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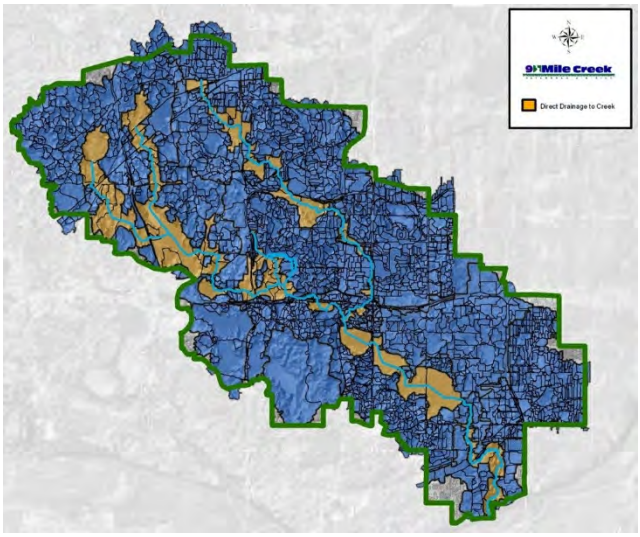
Memorandum

DRAFT

To: Randy Anhorn, Nine Mile Creek Watershed District
From: Janna Kieffer
Subject: Scope of Work to Update NMCWD Watershed Model
Date: February 12, 2020

Background

In 2005, the Nine Mile Creek Watershed District (NMCWD) completed development of a watershed-wide Xp-SWMM hydrologic and hydraulic model. The model simulates conveyance of stormwater through the trunk storm sewer systems throughout the watershed and through the Nine Mile Creek system, including the North Fork, South Fork, County Ditch 34, Braemar Branch, and the Main Stem of Nine Mile Creek. The watershed-wide model included 3,065 subwatersheds, with the level of detail in the subwatershed delineations varying by city, depending on the availability of elevation data and detailed storm sewer data. The watershed-wide model was originally broken into 17 separate models due to model size and computing restrictions at the time-- 16 detailed "city" models with discharges feeding into one "creek" model. Figure 1 (attached) shows the subwatersheds, with each "city" and "creek" model represented in a different color.



The 2005 watershed-wide Xp-SWMM model included 3,065 subwatersheds, with those from the "city" models shown in blue and the "creek" model shown in brown.

These models were used to update flood management elevations along the creek system that were published in the NMCWD 2007 Water Management Plan and to support the update of Hennepin County FEMA flood insurance rate maps (FIRMs). The models were also used by several cities (namely Edina and Bloomington) to establish 100-year flood elevations for interior waterbodies and by several partner agencies (e.g., cities, Hennepin County, MnDOT, Three Rivers Park District) to support evaluation and design of various roadway and infrastructure improvements since 2005.

In 2013, the NMCWD updated the watershed-wide models to reflect publication of Atlas 14 precipitation frequency estimates. Results from the updated creek model were used to establish revised flood management elevations along the Nine Mile Creek system. The NMCWD has had flood management elevations in place for decades based on past computations that used future land use development

projections. The historic Nine Mile Creek flood management elevations were compared to the updated Atlas 14 flood elevations, and the higher of these elevations were selected as the revised regulatory flood management elevations.

The focus of the 2013 model update efforts was on the Nine Mile Creek system, including inline lakes and storage areas. While some updates were made to the "city" models to capture and re-route additional overflows resulting from the increased precipitation, a rigorous review of revised flood elevations in ponds, wetlands, and lakes not directly tributary to the creek system was not included in the scope of the 2013 project. Therefore, it was recommended at the time that the revised flood elevations for waterbodies within the "city models" not be used for management purposes until more detailed analyses and/or review could be conducted for the "city" models.

Since the NMCWD's 2013 Atlas 14 updates (published in 2015), four of the six cities within the NMCWD (Edina, Bloomington, Richfield, Minnetonka) have conducted additional Atlas 14 modeling analyses using the NMCWD's "city" models as a base. City efforts generally have included updating the models with more current elevation and storm sewer information, adding more detail where appropriate, and conducting additional QA/QC of model results. Model results have been or are being used by these cities to identify and prioritize flood-prone areas and evaluate flood risk reduction options.

