REGIONAL CLIMATE VULNERABILITY ASSESSMENT

Part 1: Localized Flood Risk
Chapter 3: Wastewater

METROPOLITAN COUNCIL

January 2019

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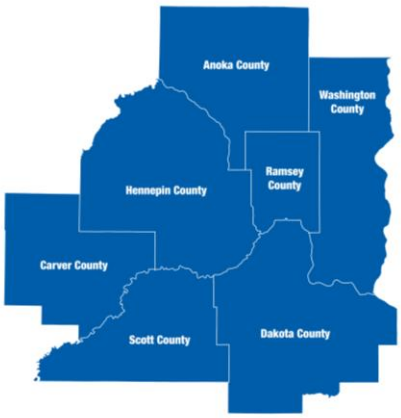

The Metropolitan Council is the regional planning organization for the seven-county Twin Cities area. The Council operates the regional bus and rail system, collects and treats wastewater, coordinates regional water resources, plans and helps fund regional parks, and administers federal funds that provide housing opportunities for low- and moderate-income individuals and families. The 17-member Council board is appointed by and serves at the pleasure of the governor.

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Chapter 3: Wastewater

Metropolitan Council Environmental Services (MCES) is the regional wastewater treatment provider for the Twin Cities metro area, treating on average 250 million gallons of wastewater from 109 of the region's communities. The regional wastewater collection system consists of 8 wastewater treatment facilities, about 632 miles of interceptor pipe, 7,550 maintenance holes, 216 meters, and 62 lift stations.

Given the well documented precipitation increases within Minnesota, the Council must manage its wastewater assets in a proactive and preventative manner. The Council has analyzed its wastewater infrastructure using its *Localized Flood Map for Climate Vulnerability Screening*. The localized flooding areas shown on this map are referred to as "Bluespots." To learn about the methods employed in creating the localized flooding data layer, please refer to the document entitled *Localized Flood Risk – Introduction* on the Climate Vulnerability Assessment (CVA) webpage: *https://metrocouncil.org/CVA*.

The following assets have been analyzed in this chapter of the Regional Climate Vulnerability Assessment:

- MCES Wastewater Treatment Plant (WWTP) Facilities & Access
- MCES Flow Meters (RTU/CLP Cabinets & Meter Vaults)
- MCES Lift Stations
- MCES Maintenance Holes

Ventilation Tubes at East Bethel WWTP. Source: Metropolitan Council Digital Image Library

Localized Versus Riverine Flooding

Riverine flooding occurs when extended rainfall or snowmelt causes a river to exceed its capacity. Localized flooding occurs when high intensity rainfall creates a flooded area independent of an overflowing water body. Riverine flooding areas are generally known and regulated by relevant stakeholders, be it local floodplain managers or state agency staff. It is advisable that riverine flooding be considered with the latest modelling data and *Atlas 14 precipitation estimates* to ensure that all floodplain mapping is up to date and as accurate as possible.

The localized flooding data layer does not replace the FEMA flood information. Instead, this data allows for a localized screening of areas that could be prone to surface water flooding that can occur outside the influence of streams and rivers. In recent years, cities have seen much more surface or localized flooding from short, intense rain events. While communities plan for such occurrences, in some instances stormwater infrastructure can become overwhelmed or blocked. The localized flooding data shows potential flood risks in the wastewater system in the event of stormwater infrastructure failure.

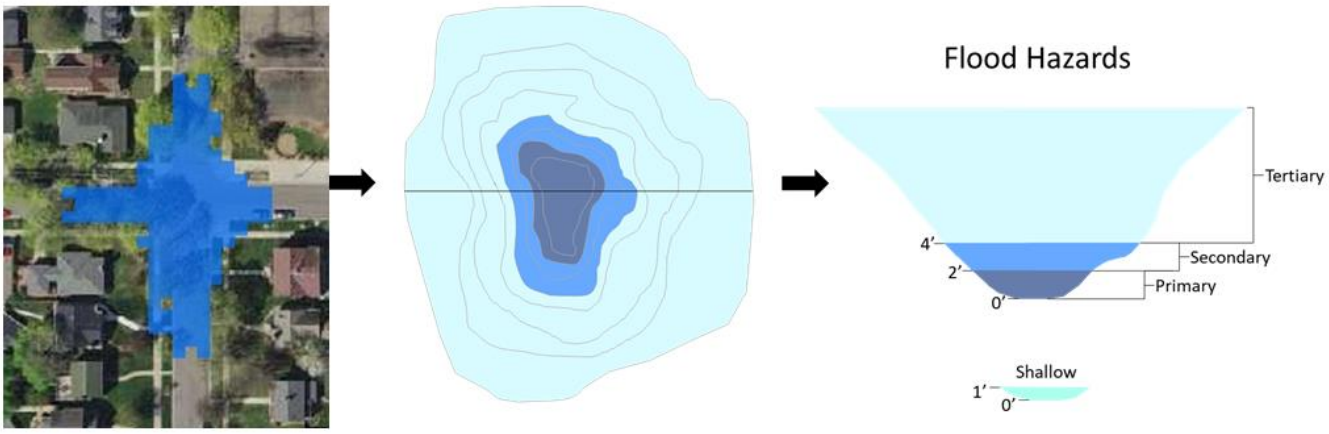
Some maps in this assessment include the FEMA floodplain as a point of reference. For instance, when mapping potential localized flooding impacts on MCES Wastewater Treatment Plants, the FEMA

floodplain (shown in shades of brown) is included to highlight other considerations. Council staff plan for the risk of riverine flooding at the eight wastewater treatment plants, but it is still important to reference the riverine floodplain risk to better understand how riverine flooding risk and subsequent vulnerabilities may relate to the potential risk of localized flooding.

Localized Flood Hazard Categorization

Figure 1 below shows an aerial map view and a cross-section of a generalized Bluespot. This visualization can help stakeholders understand that the first areas to fill with water tend to carry the highest risk, and therefore assets in those areas tend to have the highest vulnerability to impacts associated with localized flooding.

Figure 1. Map view of a Bluespot and a Bluespot Cross-section using Council Categorization



The third image in Figure 1 shows the Council categorization of localized flood risk. Primary, Secondary, and Tertiary categorizations make up the contiguous Flood Impact Zone (FIZ), while Shallow areas are isolated localized flooding areas of 3in to 1ft in depth. The vulnerability of specific assets depends on each asset's sensitivity and exposure to different levels of flooding. This is discussed more thoroughly in each section of this chapter.

Vulnerability Assessment

For the wastewater analysis, exposure throughout the system was assessed, primarily in terms of the number and nature of the assets affected by any potential localized flood hazard. In summary, for all wastewater components, the presence of the Flood Impact Zone (FIZ) itself provides the measure of vulnerability.

Wastewater infrastructure was given a level of risk based on Flood Impact Zone. Additional characteristics of sensitivity could be considered for each wastewater indicator, including the size of the wastewater treatment facility, the severity of inflow & infiltration (I/I) in the area, and the infrastructure's increased risk for freeze-thaw impacts based on its location in wetland or hydric soils. For this study, staff determined that the Flood Impact Zone (FIZ) provides a sufficient, generalized measure of risk, and these secondary measures of sensitivity could be assessed in future studies.

For all indicators, the level of risk is highest for the Primary Flood Impact Zone, then the Secondary Flood Impact Zone, then lowest for the Tertiary Flood Impact Zone. The relative risk of the Shallow areas depends on the characteristics of the indicator or asset. For indicators that relate to vehicular access, such as WWTP access, the Shallow areas are removed from the analysis because vehicles can access the work sites through the 3-inch to 1-foot depth of the Shallow areas. Staff characterized

Tertiary as low risk due to the reduced likelihood, and therefore reduced risk, of localized flooding occurrence at such depths.

For indicators that are related to infiltration and inflow, such as maintenance holes, Shallow flooding is grouped with Primary as the highest risk, given the fact that even shallow flooding can lead to inflow into the wastewater system. Across all wastewater assets, Table 1 below shows how vulnerability is analyzed based on the flood hazards.

Table 1. Vulnerability Matrix for Wastewater Assets

Flood Hazard		Vulnerability
Flood Impact Zone	Shallow	***Varying***
	Primary	*High*
	Secondary	*Medium*
	Tertiary	*Low*

For each wastewater asset, the Methodology section details relative vulnerability of the asset at different localized flood depths. The following section details a regional overview of asset exposure to localized flooding hazards.

Community Use of the Data

The *Localized Flood Map for Climate Vulnerability Screening* is available at high resolution. Local communities and other stakeholders may conduct similar analyses to assess conditions and vulnerabilities that may inform adaptive strategies for local system assets. *The Localized Flood Map Screening Tool* is also available for stakeholders that do not have access to GIS software.

Assessment Overview of Regional Wastewater Assets

To analyze the potential localized flood impacts to the regional wastewater system, the Council has produced an overview of systemwide exposure to localized flooding hazards. It should be emphasized that this analysis was conducted in 2018, so as assets are constructed or removed, the analysis should be updated as required.

Table 2 provides an overview of potential localized flooding impacts to wastewater assets. Due to the extensive nature of the Metropolitan Council's wastewater system, these system assets are subject to some potential localized flooding impacts. However, the percentage of total assets within a Flood Impact Zone across all wastewater assets is relatively low, with 76.1% of the highest risk assets, maintenance holes, located outside areas of potential risk. For the maintenance holes within hazard areas, 46.3% fall within the Primary Flood Impact Zone, considered the highest

A row of interceptor pipes in south Washington County. Source: Metropolitan Council Digital Image Library

category of flood hazard. Nearly half of all at-risk maintenance holes are located within the Primary flood hazard area.

It is important to note that Table 2 shows systemwide percentages and averages. Asset-based and site-specific analysis (assessment of a certain lift station, for example) should be conducted to clearly identify and prioritize areas of vulnerability and subsequent site-specific strategies to increase resilience of MCES assets.

Table 2. Wastewater Assets*, Localized Flood Vulnerability by Flood Impact Zone

			Flood Impact Zone % Assets in a FIZ			
Asset*	Total	Total Assets in FIZ*	Primary	Secondary	Tertiary	Shallow
Maintenance Holes	7,550	23.1% (1748)	46.3% (810)	19.7% (345)	20.9% (365)	13.0% (228)
Flow Meter CTU/PLC Cabinets	168	10.1% (17)	29.4% (5)	11.8% (2)	47.6% (10)	N/A)
Meter Vaults	159	12.6% (20)	30.0% (6)	5.0% (1)	55.0% (11)	10.0% (2)
Lift Stations	62	14.5% (9)	22.2% (2)	33.3% (3)	44.4% (4)	0% (0)

**WWTPs are analyzed separately in more detail in this chapter.*

The sections that follow will describe the vulnerability of each component of the wastewater system, including the methodology for assessing vulnerability by asset, analysis, considerations for planning and response, and strategies for addressing the system vulnerabilities.

MCES Wastewater Treatment Plant (WWTP) Facilities & Access

Rationale

Wastewater Treatment Plant facility vulnerability to potential localized flooding impacts can affect various locations within a given facility area, from operational areas to parking lots. Facilities have site-specific vulnerabilities to localized flooding, so it is important to understand the significance of potential exposure by examining each site individually.

