US Army Corps of Engineers

Cahokia Heights & East St. Louis

Flood Hazard Analysis

(Floodplain Management Services -FPMS)

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Cahokia Heights & East St. Louis – Flood Hazard Analysis

Executive Summary

The US Army Corps of Engineers, in collaboration with the Cities of Cahokia Heights and East St. Louis, IL (Sponsors), evaluated opportunities to manage flood risk within portions of the Edgemont, Parkside and Ping Pong watersheds. The study was conducted under the US Army Corps of Engineers Floodplain Management Services (FPMS) program and the intent of this report is to provide information to better assist the City of Cahokia Heights and East St. Louis officials as they make decisions regarding flood risk management within the study area. The Authority and scope of this study do not include detailed design or construction activities. City officials may choose to implement any or all of the measures identified as funding becomes available.

The study area is bordered by Illinois Route 157, Interstate 255, St. Clair Avenue, and Lake Drive and is located in St. Clair County, IL. The Cahokia Heights & East St. Louis Flood Hazard Analysis Report will evaluate flood risk management alternatives for the purpose of minimizing future flood damages to structures within the defined study area. The flood risk management measures proposed for evaluation include:

- Replace undersized main and tributary storm sewers,
- Add storm sewer inlets and conduit to main pipe network for undrained areas,
- Clean and repair storm sewers,
- Raise the elevation of the Harding Ditch levee depression by the Parkside pump station,
- Increase pump capacity of the Parkside pump station,
- Re-establish the former detention basin and connect it to the Parkside pump station,
- Add storm sewer inlets at low points and pipe it to the canals,
- Restore existing drainage ditches,
- Install pump stations and associated conduit network in the Ping Pong watershed, and
- Increase the number and size of culverts.

Due to study constraints, non-structural measures are discussed in the report as considerations for the Sponsors but were not evaluated independently. Each structural measure was evaluated independently for effectiveness, and then in combination. Subsequently, an array of alternatives was developed that take into consideration effectiveness and maintenance requirements. The study was broken into individual watersheds (Edgemont, Parkside, and Ping Pong) because they are hydraulically independent. Each area was evaluated for the same Array of Alternatives which are noted below. Each alternative will require some level of Operations and Maintenance, Repair, Rehabilitation, and/or Replacement (OMRR&R) conducted by the Sponsors to remain effective.

The alternatives were developed to provide varying levels of flood risk reduction using structural measures based on cost. The Limited Flood Risk Reduction Alternative was developed to provide the least costly option that would have some risk reduction impact. The Intermediate Flood Risk Reduction Alternative provides a middle option in terms of cost and level of risk reduction. The Maximum Flood Risk Reduction Alternative was developed to provide the highest level of risk reduction.

Below is a summary of each retained alternative and their respective measures, broken out by the three watershed areas.:

Alternative 1) Limited Flood Risk Reduction

This alternative is the least costly but only provides a limited amount of flood risk reduction and still leaves many structures at increased risk of inundation.

- **Edgemont**: clean and repair storm sewers.
- **Parkside:** clean and repair existing storm sewers and restore existing drainage ditches.
- **Ping Pong:** restore existing main drainage ditches draining to Canal 1 (Edgemont and Steiger) and restore local drainage ditches and culverts East of Canal 1 along roadways.

Alternative 2) Intermediate Flood Risk Reduction

This alternative provides a somewhat more costly option but also increases the level of flood risk reduction. Fewer structures remain at risk of inundation than the Limited Alternative but there is still a significant amount of flood inundation overall.

- **Edgemont:** clean and repair storm sewers, replace undersized main and tributary storm sewers, increase pump capacity of the Parkside pump station, and raise the elevation of the Harding Ditch levee depression adjacent to the pump station.
- **Parkside:** clean and repair storm sewers, restore existing storm sewer drainage ditches, re-establish detention basin and connect to Parkside pump station, increase pump capacity of the Parkside pump station, and the raise in elevation of the Harding Ditch levee depression adjacent to the pump station will also benefit Parkside.
- **Ping Pong:** restore existing main drainage ditches draining to Canal 1 (Edgemont and Steiger), restore local drainage ditches and culverts East of Canal 1 along roadways, and increase the number of the culverts on the Southeast side draining area to Canal 1.

Alternative 3) Maximum Flood Risk Reduction

This alternative is the most expensive of the alternatives evaluated but provides the highest level of flood risk reduction to structures within the study area.

- **Edgemont:** clean and repair storm sewers, replace undersized main and tributary storm sewers, increase capacity of the Parkside pump station, raise the elevation of the

Harding Ditch levee depression adjacent to the pump station, and add storm sewer inlets and conduit to main storm sewer lines for undrained areas.

- **Parkside:** clean and repair storm sewers, restore existing drainage ditches, re-establish detention basin and connect to Parkside pump stations, increase capacity of the Parkside pump station, raise the elevation of the Harding Ditch levee depression adjacent to the pump station, add storm sewer inlets at low points and pipes to carry the water to the canals, and replace undersized storm sewers.
- **Ping Pong:** restore existing main drainage ditches draining to Canal 1 (Edgemont and Steiger), restore local drainage ditches and culverts East of Canal 1 along roadways, increase the number of the culverts on the Southeast side draining area to Canal 1, and install pump station and associated conduit network.

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1.0 Study Purpose

This report examines opportunities to reduce the flood inundation risk to structures located within the Edgemont, Parkside and Ping Pong watersheds. The study area is within the city limits of Cahokia Heights and East St. Louis in St. Clair County, IL. It is generally bounded by Illinois Route 157 on the east, Interstate 255 on the west, St. Clair Avenue on the north, and Lake Drive on the south. Many of these residential structures are repeatedly at risk of inundation during regular precipitation events. The purpose of this report is to provide the City of Cahokia Heights and East St. Louis officials with information to support making informed decisions regarding future flood risk management activities within the study area.

1.1 Scope

The scope of this report is to provide the Cities of Cahokia Heights and East St. Louis with an evaluation of the flood prone areas within the defined study area, conduct engineering analysis of structural alternatives to reduce flood risk, and present the findings and conceptual cost estimates to assist the city with reducing long-term flood risk. The evaluations in this report take into consideration local hydraulics and existing site conditions. Information referenced during the study were provided by the Cities of Cahokia Heights and East St. Louis (Hurst-Rosche Inc. and Thompson Civil LLC.), St. Clair County, Federal Emergency Management Agency (FEMA), Illinois Emergency Management Agency (IEMA), U.S. Army Corps of Engineers (USACE), U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Metro East Sanitary District (MESD), Heartlands Conservancy, Southern Illinois University Edwardsville (SIUE), Illinois Department of Natural Resources (IDNR), and Environmental Protection Agency (EPA).

1.2 Annual Exceedance Probability

Throughout this report, storm events and their resultant inundation will be referred to by Annual Exceedance Probability (AEP). For example, a storm event with a 1% AEP would have a 1% chance of occurring in a given year. Additionally, in the past, storm events have often been described by their “return period” – or the estimated average length of time between storm events of a similar magnitude. A 1% AEP event would have been referred to as having a 100-year return period or being a 100-year event. This terminology is no longer used because it falsely conveys a sense of time and lowers public risk perceptions. AEP terminology reminds the observer that the occurrence of a rare storm does not reduce the chances of another rare storm occurring within a short time period. Table 1 provides a list of standard AEP events for reference, with their equivalent “return period”.

The 1% AEP precipitation event does not necessarily correspond with a 1% AEP stream water level AEP. Several factors such as extent and duration of precipitation as well as the soil moisture conditions at the time of the event have an influence on the volume of runoff into a stream. It is this varying degree of runoff that affect the stream water level. For this study, the 1% AEP rainfall event is assumed to yield the 1% AEP stream water level event. Simulations will use a uniform rainfall distribution, 24-hour duration, and a normal antecedent moisture condition.

Table 1: Comparison of AEP, ACE, and Return Period Terminology

AEP	Return Period*
20%	5-year
10%	10-year
4%	25-year
2%	50-year
1%	100-year
0.5%	200-year
0.2%	500-year
0.1%	1000-year
*Note: Return Period is a term that can be misleading, is often misunderstood, and is no longer used by USACE (see ER 1110-2-1450).	

Table 2 shows the 24-hour duration rainfall depths used in the analysis of this study area, based upon Annual Exceedance Probability (AEP).

Table 2: NOAA Atlas 14 24-hour duration rainfall depth for East St. Louis, IL

Storm Event	Depth of Precipitation (Inches)
10 % AEP	4.51
1% AEP	7.65

2.0 Study Background

2.1 Study Authority

This study is a special study under the Flood Plain Management Services (FPMS) program and is authorized by Section 206 of the Flood Control Act of 1960 (P.L. 86-645), as amended. The program allows the US Army Corps of Engineers to conduct small, conceptual studies for local communities.

> *"That, in recognition of the increasing use and development of the*

floodplains of the rivers of the United States and of the need for information on flood hazards to serve as a guide to such development, and as a basis for avoiding future flood hazards by regulation of use by States and municipalities, the Secretary of the Army, through the Chief of Engineers, Department of the Army, is hereby authorized to compile and disseminate information on floods and flood damages, including identification of areas subject to inundation by floods of various magnitudes and frequencies, and general criteria for guidance in the use of flood plain areas; and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard: Provided, that the necessary surveys and studies will be made and such information and advice will be provided for specific localities only upon the request of a State or responsible local governmental agency and upon approval by the Chief of Engineers."

2.2 Study Location

The study area encompasses portions of Cahokia Heights and East St. Louis, IL and lies within St. Clair County. The area is low-lying, within what is known as the American Bottoms and lies at the base of the bluffs, subjecting it to upland drainage. The area lies behind the federally accredited East St. Louis Levee. The Edgemont watershed, the area north of Main Street, drains to the Parkside pump station that empties into Harding Ditch. The area south of State Street drains into a ditch known as Canal 1. It flows south past Frank Holton State Park and eventually empties into Harding Ditch. Harding Ditch runs along the western edge of the study area and makes its way south draining into Prairie Du Point Creek which empties into the Mississippi River.

Figure 1 shows the study area boundary, and Figure 2 shows the general vicinity of the area, as well as boundaries between Cahokia Heights and East St. Louis. The Cahokia Heights area was referred to historically as the city of Centerville, and the villages of Cahokia and Alorton as they were known prior to their merger in May 2021. These historic names may be used in news articles and other reports.

The study area is approximately 2.5 square miles with a population of about 6,500 residents according to the United States Census Bureau (United States Census Bureau, 2020).

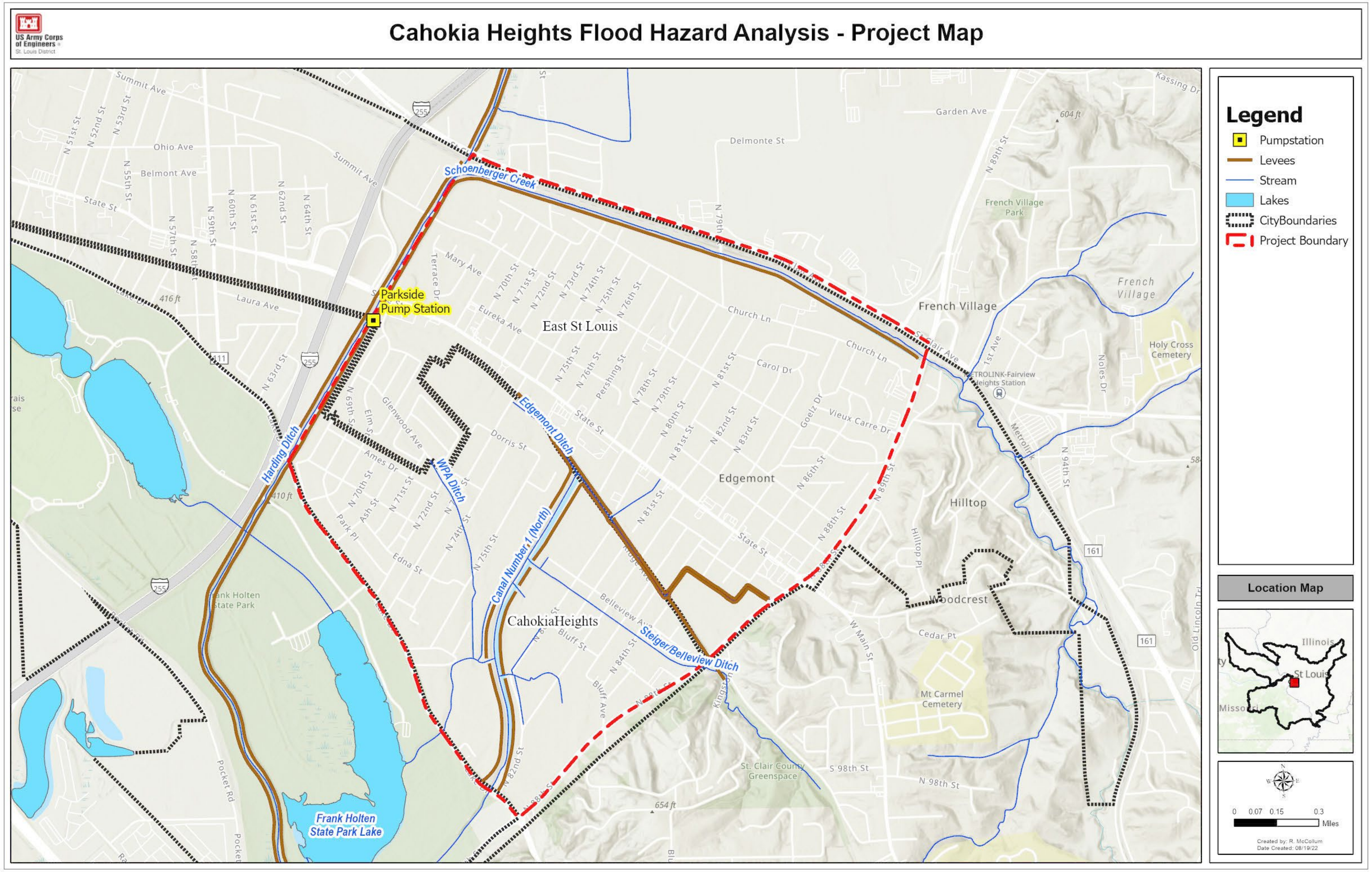

Figure 1: Study Boundary Map

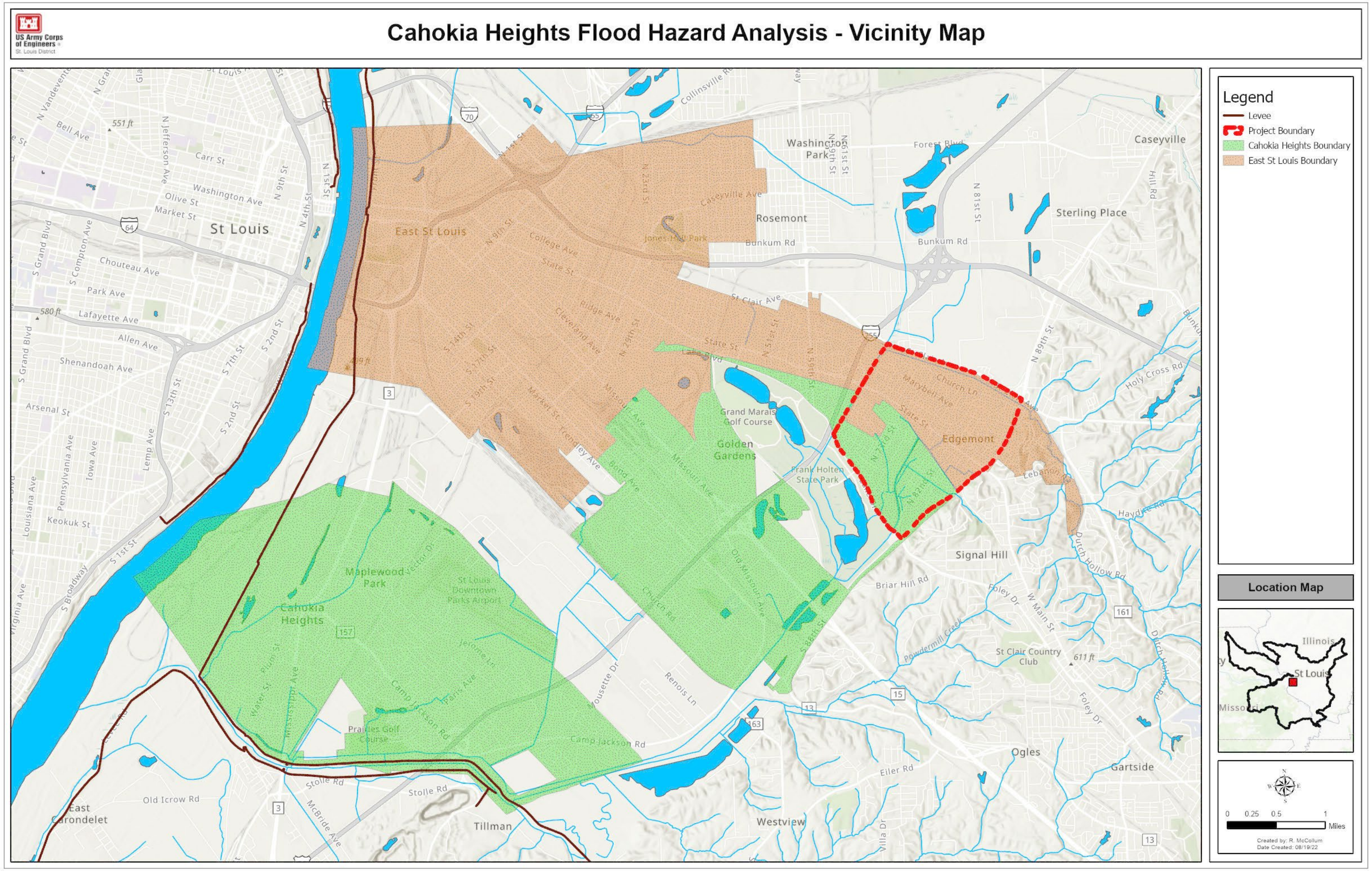

Figure 2: City Boundary Map (study area outlined in red)

2.2.1 Watershed Boundaries

The study area lies within the larger Prairie du Pont watershed and is broken into three sub-watersheds. Shown in Figure 3, they are the Edgemont, Parkside, and Ping Pong watersheds. The study area encompasses primarily residential structures with some commercial businesses running along State Street. It has relatively little greenspace overall and is comprised mostly of urban development. The majority of the area is low-lying and has elevations from 402 ft at its lowest point up to 458 ft at the highest point within the study area boundaries (see Figure 4). Elevations reported are referenced in the NAVD88 vertical datum unless otherwise noted.

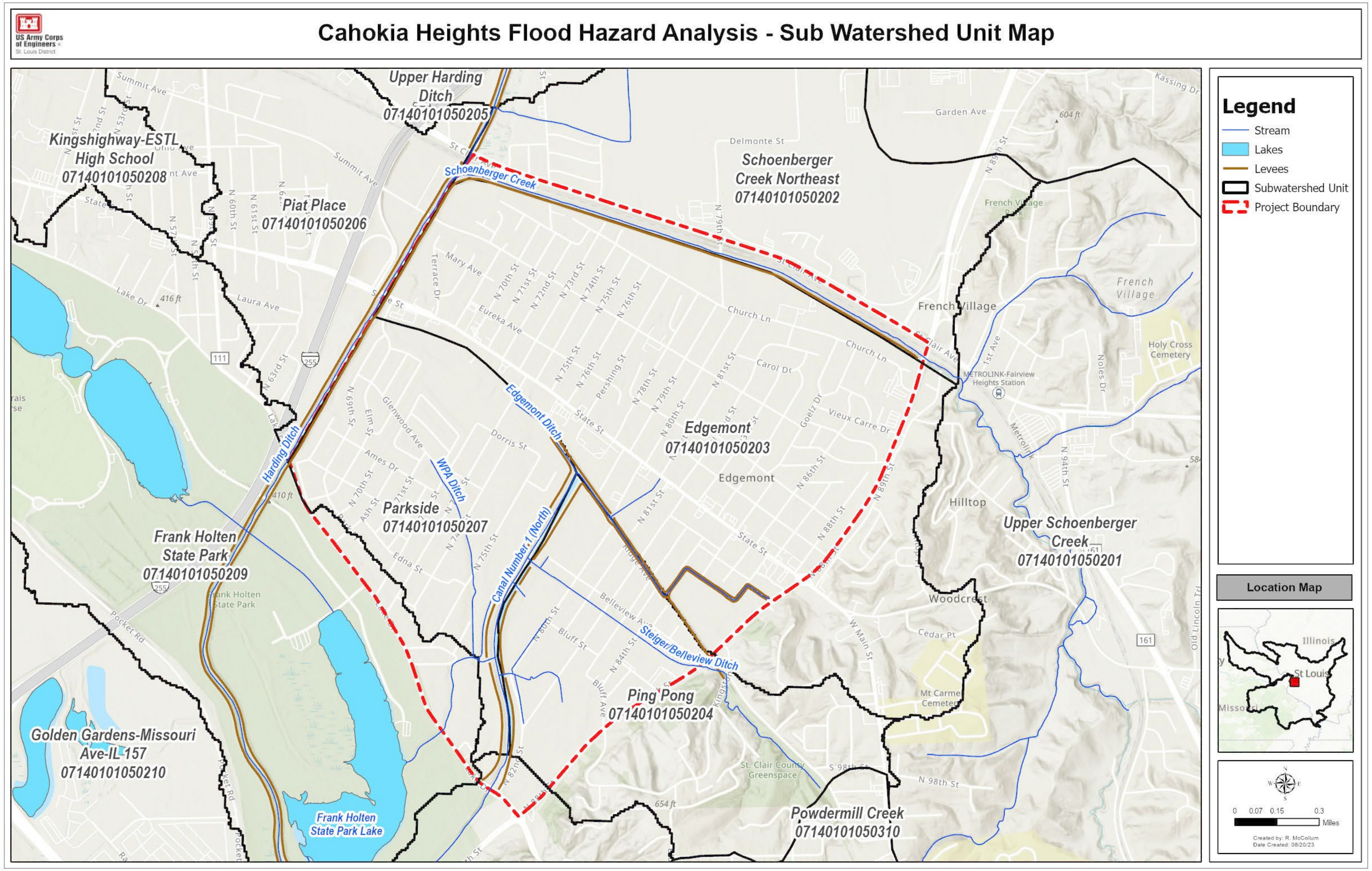

Figure 3: Sub Watershed Map

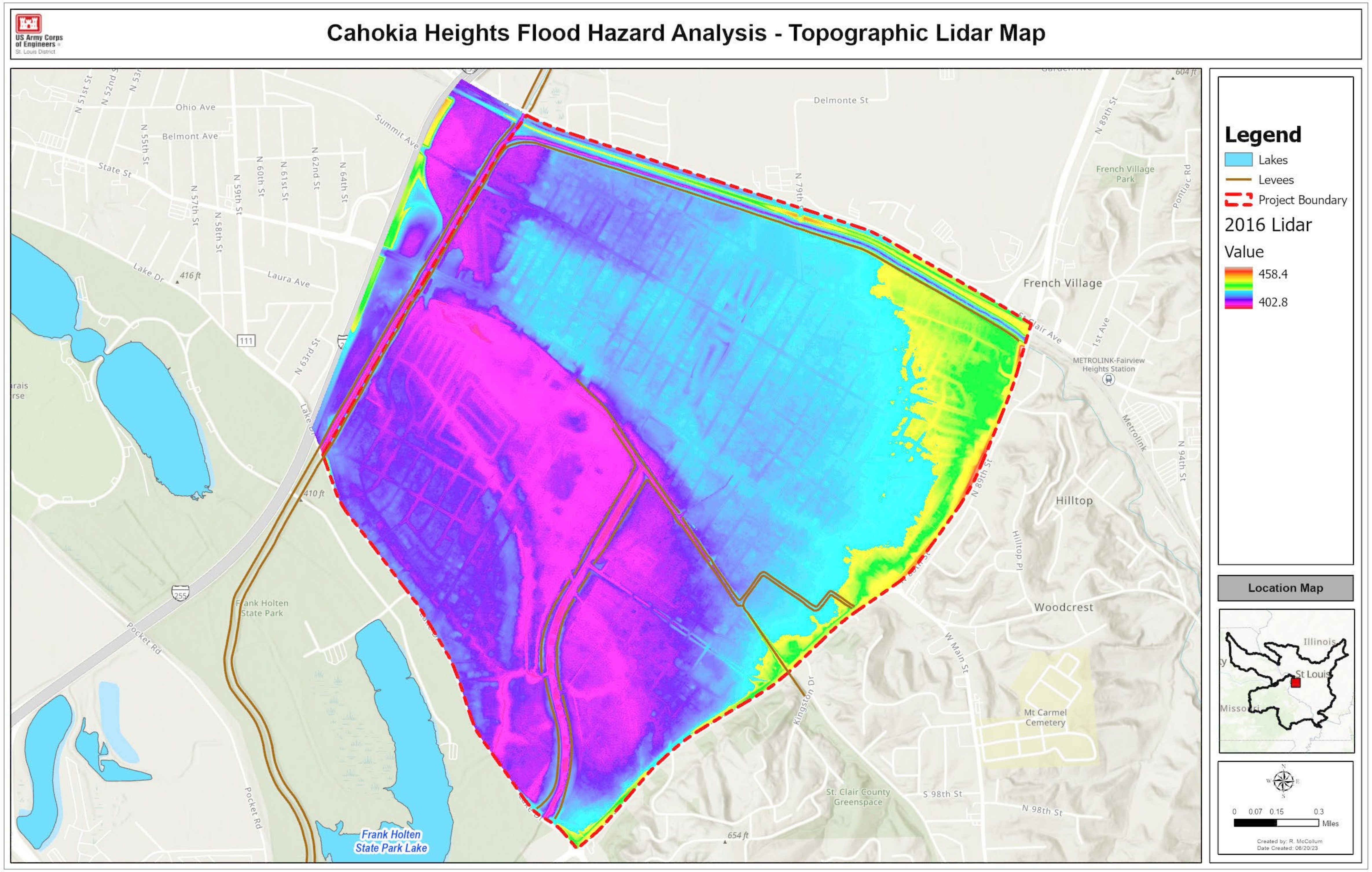

Figure 4: Topographic Lidar Map of the Study Area

2.3 Cahokia Heights & East St. Louis History of Flooding

2.3.1 Environmental Justice

Environmental justice (EJ) is defined as the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies, with no group bearing a disproportionate burden of environmental harms and risks.

Due to the funding limitations of this study, a full evaluation of EJ impacts was not conducted. However, an initial screening using the EPA Environmental Justice Screening and Mapping Tool (EJSCREEN Version 2.1) (USEPA, 2023) and CEQ's CJEST (version 1.0) (CEQ, 2022) was used to determine that this community did meet the criteria as a disadvantaged community. The study area met the following criteria: low income, expected population loss rate, abandoned mine, health (asthma and diabetes), low life expectancy, unemployment, and low high school attainment.

Following that evaluation, a list of relevant community information from the EJ screen tool was downloaded and is included in Appendix B. This information may aid in the development of applications for technical/financial resources for securing additional support for city officials to support their respective communities.

2.3.2 History of Flooding in Cahokia Heights & East St. Louis Watershed

The Cahokia Heights and East St. Louis study area has endured decades-long challenges with repeated flooding as a result of several factors including development in low lying areas, upland drainage, increased intensity and frequency of storm events, undersized and failing infrastructure, and maintenance challenges. Water is currently unable to drain effectively from the study area following precipitation events, resulting in flooding of roads and structures. The level of inundation can range from inches to several feet. The extreme rain event on July 26, 2022, produced several feet of inundation to structures. This event caused considerable structural damage within the study area. Moderate to significant flooding events also have the potential to limit vehicular and pedestrian movement.

The following is an excerpt from the EPA trip report dated July 25-26, 2022:

> *"During the early hours of July 26, 2022, a severe rain event occurred in the St. Louis area, including Cahokia Heights. Over 6 inches of rain fell over Cahokia Heights over an 11-hour period from 1:00 A.M. to noon on July 26 (based on National Weather Service data for the St. Louis Downtown Airport, located in Cahokia Heights). As a result of the storm, which caused widespread flooding throughout the region, the City's Public Works staff were deployed to respond to emergencies throughout the City on July 26."*

Time progression pictures of the flooding from that event are below in section 2.4.2 (Figure 9 - Figure 11). (Maraldo, 2022) . The NOAA Weather Service website shows surrounding areas (St.

Louis Science Center to the west & Scott Air Force Base to the east) receiving 8.5 to 8.7 inches of rain on July 26, 2022.

2.4 Flood Impacts

2.4.1 Flooding on Roads

During the July 26, 2022 flood event, several area streets were impassible to pedestrian and vehicular traffic for a period of several hours. The waters receded relatively quickly but left sediment and debris on the streets. Figure 5 through 14 show the results of flooding within the Cahokia Heights and East St. Louis area during other flooding events.

Figure 5: Flooded road in Cahokia Heights- June 2015 (Photo courtesy of Robert Cohen/St. Louis Post Dispatch/ Polaris (Earthjustice))

Figure 6: Flooded roads and homes in Cahokia Heights (Photo courtesy of Belleville News Democrat)

Figure 7: Flooding of streets and homes in Cahokia Heights (Photo courtesy of Equity Legal Services (Earthjustice))

Figure 8: Flooded streets in East St. Louis. (Photo courtesy Belleville News Democrat)

2.4.2 Impacts on Structures

The impact of flooding to structures can be devastating. Repeated inundation can cause structures to develop mold and become structurally compromised.

Figure 9: Cahokia Heights Flooding (EPA Identified Sanitary Sewer Overflow Outlined in Red) - 7:38am 26Jul22- (Photo courtesy of USEPA)

Figure 10: Flooding in Cahokia Heights 11:33am 26Jul22 (Photo courtesy of USEPA)

Figure 11: Flooding in Cahokia Heights 2:20pm 26Jul22 (Photo courtesy of USEPA)

Figure 12: Water damage at a condemned home on Belleview (Photo courtesy of Derik Holtmann - Belleville News Democrat)

Figure 13: Flood water mark on structure July 2022 (Photo courtesy of USACE)

Figure 14: Flooding in East St. Louis July 2022 (Photo courtesy of Belleville News Democrat)

2.4.3 Impacts on Sanitary Sewer

Flooding issues in the Cahokia Heights area have exacerbated existing sanitary sewer problems within the study area for years. During rain events, the sanitary sewer system appears to become overwhelmed and begins surcharging. Surcharging occurs when the capacity of the system is exceeded, and water begins coming up to the surface. This results in sewage backing up into residences, streets, and yards. While the sanitary sewer problems are separate from the storm sewer concerns noted in this report, any improvements to the storm sewer and flooding issues are anticipated to have a positive impact on the sanitary sewer issues as well by preventing surface drainage from intruding into the sanitary sewer system. In order to address the sanitary sewer issues, the city of Cahokia Heights is partnering with USACE on a Section 219 project to initiate crucial sanitary sewer system improvements.

3.0 Existing Conditions

3.1 Flood Risk Management Context

The study area lies within the larger Metro East Levee system (Figure 15). The primary outlets for the interior drainage within the study area are Harding Ditch and Canal 1. Harding Ditch runs along the West side of the study area heading South. Canal 1, which runs between the Parkside and Ping Pong watersheds, empties into Harding Ditch south of Lake Drive. From there Harding Ditch continues south eventually reaching Prairie du Pont Creek which empties directly into the Mississippi River. Harding Ditch is maintained by MESD. The MESD South pump station brings water from Harding Ditch into Prairie du Pont Creek. Operation of the MESD South pump station is directly affected by Mississippi River conditions. Therefore, conditions on the Mississippi River affect water levels on Harding Ditch. Flooding problems on Harding Ditch have been noted during high Mississippi River stages.

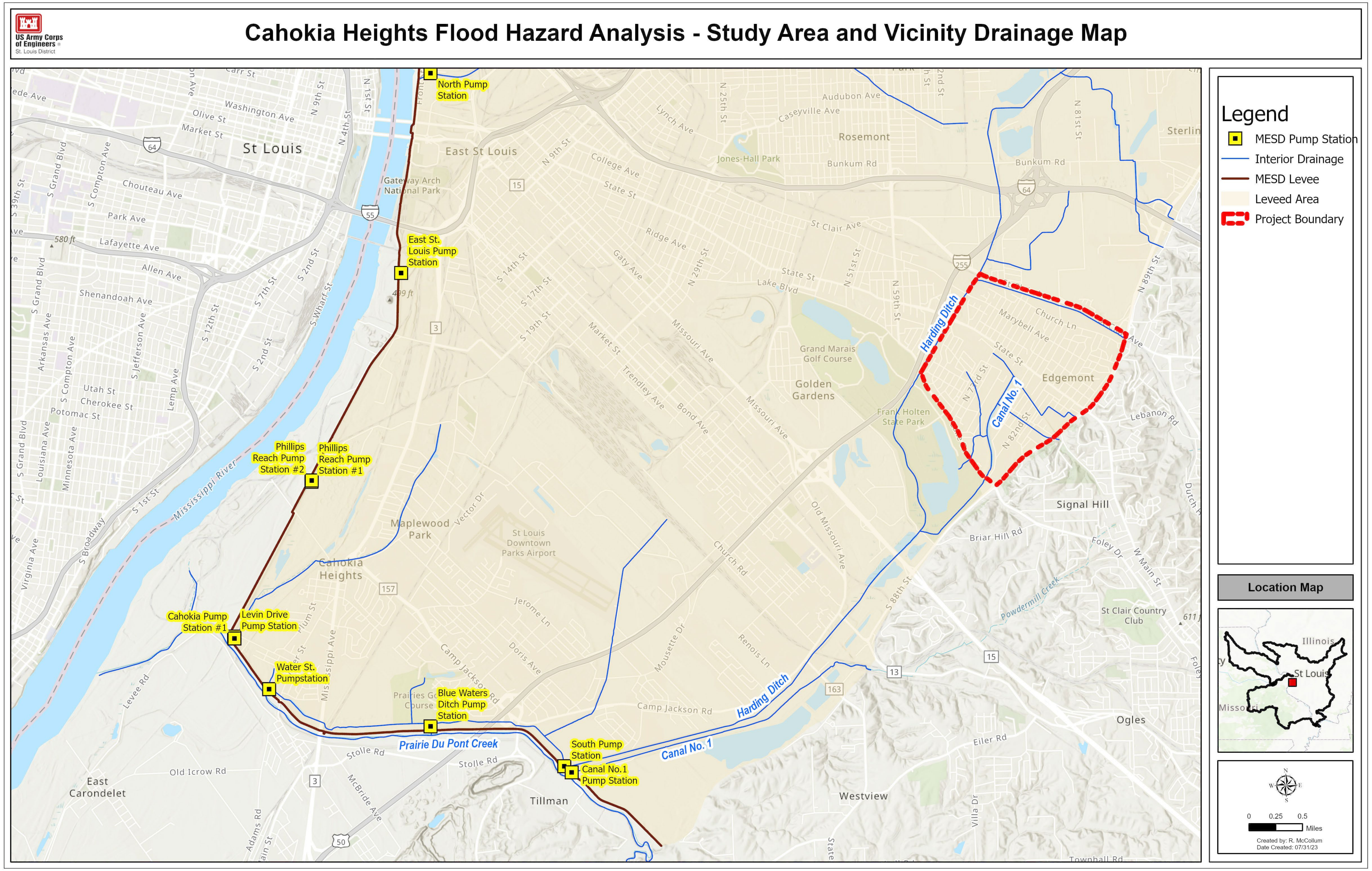

Figure 15: Study Area and Vicinity Drainage Map

3.2 Hydraulics and Hydrology

Within the study area, water cannot effectively drain, causing inundation to roads and structures after precipitation events. This can be attributed in whole or in part to:

- pump station not operating to full capacity,
- broken and blocked storm sewer networks,
- inadequate number of storm sewer inlets (of which, some are blocked),
- homes being built in low lying areas,
- undersized storm sewers,
- insufficient number of culverts,
- existing culverts are undersized and in disrepair,
- local drainage ditches (along the side of the road) and
- main ditches (Steiger, WPA, Belleview) that have sedimented in and are not draining effectively,
- undrained areas without a storm sewer network, and
- a nonfunctional detention basin.

Figure 16: Blocked storm sewer inlet July 2022 (Photo courtesy of USACE)

While the storm sewer networks were likely adequate when initially designed and installed, continued development, in addition to more frequent and intense rain events, has made these undersized for current conditions.

Parkside pump station is not currently operating at full capacity (see section 3.3). City engineers estimate it to be operating at about 40% capacity.   The drainage systems currently available throughout the study area are also insufficient to carry the majority of floodwater to the pump station.

Hydraulic Engineers ran numerical stormwater and hydraulic models to capture the existing conditions of the area drainage. The PC Stormwater Management Model (PCSWMM) was utilized for modeling stormwater in pipe networks, and additional hydraulic modeling was completed using the Hydrologic Engineering Center's River Analysis System (HEC-RAS). These same models were also used to examine the effects of the proposed measures. The models were assembled using a terrain dataset that incorporated additional field survey data collected by USACE. The storm sewer network analysis relied on a storm sewer survey performed by IDNR.

Two separate two-dimensional (2D) and one-dimensional (1D) PCSWMM models were created for the project area. The separating boundary for the models was State Street. The first model covered the entire Edgemont watershed draining to the Parkside pump station. The second model covered both the Parkside and Ping Pong watersheds with portions draining to the Parkside pump station as well as Canal 1.

To capture the effects of Harding Ditch backwater in the Parkside and Ping Pong watersheds, a 2D unsteady flow HEC-RAS model was created of the Ping Pong and Parkside watershed. The extents cover the areas around Canal 1 and the bluffs to the east of Hwy 157.

3.3 Mechanical Engineering Analysis of Pump Stations

Owned and operated by East St. Louis, the Parkside pump station is located approximately 375 feet south of State Street, on 68th Street. It is positioned on the landside of the levee, on the left overbank of Harding Ditch. The station is designed to operate automatically with float switches but is normally manually operated. It was designed to be a 100 cfs stormwater station and consists of three (3) submersible Flygt PL 7061 pumps with capacities of 32.3 cfs each at 23 feet of total head. The pumps are operated by 460-volt, three phase, 135 HP motors. The pumps also include a Monitoring and Status (MAS) system that is capable of sensing temperature, vibration, and leakage to protect the pump by raising an alarm when undesirable events occur. The actual design operating elevations for the station are unknown since original design documents were unavailable. Based on assumptions, available data, and current standards, it was estimated that the minimum shutoff elevation should be 3 feet above the pump impeller, and the minimum drawdown should be 14 feet. The station discharges into Harding Ditch and, because there is no information available about the size of the discharge pipes, it is assumed that the discharge pipes are 36-inches in diameter.

Parkside pump station does not currently operate at its fully designed capacity. During the July 2022 flood event it was noted by a pump station operator with the City of East St. Louis that the station was not keeping up with the incoming flows, and the pumps automatically shut off during operation when the water levels were too high. This led to the need of portable pumps to pump the water down. It was not confirmed if there was a high water cut off elevation programmed for the pumps, but this is a likely reason for this situation.

A site visit of the station was conducted by USACE personnel a few weeks after the flood event. During the site visit Pump #3 was currently pulled out of service and being rehabilitated. Pump #2 was operational and was observed running. It was noted that Pump #2 had been rehabilitated in the last year. Pump #1 had also been rehabilitated in the last year but was not run due to an object being stuck in the impeller.

The station building also has a large opening in the roof due to a missing roof panel. This opening exposes the electrical boxes and motor control center (MCC) to the outside elements.

The sump of the station also features a trash rack to prevent large debris from entering and damaging the pump. During observation of the station, the trash rack was clogged with debris leading to an excessive amount of ponding in the sump. Clogged inlets can prevent proper flow to the pumps. It was also noted that two of the pumps have had debris clog their impeller, resulting in the need for rehab. Any type of damage to the pump impellers can lead to balancing and pumping issues and will affect the performance of the pumps. It is also assumed that the discharge system of the station does not include a mechanism to prevent backflow. The discharge culvert only features steel bars spaced apart to prevent debris from entering the outlet. It was also noted that when the water levels of Harding Ditch are high, water will recirculate within the ditch. Backflow into the pumps can cause damage to shaft and overall wear on the pump over time. Figure 17 -Figure 22 depict the current conditions at the pump station.

Figure 17: Parkside Pump Station- Crews Operating Portable Pumps Due to Pump Failure - July 2022 (Photo Courtesy of Belleville News Democrat)

Figure 18: Overgrown exterior of Parkside pump station. July 2022 (Photo courtesy of USACE)

Figure 19: Pump tubes and electrical motor control center (MCC) on operating floor at Parkside pump station. July 2022 (Photo courtesy of USACE)

Figure 20: Corroded pump tube and sump clogged with trash/debris at Parkside pump station. July 2022 (Photo courtesy of USACE)

Figure 21: Parkside pump station discharge into Harding Ditch. July 2022 (Photo courtesy of USACE)

Figure 22: Hole in roof of Parkside pump station and rusted equipment. July 2022 (Photo courtesy of USACE)

3.4 Stormwater Infrastructure

The current state of stormwater drainage in the three watersheds is poor. The storm sewer systems are blocked and undersized. There are an insufficient number and, in some areas, a total lack of storm sewer inlets. Drainage ditches are discontinuous, disconnected, and have sedimented in over time. Surface grades in many areas do not convey runoff into ditches or storm sewer inlets. Culverts are insufficient, undersized and in disrepair. Significant corrective action is needed to fully improve the drainage conditions and reduce flood risk.

