Medicine Lake Road and Winnetka Avenue Area

Long-Term Flood Mitigation Plan

Prepared for
Cities of Golden Valley, New Hope, & Crystal

Final Draft
May 31, 2016

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Certifications

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

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Acronyms

Acronym	Description
BCWMC	Bassett Creek Water Management Commission
DFA	Damage Frequency Assessment
EPA	United States Environmental Protection Agency
FDR	Flood Damage Reduction grant
FEMA	Federal Emergency Management Agency
JWC	Joint Water Commission
MLRWA	Medicine Lake Road and Winnetka Avenue
MnDNR	Minnesota Department of Natural Resources
NOAA	National Oceanic and Atmospheric Administration
PWI	public waters inventory
SSID	storm sewer improvement district
TIF	tax increment financing
USACE	U.S. Army Corps of Engineers
USDC	United States Department of Commerce

1.0 Project Background

The Medicine Lake Road and Winnetka Avenue area long-term flood mitigation plan was the outcome of several studies and a long history of flooding in the area, including flooding at the low point on Medicine Lake Road east of Winnetka Avenue, and downstream in the DeCola Ponds system. The Cities of Golden Valley, New Hope, and Crystal recognized the magnitude of flooding, the potential public safety issues, and the contribution of the watershed runoff to this problem. To begin addressing the flooding issues, the three Cities supported the development of this long-term flood mitigation plan that outlines critical flood mitigation projects and planning level costs that can be used to direct future efforts. Additionally, this plan outlines the preferred cost-allocation methods, potential sources of funding, and the organizational structure for the implementation of this plan. Hennepin County was also involved in the flood mitigation discussions and supported the direction of this flood mitigation plan.

Figure 1-1 shows the Medicine Lake Road and Winnetka Avenue project area including the subwatersheds and flow patterns used in the evaluation and development of the long-term flood mitigation plan (flood mitigation plan).

Several meetings were held with staff from the three Cities to discuss the project at various points in the flood mitigation plan development. At these meetings, the Cities' staff discussed specific items related to the flood mitigation plan and came to consensus about the preferred approach and directed future efforts in the flood mitigation plan development. Meetings between the staff of the three Cities were held on the following dates:

- September 12, 2014
- October 7, 2014
- January 23, 2015
- April 30, 2015
- February 23, 2016
- April 4, 2016

This report summarizes the Medicine Lake Road and Winnetka Avenue long-term flood mitigation plan as defined through the process of this study and the input from the staff from the Cities of Golden Valley, New Hope, and Crystal.

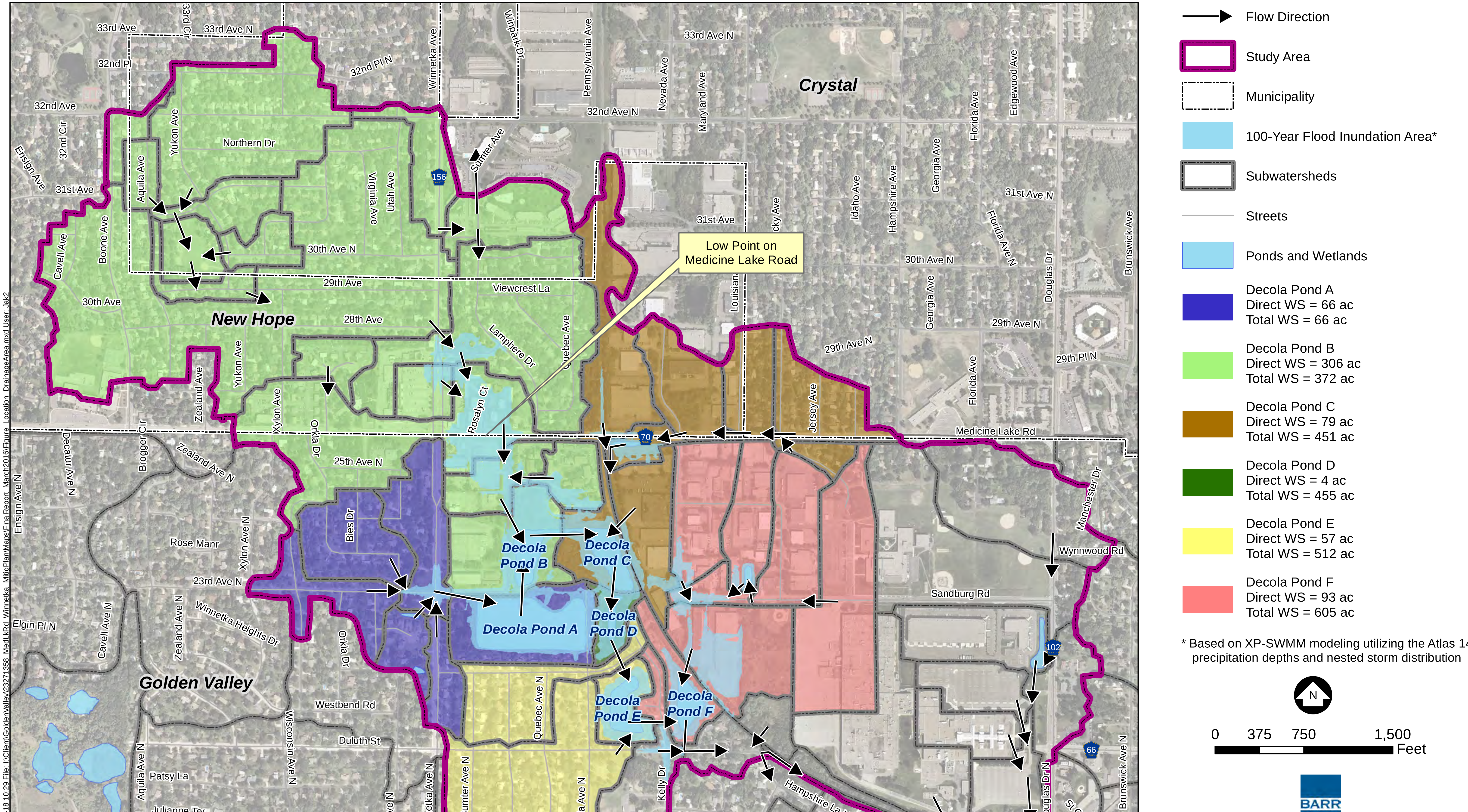


Figure 1-1

PROJECT AREA
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

1.1 History of Flooding

1.1.1 Medicine Lake Road Flooding

Several feet of flooding has been observed at the low point along Medicine Lake Road during intense storm events, resulting in the road being temporarily impassable and posing a potential public safety issue. The flooding at Medicine Lake Road is the result of runoff from the cities of Golden Valley, New Hope, and Crystal. Approximately 275 acres contribute runoff to the low point along Medicine Lake Road which during large, intense storm events, significantly contributing to the flooding on Medicine Lake Road with the majority of the flows coming from surface overflows from the upstream areas.

Flows from the Medicine Lake Road low point reach downstream DeCola Pond B via a storm sewer pipe or overland flow. The capacity of the current storm sewer pipe (60-inch equivalent arch pipe) that carries flows from the Medicine Lake Road low point south along Rhode Island Avenue to DeCola Pond B is restrictive and cannot convey all of the flows reaching the low point. Also, high water levels in the downstream DeCola Ponds system causes increased flood levels at the low point on Medicine Lake Road; ultimately, the drainage from the Medicine Lake Road low point is controlled by the 15-inch outlet from DeCola Pond C. Surface overflows from the Medicine Lake Road low point can reach the downstream DeCola Pond B by flowing south through existing parking lots and along Rhode Island Avenue N.

Significant flooding has occurred along Medicine Lake Road during recent intense storm events. The flooding at the low point on Medicine Lake Road is located at the boundary of the cities of Golden Valley and New Hope and poses a complex intercommunity water management issue resulting in serious public safety and access issues and damages to adjacent structures.

Examples of rainfall events that have resulted in significant flooding along Medicine Lake Road include:

- May 7-8, 2006 (4.0 inches of rainfall within 3.5 hours)
- June 25, 2010 (3.0 to 3.7 inches of rainfall (varying across the watershed) within 1.9 hours)

Both of these events resulted in flooding around Terra Linda Drive, Rosalyn Court, and the low point along Medicine Lake Road, including flooding of the VFW building located at the corner of Medicine Lake Road and Rhode Island Avenue.

More recently, rain events on June 21, 2013 (approximately 2.7 inches of rainfall) and July 28, 2015 (2.5 inches of rainfall within approximately an hour) resulted in flooding around the Medicine Lake Road low point with ponded water observed above the curb and on adjacent turf grass.

1.1.2 DeCola Ponds Flooding

Just downstream of the Medicine Lake Road low point are the DeCola Ponds. The DeCola Ponds system is comprised of a series of six ponds (DeCola Ponds A through F) located in the northwestern part of the city of Golden Valley, southeast of the intersection of Rhode Island Avenue and Medicine Lake Road (see Figure 1-1). The DeCola Ponds system also receives flows from the cities of Crystal, New Hope and Golden Valley. Chronic flooding has occurred historically, especially in the most downstream ponds in the system (DeCola Ponds D, E, and F), resulting in private and public property damage. There is also one (known) home on the southeast corner of DeCola Pond A (the most upstream pond) that has experienced flooding issues in the past. This area is not within a Federal Emergency Management Agency (FEMA) mapped floodplain, due to its size. Despite this, information provided by the Minnesota Department of Natural Resources (MnDNR, 2015) shows there have been five flood insurance claims from property owners in this area, and 11 of the residents on the DeCola Ponds have flood insurance policies.

DeCola Ponds A, B, and C were historically wetlands and are classified on the public waters inventory (PWI) by the MnDNR. Table 1-1 summarizes the DeCola Ponds MnDNR PWI identification numbers.

Table 1-1 DeCola Ponds MnDNR PWI Summary

Water Body	PWI ID Number
DeCola Pond A	27-0630P
DeCola Pond B and Pond C	27-0647P

The DeCola Ponds system was built in the 1960s and the ponds were originally designed for the 50-year storm event, which was standard at that time. However, approximately 18 of the homes were not built according to recommendations, and as a result, the low floors/openings in many of the homes adjacent to the ponds are below the 50-year and 100-year flood levels. On July 7, 1978, a large rain event resulted in damage to about 12 of these homes on DeCola Ponds E and F. In addition to the flood damage during the 1978 event, flood insurance claims have been made for properties on the DeCola Ponds during several other storm events including: July 23, 1987, April 21, 2001, and June 24, 2003. In addition, anecdotal evidence suggests there has been damage to properties that has gone unreported.

As the result of the 1978 flooding, various alternatives were evaluated (Barr Engineering Co., July 1979) to alleviate the flooding. The alternatives evaluated included removing the stoplog weir, removing the weir and excavating the ponds to maintain water quality treatment capacity, building a 48-inch bypass to the Honeywell Pond, and additional home flood proofing.

After the 1978 flooding, the City of Golden Valley and the homeowners affected by the flooding (Wildwood Weir Association) reached a settlement. As a result of the settlement, the City and the Association entered into an agreement in 1984 that lays out the responsibilities of the two parties with respect to the operation of the DeCola Ponds outlet. This agreement can be found in Appendix F of the 2012 DeCola Ponds study (Barr, 2012).

In 1985, the stoplog weir outlet at DeCola Pond F was replaced by a manually-controlled adjustable gate outlet. The residents living around the DeCola Ponds (Wildwood Weir Association) operate the gate, not the City of Golden Valley, consistent with the 1984 agreement. When rainfall is predicted, residents lower the gate to create additional flood storage. Under normal conditions, the DeCola Pond F gate is fully closed, which maintains the maximum normal water level in DeCola Ponds E and F at 888 feet MSL. When the DeCola Pond F gate is fully open, it maintains the minimum normal water level for DeCola Ponds E and F at 886 feet MSL, 2 feet lower than when the gate is fully closed.

DeCola Ponds A, B and C are the most upstream ponds in the system. The water levels in these three ponds typically equalize, acting essentially as one large basin. The normal water level for the three ponds is 894 feet MSL, which is controlled by the 15-inch outlet from DeCola Pond C. During large storm events, DeCola Pond B receives a significant amount of flow from the upstream subwatersheds (via the storm sewer along Rhode Island Avenue N), which is very large in comparison to the size of the pond. During these events, flows typically back-up into DeCola Pond A for storage before discharging downstream into DeCola Ponds B and C later in the runoff event. Additionally, DeCola Pond C receives flows from the subwatersheds east of the railroad tracks. High water levels in DeCola Pond D are due to overflows from DeCola Pond C during large storm events.

Although DeCola Ponds E and F are at the downstream end of the DeCola Pond system, the majority of the flows reaching these ponds during large storm events come from their direct subwatersheds rather than the upstream ponds. This is because DeCola Ponds A, B, and C provide for extended detention of the runoff volumes from the upstream sub watersheds, discharging slowly via the 15-inch outlet from DeCola Pond C. DeCola Pond E receives flows from the upstream DeCola Pond D as well as its direct subwatershed. DeCola Pond F receives a significant amount of flow from fairly large, developed subwatersheds to the east of the railroad.

1.2 Past Studies

In 2011 and 2012, the City of Golden Valley completed the *DeCola Ponds Area Flood Mitigation Study* (2012 *DeCola Ponds Study*) (Barr, 2012) to address flooding at the low point on Medicine Lake Road east of Winnetka Avenue and around the downstream DeCola Ponds. As part of the study, Barr developed an XP-SWMM model for the project area within Golden Valley, and incorporated an existing model originally developed for the City of New Hope for the area upstream of Medicine Lake Road. The XP-SWMM model was used to evaluate engineering alternatives to reduce flooding at Medicine Lake Road and in the DeCola Ponds system.

Although several of the evaluated flood mitigation alternatives were expected to reduce flooding at Medicine Lake Road and around the DeCola Ponds, no alternative fully resolved the flooding issues (some structures would remain at-risk of flooding even with implementation of the project). Additionally, the most promising flood mitigation projects came with a significant cost.

1.3 Project Goals

Because of the significant capital costs of a flood mitigation project that would only partially resolve the flooding issue, one of the *2012 DeCola Ponds Study* recommendations was for the Cities of Golden Valley, New Hope, and Crystal to develop a long-term flood mitigation plan for the project area. Based on that recommendation, the three Cities agreed to participate in the development of a long-term flood mitigation plan (this study). The objective of the long-term flood mitigation plan was to evaluate other alternatives such as property acquisition, development of flood storage, reductions of impervious cover in the DeCola Ponds watershed, flood proofing, and to perform a cost-benefit analysis to help the Cities make informed decisions in relation to flood mitigation alternatives.

The ultimate goal of the long-term flood mitigation plan is to reduce flood risk for properties within the project study area and address the public safety concerns related to the inundation of Medicine Lake Road with several feet of standing water during certain flood events. Through the plan development process and discussions with the three Cities, the specific goals identified by the Cities were to:

- Reduce flood depth at the low point on Medicine Lake Road to approximately 1.5 to 2.0 feet during the 100-year design storm event to accommodate emergency vehicle routes and protect public safety.

- Reduce flood elevations at Medicine Lake Road and the DeCola Ponds to minimize property damage.

2.0 Summary of Existing Flooding

2.1 Impact of Atlas 14 Precipitation Depths on Key Flood Areas

For this study, Barr used the XP-SWMM model that was developed for the *2012 DeCola Ponds Study*. For the 2012 study, the XP-SWMM model used the rainfall amounts for the 10-, 50-, and 100-year, 24-hour duration events outlined in the *City of Golden Valley Surface Water Management Plan* (Barr, 2009), which were based on the precipitation events included in Technical Paper 40 (TP-40) (USDC Weather Bureau, 1961), which was the design standard at that time. These events used the SCS Type II storm distribution. However, in 2013, the National Oceanic and Atmospheric Administration (NOAA) completed an update to the TP-40 values to reflect more current precipitation data (NOAA Atlas 14, Volume 8 (Atlas 14)). Barr revised the XP-SWMM model to reflect the Atlas 14 precipitation depths and used the Atlas 14 nested storm distribution.

Table 2-1 summarizes the TP-40 precipitation depths used in the *2012 DeCola Ponds Study* and the Atlas 14 precipitation depths used for the XP-SWMM model revisions.

Table 2-1 Summary of XP-SWMM Precipitation Events

Storm Event	TP-40 Precipitation Depth (in)	Atlas 14 Precipitation Depth (in)
10-year, 24-hour	4.2	4.3
50-year, 24-hour	5.3	6.4
100-year, 24-hour	6.0	7.4
200-year, 24-hour[1]	N/A	8.6

1 - The 200-year, 24-hour storm event was used for the benefit-cost analysis (see Section 3.2)

In addition to revising the precipitation events and storm distributions, Barr made modifications to the infiltration parameters in the pervious areas of the model subwatersheds. When Barr developed the XP-SWMM model for the *2012 DeCola Ponds Study*, the available soils data suggested that much of the watershed had soils classified as either HSG B (moderately drained soils) or as undefined. All undefined soils were assumed to be HSG B. However, to address anecdotal comments from City staff that the soils in the project area are "tight" (not conducive to infiltration), Barr revised the subwatershed infiltration parameters as part of the model updates. Infiltration parameters were not changed in subwatersheds that had predominantly HSG B soils. However, infiltration parameters reflective of HSG C (poorly drained soils) were selected in subwatersheds with primarily undefined soils.

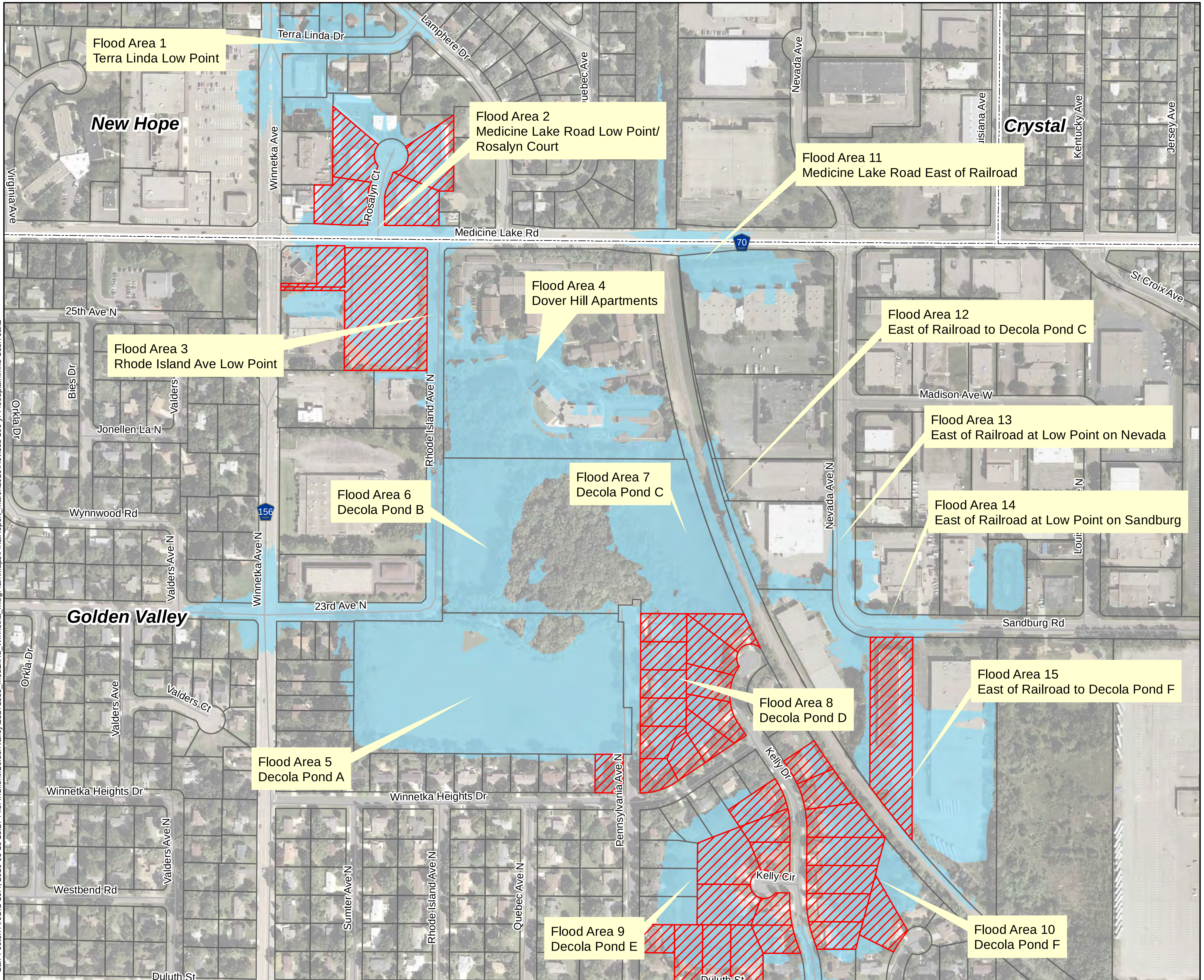
Barr utilized the revised XP-SWMM model for the existing watershed conditions to evaluate the 10-year, 50-year, 100-year, and 200-year, 24-hour storm events, based on the Atlas 14 data and the revised infiltration parameters.

Figure 2-1 shows the existing conditions 100-year floodplain within the project area, based on the results of the revised XP-SWMM modeling. The figure calls out each of the flood areas within the project area and shows the 100-year flood inundation area. Figure 2-1 also shows the at-risk properties within the project area (see additional discussion in the following sections). Table 2-2 summarizes the estimated flood elevations for each flood area for the Atlas 14 10-year, 50-year, 100-year, and 200-year, 24-hour storm events. Also included in Table 2-2 is the TP-40 100-year, 24-hour flood elevation, for comparison.

Table 2-2 Key Flood Areas and Flood Elevation Summary

Flood Area	Flood Area Description	Flood Elevation (ft-NGVD 29)[1]				
		10-yr.	50-yr.	TP-40 100-yr.[2]	100-yr.	200-yr.
1	Terra Linda Low Point	904.6	905.3	905.2	905.6	905.9
2	Medicine Lake Road Low Point/Rosalyn Court	903.8	904.7	904.5	905.1	905.4
3	Rhode Island Ave Low Point	902.6	903.7	903.4	904.1	904.4
4	Dover Hill Apartments	900.8	901.6	901.3	902.6	903.6
5	DeCola Pond A	899.7	901.6	900.8	902.6	903.6
6	DeCola Pond B	899.7	901.6	900.8	902.6	903.6
7	DeCola Pond C	899.7	901.6	900.8	902.6	903.6
8	DeCola Pond D	895.1	901.6	900.8	902.6	903.6
9	DeCola Pond E	893.6	895.9	895.4	896.2	896.3
10	DeCola Pond F	893.5	895.6	895.0	895.9	896.1
11	Medicine Lake Road East of Railroad	912.9	913.2	913.1	913.2	913.3
12	East of Railroad to DeCola Pond C	899.7	901.8	900.8	902.6	903.6
13	East of Railroad at Low Point on Nevada	902.8	902.9	902.9	903.0	903.0
14	East of Railroad at Low Point on Sandburg	901.4	902.0	902.0	902.3	902.6
15	East of Railroad to DeCola Pond F	897.5	900.5	899.5	901.4	902.1
16	Honeywell Pond[3]	881.9	883.6	882.7	884.2	884.5

1- Flood elevation based on XP-SWMM modeling utilizing the Atlas 14 precipitation depths and nested storm distribution (including adjustments for soil type and hydraulic modifications made during the Atlas 14 modeling)
2- Flood elevation based on XP-SWMM modeling utilizing the TP-40 100-year, 24-hr. SCS Type II storm distribution (including adjustments for soil type and hydraulic modifications made during the Atlas 14 modeling) - for comparison only
3- The Honeywell Pond does not include properties at-risk of flooding but flood elevations will be considered during the evaluation of the flood mitigation alternatives.



At-Risk Structures*

Streets

Parcels

Municipality

100-Year Flood Inundation Area**

* At-Risk structures determined by low opening survey and XP-SWMM modeling results utilizing the Atlas 14 precipitation depths and nested storm distribution

** Inundation area mapping is approximate based on XP-SWMM modeling results and 2007 National Geodetic Survey elevation data

N

Feet

330 165 0 330

BARR

Figure 2-1

KEY FLOOD AREAS & AT-RISK STRUCTURES
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

2.2 Low Opening Survey and At-Risk Structures

To determine which structures are at-risk of flooding, Barr conducted a survey of the lowest openings of the structures near the key flood areas. Barr developed a preliminary list of potentially at-risk properties/structures to be surveyed based on: (1) review of the floodplain mapping using the revised XP-SWMM model results for the 100-year and 200-year events; and (2) 2007 topography data collected by the National Geodetic Survey and available from the U.S. Army Corps of Engineers (USACE), which was used in the original *2012 DeCola Ponds study*.

Our work scope assumed that approximately 40-45 at-risk properties would be surveyed. However, upon review of the revised XP-SWMM model results and the floodplain mapping, Barr identified approximately 90 potential at-risk properties/structures where low opening information would be needed. Because the number of structures requiring a survey was nearly double the original estimate, Barr utilized available past survey data as much as possible to stay within budget. Past survey data sources included:

- Survey of select structures in the Terra Linda Drive and Rosalyn Court area – this survey data was collected as part of the Terra Linda Drive, Rosalyn Court, and Medicine Lake Road – Local Flood Improvement Project Study (Bonestroo, 2006) completed for the City of New Hope.
- Survey of low opening of 7500 Winnetka Heights Drive provided by the resident in 2011.
- Survey of structures on DeCola Ponds E and F collected in 1978 by Barr Engineering (Barr Engineering Co., 1979).

Barr conducted the lowest opening surveys of potentially at-risk structures on May 13, 2014, May 15, 2014, May 21, 2014, and May 22, 2014. The lowest openings of the main structures at 48 addresses were surveyed during this period. In addition to collecting the lowest opening data, the survey crew also described the lowest opening, made note of the approximate depth to the lowest floor (based on the location of the lowest opening) and the type of structure. Additionally, the survey crew photographed each of the structures and the surveyed lowest openings.

The low opening survey utilized benchmarks from the City of Golden Valley's recent benchmark reestablishment project, and three (3) of the structures surveyed in 1978 were resurveyed as part of the 2014 survey effort to verify the 1978 elevations. Based on the resultant similar survey elevations, the City of Golden Valley staff indicated they were comfortable with the use of the 1978 surveys around DeCola Ponds E and F for this flood mitigation study.

Table 2-3 summarizes the at-risk structures within the project area, based on the results of the XP-SWMM modeling and the surveys of the low openings. At-risk structures are defined as those with low opening elevations on the main structure that are located lower than the estimated 100-year flood elevations for the adjacent flood areas. It should be noted however, that structures identified as not at-risk (low opening above the 100-year flood elevation) may not provide the 2 feet of freeboard required by city policy for new construction/redevelopment. Based on the results of the XP-SWMM modeling and the lowest opening surveys, there are currently 39 structures at-risk of flooding in the project area during the

100-year storm event (see Figure 2-1). Two properties historically at risk of flooding have been flood proofed through the construction of a brick and mortar wall around the property edge or through the closing off of the walkout basement and grading around the property and are no longer considered at-risk of flooding.

Table 2-3 also summarizes the type of property, the associated flood area identification number, a summary of the storm events that result in potential flooding of the structure, the lowest opening elevation, the flood elevations for the various storm events, and the depth of flooding above the lowest opening of the structure for each of the storm events.