Access routes to Wastewater Treatment Plants also carry a potential flood risk which may affect operations and public safety. Plant operators need to access the plants to optimize processes and ensure plants remain in compliance with state and federal law, even during a flooding event. Maintenance employees need to be able to access each piece of equipment in case of malfunction or failure.

Regardless of functional classification, all roadways into and out of the plants were assessed for risk. A small number of employees require access to plants. Roads need to be passable to allow for operations and maintenance at WWTPs during a flood-related incident.

Methodology

Facilities

Localized flooding around facilities has the potential to impact buildings, employees, and infrastructure. To consider localized flood risk, Council staff analyzed the respective treatment plant parcel(s), rather than building footprints. All eight wastewater treatment plants were analyzed.

East Bethel WWTP & Water Reclamation Facility. Source: Metropolitan Council Digital Image Library

Potential impact from localized flooding hazards was calculated by percent of facility area covered by Flood Impact Zones (FIZ). Each FIZ represents a different level of vulnerability. The complete FIZ data layer was clipped to the parcel to capture only the FIZ locations on the facility site. The area of each FIZ within a parcel was divided by the total area of the sites to calculate the percent coverage of each Flood Impact Zone at each facility site (see Table 4).

Table 3. Wastewater Assets*, Localized Flood Vulnerability by Flood Impact Zone

Flood Hazard		Vulnerability
Flood Impact Zone	Shallow	*None*
	Primary	*High*
	Secondary	*Medium*
	Tertiary	*Low*

Access

The impact of localized flooding on WWTP access was determined through a two-step process. First, access routes were determined visually by selecting street centerlines from the facility entrance(s) to the nearest Principal Arterial road. These routes were then intersected with the Localized Flooding Map data layer ('Bluespot' layer) and categorized by FIZ to determine potential flood hazards. The Shallow hazards were excluded from the analysis because shallow flooding does not impair a vehicle's ability to access a facility. Table 3 shows the vulnerability associated with each Flood Impact Zone.

FEMA floodplain boundaries were also mapped with the localized flood hazards to better display the location of wastewater treatment plants in relation to both the floodplain and the Flood Impact Zone. However, riverine flooding was not included in the analysis of WWTP access as MCES already accounts for riverine flooding as part of its facility management planning.

Analysis: Facilities

The analysis shows that most wastewater treatment plants have 50% or less of the facility area at risk of localized flooding. The Primary Flood Impact Zone carries the highest percentage of coverage for facility area, which represents the highest potential vulnerability. There are low levels of potential Secondary, Tertiary, and Shallow impact zones. High levels of Primary FIZ are partially due to large clarifier tanks at the WWTPs. These tanks may flood in a rain event, but such flooding may constitute an operational risk as opposed to other localized flooding that could occur around the facility site, which could limit access to infrastructure and affect employee safety.

Table 4. Wastewater Treatment Plant Localized Flood Vulnerability by Flood Impact Zone

Facility	Primary %	Secondary %	Tertiary %	Shallow %	Total FIZ %
Metro Plant	45.37%	15.11%	8.51%	0.91%	69.90%
Blue Lake Plant	29.23%	7.75%	13.03%	1.67%	51.68%
East Bethel Plant & Water Reclamation Facility	38.21%	1.93%	0.84%	5.62%	46.60%
Empire/Farmington Plant	13.21%	3.47%	1.97%	9.49%	28.14%
Seneca Plant	6.19%	1.13%	2.06%	1.02%	10.41%
St Croix Valley Plant	6.66%	0.45%	1.74%	0.07%	8.91%
Eagles Point Plant	1.88%	0.38%	0.44%	1.27%	3.97%
Hastings Plant	0.00%	0.00%	0.00%	1.16%	1.16%

In Table 4, the highest level of potential localized flooding impact is 69.90% at the Metro Plant. The Metro Plant is surrounded by a levee which creates an almost contiguous area of potential localized flooding throughout the enclosed plant. The levee raises the elevation at which the riverine flooding could pose a risk to the plant, but the levee creates contained low spots that could elevate the risk of localized flooding within the enclosed area.

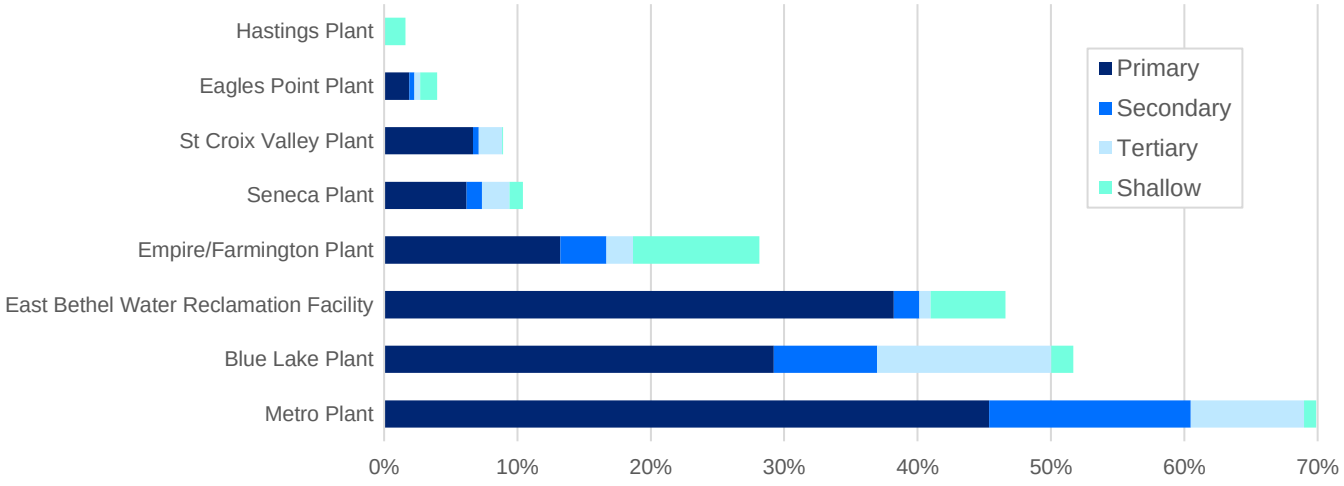
Eagles Point and Hastings Plants have the lowest potential flood risk of 3.97% and 1.16% respectively. Metro, Blue Lake, and East Bethel Plants have high percentages of Primary FIZ, so these plants should be analyzed more closely to consider possible implementation strategies to reduce potential localized flood risk. Figure 2 displays these risks differently, for ease of understanding, and to demonstrate the relative risk across the different WWTPs. Figures 3 through 10 show how localized flooding hazards may affect each individual WWTP facility area and access.

Analysis: Access

Eight facilities make up the MCES wastewater treatment plant system, detailed in Table 4 and shown in Figure 2. The Metro WWTP located south of downtown St. Paul, is the largest plant, treating an average of 172 million gallons of wastewater a day. The newest plant, East Bethel, is also the smallest, and is a water reclamation facility, infiltrating all effluent into the groundwater.

The access routes for Metro and East Bethel WWTP carry the highest risk for road obstruction due to localized flooding. In a heavy rain event, employees and visitors may be unable to access these

Figure 2. Wastewater Treatment Plant Localized Flood Vulnerability by Flood Impact Zone



WWTPs. Empire, Seneca, and Eagles Point WWTPs have limited impacts. These plants have smaller sections of access road that may be impacted and/or multiple access routes. The remaining three WWTPs do not have access roads at risk for localized flooding. Table 5 details the WWTP accesses that are affected by potential localized flood risk. In all cases, it is still important to consider how Flood Impact Zones may affect access and the need for contingency and rerouting plans. Figures 4 to 11 show how localized flooding hazards may affect each individual WWTP facility area and access.

Table 5. Metropolitan Council Wastewater Treatment Plants – Access Analysis

WWTP Name	Location	Capacity (million gallons per day)	Access
Blue Lake	Shakopee	32	Yes
Eagles Point	Cottage Grove	10	No
East Bethel	East Bethel	0.41	No
Empire	Empire Township	24	No
Hastings	Hastings	2.34	Yes
Metro	St. Paul	251	No
Seneca	Eagan	38	Partial*
St. Croix Valley	Oak Park Heights	4.5	Yes

**Figure 8 shows that the Seneca Plant has multiple access routes. Given the rerouting options, access routes at the Seneca Plant may be partially at risk for obstruction related to localized flooding.*

Considerations

Given the unique location and considerations for each WWTP, it is important to consider each plant independently. For instance, the operation and access considerations for the Metro Plant are much different than those for the East Bethel Plant, which is why each plant has its own location-specific Emergency Action Plan (EAP).

Overflowing clarifier tanks are a unique concern, as such an incident may cause operations issues for the wastewater treatment process. It is important to note that the analysis may show false positives within the facility area because some potential flood risk areas consist of functional stormwater infrastructure. For this reason, ground-truthing can assist in netting out any areas that should not be identified as potential flood risk areas. It is advisable to consider the vulnerable areas within the WWTP sites in relation to specific operational, maintenance, and public safety priorities.

Existing Strategies

Under federal OSHA legislation, each wastewater treatment plant has a specific Emergency Action Plan (EAP). For example, the Metro Plant's EAP covers all manner of hazards and was most recently updated in July 2018.

Blue Lake and Metro Wastewater treatment facilities are protected by levees and floodwalls. The Hastings WWTP also has some permanent flood protection features and relies on temporary measures during a flood event. WWTP flood adaptation strategies include use of auxiliary equipment such as backup pumps, which are used at Blue Lake and Metro plants. For example, if required at the Metro Plant, backup pumps can pump flood waters over the floodwall and into the effluent channel. MCES also stocks reserve fuel at facilities during periods of known flood risk. MCES stockpiles gravel to allow quick construction of temporary road access during floods, and procedures allow for retention of a contracted helicopter on standby in case staff require emergency access to WWTPs. At some WWTP sites, dewatering pumps have been installed to lower the groundwater table to protect underground wastewater infrastructure.