3.4.1 Edgemont and Parkside Drainage System

The Edgemont and Parkside watersheds contain an existing storm sewer network for drainage. A small portion of the Edgemont watershed does not have a storm sewer network but drains via storm gutters and is not thought to be prone to flooding.

Most of the Edgemont watershed drains to the Parkside pump station. The west portion of the Parkside watershed also drains to the Parkside pump station. The southeastern portion of the Parkside watershed drains into the Works Progress Administration (WPA) Ditch that drains the area southeast into Canal 1. The northeastern portion of the watershed drains into the western side of the Edgemont Ditch that empties into Canal 1. In both watersheds, some roadside ditches drain to an area inlet or culvert that allows water to enter the sewer system. The Parkside pump station brings the drainage from portions of these watersheds into Harding Ditch. The pump station is located on the landside of the levee on the left overbank of Harding Ditch.

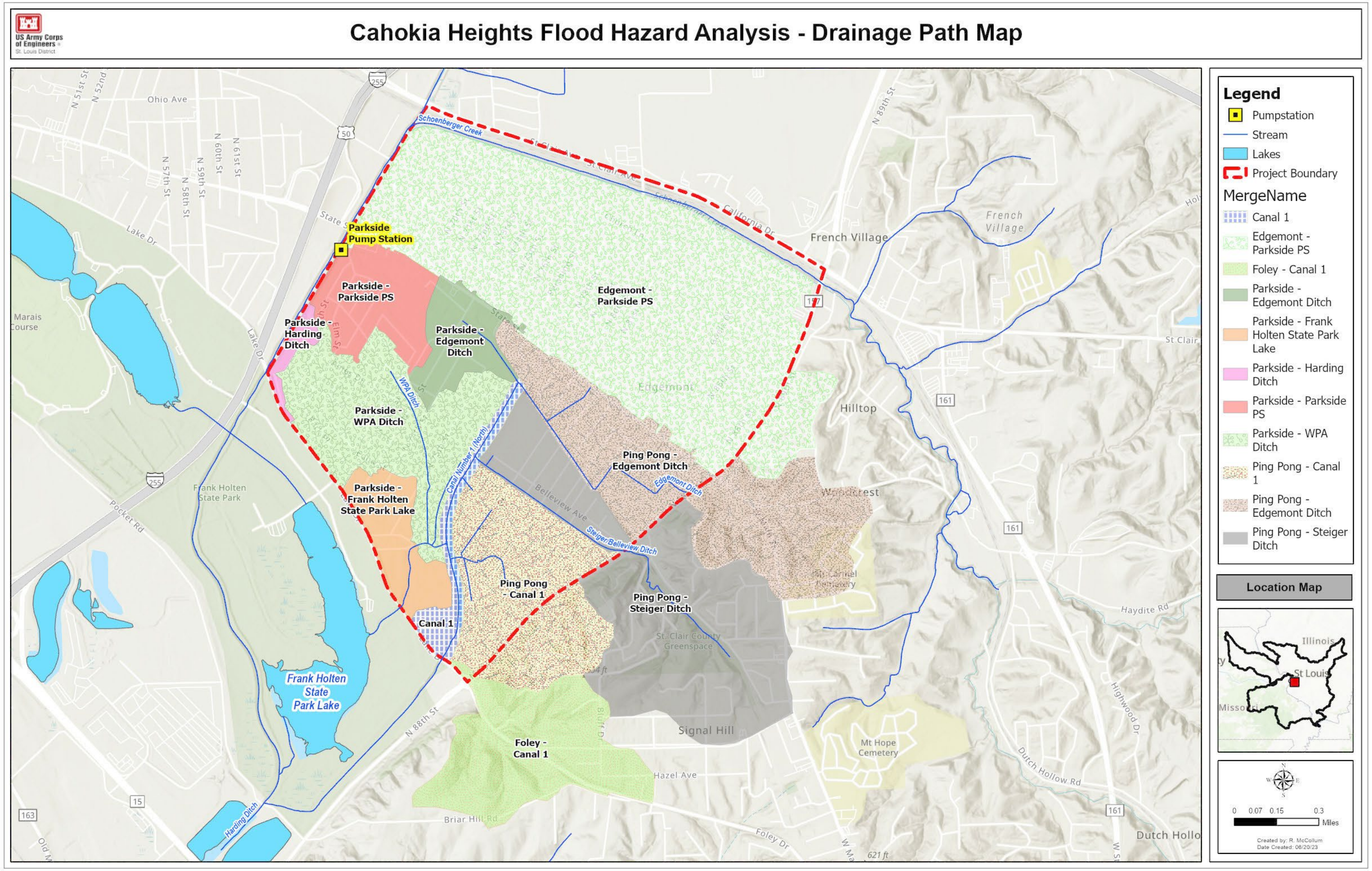

Figure 23: Drainage Path Map of Study Area

The current state of the storm sewer system is poor. Several inlets are filled with silt and trash. Several are broken. Several areas do not drain into their intended inlet due to changes in the roadway or land surface. These inlet conditions do not provide adequate drainage and leave water ponded in the roadways and ditches. Several pipes have adverse slopes - probably due to settlement over time - which further restricts drainage in the network.

The ditches in several areas along the roadside are discontinuous. Either due to settlement or landowners regrading yards, most ditches do not drain into the storm sewer network as originally conceived. As a result, standing water can be seen throughout the drainage ditches. The two main storm sewer lines (Marybelle and Eureka) are currently undersized. The main lines are between two to three feet in diameter on average.

Based on historical aerial imagery, it appears there was previously a detention basin in the upper northwest corner of the Parkside watershed within the study area. This detention basin has filled in with sediment and become overgrown with woody material over time. While it is assumed at one time it had a connection to the Parkside pump station, no current connection could be found. This area no longer functions as a detention basin.

3.4.2 Ping Pong Drainage System

The Ping Pong watershed contains no storm sewer network south of the eastern fork of the Edgemont Ditch. In this watershed, drainage tends to go into local ditches alongside the roadways. Culverts under roadways connect the ditches and drain most of the area south of Steiger Ditch to Harding Ditch. The area between the Steiger and Edgemont Ditches drains to a small ditch that empties into Steiger Ditch. North of the eastern fork of the Edgemont Ditch, the portion of the stormwater that does not enter the sewer system draining toward the Parkside pump station, instead flows south into the Edgemont Ditch. Illustration of the Ping Pong watershed drainage paths are shown in Figure 23.

The current state of the drainage in the Ping Pong watershed is poor. In areas south of the Edgemont Ditch eastern fork, the stormwater ditches are discontinuous and do not provide adequate drainage. Culverts are insufficient, blocked, or crushed (Figure 24). Standing water can be seen after most storm events. In some areas, surface water ponds in yards and does not make it into the drainage ditches.

Figure 24: Damaged culvert and sedimented local drainage ditch. July 2022 (Photo courtesy of USACE)

4.0 Harding Ditch

As discussed in Sec. 3.1, Harding Ditch is the primary drainage path for the southern portion of the Metro East Levee system with multiple tributaries that empty into the ditch.

It should be noted that while an analysis of Harding Ditch (Figure 25) was outside the scope of this study, it is recommended that a full analysis be conducted to determine the impacts of the ditch to the study area. The limited analysis that was conducted showed that, when the Mississippi River is at normal or low elevations, Harding Ditch has minimal impact to interior drainage of the study area. During a modeled 72-hour duration storm event, interior drainage peaks and then recedes from the Parkside and Ping Pong areas before flooding in Harding Ditch develops. The same can be said for drainage through the Parkside pump station. Due to the size of the Harding Ditch watershed, it was necessary to model a 72-hour duration event in order to capture the effects of the ditch on the study area.

However, it should be noted that during a 1% AEP event, if the Mississippi River is at high elevations, Harding Ditch does adversely flood the Ping Pong and Parkside watersheds, preventing them from draining to the Mississippi River. Flood levels are increased during a 1% AEP event. Additional analysis and data collection would be needed to fully assess this condition.

Additionally, there is a segment of the Harding Ditch levee - near the Parkside pump station - which has a lower elevation than the surrounding levee. The reason for this depression is unknown. The depression is a limiting factor in the overall level of flood risk reduction offered by the levee as it is the low point. Using an existing HEC-RAS model developed to analyze the Metropolitan East Sanitary District (MESD) Levee systems, it was estimated that the Parkside pump station levee depression is overtopped during a 10% AEP flood event on Harding Ditch. Though alternatives in this report include a measure for this segment to be elevated, it is recommended that further analysis of this levee system be conducted prior to any construction activities.

An analysis of Harding Ditch should focus on the segment of the ditch from Schoenberger Creek to the South pump station and include, at a minimum:

- Harding Ditch flood impacts to current study area. This includes its backwater influence on the Ping Pong and Parkside watersheds as well as its effects on the Parkside pump station.
- The channel conditions of Harding Ditch as it pertains to culvert and pump station drainage.
- Harding Ditch performance during high Mississippi River stages.
- Impacts to Harding Ditch resulting from pump upgrades. This should focus on the MESD South and Parkside pump stations.
- Assess the segment of levee depression, and any impacts if it is elevated.

Figure 25: Harding Ditch Facing South (Parkside pump station seen on left bank) July 26, 2022 (Photo Courtesy of Cahokia Heights Mayor Curtis McCall)

5.0 Study Assumptions and Constraints

5.1 Assumptions

Several site visits were performed to determine channel conditions, drainage structure (manholes, culverts etc.) and pump station conditions, high water marks from flooding on 7/25/22, and survey elevations. Survey of storm sewer networks were conducted by IDNR. However, not all required information was able to be obtained and some assumptions were needed.

Assumptions were made regarding how the sewer lines connect through the wooded area to the west of Terrace Subdivision and some inlets may not have been accounted for in the survey. These areas could drain directly into Harding Ditch or drain into the storm sewer main line to the Parkside pump station. For modeling purposes, it was assumed that the woods drain directly to Harding Ditch. Other areas to the south along the Harding Ditch's left descending bank embankment are thought to also drain to Harding Ditch. The data was not captured in the IDNR survey and assumptions were made on culvert drain dimensions.

An assumption was made that a detention basin used to function near the Parkside pump station. If it existed, it would most likely have drained to the Parkside pump station.

Assumptions were made regarding how the sewer lines are connected through Shipley Lane. Manholes/inlets may not have been seen or accessible, and therefore would not have been accounted for in the survey. It was assumed that the area drains between houses into an assumed ditch or field that leads to the old detention basin.

Several inlets were silted-in or filled with trash. Inlet invert information could not be collected. In these cases, invert elevations were interpolated from surrounding inlet inverts. Where there were groups of inlets silted-in, inverts were set approximately two to three feet below the ground surface.

The alternatives formulated and presented in this report are evaluated up to the 10% AEP rainfall event and do not address potential damages from greater (less frequent) events. The 10% AEP storm event was used, as it is the standard threshold for storm sewer system capacity. It coincides with St. Clair County regulations for storm water management.

This analysis assumed that a 24-hour duration is sufficient to capture the extents of flooding in the study area. The assumed storm duration is greater than the time of concentrations for the modeled watersheds. Time of concentration is the time needed for water to travel from the most remote part of the watershed to the model outfall.

Because of lack of information on the Parkside pump station, free outfall of the conduits to the pump station was assumed. This would be as if the pump station had adequate capacity to drain the system and any water coming to the pump station could effectively drain out. The PCSWMM modeling of the interior flooding did not account for Harding Ditch impacts.

The assumption was made that filling in the section of the levee with the lower elevation will not induce geotechnical stability failure of any part of the levee. No stability or seepage analyses were performed as part of this study.

5.2 Constraints and Considerations

Constraints are restrictions that limit the planning process. Some constraints are general and common to all studies (such as resource constraints and legal and policy constraints). Resource constraints are those associated with limits on knowledge, expertise, experience, ability, data, information, money and time. Legal and policy constraints are those defined by law, USACE policy and guidance. Other constraints are specific and unique to each study. Study considerations include information that may influence the study process or conclusions. A clear understanding of constraints and considerations is essential to the success of the planning and evaluation process.

The following specific constraints were identified for this study:

- The study is limited to the scope and funding identified in the FPMS agreement between USACE and the City of Cahokia Heights & East St. Louis.
- The availability of storm sewer and pump station data may impact the model accuracy.
- No measure should be implemented that negatively impacts an adjacent or larger watershed.

The following are considerations for the study:

- A potential project may need outside entity and/or government buy-in to aid in implementation and potential funding.
- Negative impacts to other areas with proposed modifications should be avoided if possible and addressed if unavoidable.
- Avoid or minimize negative environmental and cultural impacts.
- Channel modifications may increase flows or create a higher water surface elevation, potentially impacting areas downstream.
- Construction should take place from downstream to upstream, to prevent increased pipe sizes from overloading the storm sewer system.
- Alternatives typically require cooperation of cities and/or property owners to install and maintain them.
- Potential impacts of Harding Ditch on the study area during high and low Mississippi River levels (see Sec. 4.0).

6.0 Structural Measures to Reduce Flood Damages

A management measure is a feature or an activity that can be implemented at a specific geographic site to address one or more identified problems. Management measures are the building blocks of alternative plans and are categorized as structural and nonstructural.

Structural measures are physical modifications designed to reduce the frequency of damaging levels of flood inundation. Structural measures can be designed to act as a physical barrier between floodwaters and structures at risk of being damaged by those floodwaters, or physical systems to convey water away from the area. Structural measures considered in this report include detention basins and storm water conveyance systems (pump stations, storm sewers, channels, and culverts).

6.1 Stormwater Detention

A detention basin is a storage area designed to mitigate adverse impacts of excess water by holding that water and gradually releasing it downstream. A conceptual design for a typical in-line detention basin is presented in *Figure* 26 **.** A detention basin or ponding area is assumed to have existed historically within the Parkside watershed near the Parkside pump station. This assumed detention basin has filled with sediment over the years and is currently not functioning as a detention basin. It is assumed the basin was designed as a dry detention pond which would remain dry during non-flood conditions, so that maximum storage would be available during storm events.

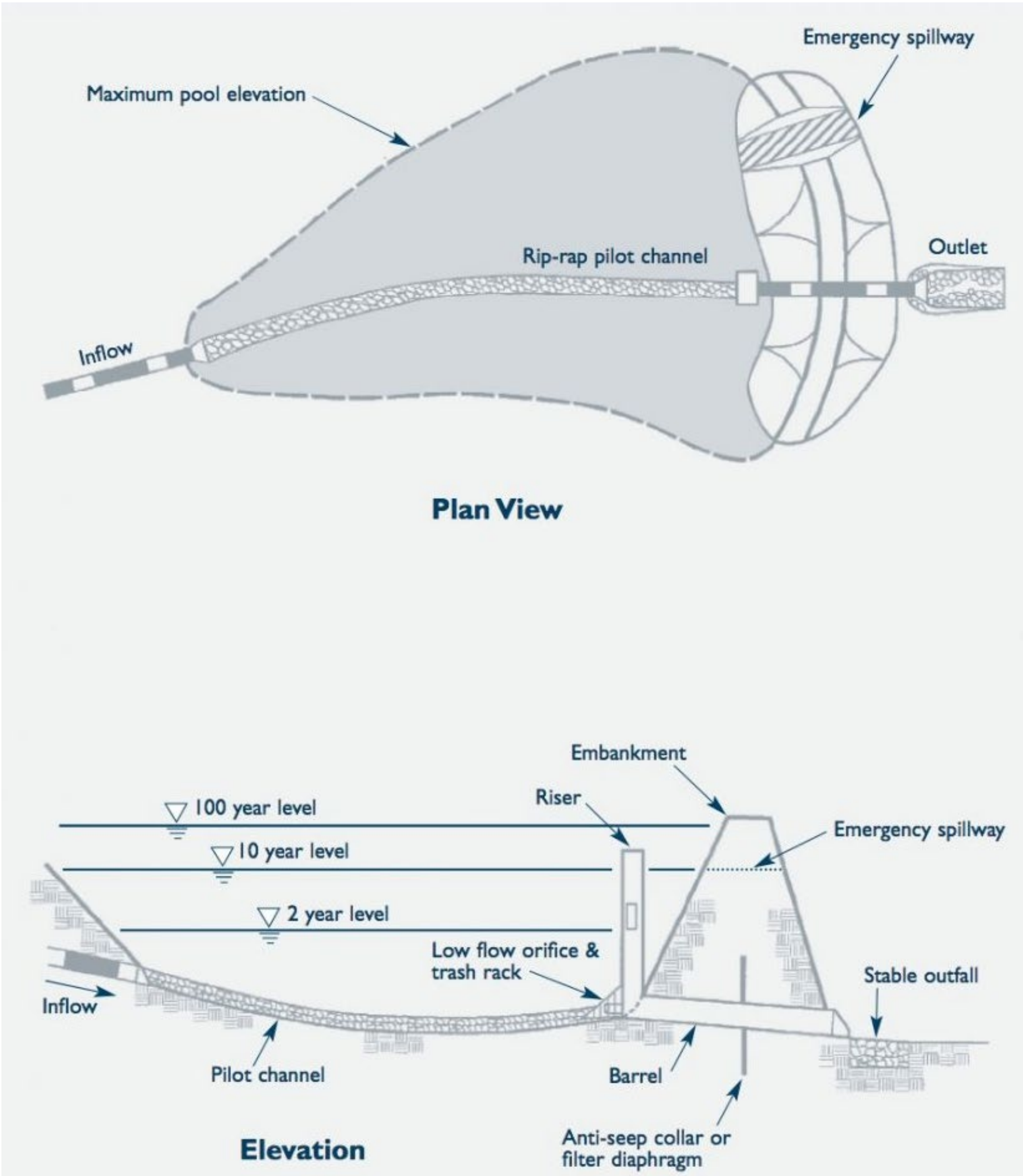

Figure 26: Example of detention basin design (Connecticut Department of Environmental Protection, 2004)

6.2 Stormwater Conveyance

6.2.1 Storm Sewers

Storm sewers are drains that carry surface water runoff from rainfall and melting snow. These sewers convey this runoff to water bodies such as catch basins, creeks, rivers, and lakes. A storm sewer's components include the above-ground drain that is usually found at street-level, just below the sidewalk line, and the subsurface piping that carries the water downstream. The storm sewer networks within the study area are undersized and in disrepair. Replacement and repair of the storm sewer networks is needed. Additional inlets are also proposed for areas with insufficient drainage.

6.2.2 Channels

Modifications to channels can include many types of actions that modify the flow characteristics of the water. For this study, the channel modification includes cleaning out (deepening) the existing channels to remove the sediment that has built up over decades and increase their capacity to hold and carry water. It should be noted that these are not permanent modifications and will need to be maintained. Over time, sediment will inevitably deposit in the channel again, reducing the capacity until removed again.

6.2.3 Culverts

A culvert is any enclosed channel open at both ends carrying water through an artificial barrier such as a roadway embankment. Culverts are the structures in line with the drainage ditches that pass under roadways, driveways or berms. Culverts will begin to fill with sediment and debris, requiring additional cleanouts in the future. They can also be damaged or settle over time, preventing them from continuing to carry water. Debris clogs may be prevented or more easily removed if grating is added to the culvert ends.

6.3 Pump Stations

The Parkside pump station is currently in disrepair and not operating at full capacity. It should be noted if repairs to the interior drainage system within the study area are made, the Parkside pump station, operating at designed capacity would be inadequate to handle the additional volume of water reaching the pump station. If the pump station were operating at design capacity, the interior flooding would still not be alleviated without the additional repairs to the drainage system since the water is prevented from reaching the pump station (see Sec. 3.0). Once interior drainage repairs are completed, the pump station would require an additional increase in capacity to accommodate the volume of water reaching the station. The cost noted in Sec. 9.0 for the Parkside pump station are for increasing the pump capacity only and do not include any repairs to the existing pump station. Rehabilitation and expansion of the pump station may be possible, but investigation of whether or not it is feasible and/or cost effective to attempt to do so is outside of the scope of the study, so all costs are based on the assumption that it would have to be replaced. Some considerations for what would be required to modify the pump station to bring it to full operation are provided in this narrative.

While an increase in the pump station capacity is needed, modifications to the Parkside pump station to improve current performance would include exterior building repairs, sump repairs, and possibly replacing or modifying the pumps. The pump station has a large opening in the roof that exposes the electrical components to the elements. Repairing the roof of the building will prevent the equipment from further damage from weather. Previous observation of the station showed the trash rack clogged with trash and debris causing excessive ponding in the sump. The trash racks are necessary to keep the sump free of debris so there is a steady flow to the pumps and prevent trash from getting stuck in pumps. Further investigation of the trash rack when water levels are low would clarify if the trash rack is damaged or corroded, causing section loss, and allowing debris to be pulled into the pump. It may be necessary to install a mechanically operated trash rack if the system is expanded. All three pumps have been rehabilitated within the last five years.

Lastly, the current station capacity is inadequate for proposed drainage conditions according to hydraulic simulations. A new pump station with a minimum 275 cfs capacity is needed to meet the required capacity of the proposed storm sewer system. To increase the capacity additional submersible type pumps are needed. The current sump of the pump station is not large enough for bigger or additional pumps, so the existing sump will need to be expanded or a separate sump that connects to the system will need to be constructed to accommodate the additional pumps.

Improvements to the Ping Pong area would include construction of a 75 cfs pump station to pump water from the Ping Pong watershed south of Steiger Ditch into Canal 1. The station design may consist of three 25 cfs submersible pumps with 26-inch discharge piping. This is the assumed configuration needed based on similarities to the Parkside pump station with specifics to be established during a design phase. The station should be designed for automatic operation with float switches, and a manual override option.

6.4 Low Impact Design

For all three watershed areas, Low Impact Design (LID) measures were considered. LID measures include (but are not limited to): rain gardens, non-potable rainwater harvesting, and permeable surfaces. These are considered interception actions that hold water in the area as opposed to moving it away. Detailed analysis of the capabilities of these measures were not within the scope of this study, but it is unlikely that these measures would sufficiently address flood risk reduction in the study area without additional infrastructure improvements. These measures can still be considered as a means of supplementing other flood risk reduction actions.

7.0 Non-Structural Measures

Nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use of the floodplains, or by altering existing uses to accommodate the flood hazard. Examples are flood proofing, relocation or elevation of structures, flood warning and preparedness systems (including associated emergency measures), and regulation of floodplain uses. The information in this section is provided for awareness as the sponsors look to future flood risk reduction planning efforts, however due to budget constraints of this study, no analysis was conducted on non-structural measures.

7.1 Dry Flood Proofing

Dry floodproofing consists of modifying the structure to make it watertight below the level of floodwater. It can be applied to residential homes as well as commercial and industrial structures. Based on laboratory tests, a "conventional" built structure can generally be dry floodproofed up to 3 feet. Structural analysis of the strength of the walls would be required if a higher level of protection is desired. Making the structure watertight requires sealing the walls with waterproof coatings, impermeable membranes, or a supplemental layer of masonry or concrete. A sump pump and/or French drain system should also be installed as part of the measure. Closure panels are used at openings such as windows and doors. Dry floodproofing is not recommended for basements or crawlspaces due to excessive costs of reinforcing the exterior walls, preventing seepage, and the possibility of making the whole structure buoyant. Excessive floodwater velocities can damage the floodproofing materials, and unless a passive system is incorporated into the design, there may not be adequate time to install closures during a flash flood event. Extra caution should be taken when considering dry flood proofing for residential structures due to associated risks including installation challenges, structural integrity, passive or manual operation, life safety and flood insurance limitations.

Figure 27 shows a diagram that summarizes the features of dry flood proofing. Dry flood proofing may be viable for any structures preferring to prevent all water inundation such as residential structures or finished professional office spaces that cannot withstand any water penetration. However, in flash flood events, it can be challenging to implement water prevention measures in a timely manner to keep water from entering the structure. This risk reduction measure requires the ability of the property owner to anticipate and install these measures in advance of the flood event which is not always possible.

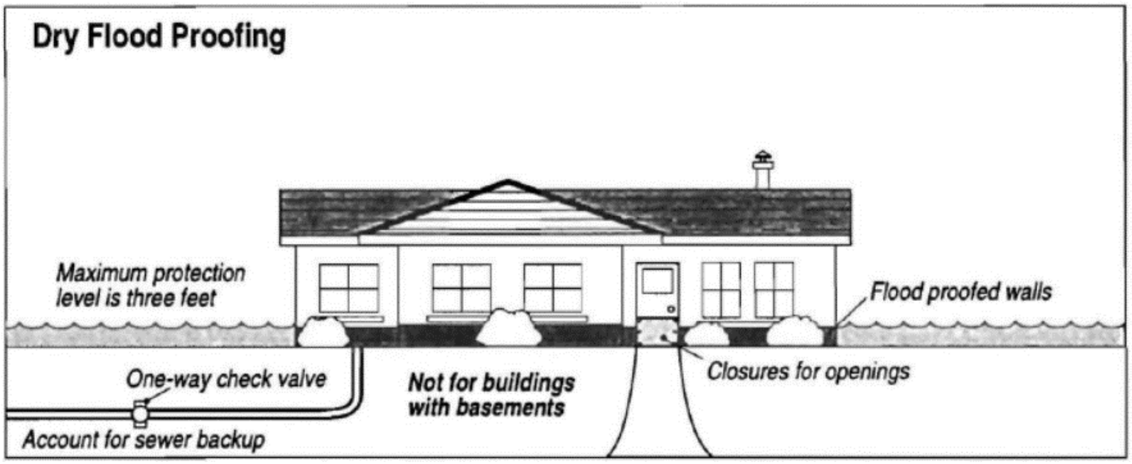

Figure 27: Dry Flood Proofing Diagram

7.2 Wet Flood Proofing

Wet floodproofing allows water to move into the enclosed parts of a structure (e.g., crawlspace or unoccupied area) and then move out when the water recedes. Construction materials and finishing materials need to be water resistant and all utilities must be elevated above the design flood elevation. Wet floodproofing is generally not applicable in large flood depths which could create large forces on interior walls, or in high velocity flows or flashy conditions which will not allow hydrodynamic pressures to equalize quickly. Wet floodproofing may be applied to commercial and industrial structures when combined with a flood warning and flood preparedness plan.

While not typically recommended, a residential structure can be wet floodproofed by being constructed and finished with water resistant materials as shown in Figure 28. Wet flood proofing is best suited for warehouse structures given the open floorplans that can be retrofitted to elevate high value machinery and inventory. If the structure does have a subfloor area such as a basement, it is commonly recommended to fill the basement with sand or other material and relocate the lost square footage into a new addition above the base flood elevation.

Wet floodproofing may reduce National Flood Insurance Program (NFIP) premium rates if certain conditions are met, including the lowest floors being elevated to or above the base flood elevation ("BFE"), i.e., if the basement is filled or converted to a crawlspace.

Figure 28: Wet Flood Proofing Diagram

7.3 Elevation

Elevation (Figure 29) is the lifting of an existing structure to an elevation which is at least equal to or greater than the target flood elevation. The final elevation should place the first floor and associated ductwork, plumbing, mechanical and electrical systems above the design water surface elevation. In many elevation scenarios, the cost of elevating a structure an extra foot or two is less expensive than the first foot, due to the cost incurred for mobilizing equipment. Elevation can be performed using fill material, on extended foundation walls, on piers, posts, piles, and columns. Elevation is also a very successful measure for reinforced slab on grade structures. It is possible that the structure being assessed has an existing crawlspace or basement which would require abandoning to reduce future flood damages and to implement the structural supports for the elevation. Abandonment would consist of filling in the existing basement or crawlspace with clean run fill material and possibly capping with concrete. If the basement or crawlspace is abandoned, a small addition to the structure may need to be constructed on the side of the structure above the projected water surface elevation to contain utilities and mechanical equipment.

Whether a structure may be elevated depends on several factors including the foundation type, wall type, size of structure, and condition. Elevation of a structure most commonly applies to smaller residential and commercial buildings. Residential and commercial property owners can get reduced flood insurance premiums under the NFIP if the first floor of their structure is at or above the Base Flood Elevation (BFE) (or higher if specified by local regulations) after elevation occurs.

Figure 29: Elevation of a Residential Structure. Image- USACE

7.4 Acquisition or Relocation

Structure acquisition (buyout) and relocations are mitigation strategies that remove the hazard from the floodplain, which is the only nonstructural alternative that permanently reduces flood risk.

7.4.1 Acquisition

Property acquisition consists of purchasing the at-risk structure and land that the structure sat upon. The structure is either demolished or is sold to others and relocated to a site outside of the floodplain. The land where the structure was originally located is purchased, becoming deed restricted to prevent development from occurring in the future, and becomes available for open space management as stipulated by the NFIP. Property acquisition and structure removal are usually associated with frequently damaged structures. Implementation of other measures may be effective but if a structure is subject to repeated damage, this measure may represent the best alternative to eliminating risks to the property and residents in perpetuity. Acquisition and conversion to open space (Figure 30) reduces the opportunity for flood damages, causes no increase in flood potential elsewhere, and improves the natural riparian environment.

Figure 30: Acquisition (buyout) of a residential structure and conversion to open space

7.4.2 Relocation

Relocation requires physically moving the existing at-risk structure away from the flood hazard area to a location which is completely outside of the floodplain. The land where the structure had been originally located is purchased, becoming deed restricted to prevent development from occurring in the future, and becomes available for open space management as stipulated by the NFIP. Relocation makes the most sense when at-risk structures can be relocated from a high flood risk area to a location of no flood risk. Where possible, relocating a structure within its existing community continues to support the local tax structure which could otherwise be adversely impacted by a significant number of acquisitions, and provides societal cohesion for the relocated residents. Permanent relocation and conversion to open space reduces the risk for flood damages, causes no increase in flood potential elsewhere, and improves the natural riparian environment.

7.5 Floodplain Mapping

Floodplain Mapping is a non-physical, nonstructural measure that identifies flood risk, whether in the form of a map which portrays flood boundaries, or as an inundation map illustrating the depth of flooding. This measure is a significant tool when assessing and communicating flood risk.

7.6 Risk Communication

Risk Communication develops and uses educational tools such as presentations, workshops, hand-outs, and pamphlets to communicate flood risk and flood risk reduction measures to government entities and floodplain occupants in an effort to reduce the consequences associated with flooding.

7.7 Land Use Regulations and Ordinances

Land Use Regulations are effective tools in reducing flood risk and flood damage. The principles of these tools are based in the National Flood Insurance Program (NFIP) which requires minimum standards of floodplain regulation.

Floodplain ordinances restrict or control development that would significantly increase flood levels and are particularly restrictive in floodway areas that include the stream and a high velocity flood area adjacent to the stream. Development is normally allowed in the floodplain area outside of the designated floodway (in the floodway fringe), but this development must be elevated on fill or by some other method so that it would not be damaged by a 1% AEP flood event. Communities and counties have the option of passing more restrictive floodplain ordinances or development regulations such as those that would earn points in FEMA's Community Rating System program. Floodplain ordinances that comply with the National Flood Insurance Program requirements are in effect in St. Clair County Flood Plain Code - Chapter 13.

8.0 Array of Alternatives Evaluated

The following alternatives were developed using only the structural measures described above for each watershed area: Limited Flood Risk Reduction, Intermediate Flood Risk Reduction, and Maximum Flood Risk Reduction.

The Limited Flood Risk Reduction Alternative was developed to provide the least costly option that would have some risk reduction impact. This alternative still leaves many structures at increased risk of inundation. The Intermediate Flood Risk Reduction Alternative was developed to provide a middle option in terms of cost and level of risk reduction. This alternative provides a somewhat more costly option but also increases the level of flood risk reduction. Overall, fewer structures remain at risk of inundation than the Limited Alternative. The Maximum Flood Risk Reduction Alternative is the costliest of the alternatives evaluated but provides the highest level of flood risk reduction to structures within the study area. Tables 3 - 5 in sections 8.1 - 8.3 show the measures evaluated for each Alternative within the respective sub watersheds. Figures 30 - 40 show the H&H modeling results for the levels of inundation for the existing conditions and the Limited, Intermediate and Maximum Flood Risk Reduction Alternatives during a 10% AEP event. Darker inundation colors equate to higher elevations of the water surface. Appendix A discusses the results in greater detail and also provides results from a less frequent 1% AEP event.

It should be noted that the Edgemont and Parkside watersheds both include a measure to increase the capacity of the Parkside pump station. The pump station primarily benefits the Edgemont watershed but does also provide some benefit to the Parkside watershed and therefore is included as a measure in both.

By implementing proposed measures, there is some level of risk of transferring the flood impacts downstream. However, analysis shows Harding Ditch controls the flooding downstream of State Street as well as on Canal 1 downstream of Lake Drive. Further analysis of Harding Ditch could capture potential impacts. Any work being done within the MESD footprint should be coordinated with USACE and MESD. Additionally, there is some level of risk of transferring flood impact between the Parkside and Ping Pong watersheds and repairs should be coordinated. Implementing measures in the Parkside watershed have the potential to adversely impact Ping Pong if no proposed changes are implemented within the Ping Pong watershed. Additional evaluation is recommended when implementing these measures. The Edgemont watershed is hydrologically disconnected from both Parkside and Ping Pong watersheds and has low risk of transferring flood impacts.

8.1 Edgemont Watershed

Table 3: Table of Measures and Alternatives Evaluated for Edgemont Watershed

Measures	Limited Flood Risk Reduction	Intermediate Flood Risk Reduction	Maximum Flood Risk Reduction
Replace undersized main and tributary storm sewers		X	X
Adding storm sewer inlets and conduit to main pipe network (for undrained areas)			X
Clean and repair storm sewers	X	X	X
Raise the elevation of the Harding Ditch Levee depression adjacent to the Parkside pump station		X	X
Increase capacity of Parkside pump station		X	X

Below are a series of images showing the existing condition inundation during a 10% AEP event and the H&H modeling results demonstrated for each alternative in the Edgemont Watershed. The Limited Risk Reduction Alternative shows almost no improvement to the affected areas. The Intermediate Risk Reduction Alternative shows some improvement, however much of the area remains at risk from uncontrolled drainage. Areas still impacted with water are outlined in red on Figure 32. The Maximum Risk Reduction Alternative shows significant improvement across all areas. There is minor flooding that remains in Faith Court and Success Court; however, the water is limited to the street and does not impact structures. The wooded area between Harding Ditch and Terrace Subdivision also remains impacted, but water does not enter any structures. Connection to the proposed storm sewer system could alleviate flooding. As stated previously (sec 5.1), the exact drainage throughout this area is unknown. Appendix A has more detailed images of the modeling.

