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BARR

Technical Memorandum

To: Tina Carstens
From: Erin Anderson Wenz, Brandon Barnes, and Michael McKinney
Subject: Identification and Prioritization of Potentially Flood-Prone Structures
Date: September 4, 2018
c: Brad Lindaman

1.0 Introduction and Background

The purpose of this memorandum is to update the list of potentially flood-prone structures that Barr developed in May of 2016 (Barr, 2016). Flood-risk areas and inundation extents defined in 2016 were based on best available data at that time. Since the 2016 analysis, the District stormwater models have been updated and validated using flow and stage monitoring data collected by District staff in 2017.

Using results from the validated XP-SWMM models, flood area extents were updated and flood-risk areas were identified. This memorandum documents methodology used to identify and prioritize flood-risk areas and develop planning-level opinions of cost for each flood-risk area.

2.0 Model Validation and Flood-Risk Areas

Hydrologic and hydraulic updates were made to District stormwater models to validate simulation results to measured stage data collected by District staff from June of 2016 through March of 2018. The impact of model validation varied across the District, but in general, validation caused flood levels to increase in the northwestern and northern portions of the District, and flood levels to decrease in the southern portions of the District compared to flood levels defined in 2016 (Barr, 2016).

After validating the models to measured stage data, the 100-year, 4-day (50^{th} percentile) Atlas 14 rainfall event (8.3 inches) was simulated, and flood elevations were calculated. Floodplain extents were intersected with Ramsey and Washington County building structure outlines (Ramsey County, 2015; MN DNR, 2011). Habitable structures (e.g., residences, office and commercial buildings, apartments, etc.) that intersected the floodplain were identified as potentially flood-prone. Within the Ramsey County dataset (Ramsey County, 2015) structures identified as "residential", "non-residential", and "mobile home" were considered habitable structures. Because similar data categories do not exist in the Washington County dataset (MN DNR, 2011), structures greater than 550 square feet in area were considered to be habitable structures, and were manually evaluated as needed.

Floodplain extents and potentially flood-prone structures are shown in figures in Appendix A.

3.0 Prioritizing Flood-Risk Areas

A high-level evaluation of each potential flood-risk area (see Section 2.0) was performed to determine if flooding was caused by:

a) proximity to District managed waterbodies or facilities (e.g., high water level of a District-managed waterbody, capacity through a District-managed culvert, etc.), or
b) local flooding not related to District managed waterbodies or facilities (e.g., high water level of municipal pond, capacity through municipal storm sewer infrastructure, etc.).

These two types of flood-risk areas are shown as *Potential District Flood-Risk Areas* and *Potential Local Flood-Risk Areas* in the figures in Appendix A.

Flood-risk areas near District managed waterbodies or facilities were then further examined to determine:

- The number of habitable structures that would potentially be affected by flooding;
- The potential for roadway flooding during an event; and
- The potential for implementing flood-mitigation projects that could simultaneously improve water quality.

This information was used to prioritize potentially flood-prone areas for further evaluation of mitigation options. The list of criteria considered in the analysis are listed below:

(1) **Flood-prone area located near a District-managed water body:** The District is responsible for managing the following water resources. Flood-risk areas caused by high water levels in these District managed water resources are assigned high priority.

Lakes

Battle Creek Lake	Beaver Lake	Bennett Lake
Carver Lake	Eagle Lake	Emily Lake
Gervais Lake	Keller Lake	Kohlman Lake
Lake Owasso	Lake Phalen	Round Lake (Maplewood)
Round Lake (Little Canada)	Shoreview Lake	Snail Lake
Tanners Lake	Twin Lake	Wabasso Lake
Wakefield Lake	Willow Lake	

Streams

Battle Creek	Fish Creek	Gervais Creek
Kohlman Creek	Willow Creek	Snake Creek

(2) **Flood-prone area adjacent to a District-managed facility:** The District responsible for managing a number of storm water facilities, many of which are not located on a District-managed water body. Each of these facilities are identified in the District's plan. Flood-risk areas

caused by or impacted by District-managed facilities are assigned high priority. Flood issues related to *Local Flood-Risk Areas* are considered to be the responsibility of the respective municipality. However, the district may assist the responsible local governmental unit with addressing flood-risk in these areas.

(3) **Number of structures impacted:** As part of the District's high-level vulnerability assessment, 100-year inundation maps were developed using the validated XP-SWMM models (discussed in Section 2.0). Structures were identified as potentially *impacted* if the structure outline intersected the 100-year floodplain. Note: because in the majority of cases, low-entry elevations for habitable structures have not been surveyed, the number of impacted structures identified in each flood-risk area should be considered an estimate of the number of structures potentially impacted by peak 100-year flood inundation. Flood-risk areas with a large number of identified impacted structures are assigned high priority.

(4) **Flood-prone area upstream of an impaired or at-risk water body:** A waterbody that does not meet MPCA water quality standards is considered by RWMWD to be impaired and is included on the MPCA's impaired waters list. RWMWD also classifies several waterbodies "at-risk," based on several criteria listed in the District's plan. Flood-risk reduction projects may inherently provide or be modified to provide water quality benefits to downstream waterbodies. For this reason, flood-risk areas tributary to impaired or at-risk waterbodies were assigned high priority.

(5) **Street flooding:** Cities and local roadway authorities frequently design storm water systems to convey runoff from relatively small events (5- or 10-year frequency). Because road inundation during larger rainfall events may prevent residents and emergency vehicles from accessing critical facilities (hospitals, grocery stores, etc.), the District requires that storm water storage areas be designed to prevent roadway flooding during a 100-year event. Areas where stormwater pooling occurs on roads adjacent to flood-prone areas where considered a priority.

District flood-risk areas were prioritized by assigning point values to the five categories described above. The points assigned to each category are summarized in Table 1. Although both Local flood-risk areas and District flood-risk areas are shown the figures included in Appendix A, only District flood-risk areas were evaluated and prioritized in Table 1. It is important to note that the models developed do not simulate all of the local storm sewer systems within the watershed. As a result, each City may identify separate, localized flooding areas that are not shown on the attached figures. The District should continue to work cooperatively with the cities to address localized flooding concerns and manage inflows to District water bodies.

4.0 Planning Level Opinion of Cost

There are several factors that affect the cost of implementing a flood-risk reduction project:

- The volume of stormwater that must be stored within the watershed or conveyed downstream;
- The potential to reduce flood-risk by retrofitting existing stormwater infrastructure;
- The potential to reduce flood-risk by constructing new flood detention facilities; and
- The potential need to acquire property when other flood-reduction alternatives are not feasible.

Evaluating the most cost-efficient flood reduction project for a given flood-risk area requires (1) review of the source(s) and cause(s) of flooding (requiring detailed hydrologic and hydraulic review), (2) high-level review of available options to mitigate flooding (e.g., is there sufficient available space for a flood detention project? Is there sufficient grade to excavate and tie-in to existing storm sewer utilities, etc.), and (3) preliminary design and cost-comparison analysis of feasible flood-mitigation alternatives. Due to the large number of flood-risk areas identified (see Table 1 and figures in Appendix A), it was not possible to perform detailed review of flood-mitigation alternatives and develop associated cost-estimates for each within the scope of this project.

For the purpose of prioritization, a planning level opinion of cost was developed for each flood-risk area by assuming that the cost of any selected flood-reduction project must be less than the cost of purchasing the affected structures. Based on this assumption, the planning-level opinions of cost shown in Table 1 were developed by intersecting identified impacted structures (see Section 3.0) with Ramsey and Washington County parcel data (Ramsey County, 2015; MN DNR, 2011) and estimating the cost of land and property acquisition. Cost associated with property acquisition were obtained from the Ramsey County Property Records and Revenue department and the Washington County Property Records and Taxpayer Services department. This evaluation assumed an estimated acquisition cost of 125% of the estimated market value. The additional 25% is intended to account for the cost of appraisals, removals, and adjustments for market value.

The planning level opinions of cost included in Table 1 do not impact the prioritization scoring, but are included to provide an estimate of the potential cost of flood-mitigation within each flood-risk area. An important note is that, based on more-detailed review of flood-mitigation alternatives, the final cost of flood-mitigation may be significantly lower or higher than the planning level opinions of cost included in Table 1. In fact, if purchasing structures is a flood-risk mitigation strategy, the planning level opinions of cost can be considered a worst-case-scenario, in which no identified flood-mitigation alternatives are more cost-efficient than acquiring all impacted structures and property.

5.0 Flood-Risk Reduction Projects: Feasibility Studies

Barr recommends that the District begin to complete detailed feasibility studies for each of the flood-prone areas prioritized in Table 1. Flood-mitigation feasibility studies should be focused on:

- Identifying the hydraulic and hydrologic sources of flooding;
- Developing flood-mitigation alternatives;
- Looking for opportunities to incorporate water quality improvement; and
- Performing cost-benefit analyses to identify preferred flood-mitigation alternatives.

In general, Barr recommends the District begin with the highest priority flood-risk areas and work down the list to lower priority flood-risk areas. Similar to the Beltline Resiliency study that is currently underway, which will identify system-wide strategies for mitigating flood-risk within the portion of the District tributary to the Beltline. Note: because there are other factors which drive prioritization (e.g., upcoming road reconstruction and CIP projects), the District may choose to pursue development of feasibility studies for certain lower-priority flood-risk areas ahead of flood-risk areas higher on the priority list.

