Content and Photos by Todd Streeter, Co-chair, Flood Advisory Commission March 2020 Updated: August 2025

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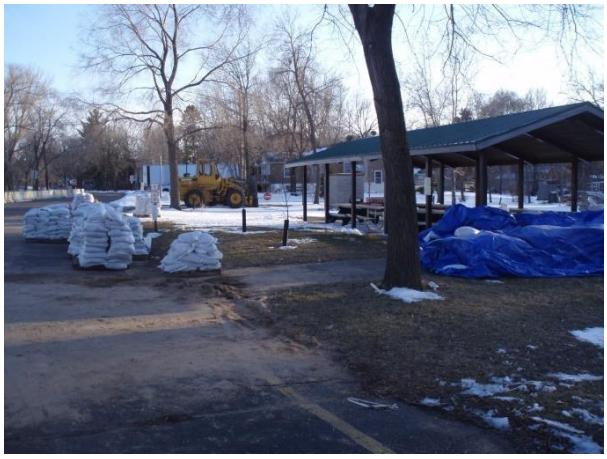

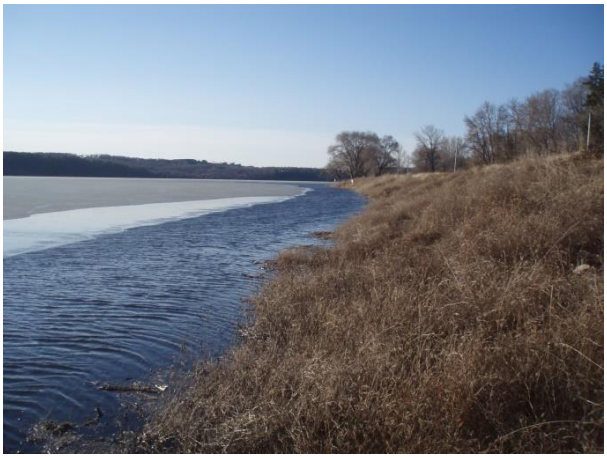

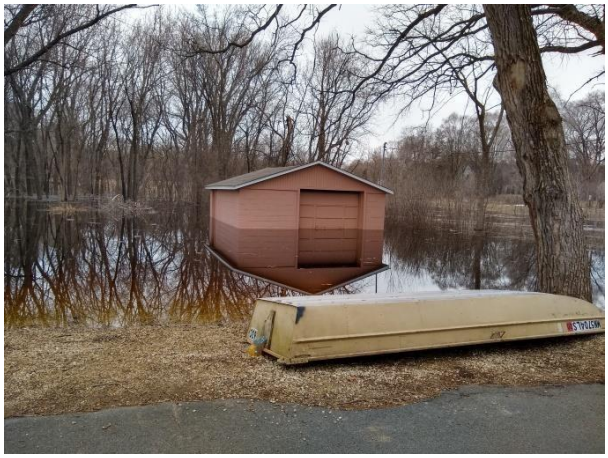

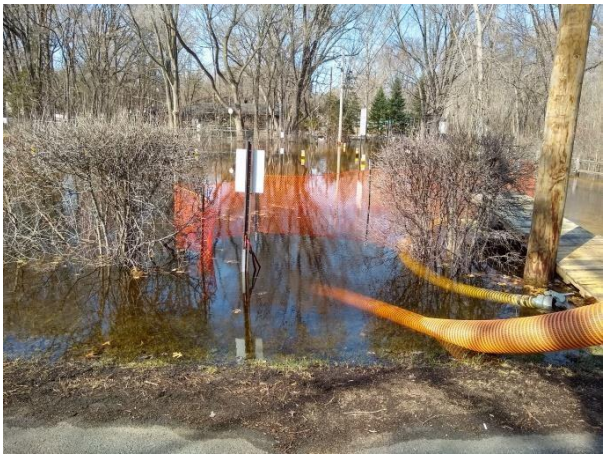

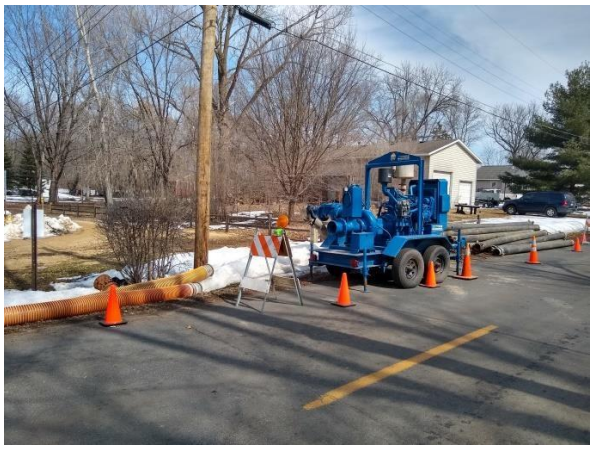

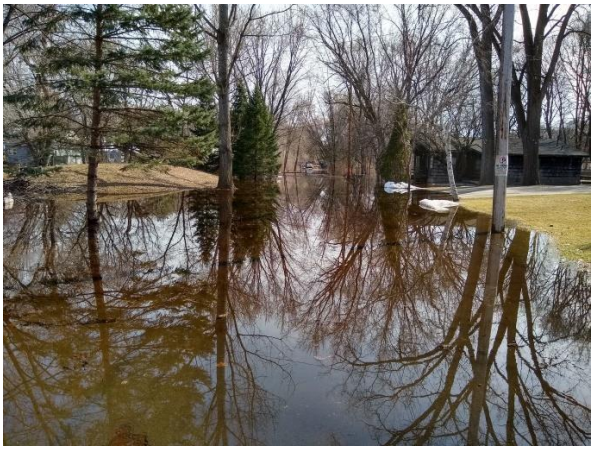

St. Croix River Flooding Characteristics

For as long as the City of Lake St. Croix Beach has enjoyed its mile-long river shoreline along the St. Croix River, it has been prone to potential flooding in the low-lying areas comprising approximately 50 homes contained in the 10, 100 and 500-year designated floodplain zone. Prior to the 1969 flood, worst on record, high water would flow directly into low-laying floodplain area until the high water would eventually recede and ultimately drain downstream. Prior to 1969, the flood impact was directly related to the unimpeded river flow into the floodplain area.

During the flood of 1969, an earthen levee (Levee 1) was constructed under emergency flood protection measures running parallel to the river along Riviera Ave. S. This levee was constructed by the Corp of Engineers and has been maintained under the continued Corp of Engineers compliance program to ensure the Levee is in proper condition to withstand future floods. Approximately at the same time, another smaller levee was constructed to fill a span of low-laying grade on 20th Street along the City of St. Mary's Point's border and approximately one block west of the main river. This second levee was constructed to impeded high river water flowing directly into the floodplain area from flood water entering from St. Mary's Point. This earthen levee (Levee 2) is also continually maintained under the same Corp of Engineers levee compliance program.

