add]

[2] A 100-year flood is also referred to as a 1% flood, since its probability of occurring each year is 1%.

BACKGROUND INFORMATION AND CONSIDERATIONS

Willow Creek drainage basin/watershed

The primary source of flooding in the Village of Shorewood Hills is overtopping of the storm drains that convey flow through the Willow Creek watershed. The Willow Creek watershed, mapped on Figure 7, covers approximately 2,000 acres extending south nearly to Odana Rd, west to Whitney Way, north to Eagle Heights, and as far east as Babcock Hall on the UW Campus. Approximately 16 percent of the watershed area is in the Village with the remaining 84 percent in the City of Madison.

A significant portion of the watershed (approximately 1,100 acres at the intersection with University Ave) drains to a 12- by 5-foot box culvert that runs north along Midvale Blvd as shown on Figure 8. At the intersection of Midvale Blvd and University Ave the storm drain splits with the 12- by 5-foot box culvert continuing north and then turning east at Locust Dr and a 12- by 4-foot box culvert running east under University Ave. The 12- by 4-foot box culvert was installed in 2010, but was recently blocked at its upstream end with plans to reconnect the line after being extended further east past Shorewood Blvd.

As the 12- by 5-foot box culvert (constructed in 1955) running under Locust Dr crosses Shorewood Blvd, its dimensions increase to 15- by 5-feet and then to 15- by 6-feet at a point approximately 800 feet further east along University Ave. At the intersection with University Bay Dr the storm drain is reduced down to a 12- by 6-foot box culvert that runs east under University Ave before turning north at Walnut St and ultimately discharging to the open channel section of Willow Creek. In 2013 an additional 96-inch diameter concrete pipe was installed parallel to the 12- by 6-foot box culvert from the intersection of University Ave and Campus Dr downstream to Willow Creek.

Precipitation intensity and frequency

NOAA ATLAS 14 storm levels

List what makes a 10-yr, 100-yr, etc. storm. Explain how these are calculated with a bell curve of rain over the duration listed, and therefore more intense storms are more severe.

How do we account for the apparent increased frequency of “extreme” rainfall in planning? What are other municipalities doing to plan? Feb 2019 model from Madison was “conservative” and that may be one mechanism to provide us some buffer.

Lake levels

The lake levels increased in part as a result of the increased rainfall. As lake levels rose this caused a dramatic threat to nearby areas, including on the isthmus and in Monona. However, this had no effect on stormwater damage in Shorewood Hills. The damage in Shorewood Hills resulted solely from rain water and drainage in the drainage basin that was unable to exit the drainage basin quick enough. Therefore, future planning for the village (including when to sand bag) should not be impacted by lake levels.

PREVIOUS REPORTS ON THIS ISSUE

Several documents including reports, memos, and presentation slides have been prepared to describe past flooding impacts across the Village and to assess potential solutions. Two of the most comprehensive studies are summarized below:

Stormwater Management Study University Avenue / Midvale Boulevard Area (Strand Associates, 1997)

The Strand Associates Report provides an overview of the flooding problems near Midvale Blvd and University Ave, describes the contributing watershed and drainage network, proposes a hydrologic/hydraulic model to estimate flows into and routing through the storm drain network, assesses 14 different project alternatives, and ultimately presents a recommended project alternative.

Modeling developed for the study estimates the existing storm drain near the intersection of Midvale Blvd and University Ave cannot fully convey the flow resulting from a 10-year storm event with significant storm drain overflow estimated to occur during the 50- and 100-year flood events. The study also highlights that this intersection is located in a depression that allows overflows from the storm drain to pond to depths that significantly impact the surrounding area. 14 project alternatives were identified to provide a 100-year level of flood protection at the intersection of Midvale Blvd and University Ave through various combinations of detention near the intersection, detention at Lucia Crest Park, increased detention at Rennenbohm Park, increased storm drain capacity along University Ave, a new storm drain through the golf course, and floodproofing at Garden Homes. The analysis concludes that project alternatives comprised entirely of detention elements could provide a 100-year level of flood protection, but

the 60 to 80 acre-feet of storage volume needed to meet this objective was not cost effective compared to other alternatives. An alternative including additional conveyance capacity along University Ave was also found capable of providing a 100-year level of flood protection but again was estimated to not be a cost-effective alternative (cost estimates assumed this project alternative would not be completed along with other improvements to University Ave as currently proposed).

The preferred alternative identified by the Strand Associates Report includes tunneling a new storm drain under the Blackhawk Country Club towards an outlet to Lake Mendota. Several variations of this alternative were analyzed to include pairing with different detention options, but including detention was estimated to be far less cost effective than incrementally increasing the size of the tunnel.

Alternative Stormwater Management Analysis (Applied Ecological Services, 2001)

The Applied Ecological Services Report builds on the Strand Associates Report by further investigating detention options to address flooding issues along University Ave. The study identifies 18 sites across the Willow Creek watershed potentially suitable for providing detention, estimates the storage volume that can be provided at each of the sites, and estimates peak flow release rates that can be achieved at each site for the 50-year storm event.
The study concludes that detention across the Willow Creek watershed can be used to reduce peak flow rates to match the storm drain capacity along University Ave during a 50-year storm event. Facilities at the Hamilton School and Rennebohm Park sites are estimated to be the most effective at reducing peak flow rates and would be necessary elements in any distributed detention approach to meet the 50-year flood protection objective. The study states the costs for implementing a distributed detention project would be substantially less than the project recommended in the Strand Associates Report but no detailed cost estimates for the distributed detention project alternative are provided.

POTENTIAL SHORT-TERM SOLUTIONS

Improve Village infrastructure (especially roadways and underground utilities)

Strong recommendation to prioritize future road reconstruction within the Village to areas with stormwater risk, both in catastrophic rains and in typical rains (coordination with Public Works committee).

Resolution: Communicate these questions to the Public Works committee for consideration.

Sand bagging and preparedness

How to get sand bags; how to know if water levels are sufficiently high that this is needed.

If we learned that a similar rain was likely tomorrow, what would our emergency plan be? Sandbagging along the tracks in vulnerable areas? Helping individual homes sandbag? How soon could this be put together?

Are there solutions that can be easily deployed by residents? E.g., quick dams; water dams; gel dams; flood doors.