Table 2-3 At-Risk Properties[1]

Address	City	Property Type	Flood Area	Flooding Events[5]	Elevation of Lowest Opening (ft-NGVD29)[2]	10-year Flood Elevation (ft-NGVD29)[3]	50-year Flood Elevation (ft-NGVD29)[3]	100-year Flood Elevation (ft-NGVD29)[3]	200-year Flood Elevation (ft-NGVD29)[3]	10-year Flood Depth (ft)[4]	50-year Flood Depth (ft)[4]	100-year Flood Depth (ft)[4]	200-year Flood Depth (ft)[4]
7145 SANDBURG RD	GOLDEN VALLEY	Business	15	100-yr., 200-yr.	900.82	897.5	900.5	901.4	902.1	0.0	0.0	0.6	1.3
7825 MEDICINE LAKE RD	GOLDEN VALLEY	Business	2	50-yr., 100-yr., 200-yr.	903.77	903.8	904.7	905.1	905.4	0.0	1.0	1.3	1.6
7775 MEDICINE LAKE RD	GOLDEN VALLEY	Business	2	50-yr., 100-yr., 200-yr.	904.5	903.8	904.7	905.1	905.4	0.0	0.2	0.6	0.9
2740 ROSALYN CT	NEW HOPE	Multi-Residential	2	10-yr., 50-yr., 100-yr., 200-yr.	903.25	903.8	904.7	905.1	905.4	0.5	1.5	1.8	2.2
2710 ROSALYN CT	NEW HOPE	Multi-Residential	2	50-yr., 100-yr., 200-yr.	904.45	903.8	904.7	905.1	905.4	0.0	0.3	0.6	1.0
2700 ROSALYN CT	NEW HOPE	Multi-Residential	2	50-yr., 100-yr., 200-yr.	904.22	903.8	904.7	905.1	905.4	0.0	0.5	0.9	1.2
2730 ROSALYN CT	NEW HOPE	Multi-Residential	2	50-yr., 100-yr., 200-yr.	904.31	903.8	904.7	905.1	905.4	0.0	0.4	0.8	1.1
7500 WINNETKA HEIGHTS DR	GOLDEN VALLEY	Residential	5	50-yr., 100-yr., 200-yr.	899.8	899.7	901.6	902.6	903.6	0.0	1.8	2.8	3.8
2155 KELLY DR	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	900.14	895.1	901.6	902.6	903.6	0.0	1.4	2.5	3.4
2145 KELLY DR	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	899.66	895.1	901.6	902.6	903.6	0.0	1.9	3.0	3.9
2135 KELLY DR	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	899.13	895.1	901.6	902.6	903.6	0.0	2.5	3.5	4.5
2125 KELLY DR	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	898.55	895.1	901.6	902.6	903.6	0.0	3.0	4.1	5.0
7350 WINNETKA HEIGHTS DR	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	898.13	895.1	901.6	902.6	903.6	0.0	3.5	4.5	5.5
7400 WINNETKA HEIGHTS DR	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	898.25	895.1	901.6	902.6	903.6	0.0	3.3	4.4	5.3
7450 WINNETKA HEIGHTS DR	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	898.19	895.1	901.6	902.6	903.6	0.0	3.4	4.4	5.4
2120 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	899	895.1	901.6	902.6	903.6	0.0	2.6	3.6	4.6
2140 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	897.8	895.1	901.6	902.6	903.6	0.0	3.8	4.8	5.8
2200 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	897.88	895.1	901.6	902.6	903.6	0.0	3.7	4.8	5.7
2220 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	897.08	895.1	901.6	902.6	903.6	0.0	4.5	5.6	6.5

Address	City	Property Type	Flood Area	Flooding Events[5]	Elevation of Lowest Opening (ft-NGVD29)[2]	10-year Flood Elevation (ft-NGVD29)[3]	50-year Flood Elevation (ft-NGVD29)[3]	100-year Flood Elevation (ft-NGVD29)[3]	200-year Flood Elevation (ft-NGVD29)[3]	10-year Flood Depth (ft)[4]	50-year Flood Depth (ft)[4]	100-year Flood Depth (ft)[4]	200-year Flood Depth (ft)[4]
2240 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr., 100-yr., 200-yr.	896.91	895.1	901.6	902.6	903.6	0.0	4.7	5.7	6.7
7820 TERRA LINDA DR	NEW HOPE	Residential	1	200-yr.	905.62	904.6	905.3	905.6	905.9	0.0	0.0	0.0	0.2
1920 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	9	10-yr., 50-yr., 100-yr., 200-yr.	892.25	893.6	895.9	896.2	896.3	1.3	3.7	3.9	4.1
7450 DULUTH ST	GOLDEN VALLEY	Residential	9	10-yr., 50-yr., 100-yr., 200-yr.	892.53	893.6	895.9	896.2	896.3	1.0	3.4	3.6	3.8
7400 DULUTH ST	GOLDEN VALLEY	Residential	9	10-yr., 50-yr., 100-yr., 200-yr.	891	893.6	895.9	896.2	896.3	2.6	4.9	5.2	5.3
7350 DULUTH ST	GOLDEN VALLEY	Residential	9	10-yr., 50-yr., 100-yr., 200-yr.	891.81	893.6	895.9	896.2	896.3	1.8	4.1	4.4	4.5
1925 KELLY DR	GOLDEN VALLEY	Residential	9	10-yr., 50-yr., 100-yr., 200-yr.	890.78	893.6	895.9	896.2	896.3	2.8	5.1	5.4	5.6
1945 KELLY DR	GOLDEN VALLEY	Residential	9	10-yr., 50-yr., 100-yr., 200-yr.	893.06	893.6	895.9	896.2	896.3	0.5	2.9	3.1	3.3
1965 KELLY DR	GOLDEN VALLEY	Residential	9	10-yr., 50-yr., 100-yr., 200-yr.	892.18	893.6	895.9	896.2	896.3	1.4	3.8	4.0	4.2
2005 KELLY DR	GOLDEN VALLEY	Residential	9	10-yr., 50-yr., 100-yr., 200-yr.	893.29	893.6	895.9	896.2	896.3	0.3	2.6	2.9	3.0
2015 KELLY DR	GOLDEN VALLEY	Residential	9	50-yr., 100-yr., 200-yr.	893.75	893.6	895.9	896.2	896.3	0.0	2.2	2.4	2.6
2035 KELLY DR	GOLDEN VALLEY	Residential	9	50-yr., 100-yr., 200-yr.	894.11	893.6	895.9	896.2	896.3	0.0	1.8	2.1	2.2
2065 KELLY DR	GOLDEN VALLEY	Residential	9	50-yr., 100-yr., 200-yr.	894.7	893.6	895.9	896.2	896.3	0.0	1.2	1.5	1.6
2080 KELLY DR	GOLDEN VALLEY	Residential	10	50-yr., 100-yr., 200-yr.	895.57	893.5	895.6	895.9	896.1	0.0	0.1	0.3	0.5
2060 KELLY DR	GOLDEN VALLEY	Residential	10	50-yr., 100-yr., 200-yr.	893.98	893.5	895.6	895.9	896.1	0.0	1.6	1.9	2.1
2040 KELLY DR	GOLDEN VALLEY	Residential	10	50-yr., 100-yr., 200-yr.	894.13	893.5	895.6	895.9	896.1	0.0	1.5	1.7	2.0
2020 KELLY DR	GOLDEN VALLEY	Residential	10	50-yr., 100-yr., 200-yr.	893.52	893.5	895.6	895.9	896.1	0.0	2.1	2.3	2.6
2000 KELLY DR	GOLDEN VALLEY	Residential	10	10-yr., 50-yr., 100-yr., 200-yr.	892.03	893.5	895.6	895.9	896.1	1.4	3.6	3.8	4.1
1940 KELLY DR	GOLDEN VALLEY	Residential	10	10-yr., 50-yr., 100-yr., 200-yr.	893.1	893.5	895.6	895.9	896.1	0.4	2.5	2.8	3.0
1920 KELLY DR	GOLDEN VALLEY	Residential	10	10-yr., 50-yr., 100-yr., 200-yr.	892.5	893.5	895.6	895.9	896.1	1.0	3.1	3.4	3.6

Address	City	Property Type	Flood Area	Flooding Events[5]	Elevation of Lowest Opening (ft-NGVD29)[2]	10-year Flood Elevation (ft-NGVD29)[3]	50-year Flood Elevation (ft-NGVD29)[3]	100-year Flood Elevation (ft-NGVD29)[3]	200-year Flood Elevation (ft-NGVD29)[3]	10-year Flood Depth (ft)[4]	50-year Flood Depth (ft)[4]	100-year Flood Depth (ft)[4]	200-year Flood Depth (ft)[4]
1925 MARYLAND AVE N	GOLDEN VALLEY	Residential	10	10-yr., 50-yr., 100-yr., 200-yr.	891.3	893.5	895.6	895.9	896.1	2.2	4.3	4.6	4.8
2400 RHODE ISLAND AVE N (Garage)	GOLDEN VALLEY	Multi-Residential	4	200-yr.	903.56	900.8	901.6	902.6	903.6	0.0	0.0	0.0	0.0
2400 RHODE ISLAND AVE N (Garage)	GOLDEN VALLEY	Multi-Residential	4	200-yr.	903.57	900.8	901.6	902.6	903.6	0.0	0.0	0.0	0.0

1 - Properties determined to be at-risk of flooding based on comparison of modeled flood elevations and surveyed low openings.
2 – Lowest openings determined from 2014 survey (Barr), 2006 survey (from New Hope/Stantec), and 1978 survey (Barr, verified in 2014)
3 - Flood elevation based on XP-SWMM modeling utilizing the Atlas 14 precipitation depths and nested storm distribution
4 - Flood depth above low opening of structure, based on difference between the flood elevation and the lowest opening of structure
5- The 200-year, 24-hour storm event was used for the benefit-cost analysis (see Section 3.2)

3.0 Flood Mitigation Plan

3.1 Impact of Land Use and Policy Change (Impervious Surface Reductions)

In an effort to quantify the potential impact of land use policy changes on the reduction in flooding in the DeCola Ponds watershed (instead of construction of expensive flood mitigation storage), Barr evaluated the impact of impervious surface reductions within the DeCola Ponds watershed.

The first task used the existing conditions XP-SWMM model to evaluate the impact of reductions in watershed imperviousness by 1, 2, 5, 10, and 25 percent throughout the project area on the expected flood elevations in the key flood areas within the DeCola Ponds watershed.

The second task included determining potential reasonable reductions in imperviousness within the DeCola Ponds watershed. The most significant opportunities to reduce imperviousness within this watershed would be through the reduction in road widths and in parking lot area. Barr evaluated opportunities to reduce street widths using the current road width guidance from the Cities of Golden Valley, New Hope, and Crystal and comparing with actual road widths within the project area using GIS software. However, the measured widths of the existing roads are already 3 to 6 feet narrower than outlined in the Cities' current guidance, limiting opportunity to further narrow these streets. Additionally, the pavement management plans as provided by the Cities indicate that only a few road reconstruction projects are expected within the DeCola Ponds watershed in the next 20 years.

Regarding reducing the amount of impervious surface in parking lots, Barr considered the United States Environmental Protection Agency (EPA) guidance related to green parking (EPA, 2014), which summarizes the typical design criteria for parking stalls for a given land use along with the actual parking demand (national average). Barr compared the actual parking demands (summarized in the green parking guidance) with the Cities' parking requirement information. Barr determined there may be the opportunity to reduce the number of parking stalls by up to 20-25 percent in commercial and industrial areas, which translates to an overall reduction in the parking lot impervious area by approximately 10 percent.

Based on the analysis related to street widths and parking lot area, Barr estimated that a reasonable reduction in the project area total imperviousness ranges from 0.5 to 6 percent. The XP-SWMM modeling of different reductions in imperviousness in the DeCola Ponds watershed showed that impervious reductions in this range will have minimal impact on the flood elevations, with a typical reduction in the flood levels of less than 0.1 feet for the 100-year storm event. Assuming a reasonable five (5) percent reduction in imperviousness, no at-risk structures would be removed from the 100-year floodplain. A more significant reduction in imperviousness (e.g., 25 percent reduction) also would not result in the removal of any properties from the floodplain.

The overall impact of land use changes and reductions in the DeCola Ponds watershed imperviousness on flood elevations is less than originally expected. To alleviate flooding in the DeCola Ponds watershed, the flood mitigation plan needs to focus on the incorporation of additional flood storage throughout the watershed to reduce flood elevations and the number of at-risk structures.

Additional details regarding the evaluation of changes to land use policy and imperviousness are summarized in the Medicine Lake Road and Winnetka Avenue Long-Term Flood Mitigation Plan – Phase 1 Summary Memo (dated September 5, 2014) included as Appendix A to this report.

3.2 Benefit-Cost Analysis of Initial Flood Mitigation Alternatives

Based on discussions with the staff from the Cities of Golden Valley, New Hope, and Crystal, three flood mitigation alternatives were initially evaluated to evaluate the impact on flood damage reductions, using the XP-SWMM model for the 2-, 10-, 100-, and 200-year design storm events. Additionally, Barr performed a benefit-cost analysis to help the Cities select the most preferred flood mitigation alternative to pursue.

The three flood mitigation alternatives evaluated in the benefit-cost analysis included:

- **Alternative 1: Existing Conditions**
    - This alternative is the same as existing conditions (Do Nothing scenario with no flood proofing, voluntary acquisition, or flood mitigation projects).
- **Alternative 2: Flood Proofing and Voluntary Acquisition of At-Risk Structures**
    - Based on the estimated depth of flooding and assumptions described later, this alternative includes flood proofing of 19 structures and acquisition of 20 structures.
- **Alternative 3: Flood Mitigation Projects**
    - This alternative focuses on the construction of 14 flood storage mitigation projects within the project area (see Figure 3-1). This evaluation included conceptual evaluation of all projects and locations identified by the Cities' staff, with the goal of reducing the flood depth at the low point on Medicine Lake Road to approximately 1.5 feet (18 inches) to 2.0 feet, maximizing reductions in the 100-year flood elevations at all key flood locations, and flood proofing and/or voluntary acquisition of any remaining at-risk properties.

3.2.1 FEMA Benefit-Cost Analysis

Barr utilized the Federal Emergency Management Agency (FEMA) benefit-cost analysis protocol and software (BCA Tool 5.0) to evaluate the benefit-cost of each of the initial flood mitigation alternatives outlined above. The FEMA software ultimately determines a benefit-cost ratio that can be used by project developers, planners, and reviewers to make it easier to determine the most cost-effective approach to selecting projects addressing a range of natural disasters. Typically, the software is used to evaluate individual projects for FEMA funding, with funding going to projects with a benefit-cost ratio greater than 1.0. However, FEMA usually prefers acquisition, which eliminates all flood risk.

For the evaluation of the proposed flood mitigation alternatives outlined above, Barr utilized the Damage-Frequency Assessment (DFA) module to evaluate the flood mitigation alternatives. The module requires the following information to use the software and determine the benefit-cost ratio:

- Mitigation type (acquisition, elevation, relocation, flood proofing, and drainage improvements).
- ALL anticipated project costs (e.g., easements, permitting, engineering and design, construction, and maintenance).
- Project useful life.
- Loss of function (e.g., roads service, utility service) BEFORE and AFTER mitigation.
- Damages BEFORE and AFTER mitigation.

Based on the inputs to the software, the FEMA benefit-cost software annualizes the expected benefits and costs to determine the benefit-cost ratio. The benefit of the project is the difference in the expected damages before a project and the expected damages after a project. The cost of a project is the total cost of a proposed mitigation project.

3.2.2 Damages

To perform the benefit-cost analysis, the flood damages before and after project mitigation were quantified for each of the various storm events. For single-family residential properties, Barr determined flood damages based on depth-damage relationships for residential structures developed by the USACE (USACE, 2003). With the exception of one home, all of the single-family residential properties at-risk of flooding have walk-out basements. For these homes, Barr applied the depth-damage relationship developed for homes that are "Two or more stories, no basement." For the remaining at-risk single-family residential home, Barr applied the depth-damage relationship for "One story, with basement."

To determine flood damages for multi-family residential, commercial, and industrial properties, Barr staff and a real estate consultant (Dan Wilson) conducted in-person interviews with the property owner and/or property tenant following the USACE commercial and industrial flood damage survey primary survey form.

3.2.2.1 Loss of Function

Loss of function is part of the damages and includes loss of road service, utility service, etc. during a flooding event. In the case of the Medicine Lake Road flood mitigation alternatives, the primary loss of function is the flooding at the low point on Medicine Lake Road, which is impassible at times. The frequency and duration of loss of function could be estimated based on the XP-SWMM modeling results along with daily average traffic counts available for Medicine Lake Road (available through Google Earth Pro, as directed by FEMA guidance and derived from Minnesota Department of Transportation, Hennepin County and city data) to quantify damages associated with the loss of function of Medicine Lake Road as outlined in the BCA guidance (FEMA, 2009; FEMA, 2011).

3.2.3 Project Useful Life

The project useful life is a way of quantifying the lifespan of any given alternative based on available guidance. Table 3-1 summarizes the assumed project useful life of the mitigation project types proposed as part of this study.

Table 3-1 Assumed Project Useful Life

Mitigation Type	Assumed Useful Life	Source
Flood Proofing	30 years	FEMA BCA Guidance (2011)
Acquisition	100 years	FEMA BCA Guidance (2011)
Flood Mitigation Projects (Constructed Detention)	80 years	National Cooperative Highway Research Program Report 792 (2014)

3.2.4 Project Costs

3.2.4.1 Flood Storage Mitigation Projects

Planning level cost estimates were developed for the various flood storage mitigation projects based on the conceptual design of each project. Although the point estimate of cost was used for the benefit-cost analysis, there is cost uncertainty and risk associated with this concept-level cost estimate. The costs reported for flood mitigation projects include contingencies (25 percent), engineering and design (30 percent), construction management (10 percent), and estimated land acquisition/easement costs (if applicable). The costs do not include any wetland mitigation costs and assume that the excavated soils are not contaminated. The range of probable costs presented reflects the level of uncertainty, unknowns, and risk due to the concept nature of the individual project designs. Barr used industry resources for cost estimating (ASTM E 2516-11 Standard Classification for Cost Estimate Classification System) to provide guidance on cost uncertainty. Based on the current level of design (planning level estimate), the cost range is expected to vary by -20 percent to +40 percent from the planning level point opinion of cost. Additionally, since this is a long term flood mitigation plan, the planning level costs may need to be adjusted for inflation.

3.2.4.2 Flood Proofing

For planning purposes, Barr assumed that any structure with a depth of flooding between 0 and 3 feet during the 100-year design storm event would be targeted for flood proofing measures. The planning level costs for flood proofing of structures were based on depth of flooding, as summarized in Table 3-2.

Table 3-2 Planning Level Flood Proofing Costs

Depth of Flooding (ft)	Planning Level Cost
0	$15,000
1	$30,000
3	$90,000
6	$180,000

Although the point estimates were used for the benefit-cost analysis, the final flood proofing costs for the flood mitigation plan were buffered by the same -20 percent to +40 percent that was applied to the flood mitigation project costs, to reflect uncertainty in the planning level flood proofing costs.

3.2.4.3 Voluntary Acquisition

For planning purposes, Barr estimated that any structure with a depth of flooding greater than 3 feet during the 100-year design storm event would be targeted for potential acquisition.

To estimate the cost of acquisition of at-risk properties for the cost-benefit analysis, Barr evaluated acquisition costs, estimated property removal/demolition costs, and estimated relocation costs. Barr determined the acquisition and removal costs for single-family residential properties using the current Hennepin County taxable market values (from 2014 Hennepin County parcel data) and multiplying by a factor of 1.5. This factor was provided by the City of Golden Valley based on recent property acquisition and demolition costs. A real estate appraiser subconsultant (Dan Wilson) estimated the acquisition costs for the at-risk multi-family residential, commercial, and industrial properties. These estimates were based on in-person interviews, the current Hennepin County taxable market value, and other sources to establish market values. Removal costs were assumed to be equivalent to 20 percent of the acquisition costs, based on the guidance provided by the City of Golden Valley.

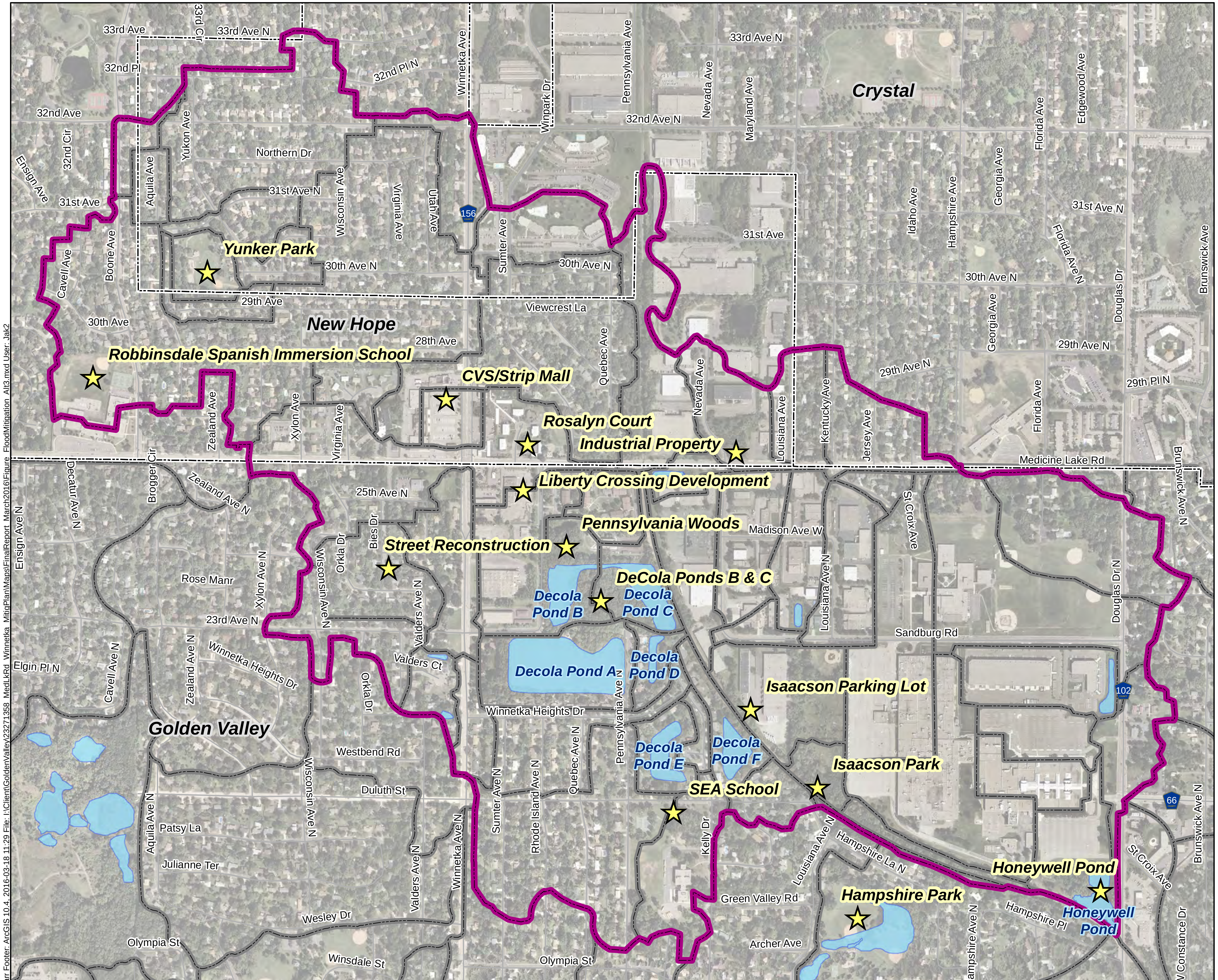
Although Barr originally included relocation costs in the cost estimates for each at-risk property and included the costs used in the benefit-cost analysis, Barr removed relocation costs from the final acquisition costs. These relocation costs were removed based on feedback from City staff at the April 30, 2015 meeting where City staff noted their assumption that any acquisitions would be voluntary. Additionally, to account for potential increases in market values for voluntary acquisition, the estimates were also buffered by the same -20 percent to +40 percent that was applied to the flood mitigation project costs.

3.2.5 Benefit-Cost Analysis Results

Table 3-3 is a summary of the FEMA benefit-cost analysis for the three initial flood mitigation alternatives for the Medicine Lake Road and Winnetka Avenue project area.

Table 3-3 FEMA Benefit-Cost Analysis Summary for the Flood Mitigation Alternatives

Alternative	Total Benefits	Total Costs	Benefit-Cost Ratio
Alternative 1 – Existing Conditions (Do Nothing)	$0	$0	0.0
Alternative 2 – Flood Proofing and Acquisition Only	$6,800,000	$12,300,000	0.6
Alternative 3 – Flood Mitigation Projects	$6,300,000	$27,500,000	0.2



Potential Flood Storage (Alternative 3)

Study Area

Municipality

Subwatersheds

Streets

Ponds and Wetlands

N

0 375 750 1,500 Feet

BARR

Figure 3-1

BENEFIT-COST ANALYSIS
FLOOD MITIGATION PROJECTS
(ALTERNATIVE 3)
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

3.3 Recommended Flood Mitigation Projects (Alternative 2.5)

At the January 23, 2015 meeting where Barr presented the initial flood mitigation projects and the results of the FEMA benefit-cost analysis, the City staff from the Cities of Golden Valley, New Hope, and Crystal acknowledged that the most likely alternative would be some combination of Alternatives 2 and 3 (outlined above). This resulted in the evaluation of Alternative 2.5, which includes a combination of flood mitigation projects along with voluntary acquisition and flood proofing for any of the remaining at-risk structures. The Alternative 2.5 projects are expected to have the most significant impact on flood elevation reduction and are primarily located on publicly owned land; however, there are several projects that are located on private property and will require the purchase of a parcel or an easement. Appendix C includes the memo summarizing the complete evaluation of Alternative 2.5 (dated 2/16/2016).

3.3.1 Project Summary

For Alternative 2.5, Barr evaluated eight (8) of the 14 flood storage mitigation projects from Alternative 3 using the XP-SWMM model of the project area. Figure 3-2 shows the location of the recommended flood storage mitigation projects. The following paragraphs briefly describe each of the recommended flood mitigation projects:

- **Yunker Park**: Flood mitigation in Yunker Park in the City of Crystal will include development of approximately 4.7 additional acre-feet of flood storage and diversion of storm sewer to the flood storage site. City staff indicated that land in this park is low and often wet under existing conditions. There may also be an opportunity to incorporate water quality treatment volume along with the flood storage volume and create wetland habitat in this area.

- **Rosalyn Court**: Flood mitigation at Rosalyn Court in the City of New Hope will include development of approximately 3.3 acre-feet of flood storage on the parcel adjacent to the low point on Medicine Lake Road. This parcel has the most at-risk structure in the Rosalyn Court complex (2740 Rosalyn Court) and will require the purchase of the parcel for the development of the flood storage.