The construction of Levees 1 & 2 has eliminated direct free-flowing high water from the St. Croix River from flooding the floodplain area. Despite the construction of these levees, since 1969 the floodplain area has continued to experience flooding not from direct river flows, but rather from the rising water table that expands inland and eventually rises to the surface with the increased river water volume. The resulting subsurface hydrostatic water pressure pushes the rising water table into the floodplain area. As the river continues to rise during a major flood event, the expanding and rising water table will also rise and eventually percolate through the area's sandy soils and become visible in the floodplain's low-laying areas. While both Levees have eliminated flood damage to the City's infrastructure from direct river water flowing into the area, their existence has created kind of fish bowl where the Levees and natural terrain have in effect created walls keeping the direct flow of river water out of the floodplain, but unable to prevent the rising water table from inundating the lowest floodplain areas with seeping water rising in conjunction with the continued rising of the St. Croix River's water elevation.

The St. Croix river's flooding potential is determined by three primary events; a) Amount of fall rain and soil saturation, amount of snow and its water content (liquid equivalent) throughout the winter, the depth of frost and snowpack conditions, rate of spring snowmelt, and spring precipitation - all experienced in the north St. Croix River Watershed area (approximately 14,000 acres south of Duluth); b) Amount of similar conditions in the metro area impacting the volume of water and flooding of the Minnesota and Mississippi Rivers; and c) The amount of rain experienced in the spring, summer or fall. When these conditions exist, there is a significant chance of potential flooding.

While water coming downstream from the St. Croix Watershed is of major concern, the St. Croix's rising elevation is also caused by water flowing north from Prescott. During most flood events, high water levels of the flooding Mississippi River will actually cause the Mississippi's water volume to enter the St. Croix River at Prescott and travel upstream causing the St. Croix to backfill and raise the river's elevation. When this condition occurs, it also extends the duration of the floodplain inland flooding. The time required for the Mississippi to begin to recede with enough volume of water to stop the St. Croix's rise and then its eventual flowing downstream to drain the St. Croix back into the Mississippi could add a week to perhaps up to three weeks or longer to the city's flood management activities (as in 2019).

As the spring flood threat looms, its severity is also directly impacted by the amount of precipitation (rain fall) that is experienced from late March through May. Near record snowfall and record April rains in 2001 produced the second worst flood on record. Record rains during summer and fall have also produced inland flooding events.

The last major contributor to inland flooding focuses on favorable snowmelt conditions of warm days and below freezing nights, essentially allowing intermittent amounts of water to drain into and then out of the St. Croix. This daily pulsating of thaw then freeze, thaw then freeze over many weeks is highly desirable. Conversely, a dramatic thaw could release high volumes of unimpeded water into the river.

Since 1969, the City has focused its emergency flood preparations and required pumping of low-lying areas, primarily along 19th and 20th Street, to ensure the rising water table will not pose a serious threat to the City's infrastructure and to provide emergency access to homes in and around the floodplain area. The city does not pump inland flooding to protect personal property. If properties located in the floodplain experience direct flooding from the raising water table, they are encourage to seek out flood insurance and make any other necessary plans that may impacting septic systems, operating wells, and access to their property when water levels in low-laying areas may be too high to drive personal vehicles. For any residence seeking flood insurance, it is critical to know there is a "mandatory 30-day pre-flood qualifying period" in which the policy must have already been in place before the property experiences impacts from flooding. Timing the policy's activation is very important. For concerned residents, planning well in advance or at the earliest stages of potential inland flooding notifications could significantly protect their home and property.

From 1969 to 2010, there have been numerous high water and serious flood events requiring time consuming and expensive emergency preparations on behalf of the city, county and state based on the severity of each flood event. These flood preparations and related expenses where conducted without any knowledge of the inland water's rate of rise, duration and crest as it related to the actual river elevation rise in the St. Croix River and its predicted crest.

St. Croix River and Inland Flooding Crest Relationship

The actual relationship of inland flooding rate of rise (how fast it rises), its eventual crest (when it stops rising), and its receding in conjunction with the river's actual crest was never understood until 2010. This newly discovered relationship would significantly alter the city's flood activities and related expenses.

During a high water event in the spring of 2010, inland water rise measuring stations were set up in the city garage/culvert area, in the ponding area adjacent to the city garage, and at the 20th St. beach parking lot next to the culvert running between the parking lot and the city garage. Measurements of the inland water rise were taken in the morning and again in the evening and tabulated on a spreadsheet. During the approximate 3-week high water event, inland water would rise slowly then increase as the river approached its predicted crest date. As the river crested, the inland water would continue to rise but at a slower rate. On the third day after the river's crest, the inland water rise ceased. The water level held steady for a day and then slowly began to recede. The inland water continued to recede slowly in the coming days and then began to recede more rapidly. Throughout the duration of this high water event, there was no rain to further add to the volume of water in the test measuring areas. This allowed for measurement of actual river rise, crest and its receding its direct relationship to inland water rise, crest and its receding. This emerging relationship was an important discovery that could aid in the city's future flood emergency planning.

River and Inland Crest Relationship Confirmation

In the fall of 2010, steady summer rains again posed high water elevations on the St. Croix River. Measurement stations were again set up at the same spring locations to measure the inland water rise, crest and eventual receding. Using the same spreadsheet monitoring of measurements during the morning and again in the evening, the relationship of the river's rise and crest were closely tabulated with the inland water rise and eventual crest. As in the spring, there was no rain during this high water event. As before, the inland rise rate was initially slow and then accelerated as the river neared its predicted crest date. Three days after the St. Croix River crested, the inland water ceased to rise any further and then began to recede slowly. This identical testing of the river and inland crest relationship confirmed the initial discovery earlier in the spring. This confirmation of the inland flooding relationship to the river's expected cresting date has provided an essential new decision-making matrix to plan and adjust anticipated flood management activities and resulting cost considerations for future floods.