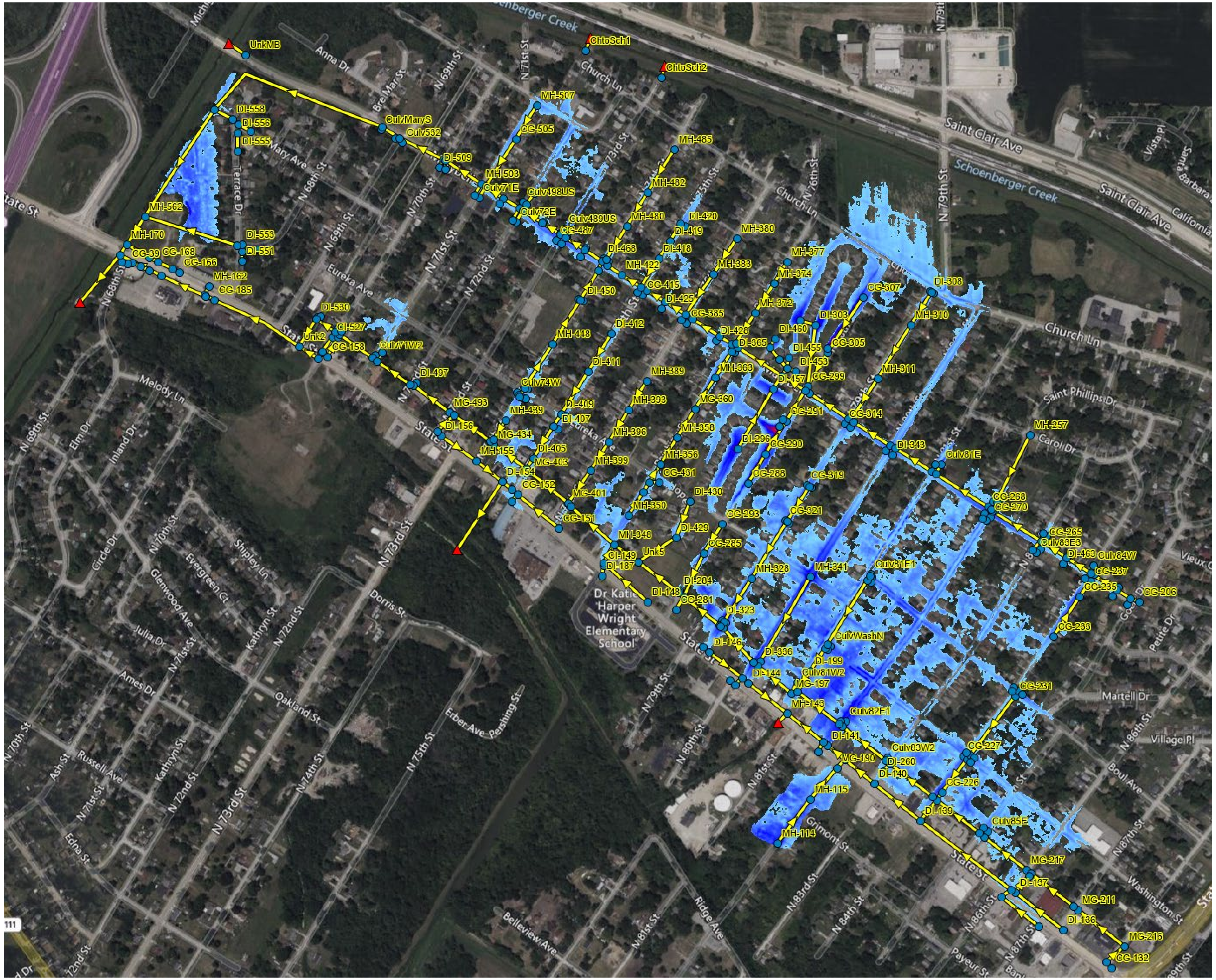

Figure 31: Edgemont Watershed- Existing Conditions- 10% AEP

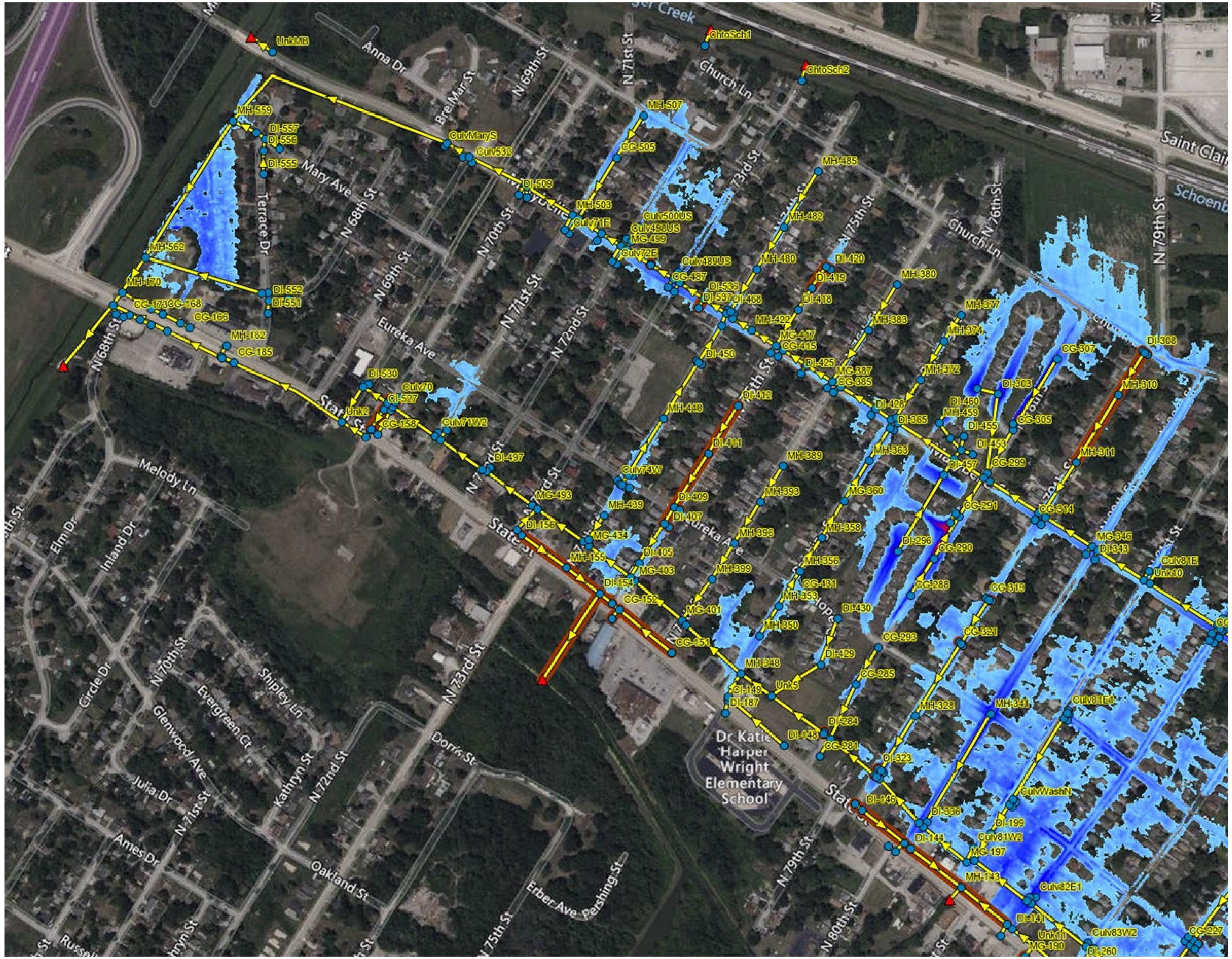

Figure 32: Edgemont Watershed- H&H Limited Risk Reduction Results - 10% AEP

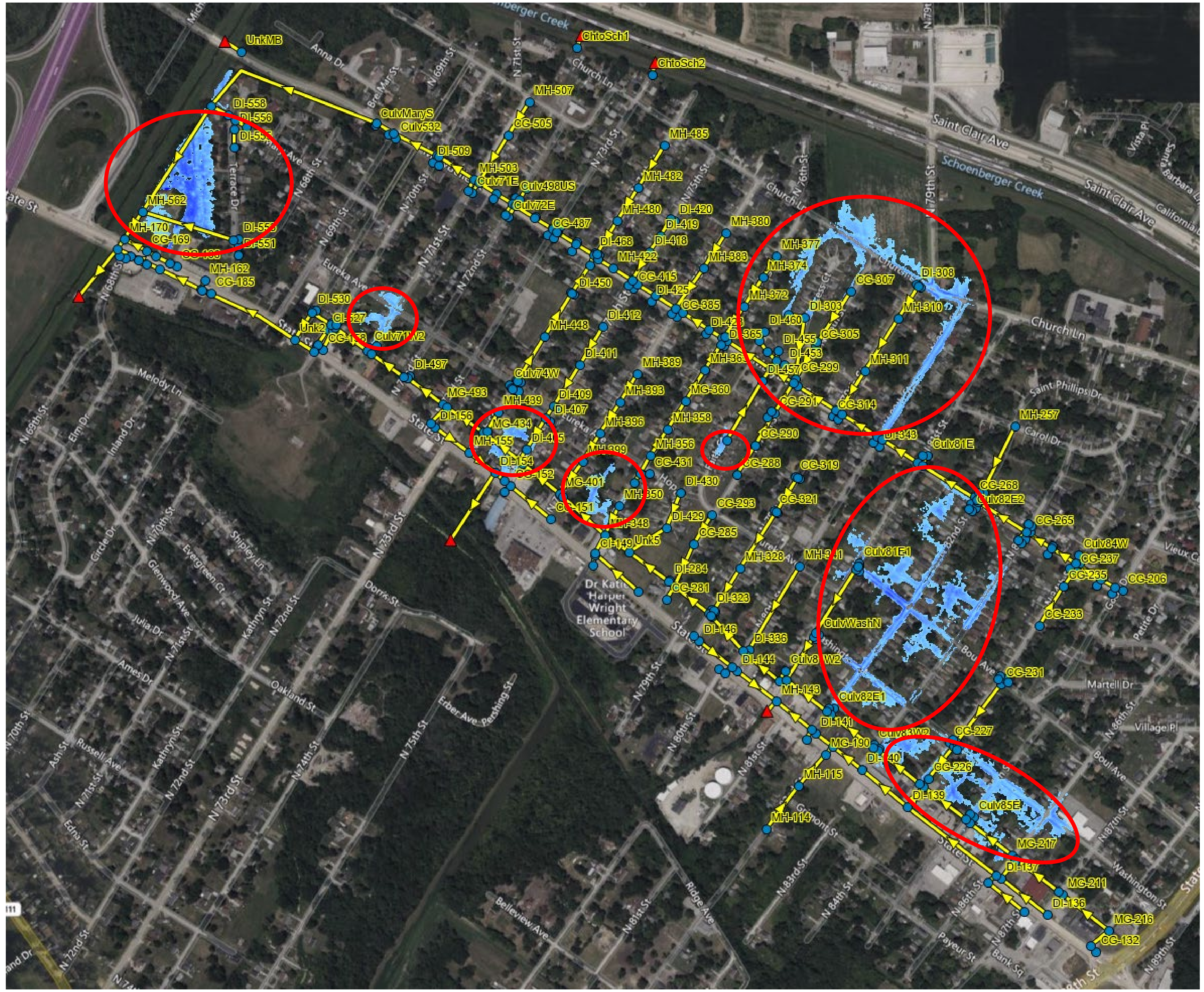

Figure 33: Edgemont Watershed- H&H Intermediate Risk Reduction Results- 10% AEP (areas still impacted by water circled in red)

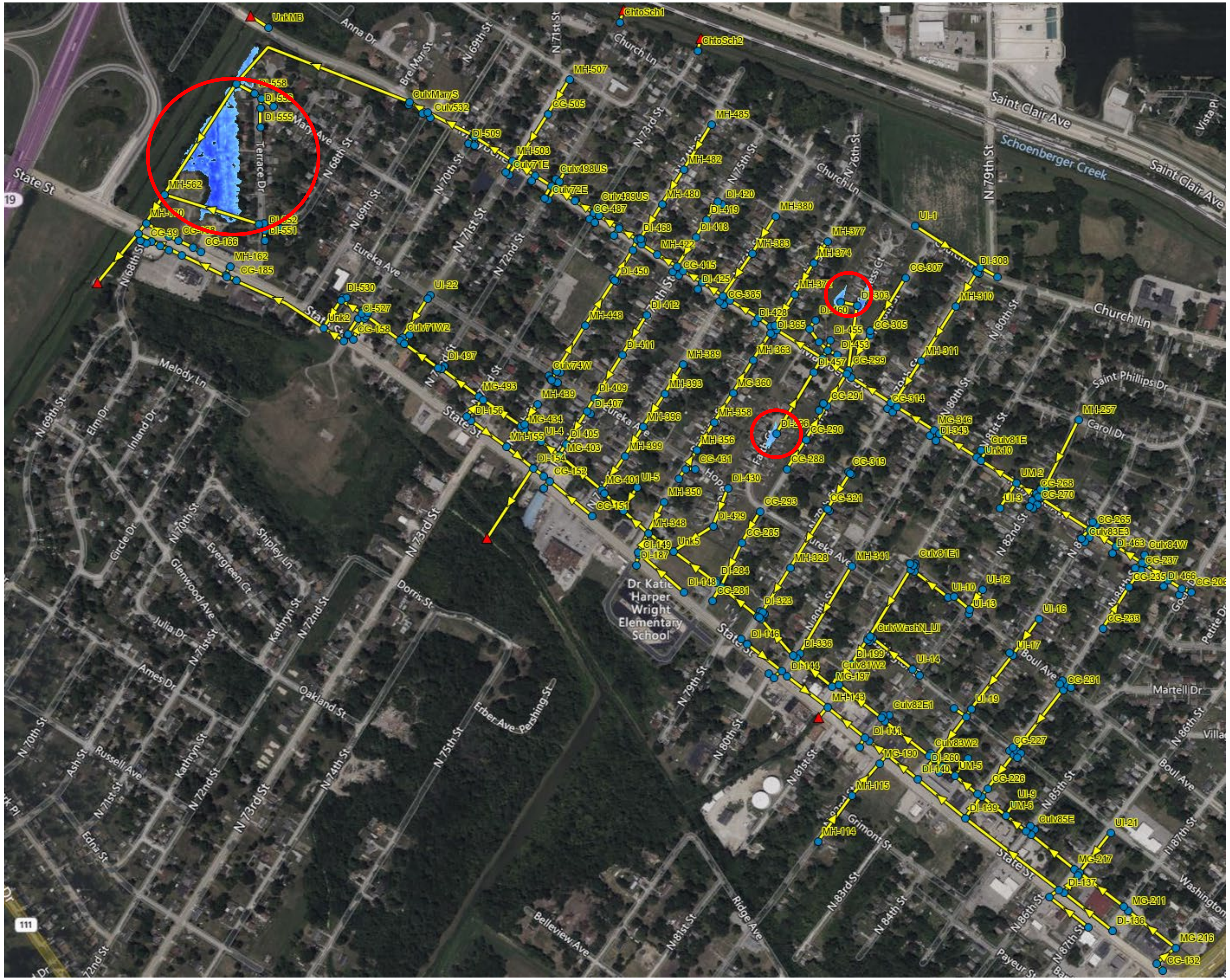

Figure 34: Edgemont Watershed- H&H Maximum Risk Reduction Results- 10% AEP (areas still impacted by water circled in red)

8.2 Parkside Watershed

Table 4: Table of Measures and Alternatives Evaluated for Parkside Watershed

Measures	Limited Flood Risk Reduction	Intermediate Flood Risk Reduction	Maximum Flood Risk Reduction
Re-establish detention basin and connect to Parkside pump station		X	X
Add storm sewer inlets at low points and pipes to canals			X
Replace undersized storm sewers			X
Clean and repair existing storm sewers	X	X	X
Increase pumping capacity of Parkside pump station		X	X
Raise the elevation of the Harding Ditch Levee depression adjacent to the Parkside pump station		X	X
Restore existing drainage ditches	X	X	X

Below are a series of images showing the existing inundation conditions during a 10% AEP event and the H&H modeling results demonstrated for each alternative in the Parkside Watershed. The Limited Flood Risk Reduction Alternative shows almost no improvement over the existing conditions. The Intermediate Flood Risk Reduction Alternative shows only slight improvement. The Maximum Flood Risk Reduction Alternative shows significant improvement in nearly all of the areas. With the Maximum Flood Risk Reduction Alternative, stormwater is contained underground during the 10% AEP storm event, except for two locations. The first exception is located at the inlets on Glenwood Avenue. The inlets in question are the ones that are closest to where the pipe network discharges into WPA Ditch. This area is almost as low as the ditch it discharges into. The second exception is for the inlets on Shipley Lane. It was assumed that the area drains between houses into a ditch or field that leads to the old detention basin. With the restoration of the ditch flowing to the detention basin, the flood risk is reduced with the 10% AEP storm not entering structures on Shipley Lane.

Figure 35: Parkside Watershed- Existing Conditions- 10% AEP

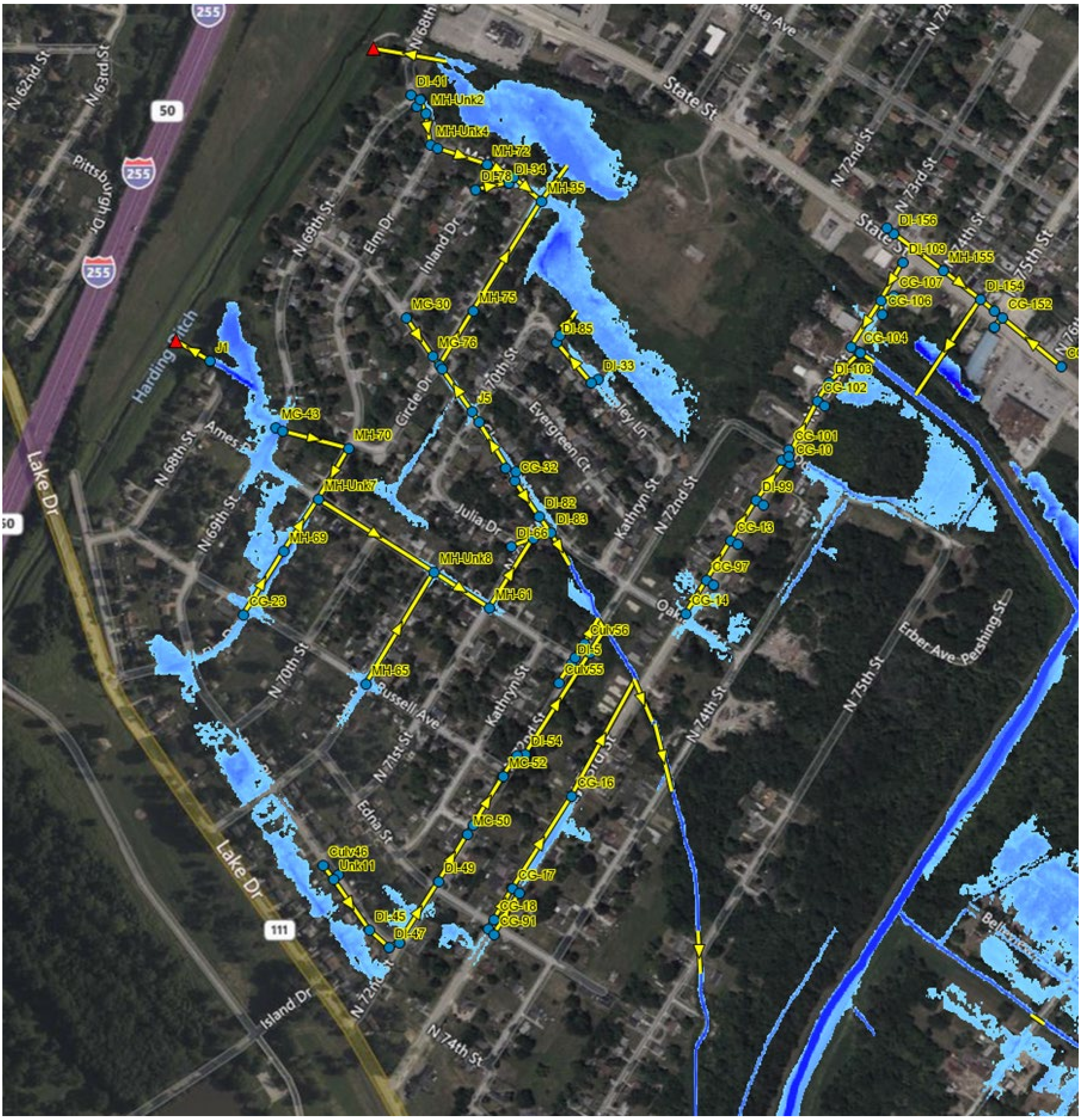

Figure 36: Parkside Watershed- H&H Limited Risk Reduction Results - 10% AEP

Figure 37: Parkside Watershed- H&H Intermediate Risk Reduction Results- 10% AEP

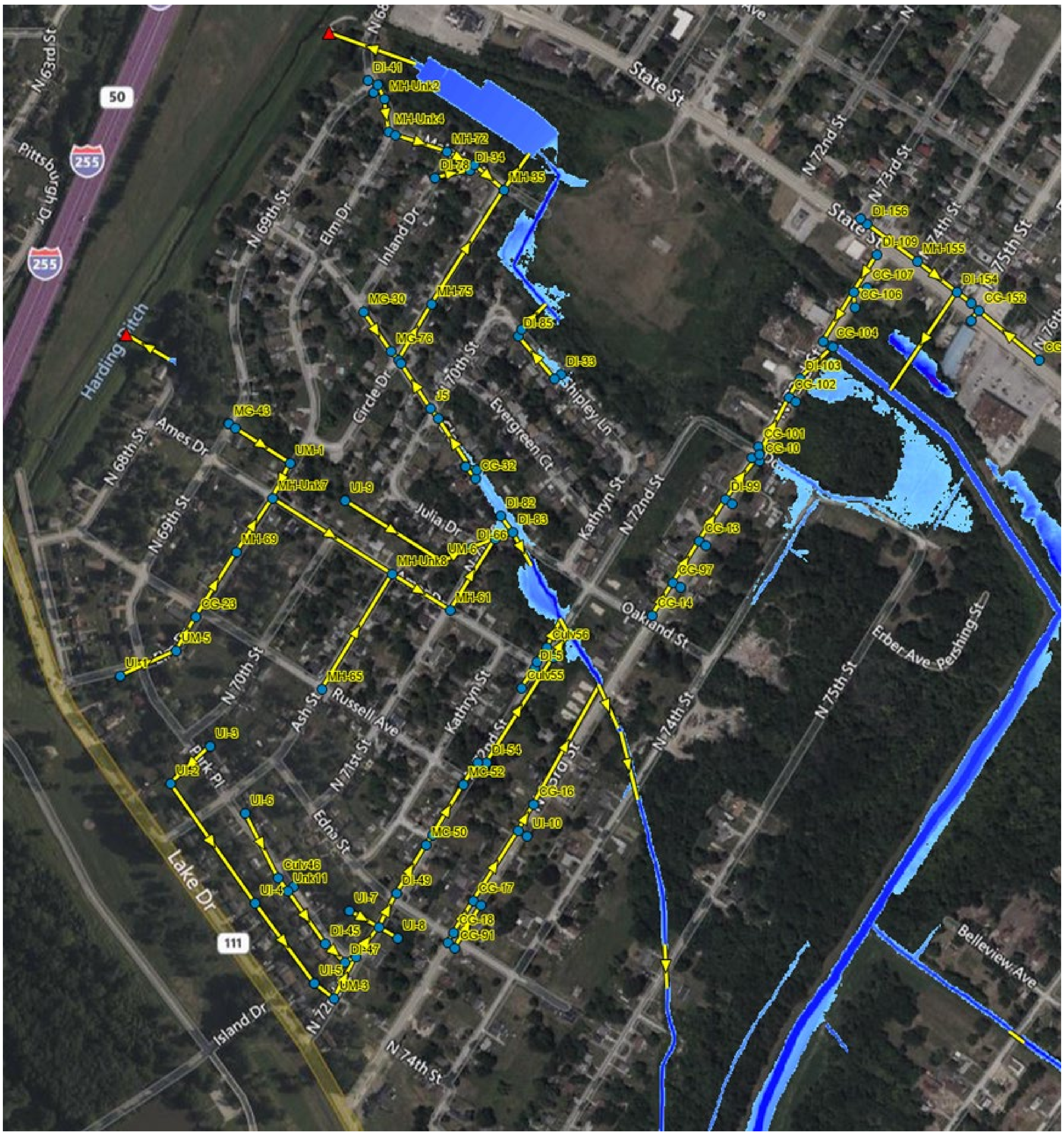

Figure 38: Parkside Watershed- H&H Maximum Risk Reduction Results- 10% AEP

8.3 Ping Pong Watershed

Table 5: Table of Measures and Alternatives Evaluated for the Ping Pong Watershed

Measures	Limited Flood Risk Reduction	Intermediate Flood Risk Reduction	Maximum Flood Risk Reduction
Restore existing main drainage ditches (Edgemont and Steiger ditches) draining to Canal 1	X	X	X
Install pump station and associated conduit network (must be done together)			X
Restore drainage ditches and culverts East of Canal 1 along roadways	X	X	X
Increase number of culverts on the Southeast side draining area to Canal 1		X	X

Below are a series of images showing the existing condition inundation during a 10% AEP event and the H&H modeling results demonstrated for the Limited and Intermediate Risk Reduction Alternatives in the Ping Pong Watershed. There is no significant difference between the Limited and Intermediate Risk Reduction Alternatives. The Maximum Flood Risk Reduction Alternative was not evaluated due to study constraints; however, it is anticipated if the Maximum Flood Risk Reduction measures are implemented, the existing inundation risk would be sufficiently reduced. The proposed new sewer system in the Ping Pong watershed was not hydraulically analyzed using the PCSWMM model; however new sewer pipe sizes were assumed for computing quantities and cost.

Within the Ping Pong watershed, no information was available on the culverts in the area that drain the area north of Edgemont Ditch. Water appears to stay out of structures, so a detailed design analysis was not performed.

For the Limited and Intermediate Flood Risk Reduction Alternatives, specifically regarding the cleanout of the roadway ditches, no remaining problems are observed in the area north of Steiger ditch. The ditch cleanout will improve drainage in the area; however, the model may be under-predicting proposed conditions water levels in the area north of Steiger Ditch for the 10% AEP storm event due to the level of detail of the area captured by the model. For the Intermediate Flood Risk Reduction Alternative, an increase in the number of culverts was examined. There was not much improvement to drainage in the area due to the relatively low-lying, flat topography. The culvert leading to Canal 1 does not effectively drain this area north of Steiger Ditch; therefore, water is ponded in the low-lying areas.

Restoring the ditch connecting the culverts south of Steiger Ditch would improve the area drainage. Study constraints prevented a detailed analysis of this measure. The ditch may not improve the situation enough to adequately reduce the flood risk. If this is the case, the best solution for reduction of flood risk would be dry floodproofing. Flood proofing to the 10% AEP event would provide the same level of protection as an improved drainage system.

Construction of a pump station to pump water from the Ping Pong watershed south of Steiger Ditch into Canal 1 may be necessary due to the higher water surface levels in Canal 1. These high stages that occur during the frequency storm events currently do not allow water in the area to drain effectively. Based on required pump capacity for the Edgemont and Parkside networks, the required pump capacity for the area south of Steiger Ditch is 75 cfs.

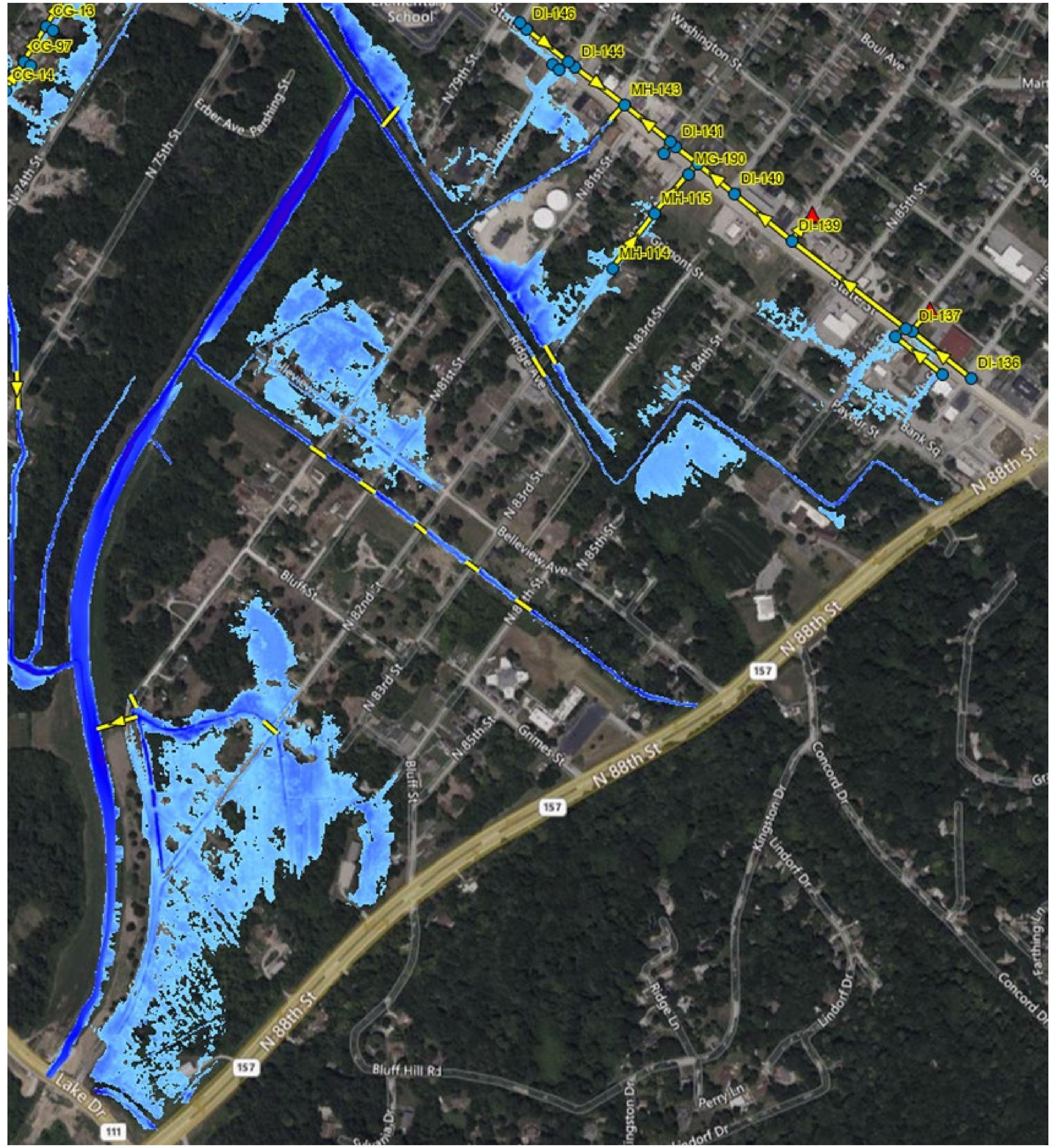

Figure 39: Ping Pong Watershed- Existing Conditions- 10% AEP

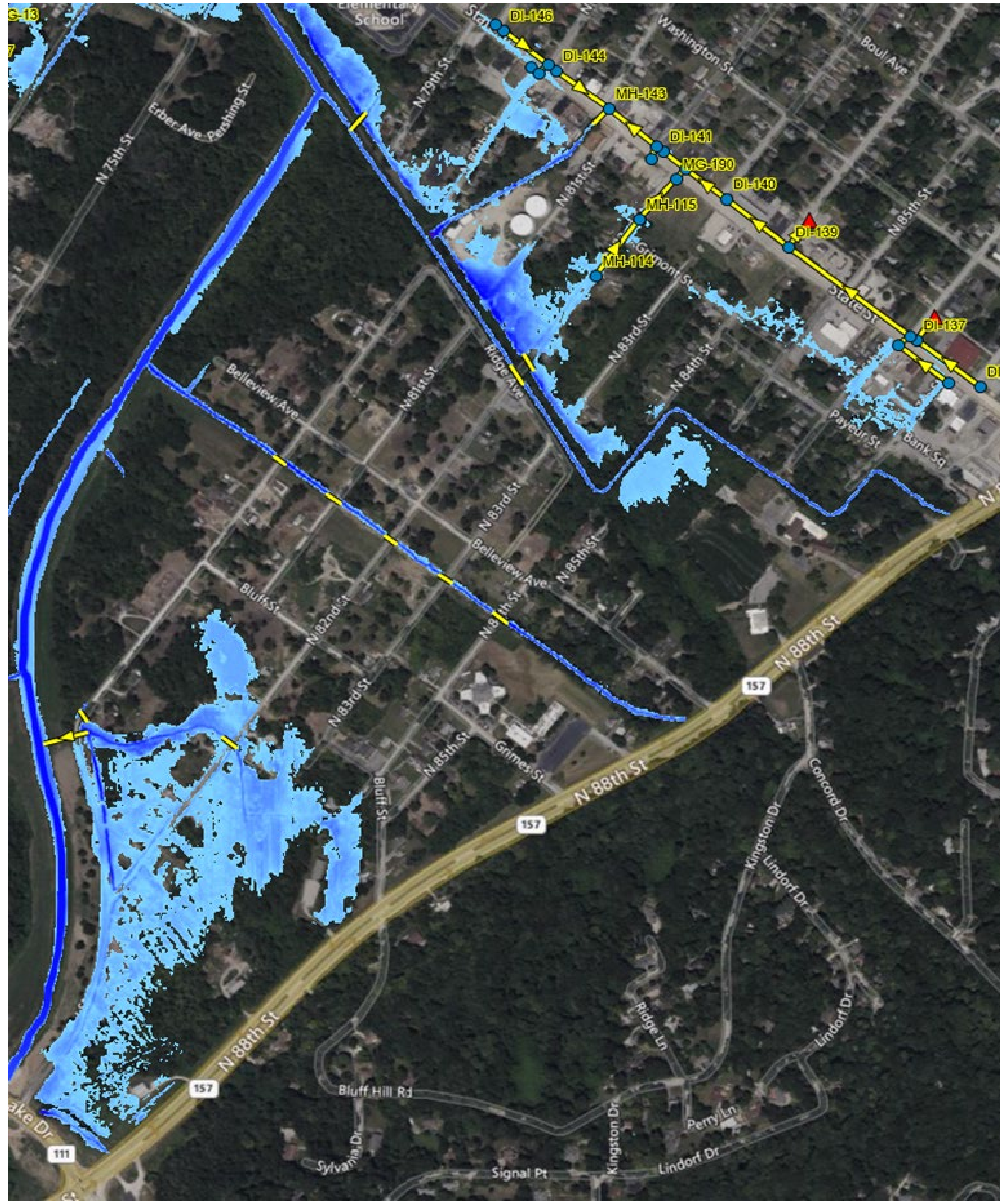

Figure 40: Ping Pong Watershed- H&H Limited Risk Reduction Results - 10% AEP

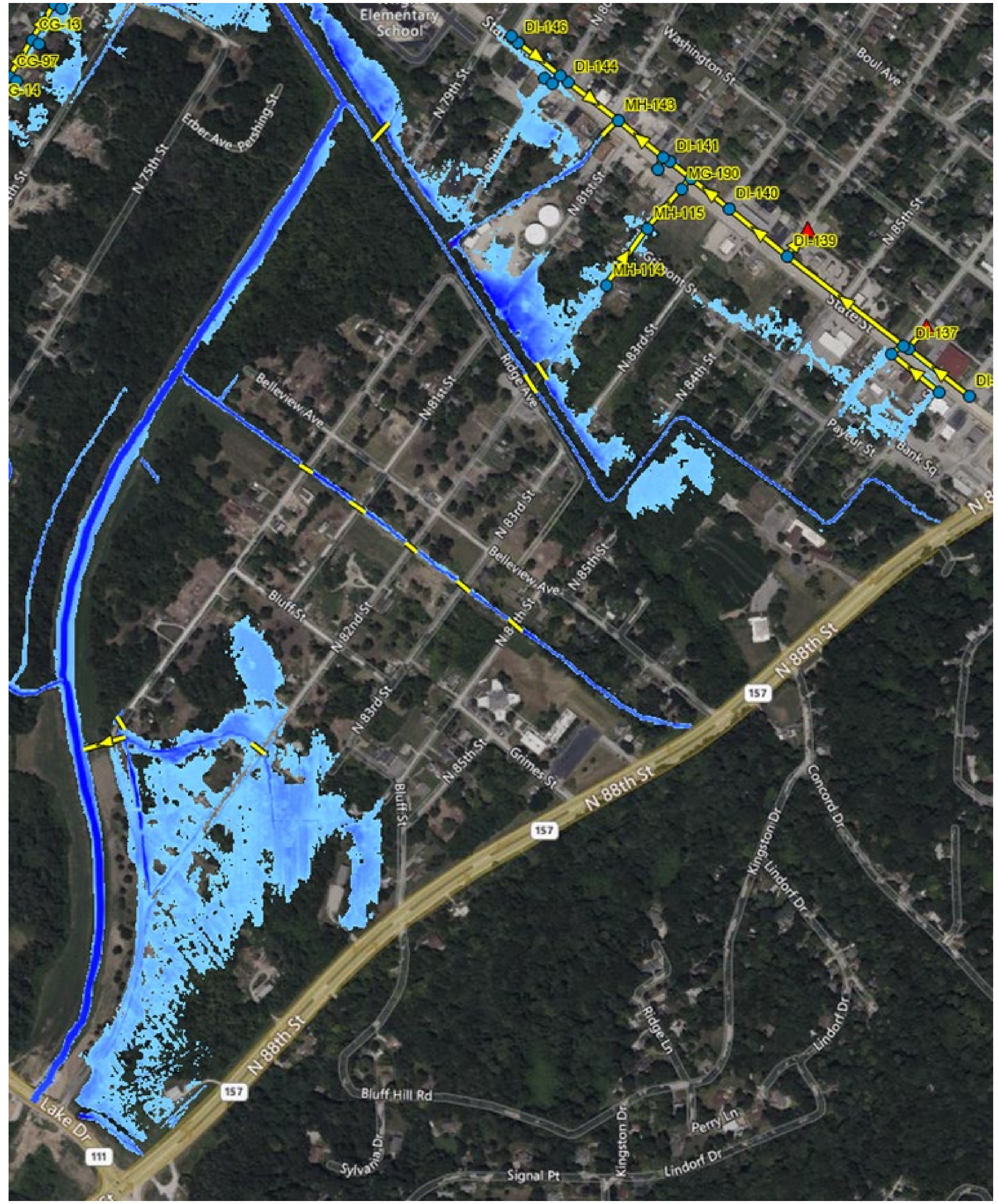

Figure 41: Ping Pong Watershed- H&H Intermediate Risk Reduction Results - 10% AEP

9.0 Cost Estimates

9.1 Quantity Determination and Assumptions

Quantities and sizes of proposed sewer system components to improve the drainage of the study area were determined by the H&H modeler. These components were itemized and shared with the civil design engineer to estimate construction quantities to install those items. The following assumptions were made in the absence of detailed design of each feature.

- Where riprap revetment is required, the following were assumed for estimating purposes:
    - Riprap unit weight: 1.65 tons/CUYD
    - Riprap gradation: R200
    - Layer thickness: 1.5 FT.
- All new sewers are construction under existing asphalt roadways and would require removal and replacement of the roadway (as opposed to horizontal directional drilling). Both existing and proposed sewers would be constructed of reinforced concrete pipe.
    - Asphalt thickness: 6 inches
    - Aggregate base thickness: 6 inches
    - Unit Weight of aggregate base: 1.85 tons/CUYD
    - Width of trench on either side of pipe: 12 inches
    - Minimum aggregate cover above pipe: 6 inches
    - Minimum aggregate bedding thickness below pipe: 6 inches
- Where channel excavation is proposed, spoils are taken off site and do not contain HTRW materials.
- Where levee embankment is proposed:
    - Embankment material is lean clay from a borrow site assumed to be 12 miles away. No specific borrow site was identified or investigated for suitability of material or potential cultural, environmental or HTRW impacts.
    - The depressed segment of levee does not serve as a designated overtopping point for the levee system and can be filled in to match adjacent levee crest elevation without compromising the levee system during a flood event for which the system was designed. *NOTE: The reason for the depressed segment of levee is unknown and could not be determined within the scope of this study. If this assumption is found to be false, and the depressed segment was designed as a designated overtopping point, significant cost increase would be required to improve the levee system as a whole rather than just filling in the depressed segment*.

9.2 Alternative Cost Estimates

The tables below summarize the rough order of magnitude (ROM) cost estimates for each alternative. A more detailed summary is provided in Appendix C. A contingency of 35% is included in the construction costs. Engineering and Design (E&D) costs were estimated at 18% of construction costs. Additionally, Construction Management (CM) costs were estimated at 10% of construction costs. The Parkside Pump Station is kept as a standalone cost because it is physically located in the Parkside watershed but primarily benefits the Edgemont watershed. It should be factored into total project cost for the Intermediate and Maximum Alternatives for both Edgemont and Parkside watersheds.

Edgemont

	Construction	E&D	CM	Total Cost
Limited	$254,000	$50,000	$30,000	**$334,000**
Intermediate	$29,080,000	$5,230,000	$2,910,000	**$37,220,000**
Maximum	$29,601,000	$5,330,000	$2,960,000	**$37,891,000**

Parkside

	Construction	E&D	CM	Total Cost
Limited	$1,219,000	$220,000	$120,000	**$1,559,000**
Intermediate	$1,404,000	$250,000	$140,000	**$1,794,000**
Maximum	$6,325,000	$1,140,000	$630,000	**$8,095,000**

Pump Station

	Construction	E&D	S&A	Total Cost
Pump Station	$39,323,000	$7,080,000	$3,930,000	**$50,333,000**

PingPong

	Construction	E&D	CM	Total Cost
Limited	$2,072,000	$370,000	$210,000	**$2,652,000**
Intermediate	$5,000,000	$900,000	$500,000	**$6,400,000**
Maximum	$14,494,000	$2,610,000	$1,450,000	**$18,554,000**

A summary of the cost for each of the alternatives combined is below. This summary does not break the cost by sub watershed.

	Construction	E&D	CM	Total Cost
Limited	$3,545,000	$640,000	$360,000	**$4,545,000**
Intermediate	$74,807,000	$13,460,000	$7,480,000	**$95,747,000**
Maximum	$89,743,000	$16,160,000	$8,970,000	**$114,873,000**

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Appendices:

Appendix A- Hydraulics & Hydrology

Appendix B- Environmental Justice

Appendix C- Cost

Cahokia Heights & East St. Louis- Flood Hazard Analysis

Appendix A Hydraulics and Hydrology

August 2023

Prepared by:
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A-1.0 Study Purpose

This appendix examines the hydrologic and hydraulic conditions related to the localized flooding in the area and possible opportunities to reduce the flood inundation risk to structures and property. The study area is within the city limits of Cahokia Heights and East St. Louis in St. Clair County, IL. It lies between Illinois Route 157, Interstate 255, St. Clair Avenue, and Lake Drive. The study area falls within the Edgemont, Parkside, and Ping Pong watersheds. Shown in Figure A-1, the watersheds are delineated. The delineation was determined by the USGS and is identified by a 12-digit Hydrologic Unit Code (HUC 12).

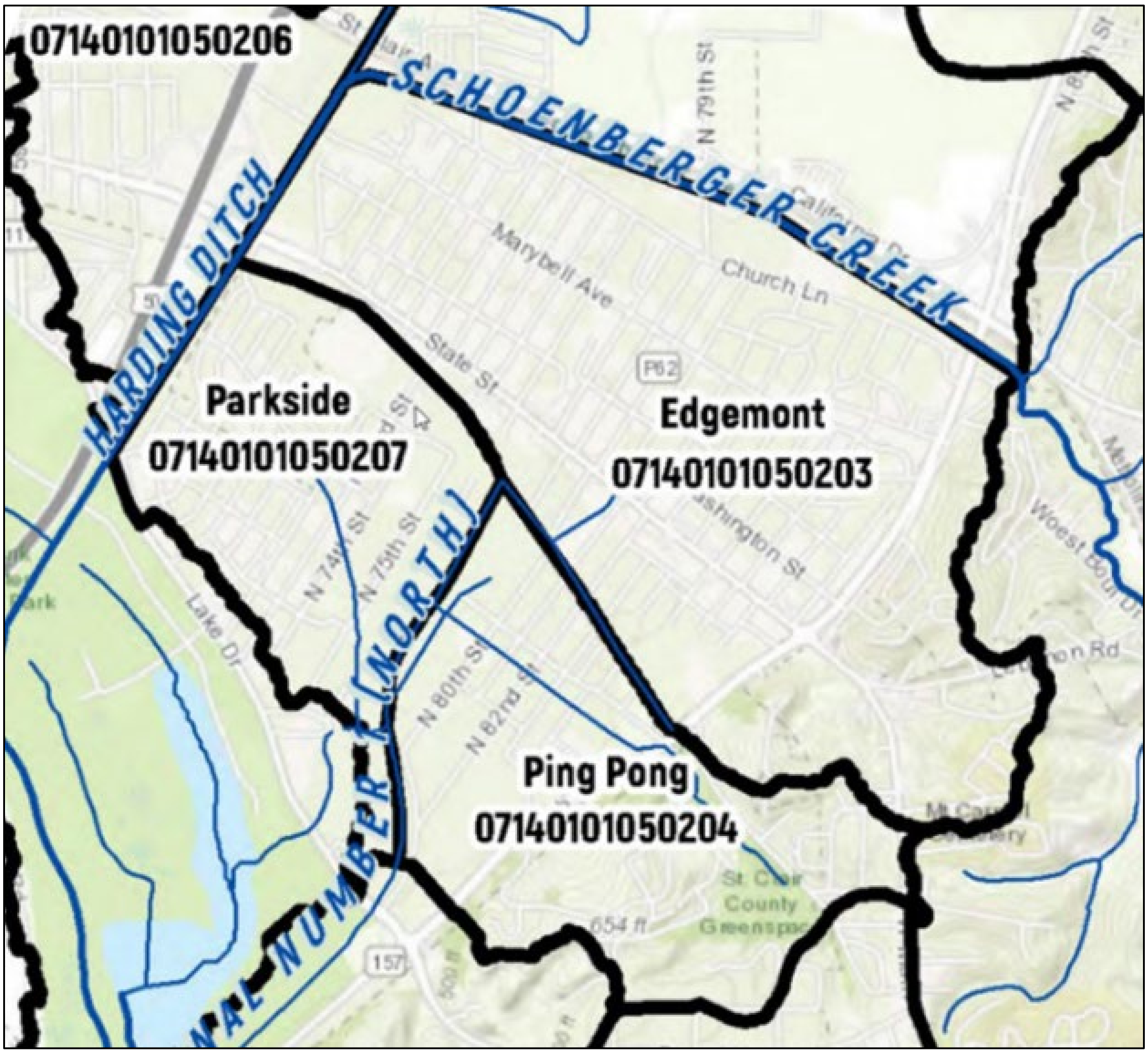


Figure A- 1: Study Area Delineated Watersheds - HUC 12

Many of the residential structures in the study area are repeatedly at risk of inundation during regular precipitation events. The purpose of this report is to provide the City of Cahokia Heights and East St. Louis officials with information to aid making informed decisions regarding future flood risk management activities within the study area.