Auxiliary equipment provides backup service at MCES WWTPs during floods, power outages and other emergencies. Source: Metropolitan Council Digital Image Library

Proposed Strategies

Metropolitan Council Environmental Services may consider the following:

- ☐ Conduct a facility-specific analysis for localized flood risk using the Localized Flood Map data
- ☐ Consider localized flood risk areas in terms of specific operational, maintenance, and public safety priorities
- ☐ Utilize local knowledge at each WWTP to evaluate and verify potential localized flood risk
- ☐ Implement stormwater management best practices in flood-prone areas of facilities
- ☐ Collaborate with MCES Water Resources staff and watershed districts on innovative implementation approaches to stormwater management and green infrastructure projects at WWTP sites
- ☐ Develop a facility-specific protocol for maintaining access during extreme rain events
- ☐ Conduct a more detailed analysis and prioritization of access roads

Potential Localized Flooding at MCES Wastewater Treatment Plants

Blue Lake WWTP

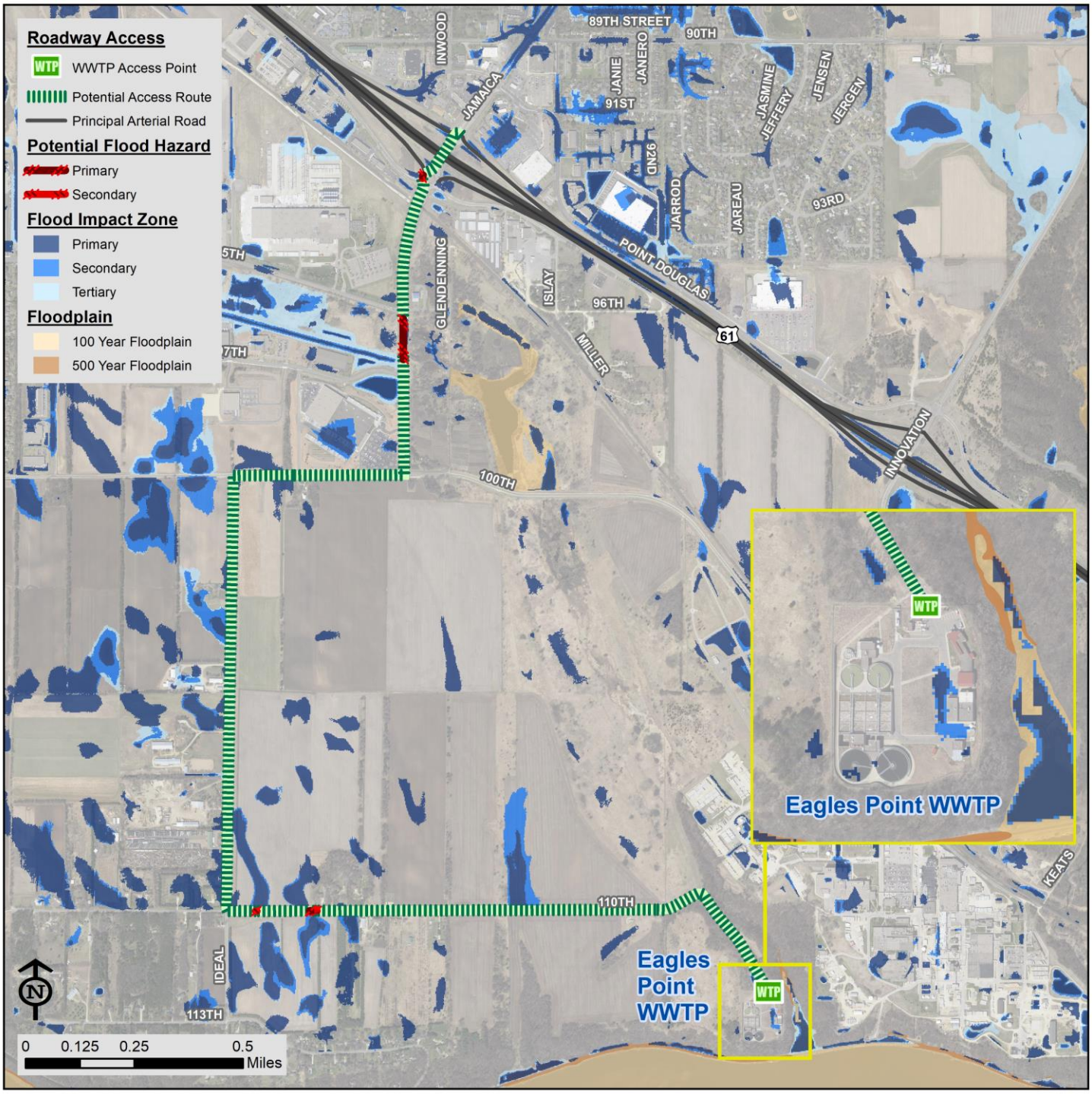
Located in Shakopee, Blue Lake WWTP treats an average of 29 million gallons of wastewater per day from 285,000 residents in 27 communities. Localized flooding does not appear to affect plant access, nor does it appear to affect internal operations given the fact that the Primary FIZ in the internal plant area consists of stormwater basins and clarifier tanks. The plant site is within the FEMA floodplain.

Figure 3. Blue Lake Wastewater Treatment Plant Potential Localized Flooding

Eagles Point WWTP

Perched on a limestone bluff overlooking the Mississippi River, Eagles Point WWTP is located in Cottage Grove. The new treatment plant has a capacity to treat 10 million gallons of wastewater per day. Very little potential localized flooding affects the plant site itself, while access to the plant from Hwy 61 may be at risk of Primary FIZ just along Jamaica Ave, just north of 100th Street.

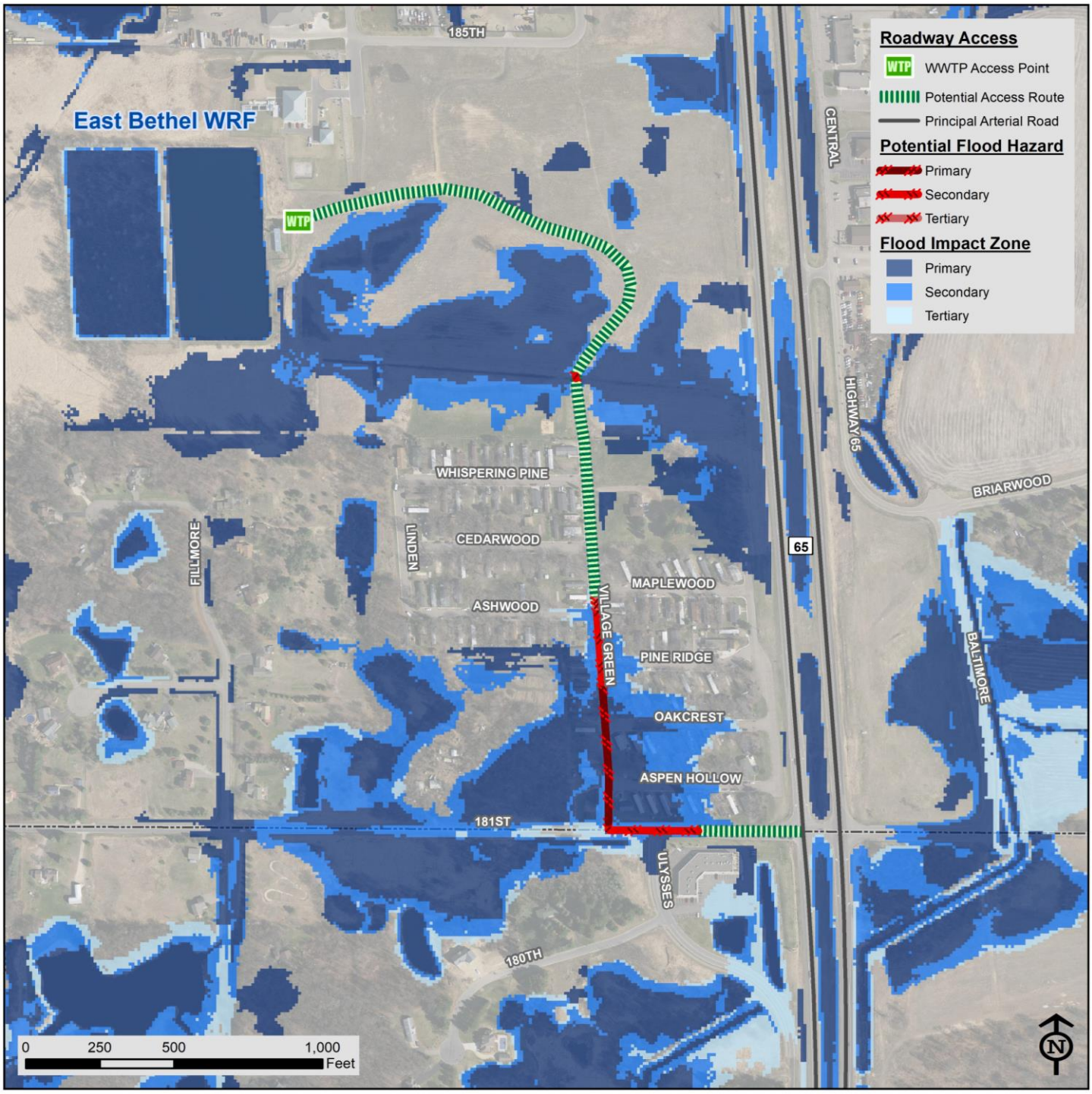
Figure 4. Eagles Point Wastewater Treatment Plant Potential Localized Flooding



East Bethel WWTP

The East Bethel Water Reclamation Facility is the Council's first water reuse facility. It opened in July 2014 has the capacity to treat to very high standards. Localized flooding may affect plant access along Village Green Drive, with Secondary and Primary FIZ present here. Plant employees may opt to access the plant via 185 Ave and Buchanan Street NE, which only shows potential for Tertiary FIZ along portions of its route, making this access a preferred route in a localized flooding event.

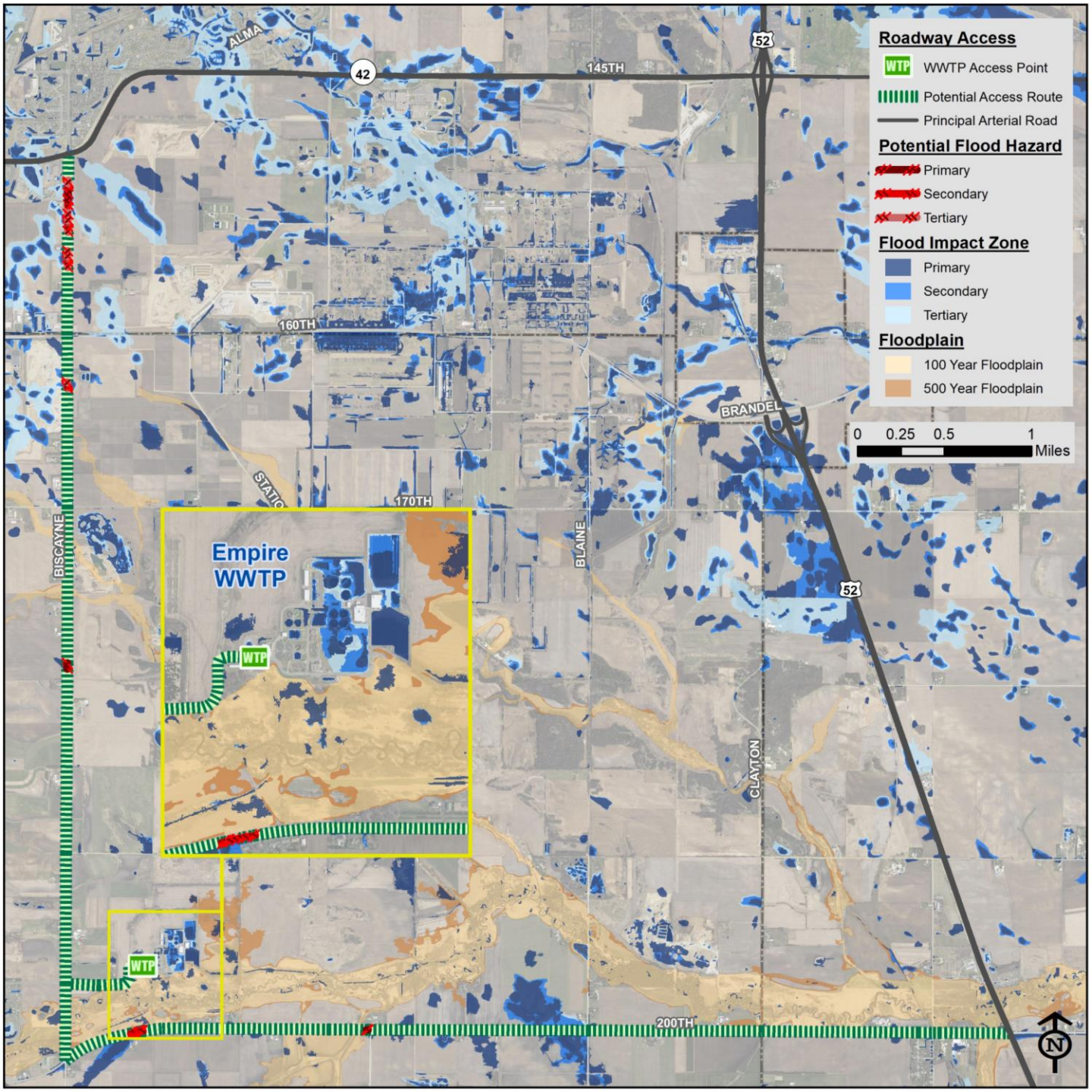
Figure 5. East Bethel Wastewater Treatment Plant Potential Localized Flooding



Empire WWTP

The Empire Plant plant size has been doubled to meet growth in the service area, and treated wastewater is discharged to the Mississippi River to the north. Access routes along Biscayne Ave and 200th Street may be affected by Secondary FIZ in a localized flooding event. Portions of the site may be subject to riverine flooding given the plant's proximity to the Vermillion River.