- **Liberty Crossing**: Approximately 7.8-acre-feet of flood storage will be developed at the Liberty Crossing redevelopment site in the City of Golden Valley. This area will provide flood mitigation storage and convey flows from the low point on Medicine Lake Road to the expanded storage at Pennsylvania Woods and around DeCola Ponds B and C (once constructed). The City of Golden Valley is working with the Liberty Crossing developer on the final design and construction of the flood mitigation project and has established a TIF district to finance the project.

- **Pennsylvania Woods/DeCola Pond B and Pond C**: This set of projects is intended to be constructed together and are located in the City of Golden Valley. However, the Pennsylvania Woods portion of this project will require acquisition of easements from the Dover Hill Apartments property owner, while the DeCola Ponds B and C portion of the project is located on City-owned property. The combined project will include development of approximately 24.5 acre-feet of flood storage on the wooded portion of Pennsylvania Woods and DeCola

Ponds B and C. Additionally, the overflow from DeCola Pond C to DeCola Pond D will be raised to elevation 901.2 feet MSL (NGVD 1929). In addition to the development of the flood storage in this area, there is also the opportunity to improve the habitat and ecological function while preserving the existing recreational uses.

- **Isaacson Industrial Parcel/Isaacson Park**: This set of projects is intended to be constructed together and are located in the City of Golden Valley. However, the Isaacson Industrial parcel portions of this project will require the acquisition of the property at 7145 Sandburg Road while the Isaacson Park project is located on City-owned property. These projects will include development of approximately 19.8 acre-feet of flood storage on an industrial parcel east of the railroad and 0.7 acre-feet of storage at the south end of Isaacson Park. This combined project will also include diversion of the majority of flows away from DeCola Pond F, along the east side of the railroad, which will require coordination with the railroad. Additionally, there may be the opportunity to incorporate water quality treatment volume along with the flood storage volume.
- **SEA School**: This project will include development of approximately 8.3 acre-feet of flood storage on the publicly owned area north of the SEA school in the City of Golden Valley. In addition to the development of the flood storage in this area, there is also the opportunity to incorporate water quality treatment, develop habitat, and provide educational opportunities for the SEA school.

3.3.2 Impact on Flood Elevation and At-Risk Properties

Table 3-4 summarizes the existing conditions peak flood elevations for the Atlas 14 100-year design event at key locations in the DeCola Ponds watershed and the expected peak flood elevation upon implementation of the Alternative 2.5 projects.

Table 3-4 Key Flood Areas and 100-year Flood Elevation Summary for Alternative 2.5

Key Flood Area	Key Flood Area Description	Existing Conditions Flood Elevation (ft MSL)	Alternative 2.5 Flood Elevation (ft MSL)	Change in Flood Elevation (ft)
1	Terra Linda Low Point	905.6	905.5	-0.1
2	Medicine Lake Road Low Point/Rosalyn Court	905.1	901.8	-3.3
3	Rhode Island Ave Low Point	904.1	901.8	-2.3
4	Dover Hill Apartments	902.6	901.8	-0.8
5	DeCola Pond A	902.6	901.8	-0.8
6	DeCola Pond B	902.6	901.8	-0.8
7	DeCola Pond C	902.6	901.8	-0.8
8	DeCola Pond D	902.7	899.2	-3.5
9	DeCola Pond E	896.2	894.0	-2.2
10	DeCola Pond F	895.9	893.7	-2.2

Key Flood Area	Key Flood Area Description	Existing Conditions Flood Elevation (ft MSL)	Alternative 2.5 Flood Elevation (ft MSL)	Change in Flood Elevation (ft)
11	Medicine Lake Road East of Railroad	912.2	912.2	0.0
12	East of Railroad to DeCola Pond C	902.7	902.2	-0.5
13	East of Railroad at Low Point on Nevada	903.0	903.0	0.0
14	East of Railroad at Low Point on Sandburg	902.3	902.3	0.0
15	East of Railroad to DeCola Pond F	901.4	900.0	-1.4
16	Honeywell Pond	884.2	884.2	0.0

Table 3-5 summarizes the number of at-risk properties that remain after the implementation of Alternative 2.5. Figure 3-3 shows the remaining at-risk properties after the implementation of Alternative 2.5

Table 3-5 Alternative 2.5 Impact on At-Risk[1] Structures

Mitigation Type	Existing Conditions	Alternative 2.5
At Risk, No Mitigation	39	0
Voluntary Acquisition	0	2[2]
Acquisition (for Construction of a Flood Mitigation Project)	0	2[3]
Flood Proofing	0	23[4]
No Flood Risk	0	12
Total Number of Structures	***39***	***39***

[1]At-Risk structures defined as those with low openings below the estimated 100-year flood elevation
[2]Properties located in Golden Valley (2); There may be an opportunity to flood proof these structures and will be evaluated at each location.
[3]Properties located in New Hope (1) and Golden Valley (1)
[4]Properties located in Golden Valley (23)

Under existing 100-year flood conditions, there is approximately 5 feet of standing water at the low point on Medicine Lake Road and there are 39 structures identified as being at-risk of flooding (the estimated 100-year peak flood elevation is above the surveyed low opening). Again, the structures in Table 3-5 identified to not be at-risk (low opening above the 100-year flood elevation) may not provide 2 feet of freeboard as required by city policy for new construction/redevelopment. Based on the evaluation of Alternative 2.5, the following is a summary of the general conclusions:

- Implementation of the Alternative 2.5 projects will result in approximately 18 inches of standing water at the low point in Medicine Lake Road during the 100-year flood event, thus achieving one of two project goals. This reduction in flooding will improve public safety and allow for emergency vehicles to travel through this area during the 100-year flood event.
- Alternative 2.5 significantly reduces flooding at DeCola Ponds D, E, and F, reduces the number of at-risk structures by 12, and minimizes the number of voluntary acquisitions, thus achieving the second project goal.

3.3.3 Project Costs

Planning level costs were developed for implementation of Alternative 2.5, including the flood mitigation project costs and the associated voluntary acquisition/demolition and flood proofing costs. Barr developed the estimated costs based on the methodology discussed in Section 3.2 above.

Table 3-6 below summarizes the planning level cost estimate range for each component of Alternative 2.5, which includes the most critical flood mitigation projects needed to help improve the flooding around the low point on Medicine Lake Road and the DeCola Ponds.

Table 3-6 Alternative 2.5 Planning Level Cost Estimates

Project	-20%	Point Estimate of Probable Cost	+40%
Liberty Crossing Flood Mitigation Project	$ 3,750,000	$ 4,690,000	$ 6,570,000
DeCola Ponds B and C Expansion & Pennsylvania Woods Flood Mitigation Projects	$ 3,660,000	$ 4,570,000	$ 6,400,000
Rosalyn Court Flood Mitigation Project	$ 1,790,000	$ 2,240,000	$ 3,130,000
Yunker Park Flood Mitigation Project	$ 860,000	$ 1,080,000	$ 1,510,000
Isaacson Park/Industrial Parcel Flood Mitigation Project	$ 4,580,000	$ 5,730,000	$ 8,020,000
SEA School Flood Mitigation Project	$ 1,700,000	$ 2,130,000	$ 2,980,000
Flood Storage Mitigation Project Subtotal	***$ 16,340,000***	***$ 20,440,000***	***$ 28,610,000***
Voluntary Acquisition and Demolition of At-Risk Structures[1]	$ 820,000	$ 1,020,000	$ 1,430,000
Flood Proofing of At-Risk Structures[1]	$ 720,000	$ 900,000	$ 1,270,000
Total Project Cost	***$ 17,880,000***	***$ 22,360,000***	***$ 31,310,000***

[1] – Voluntary acquisition and flood proofing costs are based on the full implementation of flood mitigation projects in Alternative 2.5 and the associated reduction in flood elevations.

3.3.4 Implementation Order & Timeline

Table 3-7 outlines the recommended order of flood mitigation project implementation for the projects identified in Alternative 2.5. The order is based on engineering judgement and the expected impact of the given project on reductions in flood elevation and the number of at-risk structures. However, the actual sequencing of the flood mitigation projects is flexible and will be based on opportunities within the DeCola Ponds watershed and availability of funding. For example, the Liberty Crossing flood mitigation storage is already being pursued with a redevelopment project in the DeCola Ponds watershed.

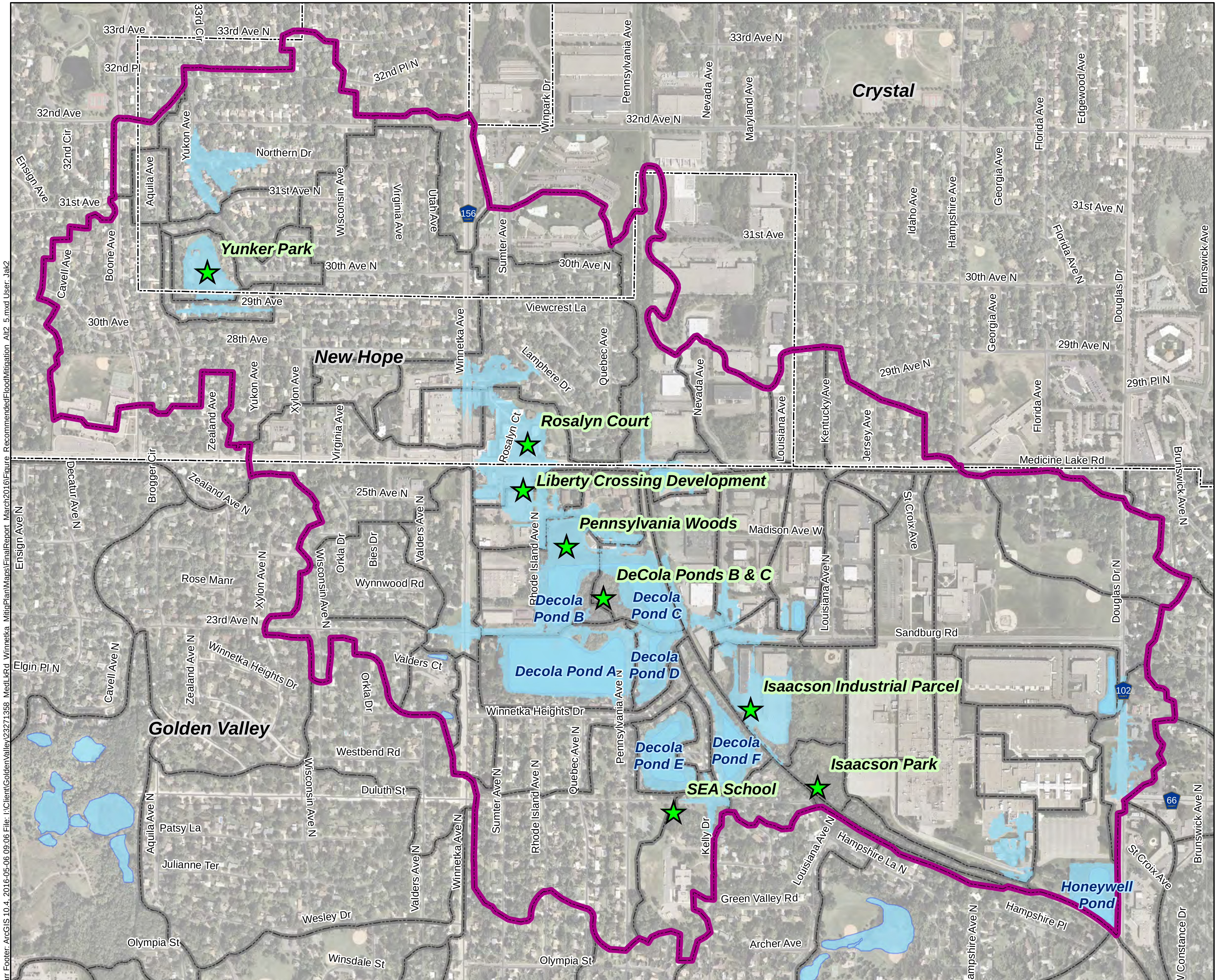
Table 3-7 Alternative 2.5 Implementation Order

Project Implementation Order	Project Name	Project Location	Point Estimate of Probable Cost[1]
1	Liberty Crossing Conveyance/Storage	Golden Valley	$ 4,690,000
2	Expansion of Pennsylvania Woods & DeCola Ponds B/C	Golden Valley	$ 4,570,000
3	Storage at Isaacson Park/Industrial Parcel; Diversion from DeCola Pond F	Golden Valley	$ 5,730,000
4	Storage at Rosalyn Court	New Hope	$ 2,240,000
5	Storage at SEA School	Golden Valley	$ 2,130,000
6	Expansion of Storage at Yunker Park	Crystal	$ 1,080,000
Ongoing	Voluntary Acquisition & Flood Proofing[2]	Golden Valley	$ 1,920,000
	Total Project Cost		**$22,360,000**

[1]Based on the current level of design, the cost range is expected to vary by -20 percent to +40 percent from the planning level point opinion of probable cost.
[2]Reflects properties that need to be flood proofed (or voluntary acquisition) following implementation of flood mitigation projects in Alternative 2.5; however, this plan does not preclude a property owner from pursuing flood proofing or voluntary acquisition at any time during the life of this plan.

Additionally, as projects are implemented, the impact of the final project design should be evaluated utilizing the XP-SWMM model for the project area to estimate the resulting flood elevations and remaining numbers of at-risk properties which can be used to inform future decisions.

Implementation of the Alternative 2.5 flood mitigation projects has already started with the design and construction of the Liberty Crossing flood mitigation storage and conveyance project as part of the Liberty Crossing redevelopment project in Golden Valley. Additional projects identified in the flood mitigation plan will be implemented as funding allows once the implementation commission is established (see discussion in Section 5.0). Full implementation could take as long as 10 or 20 years (or more) depending on the availability of funding for the various projects (see Section 4.1).



Recommended Flood Storage (Alternative 2.5)
Study Area
Municipality
100-Year Flood Inundation Area*
Subwatersheds
Streets
Ponds and Wetlands

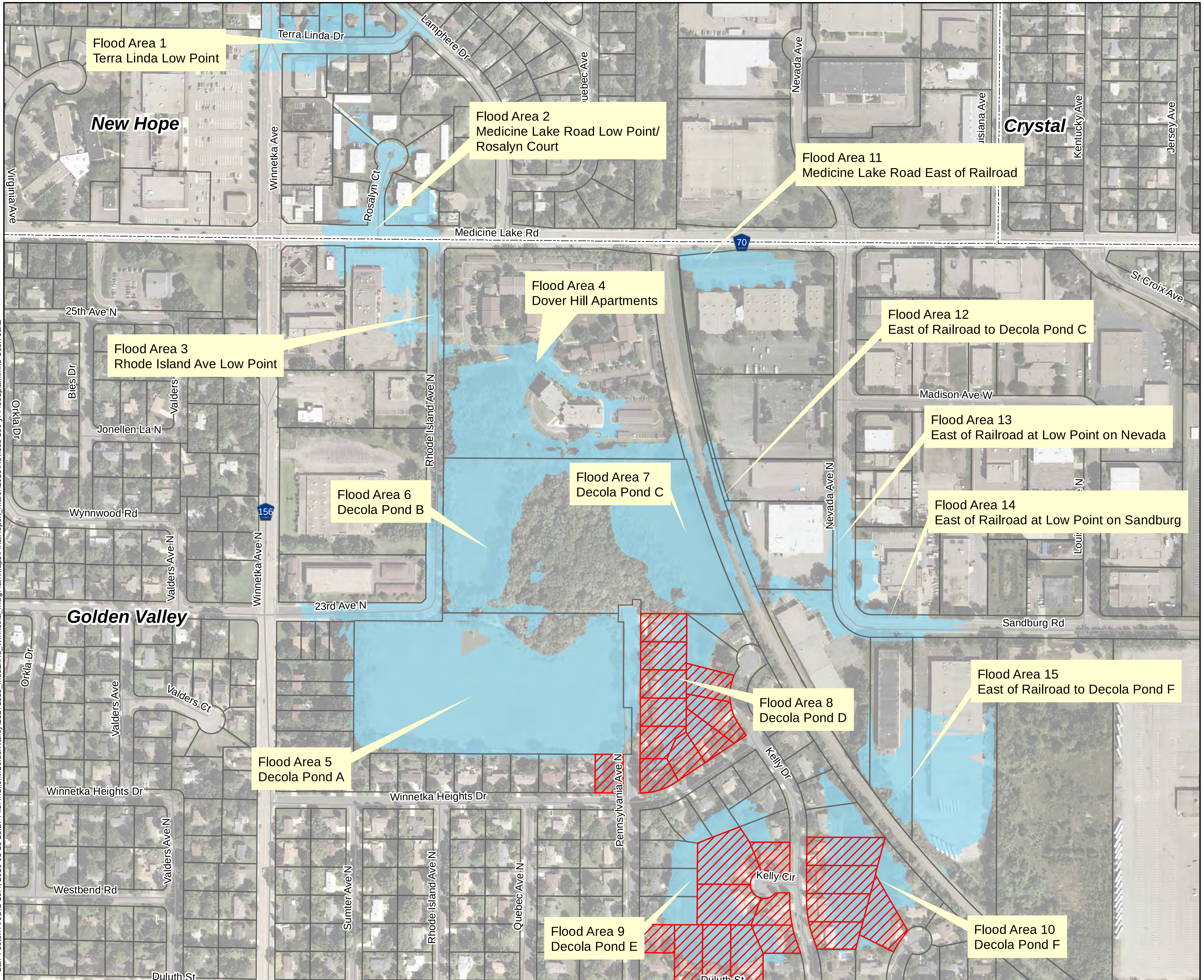
N

0 375 750 1,500 Feet

BARR

Figure 3-2

RECOMMENDED FLOOD MITIGATION PROJECTS (ALTERNATIVE 2.5)
Medicine Lake Road and Winnetka Avenue Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal



At-Risk Structures*

Streets

Parcels

Municipality

100-year Flood Inundation Area**

* At-Risk structures determined by low opening survey and XP-SWMM modeling results utilizing the Atlas 14 precipitation depths and nested storm distribution

** Inundation area mapping is approximate based on XP-SWMM modeling results and 2007 National Geodetic Survey elevation data

N

Feet

330 165 0 330

BARR

Figure 3-3

REMAINING AT-RISK STRUCTURES
ALTERNATIVE 2.5
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

4.0 Financing Strategies

This section outlines the preferred cost allocation method as presented to, discussed with, and agreed to by staff from the Cities of Golden Valley, New Hope, and Crystal. Additionally, this section summarizes potential project financing options for the recommended flood mitigation projects. Further information in relation to these items can be found in the memos includes in Appendices B and C.

4.1 Project Cost Allocations

As part of the Alternative 2.5 analysis, four (4) cost allocation methods were further evaluated based on input from staff from the three Cities (see Appendix C). After careful consideration of the cost allocation methods, the staff from the Cities of Golden Valley, New Hope, and Crystal, and a representative of Hennepin County selected the cost allocation approach shown in Table 4-1 as the preferred method. The approach is generally described below:

- Half of the total project costs (50%) will be paid for through funding secured from outside sources (described in Section 4.2.5)
- A portion (27%) of the total project costs will be shared amongst the Cities based on the formula listed in Table 4-1
- Another portion (3%) of the total project costs will be paid by Hennepin County Transportation Department based on its percentage of contributing drainage within the DeCola Ponds watershed
- Another portion (15.8%) would be funded through the cities stormwater utility fees. The fee increase could be limited to property owners within the DeCola Ponds watershed or spread over a larger area such as an entire City.
- The remaining portion (4.2%) of the project costs would be paid by the direct beneficiaries (existing at-risk properties – See Figure 4-1).

Ultimately, each City will decide what their funding sources are and how to best fund their share of the total project. If any of the Cities determines that special assessments to benefitting property owners will be used as a funding mechanism, the assessment terms should be according to that City's policies.

For the preferred cost allocation method to be successful, the new implementation commission (see Section 5.0) must include a policy or an objective in the final plan to pursue outside funding sources.

Table 4-1 summarizes the breakdown of the preferred cost-share alternative, showing the percentage that would be applied to the implementation projects. Table 4-2 further breaks down the cost assigned to the beneficiary properties, including the cost per property and the estimated annual cost assuming recovery periods of 10 years, 15 years, and 20 years for the special assessments. Barr also assumed that the cost allocated to each property within the DeCola Ponds watershed is equal, regardless of property type or value. As the Cities begin moving toward implementation of the flood mitigation projects, they may want to consider a cost allocation method that considers property type or valuation to allocate costs to the properties within the DeCola Ponds watershed.

Figure 4-1 shows the location of 36 remaining at-risk structures after the implementation of the Alternative 2.5 flood mitigation storage. The 36 at-risk structures represent 69 individual properties (3 of the 36 at-risk structures are condominium buildings in the Rosalyn Court complex, each containing 12 units). The following is the breakdown of the properties:

32 single family homes
36 condominium units (3 buildings x 12 units each)
1 business
69 properties

The allocation to the beneficiaries does not include the following properties due to acquisition for project construction: 7775 Medicine Lake Road (former VFW, to become the Liberty Crossing development), 7145 Sandburg Road, and 2740 Rosalyn Court.

Table 4-1 Cost-Share Alternative[1] (as a Percentage and Cost) for Full Implementation of Alternative 2.5

Cost Share Alternative	Outside Funding Sources	City of Crystal	City of New Hope	City of Golden Valley	Hennepin County	Stormwater Utility[2]	Beneficiaries – At-Risk Properties[3] Total
As a Percentage	50%	5.9%	7.7%	13.4%	3%	15.8%	4.2%
As a Total Project Cost (Point Estimate = $22,360,000)	$11,180,000	$1,320,000	$1,720,000	$3,000,000	$670,000	$3,538,500	$931,500

[1]50% from Outside Funding Sources, 27% to Cities based on 50% Tax Capacity/50% Watershed Area and 3% for Hennepin County based on % of watershed area, 15.8% to Stormwater Utility, 4.2% to Direct Beneficiaries (At-Risk Properties)
[2]Generated by city stormwater utilities (approximate cost split between Golden Valley (50%), New Hope (25%), and Crystal (25%))
[3]Applied to 69 at-risk properties (36 structures) (does not include the following properties due to acquisition for construction: 7775 Medicine Lake Road (VFW), 7145 Sandburg Road (Industrial Parcel), 2740 Rosalyn Court)

Table 4-2 Cost-Share Alternative[1] (as a Percentage and Cost) to Beneficiary Properties for Full Implementation of Alternative 2.5

Cost Share Alternative	Total	Total Cost Per Property[1,2]	Special Assessment Estimated Annual Principal Payment per Property		
			10-yr recovery period	**15-yr recovery period**	**20-yr recovery period**
As a Percentage	4.2%	0.06%	0.006%	0.004%	0.003%
As Total Cost	$931,500	$13,500	$1,350	$900	$675

[1]Assumes costs applied equally to all properties regardless of type or value; actual cost per property will be determined by the implementation commission
[2]Applied to 69 at-risk properties (36 structures) (does not include the following properties due to acquisition for construction: 7775 Medicine Lake Road (VFW), 7145 Sandburg Road (Industrial Parcel), 2740 Rosalyn Court)

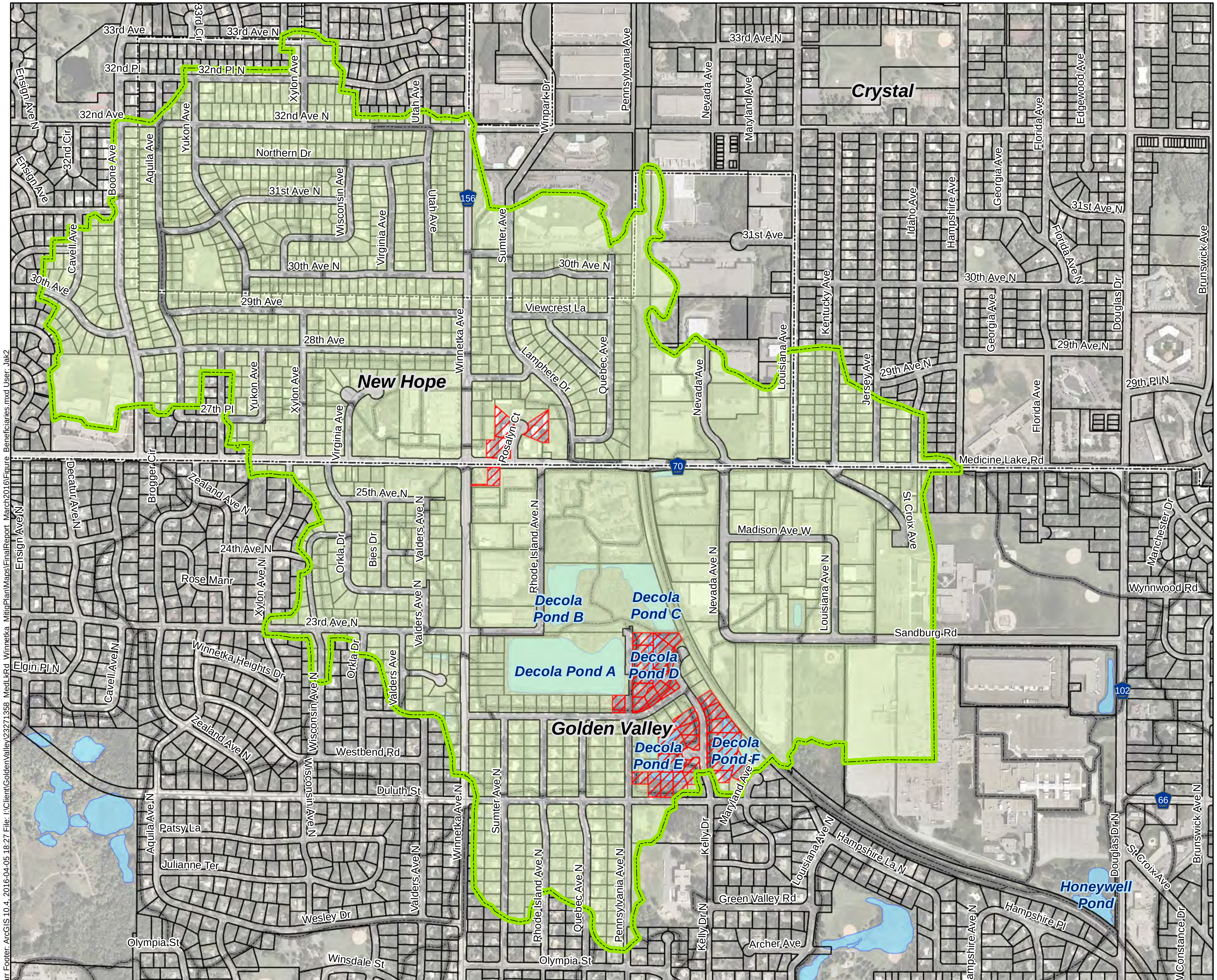


Figure 4-1

BENEFICIARY PROPERTIES FOR COST-ALLOCATION
Medicine Lake Road and Winnetka Avenue Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

4.2 Project Financing

Cities finance capital improvement projects using a variety of tools, including:

- bonds
- storm sewer improvement district
- tax increment financing district
- tax abatement
- stormwater utility fees
- outside funding sources

The above financing methods are described in in the following sections.

4.2.1 Bonds

Cities borrow money by issuing and selling municipal bonds, also known as general obligation bonds. Cities have limits on the amount of debt they can take on through issuing and selling bonds. The current "net debt" limit is 3% of the estimated market value of taxable property in the city (from 2014 Handbook for Minnesota Cities, League of Minnesota Cities).