Employing the Relationship Discovery to New Flood Events

In spring of 2011 and in the summer of 2014, the city experienced another major flood and high water event respectively. Armed with this new crest relationship information, the city adjusted its flood response by calibrating the predicted river crest height and date with the potential inland water level in the floodplain area. Careful monitoring of the predicted river rise, anticipated river crest date, and potential rain precipitation allowed the city to carefully adjust its flood management measures and related expenditures. The inland flooding measures in 2011 included purchase and placement of Jersey barriers along the beach park embankment area due to concerns of excessive river elevation predictions. As that threat dissipated, careful monitoring of inland water levels lead to placing a pump at the vacant city-owned lot along 19th Street to mitigate rising water in this area, but pumping at the beach parking lot was withheld as it was deemed to not potentially be needed if the weather and rain didn't add to the inland water rise. With continued careful inland monitoring and favorable weather in conjunction with the predicted river crest, it was determined no additional flood prevention actions were necessary and reduced ongoing related flood management expense.

In the spring and summer of 2019, the St. Croix River was faced with another major flood event prediction. The City prepared for this event in accordance with the approved Flood Management protocols as before, held a floodplain resident informational meeting, and declared a flood emergency in preparation of the necessary measures needed to address inland flooding. Close monitoring of the same inland measuring protocols assisted the city in the ensuing preparations.

As a precaution, a pump and discharge hose was secured for the beach parking lot due to predicted and actual seasonal precipitation. This event experienced two crests. The first crest was associated with typical spring snow melt but as the river started receding, spring rains began to swell the river basin and added to the volume of water still residing in the floodplain. Even as the flood situation extended beyond the initial river crest, careful monitoring of the relationship with the inland flooding and anticipated second crest allowed the city to hold on any further deployment of additional pumps and supporting actions and materials. A single 8" pump was activated during the day to test all systems and to keep the inland water at an acceptable level. While no further measures were needed to address inland flooding due to the careful monitoring of the second river crest and inland crest expectations, it was determined this would be the limit of minimal pumping activity to protect the city infrastructure

and emergency access. In post flood assessments to the inland and river bank areas, 50 mph winds from the east caused significant bluffland and riverbank erosion with restoration cost projections exceeding the costs associated with the pumping activities of the inland area.

River and Inland Crest Relationship and Overall Flood Potential

In successive flood events since 2010, having an understanding of the river and inland crest relationship has provided an essential insight to the anticipated standard flood management activities verses the actual required flood emergency response and net expenses incurred by the city. This relationship has allowed the city to amend its response, needed procurement of pumps, labor, materials and related expense to meet the anticipated needs of inland flooding as it relates to the river's elevation and timing of its expected crest date. The experienced river crest elevations and its relationship with inland flooding levels since 2010 have provided direct reduction in flood management oversight and related costs and now offers a new decision-making matrix for the amount of flood management response that may be necessary to address similar flooding situations in the future.

While this new flooding relationship is essential in maintaining a balance between similar flood events verses required actions and expense of anticipated major flood events, it has become an indispensable time and cost saving decision-making method to use as the primary approach to initial flood planning activities with the understanding that additional decisions and activities may be required if a high water or minor flood event becomes a major flood event warranting more flood emergency measures and expenditures. During seasonal high water and moderate flood events, this river and inland crest relationship will save the city significant time, effort and expenditures for many years to come.

Flood Event Information from 2010 to 2024

Spring 2010	**Crest Pred.**	**River Crest**	**Inland Crest**	**Garage Floor Elevation**	**Approx. Inland Elevation**	**Flood Activities**
	687.60	685.93 Mar 25	Mar 28	684	679	Short of calling in pump

Notes Water visible in 17th Street catch basin at crest of 685.93. No rain during flood event.

Fall 2010	**Crest Pred.**	**River Crest**	**Inland Crest**	**Garage Floor Elevation**	**Approx. Inland Elevation**	**Flood Activities**
	686.20	685.30 Oct 3	Oct 6	684	n/a	Short of calling in pump

Notes No rain during flood event.

Spring 2011	**Crest Pred.**	**River Crest**	**Inland Crest**	**Garage Floor Elevation**	**Approx. Inland Elevation**	**Flood Activities**
	687.80	686.09 Mar 31	Apr 4	684	682	Short of calling in pump
		687.28 Apr 12	Apr 15	684	685	4” pump at city property (19th St.)

Notes Dire flood prediction (similar to 1969) due to excessive fall rain, saturated soils, heavy snow and worst icepack in years. Convened resident meeting with prediction background and city flood response activities. Water 3” from top of 17th St. catch basin at river crest level of 687.28. Stopped pumping at 19 St. on Apr 17. Purchased and delivered Jersey barriers to beach park area. Erected corrugated culvert tube over 17th St. catch basin and waterproofed base with rubber membrane and then sandbags. Issued floodplain resident ID badges and rearview mirror ID for autos. A team of pump volunteers from the Amateur Emergency Services were on standby status if needed for pumping. Floodplain road closures were in effect. Minimized pumping activities due to river and inland crest relationship timing and favorable weather throughout the event.

Flood Event Information from 2010 to 2019

Summer 2014	**Crest Pred.**	**River Crest**	**Inland Crest**	**Garage Floor Elevation**	**Approx. Inland Elevation**	**Flood Activities**
	687.60	687.58 Jun 27	Jun 30	684	n/a	8" pump on 20th pumped days only

Notes Late spring and early summer rains created summer flood event. Continued record rain in June caused FAC/Council to move forward with 8" pump on 20th St. Pump came with large gas tank attached to base of pump. This proved far more convenient and much safer. Day pumping allowed for reducing inland water level during the day thus allowing acceptable seepage increase overnight. This strategy reduced the costs and human resources needed to run pump 24 hours a day. The Amateur Emergency Services watched over pumping activities. Road closures were placed at two ends of Riviera Ave. S. and on 17th and 18th Streets. Duration was one week.

Spring/ 2019 Summer	**Crest Pred.**	**River Crest**	**Inland Crest**	**Garage Floor Elevation**	**Approx. Inland Elevation**	**Flood Activities**
	689.00	688.74 Apr 1	Apr 4	684	n/a	8" pump on 20th sporadic pumping
	687.60	687.19 Apr 26	Apr 29	684	n/a	

Notes Typical winter snowfall, approximately 6 feet of frost and record February snowfall created the first flood event. Heavy consistent rain in April created the second river rise and crest. Due to the unpredictable rainy weather pattern, FAC/Council moved forward with an 8" pump on 20th St. Flood mailings and a resident meeting was conducted for floodplain residents. Pumping activity was sporadic due to improving weather conditions, desire to keep down costs and operating oversight, and to determine the "non-pumping" threshold as associated with the river and inland crest prediction relationship. This event essentially set the pumping threshold limits for similar flood events in the future. Other measures included staging the corrugated culvert tube at 17th St. in case it was needed to be placed over catch basin along with approximately 50 sandbags on a pallet. Issued floodplain resident ID badges and rearview mirror ID for autos. Road closures were placed at two ends of Riviera Ave. S. and on 17th and 18th Streets. Due to high Mississippi and Minnesota river levels, the lower St. Croix river was unable to drain thus keeping the inland water at a relative static level for many weeks. The inland water finally receded near grade level in the first week of June.