Resolution: Communicate these questions to the ad hoc Disaster Preparedness committee for consideration.

Retention upstream in basin

The upstream water falls entirely within the City of Madison.

Retention within the Village (rain Gardens, vaults, etc.) are understood to not play a significant role for the magnitude of precipitation for the two events described here.

Cleaning out the area North of the railroad tracks

Last done in 2013.

NFIP flood insurance

The Village is now enrolled; residents and businesses can purchase directly from NFIP (www.floodsmart.gov) or through many insurance agents.

POTENTIAL LONG-TERM SOLUTIONS

Research to inform long-term solutions

The Committee recommends the Board of Trustees contract with a qualified consulting engineer to assist in developing and assessing a range of project alternatives. Using the City of Madison's storm drain model, the consultant would first help the Village to better understand tradeoffs between potential project elements including but not limited to the following below.

Note: This recommendation was acted upon by the Village Board in April 2019.

Conveyance vs detention

To what extent can detention be used to reduce the quantity or size of stormwater conduits being considered along either University Avenue or under the golf course? Or, put in a different way, how much more conveyance would be needed to provide a comparable benefit if detention was excluded from consideration?

Detention near Garden Homes vs further upstream

How much less efficient is it to provide detention further upstream in the watershed compared with detention considered previously near the intersection of Midvale Blvd and University Ave? How would the inlet structure proposed near Midvale Blvd and University Ave be impacted if a detention basin/vault was also not provided at that location?

Added conveyance along University Ave vs a tunnel under the golf course

What level of protection can be provided by maximizing the conveyance capacity of the storm drains along University Ave between Shorewood Blvd and University Bay Dr? How does

maximized conveyance capacity along University Ave compare to an incrementally larger tunnel (or an additional tunnel) under the golf course?

Results from these analyses would be used to select, define at a conceptual level, and analyze through the City's storm drain model a limited number of project alternatives that would provide varying levels of flood protection (e.g. up to the 20-year, 100-year, and the August 20 flood events) across the Village.

Box culvert along University Avenue

Current drainage along University Avenue: [Work with Brian Berquist to fill in details here and fill in local altitude minima]

Planning has already begun in preparation for stormwater conduit improvements along University Avenue, East of Shorewood Boulevard. This will be coordinated by City of Madison, with an estimated start date of 2021. The city engineering website describes the project as going from "Shorewood Boulevard/Hill St to University Bay Drive/Farley Ave" (https://www.cityofmadison.com/engineering/projects/university-avenue).

A major ongoing focus for the committee will be to understand the scope and impact of this project.

Tunnel from Midvale & University Ave to Lake Mendota (under the golf course)

A tunnel from the vicinity of University Ave & Midvale, under the Blackhawk Country Club golf course, that would drain directly into Lake Mendota near the Shorewood Hills Marina.

The effectiveness of this solution is being pursued with ongoing modeling, conducted by AE2S in coordination with City of Madison. Questions the committee is asking include:

- Logistics:
    - The tunnel would start in the vicinity of Midvale Boulevard and University Avenue (i.e., the lowest relevant point).
    - Need to configure how to channel water into the opening of the tunnel. Options being examined include retention areas and/or grating of the roadway.
    - Need to identify a path for the tunnel to reach Lake Mendota.
    - Need to understand how much this would help for flooding along the University Avenue corridor.
- What is the cost?

- Are there ecological concerns for Lake Mendota? There is no difference in overall loading to Lake Mendota, since all of this water eventually reaches the lake. Providing a direct conduit would enable the water to drain without bringing significant organic material with it, which could potentially reduce overall organic matter carried in.

Building of retention area(s)

Partially addressed in the Strand report. Also raised at the Feb 2019 committee meeting by the Madison engineering consultant.

Additional possible solutions

To be informed by current modeling.

