Prior Lake Stormwater Management & Flood Mitigation Study

Prepared for
Prior Lake-Spring Lake Watershed District and the City of Prior Lake

September, 2016

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
952.832.2600
www.barr.com

1.0 Executive Summary

1.1 Introduction

In the spring of 2014, the Prior Lake watershed experienced record amounts of precipitation which led to a historic flooding event. This event triggered many questions and highlighted the need to develop watershed modeling and evaluate flood mitigation strategies for future events. Prior Lake Spring Lake Watershed District (PLSLWD) and the City of Prior Lake, in collaboration with Spring Lake Township, retained Barr to complete this study which includes calibrated modeling of the watershed, review of flood-related issues and projects, identification and evaluation of a suite of potential flood reduction strategies and implementation plan recommendations. The study work also included a public input process that has engaged a broad range of stakeholders including local units of government, lake associations, the agricultural community and private landowners. Their input was used to guide the development and evaluation of the available flood mitigation options described herein.

The study area included the Prior Lake-Spring Lake watershed upstream of the Lower Prior Lake outlet structure, encompassing approximately 19,000 acres (30 square miles) of land in Scott County, Minnesota with agricultural land predominant in the south and western areas and residential land uses surrounding the study lakes.

Lake levels for Upper and Lower Prior Lakes have historically been one of the most important issues for the community, specifically the residents living around the Lakes, since Prior Lake does not have a natural outlet. In 1978 a Flood Insurance Study (FIS) was completed for Prior Lake, which established the regulatory flood zone around Prior Lake and resulted in the calculated 100-year flood elevation of 908.9 feet mean sea level (MSL). After significant study, public process and agency coordination the establishment of the Prior Lake Outlet and Channel (PLOC) was selected as the first flood mitigation effort by the PLSLWD and the outlet system was first used in 1983. In 1987, an operating plan was adopted for outlet control structure which set operating procedures and allowable discharges. The FIS was updated in 1997, but the modeling did not account for the benefit of the outlet structure because the channel capacity downstream of the control structure and legal constraints with the adjoining communities limit the discharge the City of Prior Lake can pass through the control structure (FEMA, 1997). Beginning in 2004, PLSLWD pursued improvements to the outlet structure of the PLOC which included a fixed weir set at an elevation of 902.5 feet MSL and a slide gate to allow manual discharge of water between lake level elevations of 902.0 and 902.5 feet MSL. The current outlet configuration will not allow the outflow rate to exceed 65 cfs.

Even with the lake outlet in operation, the 2014 flood level of 906.2 feet MSL for Prior Lake is significantly higher than any other flood event since 1915 (PLSLWD, 2003). Without the lake outlet, the 2014 flood level would have been more than 6 feet higher. There is a significant incremental increase in the number of homes that are at risk of flooding for each foot above a lake level of 906.5 feet MSL, while there are linear increases in other types of infrastructure at risk with increasing flood levels.

1.2 Study Goals

The goals of this study were as follows:

1. Update the flood model
2. Compile and review historical studies and projects to summarize efforts already accomplished toward flood damage reduction
3. Identify a universe of flood damage reduction strategies
4. Evaluate the cost/benefit of the strategies and define community goals for flood protection
5. Develop an implementation plan that identifies a suite of projects or mechanisms to reduce flood damage potential

1.3 Community Planning Process

This study included a process for gathering input from the community, including advisory groups, study partners, and decision-making bodies that needed to be part of the process (see Section 4). The following describes the results of the community planning process with the meetings listed in chronological order:

1. Public Kick-Off Meeting—February 19, 2015. This open house format meeting was intended to inform the public of the study goals and objectives, receive input on what they experienced during the 2014 flooding and to obtain their ideas for flood mitigation options. The meeting included specific survey questions to provide feedback, which was also made available on the PLSLWD website.
2. First Advisory Group Meeting—May 7, 2015. This meeting was used to present preliminary modeling results and gather feedback on potential flood mitigation options and the draft criteria for a selection matrix.
3. Second Public Meeting—May 28, 2015. Attendees were provided with a study update, including a summary of the watershed modeling and an overview of the matrix. Thirty attendees (with 18 indicating that they live on the lakeshore, eight in the city, and three in rural areas) completed a survey that rated important factors in selecting a potential flood-mitigation project and their feelings about use of public funding for flood mitigation efforts. The survey results indicated the following:
    a. Water quality was most important factor, followed closely by cost/benefit
    b. Half of the respondents thought it was important, and another 36% thought it was very important that options should protect properties and public roads below the 100-year FEMA flood level
    c. Project readiness was the least important factor
    d. 69% supported use of public money to protect individual homes/businesses
    e. 60% supported increasing property taxes to finance the options
    f. City of Prior Lake has obligation to maintain emergency access to properties
    g. General sentiment that public funds should be used to benefit entire community
4. Farmer Listening Session—February 3, 2016. This meeting was held to gain a better understanding of how farmers were impacted during the 2014 flood event and receive feedback

regarding the proposed flood mitigation. The meeting was hosted by the PLSLWD Farmer-led Council.

5. Second Advisory Group Meeting—February 4, 2016. This meeting was held to gather feedback on the up-to-date information from the analysis of flood mitigation scenarios as well as responding to public policy questions that included:
    a. Should public dollars be used to protect public infrastructure (such as sanitary sewer and water utilities)? There was consensus that this should be maintained
    b. To what degree should access (from streets) be provided during flood events? There was not unanimity on this, except that emergency vehicle access should be maintained
    c. To what degree should public dollars be used to protect or assist in the protection of private property? There was general consensus that it was a government's responsibility to provide access to properties through public rights-of-way, however not necessarily protect the property itself. However, there was not specific feedback on the allowable frequency and duration of access disturbances. Some felt that public dollars should not be spent on specific improvements to private property (such as floodproofing or buyouts) but did support strategies such as upper watershed storage. Some felt that less frequent flooding with a longer period between events was okay, but we should consider protecting homes that get flooded on a greater frequency (such as 25 years).
6. Joint Policy Group Meetings—February 8, 2016 and September 26, 2016. The policy makers provided direction on the community goals to be used to complete the study. Those goals and priorities are as follows:
    a. Protection of Public Safety - Maintain emergency vehicle access at all times
    b. Protection of Health and Safety - Protect public utility infrastructure (i.e. sanitary sewer and water distribution.)
    c. Maintain traffic flow through the County Road 21 corridor
    d. Maintain access to private properties

1.4 Monitoring and Modeling

PLSLWD collected lake stage and stream flow data for several sites within the Prior Lake watershed during the 2014 monitoring season which were used for watershed model calibration. More than seven inches of rainfall fell across most of the watershed between June 15th and the 20th, which contributed to the peak discharge rates observed at all five monitoring sites. The peak Spring Lake elevation occurred three days after the peak discharge rates occurred in the upper watershed, while Prior Lake did not reach its peak flood level until 11 days after the peak discharge occurred in the upper portion of the Spring Lake watershed. The County Ditch 13 watershed, which represents 29% of the Prior Lake watershed, contributed more than 53% of the flow volume that discharged from the Prior Lake outlet in 2014. In addition, watershed yield and peak discharge rates (normalized to drainage area) from the County Ditch 13 watershed were more than 30% higher than any of the monitoring stations used in the model calibration.