Project Objective

The NMCWD has a long history in flood planning and floodplain management going back to the 1960s and seeks to continue to be a leader in flood management. The NMCWD's Water Management Plan identifies several policies and actions related to reducing risk to public safety and permanent structures from flooding, including working with cities to address increased flood potential from Atlas 14 rainfall frequency estimates and understanding and addressing the potential for increased flood risk due to predicted changes in climate. This memo describes a proposed scope of work to update the NMCWD's Xp-SWMM model so as to continue to house the "best available" modeling information on a watershed basis. This memo also describes additional potential analyses to further assess flood risk and vulnerability within the Nine Mile Creek watershed, including snowmelt and Atlas 14 and mid-21st century moderate rainfall estimates, and conduct a watershed-wide resiliency assessment to identify opportunities to optimize storage and floodplain use throughout the creek system and projects to alleviate regional flooding issues.

Proposed Scope of Work

A proposed scope of work to update NMCWD's watershed-wide Xp-SWMM model (Phase 1) is summarized below, along with an estimated cost. Also summarized are potential future work phases for consideration, including using the model for a watershed-wide flood risk/vulnerability assessment (Phase 2) and resiliency assessment (Phase 3). Costs for Phases 2 and 3 can be developed following additional discussion with NMCWD staff and Board of Managers.

Phase 1- Update the NMCWD's Xp-SWMM Model

A watershed-wide model provides an important tool to assist in floodplain regulation and management, identifying flood-prone areas, and addressing localized and regional flood issues. The NMCWD has

offered use of the watershed-wide model to partner agencies since 2005. Now that many of the cities within the watershed have improved the level of detail within the "city" models, it is recommended that the NMCWD update their watershed-wide model by combining, or "stitching together" the updated "city" models, where available. With this effort, the "best available" modeling information will once again be available watershed-wide. The tasks included in this effort are summarized below.

Task 1. Combine updated "city" models and creek model

The updated "city" models and creek model will be combined into one or two watershed-wide models. With current computing power being significantly better than it was back in 2005, combining the models will allow for easier and more flexible use of the model for various simulations as needs arise from the NMCWD and/or partner agencies. This task will include the following subtasks:

- Merging the numerous "city" and creek models together, including addressing any surface overflows and cross-connections at boundaries between the "city" models
- Updating hydrologic model inputs for consistency across the watershed, as needed.
- Simulating the Atlas 14 100-year, 24 hour event and QA/QC of creek flows to ensure successful combining of models
- Preparing documentation memo

Estimated Cost - $25,000

Task 2. Update Eden Prairie portion of the model

At the time of original model development, the data available for the portion of the watershed in Eden Prairie was very limited. Elevation data (i.e., two-foot topographic data or a digital elevation model) was not available in electronic (GIS) format, nor was storm sewer data available throughout the city. As a result, the subwatershed delineations in this portion of the watershed are courser (see Figure 1) and there is less confidence in the accuracy of the storage information and storm sewer connections between waterbodies. Part of this area northeast of Bryant Lake was updated in 2017 as part of the Chamberlain-Cherokee modeling analysis conducted in partnership with the City of Eden Prairie.

If combining the other "city" models (Task 1), it would be a good time to also update the model throughout Eden Prairie to have a more consistent level of detail throughout the watershed-wide model. The City of Eden Prairie is currently in discussions with the Riley-Purgatory-Bluff Creek Watershed District to update their watershed-wide hydrologic and hydraulic models to incorporate more detailed subwatersheds that the city has developed as part of recent water quality modeling efforts. There may be some cost efficiencies in updating the portion of the city in the Nine Mile Creek model on a similar time frame.

Estimated Cost - $15,000

Task 3. Review Hopkins portion of the model and update, as needed

The portion of the watershed-wide model located within the city of Hopkins has not been updated since original model development, with exception of the NMCWD's Atlas 14 model updates in 2013 which did not include review of storm sewer or storage assumptions. At the time of original model development, detailed subwatersheds were delineated in Hopkins based on storm sewer information that was available electronically (in CAD format). However, since cities have made significant progress in mapping their storm sewer systems in GIS in the past decade, it is recommended that the Hopkins portion of the model be reviewed to identify any significant differences in storm sewer conveyance and storage assumptions. This scope assumes that minimal model updates will be needed.