Figure 1. Notable flood impacts resulting from the June 16, 2018 storm event

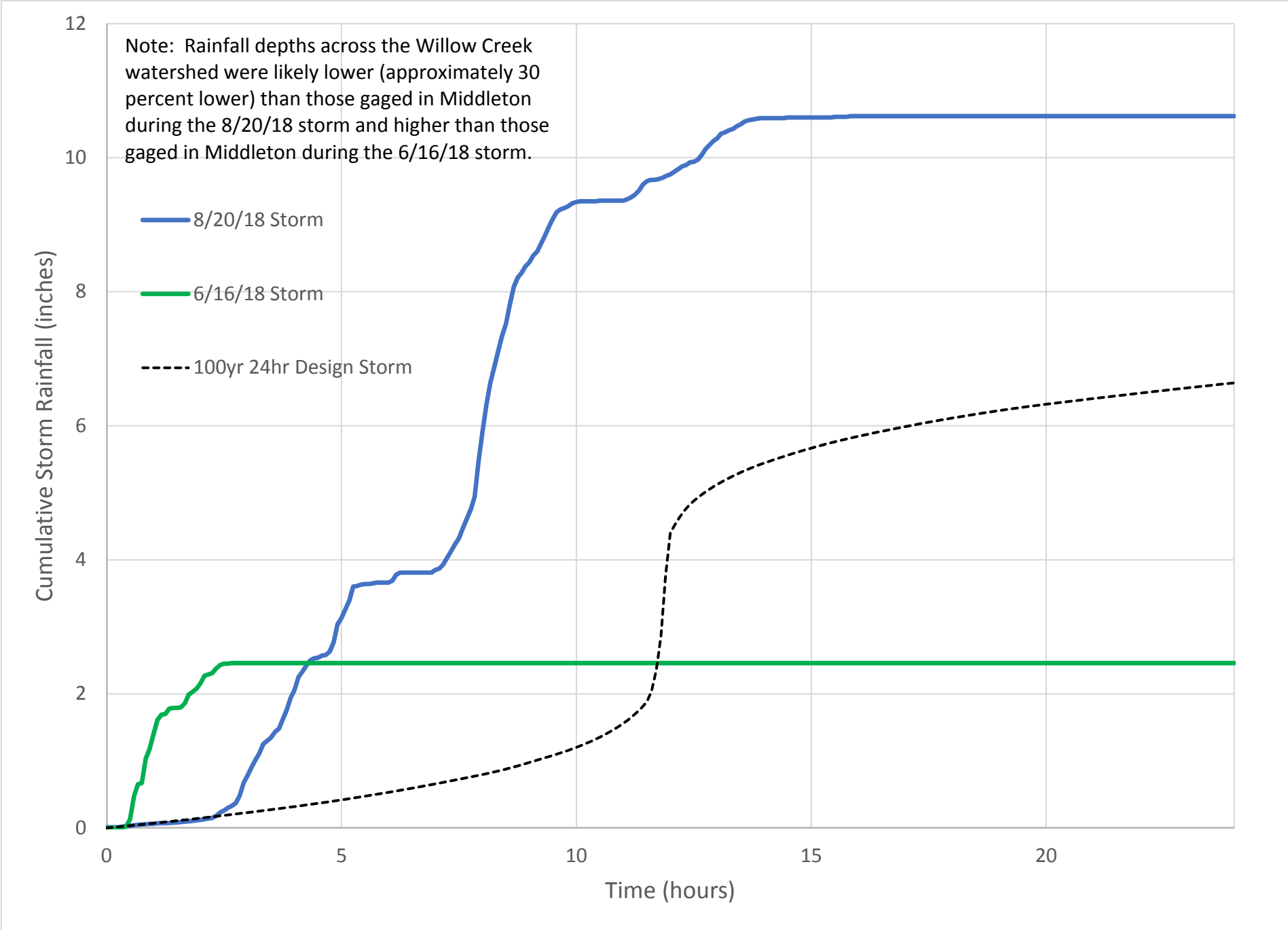


Figure 2. Comparison of gaged cumulative rainfall depths at the USGS Middleton station againt the 100-year 24-hour design storm

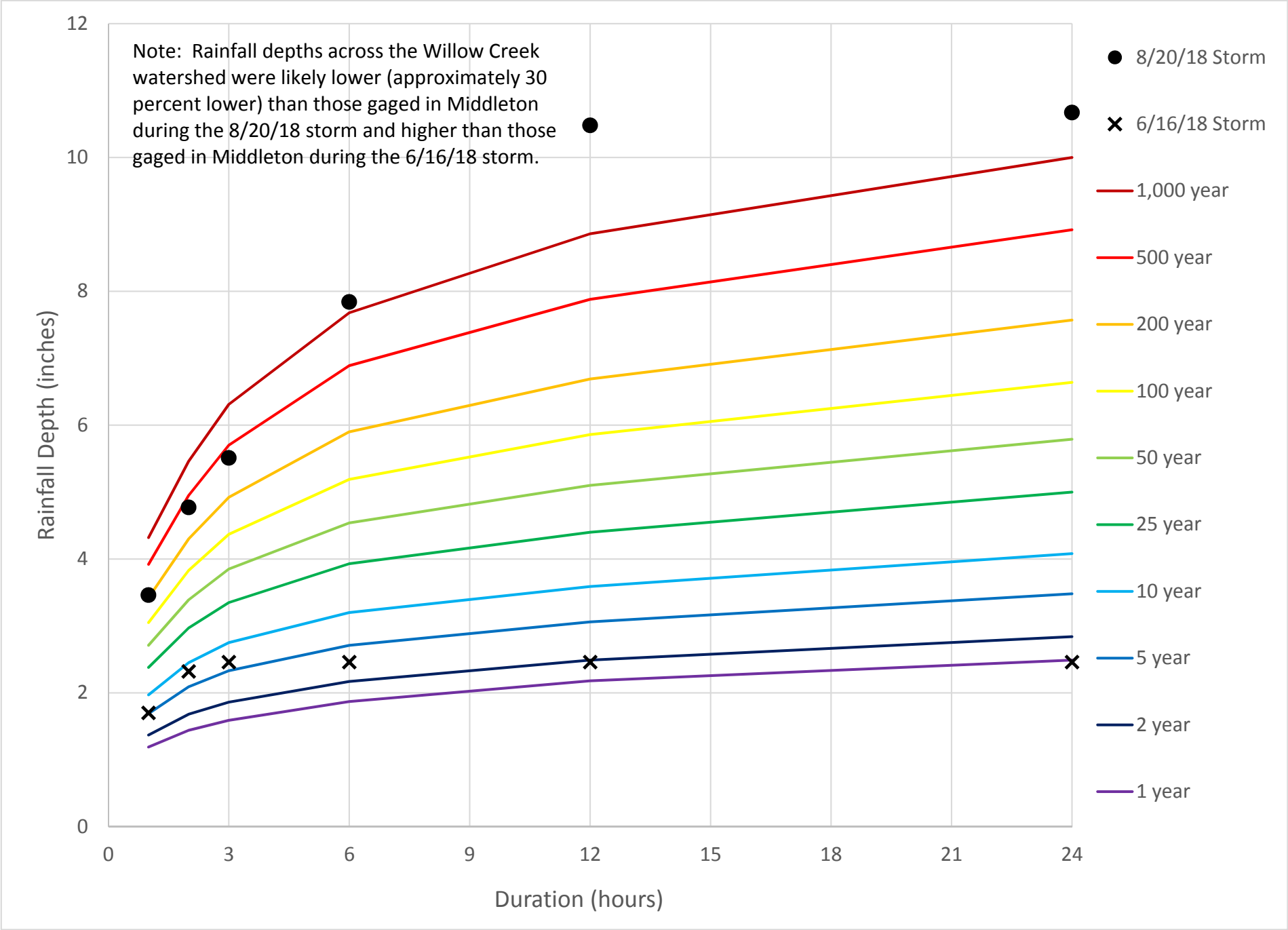


Figure 3. Comparison of gaged rainfall depths at the USGS Middleton station against statistically derived NOAA Atlas 14 recurrence interval data