A-1.1 Study Scope

The scope of this report is to provide the Cities of Cahokia Heights and East St. Louis with an evaluation of the flood prone areas within the defined study area, conduct engineering analysis of structural alternatives, and present the findings and conceptual cost estimates to assist the city with reducing long-term flood risk. The evaluations in this report take into consideration local hydrology and hydraulics and site conditions. Sources referenced throughout the main report include information from the Cities of Cahokia Heights and East St. Louis (Hurst-Rosche Inc. and Thompson Civil LLC.), St. Clair County, Federal Emergency Management Agency (FEMA), Illinois Emergency Management Agency (IEMA), U.S. Army Corps of Engineers (USACE), U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Metro East Sanitary District (MESD), Heartlands Conservancy, Southern Illinois University Edwardsville (SIUE), Illinois Department of Natural Resources (IDNR), and Environmental Protection Agency (EPA).

A-1.2 Flood Hazard Areas

The flood hazard areas that will be addressed in this study are shown in Figure A-2. The area of documented flooding, highlighted in blue, is based upon local resident information gathered by the Heartlands Conservancy. The specific problems identified by this hydraulic analysis are shown in Figures A-3 and A-4. The focus of the corrective actions detailed in this appendix will address these issues.

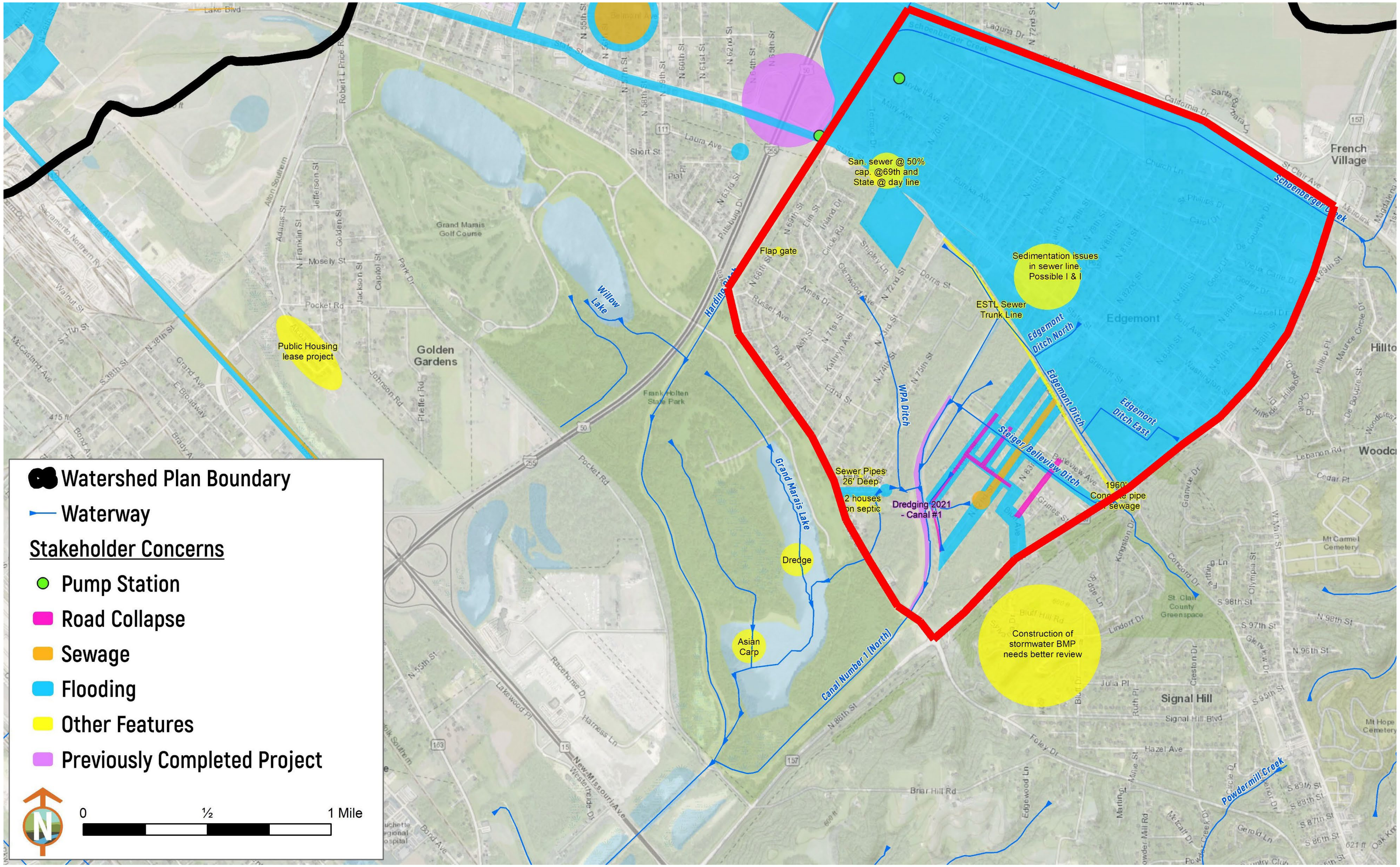


Figure A- 2: Study Flood Hazard Area (Image Courtesy of Heartlands Conservancy)- Red study area boundary added by USACE.

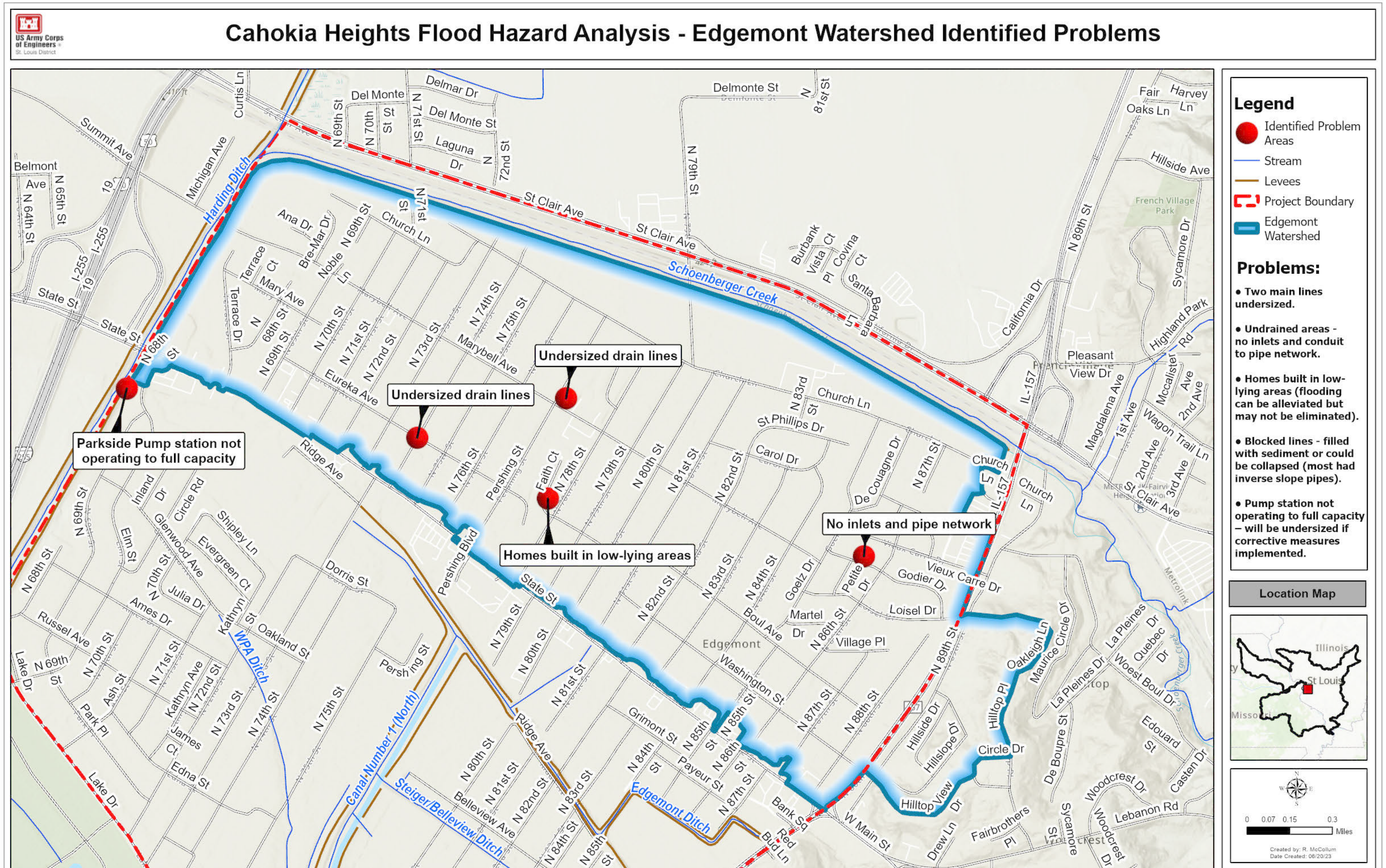


Figure A- 3: Edgemont Watershed Identified Problems

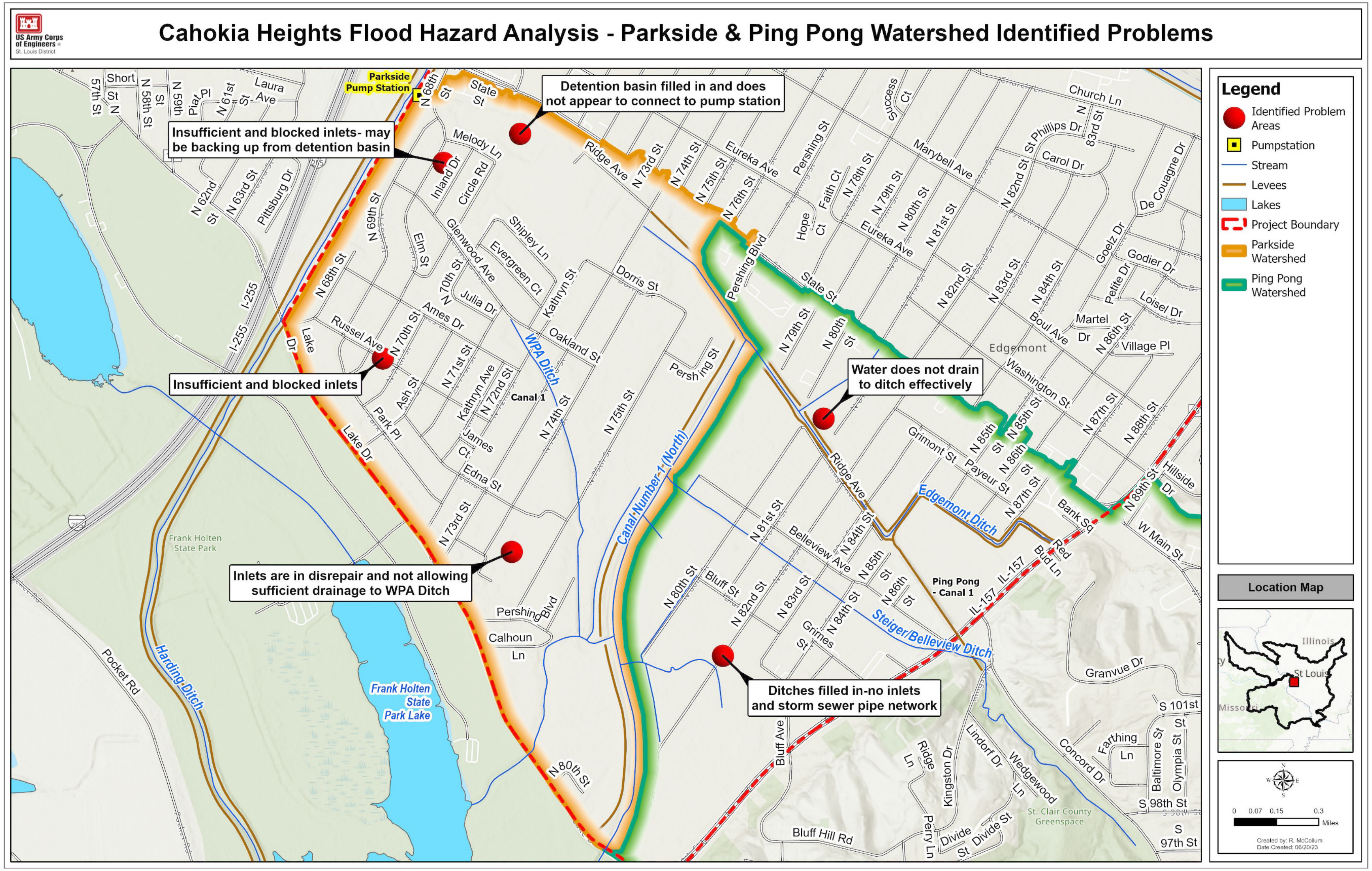


Figure A- 4: Parkside and Ping Pong Watershed Identified Problems

A-2.0 Current State of Drainage

The current state of drainage in the three watersheds is poor. Within the study area, water cannot effectively drain causing inundation to roads and structures after precipitation events. This can be attributed to:

- pump station not operating to full capacity,
- broken and blocked storm sewer networks,
- inadequate number of storm sewer inlets (some blocked),
- homes being built in low lying areas,
- undersized storm sewers,
- insufficient number of culverts
- existing culverts are undersized and in disrepair,
- local drainage ditches (along the side of the road) and
- main ditches (Steiger, WPA, Belleview) that have sedimented in and are not draining effectively,
- undrained areas without a storm sewer network, and
- nonfunctional detention basin.

While the storm sewer networks were likely adequate when initially designed and installed, continued development, in addition to more frequent and intense rain events, has made these undersized for current conditions. Maintenance challenges also exacerbate the surcharging conditions.

Parkside pump station is not currently operating at full capacity (see section 3.2 in main report). City engineers estimate it to be operating at about 40% capacity. The drainage systems currently available throughout the study area are also insufficient to carry the majority of floodwater to the pump station.

Significant corrective action is needed to improve the drainage conditions and mitigate flood risk.

The watershed captured in the existing conditions model is illustrated in Figure A-5. The watersheds are broken up into sub-areas based on drainage path. The sub-areas cover the Edgemont, Parkside, and Ping Pong watersheds.

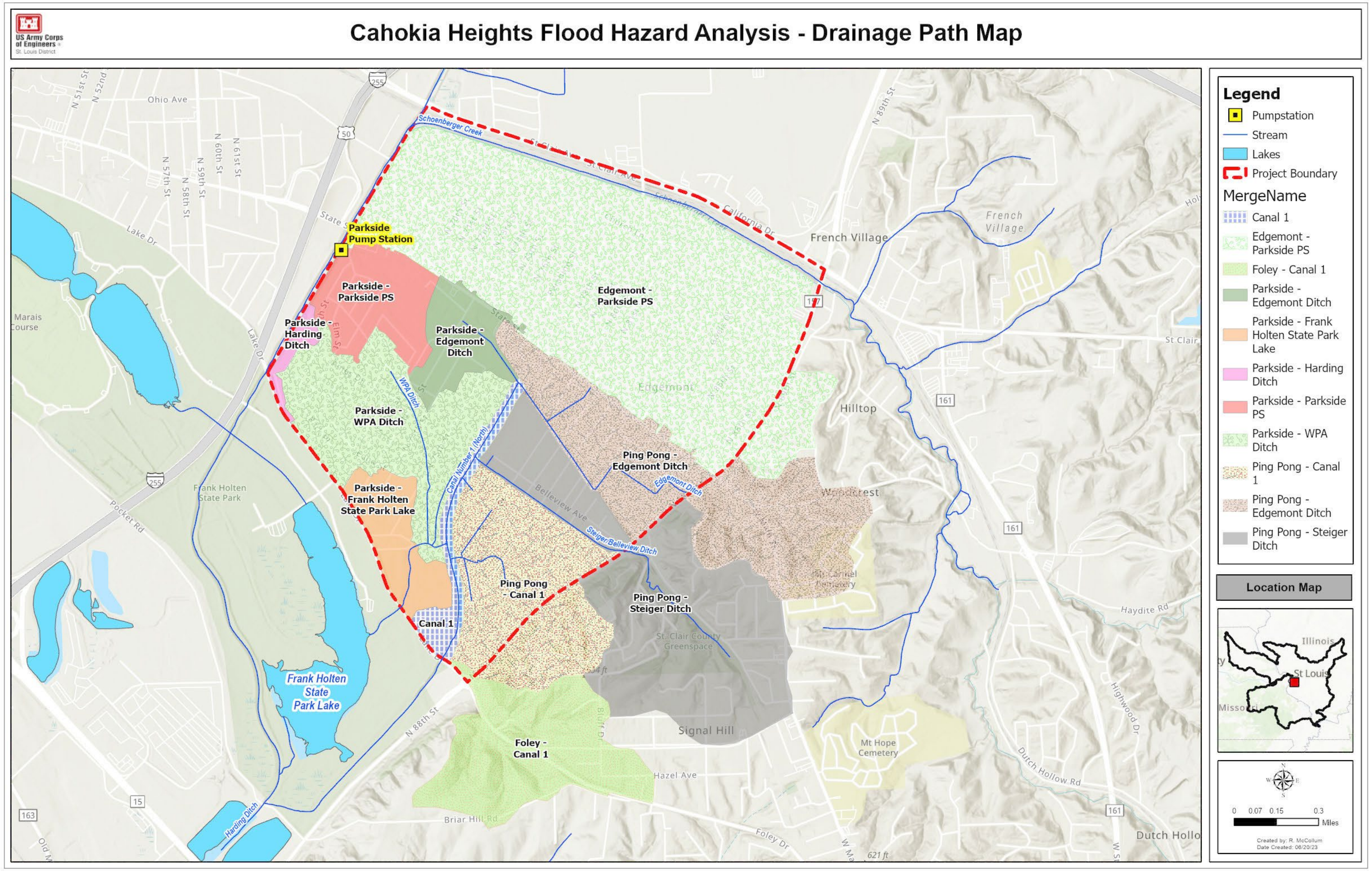


Figure A- 5: Project Watershed Sub-Areas Based on Drainage Path

A-2.1 Existing Storm Sewer System – Edgemont and Parkside

The Edgemont and Parkside watersheds contain an existing storm sewer network for drainage. A pump station, located on 68th Street, 375 feet south of State Street, provides drainage of the area into Harding Ditch. The pump station is located on the landside of the levee on the left overbank of Harding Ditch. Most of the Edgemont watershed drains to the Parkside pump station. The west portion of the Parkside watershed also drains to the Parkside pump station. The southeastern portion drains into WPA Ditch that drains the area southeast into Canal 1. The northeastern portion of the watershed drains into the western side of the Edgemont Ditch that empties into Canal 1. In both watersheds some roadside ditches drain to an area inlet or culvert that allows water to enter the sewer system. Illustrations of the Edgemont and Parkside watersheds are shown in Figures A-6 and A-7.

The current state of the storm sewer system is poor. Several inlets are filled with silt and trash. Several are broken. Several areas do not drain into their intended inlet due to changes in the roadway or land surface. These inlet conditions do not provide adequate drainage and leave water ponded in the roadways and ditches. Several pipes have adverse slopes probably due to settlement overtime which further restricts drainage in the network. The ditches in several areas along the roadside are discontinuous. Either due to settlement or landowners regrading yards, most ditches do not drain into the storm sewer network as originally conceived. As a result, standing water can be seen throughout the drainage ditches.

A-2.2 Ping Pong Watershed Drainage

The Ping Pong watershed contains no storm sewer network south of the eastern fork of the Edgemont Ditch. In this watershed, drainage tends to go into ditches alongside the roadways. Culverts connect the ditches and drain most of the area south of Steiger Ditch to Harding Ditch. The area between the Steiger and Edgemont Ditches drain to a small ditch that empties into Steiger Ditch. North of the eastern fork of the Edgemont Ditch, the portion of the stormwater that does not enter the sewer system draining toward the Parkside pump station, instead flows south into the Edgemont Ditch. Illustration of the Ping Pong watersheds is shown in Figure A-8. The blue lines appearing south of the western fork of the Edgemont Ditch are culverts.

The current state of the drainage in the Ping Pong watershed is poor. In areas south of the Edgemont Ditch eastern fork, the stormwater ditches are discontinuous and do not provide adequate drainage. Culverts are insufficient, blocked or crushed. Standing water can be seen after most storm events. In some areas, surface water ponds in yards and does not make it into the drainage ditches.

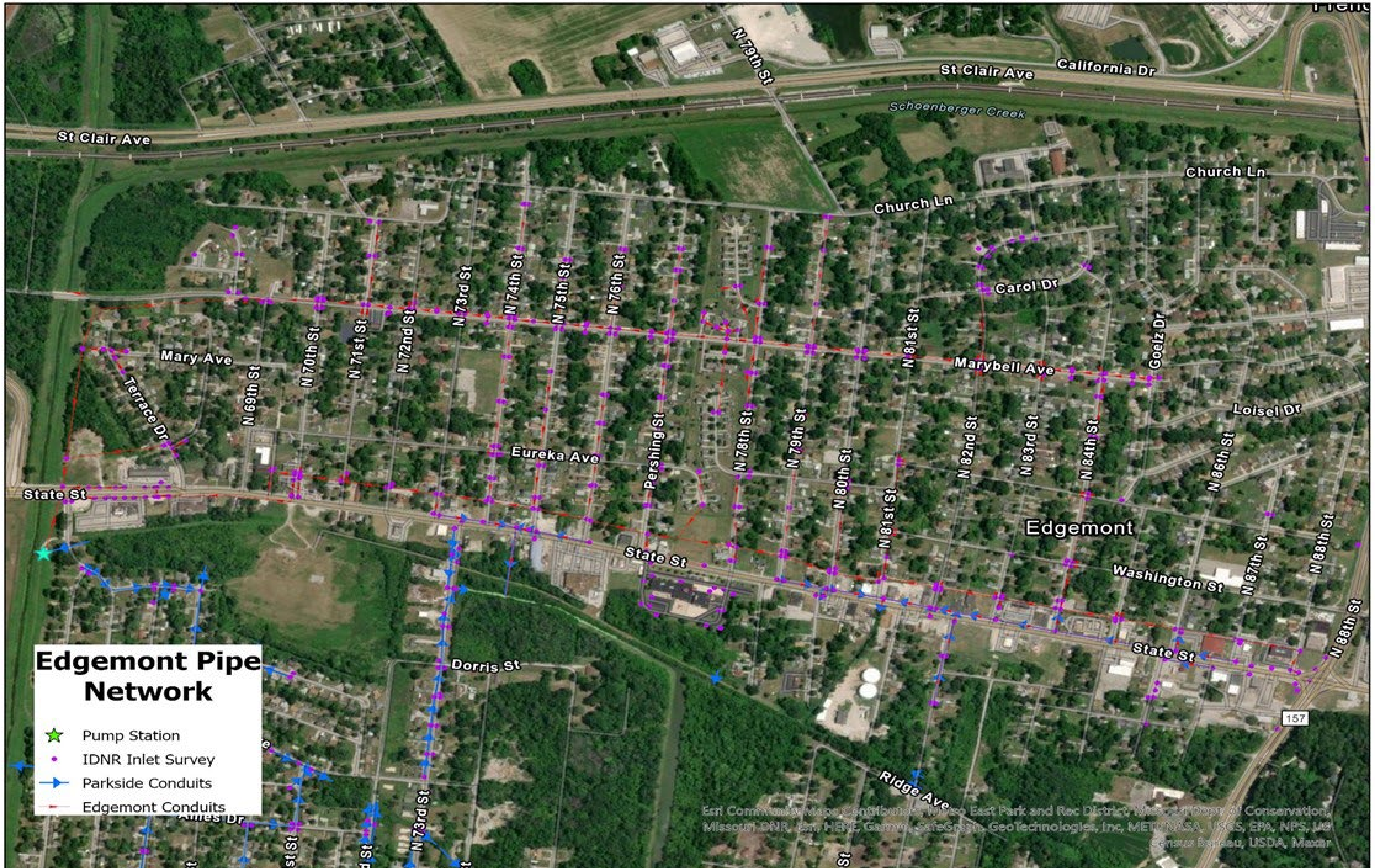


Figure A- 6: Edgemont Storm Sewer System

Figure A- 7: Parkside Storm Sewer Network

Figure A- 8: Ping Pong Watershed Drainage Structures

A-3.0 Hydrologic Modeling

The hydrology and hydraulic modeling analysis relied primarily on PCSWMM version 7.5 to capture the flood levels and discharges associated with the localized flooding. PCSWMM is a modeling software package that relies on the SWMM engine to compute discharges and water levels in storm sewer networks. PCSWMM also has the capability to simulate both 1D and 2D river and overland flow hydraulics. In this project the hydraulics of the study area storm sewer system, ditches, and flood plain will be examined.

An additional modeling software, HEC-RAS version 6.3.1, was used to assess the hydraulic conditions of Harding Ditch on the Ping Pong and Parkside watersheds. The USACE Hydraulic Engineering Center's River Analysis System (HEC-RAS) is software that can compute one-dimensional steady flow hydraulics calculations; one and two-dimensional unsteady flow river hydraulics calculations; quasi-Unsteady and full unsteady flow sediment transport-mobile bed modeling; water temperature analysis; and generalized water quality modeling (nutrient fate and transport). This is the preferred software package of the USACE Hydrology and Hydraulics Community of Practice.

A-3.1 Design Considerations for the Storm Sewer System

There is no specific guidance for storm sewer design for USACE projects. Each local municipality in which projects reside may have its own requirements; however, no local regulations directly govern federal projects. Where applicable, federal projects try to adhere to local requirements. This study tries to exceed the storm water design regulations for St. Clair County, Illinois. The regulations regarding storm water management for St. Clair County, Illinois were found at: https://www.co.st-clair.il.us/webdocuments/CountyCode/Stormwater%20Control%20Code.txt

The discussion on page 11 of the St. Clair County, Illinois stormwater regulations states that a minor drainage system is "that portion of a drainage system designed for the convenience of the public. It consists of street gutters, storm sewers, small open channels, and swales and, where man-made, is to be designed to handle the 10% AEP runoff event." Page 22 discusses drainage system design and evaluation. It states when evaluating existing conditions and designing a drainage system the design shall provide capacity to pass the 50% AEP, 24-hour peak flow rate in the minor drainage system and an overflow path for flows in excess of the design capacity. Regarding positive drainage, all developments will pass the 1% AEP, 24-hour flow at a stage of at least one foot below all structure foundation grades in the vicinity of the flow path.

Since it is not clear whether to design the new sewer modifications to the 50% or 10% AEP storm event, the 10% AEP, 24-hour duration storm event is used for the base design of drainage modifications for this project. Most municipalities nationwide tend to require that the 10% AEP storm event be used in the design of sewer systems.

Because of the lack of structure foundation elevation information, the resulting 1% AEP storm event inundation for the project will only be shown for the maximum flood reduction measure in each respective watershed. This can be compared to the existing 1% AEP flood inundation. The resulting inundation will show residual flood risk to structures, but an overall reduction in damage levels.

A-3.2 Existing Conditions Model - PCSWMM

Two separate 2D and 1D PCSWMM models were created for the project area. The separating boundary for the models was State Street. The first model covered the entire Edgemont watershed draining to the Parkside pump station. The second model covered both the Parkside and Ping Pong watersheds with portions draining to the Parkside pump station as well as Canal 1. Lake Drive was the downstream boundary of the Ping Pong and Parkside watershed model. This is because the probability of a Mississippi River flood event coincident with a 10% AEP or 1% AEP interior flood event is low and the extents of Harding Ditch backwater flooding stops at Lake Drive during gravity flow conditions at the MESD South pump station. Illustration of the model geometry is shown in Figure A-9 for the Edgemont watershed and Figure A-10 for the Parkside/Ping Pong watershed. In the figures, watersheds are delineated in green. Inlets or manholes are blue, and the conduits are yellow.

The tributary areas for the models were determined by subdividing the USGS watershed boundaries based upon DEM data provided by the USGS (2019). The sub-watersheds were determined for every inlet or group of inlets represented in the model. Parameters such as width and slope were estimated from the terrain to reflect the watershed existing conditions.

SCS Curve Numbers were used to approximate infiltration parameters. A Curve Number grid of the project area was created from a composite of the Illinois Soil Survey Geographic Database (SSURGO) and 2019 National Land Cover Database (NLCD). Curve Numbers were determined for each land cover type and hydrologic soil grouping combination. Percent imperviousness was computed using the 2019 NLCD urban imperviousness products. Watershed surface roughness was estimated from the NLCD land cover type corresponding to the Manning's n-value ranges published in the HEC-RAS Hydraulic Reference Manual.

Depression storage was set at 0.5 inches for pervious areas and 0.2 inches for impervious areas. These estimates are higher than the default value of 0.2 (pervious) and 0.1 (impervious) inches. This is to account for the discontinuous flow through ditches and the fact that in numerous instances the ground surface does not drain directly to sewer inlets.

Conduits and junctions were added to model sewer connectivity. Parameters such as inverts, rim elevations, and conduit offsets were taken from an IDNR field survey (2022). For lines and junctions not captured in the field survey, inverts were interpolated between junctions with IDNR surveyed information. Unknown inlet or manhole rim elevations were taken from the DEM data. Conduit lengths were computed from geo-referenced pipe and inlet locations. Manning's n-values for the various conduit types are shown in Table A-1. For inlet blockages, the downstream pipe diameter was reduced to 0.1 feet for complete inlet blockage. The pipe diameters were adjusted from their estimated full size according to the percent of inlet/pipe blockage reported in the IDNR survey.

Because of lack of information on the Parkside pump station, free outfall of the conduits to the pump station was assumed. This would be as if the pump station had adequate capacity to drain the system.

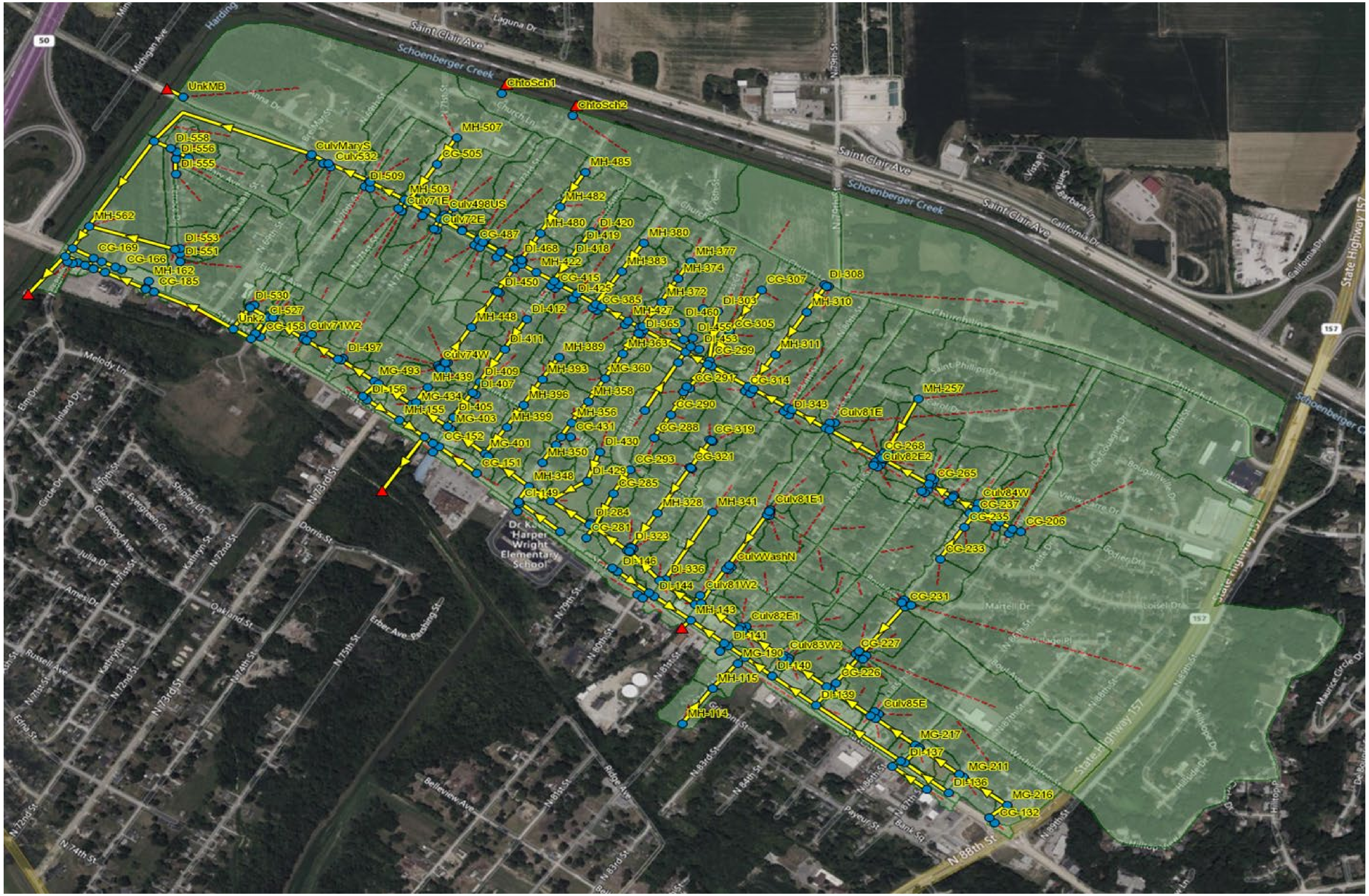


Figure A- 9: Edgemont Watershed PCSWMM Existing Conditions Model

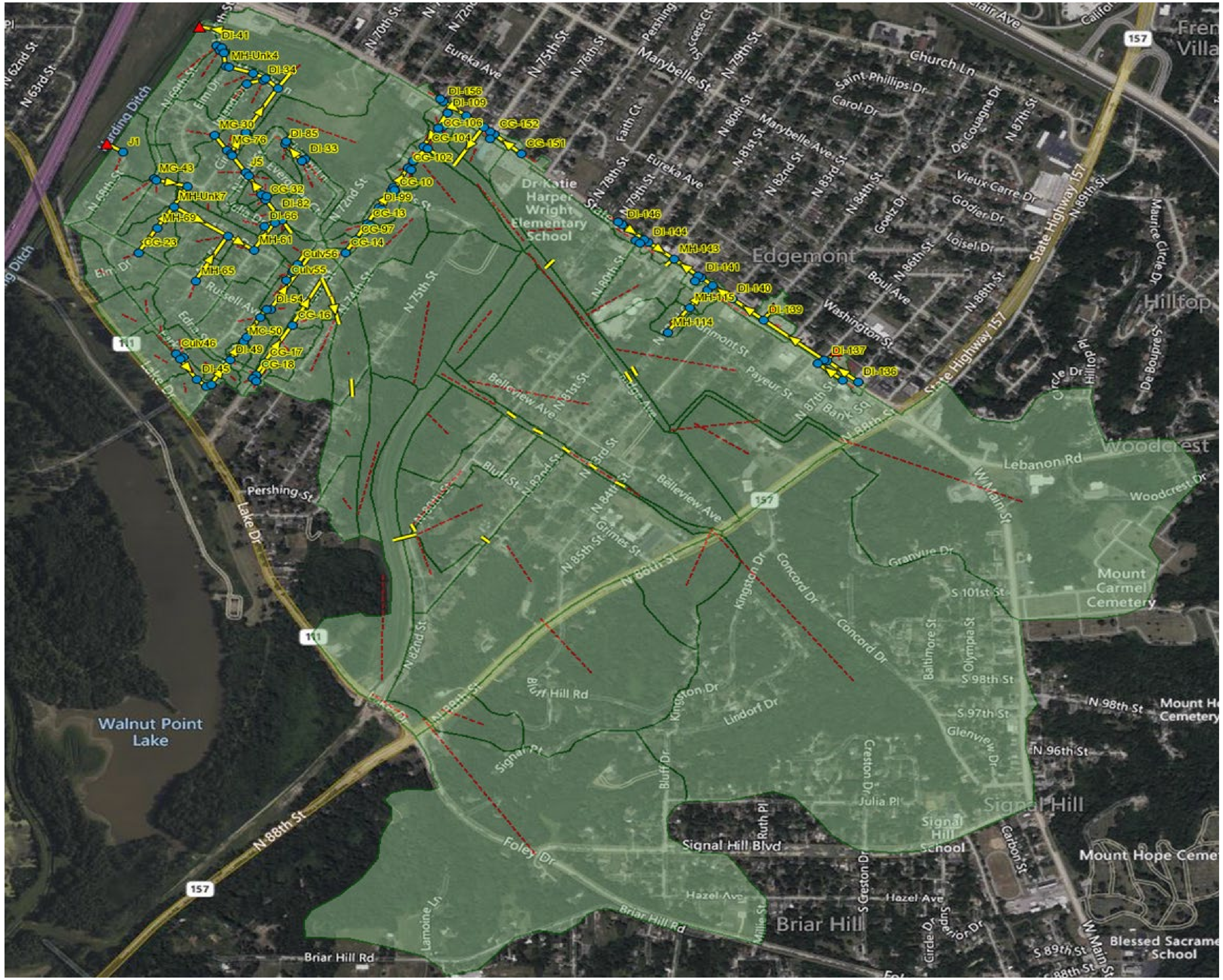


Figure A- 10: Parkside and Ping Pong Watershed PCSWMM Existing Model

Table A- 1: Sewer Conduit Manning's n-value

Material	Manning's n-value
Reinforced Concrete Pipe (RCP)	0.016
Corrugated Metal Pipe (CMP)	0.024
Vitrified Clay Pipe (VCP)	0.014
Ductile Iron (DIP)	0.012
PVC	0.01

The models created for this study were constructed as 2-Dimensional (2D) representations of the watershed drainage. The benefit of a 2D model is that overland flow and inundation from surcharge at the inlets can be visualized and surface flow computationally routed. Steps taken in the assembly of the 2D components started with importation of the USGS DEM covering the project area. Bounding layers were created that used a 30-foot cell mesh grid size for the project overland flow areas and a 10-foot grid size for the ditches. Channel centerlines were drawn that traced the locations of the ditches. Downstream boundary outflow locations were drawn and configured for outflow at their respective locations.

Grid cell points are first generated covering the surface of the watershed. The layout of the points takes into account the stream centerlines and boundary layer definition. In the regions between the 30-foot grid cells and the 10-foot grid cells, additional cell points were added to better define the surface. Once completed, a 2D cell mesh of junctions and conduits was created where the elevation for the cells/junction points were taken from the DEM. Downstream outflow boundary connections to the junction/conduit configuration are defined and the 2D junction configuration is connected using orifices to link the 2D cells to the inlets (bottom orifice technique).

A-3.3 Existing Conditions Model – HEC-RAS

A 2D unsteady flow HEC-RAS model was created of the Ping Pong and Parkside watershed. The extents cover the areas around Canal 1 and the bluffs to the east of Hwy 157. Illustration of the model geometry is shown in Figure A-11 for the Parkside and Ping Pong watershed. In the figure, the 2D gridded representation of the watersheds can be seen.

Rain on grid precipitation was used as the main source of inflow into the 2D area. The three downstream boundary conditions are located at the outlet of Frank Holton State Park Lake into Harding Ditch, the confluence of Canal 1 with Harding Ditch and a pond outlet on the south side of the Canal 1 confluence that drains to Harding Ditch. An existing HEC-RAS model created in a prior study of the Metro East Sewer District (MESD) was used to determine river stages at these boundaries. An upstream boundary condition was set at the Parkside pump station to account for circumstances when the Harding Ditch water level is high enough to pass water through the notched opening in the levee. An inflow boundary condition was also set at the outlet of the inverted siphon under Harding Ditch and Interstate 255. The siphon connects two portions of the Frank Holton State Park Lake. A previously built

HEC-HMS hydrologic model of the MESD watershed was used to determine the volume of inflow into the Frank Holton State Park Lake at this boundary.

To adequately capture rainfall runoff response from the entirety of the MESD watershed, a 72-hour duration storm event was selected and used for HEC-RAS model frequency event simulations. The gridded precipitation infiltration losses are computed using a NRCS Curve Number grid of the model area. The SCS Curve Number grid was created using the SSURGO soil hydrologic grouping grid merged with NLCD land cover grid. The Curve Numbers selected for each hydrologic grouping and land cover type can be found in the HEC-RAS Hydraulic Reference Manual version 6.3 (https://www.hec.usace.army.mil/confluence/rasdocs/ras1dtechref/latest/overview-of-optional-capabilities/modeling-precipitation-and-infiltration/curve-number).