Other types of bonds include:

- **Revenue bonds** – these bonds are tied to a specific funding stream

- **General obligation revenue bonds** – these bonds are tied to both the "full faith and credit" of the City and a specific funding stream

- **Bonds by purpose** – general obligation bonds issued for a specific purpose – not a legal requirement, but used to conveniently identify bonds to a specific project

- **Bonds by user** – these are also called "private activity bonds" and are used partially or entirely for private purposes, but are still tax exempt.

In some situations, city residents must vote in favor of a bond before City issuance of a bond, but there are many exceptions to this requirement.

The Cities could sell bonds to help pay for the projects. The amount each City would need to fund through bonding would depend on the amount of funds available in its stormwater fund (fund balance) – i.e., the smaller the fund balance, the more bonding that would be required. The bonds are rated based on the City's bond rating.

4.2.1 Storm sewer improvement district

The Cities may fund specialized city infrastructure by creating a storm sewer improvement district (SSID). Cities must pass an ordinance to create an SSID. Once established, the City "may acquire, construct, reconstruct, extend, maintain, and otherwise improve storm sewer systems and related systems" within the SSID. The City "may also acquire, maintain and improve stormwater holding areas and ponds" for the benefit of the SSID. The City pays for the improvements in the SSID by levying taxes on the property in the district. Tax levies also pay for principal and interest on bonds.

4.2.2 Tax increment financing district

Cities may use tax increment financing (TIF) to fund more than local improvements. For example, the City of Golden Valley established a TIF district to fund the Liberty Crossing flood storage/conveyance project, which is scheduled for construction in 2016.

The TIF tool segregates tax dollars from a defined area for use in developing and improving the area, which can include local improvements. The following is from the Handbook for Minnesota Cities (2014, League of Minnesota Cities):

> *TIF takes advantage of the increases in tax capacity and property taxes from development or redevelopment before the development actually occurs to pay for public development or redevelopment costs. The difference in the tax capacity and the tax revenues the property generates after new construction has occurred, compared with the tax capacity and tax revenues it generated before the construction, is the captured value. The taxes paid on the captured value are called "increments." Unlike property taxes, increments are not used to pay for the general costs of Cities, Counties, and Schools. Instead, increments go directly to the development authority to repay public indebtedness or upfront costs the City incurs in acquiring the property, removing existing structures, or installing public services.*

4.2.3 Tax abatement

Through this financing tool, Cities can authorize the issuance of bonds, which are paid back with funds collected by tax abatements. The tax is not actually forgiven (abated), but is paid normally, with the amount of property tax levied by the City used to pay for the bonds. The following example is from the Handbook for Minnesota Cities (2014, League of Minnesota Cities):

> *A City may "abate" all or a portion of City property tax on one or more parcels of real or personal property, including machinery, for economic development purposes. And Cities may issue general obligation or revenue bonds to construct public improvements. As the property owners pay the abated taxes, rather than the local property taxes, the payments go directly to paying off the bonds.*

Tax abatement bonds do not require a referendum approval and are excluded from debt limits. However, in any year, the total amount of property taxes abated by a City may not exceed 10 percent of the net tax capacity of the City for the taxes payable year applicable to the abatement or $200,000, whichever is greater.

4.2.4 Stormwater utility fees

The three Cities have stormwater utilities in place that generate fees that could be used to help pay for the identified projects. Stormwater utility fees may be based on the size of the property, the type of property, or the quantity and quality of runoff and disposal difficulties. Each of the three Cities bases their stormwater utility fees on the type of property.

Cities could impose a "user surcharge" for flood mitigation on top of the usual stormwater utility fee for properties within the DeCola Ponds watershed or spread over a larger area such as an entire City. An advantage of the user surcharge is that it would start generating the funds immediately.

4.2.5 Outside funding sources

As noted in Section 4.1, the preferred cost allocation alternative calls for a large percentage of the project implementation costs to be paid for through outside sources of funding—e.g., grants, state funding (legislation), and other outside funding sources. The following paragraphs outline several of the potential funding sources to help implement the flood mitigation projects identified in this plan; however, this is not an all-inclusive list and there may be additional funding sources not identified below.

4.2.5.1 Minnesota Department of Natural Resources

Grants for flood reduction/management projects are more limited than for water quality improvement projects. The Minnesota Department of Natural Resources' (MnDNR) Flood Damage Reduction grant (FDR) is the only state grant available for flood reduction projects. Under this program, the state can provide cost-share grants to local units of government for up to 50 percent of the total cost of a project. Cities, counties, towns, watershed districts and watershed management organizations, lake improvement districts, soil and water conservation districts, and joint powers organizations composed of any of these units (e.g., the new MLRWA implementation commission discussed in Section 5.0) may apply.

Currently, there are two different classes of grants available through the FDR Program:

1. **Small grants—**these grants are for projects with a total cost up to $300,000 (maximum state share $150,000). The MnDNR grants these funds directly from general funds appropriated by the Minnesota State Legislature. These are competitive, and are limited to available funds. Small projects and studies are covered through this grant program.

2. **Large grants—**these grants are for projects with a total cost greater than $300,000 (state share greater than $150,000). Large grant applications are received and prioritized by the MnDNR and then presented to the Governor and the Legislature for consideration in a capital bonding bill. A project will be funded based on its rank after prioritization and the amount of program funding made available by the Legislature. (Note: every biennium, the Legislature appropriates funds for these larger grants.) or flood mitigation/reduction projects to receive these funds, the projects must be approved by the legislature (i.e., they must go through the legislative process).

The types of projects eligible for FDR grants include:

- structural acquisition in the 100-year floodplain
- levees, ring dikes, and flood walls
- elevating existing structures
- flood warning systems
- public education
- flood insurance studies
- floodplain mapping
- comprehensive watershed plans
- flood storage easements

The implementation projects in this flood mitigation plan would likely require a large grant (and legislative approval).

If a presidential declaration has been issued in Minnesota, FEMA pays for 75 percent of the cost of structural acquisition, with the remaining 25 percent to be provided by the local governments. The FDR program will pay half the local share, leaving the local government unit with only a 12.5 percent share. The FDR program will also pay for half of the 35 percent nonfederal share of federal flood hazard mitigation projects.

4.2.5.2 Hennepin County

There are other potential grant sources available through Hennepin County that can be used to offset some of the costs related to the flood mitigation projects, including:

- Hennepin County Emergency Management Department, which could provide grant funds for flood damage reduction.

- Hennepin County Environmental Services Department provides funding for assessing and/or cleanup of contaminated (brownfields) sites.

- Hennepin County Natural Resources Grants are intended to help partners take advantage of opportunities to implement large projects that improve water quality or preserve, establish or restore natural areas.

4.2.5.3 Minnesota Board of Water and Soil Resources (BWSR)

BWSR receives appropriations from the Clean Water, Land & Legacy Amendment to pay for on-the-ground conservation projects that provide multiple benefits for water quality and wildlife habitat, which include appropriations from the Clean Water Fund. BWSR allocates Clean Water Fund monies through a grant program to fund projects that protect, enhance, and restore water quality in lakes, rivers, and streams in addition to protecting ground water and drinking water sources from degradation. Eligible applicants for the BWSR Projects and Practices grant include soil and water conservation districts, watershed districts, joint powers watershed management organizations, counties, cities, and joint powers boards of these organizations. The grants require a 25% local match. A flood mitigation project that also incorporates water quality treatment could be eligible for funding through this grant.

4.2.5.4 Bassett Creek Watershed Management Commission

The Bassett Creek Watershed Management Commission (BCWMC) may be an additional source of funding for the proposed flood mitigation projects. The 2015-2025 BCWMC watershed management plan (BCWMC, 2015) includes a policy that allows projects that address flooding concerns to be considered for inclusion in the BCWMC's capital improvement program (see policy 110). In March 2016, the BCWMC approved their 5-year CIP for 2018-2022, which includes $1.3 million split over 2022 and 2023 for a project somewhere in the DeCola Ponds watershed. Assuming the project moves forward, a feasibility study would be required in 2020 and the BCWMC plan would need to be amended to include the project.

4.2.5.5 Other Grant Sources

There are other potential grant sources available through different organizations that can be used to offset some of the costs related to the flood mitigation projects, including the Metropolitan Council and the Minnesota Department of Employment and Economic Development. Like Hennepin County, both of these agencies provide funding for assessing and/or cleanup of contaminated (brownfields) sites. Additionally, the Metropolitan Council has a stormwater grant program that can be used for the implementation of innovative stormwater management practices that improve water quality.

5.0 Implementation Organization

Assuming the Cities of Golden Valley, New Hope and Crystal agree to begin implementing the projects recommended in this long-term flood mitigation plan, the next step is for the Cities to create a commission to oversee the implementation of the plan. The commission members would be made up of members of all three Cities, and it would make the following important decisions:

1. How much each City should contribute to the plan implementation—e.g., each City assesses just once to cover their share of all of the recommended projects, or each City assesses on a per-project basis.

2. When projects should be implemented.

3. How to payout the commission's funds for project implementation.

4. If policies or ordinances (e.g., zoning overlays) should be adopted in the DeCola Ponds watershed.

The implementation commission would also provide information to the BCWMC to update the watershed-wide XP-SWMM model after implementation of each project.

At their April 30, 2015 meeting, the City staff from the Cities of Golden Valley, New Hope and Crystal discussed the following implementation commission options:

1. A new joint commission, independent of any existing joint commission.

2. Part of the existing Joint Water Commission (JWC), as a new "charge" for the existing commission.

3. Part of the Bassett Creek Watershed Management Commission (BCWMC), likely as a subcommittee of the existing BCWMC.

At the April 30, 2015 meeting, the three Cities indicated their preference for a new joint commission, modeled after the existing JWC. The new joint commission would likely be similar in structure and function as the existing JWC, meaning there would be three voting members, one each from Golden Valley, New Hope and Crystal and each member would appointed by their respective City council through a resolution.

The new MLRWA implementation commission could either be autonomous (e.g., it would have the authority to order projects) or it could be required to bring recommendations back to the ultimate authority (the three member Cities). If modeled after the JWC, the new MLRWA implementation commission would be autonomous. In addition, the MLRWA implementation commission's decisions could move forward upon either a simple majority vote or a unanimous vote. If modeled after the JWC, the MLRWA implementation actions would require a two-thirds vote, except for actions such as capital improvements, which require a unanimous vote. The new MLRWA implementation commission would meet at least once per year to discuss projects to be implemented, the funding of projects, and other business.

Because the MLRWA implementation commission would be similar to the existing JWC, the Cities of Golden Valley, New Hope and Crystal (staff and City councils) would have a level of familiarity with the function of the new MLRWA commission. Another advantage of forming a new MLRWA implementation commission is that the new commission's sole charge would be implementing the MLRWA Long-Term Flood Mitigation Plan.

The MLRWA implementation commission could establish a periodic stakeholder communication plan centered on the implementation of the flood mitigation plan, which would include communications with neighborhood residents, business representatives, and schools, etc. from the DeCola Ponds watershed. Additional communications will happen in relation to specific projects. The technical advisors to the MLRWA implementation commission (e.g., city technical staff and potentially others) will develop a communications plan as one of the first tasks for approval by the MLRWA implementation commission.

To form a new MLRWA implementation commission, the Cities of Golden Valley, New Hope and Crystal would need to develop and enter into a new joint powers agreement, which would require the signatures of the mayors of all three member Cities.

Should the three City Councils agree to the formation of the MLRWA implementation commission, some of the first tasks would include:

- Development of a new joint powers agreement to form the commission
- Develop implementation schedule
- Develop policies and procedures
- Develop financing strategies
- Develop an outreach and communication plan with stakeholders
- Pursue outside funding sources
- Implement projects

See Appendix B (April 23, 2015 memo regarding financial implementation strategies) for more information about implementation commission options.

6.0 References

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Appendix A

Medicine Lake Road and Winnetka Avenue Long-Term Flood Mitigation Plan – Phase 1 Summary Memo

September 5, 2014

Technical Memorandum

To: Jeff Oliver, Bob Paschke, & Tom Matheson
From: Jennifer Koehler, PE & Karen Chandler, PE
Subject: Medicine Lake Road and Winnetka Avenue Long-Term Flood Mitigation Plan – Phase 1 Summary
Date: September 5, 2014
Project: 23/27-1358
c: Len Kremer, Kirk McDonald, Anne Norris, Tom Burt

1.0 Background

In 2011 and 2012, the City of Golden Valley conducted the *DeCola Ponds Area Flood Mitigation Study* (DeCola Ponds Study) (Barr, 2012) to address flooding at a low point on Medicine Lake Road east of Winnetka Avenue and around the downstream DeCola Ponds. As part of the study, Barr developed an XP-SWMM model for the project area within Golden Valley, incorporating an existing model originally developed for the City of New Hope. The XP-SWMM model was used to evaluate engineering alternatives to reduce flooding at Medicine Lake Road and in the DeCola Ponds system.

Although several of the evaluated flood mitigation alternatives were expected to reduce flooding at Medicine Lake Road and around the DeCola Ponds, no alternative fully resolved the flooding issues (some structures would remain at-risk of flooding even with implementation of the project). Additionally, the most promising flood mitigation alternatives came with a significant cost ($6 to $7 million, not including any land acquisition, easement acquisition, or wetland mitigation costs).

Because of the high expected capital costs of a project that would only partially resolve the flooding issue, one of the recommendations from the DeCola Ponds study was for the Cities of Golden Valley, New Hope, and Crystal to develop a long-term flood mitigation plan for the project area. The goal of the long-term flood mitigation plan would be to evaluate other alternatives such as property acquisition, development of flood storage, reductions of impervious cover in the watershed, and flood proofing and to perform a cost-benefit analysis to help the cities make informed decisions in relation to flood mitigation.

Figure 1 shows the project area as evaluated in the DeCola Ponds study and for the development of the Medicine Lake Road and Winnetka Avenue long-term flood mitigation plan (flood mitigation plan).

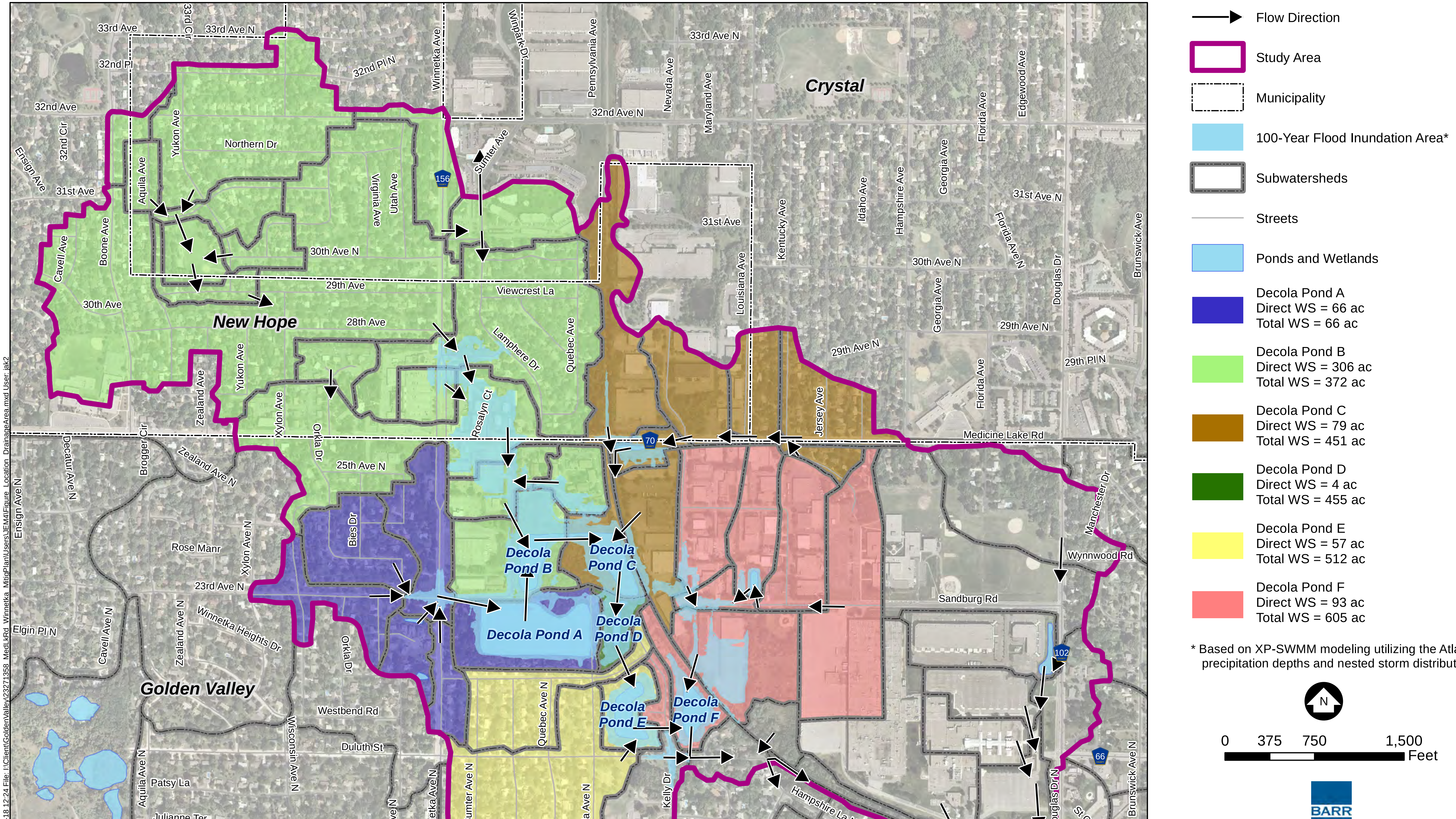


Figure 1

PROJECT AREA
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

2.0 Phase 1 Summary

This memo summarizes the completion of the first of two phases of the work for the flood mitigation plan development. Phase 1 of the Medicine Lake Road and Winnetka Avenue flood mitigation project included several tasks that built on the work completed for the City of Golden Valley as part of the DeCola Ponds study. Phase 1 included an initial assessment, which gathered information on at-risk (flood prone properties within the 100-year floodplain) properties in the project area. Information collected in Phase 1 will be used to assess and prioritize the alternatives that will be evaluated in Phase 2 of this project.

Phase 1 included the following tasks:

- Revisions to the existing XP-SWMM model of the watershed to reflect the Atlas-14 precipitation depths and nested storm distributions, and estimate the associated flood elevations.
- Identification of potentially at-risk properties and survey of the low opening elevations of the main structures.
- Estimation of the acquisition costs (including relocation and demolition) and the loss of tax revenue of all at-risk properties.
- Estimation of damages to at-risk properties.
- Evaluation of impervious surface reductions in the watershed on flood elevations.

The following summarizes the conclusions from the Phase 1 work:

- Based on the revised XP-SWMM modeling and the survey of the low openings, 41 properties are at-risk of flooding during the 100-year storm event.
- The estimated costs to acquire, remove, and relocate all of the at-risk properties are approximately $31.1 million.
- For the at-risk properties, the estimated flood damages for the 100-year event are approximately $7.2 million. The most significant damages are expected around the low point on Medicine Lake Road and Rosalyn Court and DeCola Ponds D, E, and F. Minor damages are expected around DeCola Pond A and east of the railroad near DeCola Pond F.
- Narrowing of streets and reducing the number of parking stalls in parking lots could result in an overall reduction in imperviousness within the watershed ranging from 0.5 to 6 percent. The XP-SWMM model predicted that reducing the imperviousness by 5 percent would reduce 100-year

flood elevations around DeCola Ponds A, B, C, and D by approximately 0.1 foot, with lesser impacts on the flood elevations in other areas of the watershed. A 25 percent reduction in the watershed imperviousness would not result in the removal of any properties from the 100-year floodplain.

The overall impact of reductions in the watershed imperviousness on flood elevations is less than originally expected, partially due to changes made to the infiltration parameters in the XP-SWMM model during the Phase 1 work. Because much of the pervious areas in the XP-SWMM model are now modeled as hydrologic soil group (HSG) C, which have limited infiltration capacity, significant runoff volumes can be generated from these areas during large, intense storm events. Although reductions in imperviousness will have limited impact on large, intense flood events, it would have a more significant impact on smaller, more frequent storm events and water quality.

- Development of flood storage will likely need to be a major component in the alternatives analysis to be completed in Phase 2.

The remaining sections discuss each of the Phase 1 tasks in more detail and will summarize the results of the Phase 1 analyses.

2.1 XP-SWMM Model Revisions

For the Phase 1 analyses, Barr used the XP-SWMM model that was originally developed for the DeCola Ponds Study completed in 2012. For the DeCola ponds study, the XP-SWMM model used the rainfall amounts for the 10-, 50-, and 100-year, 24-hour duration events outlined in the *City of Golden Valley Surface Water Management Plan* (Barr, 2009), which were based on the precipitation events included in Technical Paper 40 (TP-40) (USDC Weather Bureau, 1961) which was the design standard for the past 50 years. These events used the SCS Type II storm distribution. However, in 2009, the National Oceanic and Atmospheric Administration (NOAA) began a project to update the TP-40 values to reflect more current precipitation data. These updates, known as NOAA Atlas 14, Volume 8 (Atlas 14), were finalized in 2013. We revised the Phase 1 XP-SWMM model to reflect the Atlas 14 precipitation depths and used the Atlas 14 nested storm distribution.

Table 1 summarizes the TP-40 precipitation depths used in the 2012 DeCola Ponds study and the Atlas 14 precipitation depths used for the Phase 1 XP-SWMM model revisions.

Table 1 Summary of XP-SWMM Precipitation Events

Storm Event	TP-40 Precipitation Depth (in)	Atlas 14 Precipitation Depth (in)
10-year, 24-hour	4.2	4.3
50-year, 24-hour	5.3	6.4
100-year, 24-hour	6.0	7.4
200-year, 24-hour	N/A	8.6

In addition to revising the precipitation events and storm distributions, we made modifications to the infiltration parameters in the pervious areas of the model subwatersheds. When we developed the XP-SWMM model for the 2012 DeCola Ponds study, the available soils data suggested that much of the watershed had soils either classified as HSG B (moderately drained soils) or as undefined. All undefined soils were assumed to be HSG B. However, to address anecdotal comments from city staff about the soils in the project area are “tight” (not conducive to infiltration), we revised the subwatershed infiltration parameters as part of the Phase 1 model updates. Infiltration parameters were not changed in subwatersheds that had predominantly HSG B soils. However, infiltration parameters reflective of HSG C (poorly drained soils) were selected in subwatersheds with primarily undefined soils.

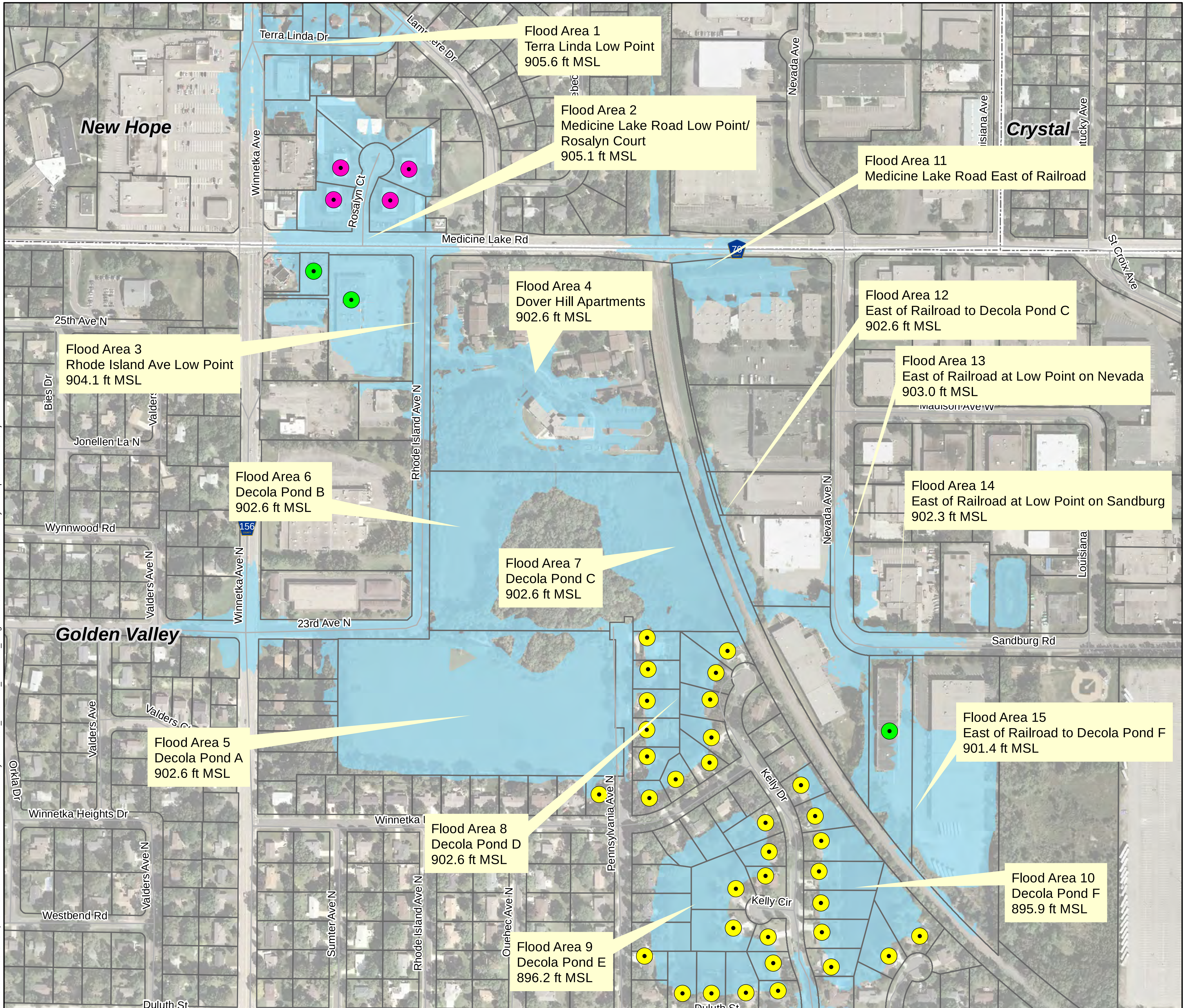
We utilized the revised XP-SWMM model for the existing watershed conditions to evaluate the 10-year, 50-year, 100-year, and 200-year, 24-hour storm events based on the Atlas 14 data and the revised infiltration parameters.

Figure 2 shows the existing conditions 100-year floodplain within the project area based on the results of the revised XP-SWMM modeling. The figure calls out each of the flood areas within the project area and includes the 100-year flood elevation. This figure also shows the at-risk properties within the project area (see additional discussion in the following sections). **Table 2** summarizes the estimated flood elevations for each flood area for the Atlas 14 10-year, 50-year, 100-year, and 200-year, 24-hour storm events. Also included in **Table 2** is the TP-40 100-year, 24-hr flood elevation, for comparison.