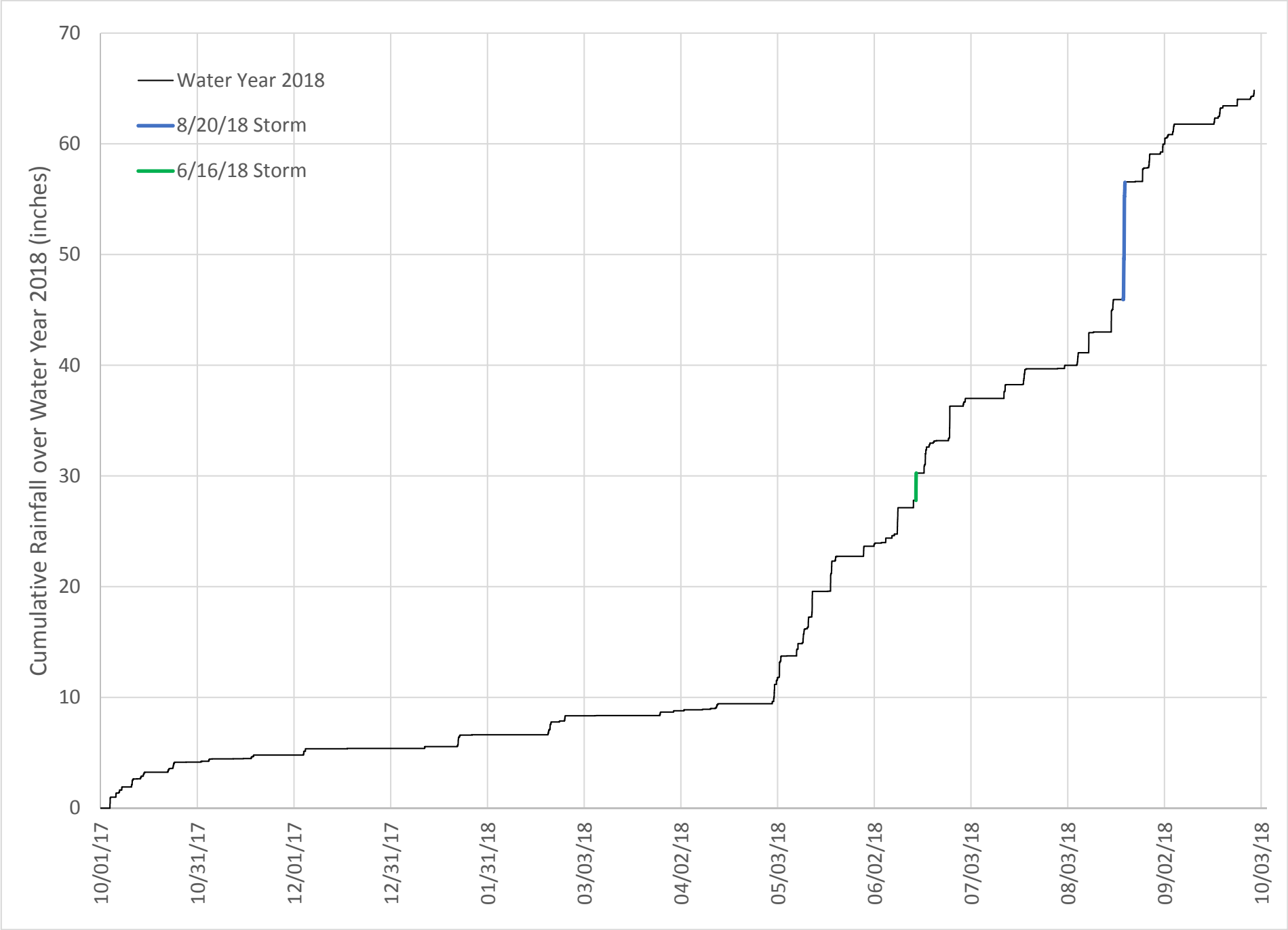


Figure 4. Gaged cumulative rainfall at the USGS Middleton station over Water Year 2018