Breaklines were created to delineate streams. Culverts were modeled as 2D area connections. Ditch culvert information was either gathered during USACE field survey or estimated based upon the terrain. The existence or status of flap gates on the culverts through the Canal 1 embankments was not captured during the IDNR or USACE survey. Due to the lack of funding for additional field data collection, some existing culverts may not be captured in the HEC-RAS model.

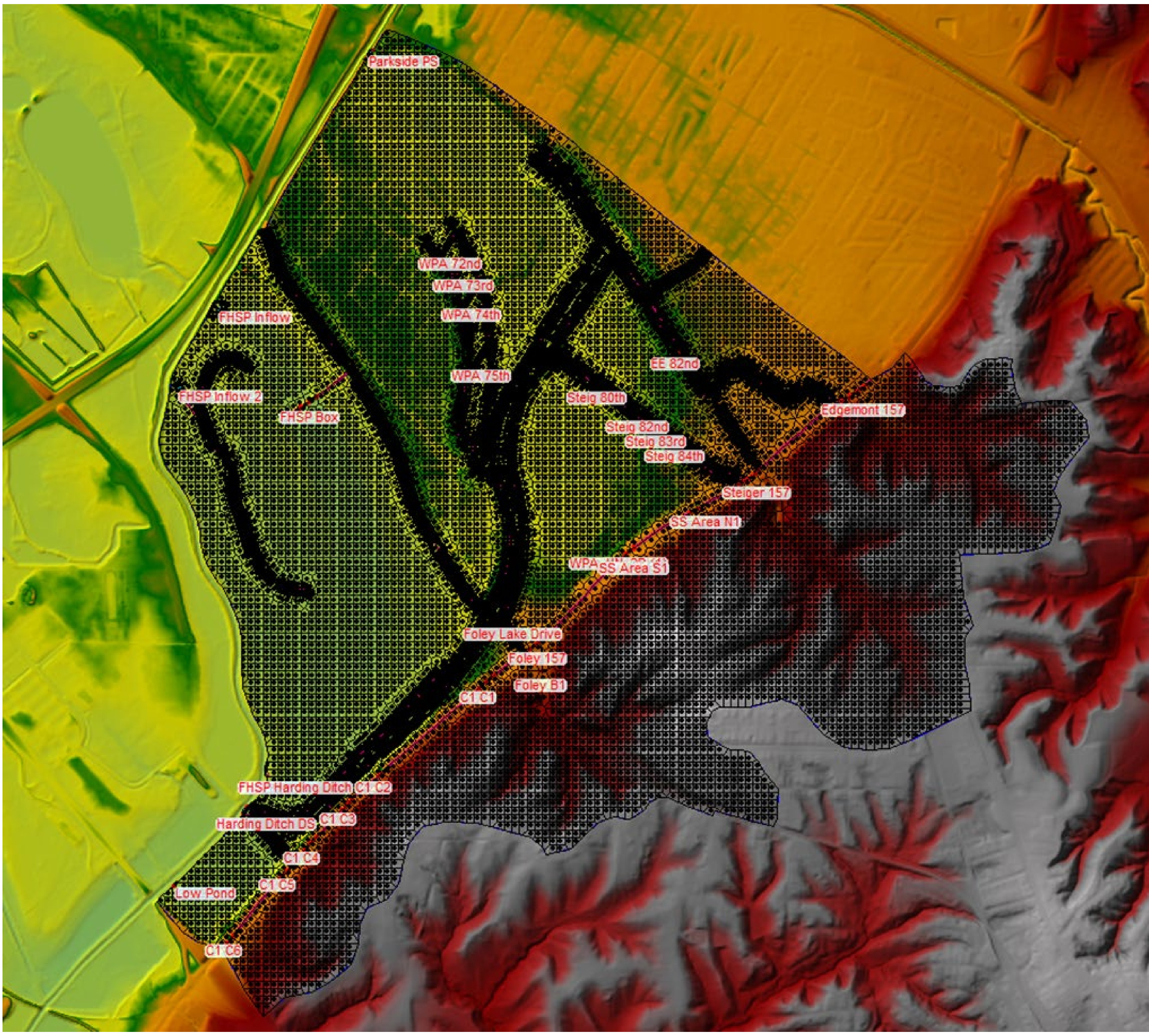


Figure A- 11: HEC-RAS Geometry Covering the Ping Pong and Parkside Watershed

A-3.4 Frequency Design Precipitation

This analysis assumed that a 24-hour duration is sufficient to capture the extents of flooding. The assumed storm duration is greater than the time of concentrations for the modeled watersheds. Depth data for various 24-hour duration rainfall events was gathered for East St. Louis, IL from the Nation Oceanic and Atmospheric Administration Atlas 14 online at https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html. Table A-2 shows the 24-hour duration rainfall depths used in this analysis, based upon Annual Exceedance Probability (AEP).

Table A- 2: NOAA Atlas 14 24-hour duration rainfall depth for East St. Louis, IL

Storm Event	Depth of Precipitation (inches)
10 % AEP	4.51
1% AEP	7.65

A-3.5 Proposed Conditions Modeling

Following creation of the existing conditions PCSWMM models, copies of these were modified to generate models for evaluating proposed conditions. Similar measures were applied to the sewer systems in both the Edgemont and Parkside watersheds. Proposed modifications such as increasing the pipeline size, correcting an adverse sloped pipe, or re-routing a sewer inlet to another sewer line were some of those examined. Regarding changes in the some of the sewer system pipes, sewer inverts are adjusted to yield more fall in a line or properly sloped where adverse sloped pipes existed. When channeling an inlet to another network trunkline, inlets are assumed to be replaced in a manner that assures adequate drainage to the downstream junction.

For the Parkside and Ping Pong watersheds, channel clean out involves digging the channel deeper and closer to its original design state. This was captured in the model by modifying the terrain adding new channel reaches created by the Civil designer. The new channel TINs were converted to rasters and mosaiced onto the USGS DEM of the project area. The model mesh cell elevations were then recomputed using the raster of the proposed terrain. This terrain manipulation was also done for the restoration of the detention basin in the Parkside Watershed.

A-4.0 Model Alternatives

The model alternatives examined were determined by the PDT during the alternative milestone meeting. The alternatives address the various problem areas observed in the existing models. They are organized by watershed. The measures examined are as follows:

- Edgemont Watershed:
    - Limited Flood Reduction
        - Clean and repair storm sewers.
    - Intermediate Flood Reduction
        - Clean and repair storm sewers

    - Replace undersized main and tributary storm sewer lines.
    - Increase capacity of Parkside pump station.
    - Raise the elevation of the Harding Ditch levee depression adjacent to the pump station.
  - Maximum Flood Reduction
    - Clean and repair storm sewers.
    - Replace undersized main and tributary storm sewer lines.
    - Increase capacity of Parkside pump station.
    - Raise the elevation of the Harding Ditch levee depression adjacent to the pump station.
    - Add storm sewer inlets and conduit to main pipe network.

- Parkside Watershed:
  - Limited Flood Reduction
    - Clean and repair existing storm sewers.
    - Restore existing drainage ditches.
  - Intermediate Flood Reduction
    - Re-establish detention basin and connect to Parkside pump station.
    - Clean and repair existing storm sewers.
    - Increase capacity of Parkside pump station.
    - Raise the elevation in Harding Ditch levee by the pump station.
    - Restore existing drainage ditches.
  - Maximum Flood Reduction
    - Re-establish detention basin and connect to Parkside pump station.
    - Clean and repair existing storm sewers.
    - Increase capacity of Parkside pump station.
    - Raise the elevation in the Harding Ditch levee by the pump station.
    - Restore existing drainage ditches.
    - Replace undersized storm sewers.
    - Add storm sewer inlets at low points and pipes to canals.

- Ping Pong Watershed:
  - Limited Flood Reduction
    - Restore existing main drainage ditches (Edgemont and Steiger) draining to Canal 1.
    - Restore ditches and culverts East of Canal 1 along roadways.
  - Intermediate Flood Reduction
    - Restore existing main drainage ditches (Edgemont and Steiger) draining to Canal 1.
    - Restore drainage ditches and culverts East of Canal 1 along roadways.
    - Increase number of culverts on the Southeast side draining to Canal 1.
  - Maximum Flood Reduction (Not analyzed due to study constraints)

- Restore existing main drainage ditches (Edgemont and Steiger) draining to Canal 1.
- Restore drainage ditches and culverts East of Canal 1 along roadways.
- Increase number of culverts in the Southeast side draining area to Canal 1.
- Install pump station and associated conduit network to pump water from the Ping Pong area storm sewer network into Canal 1.

Of the measures examined, the proposed new sewer system and pump station in the Ping Pong watershed was not modeled. For the purpose of computing quantities and cost, the new sewer pipe sizes were assumed. The Ping Pong pump station capacity was scaled to the Ping Pong watershed based on the Parkside pump station watershed area. Study constraints prevented a detailed analysis of this alternative.

A-4.1 Storm Sewer System Modification Measures

The maximum risk reduction storm sewer measures that are proposed in the Edgemont and Parkside watersheds are shown in Figures A-12 through A-15. The conduits are color coded. Blue lines signify pipe sizes to be increased, red lines remain unchanged, and yellow lines are to be cleaned out. Note that some of the lines that have their sizes increased are currently blocked. Tables located in Appendix 1 detail the proposed pipe size and invert changes for the proposed measures as compared to the existing conditions.

Storm sewer systems in the Parkside and Edgemont watersheds drain to the Parkside pump station which moves water from the project area into Harding Ditch. The current design capacity of the pump station is 100 cubic feet per second (cfs). The peak existing sewer system simulated discharge from the Edgemont network is 110 cfs for the 10% AEP event. This means that the original design of the pump station was adequately sized for the existing Edgemont storm sewer system. This does not mean that the current sewer network is adequate to handle the full volume of the present-day 10% AEP event. To mitigate this, flood risk reduction measures such as increasing the storm sewer pipe sizes and adding addition storm inlets will require additional pumping capacity.

The Parkside pump station structure is in poor shape, does not operate at capacity, and is operated manually. Because the Maximum Flood Risk Reduction Alternatives call for the addition of new sewer lines or sewer lines cleaned out with larger flow area, additional pumping capacity would be necessary. Based on peak outflow totals for the Edgemont and Parkside networks, the minimum required pump capacity for the maximum flood risk reduction measure is 275 cfs.

Figure A- 12: Edgemont West Watershed Proposed Network

Figure A- 13: Edgemont East Proposed Pipe Network

Figure A- 14: Parkside Proposed Network

Figure A- 15: Ping Pong Proposed Pipe Network

A-4.2 Existing and Proposed Model Results

To analyze the measures discussed in Section 4.0, the models were manipulated to represent the proposed changes. The manner in which the changes were made is discussed in Section 3.4. The model results will be shown as the simulated water surface level and the resulting inundation.

A-4.2.1 Existing Condition Inundation

The illustrations showing the 10% AEP storm event inundation for existing conditions are shown in Figures A-16 through A-19. The illustrations showing the 1% AEP storm event inundation for existing conditions are shown in Figures A-20 through A-23. They are organized by watershed. Darker inundation colors equate to higher elevations of the water surface.

Seen in the figures, flooding occurs throughout the watersheds during 10% AEP storm event. The sewer lines surcharge at the storm inlets inundating the area around. This indicates that the existing sewer and ditch networks are inadequate to drain the watersheds.

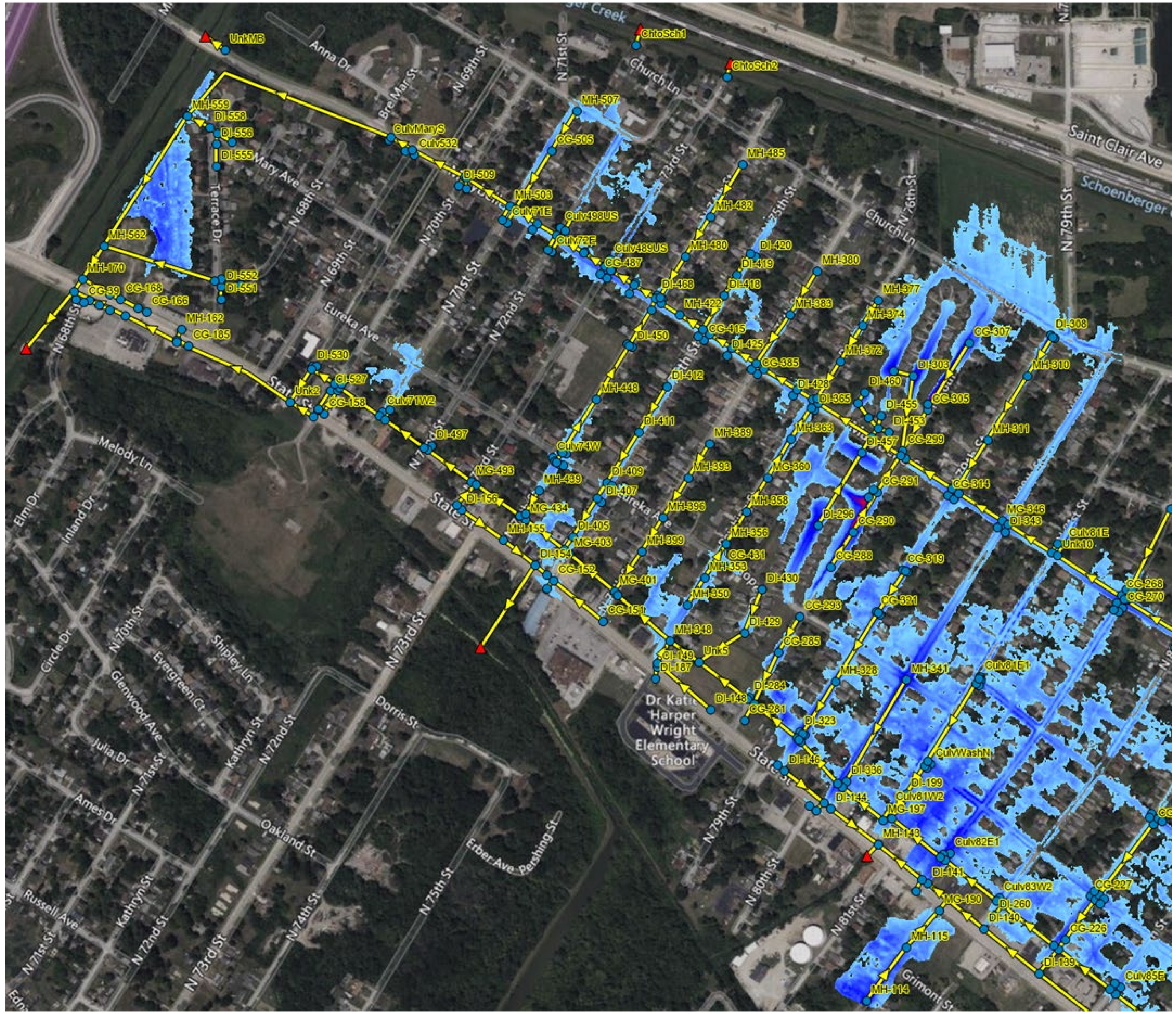


Figure A- 16: Edgemont West Watershed Existing Conditions Inundation - 10% AEP

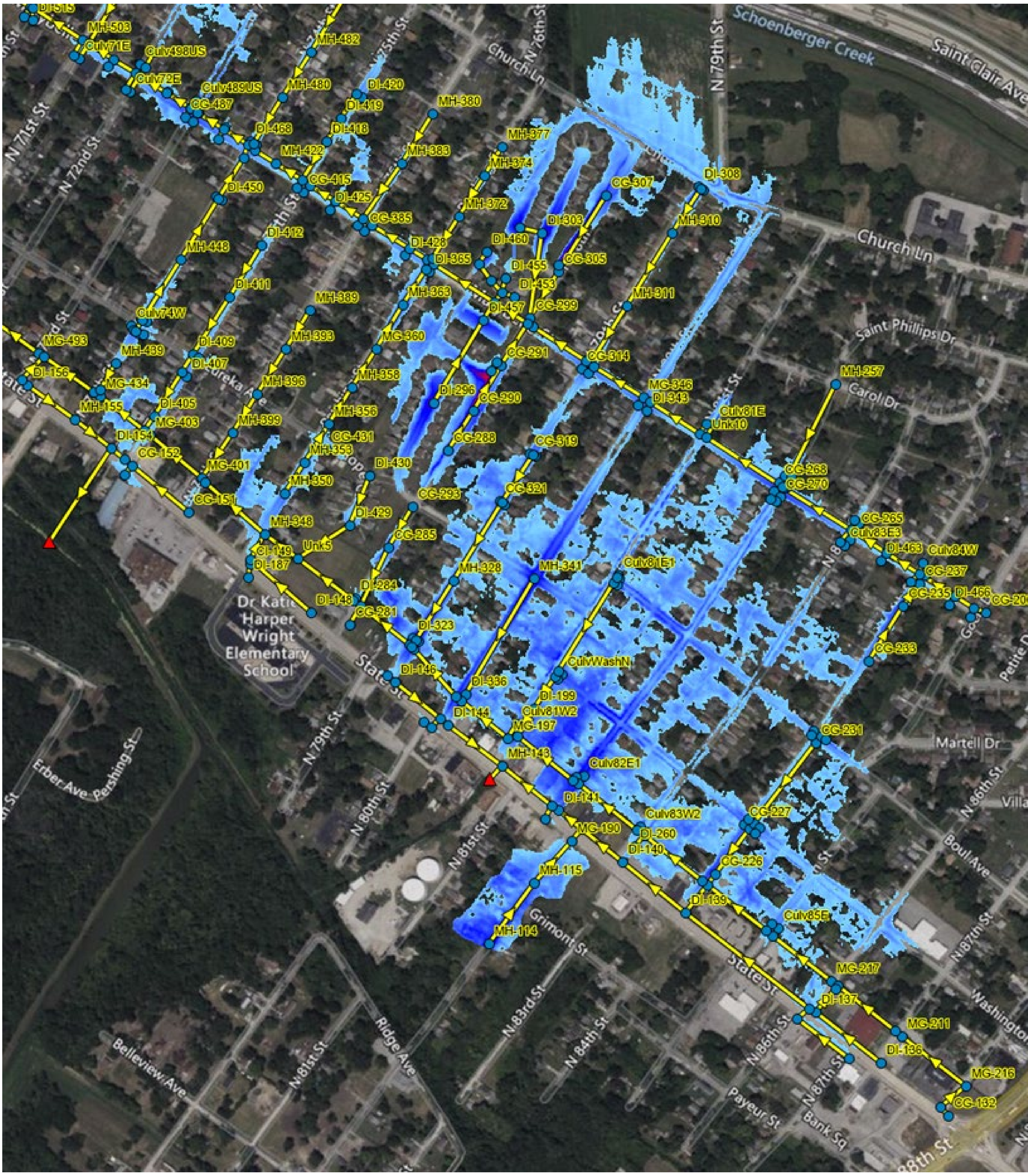


Figure A- 17: Edgemont East Watershed Existing Conditions Inundation - 10% AEP

Figure A- 18: Parkside Watershed Existing Conditions Inundation - 10% AEP

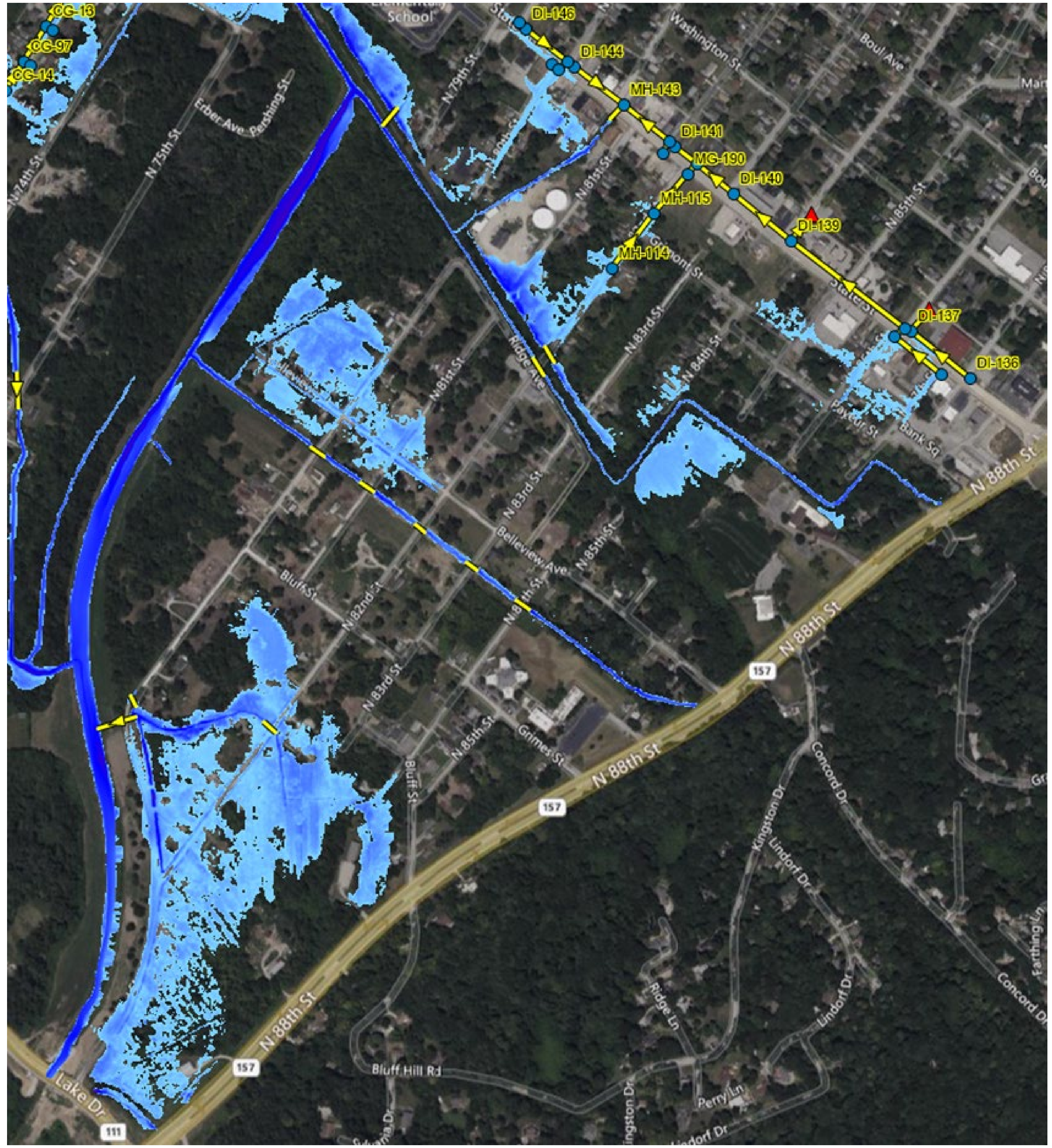


Figure A- 19: Ping Pong Watershed Existing Conditions Inundation- 10% AEP

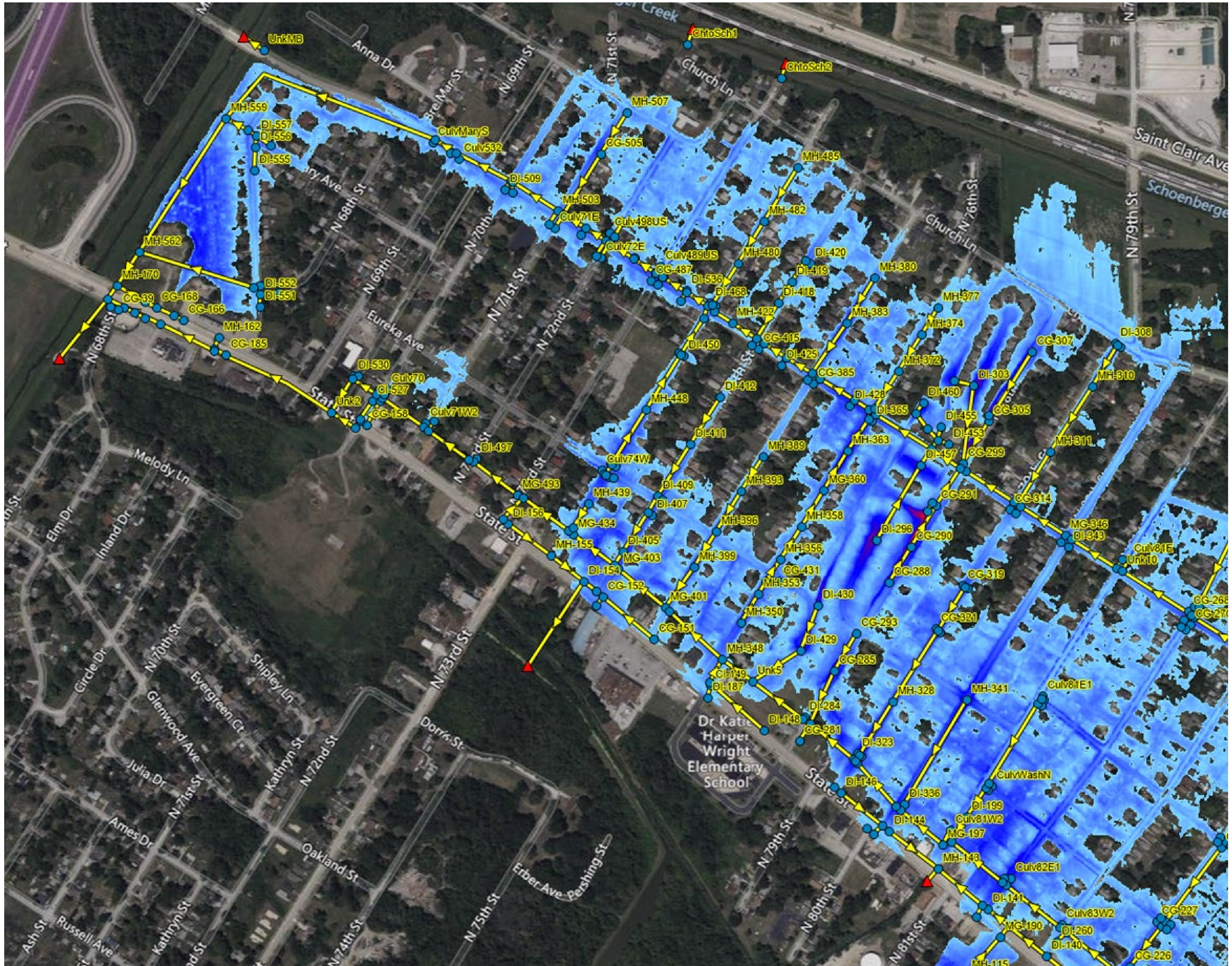


Figure A- 20: Edgemont West Watershed Existing Conditions Inundation -1% AEP

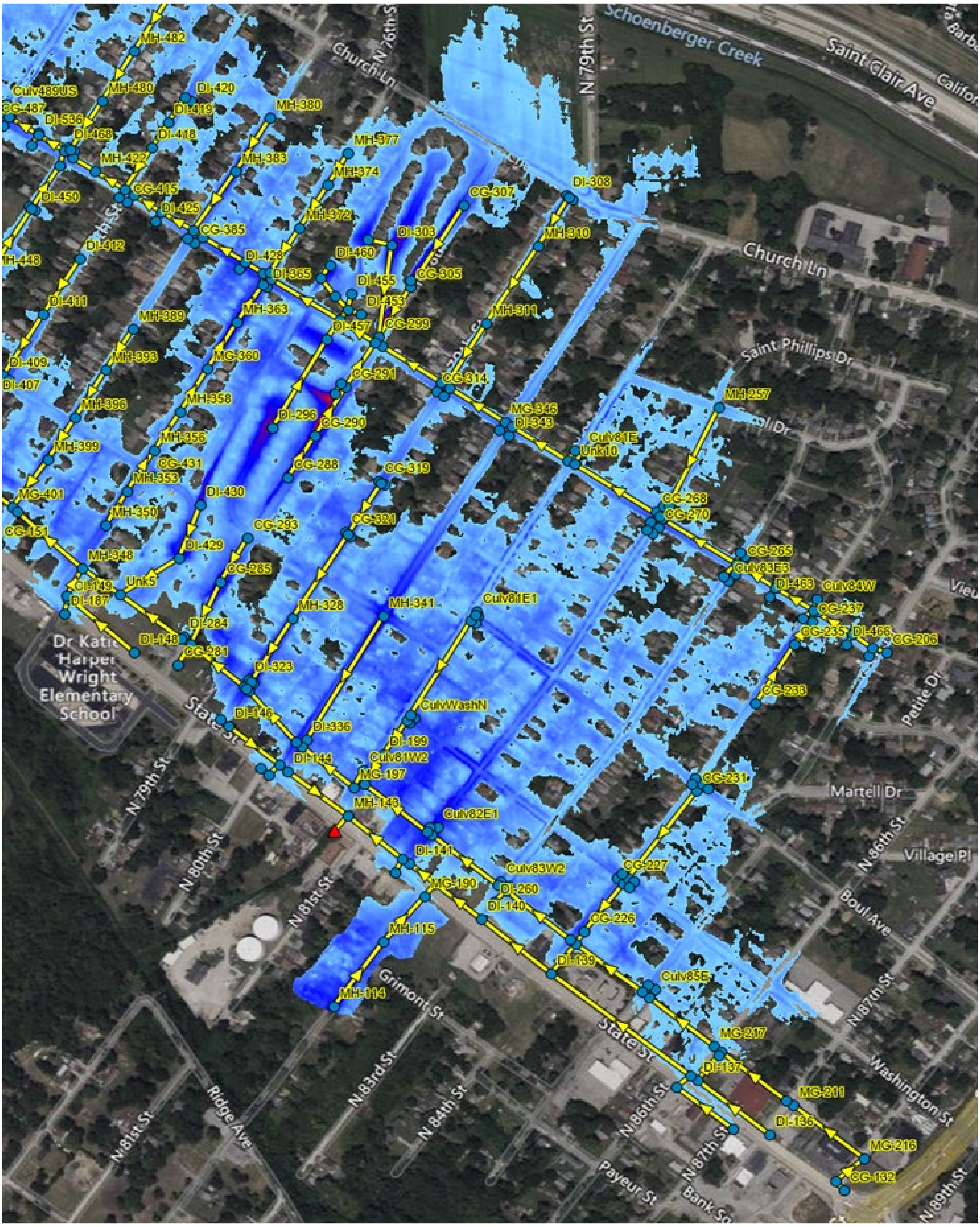


Figure A- 21: Edgemont East Watershed Existing Conditions Inundation - 1% AEP

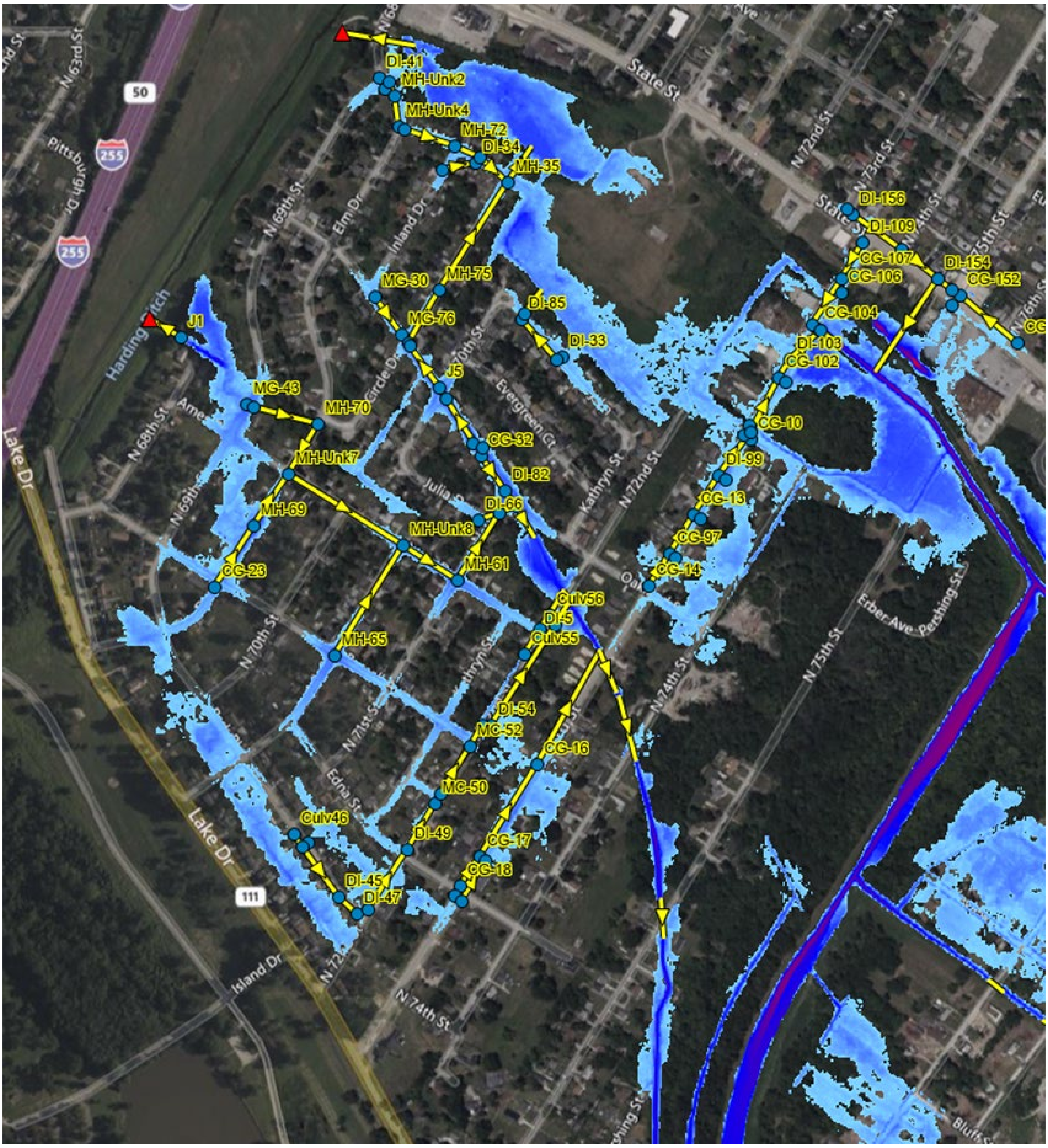


Figure A- 22: Parkside Watershed Existing Conditions Inundation- 1% AEP

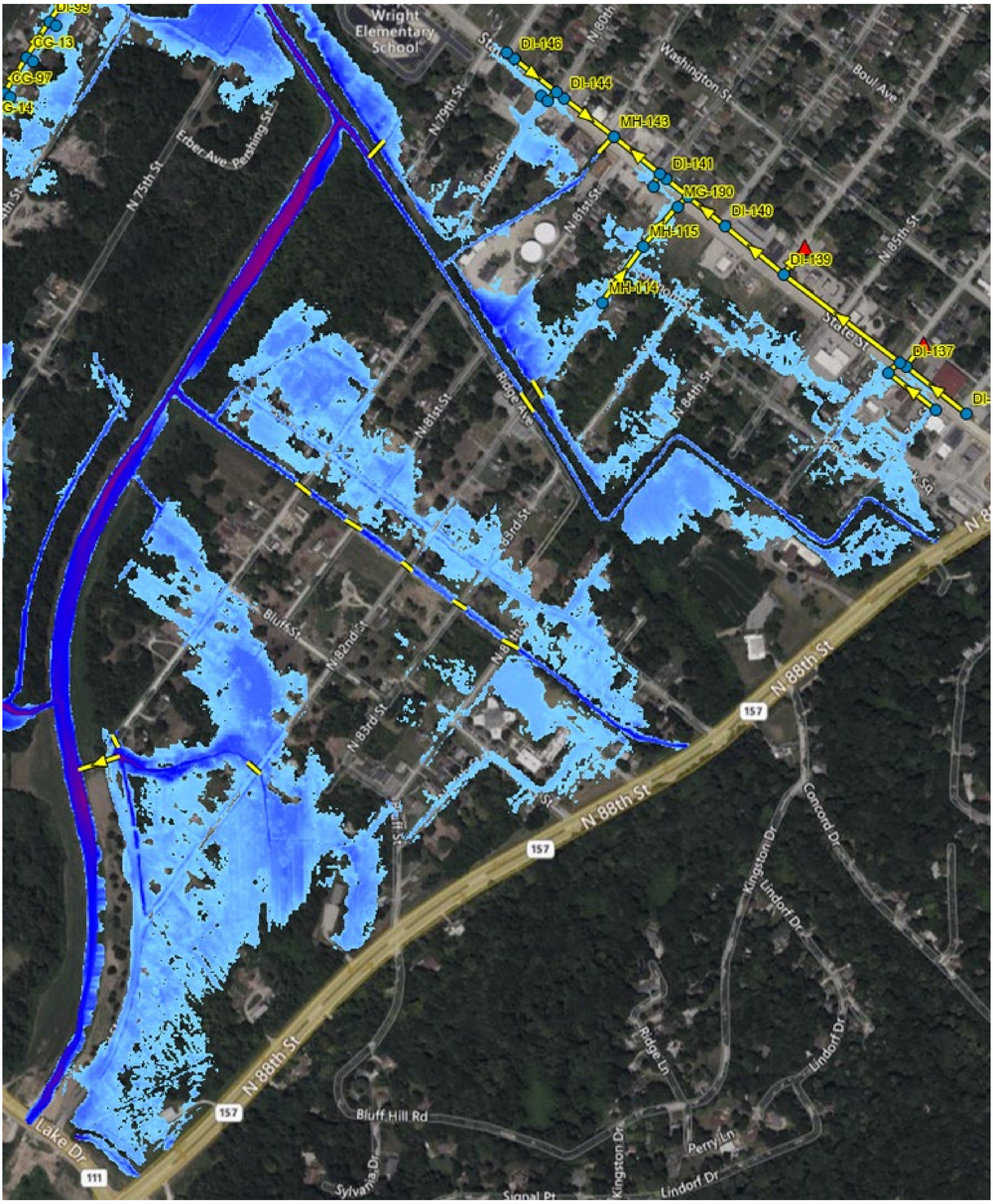


Figure A- 23: Ping Pong Watershed Existing Conditions Inundation- 1% AEP

A-4.2.2 Edgemont Watershed Corrective Measures

The illustrations showing the level of Edgemont watershed inundation remaining after each corrective measure is implemented are ordered as follows:

- Limited Flood Reduction (Figures A-24 and A-25)
    - Clean and repair storm sewers.
- Intermediate Flood Reduction (Figures A-26 and A-27)
    - Clean and repair storm sewers
    - Replace undersized main and tributary storm sewer lines.
    - Increase capacity of Parkside pump station.
    - Raise the elevation of the Harding Ditch levee depression adjacent to the pump station.
- Maximum Flood Reduction (Figures A-28 and A-29)
    - Clean and repair storm sewers.
    - Replace undersized main and tributary storm sewer lines.
    - Increase Parkside pump station capacity.
    - Raise the elevation of the Harding Ditch levee depression adjacent to the pump station.
    - Add storm sewer inlets and conduit to main pipe network.

The 1% AEP storm event inundation for the maximum flood reduction measure is shown in Figure A-30 and A-31.

For the Maximum Flood Risk Reduction Alternative, conveyance of the 10% AEP event stormwater is achieved almost entirely underground, with 2 exceptions. The first exception is at the inlets on Faith and Success Court. These areas are low and were built well after the rest of the storm sewer system. It is assumed that the area drainage was tied into a functional sewer system. The ground surface in this area is low so it was difficult to get the water surface low enough in the main line to prevent backup into the area. Remediation for this would require greatly increasing the size of the downstream sewer lines. This is rather far upstream in the sewer network so many conduit sizes would need to be increased, resulting in a substantial cost increase. Since the water remains in the roadway and stays out of structures, the backup was deemed acceptable.

The second exception is for the drainage to the wooded area west of Terrace Drive. This is the area behind the residences on the west side of Terrace Drive. A lot of assumptions were made on how the sewer lines connect through this area and inlets may not have been accounted for in the survey. In the end, it was assumed that the area drains to the wooded area and remains ponded there. Since it did not appear to be a problem, it was left to drain that way. Drainage can be added into the main line that passes through the area with little consequence if inlets do in fact exist. This area needs to be re-surveyed during the next phase of engineering analysis.

Flood risk reduction measures such as increasing the storm sewer pipe sizes and adding addition storm inlets will require additional pumping capacity. Based on peak outflow totals for the proposed

Edgemont and Parkside networks, the required pump capacity for the maximum flood risk reduction measure is 275 cfs.