Table 2 Key Flood Areas and Flood Elevation Summary

Flood Area	Flood Area Description	Flood Elevation (ft-NGVD 29)[1]				
		10-yr	50-yr	TP-40 100-yr[2]	100-yr	200-yr
1	Terra Linda Low Point	904.6	905.3	905.2	905.6	905.9
2	Medicine Lake Road Low Point/Rosalyn Court	903.8	904.7	904.5	905.1	905.4
3	Rhode Island Ave Low Point	902.6	903.7	903.4	904.1	904.4
4	Dover Hill Apartments	900.8	901.6	901.3	902.6	903.6
5	Decola Pond A	899.7	901.6	900.8	902.6	903.6
6	Decola Pond B	899.7	901.6	900.8	902.6	903.6
7	Decola Pond C	899.7	901.6	900.8	902.6	903.6
8	Decola Pond D	895.1	901.6	900.8	902.6	903.6
9	Decola Pond E	893.6	895.9	895.4	896.2	896.3
10	Decola Pond F	893.5	895.6	895.0	895.9	896.1
11	Medicine Lake Road East of Railroad	912.9	913.2	913.1	913.2	913.3
12	East of Railroad to Decola Pond C	899.7	901.8	900.8	902.6	903.6
13	East of Railroad at Low Point on Nevada	902.8	902.9	902.9	903.0	903.0
14	East of Railroad at Low Point on Sandburg	901.4	902.0	902.0	902.3	902.6
15	East of Railroad to Decola Pond F	897.5	900.5	899.5	901.4	902.1
16	Honeywell Pond[3]	881.9	883.6	882.7	884.2	884.5

1- Flood elevation based on XP-SWMM modeling utilizing the Atlas 14 precipitation depths and nested storm distribution (including adjustments for soil type and hydraulic modifications made during the Phase 1 Atlas 14 modeling)
2- Flood elevation based on XP-SWMM modeling utilizing the TP-40 100-year, 24-hr SCS Type II storm distribution (including adjustments for soil type and hydraulic modifications made during the Phase 1 Atlas 14 modeling) - for comparison only
3- The Honeywell Pond is does not include properties at-risk of flooding but will be evaluated as part of the various flood mitigation alternatives as part of Phase 2.



At-Risk Properties*

- Commercial/Industrial
- Multifamily Residential
- Single Family Residential
- Streets
- Parcels
- 100-Year Flood Inundation Area**
- Municipality

* Properties determined to be at-risk of flooding based on comparison of modeled 100-year flood elevations and surveyed low openings.
** Based on XP-SWMM modeling utilizing the Atlas 14 precipitation depths and nested storm distribution

0 220 440 880 Feet

BARR

Figure 2

100-YR FLOODPLAIN & AT-RISK PROPERTIES
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

Barr Footer: ArcGIS 10.1, 2014-07-16 12:47 File: I:\Client\GoldenValley\23271358_MedLkRd_Winnetka_MitigPlan\Users\JEM4\Revised 100-yr Floodplain.mxd User: jem4

2.2 Survey

To determine which structures are at-risk of flooding, Barr conducted a survey of the lowest openings of the structures near the key flood areas. We developed a preliminary list of potentially at-risk properties/structures to be surveyed based on 1) review of the floodplain mapping using the revised XP-SWMM model results for the 100-year and 200-year events, and 2) 2007 topography data collected by the National Geodetic Survey and available from the U.S. Army Corps of Engineers (USACOE) (as was used in the original DeCola Ponds study).

Our work scope assumed that approximately 40-45 at-risk properties would be surveyed. However, upon review of the revised XP-SWMM model and the floodplain mapping, we identified approximately 90 properties/structures as potentially at-risk and requiring the lowest opening survey. Because the number of structures requiring a survey was nearly double the original estimate, we utilized available past survey data as much as possible to stay within budget. Past survey data sources included:

- Survey of select structures in the Terra Linda Drive and Rosalyn Court area – this survey data was collected as part of the *Terra Linda Drive, Rosalyn Court, and Medicine Lake Road – Local Flood Improvement Project Study* (Bonestroo, 2006) completed for the City of New Hope
- Survey of low opening of 7500 Winnetka Heights Drive provided by the resident in 2011
- Survey of structures on DeCola Ponds E & F collected in 1978 by Barr Engineering (Barr, 1979)

Barr conducted the lowest opening surveys of potentially at-risk structures on May 13, 2014, May 15, 2014, May 21, 2014, and May 22, 2014. The lowest openings of the main structures at 48 addresses were surveyed during this period. In addition to collecting the lowest opening data, the survey crew also described the lowest opening, made note of the approximate depth to the lowest floor (based on the location of the lowest opening) and the type of structure. Additionally, the survey crew photographed of each of the various structures along with the lowest openings that were surveyed.

The low opening survey utilized benchmarks from the City of Golden Valley's recent benchmark reestablishment project, and three (3) of the structures surveyed in 1978 were resurveyed as part of the recent survey effort to verify the 1978 elevations. Based similar survey elevations, the City of Golden Valley staff indicated they were comfortable with the use of the 1978 surveys for this flood mitigation study.

Table 3 summarizes the at-risk properties within the project area, based on the results of the XP-SWMM modeling and the surveys of the low opening. At-risk properties were properties with low opening elevations on the main structure that were located lower than the estimated 100-year flood elevations for the adjacent flood areas. Based on the results of the XP-SWMM modeling and the lowest opening surveys, there are currently 41 properties at-risk of flooding in the project area during the 100-year storm event (see **Figure 2**). Included in **Table 3** are three structures identified to flood during the 200-year storm event. **Table 3** also summarizes the type of property, the associated flood area, a summary of the storm events that result in potential flooding of the structure, the lowest opening elevation, the flood elevations for the various storm events, and the depth of flooding above the lowest opening of the structure for each of the storm events.

Table 3 At-Risk Properties[1]

Address	City	Property Type	Flood Area	Flooding Events	Elevation of Lowest Opening (ft-NGVD29)[2]	10-year Flood Elevation (ft-NGVD29)[3]	50-year Flood Elevation (ft-NGVD29)[3]	100-year Flood Elevation (ft-NGVD29)[3]	200-year Flood Elevation (ft-NGVD29)[3]	10-year Flood Depth (ft)[4]	50-year Flood Depth (ft)[4]	100-year Flood Depth (ft)[4]	200-year Flood Depth (ft)[4]
7145 SANDBURG RD	GOLDEN VALLEY	Business	15	100-yr, 200-yr	900.82	897.5	900.5	901.4	902.1	0.0	0.0	0.6	1.3
7825 MEDICINE LAKE RD	GOLDEN VALLEY	Business	2	50-yr, 100-yr, 200-yr	903.77	903.8	904.7	905.1	905.4	0.0	1.0	1.3	1.6
7775 MEDICINE LAKE RD	GOLDEN VALLEY	Business	2	50-yr, 100-yr, 200-yr	904.5	903.8	904.7	905.1	905.4	0.0	0.2	0.6	0.9
2740 ROSALYN CT	NEW HOPE	Multi-Residential	2	10-yr, 50-yr, 100-yr, 200-yr	903.25	903.8	904.7	905.1	905.4	0.5	1.5	1.8	2.2
2710 ROSALYN CT	NEW HOPE	Multi-Residential	2	50-yr, 100-yr, 200-yr	904.45	903.8	904.7	905.1	905.4	0.0	0.3	0.6	1.0
2700 ROSALYN CT	NEW HOPE	Multi-Residential	2	50-yr, 100-yr, 200-yr	904.22	903.8	904.7	905.1	905.4	0.0	0.5	0.9	1.2
2730 ROSALYN CT	NEW HOPE	Multi-Residential	2	50-yr, 100-yr, 200-yr	904.31	903.8	904.7	905.1	905.4	0.0	0.4	0.8	1.1
7500 WINNETKA HEIGHTS DR	GOLDEN VALLEY	Residential	5	50-yr, 100-yr, 200-yr	899.8	899.7	901.6	902.6	903.6	0.0	1.8	2.8	3.8
2155 KELLY DR	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	900.14	895.1	901.6	902.6	903.6	0.0	1.4	2.5	3.4
2145 KELLY DR	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	899.66	895.1	901.6	902.6	903.6	0.0	1.9	3.0	3.9
2135 KELLY DR	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	899.13	895.1	901.6	902.6	903.6	0.0	2.5	3.5	4.5
2125 KELLY DR	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	898.55	895.1	901.6	902.6	903.6	0.0	3.0	4.1	5.0
7350 WINNETKA HEIGHTS DR	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	898.13	895.1	901.6	902.6	903.6	0.0	3.5	4.5	5.5
7400 WINNETKA HEIGHTS DR	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	898.25	895.1	901.6	902.6	903.6	0.0	3.3	4.4	5.3
7450 WINNETKA HEIGHTS DR	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	898.19	895.1	901.6	902.6	903.6	0.0	3.4	4.4	5.4
2120 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	899	895.1	901.6	902.6	903.6	0.0	2.6	3.6	4.6
2140 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	897.8	895.1	901.6	902.6	903.6	0.0	3.8	4.8	5.8
2200 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	897.88	895.1	901.6	902.6	903.6	0.0	3.7	4.8	5.7
2220 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	897.08	895.1	901.6	902.6	903.6	0.0	4.5	5.6	6.5
2240 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	8	50-yr, 100-yr, 200-yr	896.91	895.1	901.6	902.6	903.6	0.0	4.7	5.7	6.7
7820 TERRA LINDA DR	NEW HOPE	Residential	1	200-yr	905.62	904.6	905.3	905.6	905.9	0.0	0.0	0.0	0.2
1920 PENNSYLVANIA AVE N	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	892.25	893.6	895.9	896.2	896.3	1.3	3.7	3.9	4.1
7450 DULUTH ST	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	892.53	893.6	895.9	896.2	896.3	1.0	3.4	3.6	3.8

Address	City	Property Type	Flood Area	Flooding Events	Elevation of Lowest Opening (ft-NGVD29)[2]	10-year Flood Elevation (ft-NGVD29)[3]	50-year Flood Elevation (ft-NGVD29)[3]	100-year Flood Elevation (ft-NGVD29)[3]	200-year Flood Elevation (ft-NGVD29)[3]	10-year Flood Depth (ft)[4]	50-year Flood Depth (ft)[4]	100-year Flood Depth (ft)[4]	200-year Flood Depth (ft)[4]
7400 DULUTH ST	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	891	893.6	895.9	896.2	896.3	2.6	4.9	5.2	5.3
7350 DULUTH ST	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	891.81	893.6	895.9	896.2	896.3	1.8	4.1	4.4	4.5
7310 DULUTH ST	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	890.94	893.6	895.9	896.2	896.3	2.6	5.0	5.2	5.4
1925 KELLY DR	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	890.78	893.6	895.9	896.2	896.3	2.8	5.1	5.4	5.6
1945 KELLY DR	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	893.06	893.6	895.9	896.2	896.3	0.5	2.9	3.1	3.3
1965 KELLY DR	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	892.18	893.6	895.9	896.2	896.3	1.4	3.8	4.0	4.2
2005 KELLY DR	GOLDEN VALLEY	Residential	9	10-yr, 50-yr, 100-yr, 200-yr	893.29	893.6	895.9	896.2	896.3	0.3	2.6	2.9	3.0
2015 KELLY DR	GOLDEN VALLEY	Residential	9	50-yr, 100-yr, 200-yr	893.75	893.6	895.9	896.2	896.3	0.0	2.2	2.4	2.6
2035 KELLY DR	GOLDEN VALLEY	Residential	9	50-yr, 100-yr, 200-yr	894.11	893.6	895.9	896.2	896.3	0.0	1.8	2.1	2.2
2065 KELLY DR	GOLDEN VALLEY	Residential	9	50-yr, 100-yr, 200-yr	894.7	893.6	895.9	896.2	896.3	0.0	1.2	1.5	1.6
2080 KELLY DR	GOLDEN VALLEY	Residential	10	50-yr, 100-yr, 200-yr	895.57	893.5	895.6	895.9	896.1	0.0	0.1	0.3	0.5
2060 KELLY DR	GOLDEN VALLEY	Residential	10	50-yr, 100-yr, 200-yr	893.98	893.5	895.6	895.9	896.1	0.0	1.6	1.9	2.1
2040 KELLY DR	GOLDEN VALLEY	Residential	10	50-yr, 100-yr, 200-yr	894.13	893.5	895.6	895.9	896.1	0.0	1.5	1.7	2.0
2020 KELLY DR	GOLDEN VALLEY	Residential	10	50-yr, 100-yr, 200-yr	893.52	893.5	895.6	895.9	896.1	0.0	2.1	2.3	2.6
2000 KELLY DR	GOLDEN VALLEY	Residential	10	10-yr, 50-yr, 100-yr, 200-yr	892.03	893.5	895.6	895.9	896.1	1.4	3.6	3.8	4.1
1940 KELLY DR	GOLDEN VALLEY	Residential	10	10-yr, 50-yr, 100-yr, 200-yr	893.1	893.5	895.6	895.9	896.1	0.4	2.5	2.8	3.0
1920 KELLY DR	GOLDEN VALLEY	Residential	10	10-yr, 50-yr, 100-yr, 200-yr	892.5	893.5	895.6	895.9	896.1	1.0	3.1	3.4	3.6

Address	City	Property Type	Flood Area	Flooding Events	Elevation of Lowest Opening (ft-NGVD29)[2]	10-year Flood Elevation (ft-NGVD29)[3]	50-year Flood Elevation (ft-NGVD29)[3]	100-year Flood Elevation (ft-NGVD29)[3]	200-year Flood Elevation (ft-NGVD29)[3]	10-year Flood Depth (ft)[4]	50-year Flood Depth (ft)[4]	100-year Flood Depth (ft)[4]	200-year Flood Depth (ft)[4]
1925 MARYLAND AVE N	GOLDEN VALLEY	Residential	10	10-yr, 50-yr, 100-yr, 200-yr	891.3	893.5	895.6	895.9	896.1	2.2	4.3	4.6	4.8
1935 MARYLAND AVE N	GOLDEN VALLEY	Residential	10	10-yr, 50-yr, 100-yr, 200-yr	892.77	893.5	895.6	895.9	896.1	0.7	2.9	3.1	3.3
2400 RHODE ISLAND AVE N (Garage)	GOLDEN VALLEY	Multi-Residential	4	200-yr	903.56	900.8	901.6	902.6	903.6	0.0	0.0	0.0	0.0
2400 RHODE ISLAND AVE N (Garage)	GOLDEN VALLEY	Multi-Residential	4	200-yr	903.57	900.8	901.6	902.6	903.6	0.0	0.0	0.0	0.0

1 - Properties determined to be at-risk of flooding based on comparison of modeled flood elevations and surveyed low openings.
2- Lowest openings determined from 2014 survey (Barr), 2006 survey (from New Hope/Stantec), and 1978 survey (Barr, verified in 2014)
3 - Flood elevation based on XP-SWMM modeling utilizing the Atlas 14 precipitation depths and nested storm distribution
4 - Flood depth above low opening of structure, based on difference between the flood elevation and the lowest opening of structure

2.3 Property Acquisitions

After identifying the properties at-risk of flooding in the 100-year storm event, the property acquisition costs were evaluated along with an estimate of property removal/demolition costs. Relocation costs for at-risk properties were also estimated.

To determine the acquisition and removal costs for single-family residential properties, the acquisition and removal costs were based on the current Hennepin County taxable market values multiplied by a factor of 1.5. This factor was provided by the City of Golden Valley based on recent property acquisition and demolition costs. Dan Wilson, a real estate appraiser subconsultant, determined the relocation costs for all properties, including finding new properties, moving expenses, and other incidental costs associated with relocation.

Wilson also estimated the acquisition and relocation costs for the at-risk multi-family residential, commercial, and industrial properties. These estimates were based on in-person interviews, use of the current Hennepin County taxable market value, and other sources to establish market values. Removal costs were assumed to be 20 percent of the acquisition costs, based on the guidance provided by the City of Golden Valley.

Table 4 summarizes the acquisition, removal, and relocation costs for all at-risk properties within the project area by property type. Also included in the table is a summary of the estimated annual tax revenue from the at-risk properties.

Table 4 Summary of Acquisition & Removal and Relocation Costs for At-Risk Properties

Property Type	Acquisition and Removal Cost[1]	Relocation Cost[2]	Total	Tax Revenue[3]
Single-Family Residential	$17,507,280	$1,329,000	$18,836,280	$208,448
Multi-Family Residential	$6,624,000	$682,000	$7,306,000	$30,983
Commercial/Industrial	$4,260,000	$680,000	$4,940,000	$126,747
Total	***$28,391,280***	***$2,691,000***	***$31,082,280***	***$366,178***

1 - Acquisition and removal costs for single family residential properties based on the current Hennepin County Market Value multiplied by 1.5. Acquisition costs for multi-family residential, commercial, and industrial determined by Wilson, with removal costs estimated to be of 20% of the acquisition cost.

2 - Relocation costs for single family-residential, multi-family residential, commercial, and industrial determined by a real estate appraisal consultant.

3 - Tax revenue reflects the current Hennepin County tax information for at-risk properties. This information will be utilized in the cost-benefit analysis in Phase 2 of the project.

2.4 Damage Assessments

In addition to understanding the costs to acquire the at-risk properties, damages due to flooding for the various storm events were estimated. For single-family residential properties, Barr determined flood damages based on depth-damage relationships for residential structures developed by the USACOE (USACOE, 2003). With the exception of one home, all of the single-family residential properties at-risk of flooding have walk-out basements. For these homes, we applied the depth-damage relationship developed for homes that are "Two or more stories, no basement." For the one other at-risk single-family residential home, the depth-damage relationship for "One story, with basement" was applied.

To determine flood damages for multi-family residential, commercial, and industrial properties, Barr staff and Dan Wilson conducted in-person interviews with the property owner and/or property tenant following the USACOE commercial and industrial flood damage survey primary survey form.

Table 5 summarizes the frequency-damage estimates for the various flood areas within the project area. The most significant estimated damages were found around the Medicine Lake Road low point east of Winnetka Avenue and around DeCola Ponds D, E, and F.

Table 5 Area Frequency Damage[1] Curves

Flood Area	Flood Area Description	Damage 10-yr	Damage 50-yr	Damage 100-yr	Damage 200-yr
1	Terra Linda Low Point	$0	$0	$0	$89,330
2	Medicine Lake Road Low Point/Rosalyn Court	$160,000	$2,987,000	$3,027,000	$3,027,000
3	Rhode Island Ave Low Point	$0	$0	$0	$0
4	Dover Hill Apartments	$0	$0	$0	$40,000
5	Decola Pond A	$0	$222,035	$280,394	$334,729
6	Decola Pond B	$0	$0	$0	$0
7	Decola Pond C	$0	$0	$0	$0
8	Decola Pond D	$0	$2,339,775	$2,729,351	$3,093,051
9	Decola Pond E	$1,406,189	$2,581,726	$2,721,354	$2,820,331
10	Decola Pond F	$632,678	$1,538,410	$1,565,682	$1,664,293
11	Medicine Lake Road East of Railroad	$0	$0	$0	$0
12	East of Railroad to Decola Pond C	$0	$0	$0	$0
13	East of Railroad at Low Point on Nevada	$0	$0	$0	$0
14	East of Railroad at Low Point on Sandburg	$0	$0	$0	$0
15	East of Railroad to Decola Pond F	$0	$0	$130,000	$130,000
16	Honeywell Pond	$0	$0	$0	$0
	TOTAL	***$2,038,867***	***$6,459,911***	***$7,146,387***	***$7,707,674***

1 - Damage for single-family home estimated using the USACOE Economic Guidance Memorandum (EGM) 04-01, Generic Depth-Damage Relationships for Residential Structures with Basements (October 2003). Damage estimates for multi-family, commercial, and industrial properties based on in-person interviews with the property owner and/or property tenant following the USACOE Commercial and Industrial Flood Damage Survey Primary Survey Form.

2.5 Impervious Surface Reductions

The final task in Phase 1 was to evaluate the impact of impervious surface reductions within the watershed as a potential flood mitigation alternative. Barr first utilized the XP-SWMM model to evaluate the impact of impervious surface reductions on the predicted flood elevations. The watershed imperviousness was modified to reflect 1, 2, 5, 10, and 25 percent reductions in impervious coverage throughout the project area.

Table 6 summarizes the expected change in flood elevation at each of the flood areas for the 10-year, 50-year, 100-year, and 200-year storm events with the various reductions in imperviousness.

Table 6 Impact of Impervious Surface Reductions on Flood Elevations

Flood Area	Flood Area Description	10-year						50-year						100-year						200-year					
		Flood Elevation (ft-NGVD 29)	Change in Flood Elevation (ft) Based on Impervious Surface Reduction (%)					Flood Elevation (ft-NGVD 29)	Change in Flood Elevation (ft) Based on Impervious Surface Reduction (%)					Flood Elevation (ft-NGVD 29)	Change in Flood Elevation (ft) Based on Impervious Surface Reduction (%)					Flood Elevation (ft-NGVD 29)	Change in Flood Elevation (ft) Based on Impervious Surface Reduction (%)				
			1%	2%	5%	10%	25%		1%	2%	5%	10%	25%		1%	2%	5%	10%	25%		1%	2%	5%	10%	25%
1	Terra Linda Low Point	904.6	0.0	0.0	0.0	-0.1	-0.1	905.3	0.0	0.0	0.0	0.0	-0.1	905.6	0.0	0.0	0.0	0.0	-0.1	905.9	0.0	0.0	0.0	0.0	-0.1
2	Medicine Lake Road Low Point/Rosalyn Court	903.8	0.0	0.0	-0.1	-0.1	-0.3	904.7	0.0	0.0	0.0	-0.1	-0.1	905.1	0.0	0.0	0.0	0.0	-0.1	905.4	0.0	0.0	0.0	0.0	-0.1
3	Rhode Island Ave Low Point	902.6	0.0	0.0	0.0	-0.1	-0.2	903.7	0.0	0.0	0.0	-0.1	-0.2	904.1	0.0	0.0	0.0	-0.1	-0.1	904.4	0.0	0.0	0.0	0.0	-0.1
4	Dover Hill Apartments	900.8	0.0	0.0	0.0	-0.1	-0.2	901.6	0.0	0.0	-0.1	-0.1	-0.2	902.6	0.0	0.0	-0.1	-0.1	-0.3	903.6	0.0	0.0	0.0	-0.1	-0.2
5	Decola Pond A	899.7	0.0	0.0	-0.1	-0.1	-0.4	901.6	0.0	0.0	-0.1	-0.1	-0.3	902.6	0.0	0.0	-0.1	-0.1	-0.3	903.6	0.0	0.0	0.0	-0.1	-0.2
6	Decola Pond B	899.7	0.0	0.0	-0.1	-0.1	-0.4	901.6	0.0	0.0	-0.1	-0.1	-0.3	902.6	0.0	0.0	-0.1	-0.1	-0.3	903.6	0.0	0.0	0.0	-0.1	-0.2
7	Decola Pond C	899.7	0.0	0.0	-0.1	-0.1	-0.4	901.6	0.0	0.0	-0.1	-0.1	-0.3	902.6	0.0	0.0	-0.1	-0.1	-0.3	903.6	0.0	0.0	0.0	-0.1	-0.2
8	Decola Pond D	895.1	0.0	0.0	0.0	-0.1	-0.2	901.6	0.0	0.0	-0.1	-0.1	-0.3	902.6	0.0	0.0	-0.1	-0.1	-0.3	903.6	0.0	0.0	0.0	-0.1	-0.2
9	Decola Pond E	893.6	0.0	0.0	0.0	-0.1	-0.2	895.9	0.0	0.0	0.0	0.0	-0.1	896.2	0.0	0.0	0.0	0.0	0.0	896.3	0.0	0.0	0.0	0.0	0.0
10	Decola Pond F	893.5	0.0	0.0	0.0	-0.1	-0.2	895.6	0.0	0.0	0.0	0.0	-0.1	895.9	0.0	0.0	0.0	0.0	0.0	896.1	0.0	0.0	0.0	0.0	-0.1
11	Medicine Lake Road East of Railroad	912.9	0.0	0.0	0.0	0.0	0.0	913.2	0.0	0.0	0.0	0.0	0.0	913.2	0.0	0.0	0.0	0.0	0.0	913.3	0.0	0.0	0.0	0.0	0.0
12	East of Railroad to Decola Pond C	899.7	0.0	0.0	-0.1	-0.1	-0.4	901.8	0.0	0.0	-0.1	-0.1	-0.3	902.6	0.0	0.0	0.0	-0.1	-0.2	903.6	0.0	0.0	0.0	-0.1	-0.2
13	East of Railroad at Low Point on Nevada	902.8	0.0	0.0	0.0	0.0	0.0	902.9	0.0	0.0	0.0	0.0	0.0	903.0	0.0	0.0	0.0	0.0	0.0	903.0	0.0	0.0	0.0	0.0	0.0
14	East of Railroad at Low Point on Sandburg	901.4	0.0	0.0	0.0	-0.1	-0.2	902.0	0.0	0.0	0.0	0.0	-0.1	902.3	0.0	0.0	0.0	0.0	-0.1	902.6	0.0	0.0	0.0	0.0	-0.1
15	East of Railroad to Decola Pond F	897.5	0.0	0.0	-0.1	-0.2	-0.7	900.5	0.0	0.0	-0.1	-0.1	-0.4	901.4	0.0	0.0	0.0	-0.1	-0.2	902.1	0.0	0.0	0.0	0.0	-0.1
16	Honeywell Pond	881.9	0.0	0.0	0.0	-0.1	-0.2	883.6	0.0	0.0	0.0	0.0	-0.1	884.2	0.0	0.0	0.0	0.0	-0.1	884.5	0.0	0.0	0.0	0.0	-0.1

The second step was to evaluate what might be a reasonable reduction in imperviousness within this watershed. The most significant opportunities to reduce imperviousness within this watershed would be through the reduction in road widths and in parking lot area.

Barr evaluated opportunities to reduce street widths. The current road width guidance from the Cities of Golden Valley, New Hope, and Crystal was compared with actual road widths within the project area using GIS software, measuring road widths on aerial photos using the road types classifications as included in the 2013 MnDOT streets and highways information. Review of the pavement width guidance as compared to the actual pavement widths as measured in GIS suggests that for many of the local roads, street widths have already been reduced to widths lower than outlined in the Cities' guidance documents. For example, the guidance for the Cities of Golden Valley, New Hope, and Crystal suggest a 30 foot width for local roads; however, actual measured width indicate that local roads widths within the project area are typically within 24 to 27 feet, already 3 to 6 feet narrower that the guidance would suggest. Based on analysis of the streets in the project area, a one (1) foot reduction in street width translates to a 3 percent reduction in street area. An eight foot reduction in street width equals a 23 percent reduction in street area.

Barr also reviewed the pavement management plans as provided by the Cities. The City of Golden Valley current pavement management plan suggests that some of the roads in the western portion of the project area will be addressed in 2019, including narrowing the width of the streets in the project area to approximately 26 feet. However, the City of New Hope does not have any upcoming road reconstruction projects in the project area, and all roads in the City of Crystal within the project area were reconstructed in the 1990's and there are no plans for reconstruction within the next 20 years.

With regards to reducing the amount of impervious surface in parking lots, Barr considered the Environmental Protection Agency (EPA) guidance related to green parking (EPA, 2014). This guidance summarizes the typical design criteria for the number of stalls for a given land use type along with the actual parking demand (national average). We compared the actual parking demands with the parking requirement information from the Cities of Golden Valley, New Hope, and Crystal. For commercial areas and shopping centers, there may be the opportunity to reduce the number of parking stalls by up to 20 percent. For industrial areas, actual average parking demand as compared to the Cities' current parking requirements suggests that the number of parking stalls could potentially be reduced by up to 25 percent. We estimated that the reductions in the number of parking stalls (approximately 20-25 percent) would result in an overall reduction in the parking lot impervious area by approximately 10 percent.