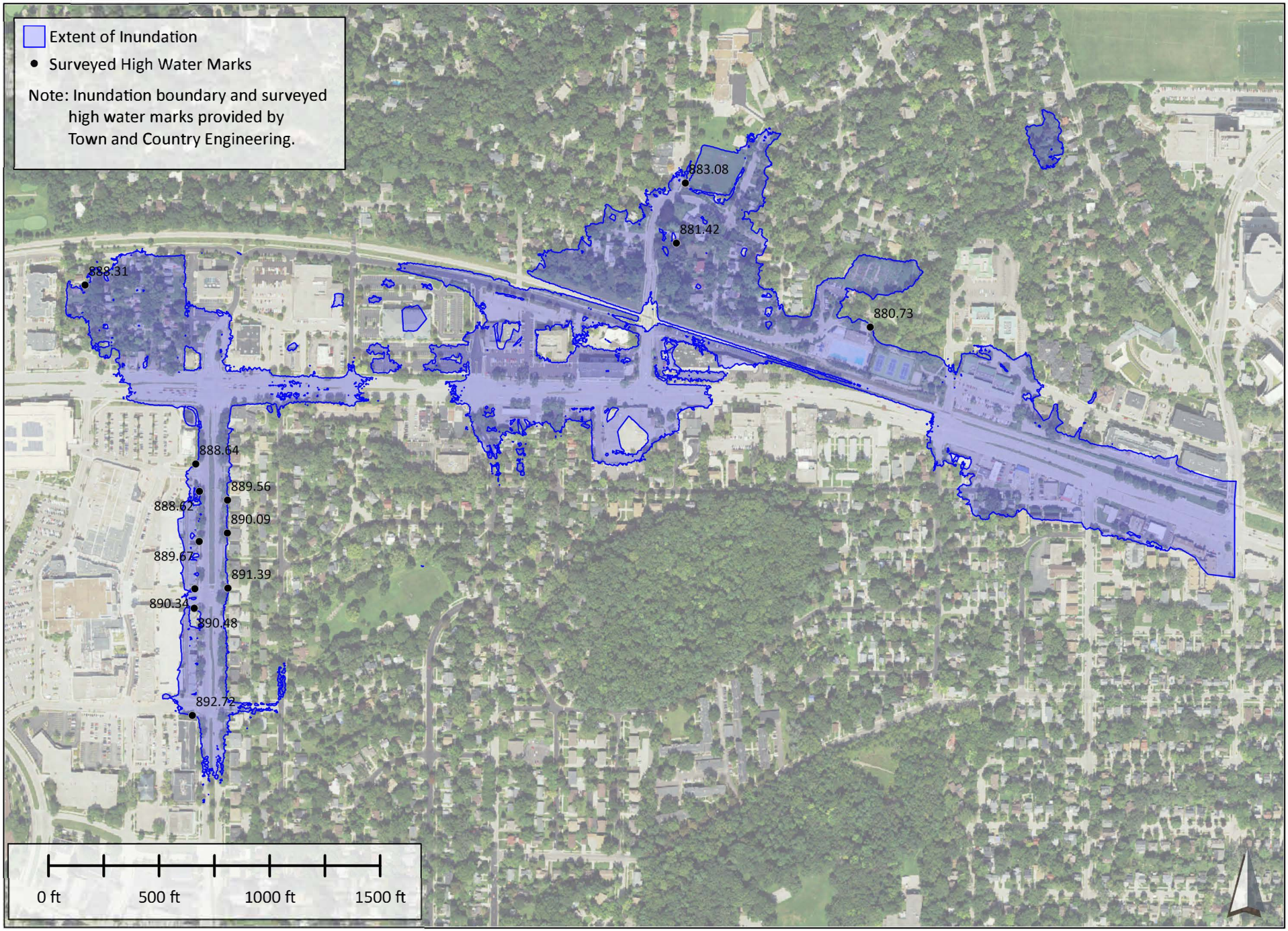


Figure 5. Estimated extent of inundation resulting from August 20, 2018 storm event