References

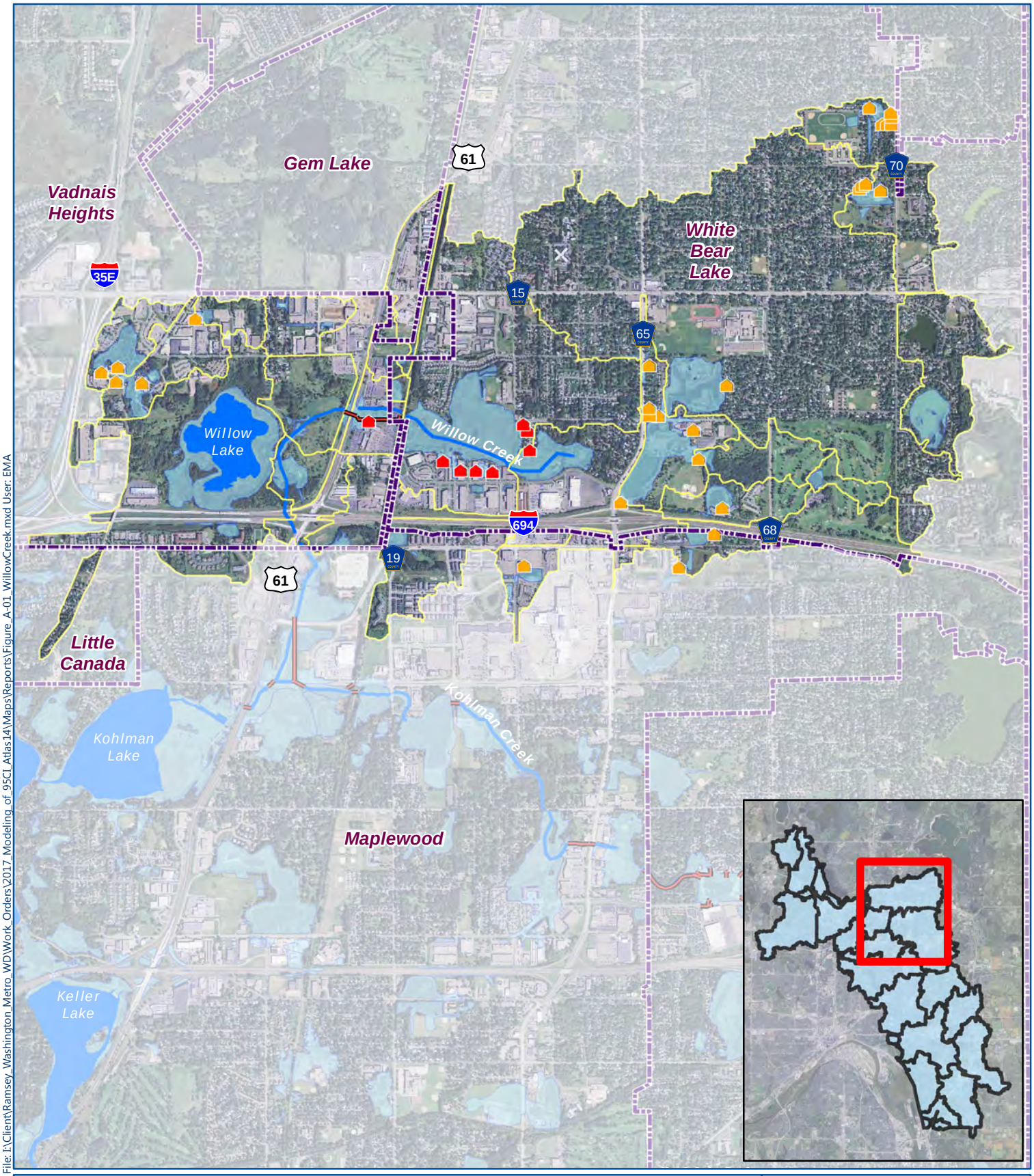
Barr Engineering Co. (Barr). 2016. Flood-Risk Reduction Project Identification and Prioritization. Prepared for the Ramsey-Washington Metro Watershed District.

Minnesota Department of Natural Resources (MN DNR). 2011. LiDAR Elevation, Twin Cities Metro Region, Minnesota 2011.

Ramsey County. 2015. Building Footprints. http://openramsey-ramseygis.opendata.arcgis.com

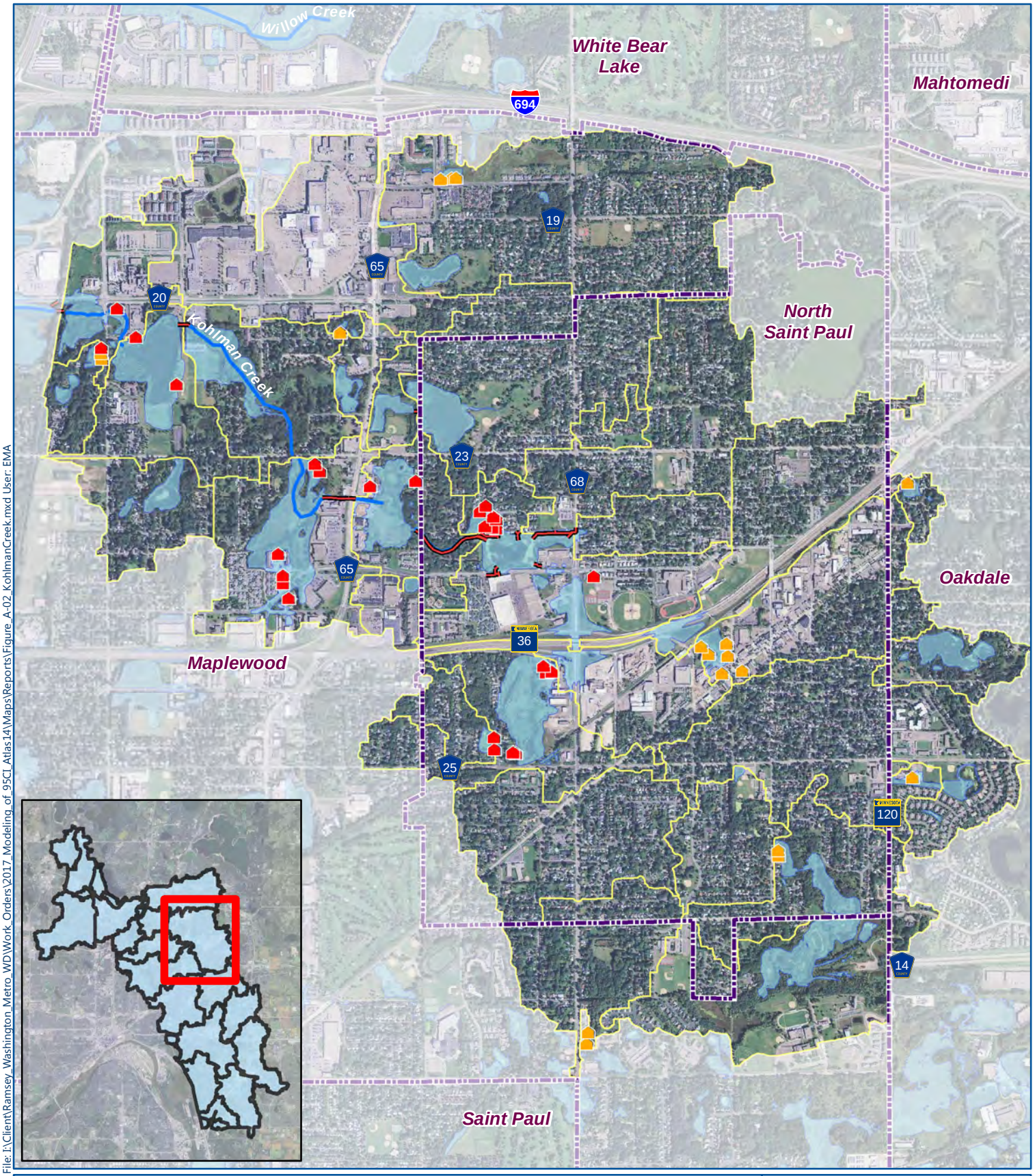
Table 1. Flood-Risk Reduction Area Prioritization