Barr created a PCSWMM computer model capable of simulating the complexity of watershed runoff from the various types of land surfaces based on the available climate data, land use/land cover characteristics,

soil type, topography and imperviousness, and then subsequently route the runoff through stream and ditch channels as well as storage areas and storm sewer/culverts, including the lake basins based on the physical constraints of the individual outlets and conveyances. Model development and preliminary use included calibration to observed flow rates and lake elevations throughout the watershed for the June-July 2014 flood event and running the model for design events intended to simulate flood levels for the 2, 10, 25, 50, 100 and 500-year return period with Atlas 14 rainfall amounts for the critical duration (30-days) event. The 100-year design event modeling produces higher lake levels (approximately one-foot higher) than the peak levels that were observed in each lake in 2014. However, the predicted flood level for Prior Lake is 1.8 feet lower than the FEMA 100-year elevation of 908.9 feet MSL, as it accounts for the effect of the existing outlet while the FEMA modeling did not. **Analysis of the monitoring and modeling data indicated that enhanced upper watershed storage – particularly in the County Ditch 13 watershed – and better control of peak discharge from the Spring Lake outlet had the highest potential for reducing peak elevations in Prior Lake.** Upper watershed storage is defined as any storage area upstream of Spring Lake and the Prior Lake basins. To have a noticeable effect on the peak Prior Lake elevation, detention storage areas would need to detain water until after Prior Lake had reached its peak.

1.5 Results Summary

Based on feedback from the public a list of flood mitigation options was developed. Each mitigation option was then rated according to its relative merits for criteria that were weighted to correspond with the study objectives and what the public viewed as important factors in selecting potential flood-mitigation options. The results of this analysis showed that improvement options involving upper watershed and Spring Lake storage, sandbagging and modifications to the Prior Lake outlet (including both increased capacity and proactive outlet management) scored highly. The results also indicated that floodproofing and/or buyouts could also be considered as part of the overall solution. As a result of relative comparisons of the merits of the universe of options the flood mitigation analysis was narrowed down to the following seven options:

- Option A—Enhanced Protection (coordinated temporary protection measures)
- Option B—Spring Lake Storage
- Option C—Prior Lake Outlet Modification (increase capacity)
- Option D—Upper Watershed Storage
- Option E—Combine Options B, C & D
- Option F—Floodproofing (for at-risk primary structures)
- Option G—Actively Manage Prior Lake outlet (low-flow gate)

Figure EX-1 shows how each of the potential improvement options are expected to improve the flood impacts for each of the flood frequency events, including summary information pertaining to the total estimated costs and number of primary structures and inaccessible properties at each flood level. **The figure shows that, if the conservative cost estimates for securing Spring Lake drainage easements are accurate, then the Spring Lake storage option will not be as cost effective (from a flood control perspective) as increasing the Prior Lake outlet capacity or increasing upper watershed storage. Options involving an increase to the Prior Lake outlet capacity and increasing upper watershed storage are comparable at cost-effectively controlling flooding on Prior Lake. Upper watershed**

storage provides better flood control for the larger flood events than any of the other individual options. For the 100-year event, the upper watershed storage option would protect an additional 30-35 primary structures and maintain accessibility to an additional 50 properties.

Implementing a combination of the first three options would drop the 100-year flood level to within a half-foot of the OHW for Prior Lake (see **Figure EX-1**), which is likely more protection than would be necessary for this event. However, the predicted 500-year flood level for Option E would still approach the high water level experienced during 2014**. Implementation of some combination of upper watershed storage (Option D), increased Prior Lake outlet capacity (Option C) and actively managing the Prior Lake outlet low-flow gate (Option G)** is expected to meet the study goals in the most cost-effective manner. The biggest limitation of this combination of options is that it may take several years for full implementation. As a result, **it is expected that some combination of Options G and A will need to represent the short-term implementation measures**. **A scaled-down version of Option B, that involves less inundation on Spring Lake and less easement cost, may also represent a more cost-effective and viable short-term implementation measure**. **It is also expected that floodproofing (Option F) and/or buyouts will be a cost-effective measure for the lowest primary structures.**

1.6 Preferred Option and Implementation Plan

********** *To be completed* **********

Based on feedback and direction from the Joint Policymaker Meeting on September 26, 2016, this section will be developed for the final report.