Spring/ 2023	Crest Pred.	River Crest	Inland Crest	Garage Floor Elevation	Approx. Inland Elevation	Flood Activities
	689.00	689.18 Apr 24	Apr 28	684	n/a	8" pump on 20th daylight pumping

Notes The winter of 2022-23 started early with the first snowfall in November and significant heavy snowfall through the season (90.3") leading state forecasters to predict major flood conditions of expected river elevation of 689 during the spring thaw. The Flood Advisory Committee (FAC) began convening regular flood management meetings starting on March 15 through to May 3, a total of 9 meetings throughout the ramp up planning and river and inland rise duration. The river crested on April 24 at 689.18 and the inland water rise crested on May 1 when the water stopped rising and started falling the following day.

A new flood preparation community website landing page was created containing direct links to NOAA flood predictions and real-time river level graphics as well as FAC status reports, important flood planning updates, and more in-depth flood planning information for the benefit of local residents. This new flood landing page was promoted through the city website home page with a direct link, through the city Facebook, and through a direct mailing to floodplain residents with a QR code linked directly to the landing page. As of May 3, the landing page had 809 views and 326 visitors seeking flood management information. Many visitors downloaded the FAC Status Reports, What You Need to Know, Theater of Operations, and LSCB Flooding Characteristics.

The high winds created soil erosion along the immediate area of the wooden steps on the north end of levee #1 and at the area immediately adjacent to the new installation of rip rap at the new stairs at Stairs #7. Both of these area are exposed land slopes that would be susceptible to erosion damage due to excessive water wave action during high water events.

Spring/ 2024 Summer	Crest Pred.	River Crest	Inland Crest	Garage Floor Elevation	Approx. Inland Elevation	Flood Activities
	689.00	688.10 July 1	July 5	684	n/a	4" city pump on 20th daylight pumping

Notes This year's summer flood event was created due to excessive late spring and early summer rain. The first round of late spring rain caused the river to rise to what would normally be viewed as an early spring high water event we have experienced many times in the past with no inland water table ponding at the beach parking lot. And after a break in the rain, the river began to recede.

Unfortunately, we experienced a second round of early summer rain that quickly pushed the river to a higher elevation reaching the moderate flood stage. And, with the water table lurking just below the surface from the first rounds of rain, it didn't take long for the inland water to rise above grade in the usual low-lying inland areas.

The pumping activities were similar to the 2023 flood when a larger 8" pump was used; start pumping in the early morning and run the pump at idle (1500 rpm) to approximate 8 or 9 pm. This was the first time the 4" pump was used at the 20th street location and it exceeded initial expectations for its pumping capacity for a 4" pump requiring 450 feet of discharge hose up an incline.

A modification from last year's flood was the positioning of the end of the discharge hose. Because it was summer and the beach was attracting beach-goers, the hose was moved from the stairs to the further right requiring another section of discharge hose allowing the discharge elbow to rest near a large cottonwood tree. This allowed unencumbered use of the stairs and located the discharged water to be south of the beach area.

In total, the pump required (10) sections of pumping discharge hose. Due to the smaller diesel fuel tank, it required more frequent checking and refilling of the fuel tank.

Due to the quick nature of the inland flooding and the first experience using the 4" pump, it took time to understand its pumping drawdown capacity (water reduction time requirement). This resulted in a high level of inland water than is typical with a larger 8" pump which resulted in water reaching the same level as the 20th street asphalt. The pumping objective is to keep the water from topping 20th street and saturating the road's substrate beneath the asphalt. While the water level did not over top the street, it was at the same level of the asphalt and thus allowing the substrate to become saturated. If the 4" pump is used at this location for a similar summer flood event, pumping velocity and daily duration should be conducted to maintain at least a minimum of 12" of freeboard between the top of 20th street and highest inland water level. This level of freeboard should reduce the possibility of compromising the structural integrity of the roadbed while it remains open for resident access and emergency services.

Typical Flood Preparations Since 2010

Notwithstanding a major flood event similar to 1969 (river elevation 692.2) or 2001 (river elevation 692.5), the preplanning and emergency flood management measures enacted since 2010 with river crests ranging from 686 to 689 have been modified due to the now known St. Croix River and inland flooding relationship. This river and inland relationship has dramatically reduced the amount of planning and staging of equipment and materials required to effectively manage inland flooding. This has resulted in reducing the cost outlays required to prepare and manage similar events.

Proactive city council actions since 2010 including the purchase of Jersey barriers, 4" pump and 500 feet collapsible hose, emergency lights and generator, and creation of pumping paddock area at the beach parking lot have also greatly improved the city's ability to respond swiftly if flooding conditions require additional flood management decisions.

Given similar flooding events experienced since 2010, the following preparations and activities should be expected in varying degrees per each future event. Should a flood event require extensive flood management response similar to 2001, the city and Flood Advisory Commission should refer to the official Flood Management Manual created after the 2001 flood as additional reference. This Manual provides significantly more actions steps, checklists and more flood management personnel considerations. The flood management actions provided herein reflect many of the known and standard steps in the Manual reflecting flood emergency Levels 1 thru 4. The flood response actions provided are in the context of a spring flood event. Should a flood event occur in the summer or fall, the following planning would apply in similar sequence.

January

Spring flood conditions are monitored in the St. Croix River Watershed area south of Duluth. Tests of fall soil saturation, winter snow levels, water content, and frost/snowpack conditions are combined to generate a potential flood forecast. The threat of potential flooding is provided by National Weather Service (Chanhassen) to all impacted cities, counties and appropriate government agencies for their potential planning activities. River elevation readings come from the Stillwater monitoring station.

The Floodplain Advisory Committee (FAC) holds its annual meeting to review the flood forecast and its current flood management readiness per recent flood management activities. If the flood threat is eminent, FAC will continue to assess its potential need to respond as conditions may warrant.