To understand the impact of impervious surface reductions through narrowing of streets and reducing the number of parking stalls on the overall imperviousness of different land use types, Barr incorporated the expected reductions in street and parking lot area into a breakdown of the various impervious surface types different land uses (Barr, 2005; Barr, 2011). Based on the analysis related to street widths and parking lot area, reasonable reductions in the project area total imperviousness ranges from 0.5 to 6 percent reductions.

The XP-SWMM modeling of different reductions in imperviousness in the watershed has shown that impervious reductions in this range will have minimal impact on the flood elevations, with a typical reduction in the flood levels of less than 0.1 feet for the 100-year storm event. Assuming a reasonable reduction of imperviousness by five (5) percent, the most significant change in the flood elevation would be seen around DeCola Ponds A, B, C, and D. However, these are not the ponds with the most significant flooding (DeCola Ponds E and F). A five (5) percent reduction in imperviousness would not remove any at-risk structures from the 100-year floodplain. Even a more significant reduction in imperviousness (e.g. 25 percent reduction), would not result in the removal of any properties from the floodplain.

The overall impact of reductions in the watershed imperviousness on flood elevations is less than originally expected. This is partially due to changes made to the infiltration parameters in the XP-SWMM model during the Phase 1 work. Because much of the pervious area in the XP-SWMM model is now modeled as HSG C, which have limited infiltration capacity, significant runoff volumes can be generated from these areas during large, intense storm events. Although there are small reductions in flood elevations during large precipitation events, the impact of the reductions in imperviousness would have a more significant impact on the smaller, more frequent storm events and improvements to water quality.

3.0 Next Steps

The final task of Phase 1 includes two meetings with staff from the Cities of Golden Valley, New Hope, and Crystal. At the first meeting, we will summarize the results of the original DeCola Ponds study and Phase 1 of the Medicine Lake Road and Winnetka Avenue long term flood mitigation plan. The second meeting will include the development of 2-3 flood mitigation alternatives for the project area to be further assessed in Phase 2 of the project.

Phase 2 of the project will include the evaluation of the 2-3 flood mitigation alternatives identified at the meeting with staff from the Cities of Golden Valley, New Hope, and Crystal. This will include completion of a cost-benefit analysis for each of the flood mitigation alternatives to help determine the most cost-effective solution. Additionally, Phase 2 will include the development of strategies for financial implementation of the flood mitigation alternative.

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Appendix B

Medicine Lake Road and Winnetka Avenue Long-Term Flood Mitigation Plan – Strategies for Financial Implementation Memo

April 23, 2015

Memorandum

To: Jeff Oliver, Bob Paschke, and Mark Ray
From: Karen Chandler, P.E., Jennifer Koehler, P.E., and Len Kremer, P.E.
Subject: Medicine Lake Road and Winnetka Avenue Long-Term Flood Mitigation Plan – Strategies for Financial Implementation
Date: April 23, 2015
Project: 23271358
c: Tom Burt, Kirk McDonald, and Anne Norris

This memo outlines strategies to finance implementation of the flood mitigation alternatives, made up of two main parts:

1. Project cost allocation and financing, including approaches for allocating costs to beneficiaries and between the cities, and methods for financing project costs,
2. Implementation commission—the structure and function of a commission, made up of members of all three cities, which would oversee the implementation of the Medicine Lake Road and Winnetka Avenue Area Long Term Flood Mitigation Plan (MLRWA Plan).

1.0 Background

At the January 23, 2015 meeting of staff from the Cities of Golden Valley, New Hope, and Crystal, Barr presented the results of the flood mitigation alternatives analysis and the results of the benefit-cost analysis. The group discussed three (3) alternatives:

- Alternative 1: Do Nothing (Existing Conditions)
- Alternative 2: Acquisition and Flood Proofing Only
- Alternative 3: Flood Mitigation Projects (followed by any necessary acquisitions or flood proofing)

Based on the discussion, the three cities agreed that Alternative 1 (Do Nothing) is not an option as it does not address the flooding of Medicine Lake Road and the public safety issues resulting from this alternative. Additionally, all 39 properties will remain at-risk of flooding.

Alternative 2, which only considers acquisition (flood depths > 3 feet) and flood proofing (flood depths < 3 feet) of at-risk properties, would result in acquisition of 20 properties and flood proofing of 19 properties. The estimated cost of this alternative is approximately $12.3 million, with a benefit-cost ratio less than 1.0. Typically, FEMA considers funding projects with a benefit-cost ratio greater than 1.0. Although this alternative will reduce damages to the at-risk structures, it will not reduce the flooding of Medicine Lake Road or the associated public safety concerns. Additionally, this alternative is not preferred by the City of Golden Valley because of the reduction in tax revenue caused by the acquisitions (nearly all acquisitions are in the City of Golden Valley).

Alternative 3 built on past studies and evaluated flood mitigation projects in locations identified by the cities at the October 7, 2014 meeting. The flood mitigation project goals were to 1) identify the storage needed to reduce the flooding on Medicine Lake Road to approximately 1.5 feet of standing water at the low point (allowing passage of emergency vehicles) during the 100-year event, and 2) remove structures from the flood plain to the maximum extent possible. This alternative included incorporating storage into the watershed at approximately 13 locations, acquisition of one property, and flood proofing of approximately 11 properties. The estimated cost of Alternative 3, including flood mitigation, acquisitions, and flood proofing was estimated to be $27.5 million. Alternative 3 also had a benefit-cost ratio less than 1.0.

At the January 23, 2015 meeting, staff from the three cities agreed that the solution would likely be some combination of Alternatives 2 and 3. Although the resultant plan will not resolve every detail about every potential project, it will provide the framework to begin addressing the flooding in the project area. The plan will outline next steps, recognizing that the implementation of the plan is long-term and may be dependent on opportunities (as they arise), such as road reconstruction projects, redevelopment, willing land owners, etc. The plan will identify specific flood mitigation projects that are more critical to helping solve the flooding problems in the Medicine Lake Road and Winnetka Avenue area, based on their proximity to the existing flood areas and Barr's understanding of the flooding (although each individual project will not be evaluated independently during this study). As each flood mitigation project is implemented, the impact will need to be reevaluated using the XP-SWMM model to not only determine the impact of a specific project but to track the cumulative impact of projects as they are implemented. Also, the plan will provide a prioritized list of at-risk properties, ranked by depth of flooding above the low opening for the 100-year event, which the cities can use when either targeting or making decisions related to acquisitions and/or flood proofing.

Table 1 below summarizes the likely alternative (between Alternatives 2 and 3), which includes the most critical flood mitigation projects needed to help resolve the flooding around the low point on Medicine Lake Road, and the estimated costs of the projects.

Table 1: Summary of Critical Flood Mitigation Projects and Costs

Flood Mitigation Project	Planning Level Opinion of Cost[1]
Projects around the Medicine Lake Road Low Point	
VFW (Liberty Crossing) site storage and conveyance	$1,720,000 – $3,026,00
Expansion of storage in Pennsylvania Woods, DeCola Ponds B & C, and raising overflow from DeCola Pond C to D	$3,272,000 – $5,724,000
Rosalyn Court area storage	$493,000 – $863,000
Yunker Park storage	$864,000 – $1,512,000
Projects around DeCola Ponds E & F	
Diversion from DeCola Pond F & storage development east of the railroad and around Isaacson Park	$1,936,000 – $3,388,000
Develop storage at School of Engineering and Arts (SEA) School	$1,701,000 – $2,977,000
Acquisition and Flood Proofing[2]	
Acquisition	$4,173,000[3]
Flood proofing	$1,016,000
Total Estimated Cost	**$15,175,000 – $22,679,000 ($17,680,000)**

[1] – Planning level cost estimates reflect 2015 dollars and reflect a range of uncertainty (-20% to +40%) due to the conceptual nature of the design (10-15% design completion). Costs assume soils are not contaminated and will not require special disposal. Costs also include planning level estimates for expected easement acquisitions based on current property ownership. Project costs will change with further design.

[2] – This specific combination of flood mitigation alternatives was not evaluated in XP-SWMM. Therefore, estimated costs assumed acquisition of Rosalyn Court property and the most at-risk properties on the DeCola Ponds—those with >5 ft of flood depth under existing conditions 100-year (approx. 4 properties). We assumed the flood proofing costs are the same as in Alternative 2.

[3] – Acquisition costs used taxable market values obtained from the 2014 Hennepin County parcel data, which were based on January 2013 valuations by the county assessor.

2.0 Project cost allocation and financing

2.1 Project cost allocation

Project costs can be allocated among the three cities and beneficiaries in a number of ways, including:

1. cost share based on watershed area
2. cost share based 50% on watershed area and 50% on taxable market value
3. cost share based on existing runoff volumes
4. cost share based on runoff volumes above pre-settlement conditions
5. cost share based on required storage volume
6. beneficiaries pay more
7. cost allocation based on combinations of cost allocation methods

The above cost allocation methods are described in Sections 2.1.1 – 2.1.7 below and summarized in Table 2.

For the cost allocation alternatives, we divided the project area into two focus areas: 1) the watersheds contributing to the Medicine Lake Road low point and DeCola Ponds A-D; and 2) the watersheds contributing to DeCola Ponds E – F. The watershed area to Medicine Lake Road and DeCola Ponds A – D were combined together because the two areas are connected and act as one during larger storm events. Additionally, the connection between the two areas will be even greater once the proposed larger conveyance is constructed between Medicine Lake Road and DeCola Ponds A – D.

The cost allocation alternatives considered the incremental (direct) and cumulative watersheds. Additionally, the cost allocation methods broke down the costs according to 1) the three participating cities, and 2) the three participating cities and Hennepin County (based on the CSAH right of way through the project area).

2.1.1 Cost share based on watershed area

In this method, costs would be allocated based on the watershed area to Medicine Lake Road and DeCola Ponds A – D, and to DeCola Ponds E – F. There are two ways that this method could be applied – by incremental (direct) tributary area, or by cumulative tributary area. Table 3 shows the cost allocation, along with the details of the basis for the allocation.

2.1.2 Cost share based 50% on watershed area and 50% on taxable market value

In this cost sharing method, the project costs would be allocated based 50 percent on watershed area and 50 percent on the taxable market value of all real property in the watershed. Taxable market values were obtained from the 2014 Hennepin County parcel data, which were based on January 2013 valuations by the county assessor.

The equation for the cost allocation per entity (city or county) is:

Entity cost allocation = total project cost * [0.5*(entity's watershed area/total watershed area) + 0.5*(entity's taxable market value/total taxable market value)]

As above, there are two ways that this method could be applied – by incremental (direct) tributary area, or by cumulative tributary area.

Allocating costs based 50% on watershed area and 50% on taxable market value is a typical method for allocating non-capital improvement costs among cities that are part of a watershed management organization joint powers agreement (e.g., Bassett Creek WMC). These organizations apply the method to the cumulative tributary area.

Table 4 shows the cost allocation, along with the details of the basis for the allocation.

2.1.3 Cost share based on existing runoff volumes

In this cost sharing method, the project costs would be allocated according to the existing 100-year watershed runoff volumes to Medicine Lake Rd and DeCola Ponds A – D, and to DeCola Ponds E – F. The existing watershed runoff volume from each city (and Hennepin County) was based on the subwatershed runoff volumes predicted by the XP-SWMM modeling, which was then allocated to the cities (and Hennepin County) within each subwatershed (by area). There are two ways that this method could be applied – by incremental (direct) tributary area, or by cumulative tributary area. Each entity's cost allocation is based on its existing watershed runoff volume compared to the total existing watershed runoff volume.

Table 5 shows the cost allocation for this method, along with the details of the basis for the allocation.

2.1.4 Cost share based on runoff volumes above pre-settlement conditions

There are two ways this cost sharing method could be applied:

1. Each city would pay for projects in their city until watershed runoff volumes are reduced to the watershed runoff volumes under pre-settlement conditions (i.e., pre-development conditions). Under this scenario, each city would be responsible for acquiring or flood proofing homes that lie within the "pre-settlement conditions" 100-year floodplain. For example, if ten homes are located

in the floodplain of DeCola Ponds under pre-settlement conditions, the City of Golden Valley would be responsible for the acquisition and/or floodproofing costs for these homes.

If more flood mitigation projects are required after each city reduces their watershed runoff volumes to pre-settlement conditions, then one of the other cost share methods would need to be applied to allocate the remaining project costs.

2. Each city would pay for projects based on their share of the increase in watershed runoff volume above pre-settlement conditions.

For this method, we assumed native/pre-settlement conditions to be a mixture (50 percent/50 percent) of oak forest and tall grass prairie (note: the draft BCWMC plan states that prior to settlement, "a predominantly oak forest interrupted by tall grass prairie and marsh covered" the portion of the watershed from the Mississippi River to Medicine Lake). We also assumed that under pre-settlement conditions, the watershed would have no impervious surfaces, all soils would be classified as hydrologic soil group B, and the subwatersheds would be the same as under existing conditions. Barr ran the XP-SWMM model under native/pre-settlement conditions and used the predicted 100-year runoff volumes from the model, compared to the existing 100-year runoff volumes, to develop the cost allocations.

This method is similar to the Lower Mississippi River WMO's "allowable flow" cost allocation; however the allowable flow calculation is based on flows using the rational equation (Q=CIA), not runoff volumes.

Table 6 shows the cost allocation for this method, along with the details of the basis for the allocation.

2.1.5 Cost share based on required storage volume

In this cost sharing method, the costs would be allocated based on the required storage volume needed for all of the proposed projects and then divided up by tributary watershed. However, the cost allocation percentages resulting from the application of this method would be the same as the results of the "existing runoff volumes" method (see Section 2.1.3).

2.1.6 Beneficiaries pay more

In this cost sharing method, beneficiaries would pay more. For example, the Shingle Creek and West Mississippi WMC (SCWM) plan calls for project costs to be apportioned so that the "area directly benefiting from the project should be apportioned 25 percent of the cost of the project." The plan gives the example of apportioning according to proportion of lake or stream footage. The SCWM plan further calls for 50 percent of the cost to be "apportioned based on contributing/benefiting area." The percentages only total 75 percent because the SCWM requires the member cities to pay for 75 percent of project costs. Applying this philosophy to the MLRWA project would mean 1/3 of the project costs would be apportioned according to "benefit" and 2/3 of the project costs would be apportioned based on contributing area. The "benefits" part of this method may unfairly cause downstream properties to bear the brunt of the cost, especially if we consider the "pre-settlement conditions" runoff volume.

One approach could be to set up overlay districts in zones closest to flooded areas. A greater portion of the costs would be allocated to areas in the zone (or zones) closest to the flood zone. Another approach could be apportion a percentage of the costs (say 10 percent) to be paid by the property owners within the existing 100-year floodplain. The amount charged to each property owner would be based on the assessed valuation of the property.

2.1.7 Cost allocation based on combinations of cost allocation methods

The cities could decide to allocate costs based on combinations of the above methods, e.g.,

- 50% watershed area/50% runoff volume (current conditions or natural conditions)
- 1/3 watershed area, 1/3 runoff volume, 1/3 taxable market value

2.2 Project financing

Cities finance capital improvement projects using a variety of tools, including:

- bonds
- storm sewer improvement district
- tax increment financing district
- tax abatement
- stormwater utility fees
- outside funding sources

The above financing methods are described in Sections 2.2.1 – 2.2.5 below.

2.2.1 Bonds

Cities borrow money by issuing and selling municipal bonds, also known as general obligation bonds. Cities have limits on the amount of debt they can take on through issuing and selling bonds. The current "net debt" limit is 3% of the estimated market value of taxable property in the city (from 2014 Handbook for Minnesota Cities, League of Minnesota Cities).

Other types of bonds include:

- Revenue bonds – these bonds are tied to a specific funding stream
- General obligation revenue bonds – these bonds are tied to both "full faith and credit" of the city and a specific funding stream
- Bonds by purpose – general obligation bonds issued for a specific purpose – not a legal requirement, but used to conveniently identify bonds to a specific project
- Bonds by user – these are also called "private activity bonds" and are used partially or entirely for private purposes, but still tax exempt.

In some situations, city residents must vote in favor of a bond before city issuance of a bond, but there are many exceptions to this requirement.

The cities could sell bonds to help pay for the projects. The amount each city would need to fund through bonding would depend on the amount of funds available in its stormwater fund (fund balance) – i.e., the smaller the fund balance, the more bonding that would be required. The bonds are rated based on the city's bond rating.

The City of Golden Valley currently owes $80.4 million on current bonds, the City of Crystal owes $13.7 million, and the City of New Hope owes $2.4 million.

Related to this, each city has a "debt load," which is the ratio of the city's debt to its tax levy. Crystal's debt load is 148% and Golden Valley's is 27%. New Hope's debt load was not obtained in time for this memo. Although Crystal's debt load ($13,741,000 at the end of 2014) is higher than its property tax levy ($9,313,153), the debt is based on special assessments, which are not included in the city's tax levy. The City of Crystal is installing storm sewer in the north part of the city (where there is currently no storm sewer), which is putting a strain on the city's finances. Potential future bonds for the City of New Hope include a $1.5 million bond issue for 2015, $3.6 million tax increment financing bond issue for 2015, and a $1.8 million bond issue for 2017. In addition, New Hope may need to issue a $1.5 million bond for an emergency water repair, and is considering a new public safety building/city hall.

2.2.1 Storm sewer improvement district

The cities may fund specialized city infrastructure by creating a storm sewer improvement district (SSID). Cities must pass an ordinance to create an SSID. Once established, the city "may acquire, construct, reconstruct, extend, maintain, and otherwise improve storm sewer systems and related systems" within the SSID. The city "may also acquire, maintain and improve stormwater holding areas and ponds" for the benefit of the SSID. The city pays for the improvements in the SSID by levying taxes on the property in the district. Tax levies also pay for principal and interest on bonds.

2.2.2 Tax increment financing district

Cities use tax increment financing (TIF) to fund more than local improvements. The TIF tool segregates tax dollars from a defined area for use in developing and improving the area, which can include local improvements. The following is from the Handbook for Minnesota Cities (2014, League of Minnesota Cities):

> TIF takes advantage of the increases in tax capacity and property taxes from development or redevelopment before the development actually occurs to pay for public development or redevelopment costs. The difference in the tax capacity and the tax revenues the property generates after new construction has occurred, compared with the tax capacity and tax revenues it generated before the construction, is the captured value. The taxes paid on the captured value are called "increments." Unlike property taxes, increments are not used to pay for the general costs of cities, counties, and schools. Instead, increments go directly to the development authority to repay public indebtedness or upfront costs the city incurs in acquiring the property, removing existing structures, or installing public services.

2.2.3 Tax abatement

Through this financing tool, cities can authorize the issuance of bonds, which are paid back with funds collected by tax abatements. The tax is not actually forgiven (abated), but is paid normally, with the amount of property tax levied by the city used to pay for the bonds. The following example is from the Handbook for Minnesota Cities (2014, League of Minnesota Cities):

> A city may "abate" all or a portion of city property tax on one or more parcels of real or personal property, including machinery, for economic development purposes. And cities may issue general obligation or revenue bonds to construct public improvements. As the property owners pay the abated taxes, rather than the local property taxes, the payments go directly to paying off the bonds.

Tax abatement bonds do not require a referendum approval and are excluded from debt limits. However, in any year, the total amount of property taxes abated by a city may not exceed 10 percent of the net tax capacity of the city for the taxes payable year applicable to the abatement or $200,000, whichever is greater.

2.2.4 Stormwater utility fees

The three cities have stormwater utilities that generate fees that could be used to help pay for the identified projects. The stormwater utility fees may be based on the size of the property, the type of property, or the quantity and quality of runoff and disposal difficulties. Each of the three cities bases their stormwater utility fees on the type of property.

Below is the current status of each city's stormwater utility:

1. City of Crystal: generated $750,500 in 2014 from its stormwater utility fee (called the Storm Drainage Fund). The city is increasing its stormwater utility fees for the next five years – in 2015 they expect to generate $819,000 in revenue. The city's stormwater utility is based on a single family residential rate of $11.70 per quarter in 2014 and $12.60 per quarter in 2015 (this rate will increase every year by $0.90 per quarter for five years). For commercial properties, the rate is 25 times the single family residential rate, or $292.50 per quarter in 2014 and $315.00 per quarter in 2015 (this rate will increase every year by $22.50 per quarter for five years).
2. City of Golden Valley: generated $2.2 million in 2014 from its stormwater utility fee (called an Enterprise Fund). The city's stormwater utility is based on a residential equivalency factor of $22 per quarter. For commercial land uses, the <u>monthly</u> charge is $22 x 5 x acres = $110/acre per month.
3. City of New Hope: generated $966,700 in 2014 from its stormwater utility fee, and expects to generate $996,600 in 2015. The city's stormwater utility is based on monthly charges of $6.55 for residential property (or $19.65 per quarter) and $9.83 (or $29.49 per quarter) for non-residential property (2015 rates).

Cities could impose a "user surcharge" for flood mitigation on top of the usual stormwater utility fee (e.g., an extra $1/month per property) for properties within the MLRWA watershed. The user surcharge would start generating additional funds and help offset the costs of providing additional storage in the watershed. The details regarding the user surcharge, such as who pays the surcharge and for how long, would need to be discussed and agreed upon by the three cities.

2.2.5 Outside funding sources

Project costs could be offset by obtaining grants, state funding (legislation), and other outside funding sources.

Grants for flood reduction/management projects are more limited than for water quality improvement projects. The Minnesota Department of Natural Resources' (MNDNR) Flood Damage Reduction grant is the only state grant available for flood reduction projects. Under this program, the state can provide cost-share grants to local units of government for up to 50 percent of the total cost of a project. Cities, counties, towns, watershed districts and watershed management organizations, lake improvement districts, soil and water conservation districts, and joint powers organizations composed of any of these units (e.g., the potential future implementation commission discussed in Section 3.0) may apply.

Currently, there are two different classes of grants available through the FDR Program:

1. Small grants; these grants are for projects with a total cost up to $300,000 (maximum state share $150,000). The MNDNR grants these funds directly from general funds appropriated by the Minnesota State Legislature. These are competitive, and are limited to available funds. Small projects and studies are covered through this grant program.

2. Large grants; these grants are for projects with a total cost greater than $300,000 (state share greater than $150,000). Large grant applications are received and prioritized by the MNDNR and then presented to the Governor and the Legislature for consideration in a capital bonding bill. A project will be funded based on its rank after prioritization and the amount of program funding made available by the Legislature. (Note: every biennium, the Legislature appropriates funds for these larger grants.)or flood mitigation/reduction projects to receive these funds, the projects must be approved by the legislature (i.e., they must go through the legislative process).

The types of projects eligible for FDR grants include:

- structural acquisition in the 100-year floodplain
- levees, ring dikes, and flood walls
- elevating existing structures
- flood warning systems
- public education
- flood insurance studies
- floodplain mapping
- comprehensive watershed plans
- flood storage easements
- cost share on federal projects

The MLRWA Plan implementation projects would likely require a large grant (and legislative approval).

If a presidential declaration has been issued in Minnesota, FEMA pays for 75 percent of the cost of structural acquisition, with the remaining 25 percent to be provided by the local governments. The FDR program will pay half the local share, leaving the local government unit with only a 12.5 percent share. The FDR program will also pay for half of the 35% nonfederal share of federal flood hazard mitigation projects.

Other potential grant sources include:

- Hennepin County Emergency Management Department, which could provide grant funds for flood damage reduction
- Hennepin County Environmental Services Department, the Metropolitan Council, and the Minnesota Department of Employment and Economic Development – these agencies provide funding for assessing and/or cleanup of contaminated (brownfields) sites.

Aside from grant funds, other potential outside funding sources include:

- Hennepin County – Medicine Lake Road and Winnetka Avenue are county roads. In preliminary conversations with Golden Valley staff, Hennepin County staff indicated openness to cost sharing for implementing MLRWA projects. The cost allocations discussed in Section 2.1 take this possibility into account.
- Bassett Creek Watershed Management Commission (BCWMC) – the (draft) 2015 BCWMC watershed management plan includes a policy that would allow this type of project to be considered for inclusion in the BCWMC's capital improvement program (see policy 110).

3.0 Implementation commission

Assuming the cities of Crystal, Golden Valley and New Hope agree to begin implementing the projects recommended in the MLRWA Long Term Flood Mitigation Plan, the next step is for the cities to create a commission to oversee the implementation of the Plan. The commission members would be made up of members of all three cities, and it would need to make the following important decisions:

1) how much each city should contribute to the plan implementation,
2) when projects should be implemented,
3) how to payout the commission's funds for project implementation, and
4) if policies or ordinances (e.g., zoning overlays) should be adopted in the MLRWA watershed.

The commission would also oversee the updating of the XP-SWMM model after implementation of each project.

We see three options for forming the implementation commission:

1. A new joint commission, independent of any existing joint commission
2. Part of the existing Joint Water Commission (JWC), as a new "charge" for the existing commission
3. Part of the Bassett Creek Watershed Management Commission (BCWMC), likely as a subcommittee of the existing BCWMC

In each of the forms above, the implementation commission could either be autonomous (e.g., it would have the authority to order projects) or it could be required to bring recommendations back to the ultimate authority (the three member cities or the BCWMC). In addition, the implementation commission's decisions could move forward upon either a simple majority vote or a unanimous vote. The MLRWA implementation commission would likely need to meet at least once per year to discuss projects to be implemented, the funding of projects, and other business.

The implementation commission could establish a stakeholder advisory committee, which would include neighborhood representatives from the watershed.

Table 7 summarizes the advantages and disadvantages of each form of the implementation commission.

Table 2. Summary of Cost Allocation Methods Results

A. Incremental Summary

Entity	To MLR & DeCola Ponds A-D				To DeCola Ponds E-F			
	Watershed Area Only	50% Watershed Area & 50% Taxable Market Value[1]	Existing Runoff Volumes (100-Yr)	Increase in Runoff Volume from Pre-settlement Conditions	Watershed Area Only	50% Watershed Area & 50% Taxable Market Value	Existing Runoff Volumes (100-Yr)	Increase in Runoff Volume from Native Conditions
Crystal	31%	32%	26%	30%	0%	0%	0%	0%
New Hope	37%	37%	38%	41%	0%	0%	0%	0%
Golden Valley	32%	31%	36%	29%	100%	100%	100%	100%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Entity	To MLR & DeCola Ponds A-D				To DeCola Ponds E-F			
	Watershed Area Only	50% Watershed Area & 50% Taxable Market Value[1]	Existing Runoff Volumes (100-Yr)	Increase in Runoff Volume from Pre-settlement Conditions	Watershed Area Only	50% Watershed Area & 50% Taxable Market Value	Existing Runoff Volumes (100-Yr)	Increase in Runoff Volume from Native Conditions
Crystal	30%	32%	26%	29%	0%	0%	0%	0%
New Hope	36%	36%	36%	39%	0%	0%	0%	0%
Golden Valley	30%	30%	34%	28%	100%	100%	100%	100%
Hennepin County	4%	2%	5%	4%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%

B. Cumulative Summary

Entity	To MLR & DeCola Ponds A-D				Entire Watershed to DeCola Ponds E-F			
	Watershed Area Only	50% Watershed Area & 50% Taxable Market Value[1]	Existing Runoff Volumes (100-Yr)	Increase in Runoff Volume from Pre-settlement Conditions	Watershed Area Only	50% Watershed Area & 50% Taxable Market Value	Existing Runoff Volumes (100-Yr)	Increase in Runoff Volume from Native Conditions
Crystal	31%	32%	26%	30%	23%	23%	19%	22%
New Hope	37%	37%	38%	41%	28%	27%	27%	30%
Golden Valley	32%	31%	36%	29%	49%	50%	55%	49%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Entity	To MLR & DeCola Ponds A-D				Entire Watershed to DeCola Ponds E-F			
	Watershed Area Only	50% Watershed Area & 50% Taxable Market Value[1]	Existing Runoff Volumes (100-Yr)	Increase in Runoff Volume from Pre-settlement Conditions	Watershed Area Only	50% Watershed Area & 50% Taxable Market Value	Existing Runoff Volumes (100-Yr)	Increase in Runoff Volume from Native Conditions
Crystal	30%	32%	26%	29%	22%	23%	18%	21%
New Hope	36%	36%	36%	39%	27%	26%	25%	28%
Golden Valley	30%	30%	34%	28%	48%	50%	53%	48%
Hennepin County	4%	2%	5%	4%	3%	2%	3%	3%
Total	100%	100%	100%	100%	100%	100%	100%	100%

[1] – Taxable market values obtained from the 2014 Hennepin County parcel data, which were based on January 2013 valuations by the county assessor.