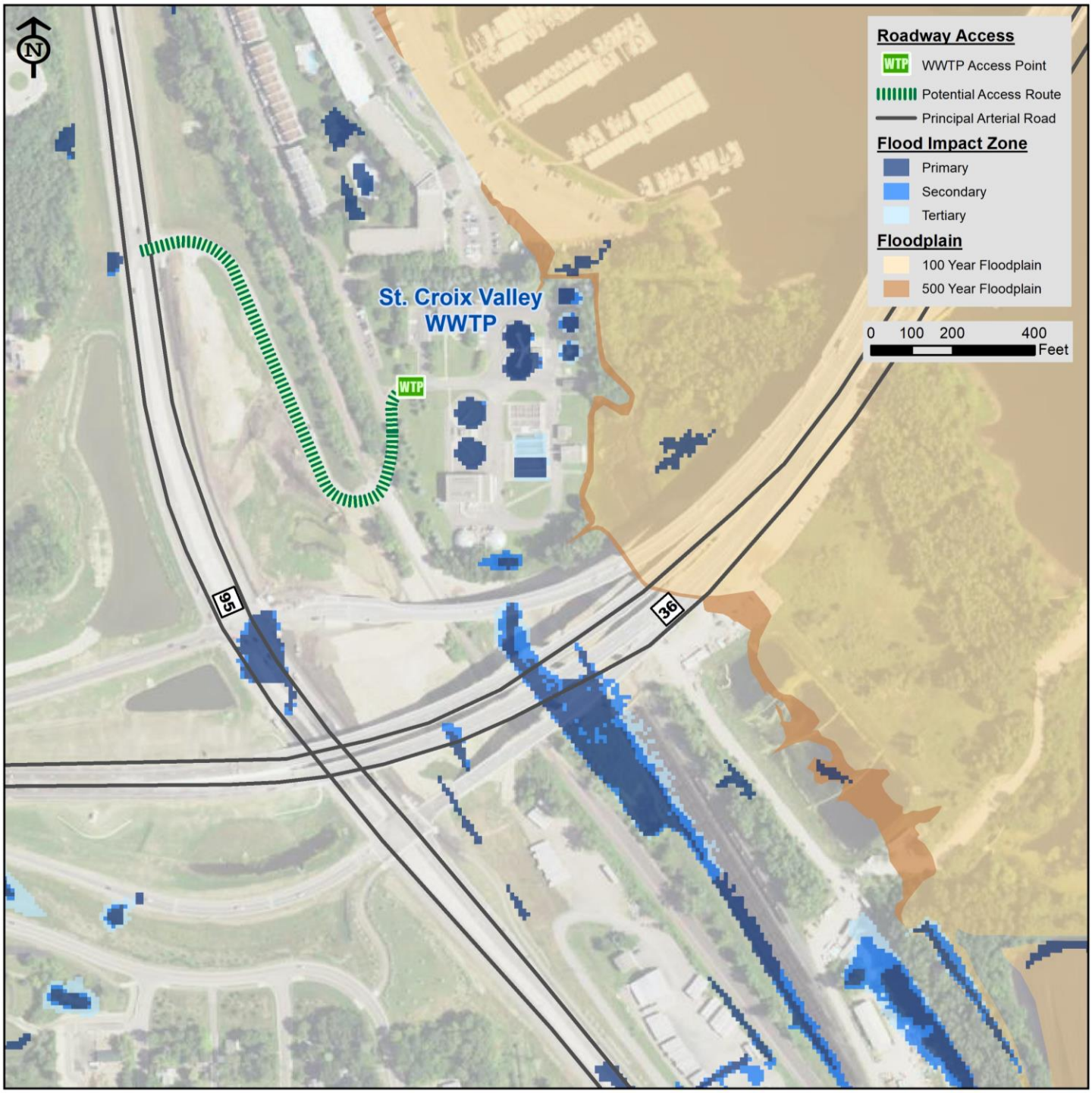
Figure 6. Empire Wastewater Treatment Plant Potential Localized Flooding



St. Croix Valley WWTP

The St. Croix Valley WWTP is located in Oak Park Heights, along the St. Croix River and adjacent to the new bridge (St. Croix Crossing) across the river. Given the short access road from State Hwy 95, there is no apparent flood risk for access to the plant. The internal area of the plant is also free of most risk, as Primary FIZ areas are operational portions of the plant, including stormwater infrastructure and clarifier tanks.

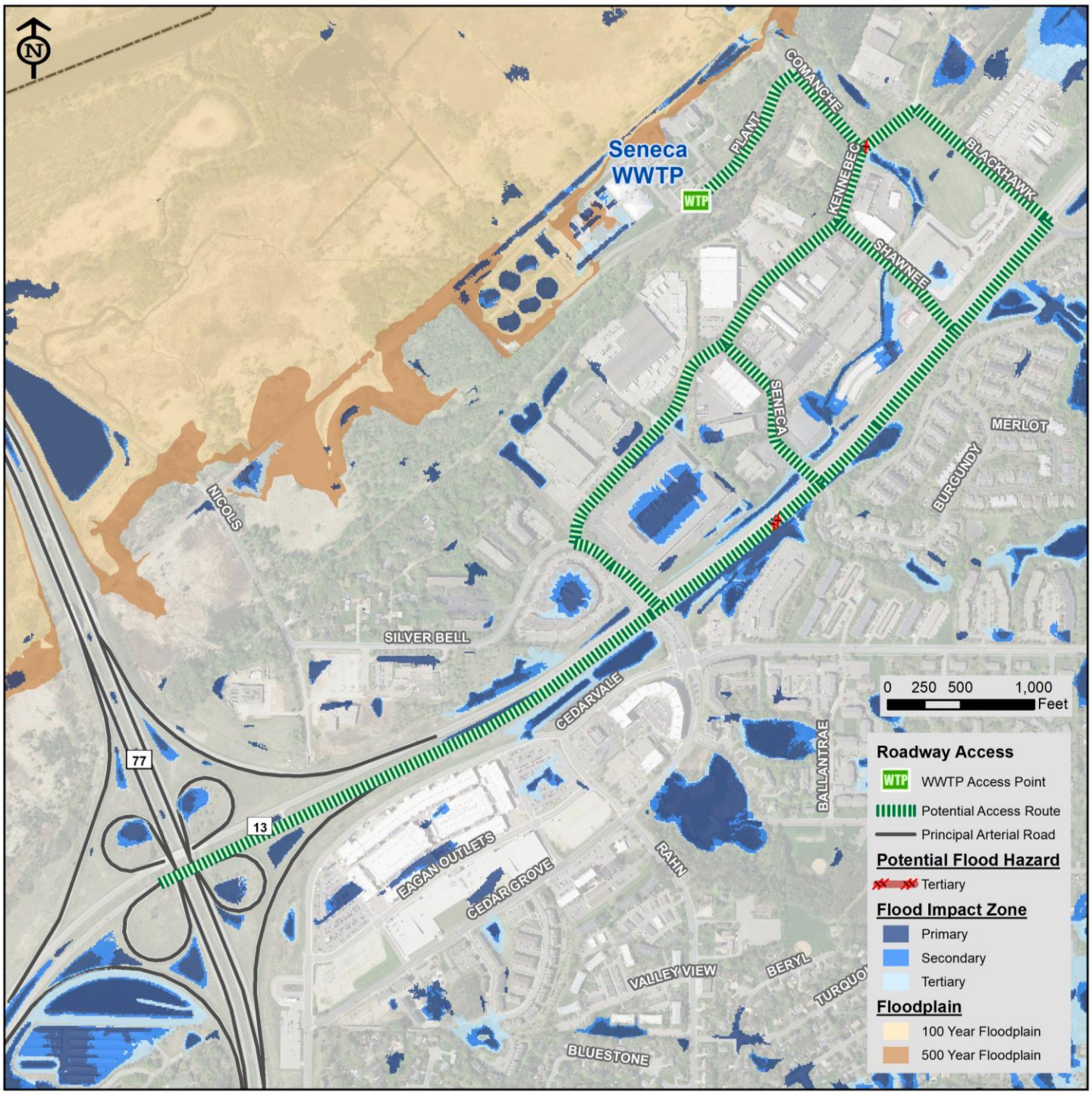
Figure 7. St. Croix Wastewater Treatment Plant Potential Localized Flooding



Seneca WWTP

Located in Eagan and along the Minnesota River, Seneca WWTP treats approximately the 21.9 million gallons of wastewater per day and serves eight metropolitan communities. Localized flooding does not affect access to the plant, given the number of access options available in a flooding event. The plant site may be at risk of riverine flooding and may carry minor risk of localized flooding during extreme precipitation events.