Points Used for Prioritization Ranking								-	2	1	10		5		1		2	
Subwatershed	**Drainage Area**	**City**	**Location Description**	**Points**	**Rank**	**Previous Rank (Uncalibrated)**	**Planning Level Opinion of Probable Cost**	**Issue Caused by Municipal Storm Sewer System**	**Impacted Structures**	**Potentially Impacted Structures**	**District Managed Lake or Stream**	***Name of District Managed Lake or Stream***	**District Managed Facility**	***Name of District Facility***	**Tributary to Impaired Water body**	***Impaired Water body***	**Inundation Pools on Street (flowing water ok)**	***Name of Road that Overtops***
Gervais Creek	CD16-05b	Little Canada	Owasso Basin	255	1	1	$14,922,000	No	124	NA	No	--	Yes	*Owasso Basin*	Stable	--	Yes	*Ryan Drive*
	CD16-05d																	
	CD16-05e																	
	CD16-05i																	
	CD16-05j																	
	CD16-05k																	
	CD16-05l																	
St. Paul Beltline	BEL-NH043	Saint Paul	Ames Lake and surrounding area	45	2	3	$8,208,000	No	19	NA	No	--	Yes	*Beltline*	Stable	--	Yes	*E Magnolia Ave*
	BEL-NM021																	
	BEL-NM022																	
	BEL-NM025																	
	Magnolia																	
	Phase II																	
Kohlman Creek	SB18-18	North Saint Paul	N of 13th Ave E	34	3	4	$3,403,000	No	8	NA	Yes	Kohlman Creek	Yes	*viromental Learning*	Impaired	Kohlman Creek	Yes	*13th Ave E*
	SB18-19																	
	SB18-21																	
Tanners Lake	TL-40	Maplewood	Tanners Lake	30	4	8	$9,833,000	No	10	NA	Yes	--	No	--	Stable	--	No	--
Kohlman Creek	SB18-07	North Saint Paul	N St. Paul Urban Ecology Center	30	4	5	$2,828,000	No	7	NA	Yes	Kohlman Creek	Yes	*Urban Ecology Center*	Impaired	Kohlman Creek	No	--
	SB18-08																	
Kohlman Creek	SB18-10	Maplewood	S of County Road CE	23	6	13	$32,435,000	No	6	NA	Yes	Kohlman Creek	No	--	Impaired	Kohlman Creek	No	--
St. Paul Beltline	BEL-19	Saint Paul	Downstream of Phalen	21	7	6	$23,250,000	No	8	NA	No	--	Yes	*Beltline*	Stable	--	No	--
	BEL-NH038																	
	BEL-NH038b																	
	BEL-NH039																	
	BEL-NH104																	
	BEL-NH109																	
	Pond2Phal																	
	Rose W																	
Kohlman Creek	SB18-14B	Maplewood	Markham Pond	20	8	NA	$20,077,000	No	2	NA	Yes	Kohlman Creek	Yes	*Markham Pond*	Impaired	Kohlman Creek	No	--
Kohlman Lake	KOHL-01C		E of Maplewood Dr	20	8	8	$10,246,000	No	2	NA	Yes	Kohlman Creek	Yes	*Kohlman Basin*	Impaired	Kohlman Lake	No	--
	KOHL-KBA																	
	KOHL-KBB																	
	KOHL-KBC																	
	KOHL-KBD																	
Kohlman Creek	SB18-09	Maplewood	E of White Bear Ave N	20	8	8	$3,955,000	No	2	NA	Yes	Kohlman Creek	Yes	*ite Bear Avenue Pipe*	Impaired	Kohlman Creek	No	--
Kohlman Creek	SB18-17A	Maplewood	SE of Hazelwood St and Beam Ave	20	8	7	$3,145,000	No	1	NA	Yes	Kohlman Creek	Yes	*Kohlman Basin*	Impaired	Kohlman Creek	Yes	*Hazelwood St*
Willow Creek	NB18-11	White Bear Lake	N of Burerkle Rd	19	12	2	$16,039,000	No	7	NA	No	--	Yes	*Willow Creek Pipeline*	Stable	--	No	--
	NB18-12																	
Willow Creek	NB18-17	Vadnais Heights	N of HW61 and Buerkle Rd	19	12	NA	$11,883,000	No	1	NA	Yes	Willow Creek	Yes	*Willow Creek Pipeline*	Stable	--	Yes	*Highway 61*
St. Paul Beltline	S-m273-g	Saint Paul	Hoyt Ave and surrounding area	19	12	13	$1,426,000	No	7	NA	No	--	Yes	*Ave flood control pr*	Stable	--	No	--
	S-m291-g																	
	S-m44-g																	
	S-m520-g																	
	S-m71-g																	
	S-m80-g																	
Lake Phalen	PHAL-16	Maplewood	W of E Shore Dr (N of Lake Phalen)	18	15	19	$7,506,000	No	4	NA	Yes	Phalen Chain	No	--	Stable	--	No	--
Gervais Lake	GERV-04	Little Canada	Gervais Lake	18	15	8	$2,805,000	No	4	NA	Yes	Gervais Lake	No	--	Stable	--	No	--
	GERV-05a																	
Carver Lake	CARV	Maplewood	Carver Lake	17	17	12	$4,054,000	No	3	NA	Yes	--	No	--	At Risk	Carver Lake	No	--
Lake Owasso	LakeOwasso	Roseville	Lake Owasso	17	17	15	$1,488,000	No	3	NA	Yes	--	No	--	At Risk	Lake Owasso	No	--
Gervais Creek	CD16-19	Little Canada	Downstream of Gervais Mill Pond	16	19	15	$1,873,000	No	3	NA	Yes	Gervais Creek	No	--	Stable	--	No	--
Battle Creek Lake	BC-39	Woodbury	Battle Creek Lake	15	20	17	$218,000	No	1	NA	Yes	Battle Creek Lake	No	--	At Risk	Battle Creek Lake	Yes	*Weir Drive*
Tanners Lake	TL-25	Maplewood	S of Minnehaha Ave and Century Ave	13	21	NA	$2,197,000	No	3	NA	No	--	Yes	*Tanners Lake*	Stable	--	Yes	*Century Ave N*
	TL-26																	
Battle Creek Lake	BC-36	Woodbury	Harvey Vogel Manufacturing Co	8	22	NA	$6,039,000	No	1	NA	No	--	Yes	*el Manufacturing Pipe*	At Risk	Battle Creek Lake	No	--
	BC-36A																	
Carver Lake	CARV-79	Woodbury	Carver Ravine Water Quality Pond	8	22	20	$289,000	No	1	NA	No	--	Yes	*Ravine Water Qualit*	At Risk	Carver Lake	No	--
St. Paul Beltline	BEL-FLNHYT	Saint Paul	SW of Herbert St and Maryland Ave E	7	24	21	$139,000	No	1	NA	No	--	Yes	*Beltline*	Stable	--	No	--
	BEL-NM003																	
Battle Creek	C-19A	Woodbury	Downstream of Battle Creek Lake	--	--	17	--	No	0	NA	Yes	Battle Creek	No	--	Impaired	Battle Creek	No	--
	C-19B																	
	C-19C																	
	C-19D																	
	C-19E																	
	C-19F																	
	C-19G																	
	C-19H																	
	C-19I																	
	C-19J																	



WILLOW CREEK: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-01



Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

0 1,000 2,000

Feet

KOHLMAN CREEK: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-02

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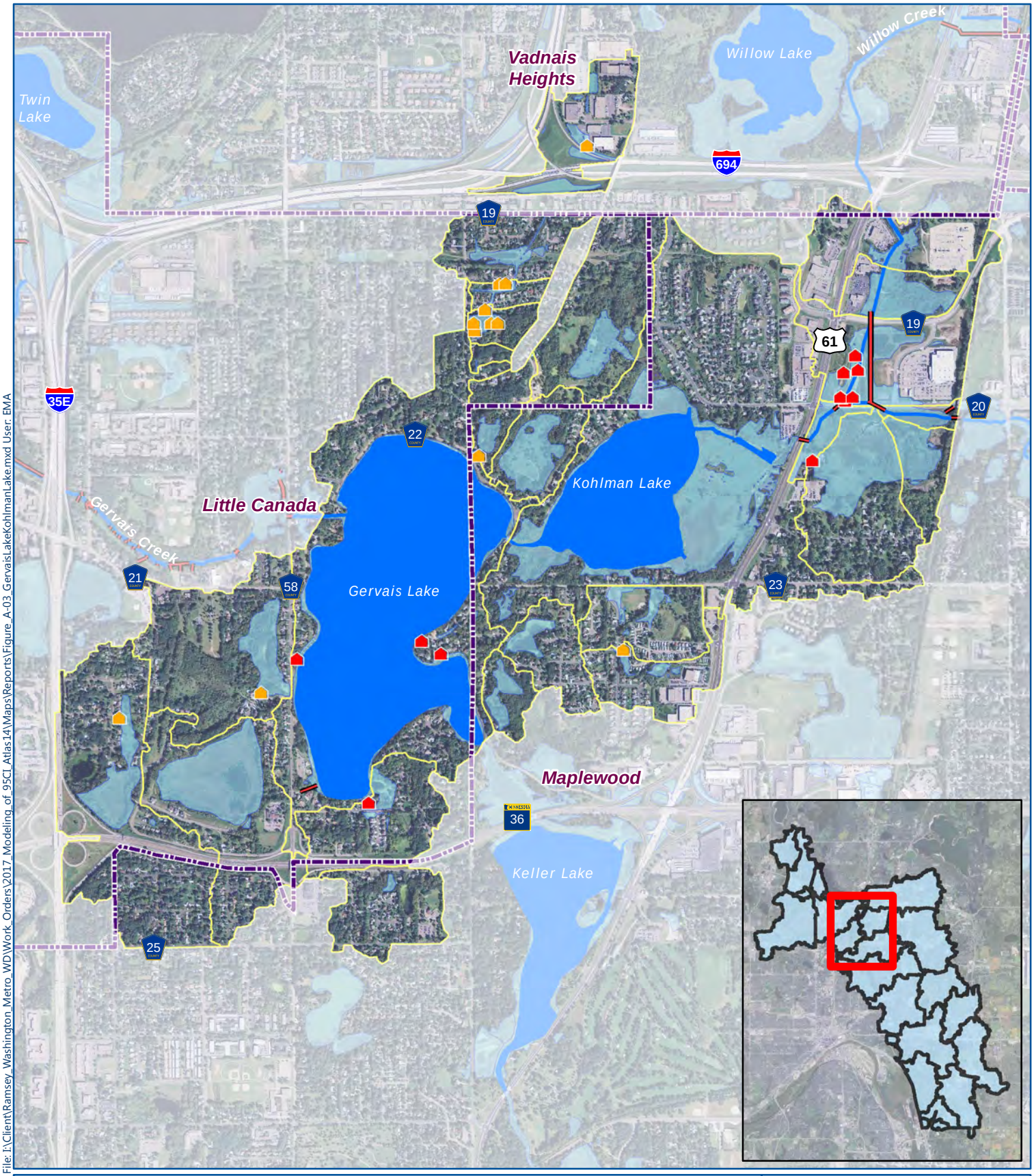

Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

0 1,000 2,000

Feet

GERVAIS LAKE & KOHLMAN LAKE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-03