General Pre-planning Activities

- Review previous flood management activities for any adjustments that may need to be considered and added to these activities
- Review any changes to residents or terrain conditions in the floodplain
- Create flood management file and city support activities for eventual documentation if required should the flood event be declared a natural disaster thus allowing flood management expenses to be reimbursed to the city

February

The National Weather Service provides new flood forecasting updates. FAC continues to monitor the situation and continues additional planning considerations as needed. This may include:

- Council review of potential flood threat by staff
- Preparation of potential flooding notice to floodplain residents
    - Potential of flood threat
    - Encouraging floodplain residents to look into getting flood insurance (Important! There is a 30-day window requiring flood coverage to be in place 30 days prior to a flood event impacting the flood insured property)
    - Encouraging floodplain residents to review their own flood management situation per septic systems, testing of uncapped wells, access to property with potential road closures, and location of trash/recycle containers in lieu of trash hauler unable to access certain areas of the floodplain
    - Encouraging floodplain residents to provide mobile phone and email contact information to the city for quick notification of future flood management notifications, including signing up for Washington County's CODE RED notification system (Notifications can be targeted to the floodplain area)
    - Provide trailer storage information

- Preparation of possible floodplain meeting (Council in attendance for required actions)
    - Typically held in mid-March
    - Provide the latest flood forecast information
    - Provide background on the city's flood management activities and what to expect
    - Mention:
        - All flood management activities undertaken are to protect city infrastructure and emergency access to impacted floodplain area along 20th Street.
        - Flood management decisions are not predicated on protecting personal property and homeowners are responsible for protecting their properties (their activities must not impede flood management activities)
        - Reminder about required flood insurance 30-day pre-flood event window when the policy must be in place prior to the property's flooding event
        - Sand and sandbags are available to floodplain residents at no charge (at park pavilion or city hall – sandbags available at city hall. Sand used by residents CANNOT be returned to city property including the beach)
    - Encourage attendees to provide contact information and CODE RED sign-up
    - Resident Q&A
    - Afterwards city council opens official meeting to declare a flood emergency (including waiving of city road weight restrictions), appoint flood management team, approve submission of pumping permit, and approval of flood management team reimbursement (if desired), thus allowing flood management activities to continue as needed (this Flood Emergency Council Meeting is recessed for potential future actions if needed)
    - Council may also approve of delivery of pump(s), placing on reserve additional pump(s), purchase and delivery of sandbagging materials as may be needed, and delivery and staging of Jersey barriers if flood conditions require

March

Conduct resident meeting and begin more detailed preparations as weather conditions and thawing of flood management areas permit. Check river elevation projections at:

https://water.weather.gov/ahps2/hydrograph.php?wfo=mpx&gage=stlm5

NOTICE: The following website references will direct you to third party websites. The City of Lake St. Croix Beach is not responsible for the content or ADA compliance status of sites not affiliated with the City.

Initial Actions

- Plow snow away from river front areas around park and fence area for potential placement of Jersey barriers
- Clear snow at park pavilion for placement of pallets of sandbags
- Clear snow away from 17th St. culvert
- Call in locates if needed
- Get trespass waivers from properties needing access to manage flood event
- Inventory flood management materials on hand
- Prepare to purchase sandbags and delivery of sand as may be needed
- Sandbag wood platform at base of wood north beach stairs if not removed already
- Monitor river rise at 17th St. flapgate area (allow inland water to drain from 17th St. culvert into river until river level reaches flapgate)
- Close and sandbag flapgate when river water approaches flapgate
- Fence off bluffland areas
- Empty city garage
- Arrange to secure pump(s) if needed making sure we have them if we need them
- Arrange potential sandbag filling with STS or high school students if possible
- Place inland river rise measuring stations at garage and beach parking lot culvert and begin monitoring inland water rise
- Talk with 17th St area residents of Riviera Ave. S. about potential road closures and their need to pump their own property
- Talk with homes on Riviera Ave. S. and 18th St. regarding their own pumping of city lot along 17th St. (They can place their discharge hose over Riviera Ave. S. and over Levee. They must provide acceptable bank erosion protection from their discharged water)
- Place road barriers along Riviera Ave. S. and 17th and 18th streets
- Consider need to orange fence all along base of levee to prevent access to levee

Additional Actions as Needed

- Meet with sheriffs and fire department to review flood management activities and needs
- Secure bobcat and operator for positioning of sandbag pallets
- Deliver palleted sandbags to park pavilion, river bank area (Jersey barriers) and 17th St. culvert and as needed
- Clear culvert area of debris at beach parking lot and garage culvert openings and surrounding area
- Stake debris containment orange fencing at 20th St. beach parking lot and garage culvert areas
- Position corrugated culvert tube to 17th St. culvert as may be needed (locate rubber membrane and notify of adjacent home of pending tubing of culvert)

- Place road barricades as situation warrants
- Distribute floodplain IDs and car badges (rearview mirror)
- Notify trash haulers of road closures and area pick locations
- Arrange STS to assist in deploying pump discharge hose to edge of river bank along 20th St.
- Arrange pump monitoring volunteers with Amateur Emergency Services
- Monitor levee 1 and 2 for potential seeping throughout flood event (There is the potential for some seeping of water at the base of the levee along Riviera Ave. S. which is normal. Note any breaking away surface grade of saturated areas at either levee as this could be a sign of too much water pressure within the levee that is causing areas to give way which could be problematic)
- Place sandbags at base of levee one when saturation areas start seeping water (if major seeping, place sandbags 3-4 feet high along base and 50' along length of problem areas)
- Inspect for boils (bubbling up of water through asphalt or water main shutoff valve caps (20th and Redwing could require beehive in major flood event)

March/April

Provided the weather and snowmelt has allowed for the preliminary flood preparations noted in February to proceed, this section will focus on pumping preparations. The calling in for a pump at the 20th St. beach parking lot culvert is a judgement call by city and flood managers. If the river crest is approaching and there is still acceptable levels of inland water ponding, reviewing the inland water rise rate (how fast the water is rising each day in inches) will determine the amount of inland water rise in relation to the inland ponding or holding capacity still available (allowable freeboard). The timing of the river's crest and knowing when the inland water will cease rising (approximately 3 days after the river's crest) yet still allowing incremental inland water to increase without threating the access to emergency vehicles to area homes is the primary matrix to be assessed. If the inland water level still allows for several inches of rise increase within the timeframe of the river crest and an additional 3 days of inland crest, it may determine: a) if calling in a pump is needed, b) if a pump is called in and staged but not engaged for pumping, and c) if a pump is called in and all hoses are connected and pumping is initiated. Pending weather forecast predicting significant rain will assist in determining the final pump connections and pump activation.