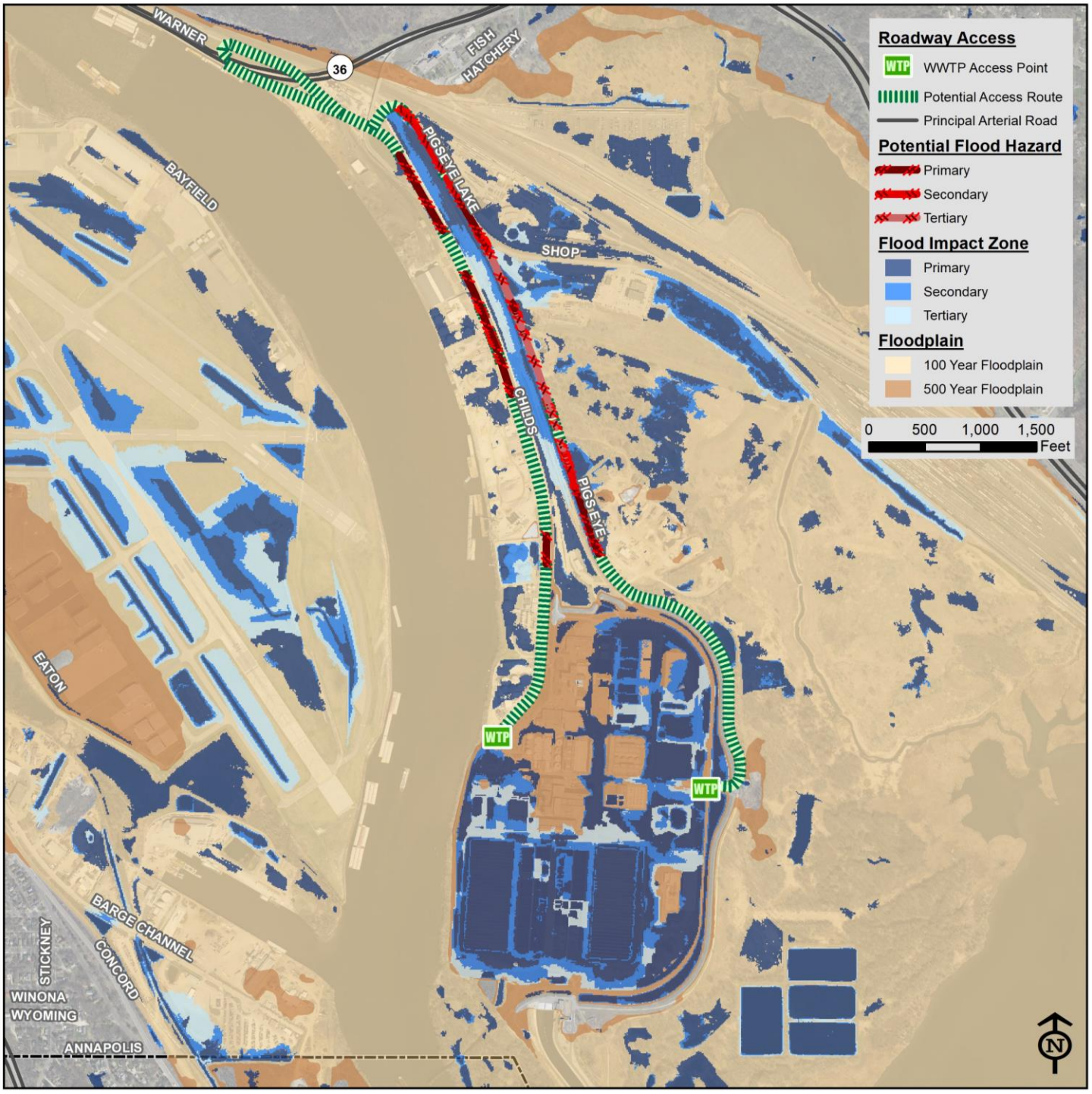
Figure 8. Seneca Wastewater Treatment Plant Potential Localized Flooding



Metropolitan (Metro) WWTP

The Metro WWTP is the largest and oldest Council plant. It treats approximately 251 million gallons of wastewater per day, from 66 communities. The plant is located along the Mississippi River, so the riverine flood risk is well known and comprehensive plans are in place to deal with riverine flooding. Localized flooding, outside of river flooding, may still disrupt access to the plant along Childs Road and Pigs Eye Lake Road. The internal portions of the plant may also be at risk of localized flooding, and these areas should be verified and examined in closer detail.

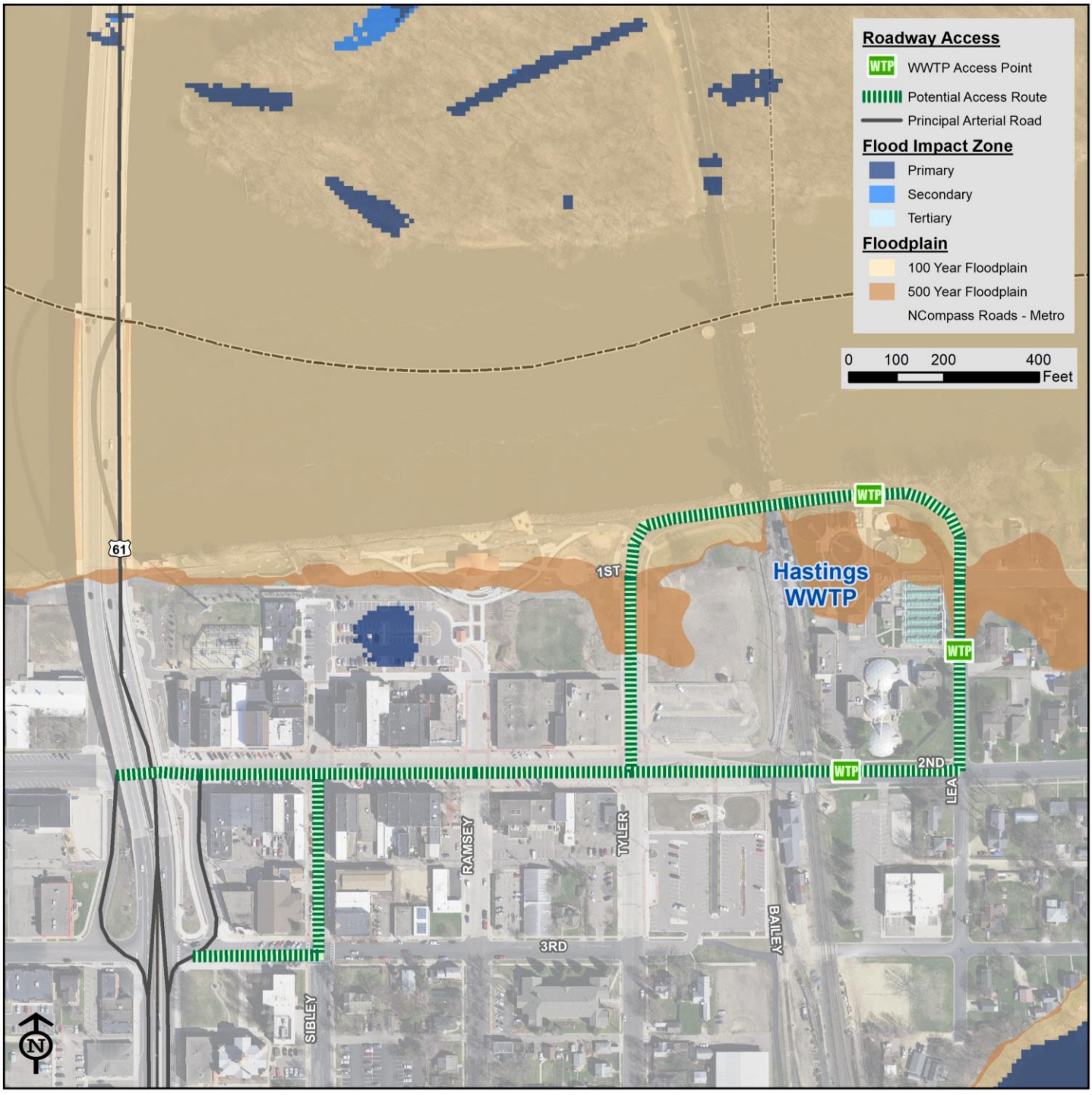
Figure 9. Metro Wastewater Treatment Plant Potential Localized Flooding



Hastings WWTP

Located in the City of Hastings, the Hastings WWTP serves a relatively small population within Hastings and nearby Marshan Township. Access to the plant is clear of any known localized flood risk. The site itself also appears to be free of any potential localized flood risk. The plant is located along the Mississippi River, so riverine flooding is a known and anticipated risk in hazard mitigation planning at the plant.

Figure 10. Hastings Wastewater Treatment Plant Potential Localized Flooding



Lift Stations

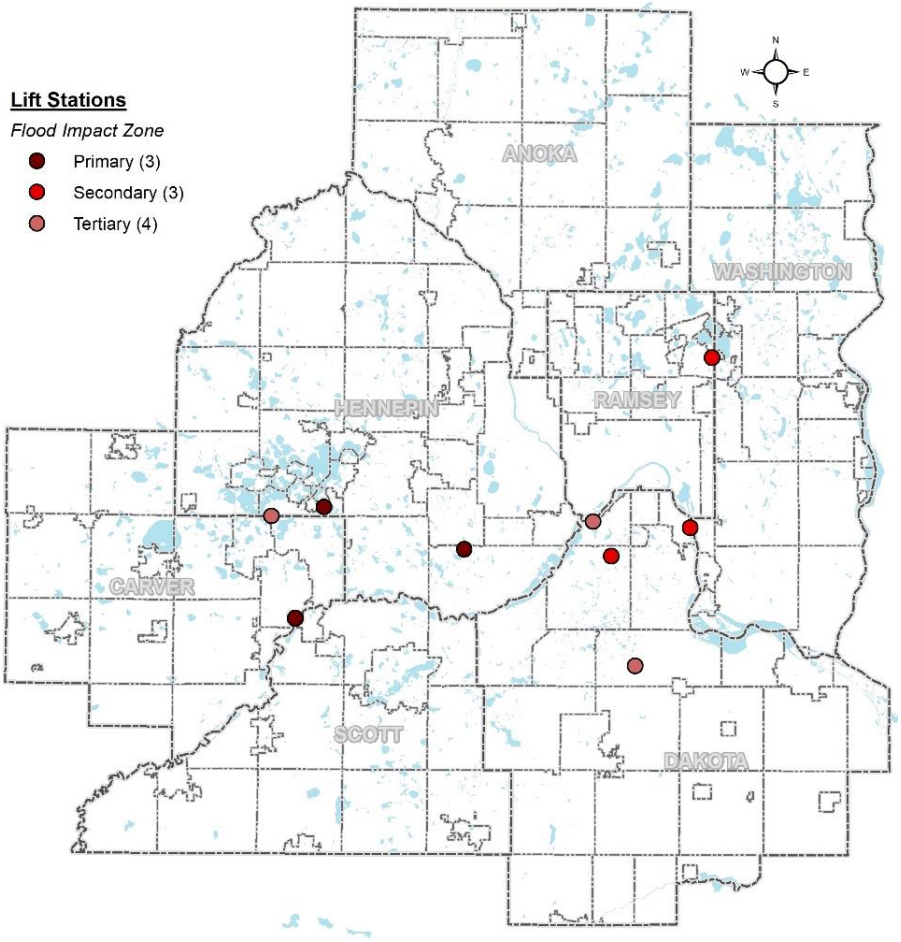
Rationale

Lift stations are crucial infrastructure of the wastewater system. Low-lying locations throughout the metropolitan area require lift stations to ensure efficient flow of wastewater. Lift stations function to "lift" wastewater to higher elevations to ensure unimpaired flow to the treatment facility.

Methodology

Council staff intersected the 62 lift stations throughout the metropolitan area with the Localized Flooding Map data layer. Lift Stations located within a FIZ were categorized by FIZ. Table 6 shows how vulnerability is determined based on FIZ.

Figure 11. Lift Stations located within Flood Impact Zones.



The potential risk associated with the Flood Impact Zones is highest in Primary zones and decreases to the lowest risk with Shallow and Tertiary zones. The Secondary FIZ poses medium risk, given the reduced likelihood of flooding.

Table 6. Vulnerability Matrix for Lift Stations

Flood Hazard		Vulnerability
Flood Impact Zone	Shallow	*Low*
	Primary	*High*
	Secondary	*Medium*
	Tertiary	*Low*

Analysis

As shown in Table 7, of the 62 MCES lift stations, 9 stations (14.5%), are located within a Flood Impact Zone. Only 2 lift stations are within a Primary FIZ, which poses the highest potential risk. There are 3 lift stations within Secondary FIZ and 4 within Tertiary. No lift stations are located within Shallow flood hazard areas.