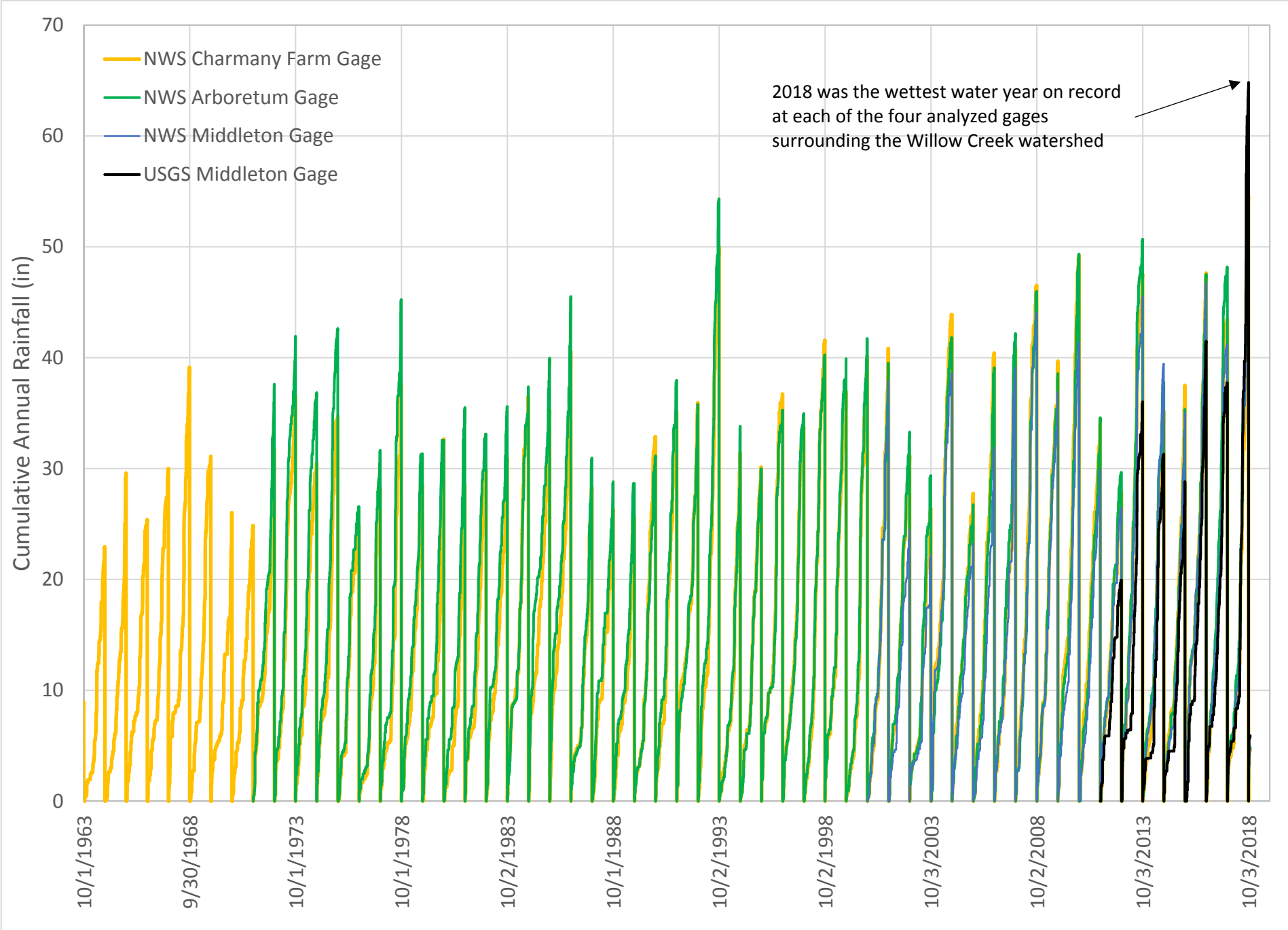


Figure 6. Comparison of long-term rain gage records

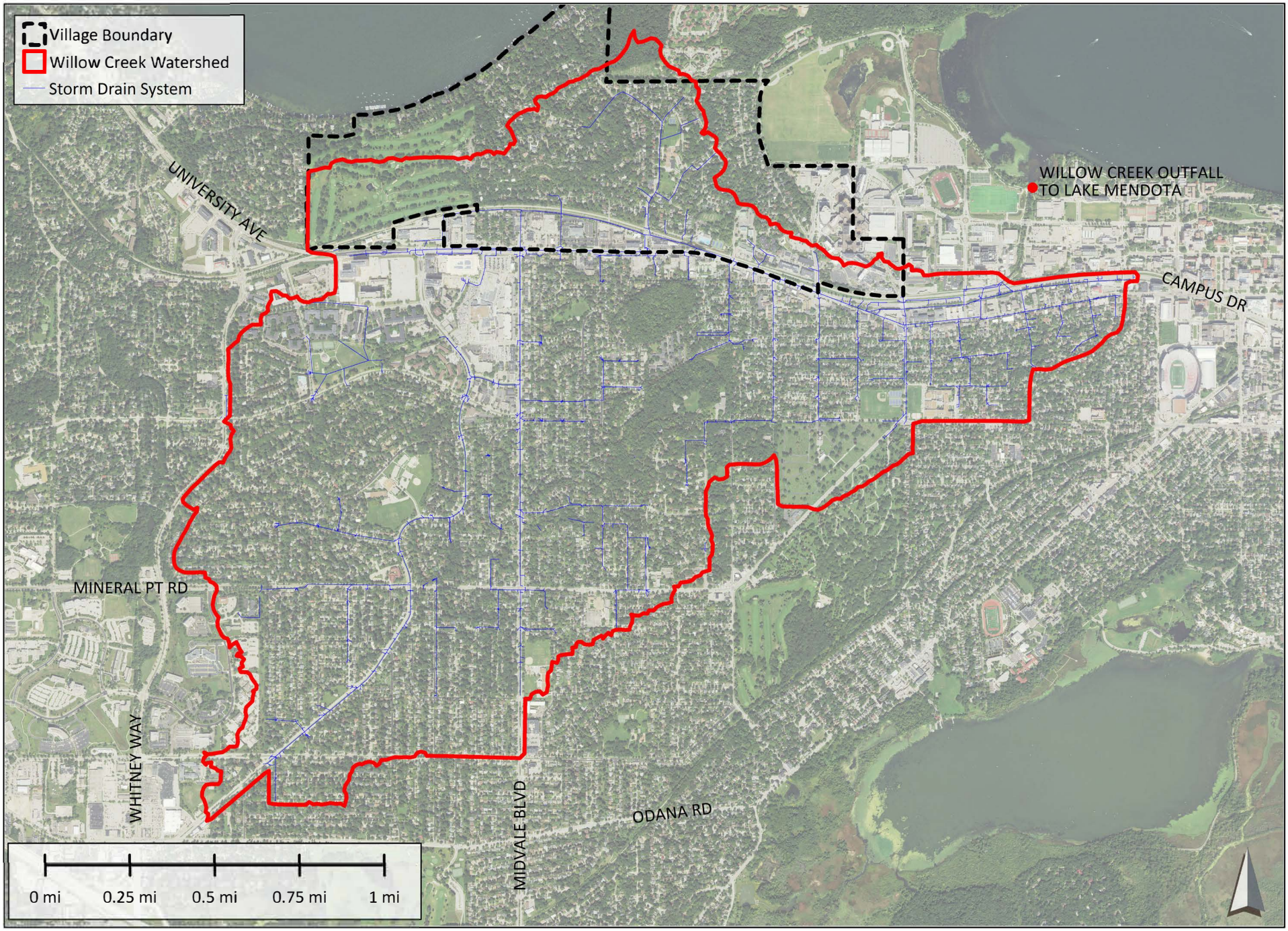