Inland Water Rise and Weather Monitoring

- Continual monitoring of rising water and predicted date and level of river crest
- Review inland water rise rate in relationship to pending river crest projection
- If inland water remains at a relative acceptable level and no significant rain is projected for the next week or so, and the river crest is within reach, consider holding on delivery of pump at 20th St. beach parking lot culvert

Weather Forecasts Predict Significant Rain

- If inland water appears to be acceptable, but the weather forecast calls for significant rain, prepare to call for pump delivery and staging of pumping activity
- Call Amateur Radio Emergency Services and arrange for them to be on standby
- Take delivery of pump and stage by beach parking lot culvert
- Stage discharge hose along left-hand side of 20th St. for potential hose connections if pump is

activated (hold on making connections unless starting pumping activity)

- Clear culvert area of debris on both the parking lot and garage culvert openings
- Connect intake hose to pump and position intake end near culvert
- Place orange fencing around intake area to prevent flooding debris from entering the suction area
- Keep rake at pump for routine clearing of flooding debris in the suction area
- Meet with Commander of Sherriff Department to review potential flood emergency activities
    - Contact information of flood management personnel
    - List of volunteers and contract info
    - Resident credentials
    - Closed roads and alternative parking areas
    - Communal collection areas for trash receptacles
    - Persons with potential health concerns who may need emergency care

Pumping Activation is Eminent

- Mail floodplain residents temporary parking alternatives (Include map showing areas along Ramada and dry areas at beach parking lot on west end. Cars must have rearview mirror ID badges. No parking on East/West streets – 17th, 18th, 19th, 20th streets. Include temporary trash collection areas.)
- Notify Amateur Radio Emergency Services of pending pumping activity to start their volunteer scheduling and any onsite amenities needed to make their presence comfortable (Shade/weather tent, chairs, cooler, etc.)
- Order portable toilet to be delivered at the beach park
- Arrange for rain and sun shade tent
- Connect discharge hose sections along 20th St. from pump to Riviera Ave. S.
- Have collapsible hose section(s) placed along span at Riviera Ave. S. to stairway directly across
- Place length of hard discharge hose down the stairway allowing enough length to enter river
- Place 90 degree elbow attachment at end of hard discharge prior to placing in river
- Secure strong and long rope to elbow and string rope over strong branch of adjacent tree to keep the discharge end upright and secure (There is a tremendous amount of water pressure and force/energy at the end of the discharge hose requiring it to be securely supported or it will forcibly whip back and forth)
- Sandbag hard discharge hose along stairway to keep it from moving
- Place removable street barricade along Riviera Ave. S. near collapsible hose to ensure cars do not drive over the hose
- If pump is “self-priming” start pump per instructions and monitor intake area for proper water suction and intake
- Monitor pump gauges to ensure pump is running normally (Keep at idle speed during initial start-up)
- Walk along discharge hose to ensure connections are good (There will be expected seeping which is normal)
- Check collapsible hose section to ensure there are no holes and all is working properly
- Check stairway and hard discharge hose and outgoing water flow to ensure proper and safe operation that will hold up over several weeks of pumping activity
- Turn pump up to approximately 1/3 of RPM capacity and re-inspect all hose operations
- Have fire department use marque sign to post river elevation levels for public awareness

Pump Monitoring

- Determine severity of inland water rise and anticipated crest in relation to the river's crest to ensure the pump's operation (Low RPM vs. high RPM) is sufficient to address the anticipated inland water levels with new weather forecast projections
- Maintain continued city and flood management communications as to current and potential changes in conditions
- If conditions worsen, decisions may include securing an additional pump to be place next to current pump to off-set any anticipated heavy weather that cannot be handled with the current pump's operation (Similar deployment steps should be consistent with the first pump's set-up and activation)

Mobilization and Staging of Jersey Barriers

If rising river levels increase to the point they threaten to top over the Levee 1 (and/or Levee 2), arrange to stage Jersey barriers along a stretch of river embankment adjacent to the beach park.

Preparations

- Initiate specific communications with county and federal flood officials as well as the Corps of Engineers to make additional river-topping flood fortification plans and decisions
- Call Tri-State to arrange delivery of Jersey barriers
- Clear placement area free of snow and debris
- Double check inventory and length of plastic wrap
- Double check amount of palleted sandbags and inventory of additional sand and sandbags
- Order more sand and sandbags if needed
- Make more sandbags enough to secure the full length of barriers end-to-end on the river side and intermittent sandbags placed along the barrier's backside to hold plastic in place

Staging

- Line barriers end-to-end along embankment area (match pin loops to receive locking pins)
- Insert locking pins
- Wrap plastic roll starting from river side base allowing extra to lay on the ground to be held down by sandbags
- Bring plastic over top of and down backside of barrier and secure with acceptable intermittent number of sandbags

Monitoring

- Maintain regular monitoring of river bank area, expected river crest and remaining freeboard along top of levee and park area embankment
- Monitor closely Levee 1 and 2 for aggressive seeping on backside
- Anticipate potential levee top-over areas and determine if additional protection measures need to be take

IMPORTANT NOTE: Jersey barriers were purchased, delivered and stage in 2011 but wrapping them in plastic was in a holding pattern during the flood event. The topping-over of Levee 1 or 2 has not occurred since their installation so actual flooding impacts to the levee's topsides, success of Jersey barriers, or river water breach into the floodplain has not been observed.

As such, all flood management activities would likely resemble "design-build" emergency measures onsite with the assistance from county and the Corps of Engineers.

Catastrophic Flood Event

To be developed.

Conclusion of Flood Event

- Throughout the flood event, all expenditures and volunteer hours must be logged in addition to any further council decisions and consequential actions taken by flood managers
- Document river crest date(s) and any flood damage to the river bank with photos
- Any damage to city infrastructure inland and river side erosion and damage to bank and trees should be documented with photos
- City staff communications with county and state agencies will have been ongoing, but discussions will be centered on the potential of a declaration of a flood disaster and all flood management files should be prepared and package for eventual submission for the city's qualification of flood expense reimbursement
- Deconstruction of flood management staging should begin as conditions and passing of flood threat permit

Post Flood Event

- Review any damage to river bank once the water has receded to allow for thorough inspection
- Review and confirm and infrastructure damage in inland areas
- Document any bad weather or winds that could cause damage to trees and river bank along with erosion and washing away of beach sand or rip-rap structures and damage to stairways
- Document observations and photos and package them into document along with actual flood costs incurred as well as potential repair costs for flood damage with assistance of the city engineer
- Separate post-flood costs into two groups, one for inland flooding activities and costs, and one for river bank damage and repair costs (This will eliminate public confusion of the actual cost (and reimbursement) of inland flooding verses the potentially high cost associated with repairing the river bank (in conjunction with flood imbursement and potential grants)
- Staff will work with county and flood agencies to prepare final submission of the total extent of flood damage and related costs for potential reimbursement