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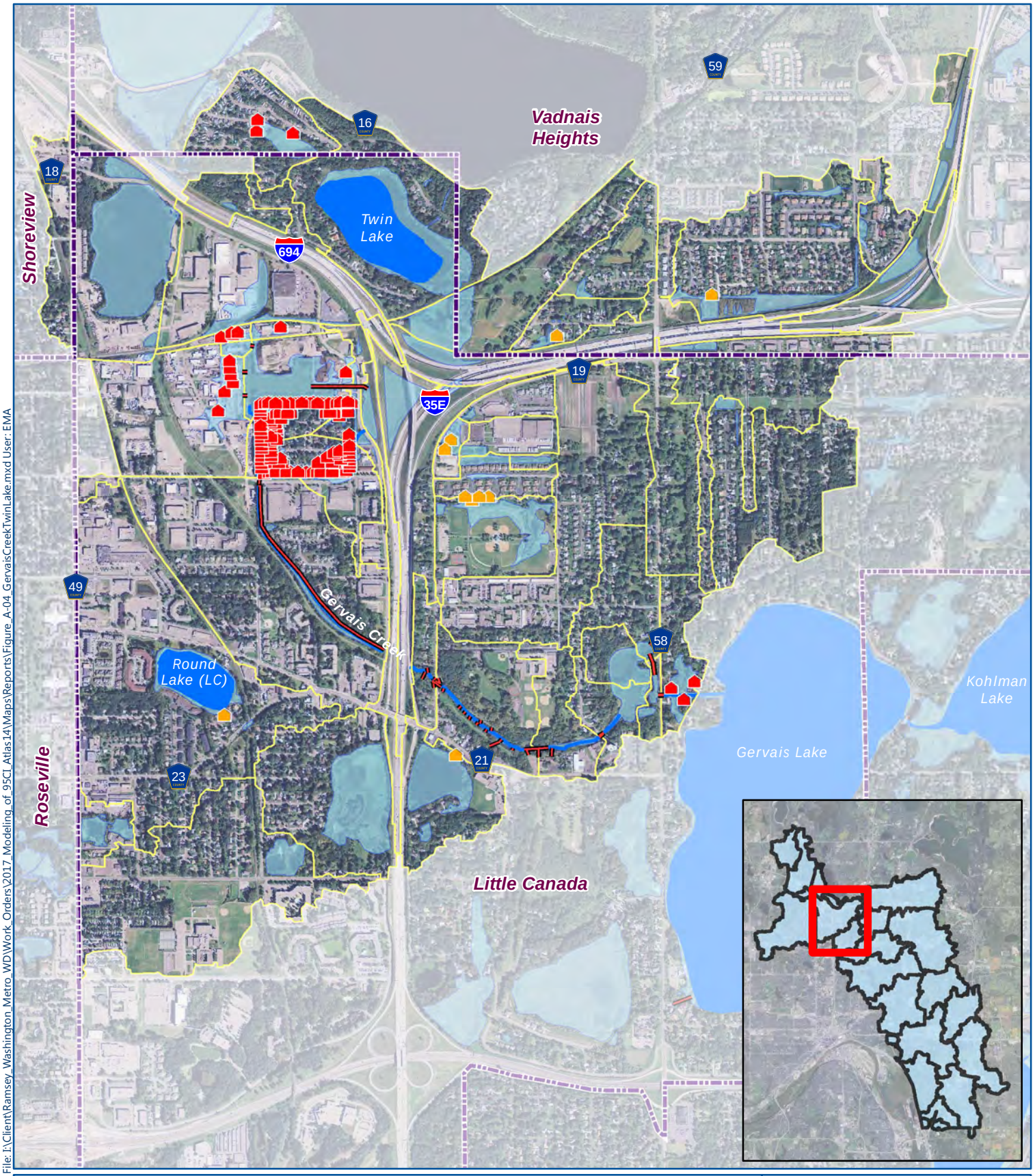


Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

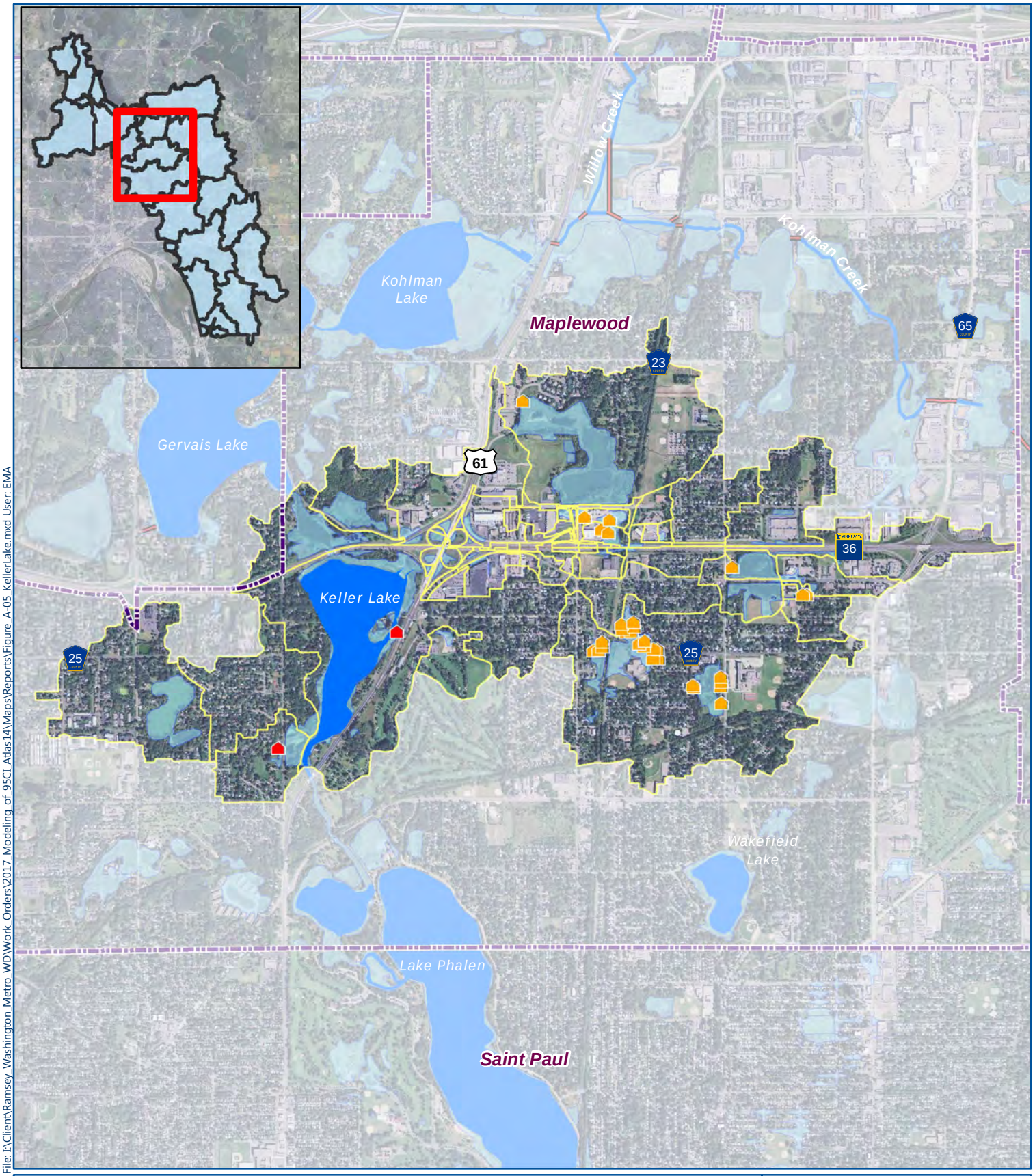
BARR

0 1,000 2,000

Feet

GERVAIS LAKE & TWIN LAKE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-04



Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

0 1,000 2,000

Feet

KELLER LAKE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-05

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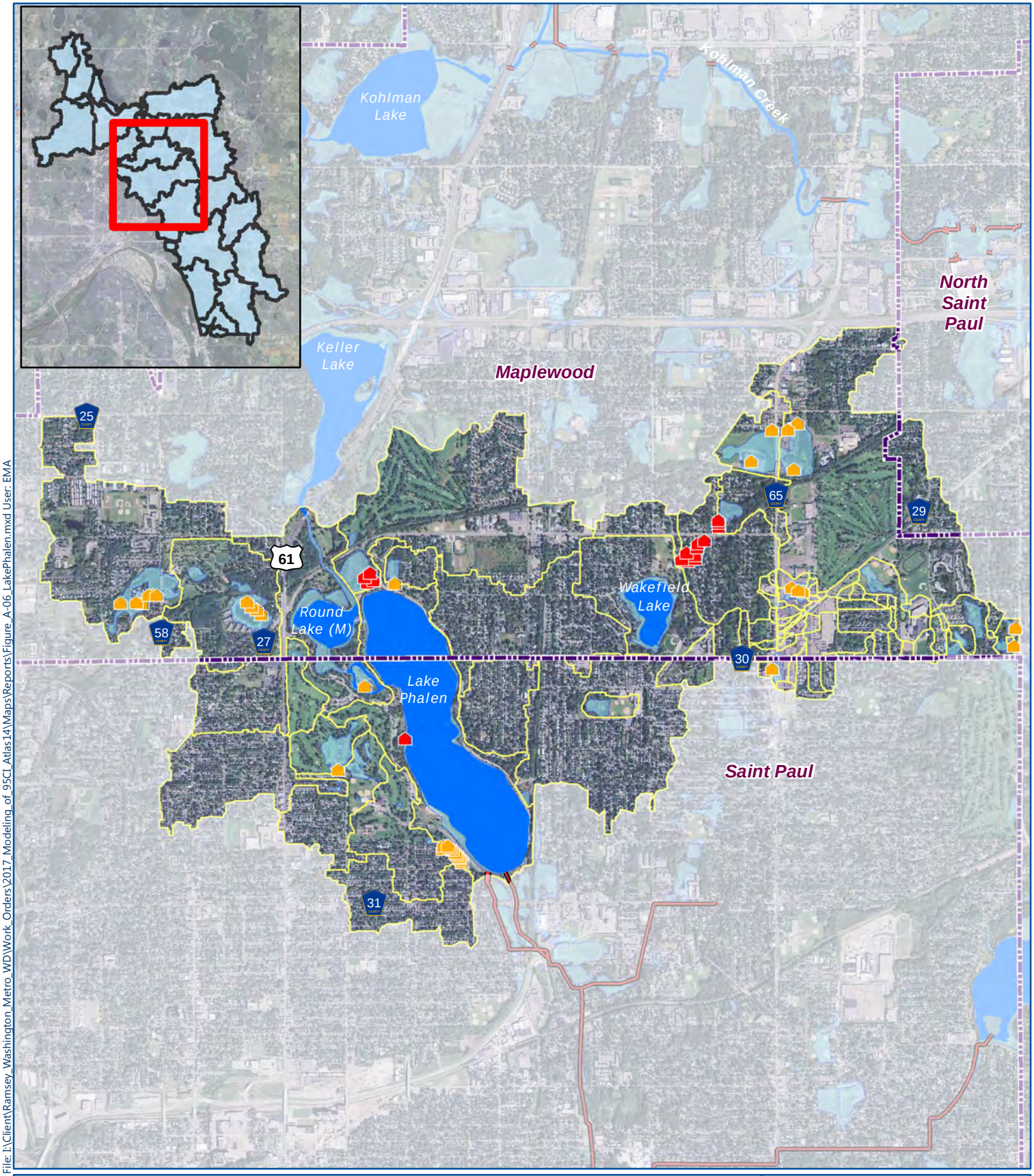

Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

0 1,000 2,000

Feet

LAKE PHALEN: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-06

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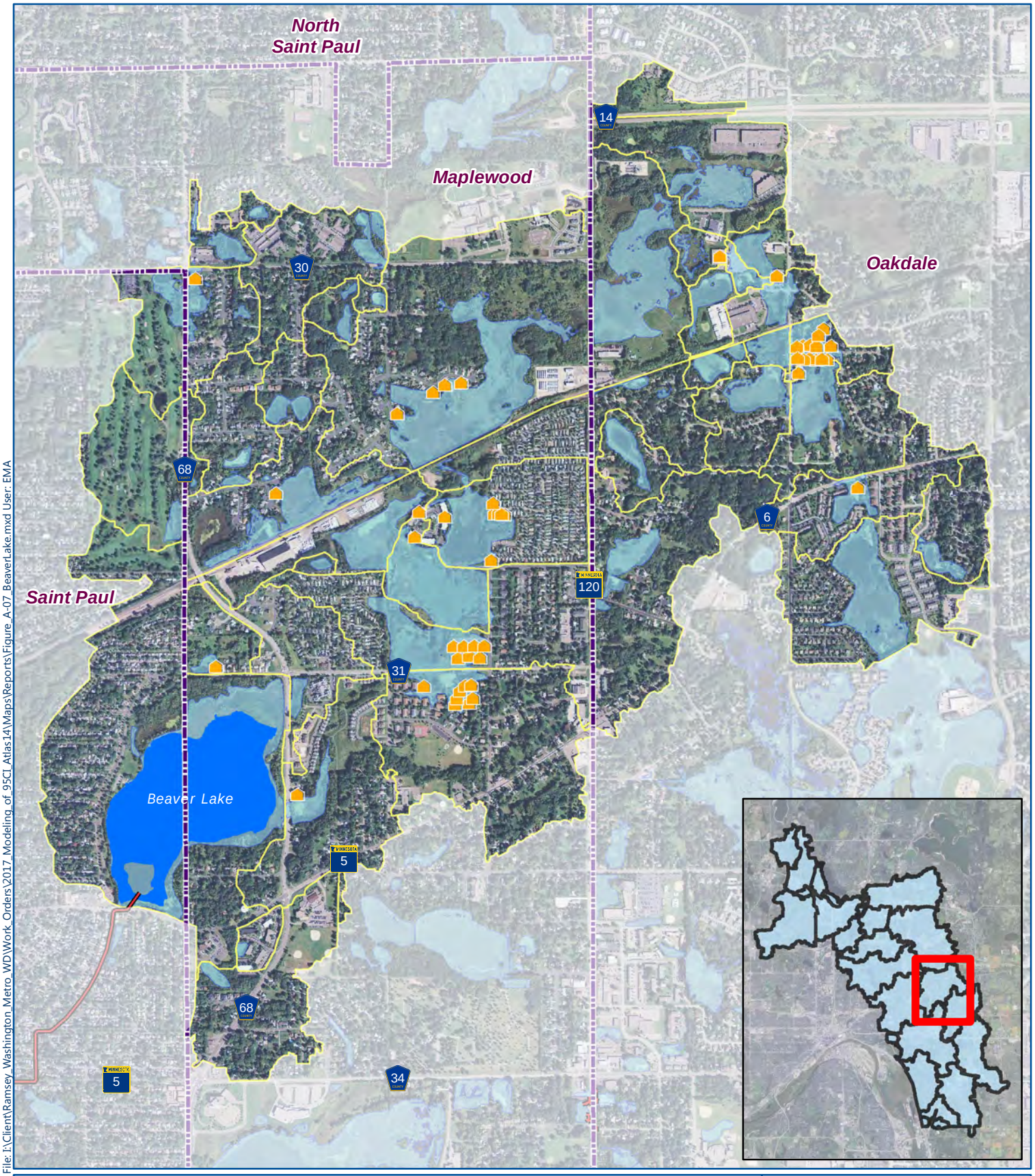

Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

0 900 1,800

Feet

BEAVER LAKE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-07

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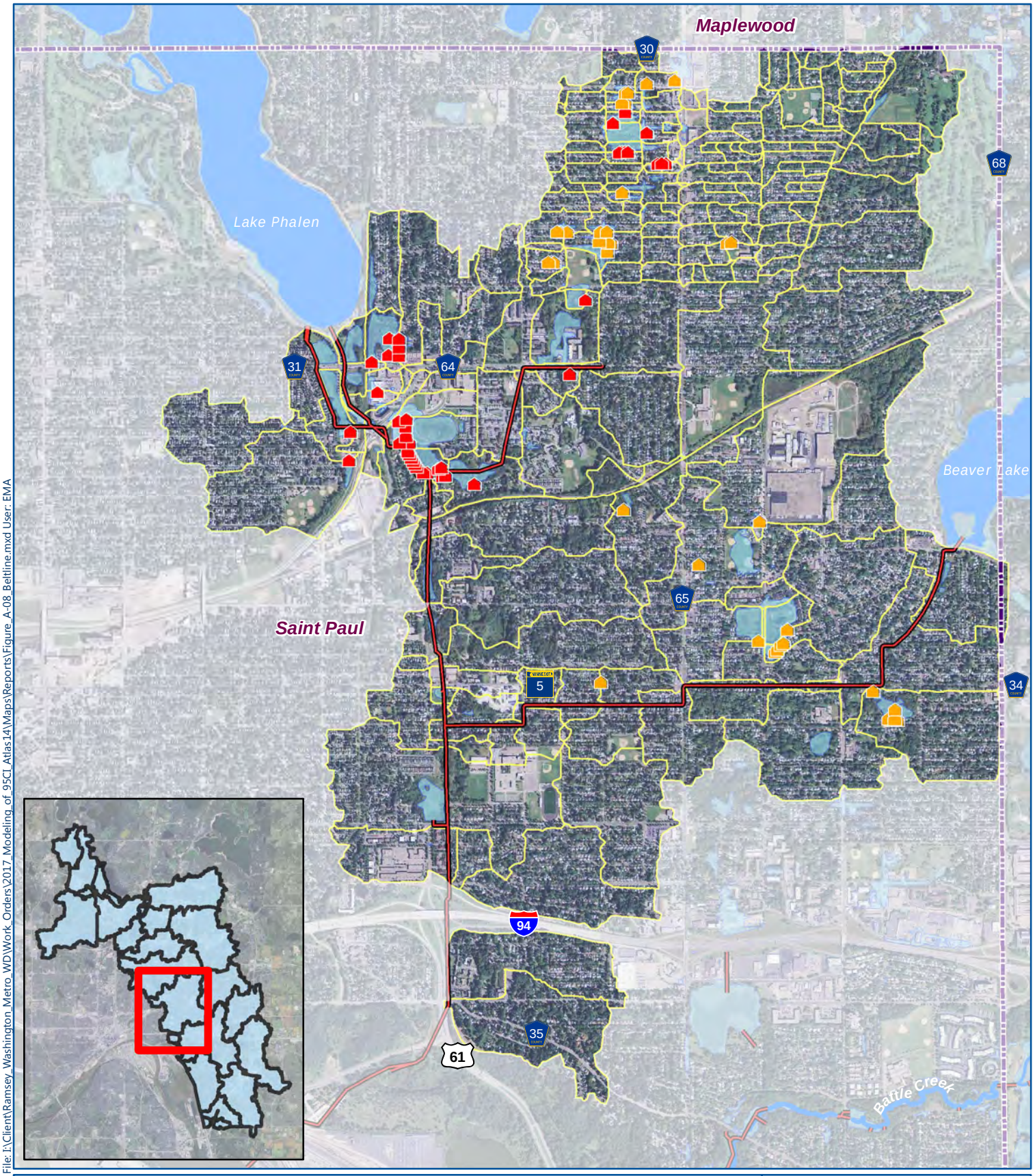

Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

0 1,000 2,000

Feet

ST PAUL BELTLINE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-08

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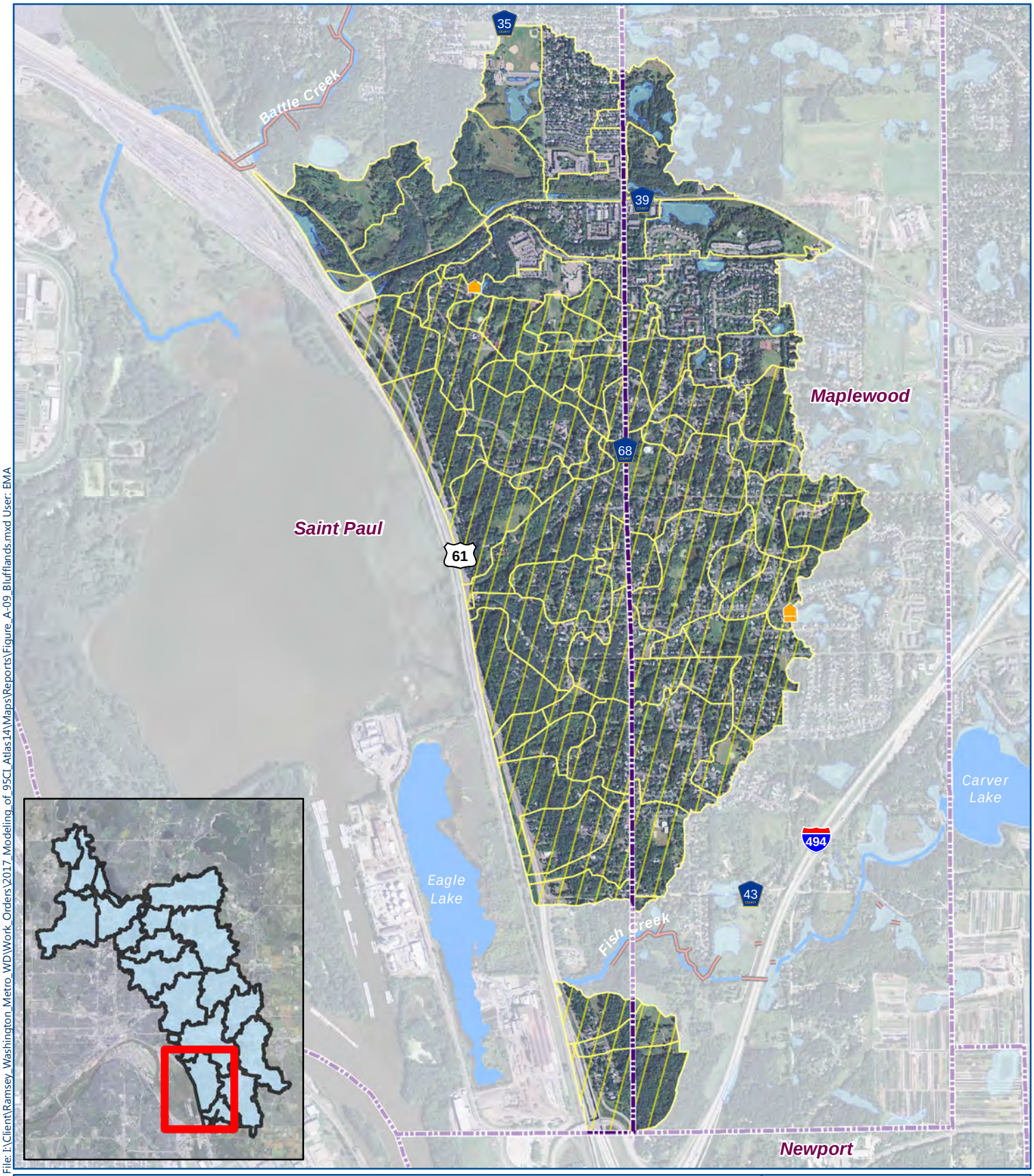


Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

No Model

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

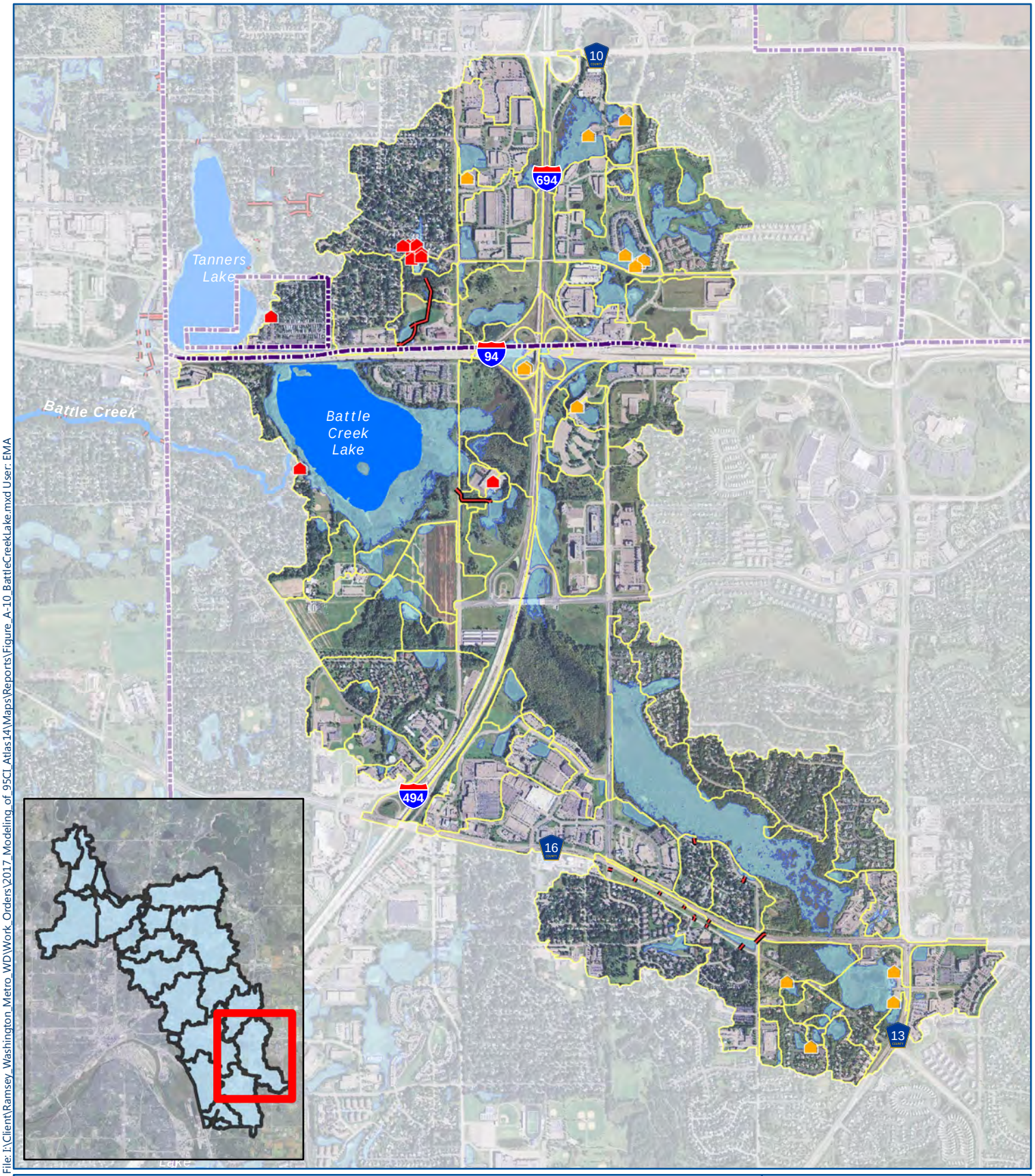
BARR

0 1,000 2,000

Feet

BLUFFLANDS: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-09



Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

0 1,000 2,000

Feet

BATTLE CREEK LAKE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-10

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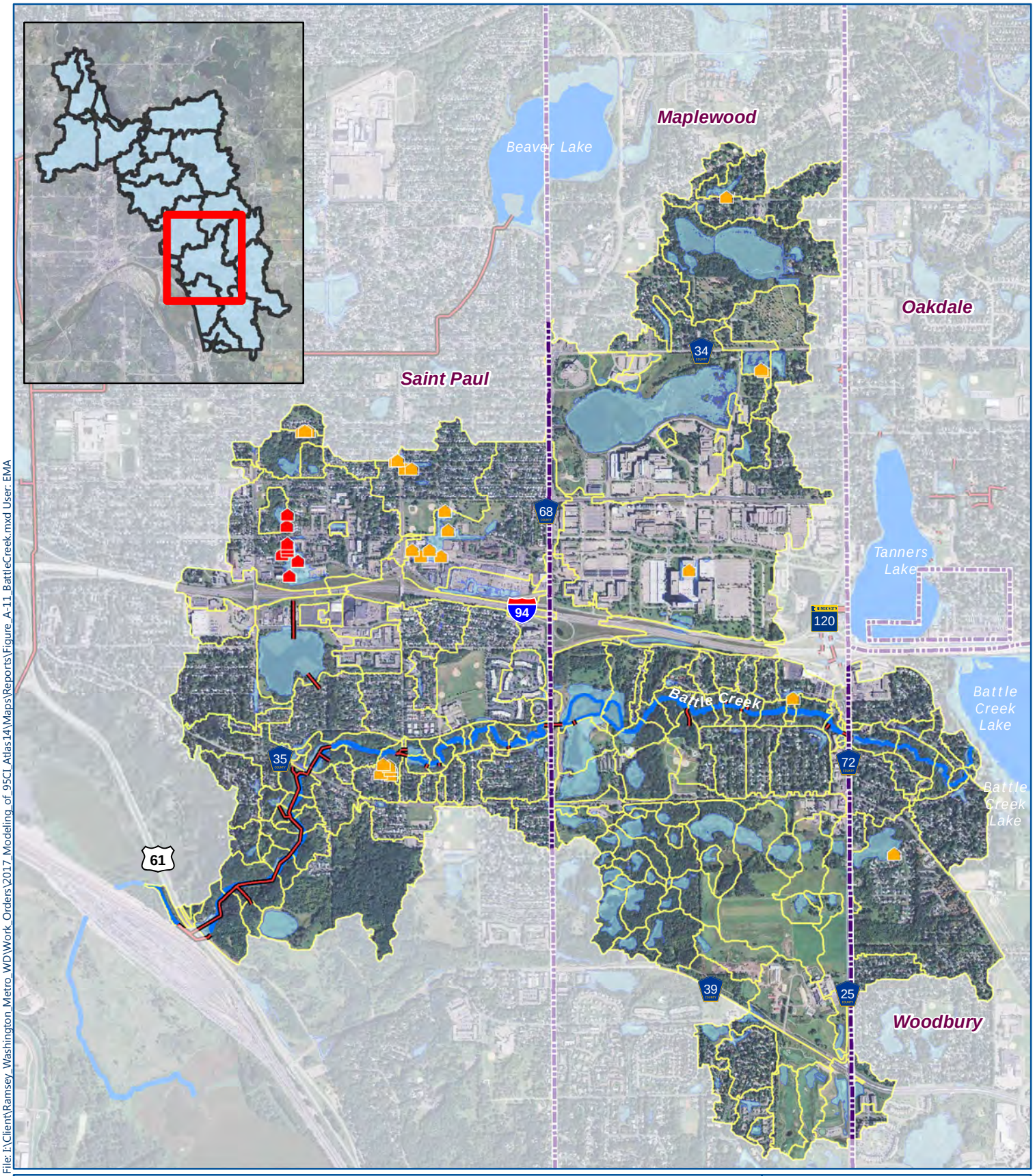


Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

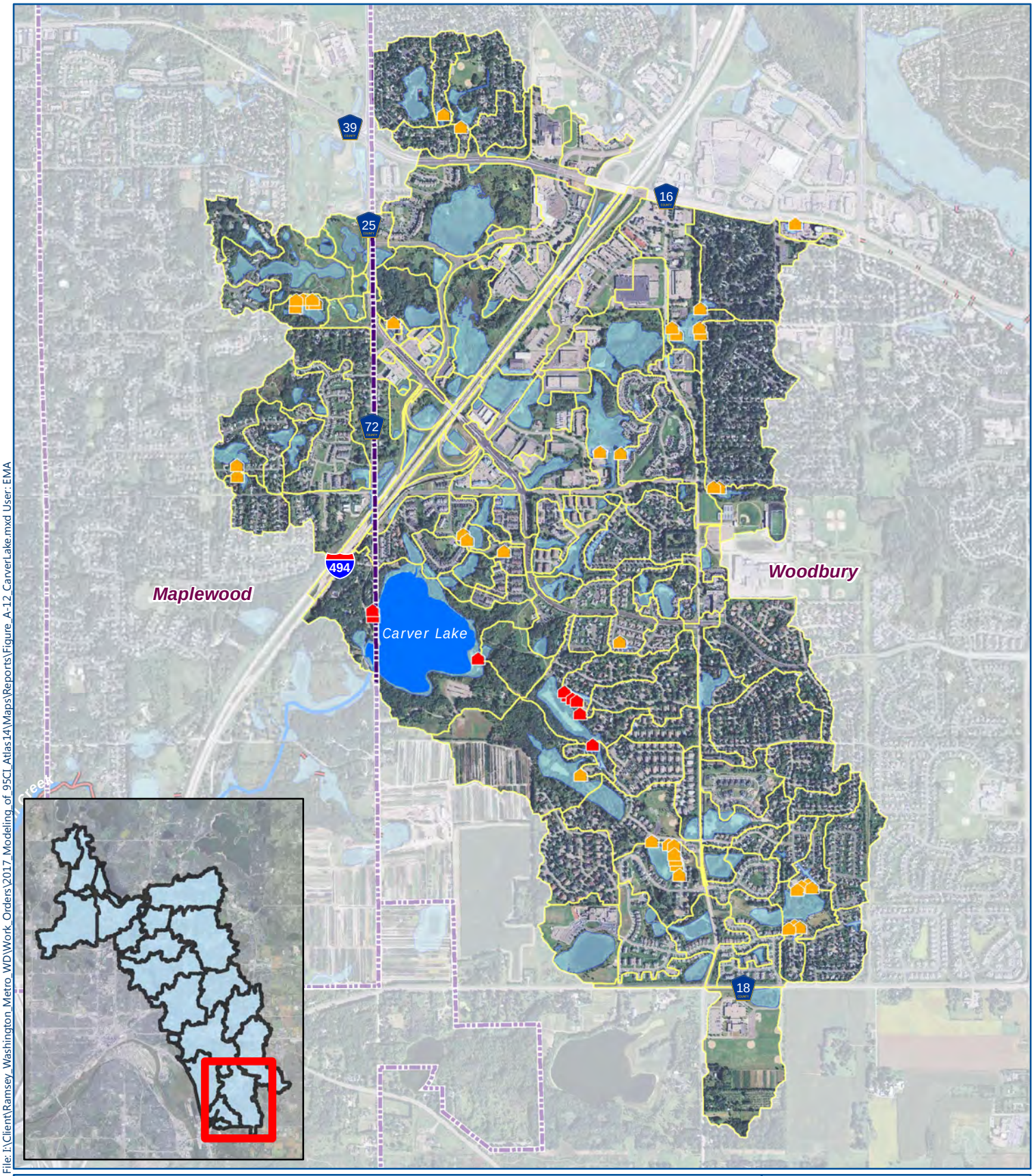
0 1,000 2,000

Feet

BATTLE CREEK: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-11

Barr Footer: ArcGIS 10.6, 2018-08-24 14:12 File: I:\Client\Ramsey_Washington_Metro_WD\Work_Orders\2017_Modeling_of_95CI_Atlas14\Maps\Reports\Figure_A-11_BattleCreek.mxd User: EMA



Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

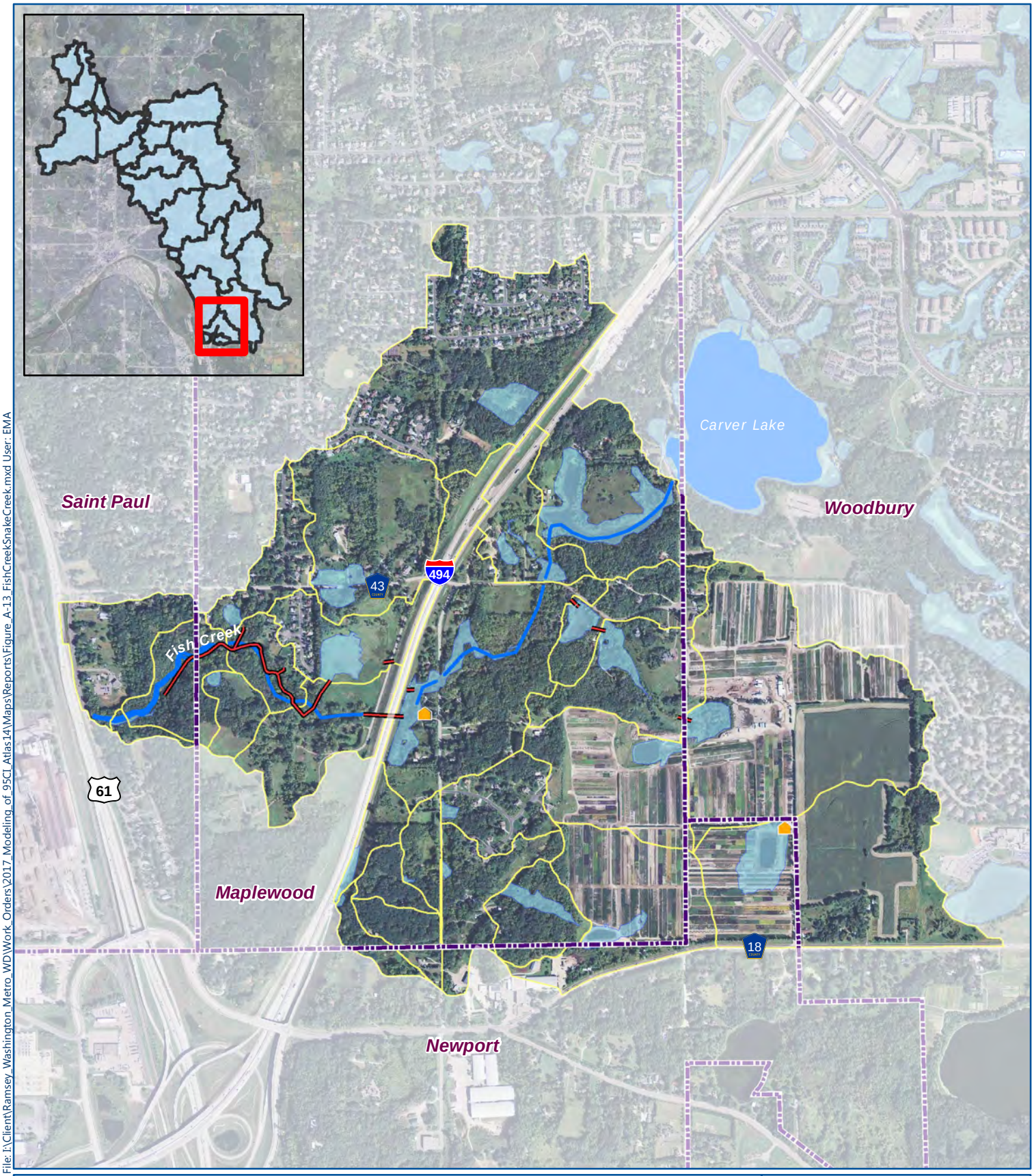
0 1,000 2,000

Feet

CARVER LAKE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-12

Barr Footer: ArcGIS 10.6, 2018-08-24 14:23 File: I:\Client\Ramsey_Washington_Metro_WD\Work_Orders\2017_Modeling_of_95CI_Atlas14\Maps\Reports\Figure_A-12_CarverLake.mxd User: EMA