Although there is relatively low risk overall for lift stations, this analysis can be used to prioritize assessment of operation and maintenance of the lift stations. Implementation strategies can reduce overall potential risk.

Though considered medium to low risk, implementation strategies could be considered for the 7 stations within Secondary and Tertiary FIZ. During an extreme rain event these stations may still be at risk.

Table 7. Lift Station Localized Flood Vulnerability by Flood Impact Zone

			Flood Impact Zone % Assets in a FIZ				
Asset	Total	Total Assets in FIZ*	Primary	Primary Mean Max. Depth	Secondary	Tertiary	Shallow
Lift Stations	62	14.5% (9)	22.2% (2)	3.07ft	33.3% (3)	44.4% (4)	0%

Figure 12 shows an example of a lift station that may be at risk of localized flooding given its location within and adjacent to a Primary FIZ. Council staff may wish to inspect this location to determine if sufficient stormwater infrastructure is in place to ameliorate any potential flood risk.

Figure 12. Example Lift Station within Potential Localized Flooding Area

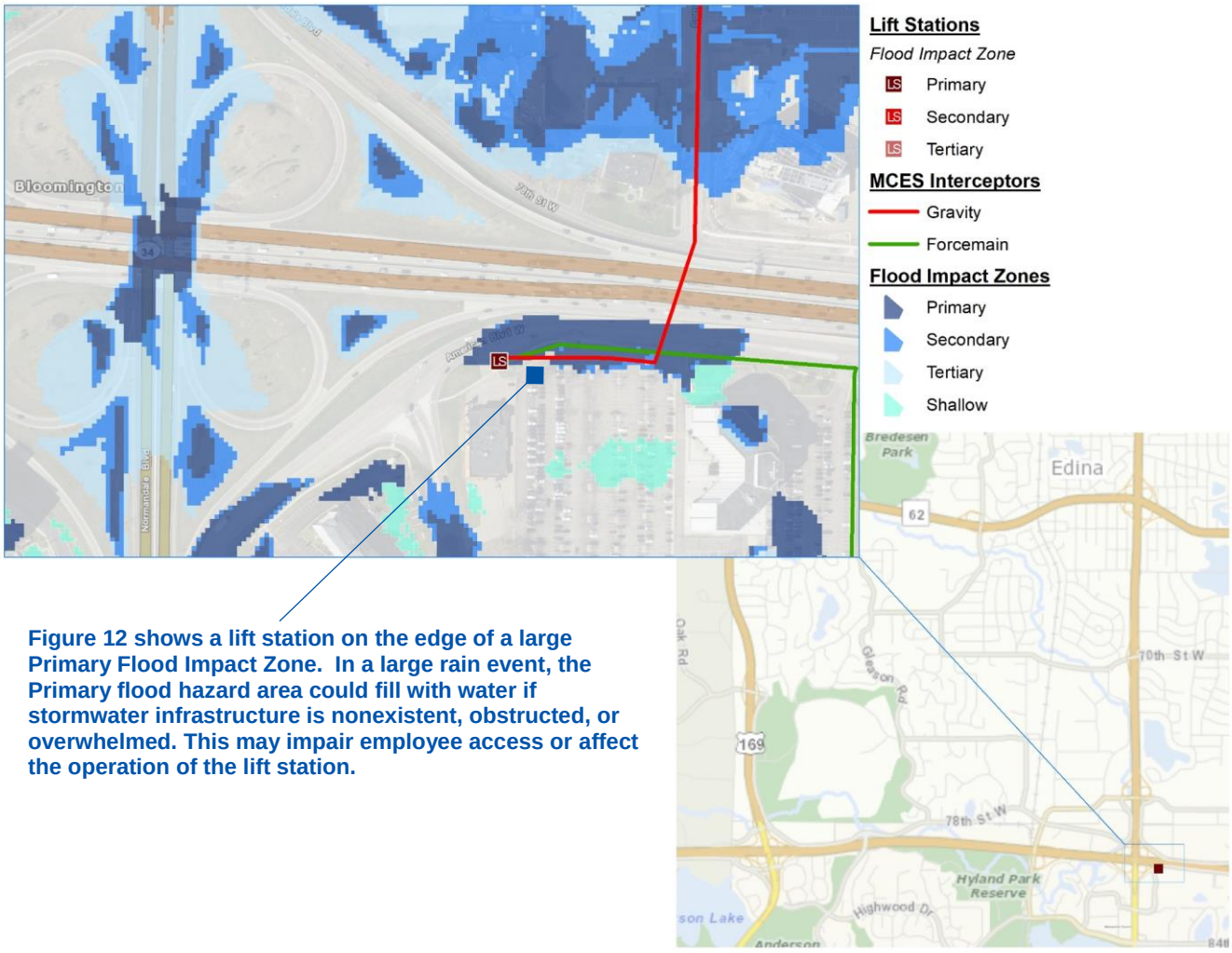


Figure 12 shows a lift station on the edge of a large Primary Flood Impact Zone. In a large rain event, the Primary flood hazard area could fill with water if stormwater infrastructure is nonexistent, obstructed, or overwhelmed. This may impair employee access or affect the operation of the lift station.

Considerations

Lift stations of different types and in different locations may be susceptible to localized flooding in various ways. These site-specific differences should be considered when analyzing potential risk posed by different localized flood hazards.

Lift stations that are outside of Flood Impact Zones may still be at risk for localized flooding because of changing topography, through adjacent site clearance or grading which can affect drainage patterns.

Existing Strategies

Lift stations and other critical facilities within the Flood Impact Zones are periodically inspected by the interceptor services group for susceptibility to flooding. Potential entry points for inflow, such as vented maintenance hole covers are inspected as needed. In the case of rain events that could cause inflow to the facilities, the interceptor services group is responsible for taking actions to limit these impacts. This could include using sandbags or other means to control high water, or removal of critical assets that could be damaged if flooded.

Proposed Strategies

Metropolitan Council Environmental Services may consider the following:

- ☐ Conduct a more detailed analysis and prioritization of potentially vulnerable lift stations
- ☐ Develop adaptation strategies for vulnerable lift stations
- ☐ Leverage local knowledge to help determine the vulnerability of identified lift stations
- ☐ Establish process for siting and building lift stations that minimizes localized flooding

Lift Station. Source: Metropolitan Council Digital Image Library

Maintenance Holes

Rationale

Maintenance Holes have a unique sensitivity to localized flooding. Primary and Shallow flood hazards pose the highest risk because of *infiltration and inflow*. Standing or flowing water on top of maintenance holes can enter the wastewater system if the lids are not adequately sealed. Shallow, very isolated, areas may still cause chronic infiltration and inflow, even during small rain events. Given the sheer number of maintenance holes, assessment of these higher risk areas can streamline prioritization efforts for maintenance and rehabilitation of the infrastructure. The structures may also crack or deterioriate below ground, and repairs to the chimey and vertical sections below the ground surface can help limit the amount of clear water entering the system.

Methodology

The 7,550 online and future MCES maintenance holes were considered in the analysis. Council staff intersected the maintenance holes with the Localized Flooding Map. Maintenance holes located within a Flood Impact Zone were categorized by FIZ.

Table 8 details that the potential vulnerability associated with the Flood Impact Zones is highest in Primary and Shallow areas and decreases to medium vulnerability with Secondary and low vulnerability with Tertiary zones.

Table 8. Vulnerability Matrix for Maintenance Holes

	Flood Hazard	Vulnerability
Flood Impact Zone	Shallow	*High*
	Primary	*High*
	Secondary	*Medium*
	Tertiary	*Low*

Analysis

As shown in Table 9, of the 7,550 online and future MCES maintenance holes, 23.1% are within a potential Flood Impact Zone. Of the maintenance holes within a FIZ, 46% intersect Primary FIZ, and 13% intersect Shallow hazard areas, representing a total of 1038 maintenance holes that exhibit a high vulnerability to potential localized flood risk. These maintenance holes are at the highest potential risk for impacts related to inflow and infiltration of surface water into the wastewater system.

Table 9. Maintenance Hole Localized Flood Vulnerability by Flood Impact Zone

			Flood Impact Zone % Assets in a FIZ				
Asset	Total	Total Assets in FIZ*	Primary	Primary Mean Max. Depth	Secondary	Tertiary	Shallow
Maintenance Holes	7550	23.1% (1748)	46.3% (810)	4.37ft	19.7% (345)	20.9% (365)	13.0% (228)

The remaining at-risk maintenance holes are spread fairly evenly between Secondary and Tertiary FIZ. These potential flood risk areas typically fill after Shallow and Primary areas and therefore constitute a lower risk and vulnerability to impacts associated with localized flooding, principally because these areas have a reduced likelihood of flooding. There are around 350 maintenance holes within each Secondary and Tertiary FIZ.

There are often several affected maintenance holes within a Flood Impact Zone. This is shown in Figure 13 and makes area-wide strategies more appropriate.

Figure 13. Example Maintenance Holes within Potential Localized Flooding Area.