Table 3. Cost Share Based on Watershed Tributary Area

A. Incremental Summary

Entity	To MLR & DeCola Ponds A-D		To DeCola Ponds E-F	
	Watershed Area (ac)	Watershed Area (%)	Watershed Area (ac)	Watershed Area (%)
Crystal	139	31%	0	0%
New Hope	170	37%	0	0%
Golden Valley	146	32%	150	100%
Total	455	100%	150	100%

Entity	To MLR & DeCola Ponds A-D		To DeCola Ponds E-F	
	Watershed Area (ac)	Watershed Area (%)	Watershed Area (ac)	Watershed Area (%)
Crystal	136	30%	0	0%
New Hope	163	36%	0	0%
Golden Valley	139	30%	150	100%
Hennepin County	18	4%	0	0%
Total	455	100%	150	100%

B. Cumulative Summary

Entity	To MLR & DeCola Ponds A-D		Entire Watershed to DeCola Ponds E-F	
	Watershed Area (ac)	Watershed Area (%)	Watershed Area (ac)	Watershed Area (%)
Crystal	139	31%	139	23%
New Hope	170	37%	170	28%
Golden Valley	146	32%	296	49%
Total	455	100%	605	100%

Entity	To MLR & DeCola Ponds A-D		Entire Watershed to DeCola Ponds E-F	
	Watershed Area (ac)	Watershed Area (%)	Watershed Area (ac)	Watershed Area (%)
Crystal	136	30%	136	22%
New Hope	163	36%	163	27%
Golden Valley	139	30%	289	48%
Hennepin County	18	4%	18	3%
Total	455	100%	605	100%

Table 4. Cost Share Based 50% on Watershed Area and 50% on Taxable Market Value

A. Incremental Summary

Entity	To MLR & DeCola Ponds A-D					To DeCola Ponds E-F				
	Watershed Area (ac)	Watershed Area (%)	Taxable Market Value ($)[1]	Taxable Market Value (%)	50% Watershed Area & 50% Taxable Market Value	Watershed Area (ac)	Watershed Area (%)	Taxable Market Value ($)[1]	Taxable Market Value (%)	50% Watershed Area & 50% Taxable Market Value
Crystal	139	31%	$85,588,000	34%	32%	0	0%	$0	0%	0%
New Hope	170	37%	$92,490,500	37%	37%	0	0%	$0	0%	0%
Golden Valley	146	32%	$74,634,000	30%	31%	150	100%	$118,276,000	100%	100%
Total	455	100%	$252,712,500	100%	100%	150	100%	$118,276,000	100%	100%

Entity	To MLR & DeCola Ponds A-D					To DeCola Ponds E-F				
	Watershed Area (ac)	Watershed Area (%)	Taxable Market Value ($)[1]	Taxable Market Value (%)	50% Watershed Area & 50% Taxable Market Value	Watershed Area (ac)	Watershed Area (%)	Taxable Market Value ($)[1]	Taxable Market Value (%)	50% Watershed Area & 50% Taxable Market Value
Crystal	136	30%	$85,588,000	34%	32%	0	0%	$0	0%	0%
New Hope	163	36%	$92,490,500	37%	36%	0	0%	$0	0%	0%
Golden Valley	139	30%	$74,634,000	30%	30%	150	100%	$118,276,000	100%	100%
Hennepin County	18	4%	$0	0%	2%	0	0%	$0	0%	0%
Total	455	100%	$252,712,500	100%	100%	150	100%	$118,276,000	100%	100%

Table 4. Cost Share Based 50% on Watershed Area and 50% on Taxable Market Value

B. Cumulative Summary

Entity	To MLR & DeCola Ponds A-D					Entire Watershed to DeCola Ponds E-F				
	Watershed Area (ac)	Watershed Area (%)	Taxable Market Value ($)[1]	Taxable Market Value (%)	50% Watershed Area & 50% Taxable Market Value	Watershed Area (ac)	Watershed Area (%)	Taxable Market Value ($)[1]	Taxable Market Value (%)	50% Watershed Area & 50% Taxable Market Value
Crystal	139	31%	$85,588,000	34%	32%	139	23%	$85,588,000	23%	23%
New Hope	170	37%	$92,490,500	37%	37%	170	28%	$92,490,500	25%	27%
Golden Valley	146	32%	$74,634,000	30%	31%	296	49%	$192,910,000	52%	50%
Total	455	100%	$252,712,500	100%	100%	605	100%	$370,988,500	100%	100%

Entity	To MLR & DeCola Ponds A-D					Entire Watershed to DeCola Ponds E-F				
	Watershed Area (ac)	Watershed Area (%)	Taxable Market Value ($)[1]	Taxable Market Value (%)	50% Watershed Area & 50% Taxable Market Value	Watershed Area (ac)	Watershed Area (%)	Taxable Market Value ($)[1]	Taxable Market Value (%)	50% Watershed Area & 50% Taxable Market Value
Crystal	136	30%	$85,588,000	34%	32%	136	22%	$85,588,000	23%	23%
New Hope	163	36%	$92,490,500	37%	36%	163	27%	$92,490,500	25%	26%
Golden Valley	139	30%	$74,634,000	30%	30%	289	48%	$192,910,000	52%	50%
Hennepin County	18	4%	$0	0%	2%	18	3%	$0	0%	2%
Total	455	100%	$252,712,500	100%	100%	605	100%	$370,988,500	100%	100%

[1] – Taxable market values obtained from the 2014 Hennepin County parcel data, which were based on January 2013 valuations by the county assessor.

Table 5. Cost Share Based on Existing Runoff Volumes

A. Incremental Summary

Entity	To MLR & DeCola Ponds A-D		To DeCola Ponds E-F	
	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)
Crystal	47	26%	0	0%
New Hope	68	38%	0	0%
Golden Valley	64	36%	74	100%
Total	179	100%	74	100%

Entity	To MLR & DeCola Ponds A-D		To DeCola Ponds E-F	
	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)
Crystal	46	26%	0	0%
New Hope	64	36%	0	0%
Golden Valley	61	34%	74	100%
Hennepin County	8	5%	0	0%
Total	179	100%	74	100%

Table 5. Cost Share Based on Existing Runoff Volumes

B. Cumulative Summary

Entity	To MLR & DeCola Ponds A-D		Entire Watershed to DeCola Ponds E-F	
	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)
Crystal	47	26%	47	19%
New Hope	68	38%	68	27%
Golden Valley	64	36%	138	55%
Total	179	100%	253	100%

Entity	To MLR & DeCola Ponds A-D		Entire Watershed to DeCola Ponds E-F	
	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)
Crystal	46	26%	46	18%
New Hope	64	36%	64	25%
Golden Valley	61	34%	135	53%
Hennepin County	8	5%	8	3%
Total	179	100%	253	100%

Table 6. Cost Share Based on Runoff Volumes Above Pre-settlement Conditions

A. Incremental Summary

Entity	To MLR & DeCola Ponds A-D				To DeCola Ponds E-F			
	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Native Conditions 100-Yr Runoff Volume (ac-ft)	Increase in 100-Yr Runoff Volume from Pre-settlement Conditions (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Native Conditions 100-Yr Runoff Volume (ac-ft)	Increase in 100-Yr Runoff Volume from Pre-settlement Conditions (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)
Crystal	47	27	21	30%	0	0	0	0%
New Hope	68	39	29	41%	0	0	0	0%
Golden Valley	64	44	20	29%	74	47	27	100%
Total	179	109	70	100%	74	47	27	100%

Entity	To MLR & DeCola Ponds A-D				To DeCola Ponds E-F			
	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Native Conditions 100-Yr Runoff Volume (ac-ft)	Increase in 100-Yr Runoff Volume from Pre-settlement Conditions (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Native Conditions 100-Yr Runoff Volume (ac-ft)	Increase in 100-Yr Runoff Volume from Native Conditions (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)
Crystal	46	26	20	29%	0	0	0	0%
New Hope	64	37	28	39%	0	0	0	0%
Golden Valley	61	41	20	28%	74	47	27	100%
Hennepin County	8	5	3	4%	0	0	0	0%
Total	179	109	70	100%	74	47	27	100%

Table 6. Cost Share Based on Runoff Volumes Above Pre-settlement Conditions

B. Cumulative Summary

Entity	To MLR & DeCola Ponds A-D				Entire Watershed to DeCola Ponds E-F			
	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Native Conditions 100-Yr Runoff Volume (ac-ft)	Increase in 100-Yr Runoff Volume from Pre-settlement Conditions (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Native Conditions 100-Yr Runoff Volume (ac-ft)	Increase in 100-Yr Runoff Volume from Native Conditions (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)
Crystal	47	27	21	30%	47	27	21	22%
New Hope	68	39	29	41%	68	39	29	30%
Golden Valley	64	44	20	29%	138	91	47	49%
Total	179	109	70	100%	253	156	97	100%

Entity	To MLR & DeCola Ponds A-D				Entire Watershed to DeCola Ponds E-F			
	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Native Conditions 100-Yr Runoff Volume (ac-ft)	Increase in 100-Yr Runoff Volume from Pre-settlement Conditions (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)	Existing Conditions 100-Yr Runoff Volume (ac-ft)	Native Conditions 100-Yr Runoff Volume (ac-ft)	Increase in 100-Yr Runoff Volume from Native Conditions (ac-ft)	Existing Conditions 100-Yr Runoff Volume (%)
Crystal	46	26	20	29%	46	26	20	21%
New Hope	64	37	28	39%	64	37	28	28%
Golden Valley	61	41	20	28%	135	89	46	48%
Hennepin County	8	5	3	4%	8	5	3	3%
Total	179	109	70	100%	253	156	97	100%

Table 7. Forms of Implementation Commission: Advantages and Disadvantages

A. New Joint Implementation Commission		
Features	**Advantages**	**Disadvantages**
Could be similar in structure and function as the existing Joint Water Commission, e.g.,: • Three voting members, one each from Crystal, Golden Valley and New Hope • Members appointed by their respective city councils through a resolution	Because it's similar to the existing JWC, there is a level of familiarity with how the new commission would work. New commission with a sole charge of implementing the MLRWA Long-Term Flood Mitigation Plan.	Need to form a new commission with a new joint powers agreement. New joint powers agreement requires signatures of all three member cities.
B. Part of Existing Joint Water Commission		
Features	**Advantages**	**Disadvantages**
Same structure and function as the Joint Water Commission: • Three voting members, one each from Crystal, Golden Valley and New Hope • Members appointed by their respective city councils through a resolution The JWC actions require a 2/3 vote, except for actions such as capital improvements, which require a unanimous vote.	Each city is familiar with how the JWC functions. Would require amendment to existing joint powers agreement, but may only require minor changes. Can purchase, hold and sell property.	Flood reduction/mitigation is different than drinking water – easier for the city councils and the public to envision the benefits of paying for drinking water projects than flood reduction/mitigation projects Would require amendment to existing joint powers agreement, which may require major changes. Amended joint powers agreement requires signatures of all three member cities. If not signed by all three member cities, would threaten existence of the JWC.
C. Part of Existing Bassett Creek Watershed Management Commission		
Features	**Advantages**	**Disadvantages**
Likely a three-member subcommittee of the nine-member BCWMC. The three members would likely be the sitting commissioners from the cities of Crystal, Golden Valley and New Hope (or their alternate commissioners, should the commissioner be absent). The subcommittee would likely make	Each city and the state agencies are familiar with how the BCWMC works. Would require amendment to existing joint powers agreement, but may only require minor changes.	Would require amendment to existing joint powers agreement, which may require major changes. Amended joint powers agreement requires signatures of all nine member cities. If not signed by all member cities, would threaten existence of the BCWMC. Would require major amendment to

Table 7. Forms of Implementation Commission: Advantages and Disadvantages

recommendations to the full BCWMC, which would have the ultimate decision authority.		the BCWMC Plan to allow for this new structure and potential new funding mechanisms. The BCWMC's obtains its CIP funding through an ad valorem tax request to Hennepin County, which must be approved by the county board. The BCWMC cannot purchase, hold, and sell property. The BCWMC cannot levy for maintenance of capital projects, unless special legislation approved by the state legislature.

Appendix C

Medicine Lake Road and Winnetka Avenue Long-Term Flood Mitigation Plan – Summary of Alternative 2.5

February 16, 2016

Memorandum

To: Jeff Oliver, Bob Paschke, and Mark Ray
From: Karen Chandler, P.E. and Jennifer Koehler, P.E.
Subject: Medicine Lake Road and Winnetka Avenue Long-Term Flood Mitigation Plan – Summary of Alternative 2.5
Date: February 16, 2016
Project: 23/27-1358
c: Tim Cruikshank, Kirk McDonald, and Anne Norris

1.0 Background

At the April 30, 2015 meeting of the city staff of the Cities Golden Valley, New Hope, and Crystal, Barr presented the potential cost-share methodologies and financial implementation strategies for the Medicine Lake Road and Winnetka Avenue Long-Term Flood Mitigation Plan. At the outcome of this meeting, the various city staff requested the following additional work:

- Evaluation of Alternative 2.5 (the most likely scenario which includes a combination of flood mitigation projects along with voluntary acquisition and flood proofing). Alternative 2.5 is a combination of Alternatives 2 and 3 which were presented to the Cities of Golden Valley, New Hope, and Crystal on January 23, 2015. At that time, the Cities agreed that the most likely alternative was some combination of Alternatives 2 & 3. The flood mitigation projects would be evaluated in a stepwise fashion to provide an understanding of the number of potential voluntary acquisitions or flood proofing required as different projects are implemented. Additionally, all acquisition costs would be revised to no longer include relocation costs as the Cities see these acquisitions as voluntary.
- Development of three additional cost-share scenarios as outlined by City staff at the April 30, 2015 meeting and application to one project example in each City.
- Development of a memo summarizing the additional analyses above and presentation to the city staff of the Cities of Golden Valley, New Hope, and Crystal.

Ultimately, the goal of this flood mitigation planning effort is to protect public safety and reduce flood risk while minimizing the number of voluntary property acquisitions. The Cities recognize that in the case of this flood area, the voluntary property acquisitions will primarily impact single family residential properties and the neighborhood, and will also reduce the tax base,

2.0 Alternative 2.5 Summary

Barr utilized the existing XP-SWMM model to evaluate Alternative 2.5 for the Atlas 14, 100-year design storm event. The modeling of the various components of Alternative 2.5 was performed in the order below, with each component building on the previous:

1) Component 1: Proposed storage as part of the Liberty Crossing development, including conveyance along Rhode Island (based on most current conceptual design), the expansion of storage in Pennsylvania Woods and DeCola Ponds B & C, and raising the natural overflow from DeCola Pond C to D
2) Component 2: Development of flood storage at Rosalyn Court and the development of additional storage in Yunker Park
3) Component 3: Diversion of flows away from DeCola Pond F, including development of storage in the area around Isaacson Park (assuming development of additional storage on the south end of the park and utilization of an entire industrial parcel for both water quality improvement and flood mitigation), and development of storage around the School of Engineering and Arts (SEA) school.
4) Component 4: Additional storage as needed to best achieve the goal of 18 inches (or less) of standing water at the low point on Medicine Lake Road

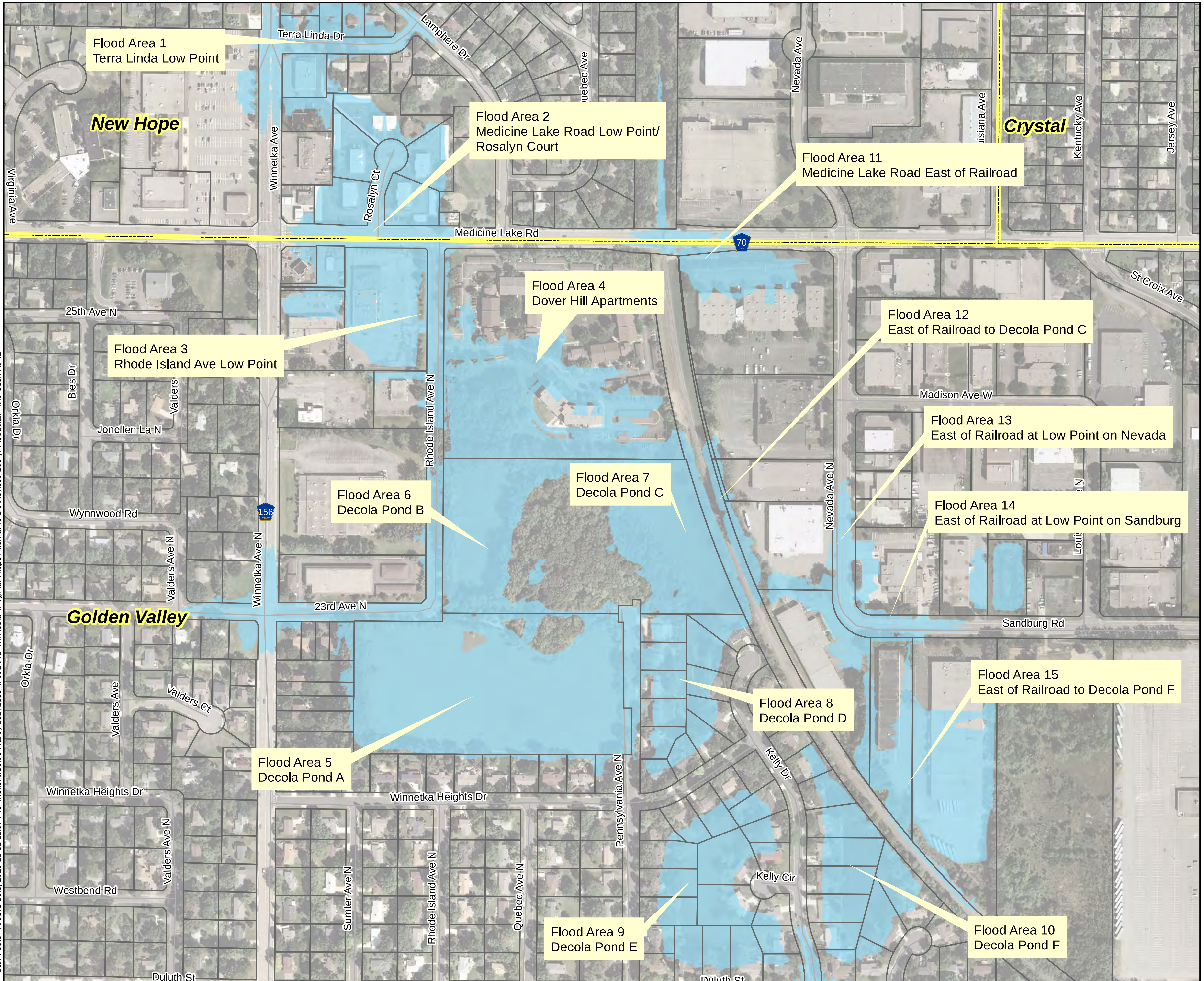
The order of the components outlined above was based on first reducing flooding around Medicine Lake Road, followed by implementation of the projects that will help reduce flooding on DeCola Ponds D, E, and F at the downstream end of the system. Portions of Component 1 are already being pursued with redevelopment in the watershed. However, the actual sequencing of the other flood mitigation projects is flexible and will be based on opportunities within the watershed and availability of funding.

In addition to evaluating the impact of the various flood mitigation components on the peak flood elevations for the 100-year event, the costs were summarized for each component or phase of implementation. The results of the analysis of Alternative 2.5 are discussed in more detail in the following sections.

2.1 Impact on Flood Elevations and At-Risk Properties

For each phase of implementation, we used the XP-SWMM model to evaluate the impact of flood mitigation projects on the Atlas 14 100-year design storm peak flood elevation at key locations within the project area (See Figure 1), and the resulting impact on the estimated number of properties identified for voluntary acquisition or flood proofing. For this study, Barr identified at-risk structures with greater than 3 feet of flooding above the low opening for acquisition while at-risk structures with less than 3 feet of flooding above the low opening were identified for flood proofing. Additionally, for each component, total project costs were developed (including the flood mitigation project costs and the remaining voluntary property acquisition and flood proofing costs after implementation of the project).

Figure 2 shows the location of the flood mitigation projects included as part of Alternative 2.5, with projects color-coded by each component.



Streets

Parcels

Municipality

100-Year Flood Inundation Area**

** Based on XP-SWMM modeling utilizing the Atlas 14 precipitation depths and nested storm distribution

N

Feet

330 165 0 330

BARR

Figure 1

KEY FLOOD AREAS
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

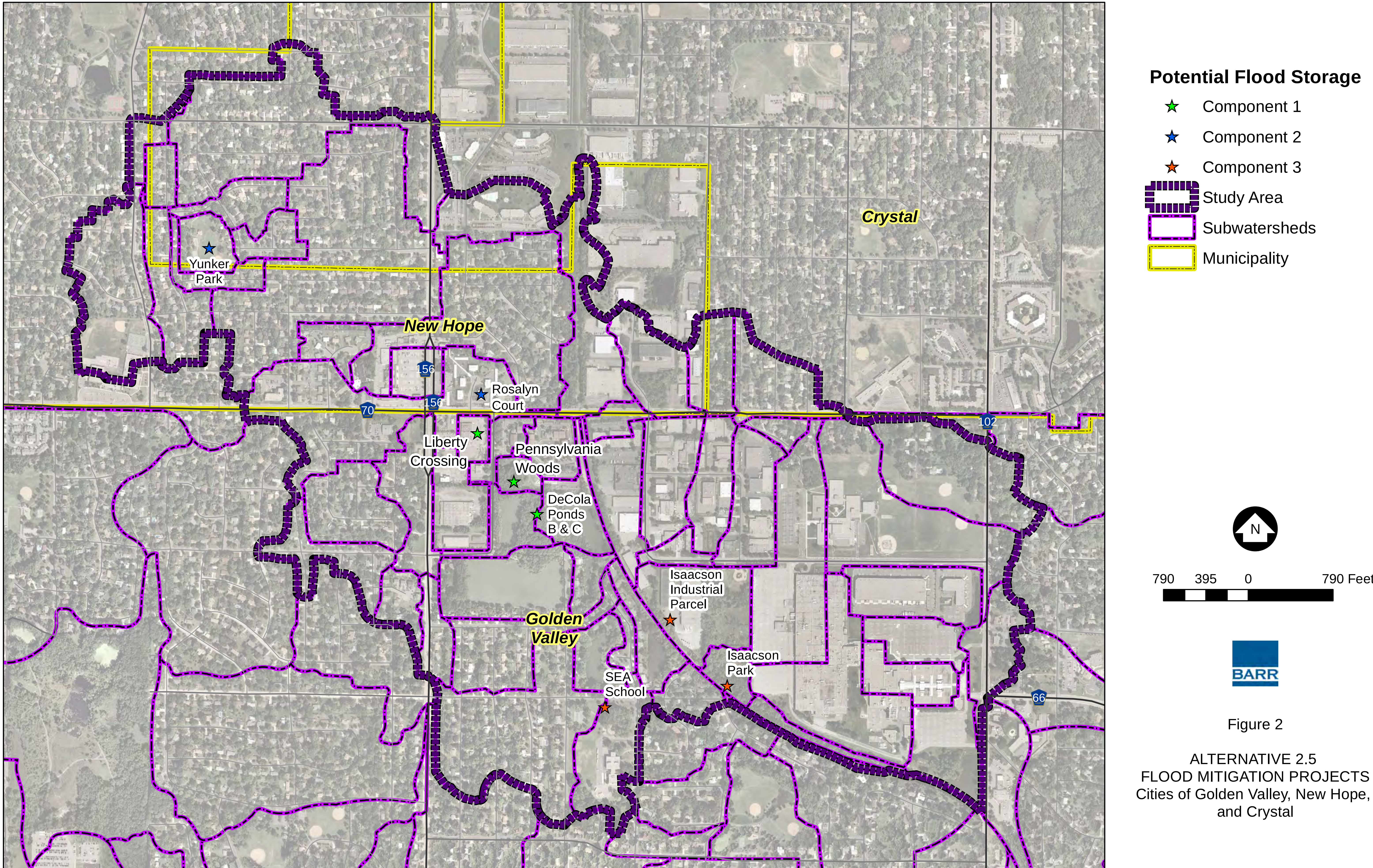


Figure 2

ALTERNATIVE 2.5
FLOOD MITIGATION PROJECTS
Cities of Golden Valley, New Hope, and Crystal

Table 1 summarizes the existing conditions peak flood elevations for the Atlas 14 100-year design event at key locations in the watershed as well as the expected peak flood elevation upon implementation of each component.

Table 1 Key Flood Areas and 100-year Flood Elevation Summary for Alternative 2.5

Flood Area	Flood Area Description	Existing Conditions	Alternative 2.5 Component 1[1]	Alternative 2.5 Component 2[1]	Alternative 2.5 Component 3[1]
1	Terra Linda Low Point	905.6	905.5	905.5	905.5
2	Medicine Lake Road Low Point/Rosalyn Court	905.1	902.0	901.8	901.8
3	Rhode Island Ave Low Point	904.1	902.0	901.8	901.8
4	Dover Hill Apartments	902.6	902.0	901.8	901.8
5	DeCola Pond A	902.6	901.9	901.8	901.8
6	DeCola Pond B	902.6	902.0	901.8	901.8
7	DeCola Pond C	902.6	902.0	901.8	901.8
8	DeCola Pond D	902.7	901.8	900.0	899.2
9	DeCola Pond E	896.2	895.8	895.8	894.0
10	DeCola Pond F	895.9	895.8	895.8	893.7
11	Medicine Lake Road East of Railroad	912.2	912.2	912.2	912.2
12	East of Railroad to DeCola Pond C	902.7	902.4	902.2	902.2
13	East of Railroad at Low Point on Nevada	903.0	903.0	903.0	903.0
14	East of Railroad at Low Point on Sandburg	902.3	902.3	902.3	902.3
15	East of Railroad to DeCola Pond F	901.4	901.4	901.4	900.0
16	Honeywell Pond	884.2	884.2	884.2	884.2

Component 1: Proposed storage as part of Liberty Crossing, Pennsylvania Woods, and DeCola Ponds B and C expansion

Component 2: Proposed storage as part of Rosalyn Court and Yunker Park (in addition to Component 1)

Component 3: Proposed storage as a part of the SEA School and Isaacson Park/Industrial Parcel with full parcel grading (in addition to Components 1 & 2)

Table 2 summarizes the number of at-risk properties that remain after the implementation of each component.