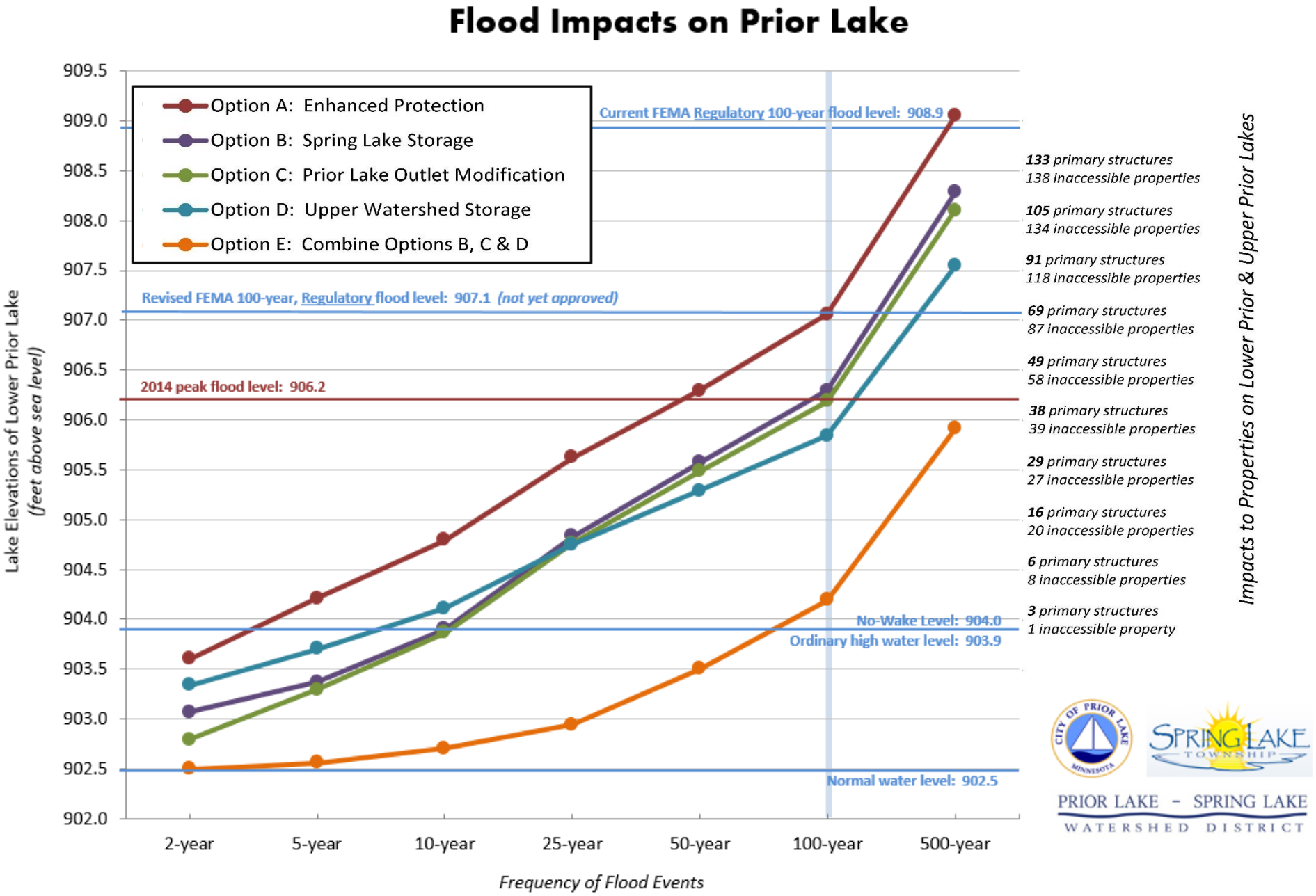

Figure EX-1 Cost/Benefit Summary of Potential Improvement Options