Estimated Cost - $5,000

Table 1. Estimated costs for Phase 1, by task

Task	Description of Task	Amount
1	Combine updated "city" models and creek model	$25,000
2	Update Eden Prairie portion of the model	$15,000
3	Review Hopkins portion of the model and update, as needed	$5,000
	Total Estimated Cost	**$45,000**

Phase 2- Flood Risk/Vulnerability Assessment- Atlas 14 and Beyond

Understanding flood risk includes identifying the likelihood of flooding and the consequences or impacts associated with the flooding. A broader understanding of flood vulnerability can also include consideration of the capacity of a system or community to weather, resist, or recover from the impacts of a flood in the short and long term. A watershed-wide flood risk/vulnerability assessment would help the NMCWD and its communities and other partners gain a better understanding of flood risks throughout the watershed under current precipitation estimates and future climate change projections. A watershed-wide flood risk/vulnerability assessment could also help identify and characterize the risks of flooding from system failures, such as a failed culvert or clogged pipe along the creek system. Characterizing these risks is a first step in evaluating options to mitigate the risks, where appropriate, to avoid significant property damage or threats to public safety.

The following section summarizes tasks that could be included in a watershed-wide flood risk/vulnerability assessment. Additional scoping for these tasks would be necessary based on discussions with NMCWD staff, board members, and Technical Advisory Committee (TAC) members.

Task 1. Simulate design rainfall events (Atlas 14 and mid-21st century predictions) and snowmelt events & identify flood-risk areas and potentially flood-prone structures

The NMCWD's updated model would be used to simulate the following design rainfall events using precipitation estimates from Atlas 14 and from mid-century climate change predictions. The model would also be used to simulate a 100-year, 10-day snowmelt event.

- 1-, 2-, 10-, 50-, and 100-year, 24-hour events using Atlas 14 data
- 100-year, 24-hour mid-21st century moderate estimate (10.2 inches)
- 10-year, 24-hour mid-21st century moderate estimate (6.6 inches)
- 100-year, 10 day snowmelt event

Inundation mapping would be completed for the design events listed above. Flood risk areas, potentially flood prone structures, and overtopping roadways would be identified for each of these events.