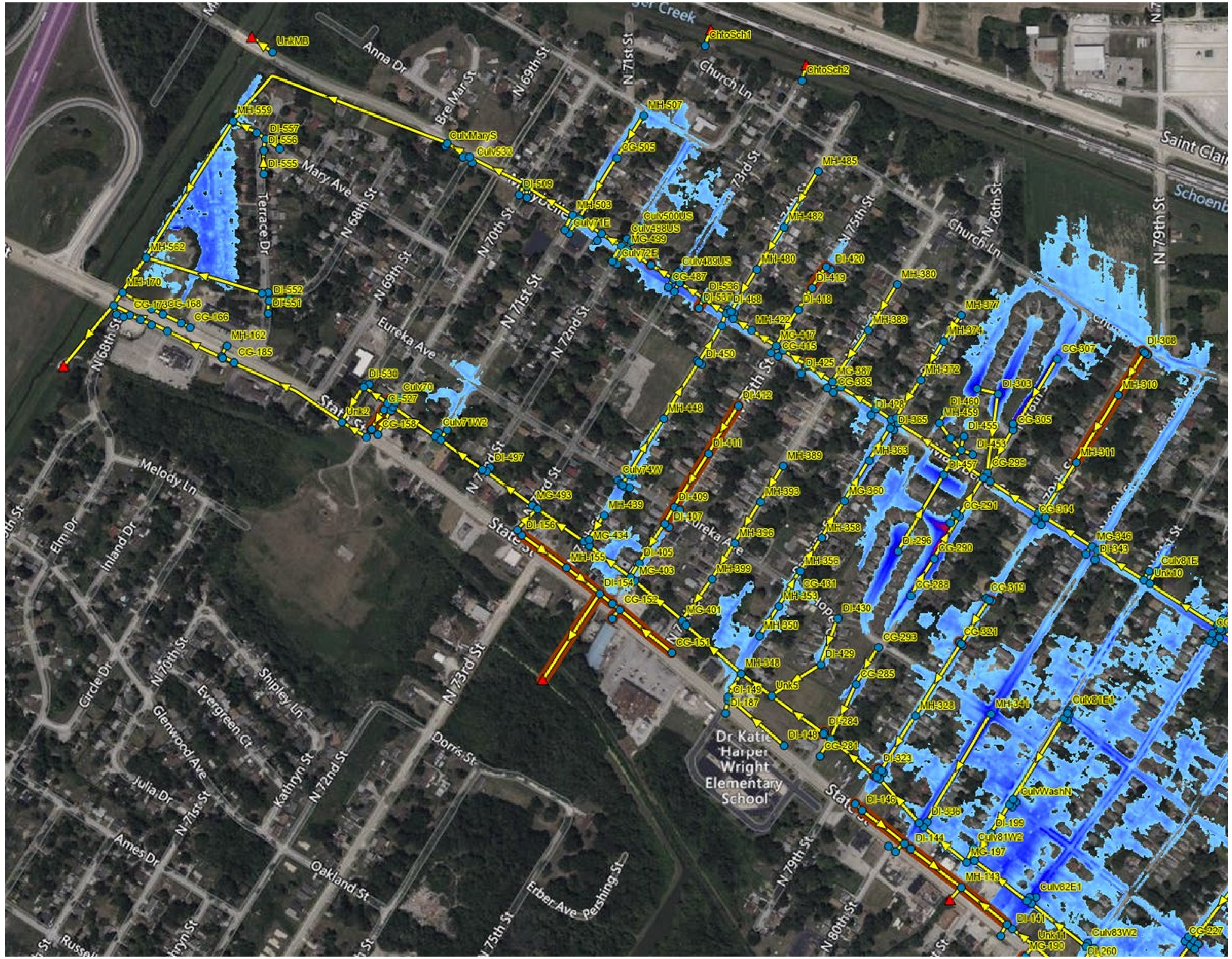


Figure A- 24: Edgemont West Watershed Limited Risk Reduction Inundation- 10% AEP (Brown denotes blocked lines)

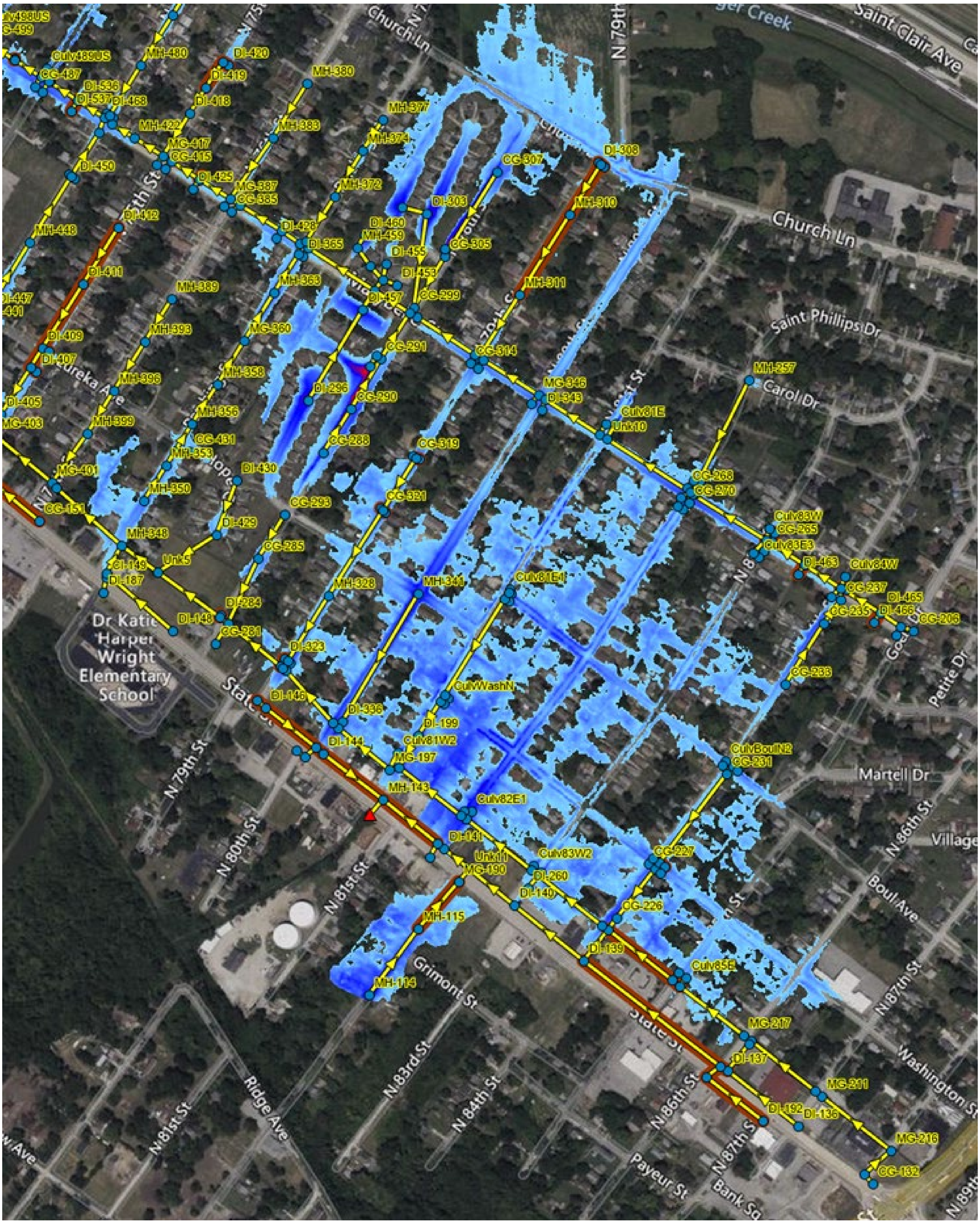


Figure A- 25: Edgemont East Watershed Limited Risk Reduction Inundation - 10% AEP (Brown denotes blocked lines)

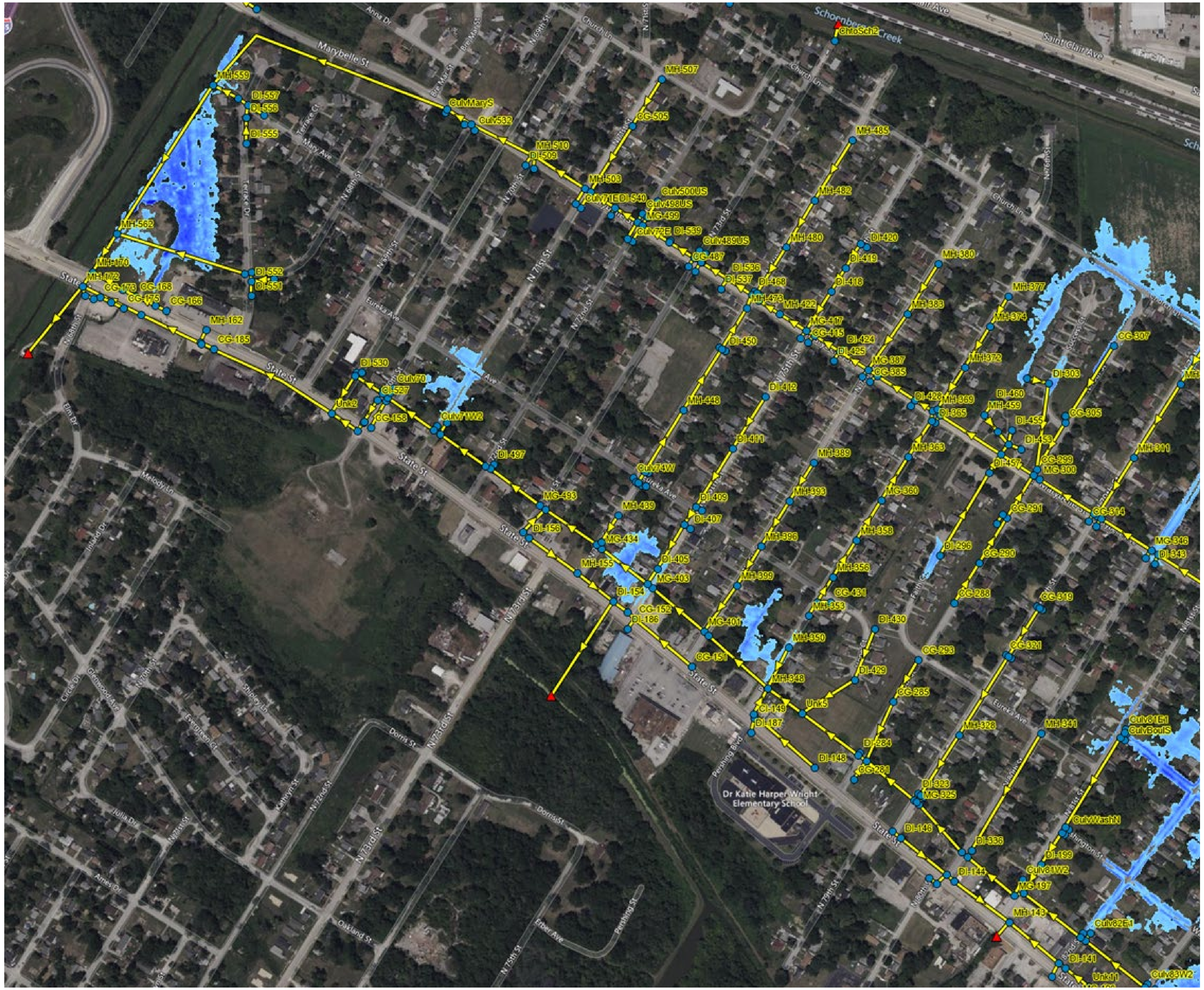


Figure A- 26: Edgemont West Watershed Intermediate Risk Reduction Inundation 10% - AEP

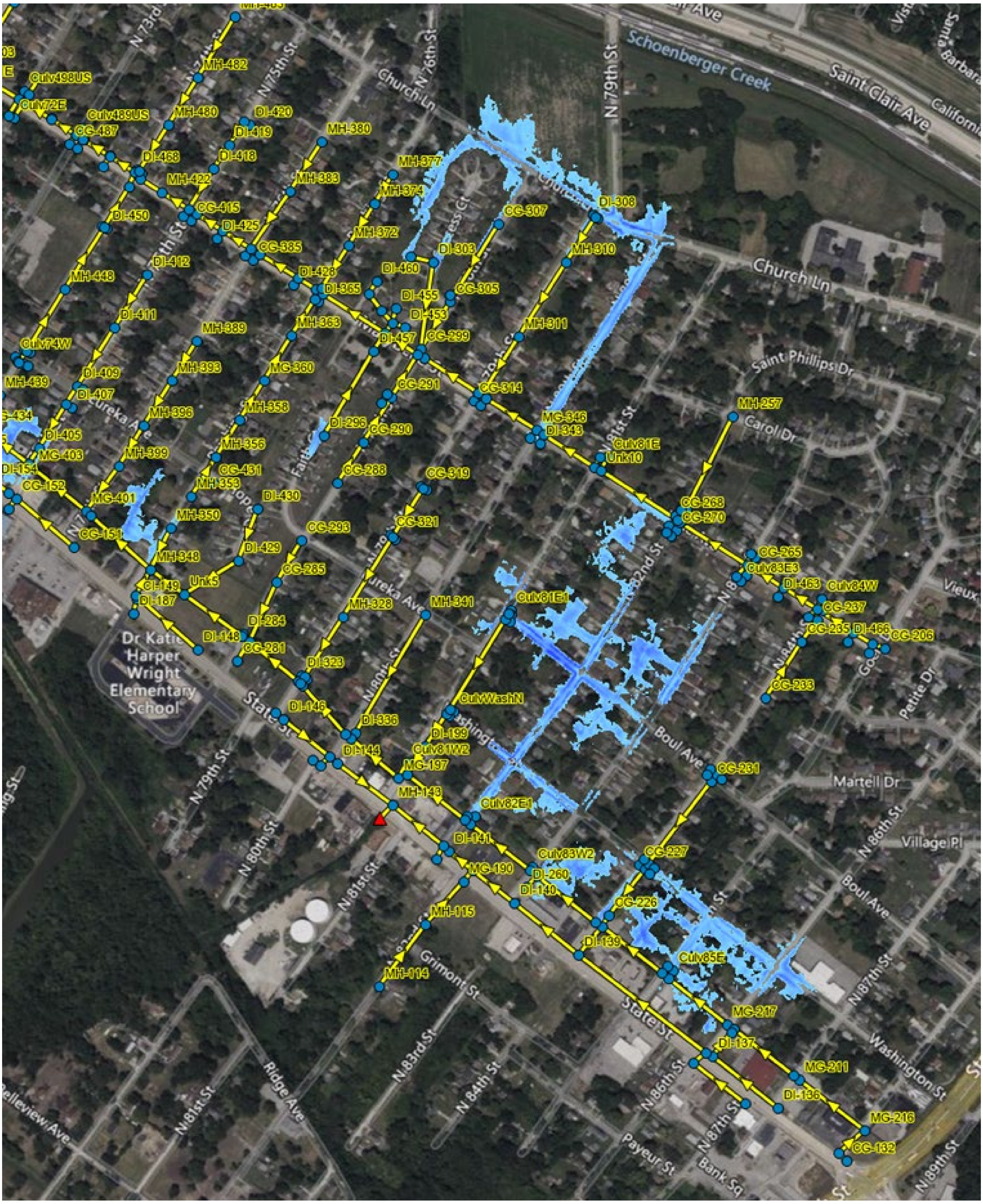


Figure A- 27: Edgemont East Watershed Intermediate Risk Reduction Inundation - 10% AEP

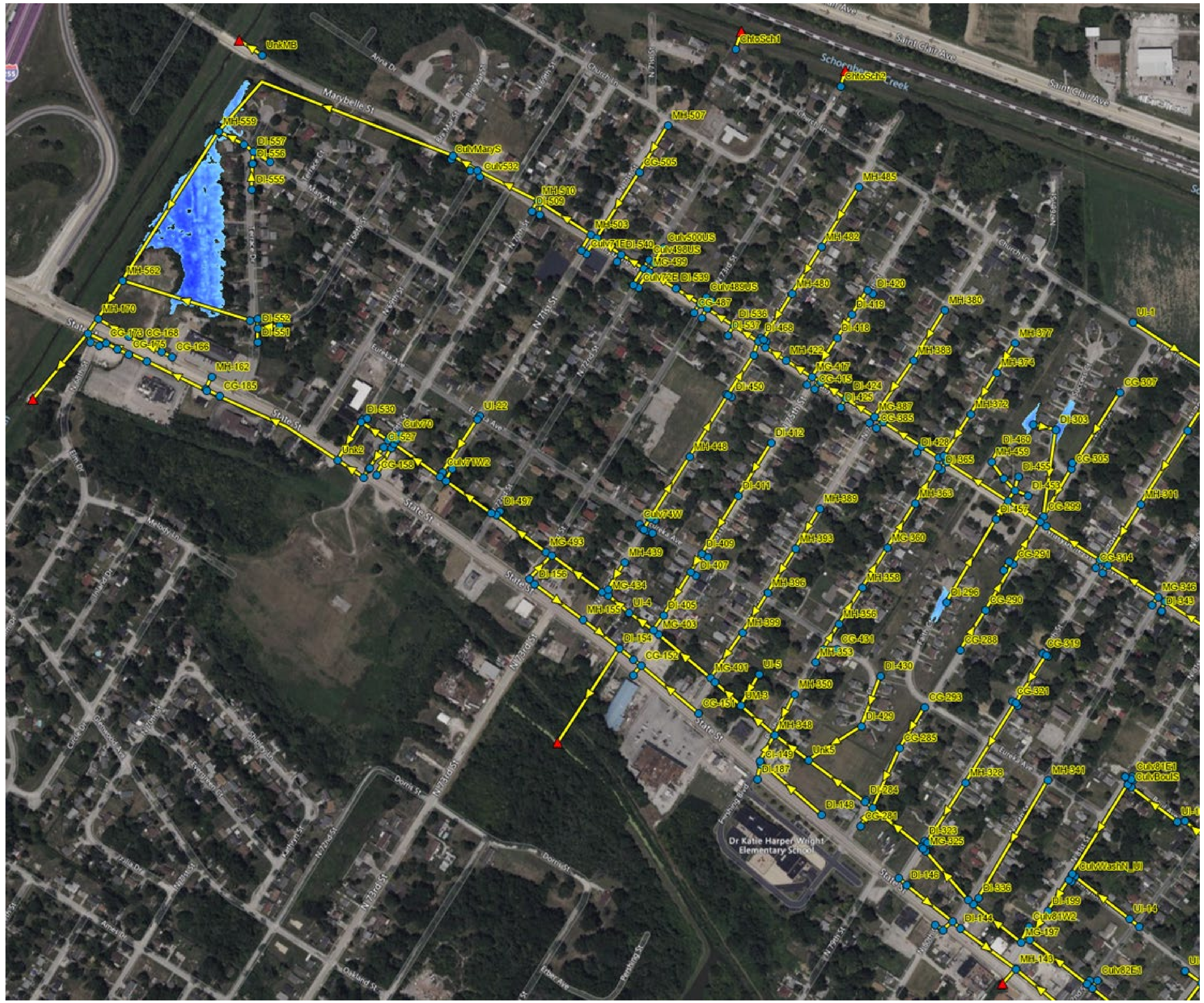


Figure A- 28: Edgemont West Watershed Maximum Risk Reduction Inundation- 10% AEP

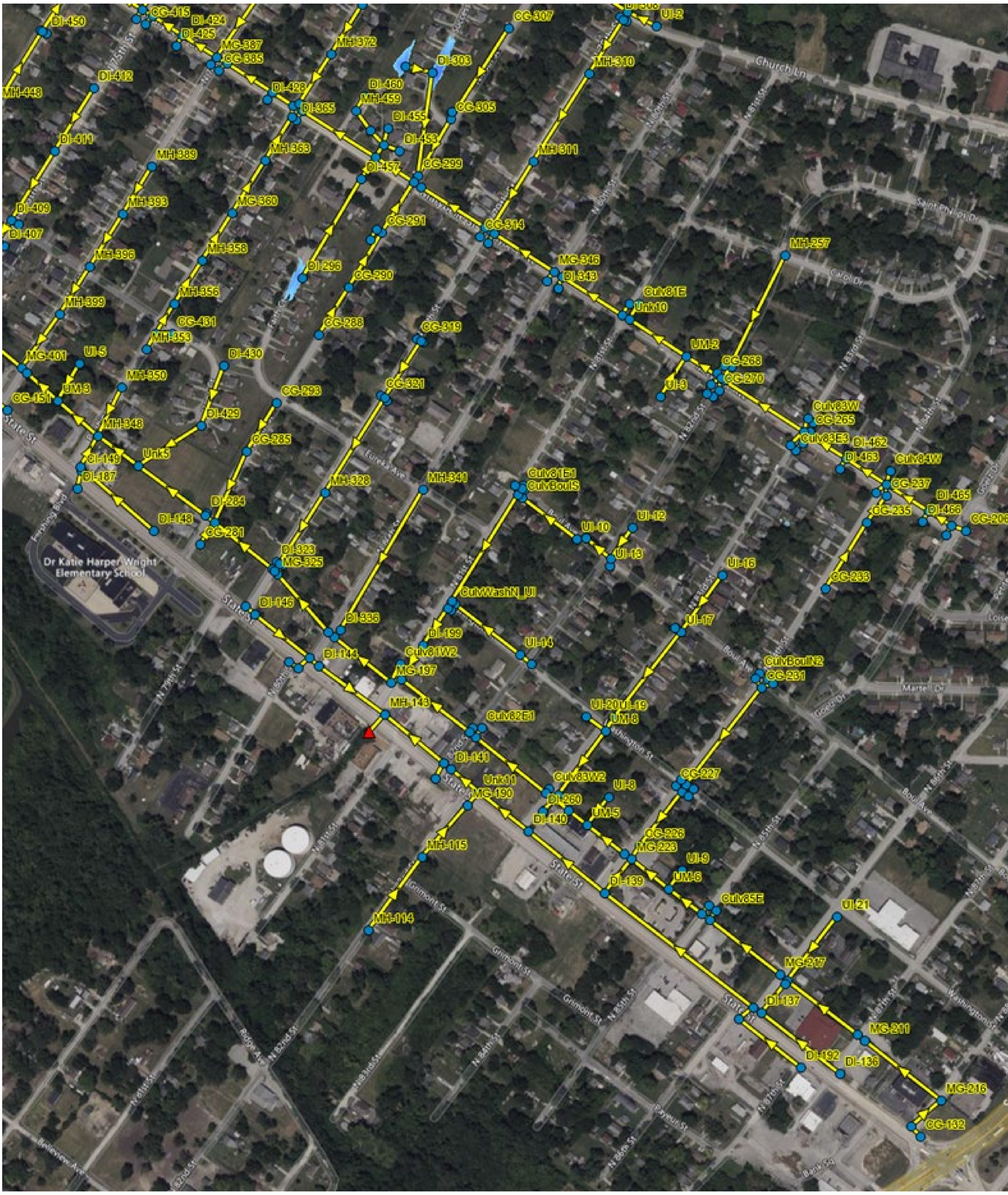


Figure A- 29: Edgemont East Watershed Maximum Risk Reduction Inundation- 10% AEP

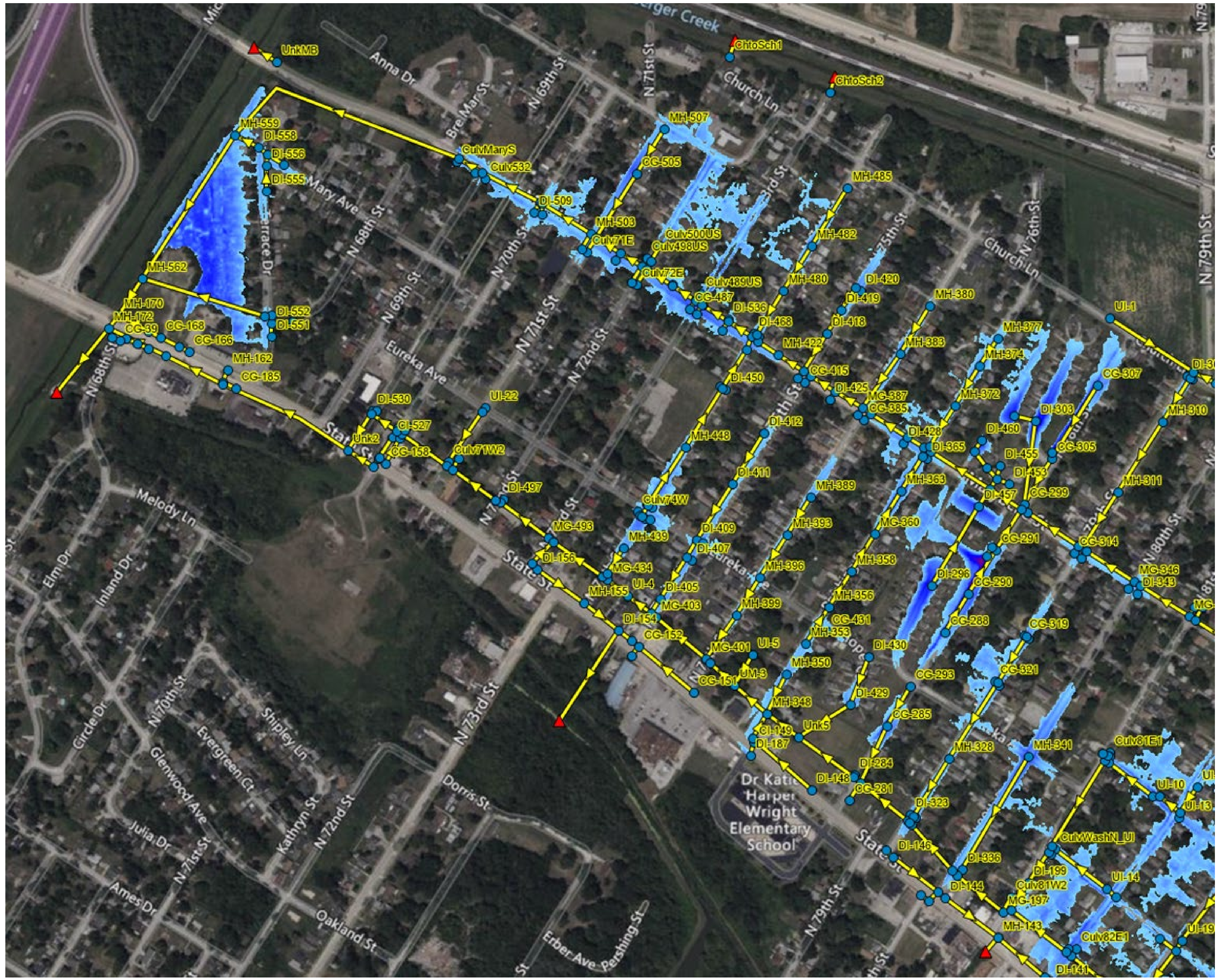


Figure A- 30: Edgemont West Watershed Maximum Risk Reduction Inundation- 1% AEP

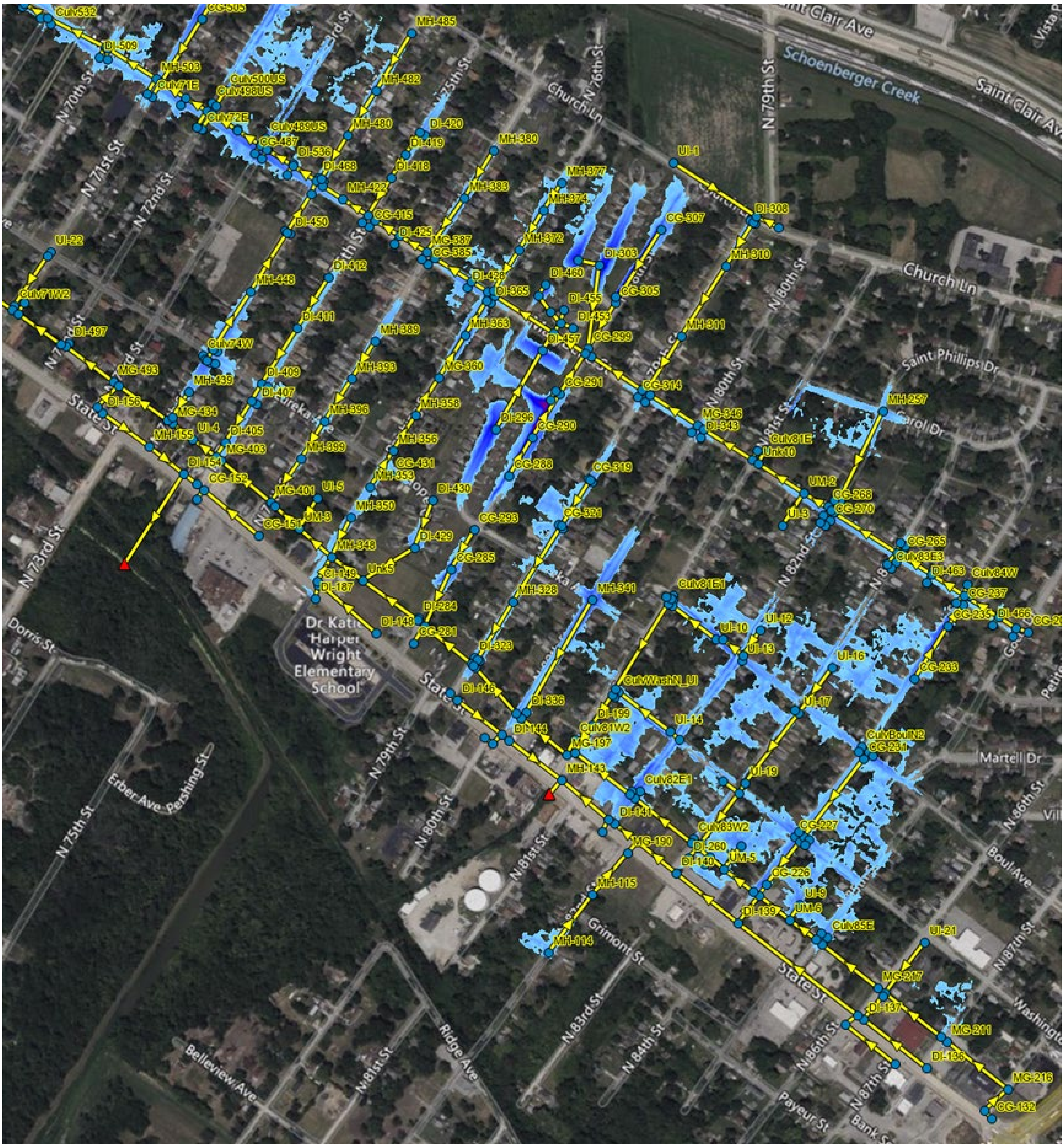


Figure A- 31: Edgemont East Watershed Maximum Risk Reduction Inundation - 1% AEP

A-4.2.3 Parkside Watershed Corrective Measures

The illustrations showing the level of Parkside watershed inundation remaining after each corrective measure is implemented are ordered as follows:

- Limited Flood Reduction (Figure A-32)
  - Clean and repair existing storm sewers.
  - Restore existing drainage ditches.
- Intermediate Flood Reduction (Figure A-33)
  - Re-establish detention basin and connect to Parkside pump station.
  - Clean and repair existing storm sewers.
  - Increase capacity of Parkside pump station.
  - Raise the elevation in Harding Ditch levee by the pump station.
  - Restore existing drainage ditches.
- Maximum Flood Reduction (Figure A- 34)
  - Re-establish detention basin and connect to Parkside pump station.
  - Clean and repair existing storm sewers.
  - Increase Parkside pump station capacity.
  - Raise the elevation in the Harding Ditch levee by the pump station.
  - Restore existing drainage ditches.
  - Replace undersized storm sewers.
  - Add storm sewer inlets at low points and pipes to canals.

The 1% AEP storm event inundation for the maximum flood reduction measure is shown in Figure A-35.

With the maximum risk reduction measure, stormwater is contained underground during the 10% AEP storm event, except for 2 locations. The first exception is located at the inlets on Glenwood Avenue. The inlets in question are the ones that are closest to where the pipe network discharges into the WPA Ditch. This area is low and is almost as low as the ditch it discharges into. Possibly further increasing the depth of WPA Ditch might help, but it may lead to more problems downstream along WPA Ditch. A possible measure for future consideration is to create ponding areas along WPA Ditch that could be used to reduce stages in WPA Ditch and allow the water in the network along Glenwood Avenue to drain more effectively. Ponding areas in general would improve water levels downstream on Canal 1. Concerns about the functionality of this measure include: depth is limited by slope to maintain the stability of the bank, it is a small watershed and there is not much drainage to it, and the lack valuable benefits as the ponding measure retains water in the area as opposed to moving it away. This was screened as a possible measure due to these concerns and a more in-depth analysis was not conducted. However, at the currently proposed ditch cleanout level, inundation predicted during the 10% AEP storm event is shown to remain in the roadway and out of the structures along Glenwood Avenue.

The second exception is for the inlets on Shipley Lane. Drainage in this area is unknown. Several assumptions were made regarding how the sewer lines connected through this area and manholes/inlets may have been missed in the survey. In the end, it was assumed that the area drains between houses into an assumed ditch or field that leads to the old detention basin. With the creation of a better-defined ditch flowing to the detention basin, the flood risk is reduced with the 10% AEP storm not entering structures on Shipley Lane. This area needs to be re-surveyed during the next phase of engineering analysis.

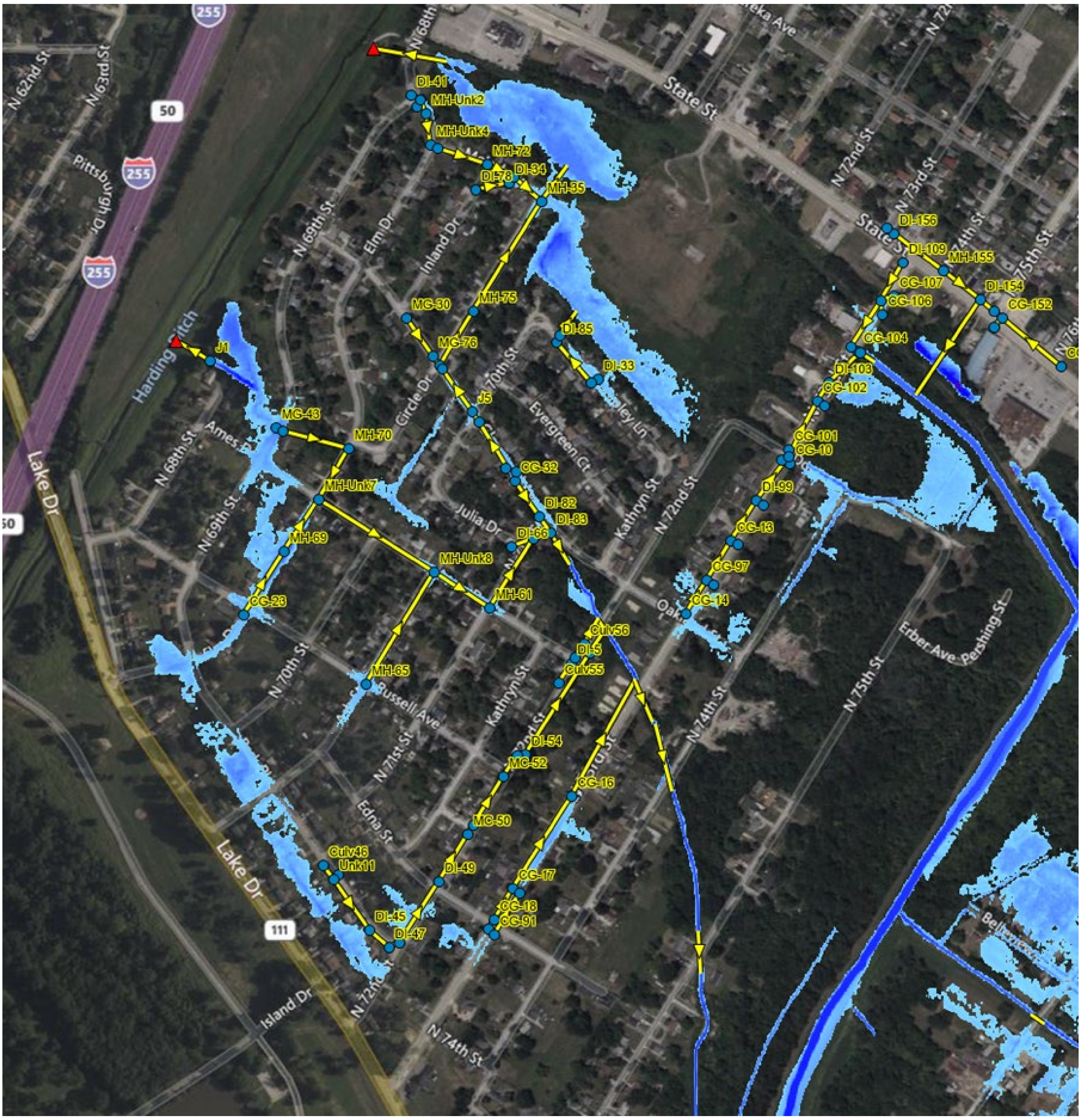


Figure A- 32: Parkside Watershed Limited Risk Reduction Inundation- 10% AEP

Figure A- 33: Parkside Watershed Intermediate Risk Reduction Inundation- 10% AEP

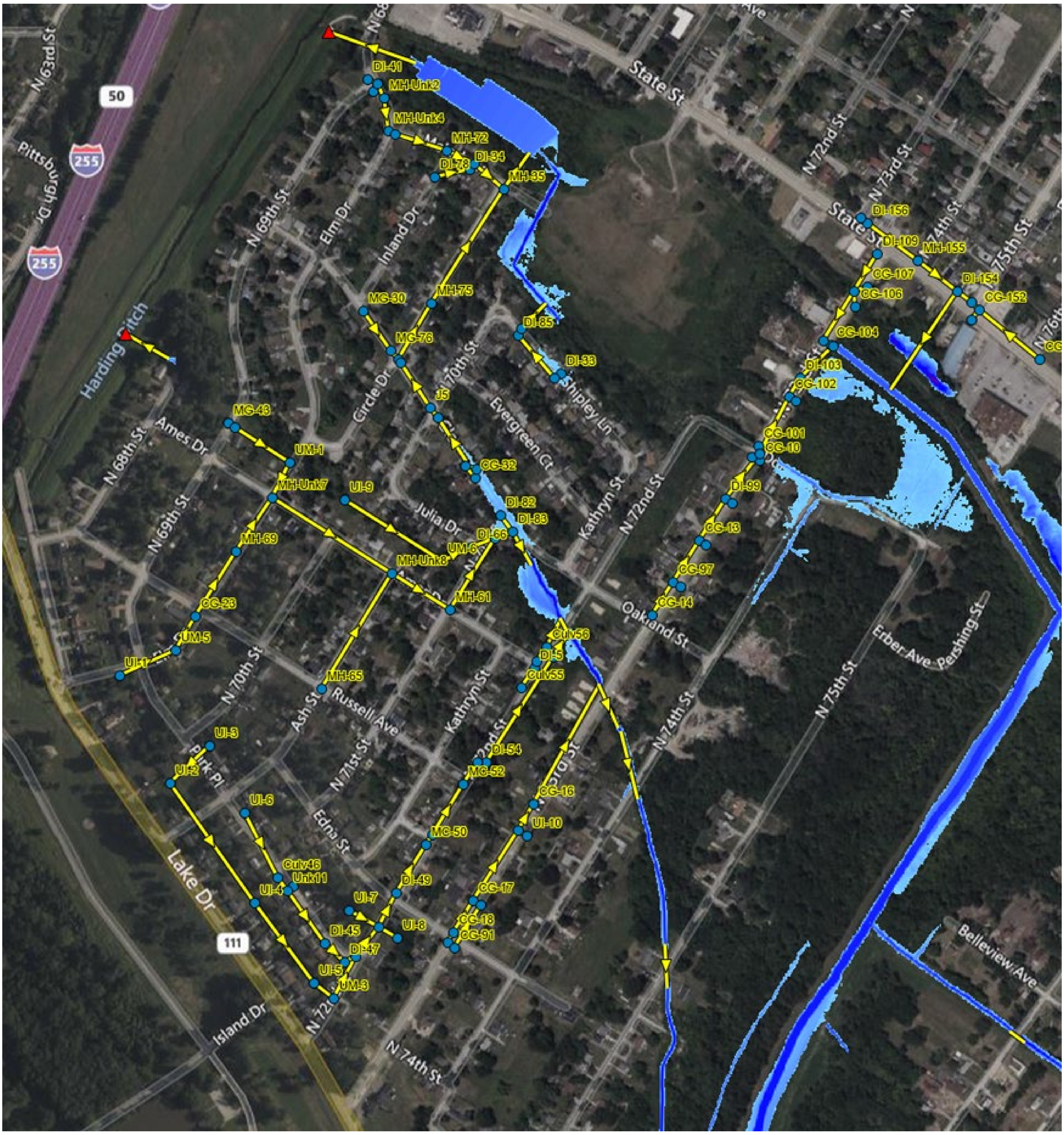


Figure A- 34: Parkside Watershed Maximum Risk Reduction Inundation- 10% AEP

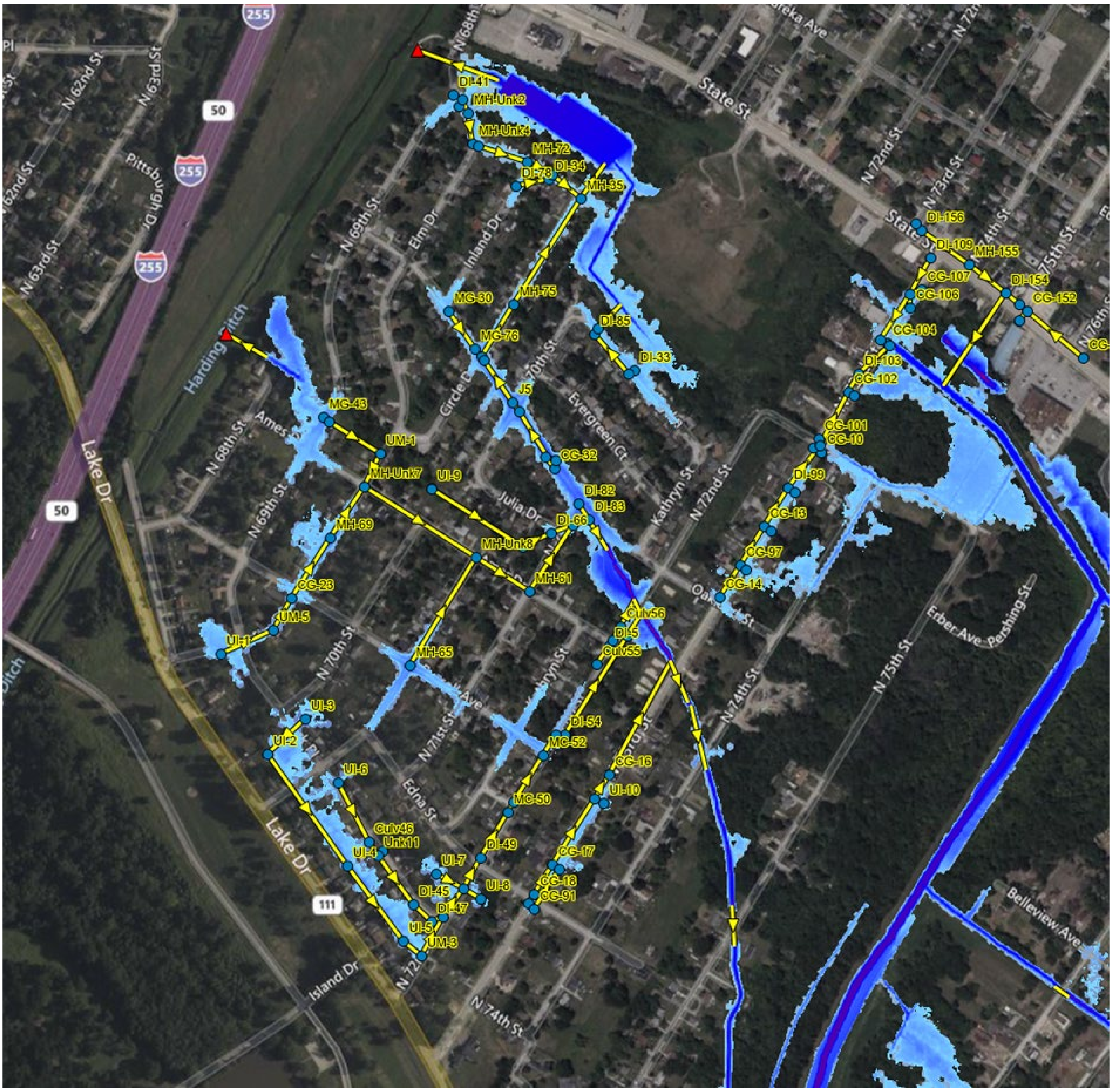


Figure A- 35: Parkside Watershed Maximum Risk Reduction Inundation -1% AEP

A-4.2.4 Ping Pong Watershed Corrective Measures

The illustrations showing the level of Ping Pong watershed inundation remaining after each corrective measure is implemented are ordered as follows:

- Limited Flood Reduction (Figure 36)
  - Restore existing main drainage ditches (Edgemont and Steiger) draining to Canal 1.
  - Restore ditches and culverts East of Canal 1 along roadways.
- Intermediate Flood Reduction (Figure 37)
  - Restore existing main drainage ditches (Edgemont and Steiger) draining to Canal 1.
  - Restore drainage ditches and culverts East of Canal 1 along roadways.
  - Increase number of culverts on the Southeast side draining to Canal 1.
- Maximum Flood Reduction (Not analyzed due to study constraints)
  - Restore existing main drainage ditches (Edgemont and Steiger) draining to Canal 1.
  - Restore drainage ditches and culverts East of Canal 1 along roadways.
  - Increase number of culverts in the Southeast side draining area to Canal 1.
  - Install pump station and associated conduit network to pump water from the Ping Pong area storm sewer network into Canal 1.