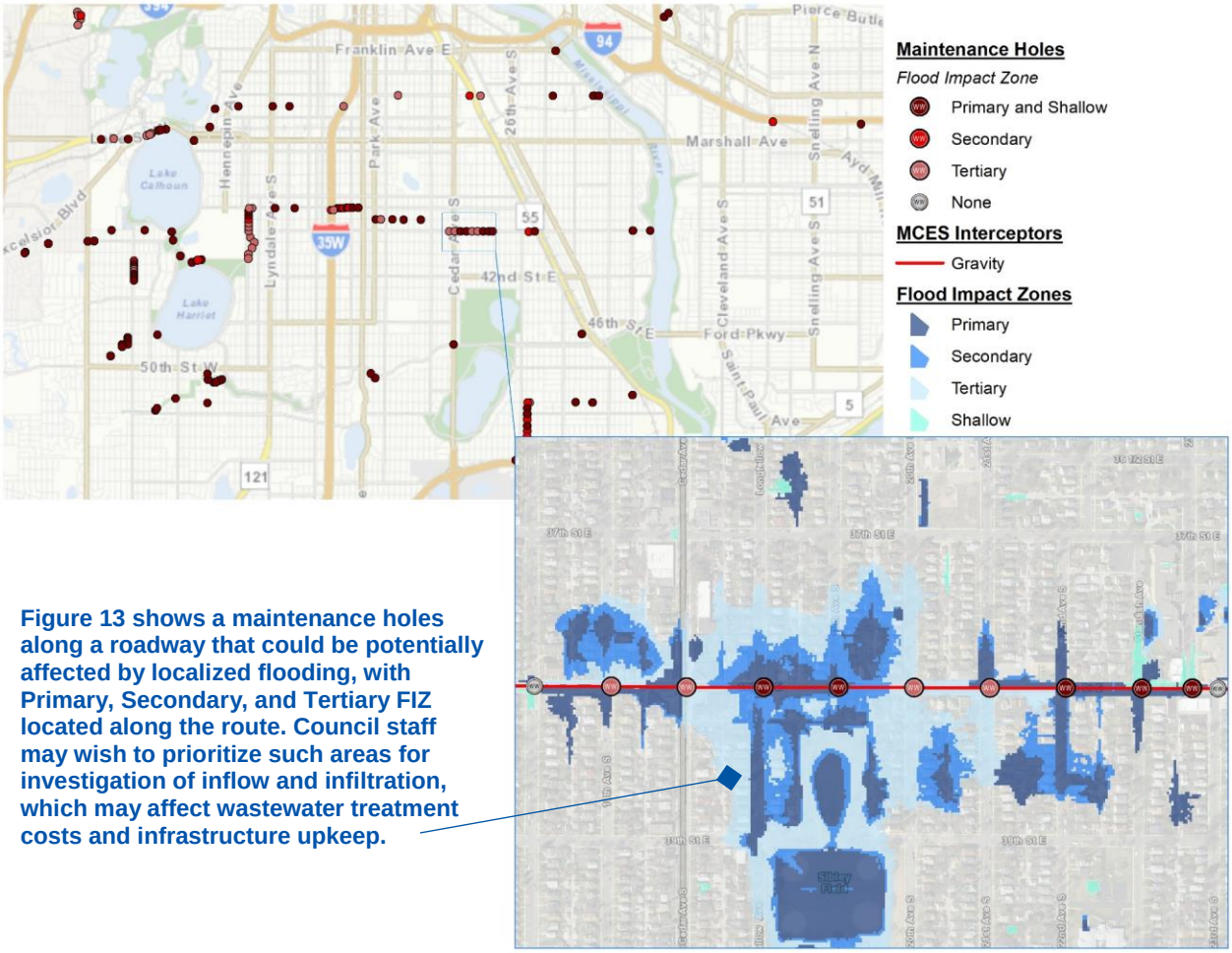
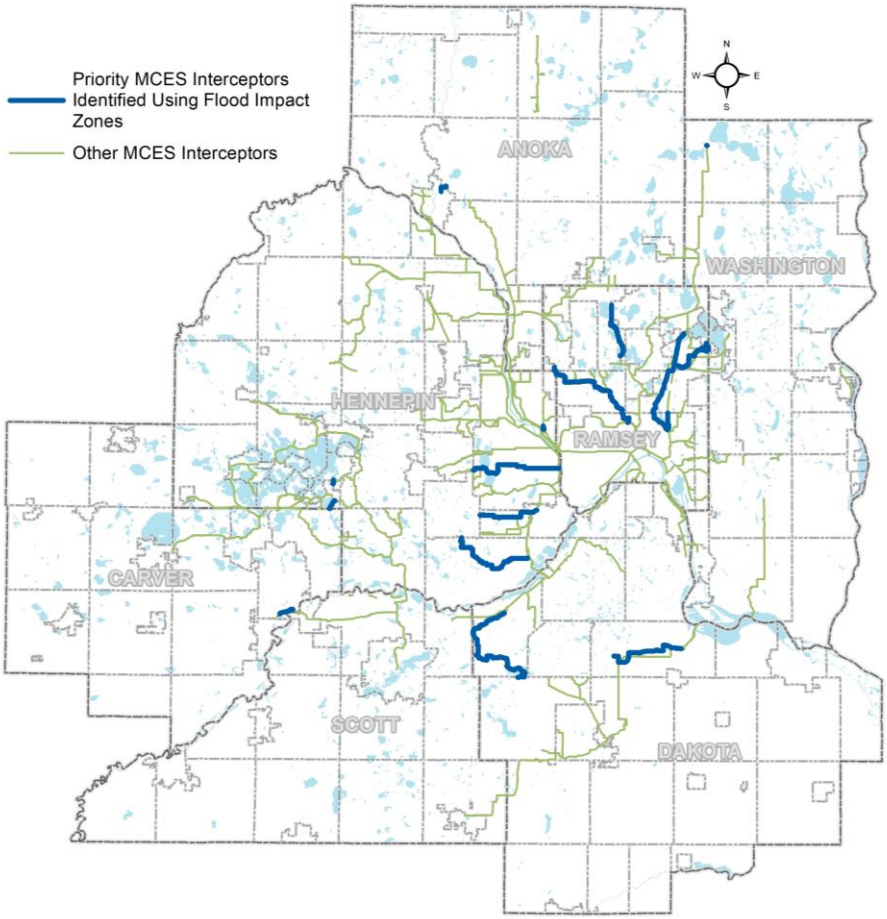


Figure 13 shows a maintenance holes along a roadway that could be potentially affected by localized flooding, with Primary, Secondary, and Tertiary FIZ located along the route. Council staff may wish to prioritize such areas for investigation of inflow and infiltration, which may affect wastewater treatment costs and infrastructure upkeep.

Maintenance Holes by Interceptor

Figure 14 displays priority interceptors based on number of maintenance holes per interceptor and/or number of maintenance hole per mile of interceptor. Consideration of specific interceptors can allow Council staff the ability to determine areas where clear water inflow could be higher and potentially caused by chronic flooding over maintenance holes. This preliminary prioritization can be combined with variables such as measured flow rates, history of excessive flow, or other metrics to further narrow areas of greater concern.

Figure 14. Priority Interceptors Identified Using Flood Impact Zones



Considerations

This analysis can be used to help prioritize maintenance hole inspections or implementation of strategies to limit inflow and infiltration. The depth and expected frequency of flooding can also help prioritize structure inspections and repairs. Council staff should keep in mind that the data consists of a snapshot in time, and therefore may not reflect more recent street improvements or infrastructure upgrades. The analysis should be ran periodically with updated asset data. The analysis can also help after a storm event in locating sources of inflow. Comparing the Flood Impact Zones to the areas of the system that experienced excessive flows allows stakeholders to determine which structures may have allowed clear water into the wastewater system.

Existing Strategies

A previous assessment was conducted using FEMA floodplain maps to to identify areas of the wastewater system at risk of riverine flooding. The areas of the wastewater system which have experienced excessive clear water flows and have maintenance holes within the FEMA floodplain zones were prioritized for inspection and repair. Typical repairs include replacing vented maintenance hole covers with sealed lids and inspecting the below ground structure for signs of deterioration and making repairs as needed. There is an ongoing program to locate and repair structures in need of repair to reduce the influences of inflow and infiltration.

Sanitary sewer maintenance hole. Source: Metropolitan Council Digital Image Library

Proposed Strategies

Metropolitan Council Environmental Services may consider the following:

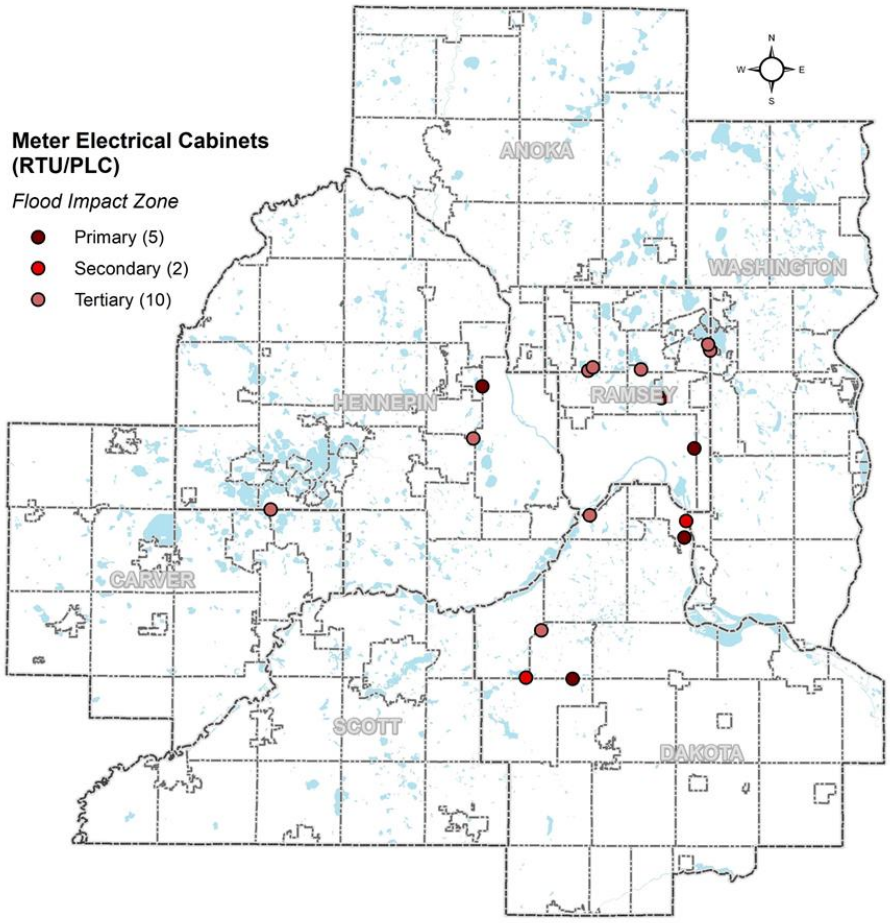
- ☐ Conduct a more detailed analysis and prioritization of all vulnerable maintenance holes throughout the metropolitan area
- ☐ Develop implementation strategies for maintenance holes in different Flood Impact Zones
- ☐ Leverage local knowledge from ES maintenance workers to help verify localized flood risk
- ☐ Work with local communities to minimize I/I through prioritization of maintenance hole improvements

Flow Meters

Rationale

Flow meters are a vital piece of wastewater infrastructure, used for calculating each community's share of regional costs. The electrical cabinet at each meter houses electrical equipment critical to the operation of the meter. These are referred to as remote telemetry units (RTU) or programable logic controllers (PLC). High levels of localized flooding have the potential to cause operational damage to this equipment. Like maintenance holes, meter vaults are susceptible to inflow and infiltration (I/I). Even minimal levels of localized flooding at a meter vault can allow stormwater into the wastewater system if the lid is not properly sealed. Employee access to meters is also a critical operational component in servicing and maintaining meters. Localized flooding may make staff access to meters difficult.

Figure 15. Meter RTU/PLC Cabinets located within Flood Impact Zones



Methodology

Meter RTU/PLC Cabinets

There are a total of 168 online and offline RTU/PLC cabinets within the MCES GIS database. The equipment in the cabinet sits approximately 3 feet above the surface. Therefore, this analysis excludes the Shallow flood hazards, Primary Flood Impact Zones (FIZ) with a max depth of less than 3 feet, Secondary FIZ with a max depth of less than 5 feet, and Tertiary FIZ with a max depth of less than 7 feet. The exclusion of these zones narrows the screening process to exclude RTU/PLC cabinets known to have zero risk; however, additional false positives may still arise based on where the cabinet is located within the FIZ. The described selection of the Localized Flood layer was intersected with the METC RTU/PLC layer and designated by the FIZ in which they fall (Primary, Secondary, or Tertiary).

Table 10. Vulnerability Matrix for Meter RTU/PLC Cabinets

Flood Hazard		Vulnerability
Flood Impact Zone	Shallow	*None*
	Primary	*High*
	Secondary	*Medium*
	Tertiary	*Low*

Meter Vaults

There is a total of 159 online meter vaults used in the localized flooding analysis. Meter vaults located within the wet or dry well of a lift station were excluded as these locations are addressed within the "Lift Stations" section of this chapter. The meter vaults layer was intersected with the localized flooding layer and designated by Flood Impact Zone (FIZ). All FIZ were used in the analysis and the Shallow hazards were grouped with Primary as the highest potential risk.