Task 2. Prioritize flood-risk areas

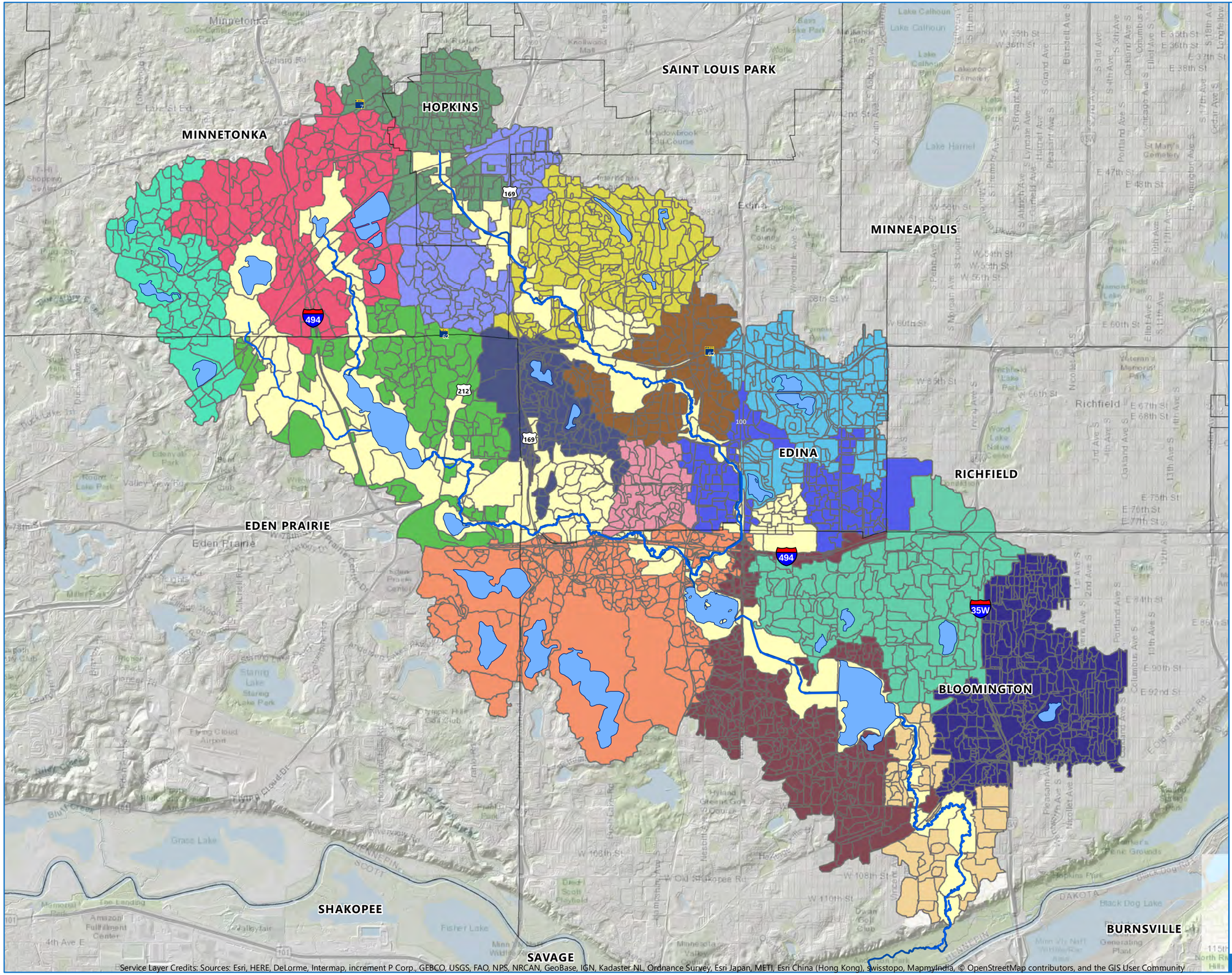
Upon identification of flood-prone areas throughout the watershed, a prioritization method could be developed based on established criteria (e.g., number of impacted structures, frequency of flooding, social vulnerability, multiple co-benefits, critical infrastructure), with feedback from TAC members. The prioritization method would be used to help identify and prioritize regional and/or intercommunity flood issues and help cities prioritize more localized flood issues.

Task 3. Risk analysis for potential pipe failures or clogging at creek crossings

The NMCWD's model and corresponding flood management elevations are based on an assumption that the existing infrastructure is in good working condition and flowing at full capacity during a simulated rainfall event. But what happens if a pipe becomes clogged with debris? Or fails entirely? The NMCWD's watershed-wide model could be used to evaluate the risks of pipe failure at creek crossings during baseflow and large storm events to identify locations where reduced (or eliminated) capacity could lead to potential damage and/or safety concerns due to creek back-ups.

Phase 3- Watershed-wide Resiliency Assessment

Recent discussions with NMCWD board members, staff, and Technical Advisory Committee meetings have indicated interest in a watershed-wide resiliency assessment to identify opportunities within the creek system or upland areas to optimize storage and floodplain use. The goal of the resiliency analysis would be to identify opportunities to reduce flood elevations at some locations along the creek system and/or create or "free up" additional capacity within the system to handle additional inflows from upstream. The analysis could also include identification of projects to alleviate regional flooding issues. Additional scoping for this task would be necessary based on discussions with NMCWD staff, board members, and Technical Advisory Committee (TAC) members.



Original XP-SWMM Models

- Creek Model
- Eden Prairie
- Edina- Cornelia/Lk Edina
- Edina- Nine Mile Central
- Edina- Nine Mile North
- Edina- Nine Mile South
- Edina- Southwest Ponds
- Edina-NMSF
- Hopkins
- Lower Valley
- Marsh Lake
- Minnetonka - East
- Minnetonka - West
- North Fork- Mtka, TH169
- Oxboro
- Penn&Skri
- West Bloomington

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Miles

Subwatersheds
Color-coded by XP-SWMM Model

FIGURE 1