Figure 7. Willow Creek Watershed

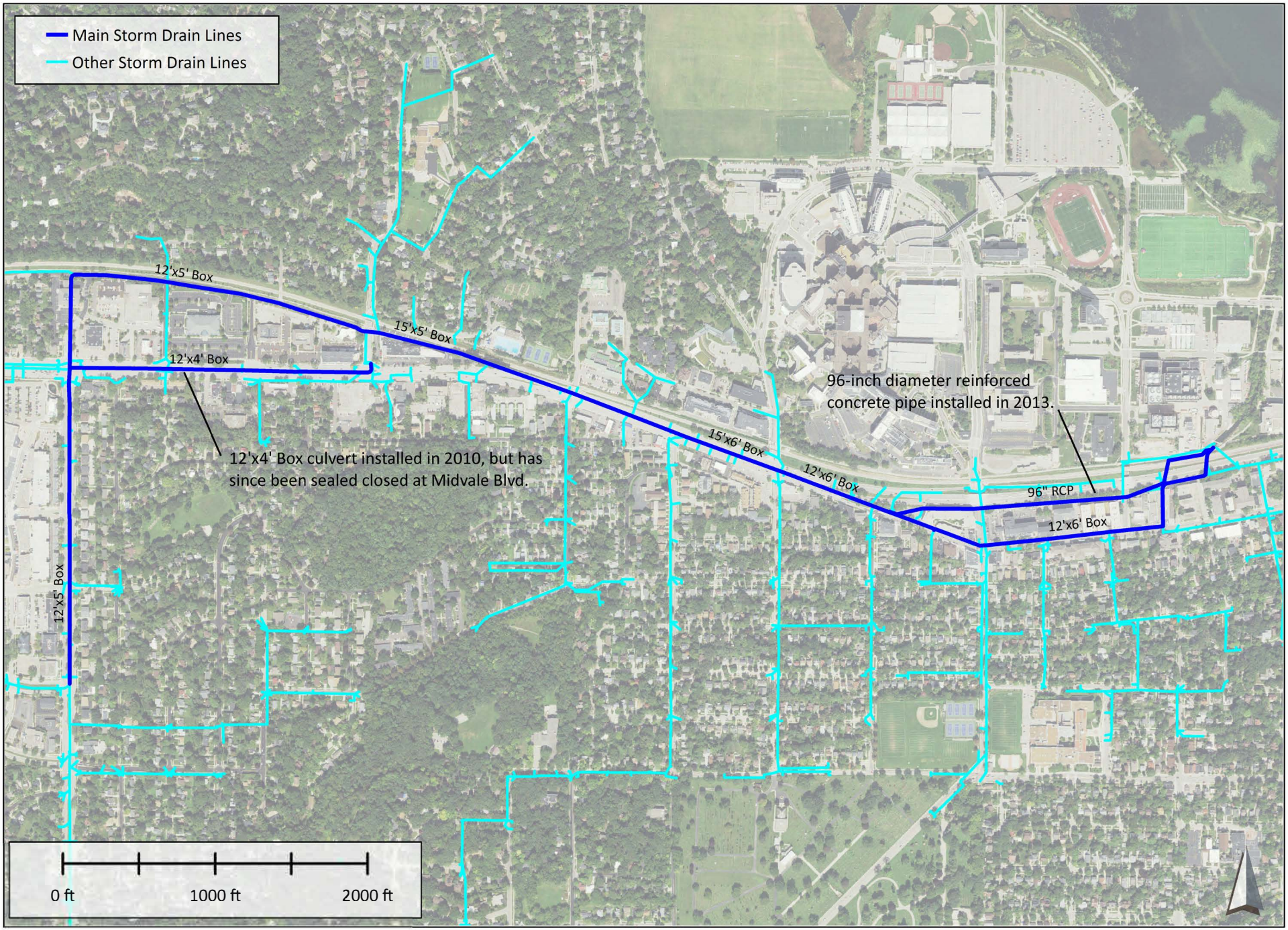
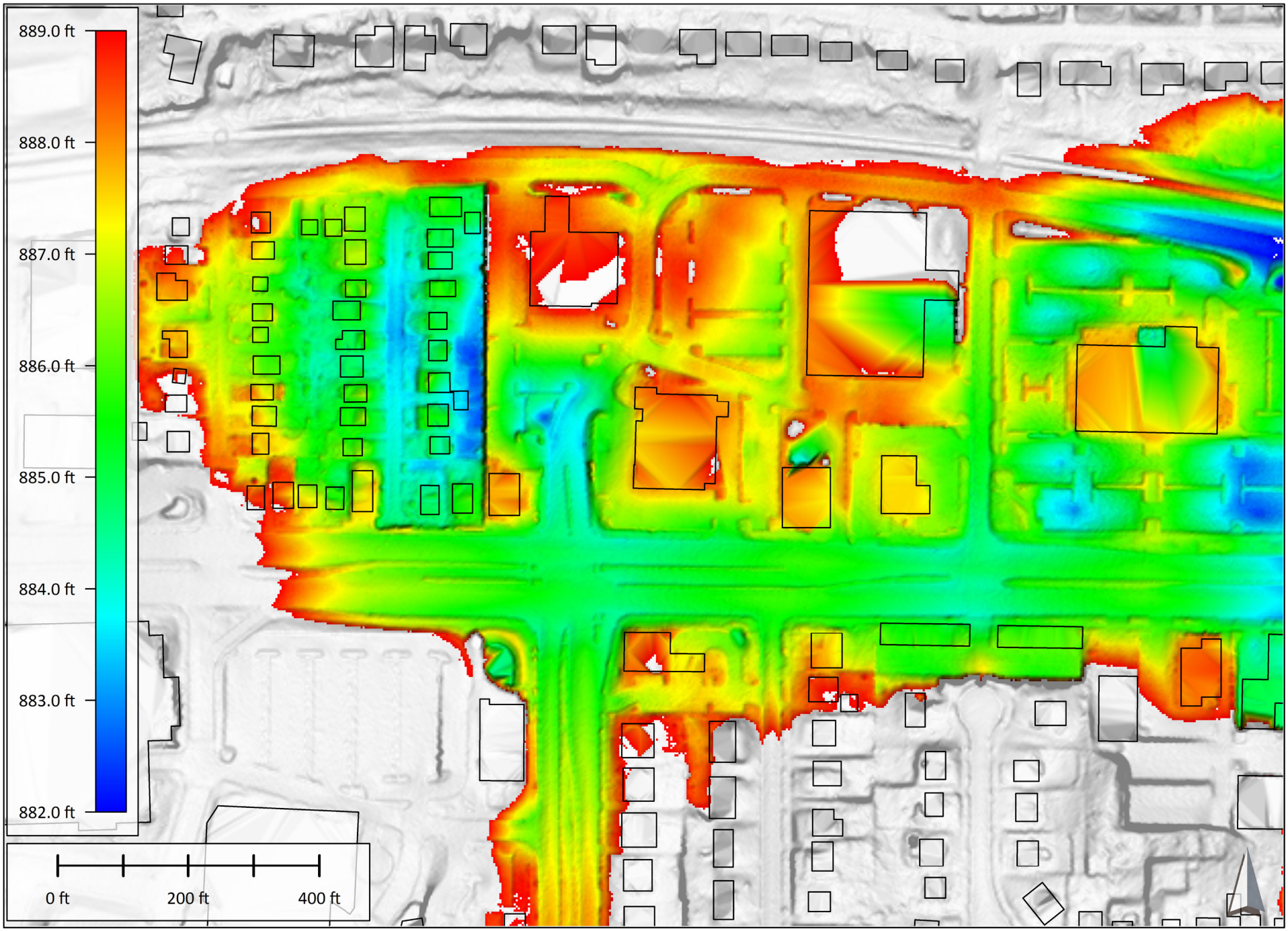
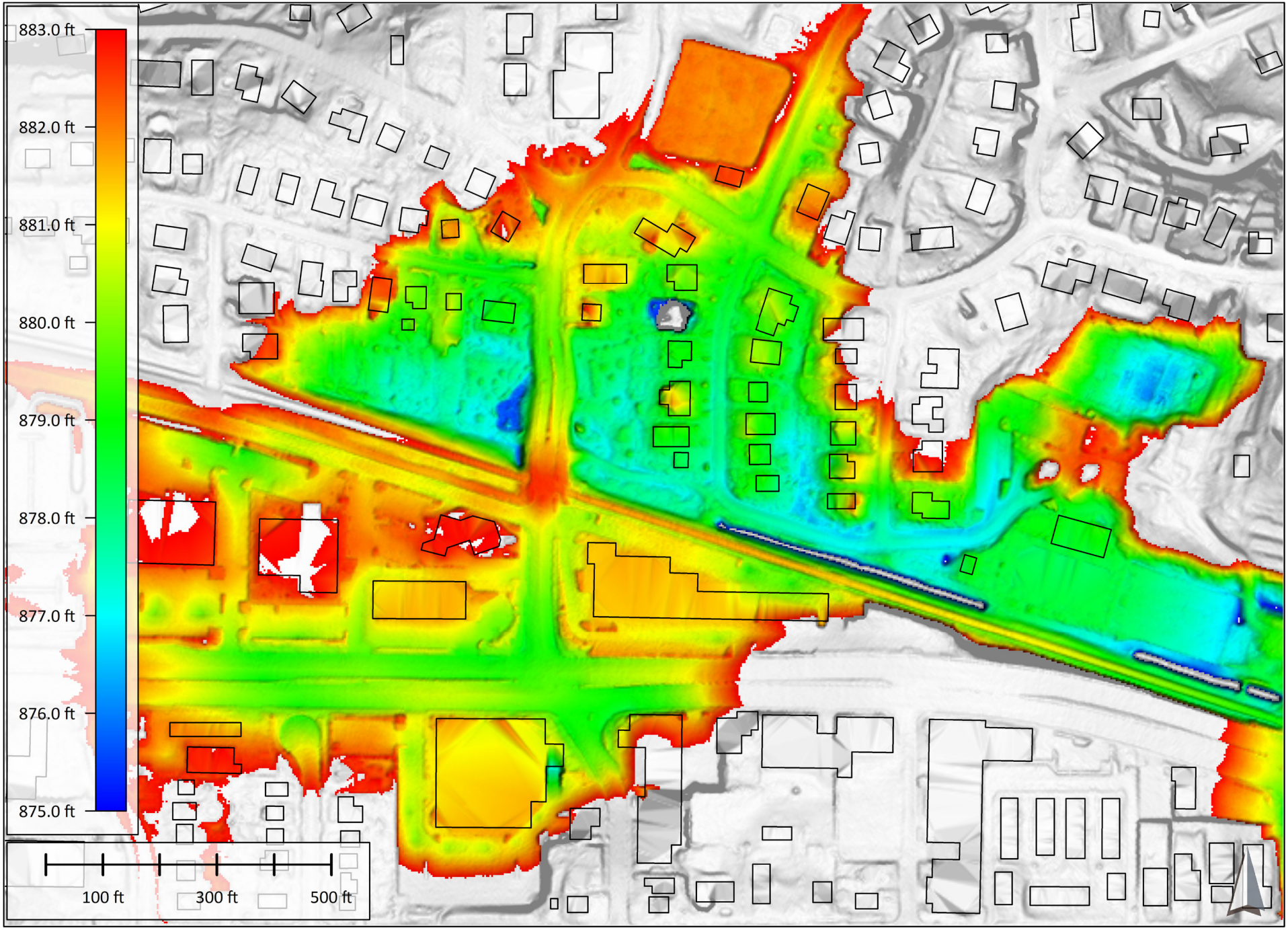