- Potentially Impacted Structures (District flood-risk area)
- Potentially Impacted Structures (Local flood-risk area)
- District Managed Stormsewers/Culverts
- Drainage Areas
- District Managed Lakes
- District Managed Streams
- Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

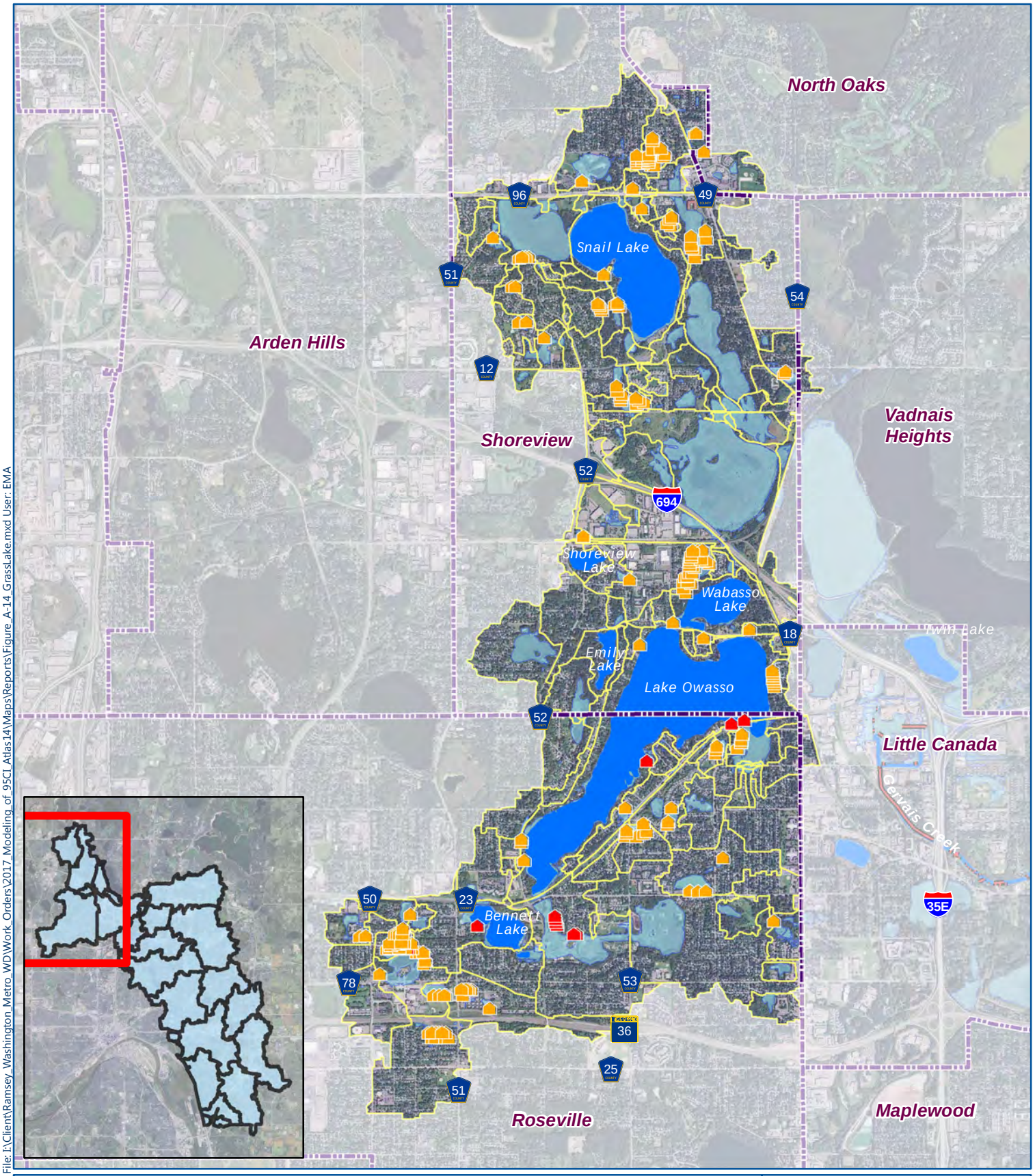
N

BARR

0 800 1,600
Feet

FISH CREEK & SNAKE CREEK: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-13



Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

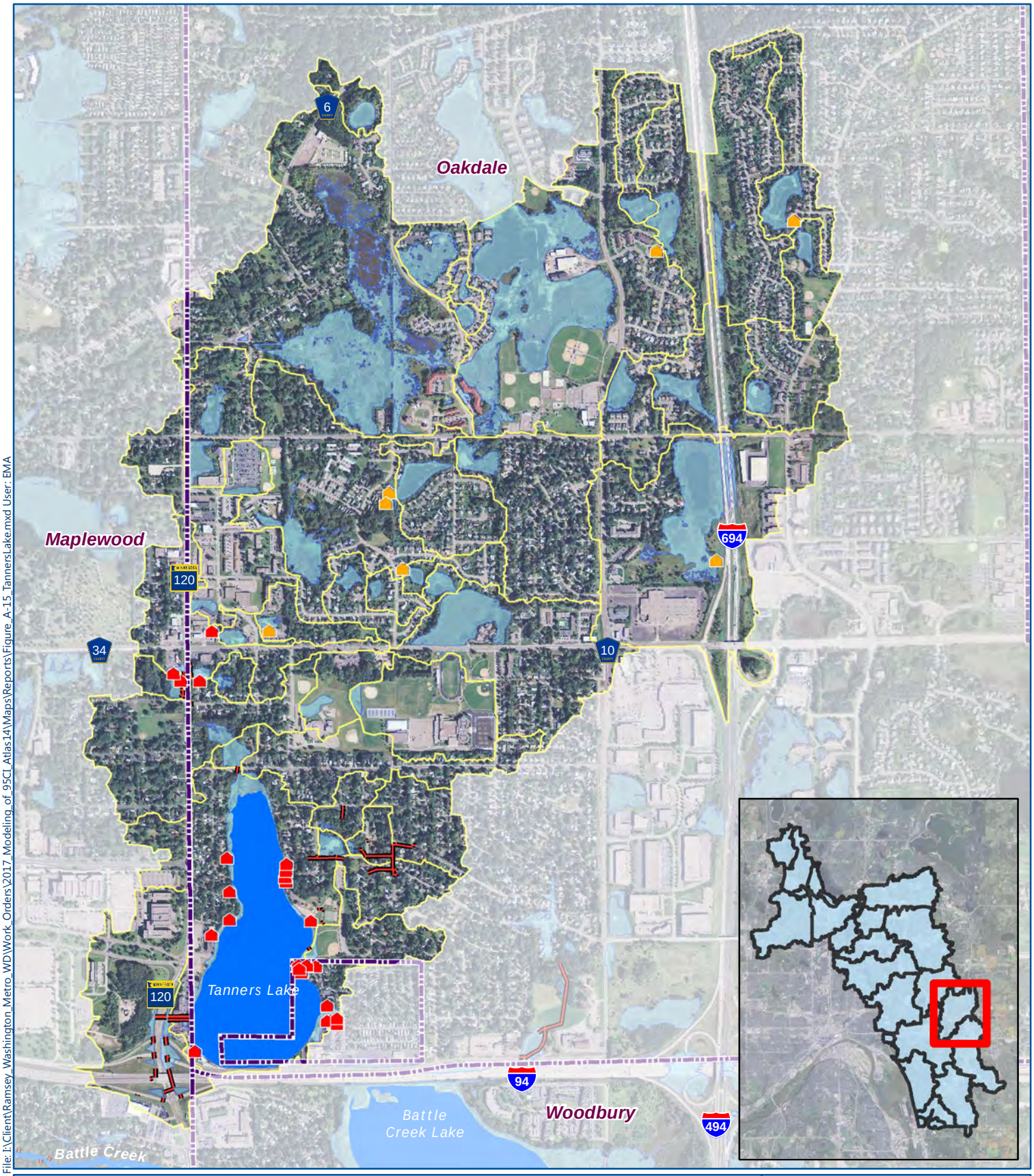
0 2,000 4,000

Feet

GRASS LAKE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-14

Barr Footer: ArcGIS 10.6, 2018-09-04 12:09 File: I:\Client\Ramsey_Washington_Metro_WD\Work_Orders\2017_Modeling_of_95CI_Atlas14\Maps\Reports\Figure_A-14_GrassLake.mxd User: EMA



Potentially Impacted Structures (District flood-risk area)

Potentially Impacted Structures (Local flood-risk area)

District Managed Stormsewers/Culverts

Drainage Areas

District Managed Lakes

District Managed Streams

Atlas 14 Inundation Extent

RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

N

BARR

0 900 1,800

Feet

TANNERS LAKE: FLOOD-RISK AREA HIGH LEVEL SCREENING

FIGURE A-15