For the Limited and Intermediate Flood Risk Reduction Alternatives, specifically regarding the cleanout of the roadway ditches, no remaining problems are observed in the area north of Steiger ditch. This is due to the way the watershed is laid out in the PCSWMM model. In the existing model the watershed drains to the main ditch in the approximate center of the watershed. Because it can be assumed that conveyance is improved in the ditches, the PCSWMM watershed is allowed to discharge directly to the main ditch that drains the area. The ditches to be cleaned out are too small to appear in the modified DEM and as a result the model will not show the true effect of the ditch cleanout in the area. To better capture the actual inundation, the watershed would need to be broken up with ditches modeled as 1D channels. Study constraints prevented a more detailed analysis of this alternative. The ditch cleanout will improve drainage in the area; however, the model may be under-predicting proposed conditions water levels in the area north of Steiger Ditch for the 10% AEP storm event.

Within the Ping Pong watershed, no information was available on the culverts in the area that drain the area north of Edgemont Ditch. Water appears to stay out of structures, so a detailed design analysis was not performed.

For the Intermediate and Maximum Flood Risk Reduction Alternative, an increase in the number of culverts was examined. There was not much improvement to drainage in the area. The culvert leading to Canal 1 does not effectively drain this area north of Steiger Ditch; therefore, water is ponded in the low-lying areas. Restoring the ditch connecting the culverts south of Steiger Ditch would improve the area drainage. Study constraints prevented a detailed analysis of this measure. The ditch will improve the situation, but the benefit of establishing a defined ditch may not be great enough to adequately reduce the flood risk. If this is the case, the best solution for reduction of flood risk would be dry floodproofing. Flood proofing to the 10% AEP storm event level would provide the same level of protection as an improved drainage system.

The proposed new sewer system in the Ping Pong watershed was not hydraulically analyzed using a PCSWMM model. New sewer pipe sizes were assumed for computing quantities and cost. Study constraints prevented a detailed analysis of this alternative. The proposed sewer system north and south of Steiger ditch could be designed to effectively drain the area leading to reduced flood risk. It is the area East of 83rd Street that may need to be extended to include the drainage between the culverts under 82nd Street and 80th Street. Drainage through the proposed pipe network may also be improved with the re-establishment of the ditch between the culverts under 82nd Street and 80th Street. Further analysis would be needed prior to making a final recommendation.

Construction of a pump station to pump water from the Ping Pong watershed south of Steiger Ditch into Canal 1 may be necessary due to high Canal 1 water surface levels. These high stages that occur during the frequency storm events currently do not allow water in the area to drain effectively. Based on required pump capacity for the Edgemont and Parkside networks, the required pump capacity for the area south of Steiger Ditch is 75 cfs.

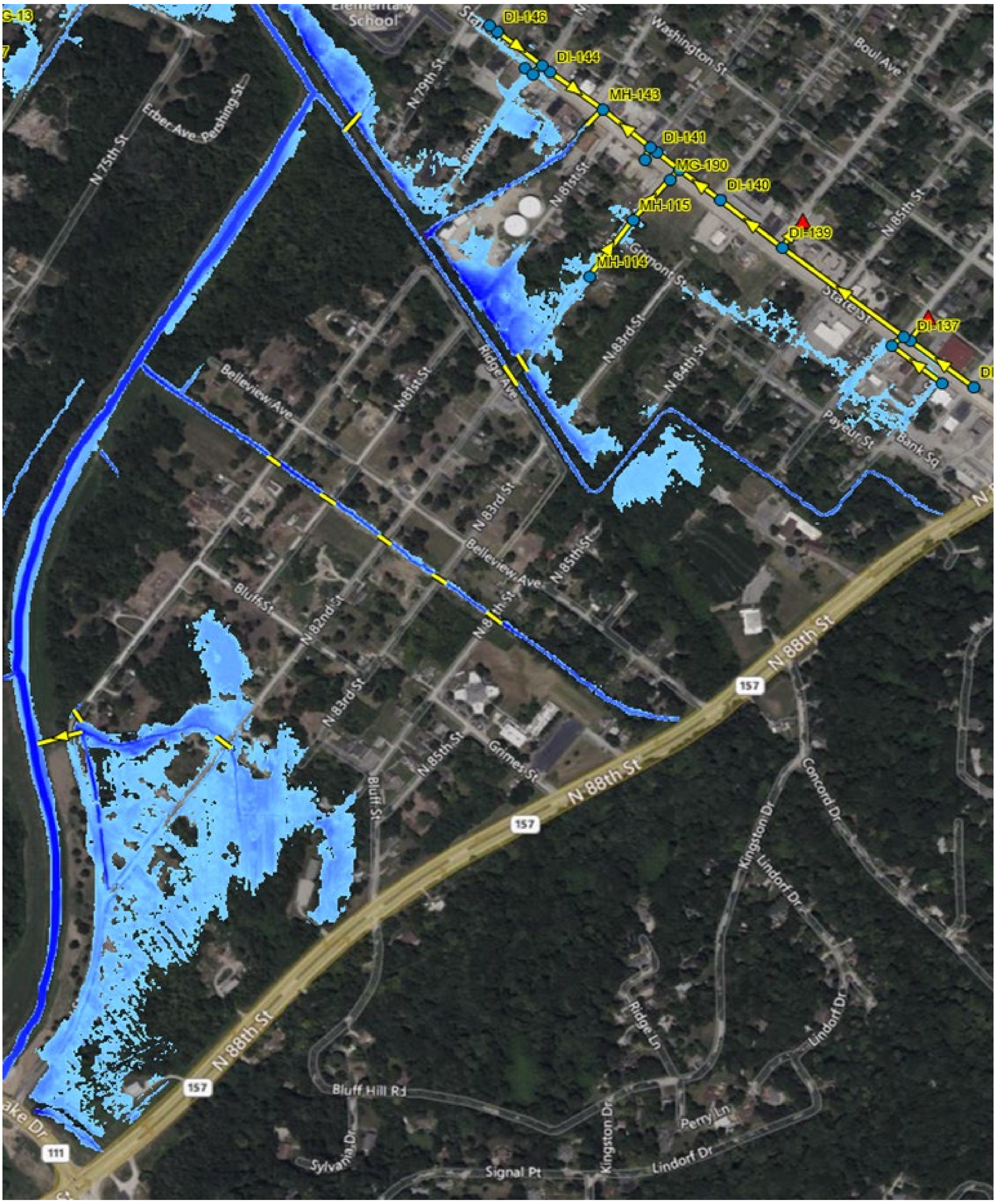


Figure A- 36: Ping Pong Watershed Limited Risk Reduction Inundation- 10% AEP

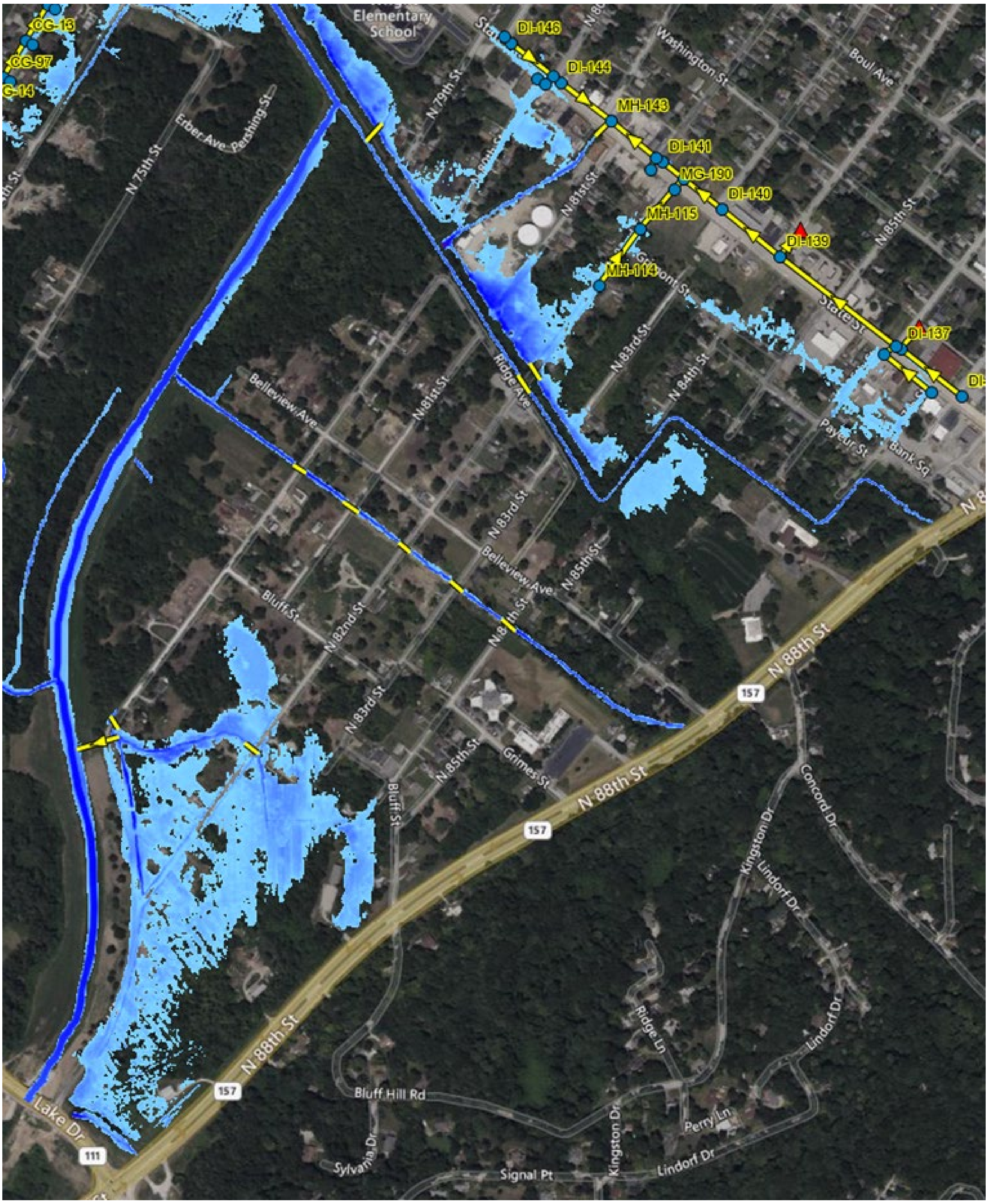


Figure A- 37: Ping Pong Watershed Intermediate Risk Reduction Inundation- 10% AEP

A-4.3 Harding Ditch Flooding

Harding Ditch is the main drainage channel that drains the southern portion of the Metro East Levee System. Harding Ditch is maintained by MESD. The MESD South pump station brings water from Harding Ditch into Prairie du Pont Creek which empties directly into the Mississippi River. Operation of the MESD South pump station is directly affected by Mississippi River conditions. During high Mississippi River stages South pump station operation is required. During normal condition gravity flow occurs through the pump station outlet structure. As a result, conditions on the Mississippi River affect water levels on Harding Ditch.

The results from the HEC-RAS modeling of the MESD drainage area and Ping Pong/Parkside watershed demonstrate that the influence of backwater flooding from Harding Ditch extends upstream to Lake Drive during the 1% AEP storm event, even with low Mississippi River stages. The extent of the Ping Pong and Parkside watershed flooding is shown in Figures A-38 and A-39 for the 10% AEP and 1% AEP flood events with a low Mississippi River stage based on existing conditions. This inundation also captures the effect of Harding Ditch overtopping the notch in the levee at the Parkside pump station. Using the MESD HEC-RAS model, it was estimated that the Parkside pump station levee notch is overtopped during a 10% AEP flood event on Harding Ditch.

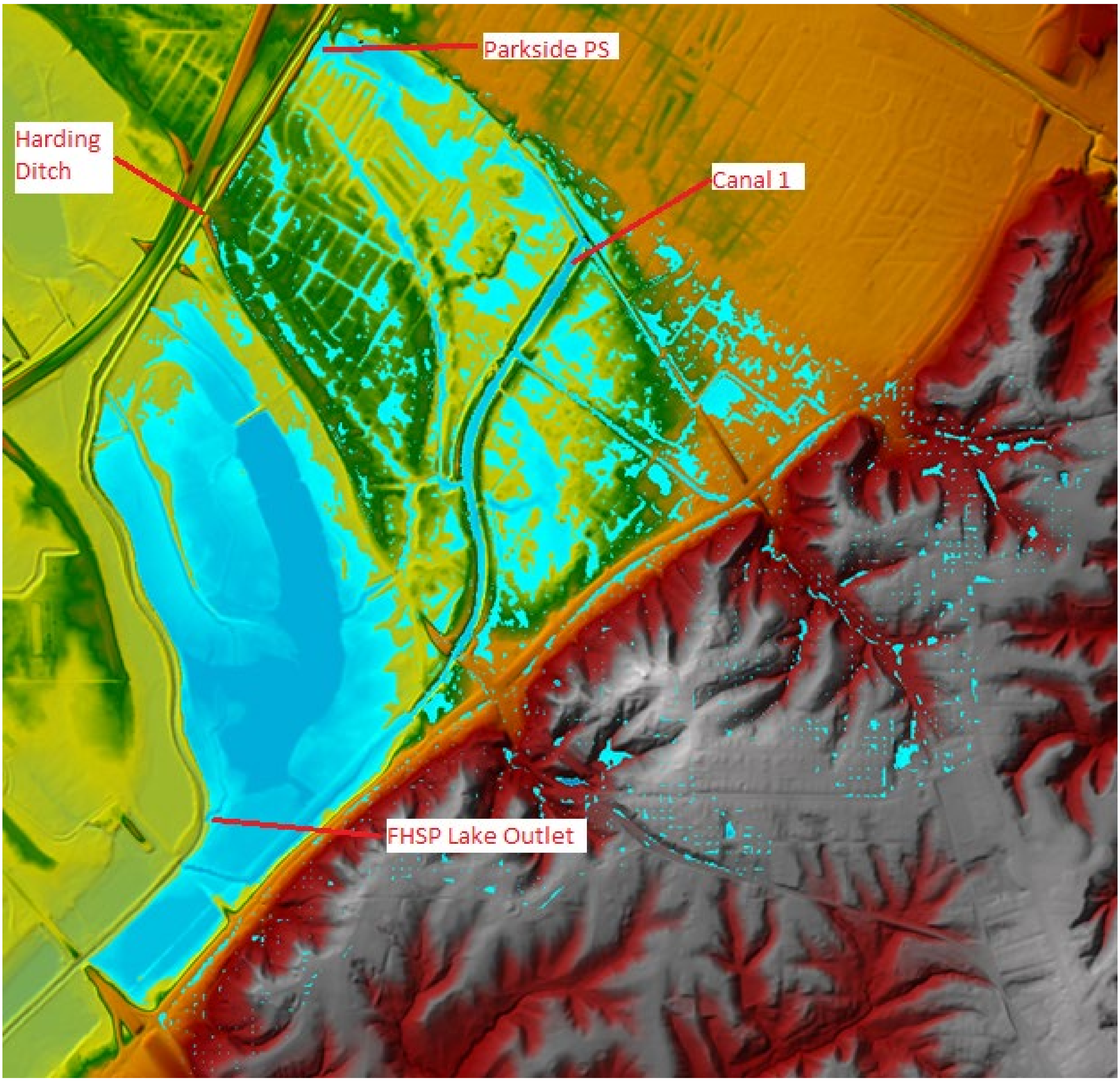


Figure A- 38: HEC-RAS Simulated 10% AEP Event Inundation During Low Mississippi River Stages

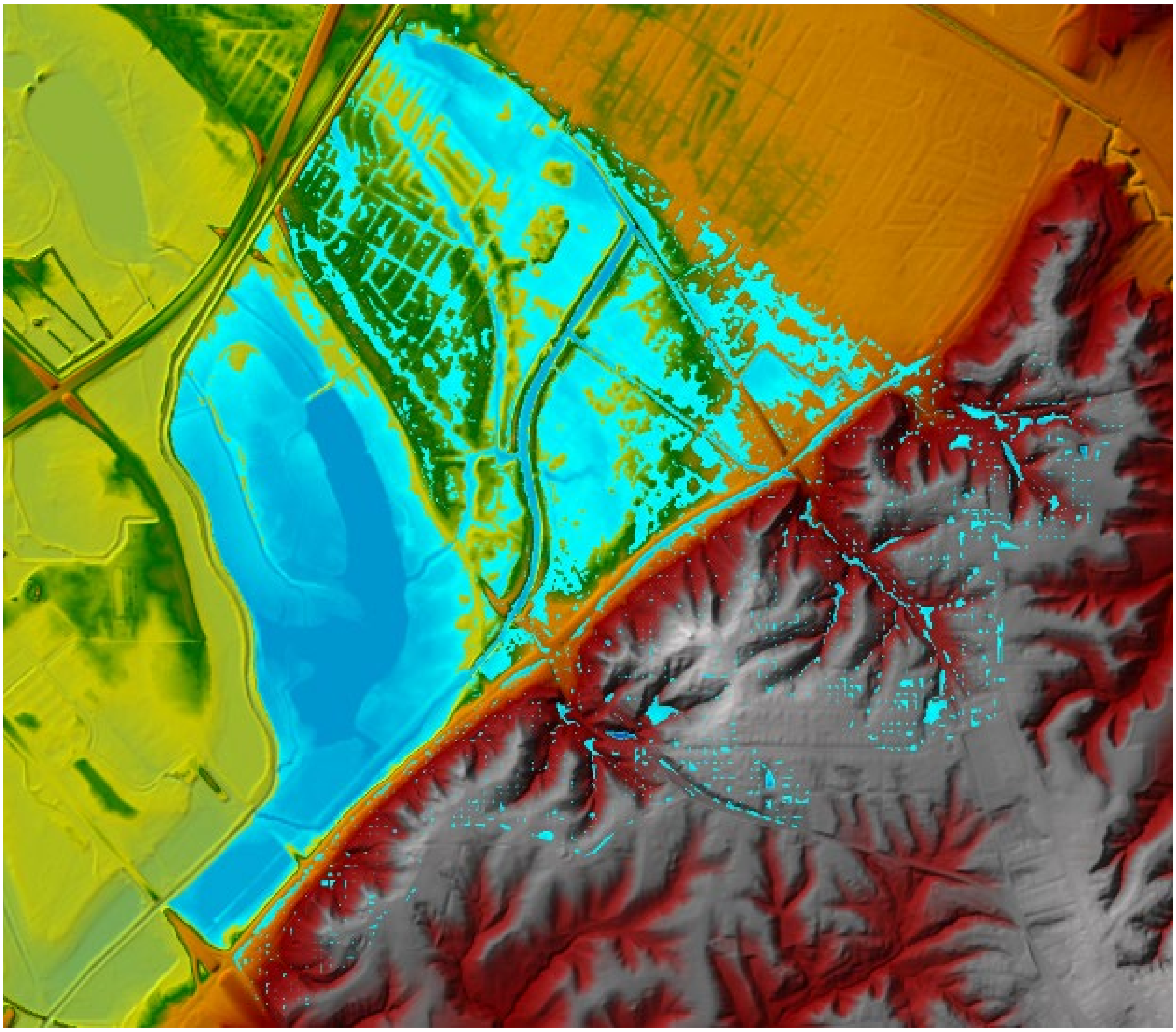


Figure A- 39: HEC-RAS Simulated 1% AEP Event Inundation During Low Mississippi River Stages

High Mississippi River stages require operation of the MESD South pump station for drainage from Harding Ditch. While under higher backwater conditions, operation of the pump station is not as efficient for conveyance of stormwater as the drainage of stormwater during gravity flow conditions (low Mississippi River stages). Though the probability of a high Mississippi River stage coincident with a 10% AEP or 1% AEP interior flood event is low, extensive Harding Ditch backwater flooding is still possible.

During a 72-hour duration storm event, drainage from the Parkside and Ping Pong interior catchment peaks and then recedes before elevated backwater flooding in Harding Ditch develops. When that elevated backwater flooding develops, the water level in Canal 1 near Lake Drive is approximately 4 feet deeper with the pumps operating than during gravity flow conditions during a 1% AEP event and 2 feet deeper during a 10% AEP event.

The peak stage at the Parkside pump station is solely the result of headwater discharges on Harding Ditch and is not the result of the South pump station operation. During MESD South pump operation, the extent of Harding Ditch backwater is independent of the peak stage at the Parkside pump station. Figures A-40 and A-41 show the extents of Harding Ditch backwater flooding during MESD South pump station operations for the 10% AEP and 1% AEP interior flood events.

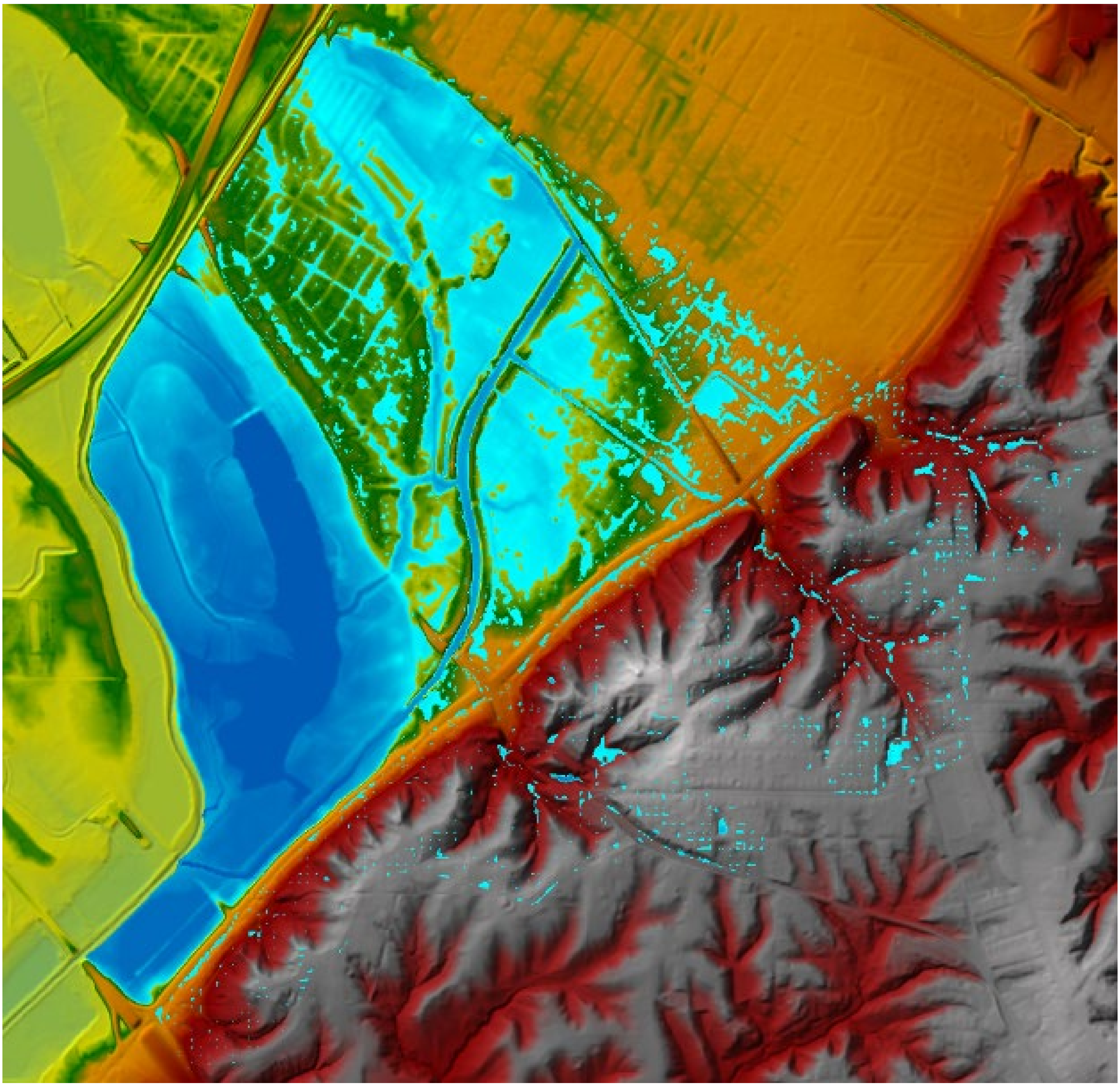


Figure A- 40: HEC-RAS Simulated 10% AEP Event Inundation During High Mississippi River Stages

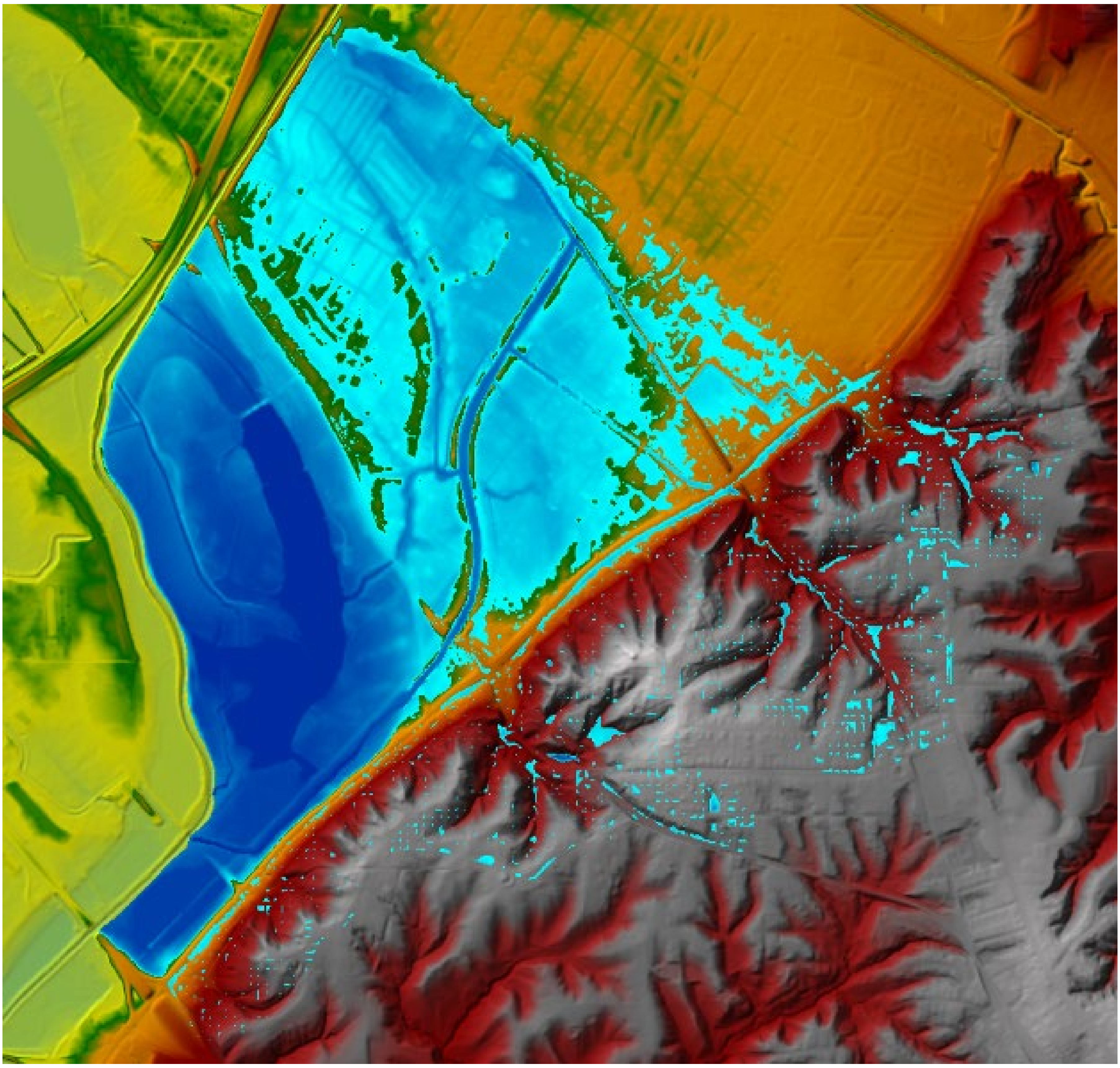


Figure A- 41: HEC-RAS Simulated 1% AEP Event Inundation During High Mississippi River Stages

A-5.0 Conclusion

Focusing on the interior flooding situation, the corrective measures examined in this study show a reduction in water surface elevation throughout the watersheds examined. The hydraulic modeling relied on the 10% AEP 24-hour duration storm event for the basis of the designs, and it was showed that stormwater conveyance can be contained underground in most areas. It has also been shown that through implementation of the maximum flood risk reduction measures there is a significant reduction in damage during the 1% AEP storm event.

One major change that should be considered now is to replace the existing Parkside pump station. Its structure is in poor shape, it does not operate at capacity, and it is only operated manually. Its operational condition contributed to the severe flooding in the Parkside Terrace subdivision in July 2022. Also, the ditches draining the Ping Pong and Parkside watersheds need to be restored. The highest priority ditch to clean out is the WPA ditch that passes through the Parkside watershed. WPA ditch is the main ditch draining the area and appears to cause the most problems in the study area.

The greatest improvement to interior drainage would be achieved if all corrective measures were implemented. Although the modeling shows that some surface drainage issues may still exist after modification of the storm sewer network, these issues can be resolved through installation of additional lines and inlets or through regrading the ground surface and ditches toward new or existing storm water inlets. It is strongly recommended that maximum corrective action be taken to reduce flood risk for long term benefit.

The potential for flooding from Harding Ditch still exists, when the Mississippi River is high, even after implementation of the flood risk reduction measures in the Parkside and Ping Pong watersheds. Further analysis of Harding Ditch, including a coincident frequency analysis of it with the Mississippi River, would be necessary to make additional flood risk reduction recommendations based on its results. Additional data collection would be needed to capture all the culverts that discharge into Canal 1 and Harding Ditch. Also, a Harding Ditch cross-section survey should be performed to update the MESD HEC-RAS model.

Any additional modeling should look at blocking Harding Ditch backwater from entering the Parkside/Ping Pong area, but subsequent impacts to other areas along Harding Ditch may result. Subsequent impacts might include backwater infiltration on the areas behind the Canal 1 embankments or complication of the Parkside/Ping Pong watershed interior drainage during high Harding Ditch stages. One potential solution could be to increase the capacity of the MESD South pump station.

A comprehensive study of Harding Ditch should be performed. In order to fully evaluate the Harding Ditch backwater condition, this comprehensive study would need to focus on the segment of the ditch from Schoenberger Creek to the South pump station.

A-6.0 Software

PCSWMM 2022, Computation Hydraulics Institute (CHI) version 7.5.3406

HEC-RAS version 6.3.1

EPA-SWMM version 5.1.015

ArcGIS Pro, ESRI, version 3.0

Google Earth Pro, Google version 7.3.4.8248

* Proposed and existing storm sewer pipe information can be made available upon request.

US Army Corps of Engineers

Cahokia Heights & East St. Louis- Flood Hazard Analysis

Appendix B Environmental Justice

August 2023

Prepared by:
U.S. Army Corps of Engineers
St. Louis District
1222 Spruce St
St. Louis, MO 63103

Environmental justice (EJ) is defined as the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies, with no group bearing a disproportionate burden of environmental harms and risks.

Several Executive Orders direct federal agencies to identify and address any disproportionately high adverse human health or environmental effects of federal actions to communities of color and/or populations with low income:

- Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (February 16, 1994)
- Executive Order 13985: Advancing Racial Equity and Support for Underserved Communities through the Federal Government (January 20, 2021)
- Executive Order 13990: Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis (January 20, 2021)
- Executive Order 14008: Tackling the Climate Crisis at Home and Abroad (January 27, 2021)
- Executive Order 14096: Revitalizing Our Nation's Commitment to Environmental Justice for All (April 21, 2023)

Environmental justice concerns may arise from impacts on the chemical, biological, and physical environment, such as human health or ecological impacts on communities of color and/or populations with low-income, and Native American tribes or from related social or economic impacts. The Council of Environmental Quality (CEQ) guidance on conducting EJ analyses in NEPA documents (CEQ, 1997) and Promising Practices for EJ Methodologies in NEPA Reviews (CEQ, 2016) indicate that minority populations exist where the percentage of people of color in an affected area either exceeds 50 percent or is meaningfully greater than in the general population or other appropriate unit of geographic analysis. The CEQ guidance also recommends utilizing the Census Bureau's poverty measures in determining populations with low-income.

CEQ has developed a Climate and Economic Justice Screen Tool (CEJST) to identify disadvantaged communities and the categories of burden. The CEQ screen tool highlights disadvantaged census tracts across all 50 states, the District of Columbia, and the U.S. territories. Communities are considered disadvantaged if they 1) are in census tracts that meet the thresholds for at least one of the tool's categories of burden, or 2) are on land within the boundaries of Federally Recognized Tribes. The tool uses datasets as indicators of burdens. The burdens are organized into categories. A community is highlighted as disadvantaged on the CEJST map if it is in a census tract that is (1) at or above the threshold for one or more environmental, climate, or other burdens, and (2) at or above the threshold for an associated socioeconomic burden.

Per Implementation Guidance of the Water Resources Development Act 2020, Section 160, an economically disadvantaged community is defined as meeting one or more of the following:

a. Low per capita income - The area has a per capita income of 80 percent or less of the national average;

b. Unemployment rate above national average - The area has an unemployment rate that is, for the most recent 24-month period for which data are available, at least 1 percent greater than the national average unemployment rate;

c. Indian country as defined in 18 U.S.C. 1151 or in the proximity of an Alaska Native Village;

d. U.S. Territories; or

e. Communities identified as disadvantaged by the Council on Environmental Quality's Climate and Economic Justice Screening Tool (USACE, Implementation Guidance for Section 160 of the Water Resources, 2023)

Due to the limitations of this study, a full evaluation of EJ impacts was not conducted. However, an initial screening using the EPA Environmental Justice Screening and Mapping Tool (EJSCREEN Version 2.1) (USEPA, 2023) and CEQ's CJEST (version 1.0) (CEQ, 2022) was used to determine that this community did meet the criteria as a disadvantaged community. The study area met the following criteria: low income, expected population loss rate, abandoned mine, health (asthma and diabetes), low life expectancy, unemployment, and low high school attainment.

Following that evaluation, a list of relevant community information from the EJ screen tool was downloaded and is included in Appendix B. This information may aid in the development of applications for technical/financial resources for securing additional support for city officials to support their respective communities.

Using EJSCREEN, an area of interest was created around the study area to develop the report. The site-specific report statistics were used to compare to the same overall categories as the State of Illinois and the nation as a whole.

For this study, no construction will be included as a part of the immediate scope of work. The study will present alternatives to reduce the flood risk associated with in this community to aid the cities of Cahokia Heights and East St. Louis as they make future decisions. The information pertaining to Environmental Justice as it relates specifically to this study area may be beneficial should city officials seek financial resource assistance to implement flood risk reduction measures. As city officials look at options and overall cost, a few technical and financial resources for them to consider are listed below:

The EPA provides numerous opportunities for financial and technical assistance for Environmental Justice Communities. Information about Environmental Justice Grants, Funding and Technical Assistance can be found on their website at:

https://www.epa.gov/environmentaljustice/environmental-justice-grants-funding-and-technical-assistance.

A few of the resources available include:

- EPA – **Region 5: Regional Technical Assistance Services Coordinator (TASC)**
    - Technical assistance centers across the nation providing technical assistance, training, and related support to communities with environmental justice concerns and their partners.
    - The new technical assistance centers will provide training, assistance, and capacity building on writing grant proposals, navigating federal systems such as Grants.gov and SAM.gov, and effectively managing grant funding. These centers will also provide guidance on community engagement, meeting facilitation, and translation and interpretation services for limited English-speaking participants.
- EPA - **Environmental Justice Collaborative Problem-Solving (EJCPS) Cooperative Agreement Program**
    - EJCPS Cooperative Agreement Program provides financial assistance to eligible organizations working on or planning to work on projects to address local environmental and/or public health issues in their communities.
    - The program assists recipients in building collaborative partnerships with other stakeholders (e.g., local businesses and industry, local government, medical service providers, academia, etc.) to develop solutions that will significantly address environmental and/or public health issue(s) at the local level.
- EPA - **Financial Technical Assistance and Tools for Water Infrastructure**
    - The Water Infrastructure and Resiliency Finance Center works with on-the-ground partners to provide financial technical assistance to communities. The Center provides:
        - Objective financial advice to help communities make informed decisions on funding drinking water, wastewater, and stormwater infrastructure projects.
        - Access to tools that help utilities make financing decisions that meet their local infrastructure needs.
- USACE- **Environmental Infrastructure Assistance**
    - This assistance supports publicly owned and operated facilities, such as water distribution works, stormwater collection, surface water protection projects, and environmental restoration, among others. This USACE assistance is broadly labeled environmental infrastructure (EI).