Table 11. Vulnerability Matrix for Meter Vaults

Flood Hazard		Vulnerability
Flood Impact Zone	Shallow	*High*
	Primary	*High*
	Secondary	*Medium*
	Tertiary	*Low*

Analysis

Meter RTU/PLC Cabinets

As shown in Table 12, of the 168 meter RTU/PLC cabinets within the metropolitan area, 17 cabinets are within a Flood Impact Zone (FIZ). Figure 16 shows the RTU/PLC cabinets that are within a FIZ, spread out across the metropolitan area. Meter RTU/PLC cabinets within the Primary FIZ areas carry the highest potential vulnerability (see Table 10). There are 5 RTU/PLC cabinets within Primary FIZ. Secondary and Tertiary flood hazards only pose a risk after Primary flooding has occurred. Although 12 RTU/PLC cabinets lie within the Secondary and Tertiary flood hazard areas, the potential risk to RTU/PLC cabinets is medium (Secondary) to low (Tertiary).

Meter Vaults

Of the 159 meter vaults within the metropolitan area, 20 vaults are within a Flood Impact Zone (Table 12). Meter vaults within the Primary and Shallow flood hazard areas carry the highest potential vulnerability (see Table 11). There are 8 meter vaults within Primary & Shallow areas. Secondary and Tertiary flood hazards only pose a risk after Primary flooding has occurred. Although 12 vaults lie within the Secondary and Tertiary flood hazard areas, the potential risk to the vaults is medium (Secondary) to low (Tertiary). Figure 16 shows a localized example of a meter vault within a Primary FIZ. In this example, the meter RTU/PLC cabinet falls outside of any FIZ.

Table 12. Meters, Localized Flood Vulnerability by Flood Impact Zone

			Flood Impact Zone % Assets in a FIZ				
Asset	Total	Total Assets in FIZ*	Primary	Primary Mean Max. Depth	Secondary	Tertiary	Shallow
Meter RTU/PLC Cabinets	168	10.1% (17)	29.4% (5)	5.17 ft*	11.8% (2)	47.6% (10)	N/A
Meter Vaults	159	12.6% (20)	30.0% (6)	4.22 ft	5.0% (1)	55.0% (11)	10.0% (2)

**Meter RTU/PLC cabinet analysis excludes Primary FIZ with max depths less than 3 feet.*

Figure 16. Example Meter within Potential Localized Flooding Area

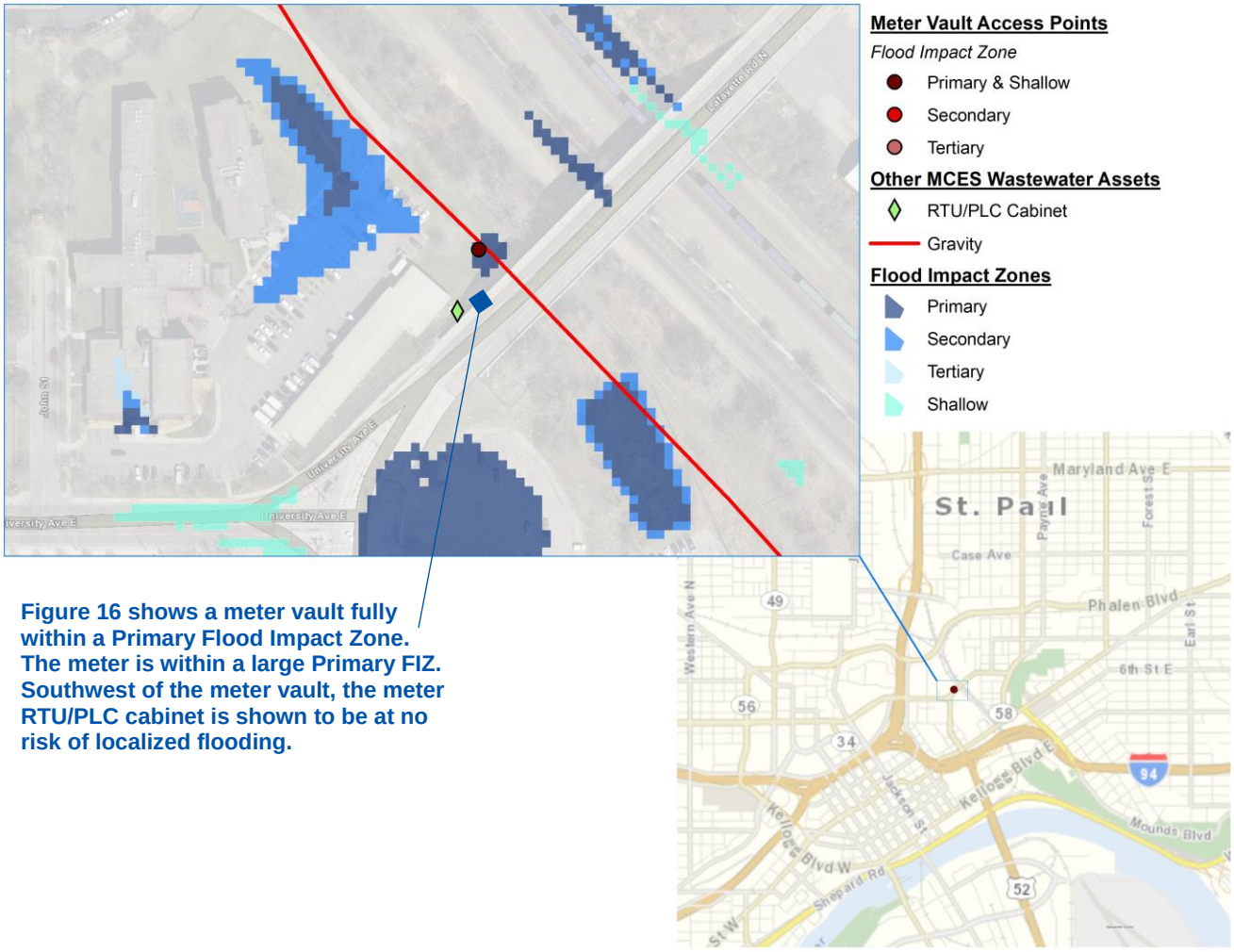


Figure 16 shows a meter vault fully within a Primary Flood Impact Zone. The meter is within a large Primary FIZ. Southwest of the meter vault, the meter RTU/PLC cabinet is shown to be at no risk of localized flooding.

Considerations

Different types and locations of flow meters and associated components may be susceptible to localized flooding in various ways. For example, some meter vault entrances are raised, like those in in the photo below. These site-specific differences should be considered when analyzing potential risk posed by localized flood hazards.

Meters that are outside of flood impact zones may still be at risk for localized flooding because of changing topography, through adjacent site clearance or grading which can affect drainage patterns. The maximum depth of any given localized flood hazard area is important because the water will only impact the meter if it reaches the electric box, which is raised 3 feet above ground level.

Both the METC Meter RTU/PLC Cabinet and Meter Vault datasets are currently incomplete. The analyses should be re-run once the datasets are finalized.

Existing Strategies

Flow meters and other critical facilities within the Flood Impact Zones are periodically inspected by the by Council staff for susceptibility to flooding. Council staff need to maintain access to flow meters, even during intense rain events, so areas site conditions around the flow meters are always a consideration.

Proposed Strategies

Metropolitan Council Environmental Services may consider the following:

- ☐ Conduct a more detailed analysis and prioritization of all vulnerable flow meters across the metropolitan area
- ☐ Leverage local knowledge of flooding to assist in prioritization and application of implementation strategies at flow meters
- ☐ Develop implementation strategies to minimize risk of flooding the electrical cabinets of flow meters
- ☐ Develop protocols for preserving access to flow meters during heavy rain events

Meter RTU/PLC cabinet raised 3 ft and inside the meter RTU/PLC cabinet. Source: Metropolitan Council Digital Image Library

Meter Vaults. Source: Metropolitan Council Digital Image Library

Summary of Proposed Council Strategies

Table 13. Wastewater Treatment Plant Facilities & Access, Proposed Strategies

Potential Strategy	Authority	Collaboration Required	Existing Practice	Priority	Cost/Time
Conduct a facility-specific analysis for localized flood risk using the Localized Flood Map data	MCES	No	Plant EAPs; SOPs	High	Low/Low
Consider localized flood risk areas in terms of specific operational, maintenance, and public safety priorities	MCES	No	Plant EAPs; SOPs	High	Med/Med
Utilize local knowledge at each WWTP to evaluate and verify potential localized flood risk	MCES	No	None	Med	Med/Med
Implement stormwater management best practices in flood-prone areas of facilities	MCES	No	SOPs	Med	High/High
Collaborate with MCES Water Resources staff and watershed districts on innovative implementation approaches to stormwater management and green infrastructure projects at WWTP sites	MCES; Watershed Districts	Likely	SOPs	Med	High/High
Develop a facility-specific protocol for maintaining access during extreme rain events	MCES; Partners	Likely	EAPs; Local SOPs	High	Med/Med
Conduct a more detailed analysis and prioritization of access roads	MCES; Partners	Likely	EAPs; Local SOPs	High	Med/Med

Table 14. Lift Stations, Proposed Strategies

Potential Strategy	Authority	Collaboration Required	Existing Practice	Priority	Cost/Time
Conduct a more detailed analysis and prioritization of potentially vulnerable lift stations	MCES	No	SOPs	High	Low/Low
Develop adaptation strategies for vulnerable lift stations	MCES	No	SOPs	Med	Med/Med
Leverage local knowledge to help determine the vulnerability of identified lift stations	MCES; Partners	Likely	SOPs	Med	Med/Med

Table 15. Maintenance Holes, Proposed Strategies

Potential Strategy	Authority	Collaboration Required	Existing Practice	Priority	Cost/Time
Conduct a more detailed analysis and prioritization of all vulnerable maintenance holes throughout the metropolitan area	MCES; Partners	Likely	I/I SOPs	High	Med/Med
Develop implementation strategies for maintenance holes in different Flood Impact Zones	MCES; Partners	Likely	I/I SOPs	Med	Med/Med
Leverage local knowledge from ES maintenance workers to help verify localized flood risk	MCES; Partners	Likely	I/I SOPs	Med	Med/Med
Work with local communities to minimize I&I through prioritization of maintenance hole improvements	MCES; Partners	Yes	I/I SOPs; Local SOPs	Med	Med/Med

Table 16. Flow Meters, Proposed Strategies

Potential Strategy	Authority	Collaboration Required	Existing Practice	Priority	Cost/Time
Conduct a more detailed analysis and prioritization of all vulnerable flow meters across the metropolitan area	MCES; Partners	Likely	SOPs	High	Low/Low
Leverage local knowledge of flooding to assist in prioritization and application of implementation strategies at flow meters	MCES; Partners	Likely	SOPs	Med	Med/Med
Develop implementation strategies to minimize risk of flooding the electrical cabinets of flow meters	MCES; Partners	Likely	SOPs	Med	Med/Med
Develop protocols for preserving access to flow meters during heavy rain events	MCES; Partners	Likely	SOPs	Med	Med/Med

Acronyms

CVA – Climate Vulnerability Assessment
GIS – Geographic Information Systems
EAP – Emergency Action Plan
FEMA – Federal Emergency Management Administration
FIZ – Flood Impact Zone
I&I – Inflow and Infiltration
MCES – Metropolitan Council Environmental Services
OSHA – Occupational Safety and Health Administration
SOP – Standard Operating Procedure
WWTP – Wastewater Treatment Plant

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