Flood Management Materials

On Hand Inventory – Spring 2020 – To Be Completed

Jersey Barriers

_____107 (_____') Jersey barriers & locking bars – Owned by city. Storage in Denmark Township by Tri-State
_____12 rolls of plastic to wrap around river side of barriers (100' long x 12' wide = 1,200 feet)
_____(_____qty) of sandbags for holding down plastic and riverside and backside of barrier

Sandbagging

_____Pallets of filled sandbags (approximate _____of sandbags at 50 per pallet)
_____Unused sandbags
_____Unused sand
_____(2) Filling chutes and (___) shovels
_____Empty pallets

17th St. Culvert Protection

_____Corrugated culvert tube (stored behind city garage)
_____Rubber membrane for sealing base

Closure of Areas

_____Orange fencing
_____

Pumping

_____Orange fencing (_____feet) and rake

Resident Credentials

_____Resident ID cards
_____Resident rearview mirror badge

Access Control

_____Orange fencing

Other Materials

_____(7) Life jackets
_____(4) Fire extinguisher with proper charge
_____(5) Clip boards
_____(4) First aid kits
_____(7) Orange vests

Other Equipment/Materials On-Hand

_____4" diesel pump
_____500' of collapsible hose
_____Hose/pump connection
Elbows _____
_____
_____
_____
_____Generator with floodlights
_____Flat bottom row boat
_____Outboard motor (donation?)

_____(4) Flashlights (Need fresh batteries?)
_____(1) Life ring with 200' rope
_____(4) Hard hats

Sources for Flood Management Materials

To Be Completed

Sandbagging

Sandbags –

- Come in bundles of _____ (5,000 costs $1000)
- Need:
  - _____for base of Jersey barriers (place on pallets under pavilion out or rain and snow)
  - 1 pallet for 17th St. Culvert
  -

Sand -

- County truck holds 10 tons ($220)
- Deliver to back area of city hall, riverbank (Jersey barrier plastic weights), park pavilion

Pallets –

- 50 sandbags per pallet

Bobcat –

- Staging of sandbags, 17th St. culvert tube and Jersey barriers
- Bucket and forks

Pumping

Pump(s) – Northern Dewatering (Elk River)

- 2019 Pumping (Additional pumps and equipment set-up. Additional hose length may be needed):
  - 8" diesel self-priming pump with self-contained large fuel storage tank on trailer
  - (1) 20' flex hose connection from pump to hard discharge hose running up 20th St.
  - (22) 20' sections of hard hose for discharge extensions to river
  - (1) 50' section of flex hose placed along Riviera Ave. S. street section for access by emergency vehicles
  - 20' of flex hose for water intake at beach parking lot culvert
  - (2) 10' hard hose extra sections
  - Suction intake screen
  - Assorted 90 and 45 degree elbows for hose connections to pump and river discharge end (Placed 45 degree elbow pointed up at end of discharge hose and secured in place by rope connected to adjacent tree to reduce river erosion)
  - Pump operated only during the daytime hours at 1200 RPM (about 1/3 of pumping capacity)
  - General goal was to maintain inland water level at 684 (city garage floor)
  - Refilled diesel fuel tank once
  - Cost $_____total or $_____week for _____weeks of pumping

Volunteer Sources

Amateur Radio Emergency Services –

- Provided pumping supervision in 2014

Sentence to Serve –

- Use for volunteer assistance for sandbagging and pump staging and other selected activities

Woodbury High School -

- Filled sandbags at pavilion

Other Sources

Utility Locates – Gopher State

- 19th St. South, Redwing to Riviera Ave. s., 20th St. South, Ramada to Riviera (no cost)

Port-o-Poddy –

- Place at beach park as usual during summer)

Road Barriers –

- Does County Fair Grounds have sawhorse barricades?

County, State and Federal Flood Management Contacts

Flood Events and Elevations

Past Flood Crest Levels

Year	1965	2001	1969	1997	1993	1986	2010 Spring	2010 Fall	2011	2014	2019
Height	694.7	692.5	692.2	690.0	688.0	686	685.9	685.5	687.3	687.6	688.74
Duration (weeks)	n/a	6	n/a	2	4		n/a	n/a	1	2	4
Crest Dates	?	?	?	?	6/28	?	3/25	10/3	3/24	6/27	4/26

Year	2023	2024
Height	689.18	688.1
Duration (weeks)	2	4
Crest Dates	4/24	7/1

1965 Worst flood on record. No levees present.

2001 70" of winter snow, ice pack, record April rains (Required (1) 8" pump with 15,000 GPM discharge and (4) 6" pumps with 9,600 GPM discharge capacity)

1969 Excessive snow melt

1997 Record 90" winter snowfall

1993 Record steady spring/summer rainfall

1986 Spring rise

2010 Spring - Excessive snowmelt due to early spring thaw

2010 Fall - Due to wet summer and excessive rains on September 22nd for much of southern and central Minnesota and Wisconsin.

2011 Saturated fall soils and rivers, with above average snow and high moisture content

2014 Excessive spring rains and saturated soils – record rain for May and June

2019 Typical winter snowfall, approximately 6 feet of frost and record February snowfall created the first flood event. Heavy consistent rain in June created the second river rise and crest.

2023 Excessive winter snowfall (90") Nov-Apr. Mild frost, winter thaws, low above freezing temps and cold nights, no downstream flooding reduced volume of water and no backup

2024 This year's summer flood event was created due to excessive late spring and early summer rains. This was the first time the city's 4" pump was used at 20th street and it did a superb job running just above idle during daylight hours.

Other Important Flood Data

Flat pool (Ordinary high water mark)	675.0
Bottom Step at 17th Street Staircase	679.4
Bottom Step at 18th Street Staircase	679.5
Lowest Inland City elevation	679.5 (garage)
Bottom Step at North Bluff Staircase	680.3
Normal High Water Mark	682.5

Bottom Step at South Bluff Staircase	682.6
Redwing Parking Lot	682.7
No Wake Zone	683
Bottom Step at 19th Street Staircase	683.5
17th Street Culvert East Side (Bottom Rim)	684
City Garage Floor	684
17th Street Culvert West Side (Bottom Rim)	685.4
20th Street @ Redwing	686.6
Flood Stage	687
Top Step at 19th Street Staircase	692.6
Riviera South of Levee (4/12/01 survey)	693.2
Top Setp at 17th Street Staircase	693.4
Top Step at 18th Street	693.5
Levee Reach 1 (4/12/01 survey)	694 695.3 – 695.9 (2003 project)
Levee Reach 1 (4/20/23 survey)	693-696 (lowest at 691.6 by old Stair #7)

Floodplain Elevations

10 year floodplain elevation	687 and below
100 year floodplain elevation	687 to 692
500 year floodplain elevation	692 to 695

Note: City engineer's marked reference point for all flood related elevation measurements are found throughout the City, but fire hydrants are primarily the main elevation indicator.