    - Under this authority, each new project must get Congressional authorization. This can be requested under the USACE 7001 process: https://www.usace.army.mil/Missions/Civil-Works/Project-Planning/WRRDA-7001-Proposals/.

- Fedcenter.gov – **Assistance Information**
    - Federal government's home for comprehensive environmental stewardship and compliance assistance information for Federal facility managers and their agencies.
    - The Grants page contains information on various Federal, State and non-profit organization grant opportunities.

- FEMA - **Disaster Assistance**
    - FEMA Illinois Severe Storm and Flooding (DR-4676-IL)
    - https://www.fema.gov/disaster/4676
    - Incident Period: Jul 25, 2022 - Jul 28, 2022
    - Declaration Date: Oct 14, 2022

- U.S. Department of Commerce – **Grant Opportunities**
    - https://www.commerce.gov/work-with-us/grants-and-contract-opportunities

- Illinois Department of Commerce and Economic Opportunity – **Grant Opportunities**
  https://dceo.illinois.gov/aboutdceo/grantopportunities/grants.html

CEQ SCREEN TOOL RESULTS

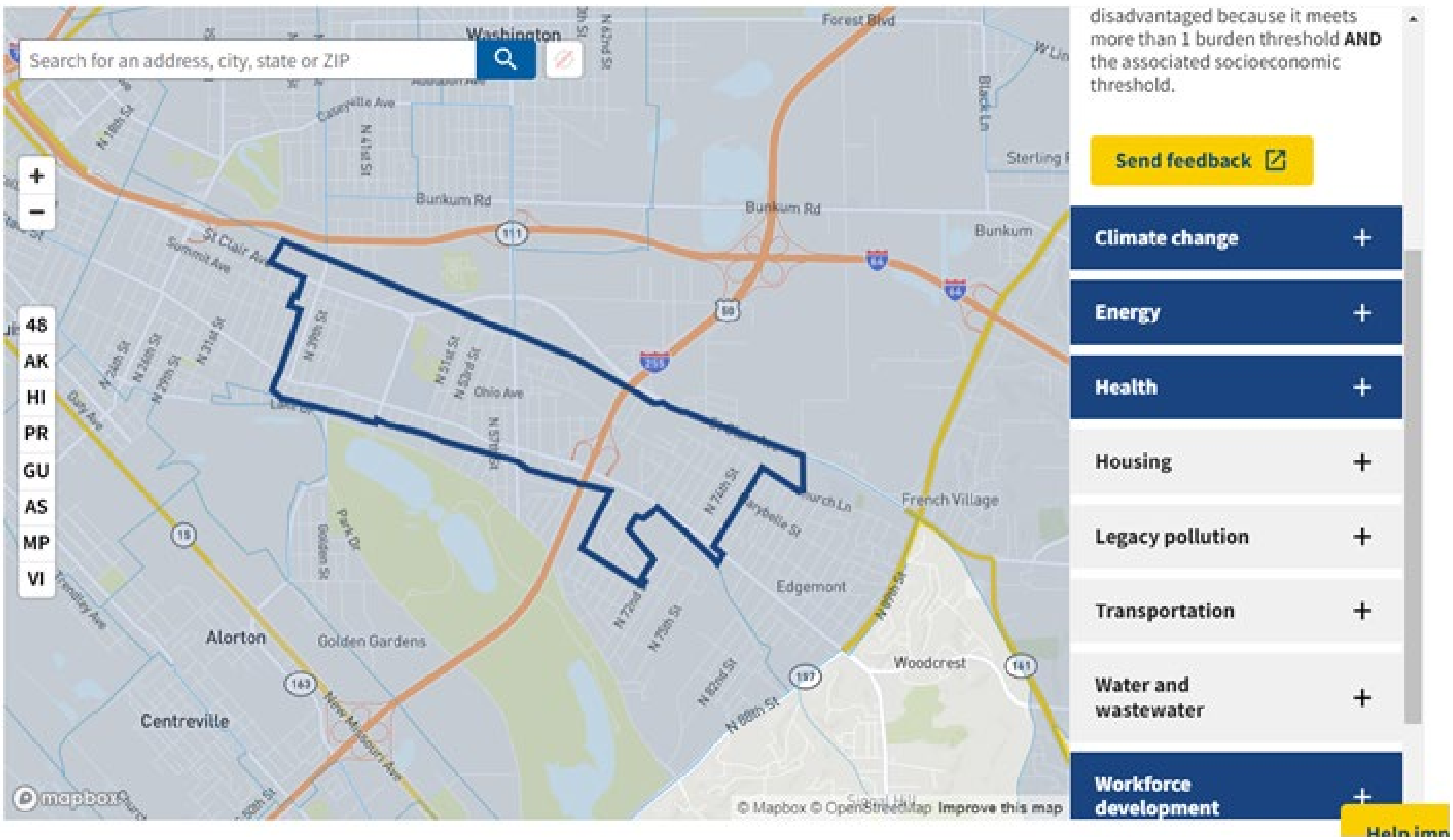


Figure B - 1: Image of CEQ Screen Tool Results for Number 17163501300

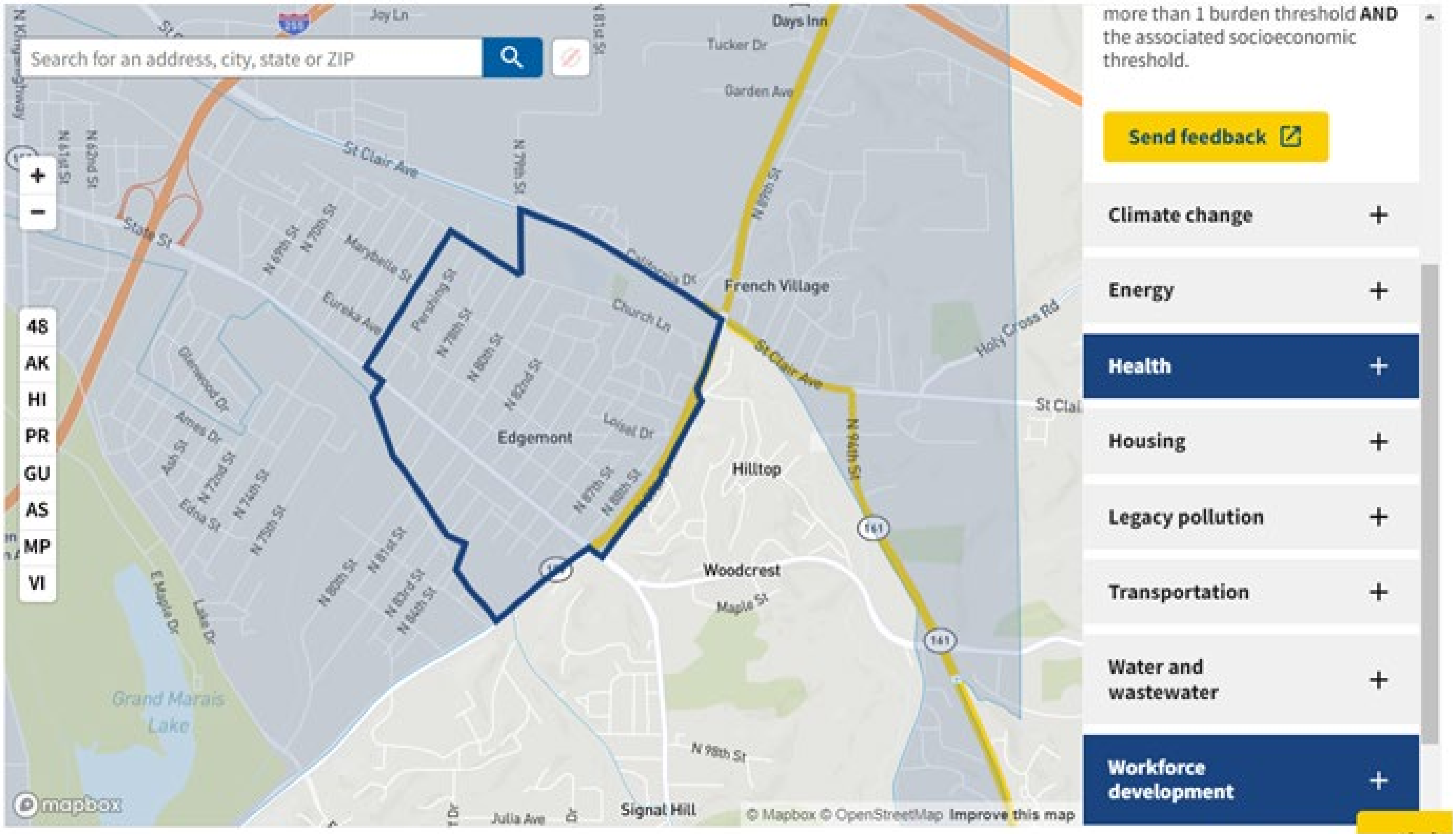


Figure B - 2: Image from CEQ Screen Tool for Number 17163501400

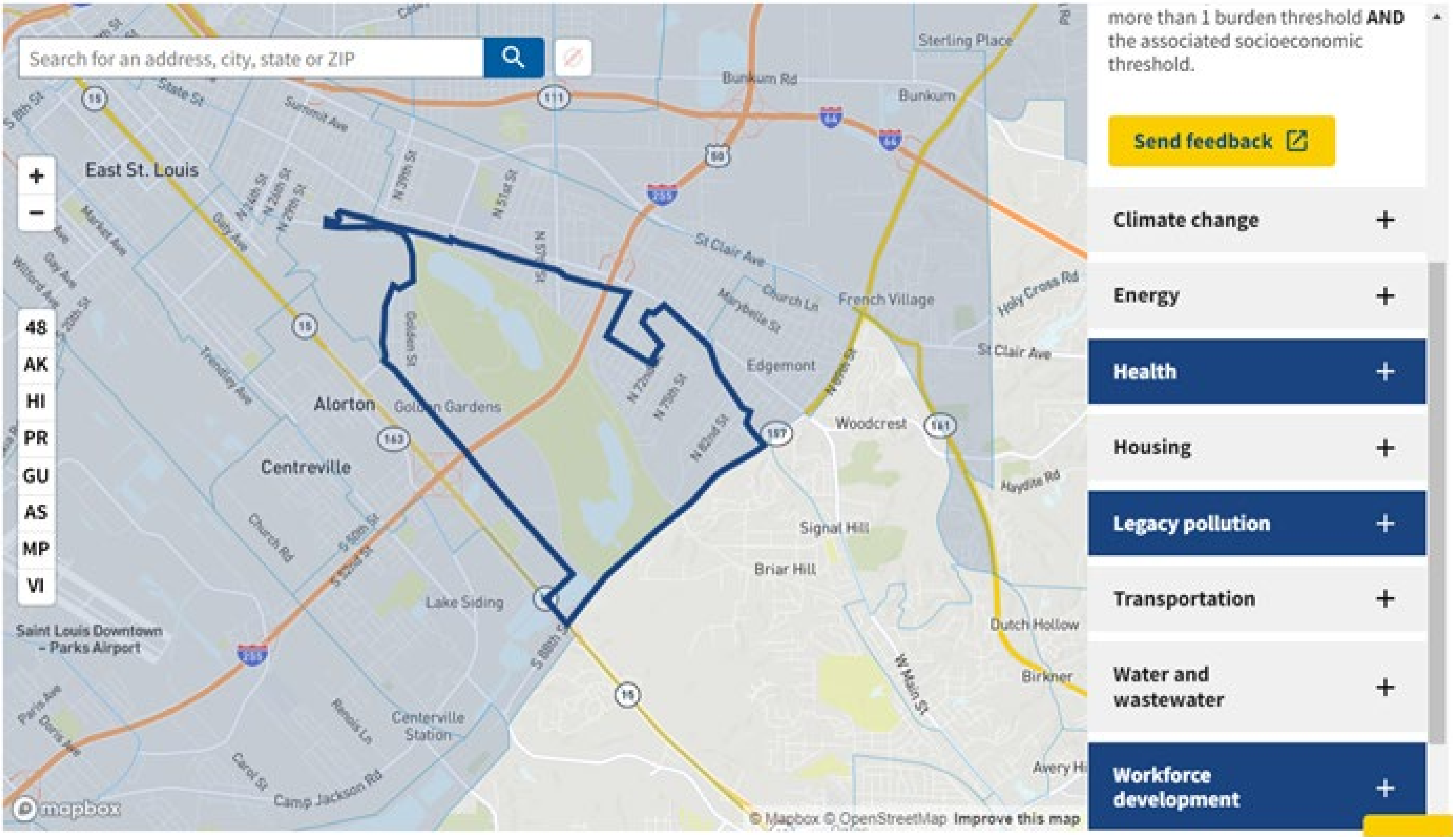


Figure B - 3: Image from CEQ Screen Tool for Number 17163502900

Table B - 1: Table of CEQ Metric Results for Study Area

Census tract 2010 ID	Percent age over 64	Total threshold criteria exceeded	Total categories exceeded	Identified as disadvantaged without considering neighbors	Identified as disadvantaged based on neighbors and relaxed low income threshold only	Identified as disadvantaged due to tribal overlap	Identified as disadvantaged	Percentage of tract that is disadvantaged by area	Share of neighbors that are identified as disadvantaged	Total population	Adjusted percent of individuals below 200% Federal Poverty Line (percentile)	Adjusted percent of individuals below 200% Federal Poverty Line
17163501300	0.23	7	4	TRUE	TRUE		TRUE	100	100	3801	0.83	0.44
17163501400	0.16	4	2	TRUE	FALSE		TRUE	100	60	3345	0.86	0.47
17163502900	0.35	5	3	TRUE	FALSE		TRUE	100	83	1757	0.78	0.39

Census tract 2010 ID	Is low income?	Income data has been estimated based on geographic neighbor income	Greater than or equal to the 90th percentile for expected agriculture loss rate and is low income?	Expected agricultural loss rate (Natural Hazards Risk Index) (percentile)	Expected agricultural loss rate (Natural Hazards Risk Index)	Greater than or equal to the 90th percentile for expected building loss rate and is low income?	Expected building loss rate (Natural Hazards Risk Index) (percentile)	Expected building loss rate (Natural Hazards Risk Index)	Greater than or equal to the 90th percentile for expected population loss rate and is low income?	Expected population loss rate (Natural Hazards Risk Index) (percentile)	Expected population loss rate (Natural Hazards Risk Index)	Share of properties at risk of flood in 30 years (percentile)
17163501300	TRUE	FALSE	FALSE	10	0.0007	FALSE	74	0.0343	TRUE	92	0.001	86
17163501400	TRUE	FALSE	FALSE	11	0.0009	FALSE	69	0.028	FALSE	74	0.0004	72
17163502900	TRUE	FALSE	FALSE	38	0.0461	FALSE	72	0.0308	FALSE	84	0.0006	79

Census tract 2010 ID	Share of properties at risk of flood in 30 years	Greater than or equal to the 90th percentile for share of properties at risk of flood in 30 years	Greater than or equal to the 90th percentile for share of properties at risk of flood in 30 years and is low	Share of properties at risk of fire in 30 years (percentile)	Share of properties at risk of fire in 30 years	Greater than or equal to the 90th percentile for share of properties at risk of fire in 30 years	Greater than or equal to the 90th percentile for share of properties at risk of fire in 30 years and is low	Greater than or equal to the 90th percentile for energy burden and is low income?	Energy burden (percentile)	Energy burden	Greater than or equal to the 90th percentile for PM2.5 exposure and is low income?	PM2.5 in the air (percentile)
17163501300	21	FALSE	FALSE	33	0	FALSE	FALSE	TRUE	92	5	FALSE	76
17163501400	12	FALSE	FALSE	33	0	FALSE	FALSE	FALSE	84	4	FALSE	75
17163502900	15	FALSE	FALSE	33	0	FALSE	FALSE	FALSE	89	5	FALSE	75

Census tract 2010 ID	PM2.5 in the air	Greater than or equal to the 90th percentile for diesel particulate matter and is low income?	Diesel particulate matter exposure (percentile)	Diesel particulate matter exposure	Greater than or equal to the 90th percentile for traffic proximity and is low income?	Traffic proximity and volume (percentile)	Traffic proximity and volume	Greater than or equal to the 90th percentile for DOT transit barriers and is low income?	DOT Travel Barriers Score (percentile)	Greater than or equal to the 90th percentile for housing burden and is low income?	Housing burden (percent) (percentile)	Housing burden (percent)
17163501300	9.51	FALSE	64	0.31	FALSE	49	283.79	FALSE	81	FALSE	84	38
17163501400	9.46	FALSE	54	0.26	FALSE	38	178.73	FALSE	56	FALSE	76	33
17163502900	9.45	FALSE	59	0.29	FALSE	52	318.29	FALSE	79	FALSE	82	36

Census tract 2010 ID	Greater than or equal to the 90th percentile for lead paint, the median house value is less than 90th percentile and is	Percent pre-1960s housing (lead paint indicator) (percentile)	Percent pre-1960s housing (lead paint indicator)	Median value ($) of owner-occupied housing units (percentile)	Median value ($) of owner-occupied housing units	Greater than or equal to the 90th percentile for share of the tract's land area that is covered by impervious	Greater than or equal to the 90th percentile for share of the tract's land area that is covered by impervious	Share of the tract's land area that is covered by impervious surface or cropland as a percent	Share of the tract's land area that is covered by impervious surface or cropland as a percent	Does the tract have at least 35 acres in it?	Tract experienced historic underinvestment and remains low income	Tract experienced historic underinvestment
17163501300	FALSE	88	70	2	52500	FALSE	FALSE	3970	52	TRUE	FALSE	FALSE
17163501400	FALSE	87	68	2	55900	FALSE	FALSE	3916	51	TRUE	FALSE	FALSE
17163502900	FALSE	78	56	1	48700	FALSE	FALSE	2039	25	TRUE	FALSE	FALSE

Census tract 2010 ID	Share of homes with no kitchen or indoor plumbing (percentile)	Share of homes with no kitchen or indoor plumbing (percent)	Greater than or equal to the 90th percentile for proximity to hazardous waste facilities and is low income?	Proximity to hazardous waste sites (percentile)	Proximity to hazardous waste sites	Greater than or equal to the 90th percentile for proximity to superfund sites and is low income?	Proximity to NPL (Superfund) sites (percentile)	Proximity to NPL (Superfund) sites	Greater than or equal to the 90th percentile for proximity to RMP sites and is low income?	Proximity to Risk Management Plan (RMP) facilities (percentile)	Proximity to Risk Management Plan (RMP) facilities	Is there at least one Formerly Used Defense Site (FUDS) in the tract?
17163501300	0.77	0.01	FALSE	60	1.33	FALSE	85	0.2	FALSE	70	0.85	
17163501400	0.21	0	FALSE	44	0.57	FALSE	79	0.15	FALSE	32	0.18	
17163502900	0.21	0	FALSE	53	0.93	FALSE	81	0.16	FALSE	65	0.7	

Census tract 2010 ID	Is there at least one abandoned mine in this census tract?	There is at least one abandoned mine in this census tract and the tract is low income.	There is at least one Formerly Used Defense Site (FUDS) in the tract and the tract is low income.	Is there at least one Formerly Used Defense Site (FUDS) in the tract, where missing data is treated as False?	Is there at least one abandoned mine in this census tract, where missing data is treated as False?	Greater than or equal to the 90th percentile for wastewater discharge and is low income?	Wastewater discharge (percentile)	Wastewater discharge	Greater than or equal to the 90th percentile for leaky underground storage tanks and is low income?	Leaky underground storage tanks (percentile)	Leaky underground storage tanks	Greater than or equal to the 90th percentile for asthma and is low income?
17163501300		FALSE	FALSE	FALSE	FALSE	FALSE	1	0	FALSE	79	6.04	TRUE
17163501400		FALSE	FALSE	FALSE	FALSE	FALSE	0	0	FALSE	66	3.41	TRUE
17163502900	TRUE	TRUE	FALSE	FALSE	TRUE	FALSE	0	0	FALSE	66	3.52	TRUE

Census tract 2010 ID	Current asthma among adults aged greater than or equal to 18 years (percentile)	Current asthma among adults aged greater than or equal to 18 years	Greater than or equal to the 90th percentile for diabetes and is low income?	Diagnosed diabetes among adults aged greater than or equal to 18 years (percentile)	Diagnosed diabetes among adults aged greater than or equal to 18 years	Greater than or equal to the 90th percentile for heart disease and is low income?	Coronary heart disease among adults aged greater than or equal to 18 years (percentile)	Coronary heart disease among adults aged greater than or equal to 18 years	Greater than or equal to the 90th percentile for low life expectancy and is low income?	Low life expectancy (percentile)	Life expectancy (years)	Greater than or equal to the 90th percentile for low median household income as a percent of area median income
17163501300	94	1260	TRUE	98	2230	FALSE	86	840	TRUE	92	72.5	TRUE
17163501400	94	1250	TRUE	97	2039	FALSE	78	760	TRUE	97	69.7	FALSE
17163502900	94	1250	TRUE	98	2200	FALSE	86	840	TRUE	94	71.8	TRUE

Census tract 2010 ID	Low median household income as a percent of area median income (percentile)	Median household income as a percent of area median income	Greater than or equal to the 90th percentile for households in linguistic isolation and has low HS attainment?	Linguistic isolation (percent) (percentile)	Linguistic isolation (percent)	Greater than or equal to the 90th percentile for unemployment and has low HS attainment?	Unemployment (percent) (percentile)	Unemployment (percent)	Greater than or equal to the 90th percentile for households at or below 100% federal poverty level and has low	Percent of individuals below 200% Federal Poverty Line (percentile)	Percent of individuals below 200% Federal Poverty Line	Percent of individuals < 100% Federal Poverty Line (percentile)
17163501300	93	47	FALSE	12	0	TRUE	95	15	FALSE	75	45	84
17163501400	79	66	FALSE	12	0	TRUE	99	42	FALSE	87	56	60
17163502900	93	48	FALSE	12	0	FALSE	80	8	FALSE	78	48	80

Census tract 2010 ID	Percent of individuals < 100% Federal Poverty Line	Percent individuals age 25 or over with less than high school degree (percentile)	Percent individuals age 25 or over with less than high school degree	Percent of residents who are not currently enrolled in higher ed	Unemployment (percent) in 2009 (island areas) and 2010 (states and PR)	Percentage households below 100% of federal poverty line in 2009 (island areas) and 2010 (states and PR)	Greater than or equal to the 90th percentile for unemployment and has low HS education in 2009 (island areas)?	Greater than or equal to the 90th percentile for households at or below 100% federal poverty level and has low	Greater than or equal to the 90th percentile for low median household income as a percent of area median income	Number of Tribal areas within Census tract for Alaska	Names of Tribal areas within Census tract	Percent of the Census tract that is within Tribal areas
17163501300	26	73	16	98	11	33	FALSE	FALSE	FALSE			
17163501400	14	57	11	91	11	26	FALSE	FALSE	FALSE			
17163502900	23	67	14	91	19	19	FALSE	FALSE	FALSE			

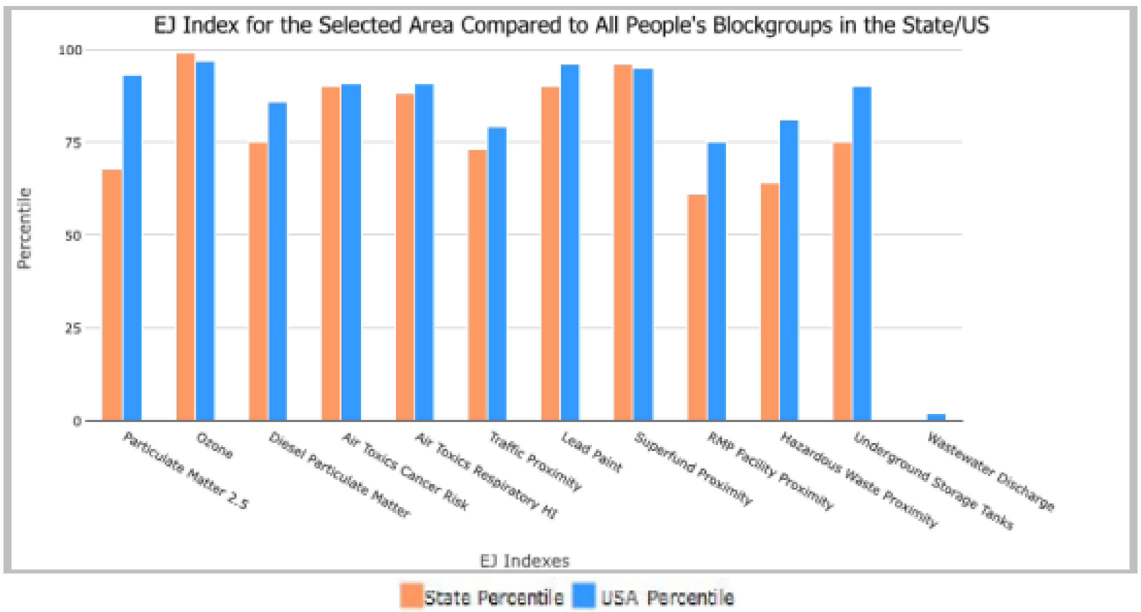
EJScreen Report (Version 2.1)

the User Specified Area, ILLINOIS, EPA Region 5

Approximate Population: 6,654

Input Area (sq. miles): 2.32

Selected Variables	State Percentile	USA Percentile
Environmental Justice Indexes		
EJ Index for Particulate Matter 2.5	68	93
EJ Index for Ozone	99	97
EJ Index for Diesel Particulate Matter*	75	86
EJ Index for Air Toxics Cancer Risk*	90	91
EJ Index for Air Toxics Respiratory HI*	88	91
EJ Index for Traffic Proximity	73	79
EJ Index for Lead Paint	90	96
EJ Index for Superfund Proximity	96	95
EJ Index for RMP Facility Proximity	61	75
EJ Index for Hazardous Waste Proximity	64	81
EJ Index for Underground Storage Tanks	75	90
EJ Index for Wastewater Discharge	0	2



This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

March 15, 2023 1/3

EJScreen Report (Version 2.1)

the User Specified Area, ILLINOIS, EPA Region 5

Approximate Population: 6,654
Input Area (sq. miles): 2.32

No map available

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

EJScreen Report (Version 2.1)

the User Specified Area, ILLINOIS, EPA Region 5

Approximate Population: 6,654

Input Area (sq. miles): 2.32

Selected Variables	Value	State Avg.	%ile in State	USA Avg.	%ile in USA
Pollution and Sources					
Particulate Matter 2.5 ($\mu g/m^3$)	9.48	9.92	32	8.67	75
Ozone (ppb)	48.6	45.2	99	42.5	87
Diesel Particulate Matter* ($\mu g/m^3$)	0.288	0.396	41	0.294	60-70th
Air Toxics Cancer Risk* (lifetime risk per million)	30	28	89	28	80-90th
Air Toxics Respiratory HI*	0.4	0.37	78	0.36	80-90th
Traffic Proximity (daily traffic count/distance to road)	230	760	41	760	50
Lead Paint (% Pre-1960 Housing)	0.69	0.4	74	0.27	85
Superfund Proximity (site count/km distance)	0.16	0.095	91	0.13	81
RMP Facility Proximity (facility count/km distance)	0.26	1.2	27	0.77	45
Hazardous Waste Proximity (facility count/km distance)	0.7	2.7	30	2.2	50
Underground Storage Tanks (count/km^2)	3.8	8.6	45	3.9	71
Wastewater Discharge (toxicity-weighted concentration/m distance)	3.4E-09	27	0	12	0
Socioeconomic Indicators					
Demographic Index	72%	34%	90	35%	90
People of Color	98%	39%	93	40%	95
Low Income	45%	27%	78	30%	75
Unemployment Rate	20%	6%	93	5%	95
Limited English Speaking Households	0%	4%	0	5%	0
Less Than High School Education	15%	10%	76	12%	72
Under Age 5	3%	6%	24	6%	27
Over Age 64	25%	16%	82	16%	80

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

For additional information, see: www.epa.gov/environmentaljustice

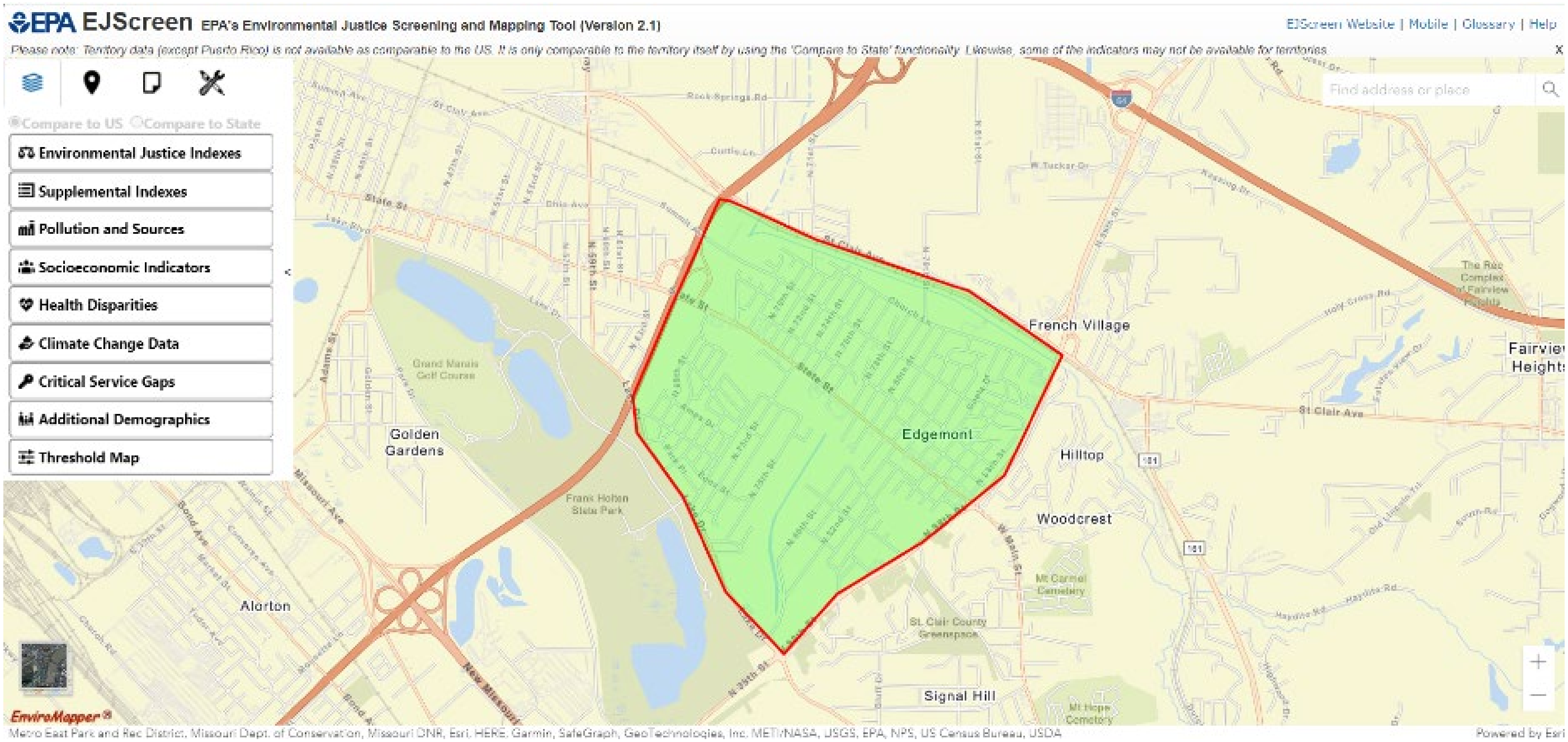


Figure B - 4: Map of Study Area Selected - EJ Screen Tool

US Army Corps of Engineers

Cahokia Heights & East St. Louis- Flood Hazard Analysis

Appendix C Cost

August 2023

Prepared by:
U.S. Army Corps of Engineers
St. Louis District
1222 Spruce St
St. Louis, MO 63103

ESTL-Cahokia Heights — 6/12/2023

Edgemont - Limited — 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$17,000	
Clean Existing Pipe		
Length of Pipe	$138,930	
Set Up Locations	$31,900	
SUBTOTAL:	$188,000	
Contingency:	$66,000	35%
Construction Subtotal:	$254,000	
E & D :	$50,000	18%
CM :	$30,000	10%
TOTAL COST:	$334,000	

ESTL-Cahokia Heights — 4/3/2023

Pump Station

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Pump Station (275 CFS)	$29,128,000	
SUBTOTAL:	$29,128,000	
Contingency:	$10,195,000	35%
Construction Subtotal:	$39,323,000	
E & D :	$7,080,000	18%
CM :	$3,930,000	10%
TOTAL COST:	$50,333,000	

ESTL-Cahokia Heights — 6/12/2023

Edgemont - Intermediate — 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$1,026,000	
Fill In Levee Gap		
Embankment	$16,280	
Underground Sewer Improvements		
Asphalt Demo	$404,000	
Excavate Trench	$1,066,740	
Soil Disposal Fee	$128,960	
Demo Existing RCP Culverts	$3,093,200	
12" RCP Culvert	$94,920	
15" RCP Culvert	$83,080	
21" RCP Culvert	$258,400	
24" RCP Culvert	$186,120	
27" RCP Culvert	$293,220	
30" RCP Culvert	$371,475	
36" RCP Culvert	$655,500	
48" RCP Culvert	$408,595	
60" RCP Culvert	$1,264,360	
72" RCP Culvert	$8,927,000	
Bedding Stone	$2,080,710	
Compacted Backfill	$636,300	
Asphalt	$374,912	
Clean Existing Pipe		
Length of Pipe	$138,930	
Set Up Locations	$31,900	
SUBTOTAL:	$21,541,000	
Contingency:	$7,539,000	35%
Construction Subtotal:	$29,080,000	
E & D :	$5,230,000	18%
CM :	$2,910,000	10%
TOTAL COST:	$37,220,000	

ESTL-Cahokia Heights — 6/12/2023

Edgemont - Maximum — 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$1,044,000	
Fill In Levee Gap		
Embankment	$16,280	
Underground Sewer Improvements		
Asphalt Demo	$404,000	
Excavate Trench	$1,066,740	
Soil Disposal Fee	$128,960	
Demo Existing RCP Culverts	$3,093,200	
12" RCP Culvert	$94,920	
15" RCP Culvert	$83,080	
18" RCP Culvert	$284,900	
21" RCP Culvert	$258,400	
24" RCP Culvert	$186,120	
27" RCP Culvert	$293,220	
30" RCP Culvert	$371,475	
36" RCP Culvert	$655,500	
48" RCP Culvert	$408,595	
60" RCP Culvert	$1,264,360	
72" RCP Culvert	$8,927,000	
Bedding Stone	$2,080,710	
Compacted Backfill	$636,300	
Area Inlet Structures	$83,700	
Asphalt	$374,912	
Clean Existing Pipe		
Length of Pipe	$138,930	
Set Up Locations	$31,900	
SUBTOTAL:	$21,927,000	
Contingency:	$7,674,000	35%
Construction Subtotal:	$29,601,000	
E & D :	$5,330,000	18%
CM :	$2,960,000	10%
TOTAL COST:	$37,891,000	

- Note the Edgemont watershed area benefits the most from the Parkside pump station, but the pump station is actually located in Parkside watershed. The cost of increasing the size of the pump station is accounted for separately for each area but should be factored into overall cost.

ESTL-Cahokia Heights — 6/12/2023

Parkside - Limited — 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$82,000	
Open Channel Improvements		
Ditch Excavation	$636,160	
Soil Disposal Fee	$79,520	
Seed and Straw	$48,300	
Clean Existing Pipe		
Length of Pipe	$41,877	
Set Up Locations	$15,400	
SUBTOTAL:	$903,000	
Contingency:	$316,000	35%
Construction Subtotal:	$1,219,000	
E & D :	$220,000	18%
CM :	$120,000	10%
TOTAL COST:	$1,559,000	

ESTL-Cahokia Heights — 4/3/2023

Pump Station

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Pump Station (275 CFS)	$29,128,000	
SUBTOTAL:	$29,128,000	
Contingency:	$10,195,000	35%
Construction Subtotal:	$39,323,000	
E & D :	$7,080,000	18%
CM :	$3,930,000	10%
TOTAL COST:	$50,333,000	

ESTL-Cahokia Heights — 6/12/2023

Parkside - Intermediate — 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$95,000	
Open Channel Improvements		
Ditch Excavation	$636,160	
Excavate Detention Basin	$110,080	
Soil Disposal Fee	$93,280	
Seed and Straw	$48,300	
Clean Existing Pipe		
Length of Pipe	$41,877	
Set Up Locations	$15,400	
SUBTOTAL:	$1,040,000	
Contingency:	$364,000	35%
Construction Subtotal:	$1,404,000	
E & D :	$250,000	18%
CM :	$140,000	10%
TOTAL COST:	$1,794,000	

ESTL-Cahokia Heights — 6/12/2023

Parkside - Maximum — 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$426,000	
Open Channel Improvements		
Ditch Excavation	$636,160	
Excavate Detention Basin	$110,080	
Soil Disposal Fee	$93,280	
Seed and Straw	$48,300	
Underground Sewer Improvements		
Asphalt Demo	$121,300	
Excavate Trench	$129,490	
Soil Disposal Fee	$18,640	
Demo Existing RCP Culverts	$699,600	
12" RCP Culvert	$86,520	
15" RCP Culvert	$26,350	
18" RCP Culvert	$56,350	
21" RCP Culvert	$168,625	
24" RCP Culvert	$110,880	
27" RCP Culvert	$96,390	
30" RCP Culvert	$238,875	
36" RCP Culvert	$948,060	
Bedding Stone	$431,575	
Compacted Backfill	$43,650	
Area Inlet Structures	$40,500	
Asphalt	$96,744	
Clean Existing Pipe		
Length of Pipe	$41,877	
Set Up Locations	$15,400	
SUBTOTAL:	$4,685,000	
Contingency:	$1,640,000	35%
Construction Subtotal:	$6,325,000	
E & D :	$1,140,000	18%
CM :	$630,000	10%
TOTAL COST:	$8,095,000	

ESTL-Cahokia Heights 6/12/2023
PingPong - Limited 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$140,000	
Open Channel Improvements		
Ditch Excavation	$1,027,200	
Soil Disposal Fee	$128,400	
Seed and Straw	$75,900	
Remove and Replace R200 Riprap	$163,735	
SUBTOTAL:	$1,535,000	
Contingency:	$537,000	35%
Construction Subtotal:	$2,072,000	
E & D :	$370,000	18%
CM :	$210,000	10%
TOTAL COST:	$2,652,000	

ESTL-Cahokia Heights 6/12/2023
PingPong - Intermediate 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$337,000	
Open Channel Improvements		
Ditch Excavation	$1,027,200	
Soil Disposal Fee	$128,400	
Seed and Straw	$75,900	
Remove and Replace R200 Riprap	$163,735	
Underground Sewer Improvements		
Excavate Trench	$112,930	
Soil Disposal Fee	$13,880	
12" RCP Culvert	$89,600	
15" RCP Culvert	$69,440	
18" RCP Culvert	$44,800	
24" RCP Culvert	$66,825	
30" RCP Culvert	$157,950	
36" RCP Culvert	$525,000	
48" RCP Culvert	$347,100	
Bedding Stone	$323,300	
Compacted Backfill	$64,800	
Area Inlet Structures	$156,600	
SUBTOTAL:	$3,704,000	
Contingency:	$1,296,000	35%
Construction Subtotal:	$5,000,000	
E & D :	$900,000	18%
CM :	$500,000	10%
TOTAL COST:	$6,400,000	

ESTL-Cahokia Heights 6/12/2023
PingPong - Maximum 7/20/2023

**Excludes Real Estate & Mitigation Costs

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$976,000	
Open Channel Improvements		
Ditch Excavation	$1,027,200	
Soil Disposal Fee	$128,400	
Seed and Straw	$75,900	
Remove and Replace R200 Riprap	$163,735	
Underground Sewer Improvements		
Excavate Trench	$112,930	
Soil Disposal Fee	$13,880	
12" RCP Culvert	$89,600	
15" RCP Culvert	$69,440	
18" RCP Culvert	$44,800	
24" RCP Culvert	$66,825	
30" RCP Culvert	$157,950	
36" RCP Culvert	$525,000	
48" RCP Culvert	$347,100	
Bedding Stone	$323,300	
Compacted Backfill	$64,800	
Area Inlet Structures	$156,600	
Pump Station (75 CFS)	$6,392,650	
SUBTOTAL:	$10,736,000	
Contingency:	$3,758,000	35%
Construction Subtotal:	$14,494,000	
E & D :	$2,610,000	18%
CM :	$1,450,000	10%
TOTAL COST:	$18,554,000	