Table 2 Alternative 2.5 Impact on At-Risk[1] Structures

	Existing Conditions	Alternative 2.5 Component 1[2]	Alternative 2.5 Component 2[2]	Alternative 2.5 Component 3[2]
At Risk, no Mitigation	39	0	0	0
Proposed (Voluntary) Acquisition	0	17	10	2
Voluntary Acquisition (for Construction of a Flood Mitigation Project)		0	1	2
Flood Proofing	0	16	22	23
No Flood Risk	4	10	10	16
Within 1' of 100-Year	2	1	2	7
>1' of 100-Year	2	9	8	9
Total Number of Properties	43	43	43	43

[1] At-Risk structures defined as those with low openings below the estimated 100-Year flood elevation

[2] Component 1: Proposed storage as part of Liberty Crossing, Pennsylvania Woods, and DeCola Ponds B and C expansion

Component 2: Proposed storage as part of Rosalyn Court and Yunker Park (in addition to Component 1)
Component 3: Proposed storage as a part of the SEA School and Isaacson Park/Industrial Parcel with full parcel grading (in addition to Components 1 & 2)

Under existing conditions, there is approximately 5 feet of standing water at the low point on Medicine Lake Road and there are 39 structures identified as being at-risk of flooding (the estimated 100-year peak flood elevation is above the surveyed low opening). Based on the stepwise evaluation of the Alternative 2.5 components, the following is a summary of the general conclusions:

- Implementation of components 1 and 2 of Alternative 2.5 will reduce flooding around the low point on Medicine Lake Road and reduce flooding on DeCola Pond D; however, with both components, there is only a small reduction of the peak flood elevations at DeCola Ponds E & F (See Table 1). Implementation of components 1 and component 2 will result in the reduction of at-risk structures by 6, primarily around Medicine Lake Road and DeCola Pond D.
- Implementation of components 1, 2, and 3 from Alternative 2.5 will achieve approximately 18 inches of standing water at the low point in Medicine Lake Road which will improve public safety and allow for emergency vehicles to travel through this area during the 100-year flood event.

However, implementation of component 2 only reduces the number of at-risk structures by 6 while component 3 significantly reduces flooding at DeCola Ponds E and F and reduces the number of at-risk structures by 12. Additionally, for component 2, 11 structures were identified for potential voluntary acquisition (1 for project construction) and 22 for floodproofing while for component 3, the numbers for voluntary acquisition and floodproofing are 4 (2 for project construction) and 23, respectively (See Table 2).

- Because components 1, 2, and 3 achieve the goal of approximately 18 inches of standing water at the low point of Medicine Lake Road, a 4th component was not evaluated.

2.2 Estimated Project Costs

Planning level costs were developed for each component of Alternative 2.5, including the flood mitigation project costs and the associated voluntary acquisition/demolition and flood proofing costs.

Planning level cost estimates were developed for the various flood mitigation projects based on the conceptual design of each project. However, there is cost uncertainty and risk associated with this concept level of design cost estimate. The costs reported for flood mitigation projects are point estimates and include contingencies (25 percent), engineering and design (30 percent), construction management (10%), and estimated land acquisition/easement costs (if applicable). The costs do not include any wetland mitigation costs and assumes that the excavated soils are not contaminated. The range of probable costs presented reflects the level of uncertainty, unknowns, and risk due to the concept nature of the individual project designs. We have utilized industry resources for cost estimating (ASTM E 2516-11 Standard Classification for Cost Estimate Classification System) to provide guidance on cost uncertainty. Based on the current level of design, the cost range varies by +40 percent to -20 percent from the planning level cost estimate.

To estimate the cost of voluntary acquisition of at-risk properties, acquisition costs were evaluated along with an estimate of property removal/demolition costs. Although relocation costs were originally estimated for each at-risk property, these costs were removed from the total acquisition costs based on feedback from City staff at the April 30, 2015 meeting, as it was assumed that any acquisitions would be voluntary. The voluntary acquisition and removal costs for single-family residential properties were determined using the current Hennepin County taxable market values (from 2014 Hennepin County parcel data) and multiplying by a factor of 1.5. This factor was provided by the City of Golden Valley based on recent property acquisition and demolition costs. Dan Wilson, a real estate appraiser subconsultant, estimated the voluntary acquisition costs for the at-risk multi-family residential, commercial, and industrial properties. These estimates were based on in-person interviews, use of the current Hennepin County taxable market value, and other sources to establish market values. Removal costs were assumed to be 20 percent of the acquisition costs, based on the guidance provided by the City of Golden Valley.

Planning level floodproofing costs were based on previous floodproofing projects and the estimated depth of flooding above the low opening of the structure.

To account for potential increases in market values for voluntary acquisition and uncertainty in the planning level flood proofing costs, the estimates were also buffered by the +40 percent to -20 percent as was applied to the flood mitigation project costs.

Tables 3, 4, and 5 below summarize the estimated costs and the planning level cost estimate range for each component of Alternative 2.5, which includes the most critical flood mitigation projects needed to help improve the flooding around the low point on Medicine Lake Road and DeCola Ponds E & F.

Table 3 Alternative 2.5 Component 1 (Liberty Crossing & Expansion of Pennsylvania Woods and DeCola Ponds B & C) Planning Level Cost Estimates

Component	Project	-20%	Opinion of Probable Cost	+40%
1	Liberty Crossing Flood Mitigation Project	$ 3,750,000	$ 4,690,000	$ 6,570,000
	DeCola Ponds B & C Expansion & Pennsylvania Woods Flood Mitigation Projects	$ 3,660,000	$ 4,570,000	$ 6,400,000
	Component 1 Subtotal	***$ 7,410,000***	***$ 9,260,000***	***$ 12,970,000***
	Voluntary Acquisition and Demolition of At-Risk Structures[1]	$ 7,090,000	$ 8,860,000	$ 12,400,000
	Floodproofing of At-Risk Structures[1]	$ 760,000	$ 940,000	$ 1,320,000
	Total Project Cost	***$ 15,260,000***	***$ 19,060,000***	***$ 26,690,000***

1 – Voluntary acquisition and floodproofing costs at each component varies based on the implementation of flood mitigation projects and the associated reduction in flood elevations; as more flood mitigation projects are implemented (and flood elevations are reduced), the expected cost of voluntary acquisitions and floodproofing will decrease from the previous component.

Table 4 Alternative 2.5 Component 2 (Component 1, Rosalyn Court, and Yunker Park Projects) Planning Level Cost Estimates

Component	Project	-20%	Opinion of Probable Cost	+40%
1	Liberty Crossing Flood Mitigation Project	$ 3,750,000	$ 4,690,000	$ 6,570,000
	DeCola Ponds B & C Expansion & Pennsylvania Woods Flood Mitigation Projects	$ 3,660,000	$ 4,570,000	$ 6,400,000
	Component 1 Subtotal	***$ 7,410,000***	***$ 9,260,000***	***$ 12,970,000***
2	Rosalyn Court Flood Mitigation Project	$ 1,790,000	$ 2,240,000	$ 3,130,000
	Yunker Park Flood Mitigation Project	$ 860,000	$ 1,080,000	$ 1,510,000
	Component 2 Subtotal	***$ 2,650,000***	***$ 3,320,000***	***$ 4,640,000***
	Voluntary Acquisition and Demolition of At-Risk Structures[1]	$ 4,380,000	$ 5,480,000	$ 7,670,000
	Floodproofing of At-Risk Structures[1]	$ 920,000	$ 1,160,000	$ 1,620,000
	Total Project Cost	***$ 15,360,000***	***$ 19,220,000***	***$ 26,900,000***

1 – Voluntary acquisition and floodproofing costs at each component varies based on the implementation of flood mitigation projects and the associated reduction in flood elevations; as more flood mitigation projects are implemented (and flood elevations are reduced), the expected cost of voluntary acquisitions and floodproofing will decrease from the previous component.

Table 5 Alternative 2.5 Component 3 (Component 2, Isaacson/Industrial, & SEA School Projects) Planning Level Cost Estimates

Component	Project	-20%	Opinion of Probable Cost	+40%
1	Liberty Crossing Flood Mitigation Project	$ 3,750,000	$ 4,690,000	$ 6,570,000
	DeCola Ponds B & C Expansion & Pennsylvania Woods Flood Mitigation Projects	$ 3,660,000	$ 4,570,000	$ 6,400,000
	Component 1 Subtotal	***$ 7,410,000***	***$ 9,260,000***	***$ 12,970,000***
2	Rosalyn Court Flood Mitigation Project	$ 1,790,000	$ 2,240,000	$ 3,130,000
	Yunker Park Flood Mitigation Project	$ 860,000	$ 1,080,000	$ 1,510,000
	Component 2 Subtotal	***$ 2,650,000***	***$ 3,320,000***	***$ 4,640,000***
3	Isaacson Park/Industrial Parcel Flood Mitigation Project	$ 4,580,000	$ 5,730,000	$ 8,020,000
	SEA School Flood Mitigation Project	$ 1,700,000	$ 2,130,000	$ 2,980,000
	Component 3 Subtotal	***$ 6,280,000***	***$ 7,860,000***	***$ 11,000,000***
	Voluntary Acquisition and Demolition of At-Risk Structures[1]	$ 820,000	$ 1,020,000	$ 1,430,000
	Floodproofing of At-Risk Structures[1]	$ 720,000	$ 900,000	$ 1,270,000
	Total Project Cost	***$ 17,880,000***	***$ 22,360,000***	***$ 31,310,000***

1 – Voluntary acquisition and floodproofing costs at each component varies based on the implementation of flood mitigation projects and the associated reduction in flood elevations; as more flood mitigation projects are implemented (and flood elevations are reduced), the expected cost of voluntary acquisitions and floodproofing will decrease from the previous component.

3.0 Project Cost Allocation

At the April 30th meeting, the Cities also requested additional cost-share alternatives to allocate project costs. These alternatives included the following:

1) 100% of costs will be shared amongst the Cities and Hennepin County according to 50% watershed area/50% tax capacity for the Cities and the percent of the watershed area for Hennepin County, applied to the entire watershed to DeCola Pond F.
2) A large percentage (e.g. 80%) of the costs will be shared amongst the Cities and Hennepin County according to 50% watershed area/50% tax capacity for the Cities and the percent of the watershed area for Hennepin County applied to the entire watershed to DeCola Pond F. The remaining percentage (e.g. 20%) of costs will be applied using the beneficiaries pay more approach. In this scenario, the beneficiaries would be all property owners in the entire DeCola Ponds watershed (area upstream of DeCola Pond F), shown in Figure 3. The Cities would need to create an overlay or taxing district for this area.
3) A large percentage (e.g. 80%) of the costs will be shared amongst the Cities and Hennepin County according to 50% watershed area/50% tax capacity for the Cities and the percent of the watershed area for Hennepin County, applied to the entire watershed to DeCola Pond F. The remaining percentage (e.g. 20%) of costs will be applied using the beneficiaries pay more approach. In this scenario, the fraction of the project that would be paid by the beneficiaries would be equally split between all properties in the entire DeCola Pond F watershed and the direct beneficiaries (i.e., the owners of at-risk properties in flood inundation areas, see Figure 4).

A fourth cost allocation method was developed during preliminary discussions of the results of Alternative 2.5 with City of Golden Valley staff on January 4, 2016 and was discussed with the three City managers at a meeting on January 6, 2016. This cost allocation method builds off of the idea of Alternative 3 above; however this strategy focuses on pursuing funding sources outside of the Cities' general funds and stormwater utilities. These outside sources of funding could include (but are not limited to), state funds, grant funds, funding through the Bassett Creek Watershed Management Commission (BCWMC), etc. For this cost allocation method to be successful, the group responsible for the implementation of the flood mitigation plan will need to make it a policy or an objective in the final plan to pursue additional funding sources. This resulted in the following additional cost allocation alternative:

4) A large percentage (e.g. 80%) of the costs will be paid for through funding secured from outside sources (50%) and shared amongst the Cities and Hennepin County (30%) according to 50% watershed area/50% tax capacity for the Cities and the percentage of the watershed area for Hennepin County applied to the entire watershed to DeCola Pond F. The remaining percentage (e.g. 20%) of costs will be applied using the beneficiaries pay more approach. In this scenario, the

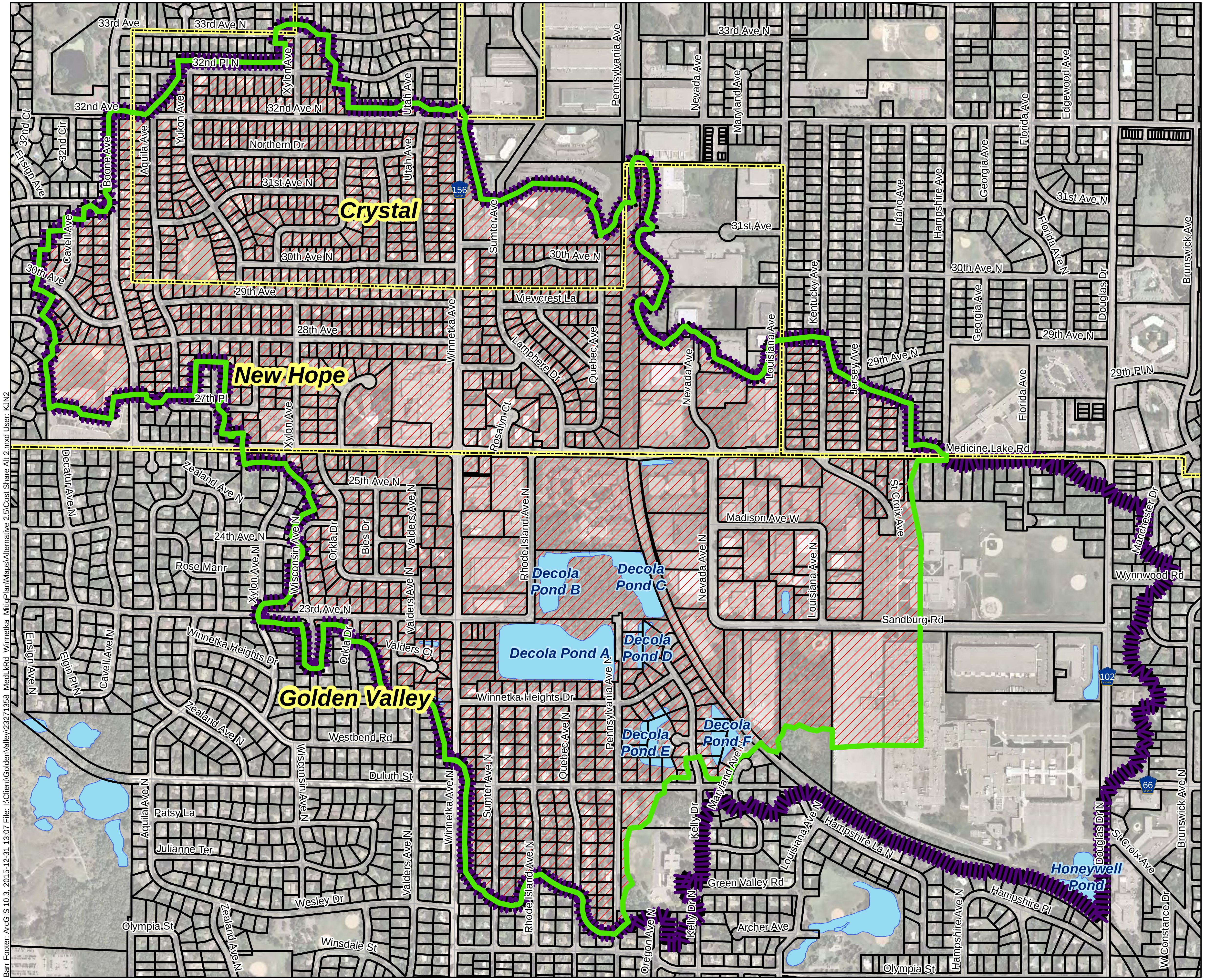
fraction of the project that would be paid by the beneficiaries would be equally split between all properties in the entire DeCola Pond F watershed and the direct beneficiaries (i.e., those property owners of at-risk properties flood inundation areas, see Figure 4).

Table 6 summarizes the breakdown of the four cost-share alternatives as a percentage that would be applied to specific projects. To help understand the difference in how the various cost-share methods translate to actual costs, the cost-share alternatives were applied to the overall estimated planning level project cost for Alternative 2.5, and to an individual flood mitigation project in each city. These costs are summarized in Table 7.

For cost-share alternatives 2 through 4, which include the beneficiaries paying more approach, some of the cost would be allocated to property owners within the entire DeCola Pond F watershed and would potentially be applied as a special assessment on the property. To understand the average annual impact on each individual property, we needed to estimate the recovery period of these assessments. Based on response from City staff, the following are the typical recovery periods for special assessments:

- The City of Golden Valley special assessments recovery period is typically 10 years.
- The City of Crystal special assessment recovery period is 10 or 15 years, depending on the project.
- For the City of New Hope, the recovery period is typically 10 years; however this is only for tax exempt properties. All other properties within New Hope do not receive special assessments.

For the cost-share alternatives outlined above and for the beneficiaries pay more approach, the estimated recovery period for the special assessments is assumed to be 10 years. We have also assumed that the cost allocated to each property within the DeCola Ponds watershed is equal, regardless of property type or value. If the cities would decide to pursue one of the beneficiaries pay more alternatives, they may want to consider a cost allocation method that considers property type or valuation.



Parcels Tributary to DeCola Pond F

Parcels

Municipality

DeCola Pond F Watershed

Study Area

Ponds and Wetlands

Streets

N

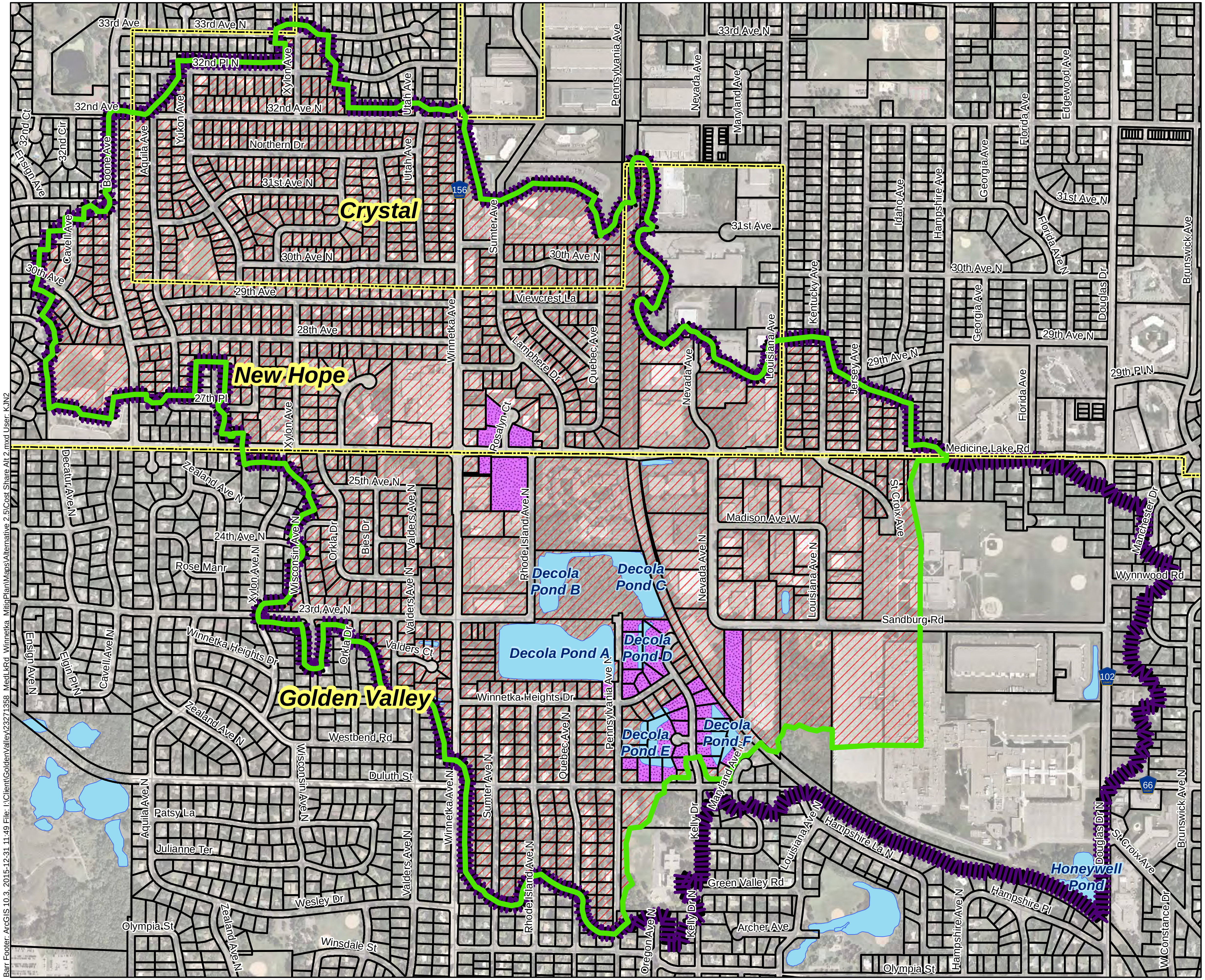
750 375 0 750

Feet

BARR

Figure 3

COST-SHARE ALTERNATIVE 2
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal



Parcels Tributary to DeCola Pond F

- At-Risk Property
- Watershed Property (Not At-Risk)
- Parcels
- Municipality
- DeCola Pond F Watershed
- Study Area
- Ponds and Wetlands
- Streets

N

750 375 0 750 Feet

BARR

Figure 4

COST-SHARE ALTERNATIVES 3 & 4
Medicine Lake Road and Winnetka Avenue
Flood Mitigation Plan
Cities of Golden Valley, New Hope, and Crystal

Table 6 Alternative 2.5 Cost-Share Alternatives as a Percentage

Cost Share Alternative[1]	Outside Funding Sources	Cities			Hennepin County	Beneficiaries					
						Watershed Properties[2]			At-Risk Properties		
		Crystal	New Hope	Golden Valley		Total	Per Property	Per Property/Per Year[3]	Total	Per Property	Per Property/Per Year[3]
1	0%	21%	28%	48%	3%	0%	0%	0%	0%	0%	0%
2	0%	17%	22%	39%	2%	20%	0.015%	0.0015%	0%	0%	0%
3	0%	17%	22%	39%	2%	10%	0.008%	0.0008%	10%	0.12%	0.012%
4	50%	6%	8%	14%	1%	10%	0.008%	0.0008%	10%	0.12%	0.012%

[1] Cost-Share Alternative 1: 50% Tax Capacity/50% Watershed Area for Cities and % of Watershed Area for Hennepin County

Cost-Share Alternative 2: 80% to Cities & County based on 50% Tax Capacity/50% Watershed Area (for Cities) and % of watershed area (for County), 20% to Beneficiaries (all properties in DeCola Pond F watershed)

Cost-Share Alternative 3: 80% to Cities & County based on 50% Tax Capacity/50% Watershed Area (for Cities) and % of watershed area (for County), 20% to Beneficiaries (10% to At-Risk Properties, 10% to Non-At-Risk Properties)

Cost-Share Alternative 4: 50% from Outside Funding Sources, 30% to Cities & County based on 50% Tax Capacity/50% Watershed Area (for Cities) and % of watershed area (for County), 20% to Beneficiaries (10% to At-Risk Properties, 10% to Non-At-Risk Properties)

[2] Reflects all properties in DeCola Pond F Watershed; For Cost-Share Alternative 3, this does not include the At-Risk properties

[3] Assumes special assessment recovery period of 10-Years, equally applied to all properties regardless of property type or value

Table 7 Alternative 2.5 Cost-Share Alternatives Applied to Flood Mitigation Projects

Project	Cost Share Alternative	Opinion of Probable Cost	Outside Funding Sources	Cities			Hennepin County	Beneficiaries					
				Crystal	New Hope	Golden Valley		Watershed Properties[1]			At-Risk Properties		
								Total	Per Property	Per Property/Per Year[2]	Total	Per Property	Per Property/Per Year[2]
Alternative 2.5 (All Projects)	1	$22,360,000	$0	$4,750,000	$6,180,000	$10,760,000	$670,000	$0	$0	$0	$0	$0	$0
	2	$22,360,000	$0	$3,800,000	$4,940,000	$8,610,000	$540,000	$4,470,000	$3,400	$300	$0	$0	$0
	3	$22,360,000	$0	$3,800,000	$4,940,000	$8,610,000	$540,000	$2,240,000	$1,800	$200	$2,240,000	$26,900	$2,700
	4	$22,360,000	$11,180,000	$1,420,000	$1,850,000	$3,230,000	$200,000	$2,240,000	$1,800	$200	$2,240,000	$26,900	$2,700
Yunker Park Project	1	$1,080,000	$0	$230,000	$300,000	$520,000	$30,000	$0	$0	$0	$0	$0	$0
	2	$1,080,000	$0	$180,000	$240,000	$420,000	$30,000	$220,000	$200	$0	$0	$0	$0
	3	$1,080,000	$0	$180,000	$240,000	$420,000	$30,000	$110,000	$100	$0	$110,000	$1,300	$100
	4	$1,080,000	$540,000	$70,000	$90,000	$160,000	$10,000	$110,000	$100	$0	$110,000	$1,300	$100
Rosalyn Court Project	1	$2,240,000	$0	$480,000	$620,000	$1,080,000	$70,000	$0	$0	$0	$0	$0	$0
	2	$2,240,000	$0	$380,000	$490,000	$860,000	$50,000	$450,000	$300	$0	$0	$0	$0
	3	$2,240,000	$0	$380,000	$490,000	$860,000	$50,000	$220,000	$200	$0	$220,000	$2,700	$300
	4	$2,240,000	$1,120,000	$140,000	$190,000	$320,000	$20,000	$220,000	$200	$0	$220,000	$2,700	$300
DeCola Ponds B&C Expansion and Pennsylvania Woods Project	1	$4,570,000	$0	$970,000	$1,260,000	$2,200,000	$140,000	$0	$0	$0	$0	$0	$0
	2	$4,570,000	$0	$780,000	$1,010,000	$1,760,000	$110,000	$910,000	$700	$100	$0	$0	$0
	3	$4,570,000	$0	$780,000	$1,010,000	$1,760,000	$110,000	$460,000	$400	$0	$460,000	$5,500	$600
	4	$4,570,000	$2,290,000	$290,000	$380,000	$660,000	$40,000	$460,000	$400	$0	$460,000	$5,500	$600

[1]Reflects all properties in DeCola Pond F Watershed; For Cost-Share Alternatives 3 & 4, this does not include the At-Risk properties

[2]Assumes special assessment recovery period of 10-Years, equally applied to all properties regardless of property type or value