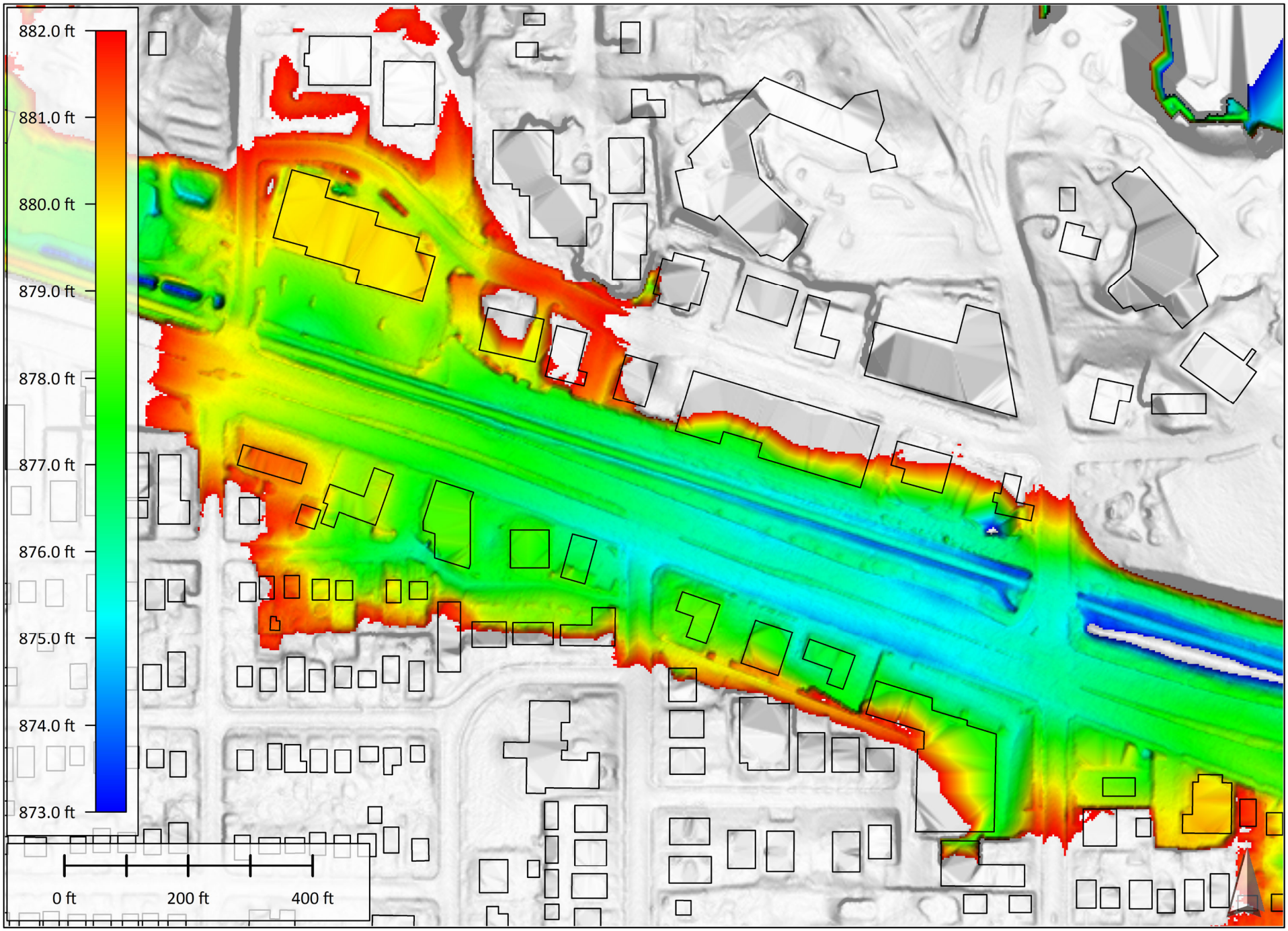
Figure 8. Storm drain locations and sizes



Ground elevations surrounding the intersection of Midvale Blvd and University Ave



Ground elevations surrounding the intersection of Shorewood Blvd and University Ave



Ground elevations surrounding the intersection of University Bay Dr and University Ave