Historic Crests – NOAA Website

(1) 694.10 ft on 04/18/1965

(2) 6**92.30 ft on 04/27/2001**

(3) 692.20 ft on 04/16/1969

(4) 691.10 ft on 04/16/2001

(5) 6**90.45 ft on 04/12/1997**

(6) 689.70 ft on 04/14/1952

(7) 689.18 ft on 04/24/2023

(8) 6**88.48 ft on 03/31/2019**

(9) 687.90 ft on 06/28/1993

(10) 6**87.63 ft on 06/27/2014**

(11) 687.50 ft on 04/06/1986

Top Snowiest Winters in the Twin Cities 1884-2023

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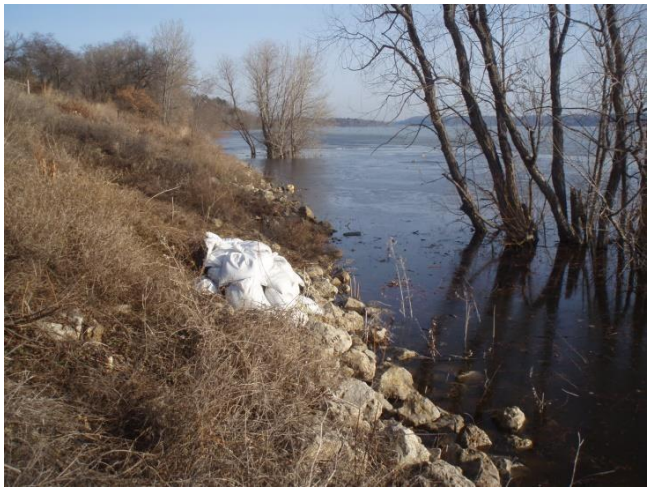
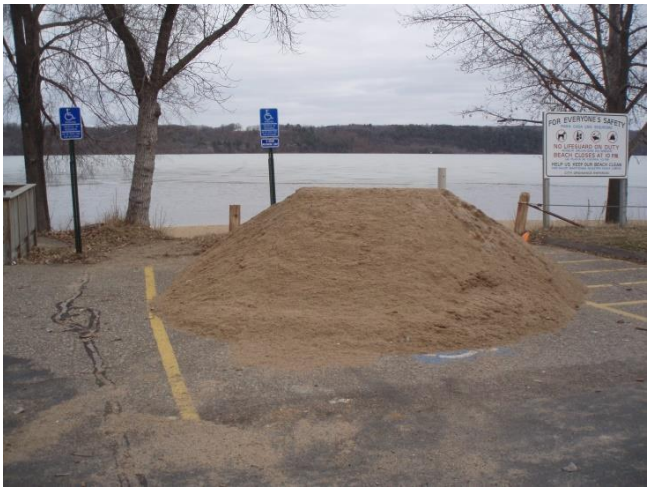
1. 1983-84 ..... 98.6*
2. 1981-82 ..... 95.0
3. 2022-23 …... 90.3
3. 1950-51 ..... 88.9
4. 2010-11 ..... 86.6
5. 1916-17 ..... 84.9
6. 1991-92 ..... 84.1
7. 1961-62 ..... 81.3
8. 1951-52 ..... 79.0
9. 1966-67 ..... 78.4
10. 2018-19 …… 77.0
11. 2000-01 ..... 75.8

Flood Management Staging & Activities Photos

2010 Spring Flood – High Water Event (687.60 Predicted)

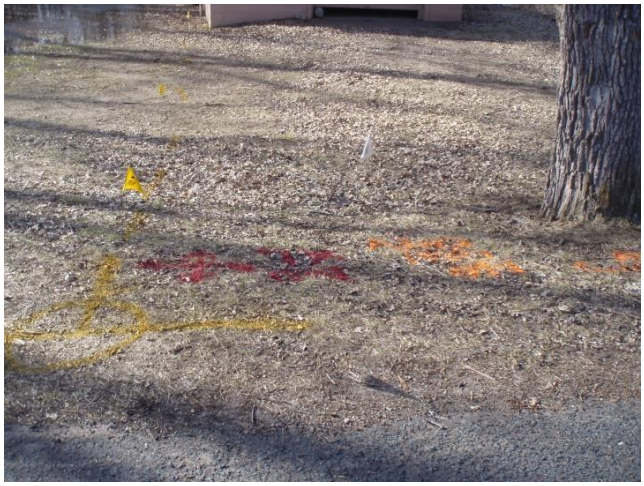


Sandbagging 17th St. flapgate as water approaches base of drain culvert



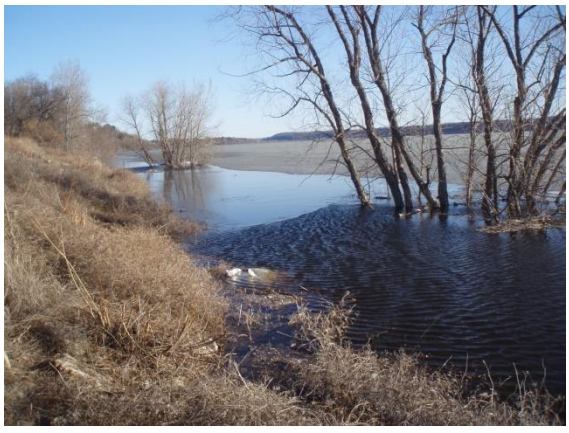
Sand placed at river embankment for pending sandbagging operations

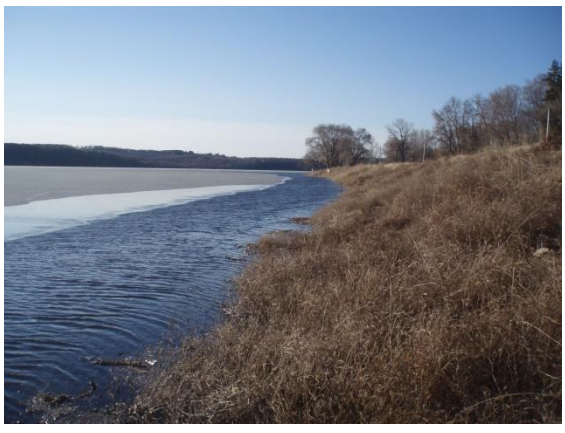
Palleted sandbags (50 per pallet) wait for pending use



Locates marked along pumping and flood activity areas

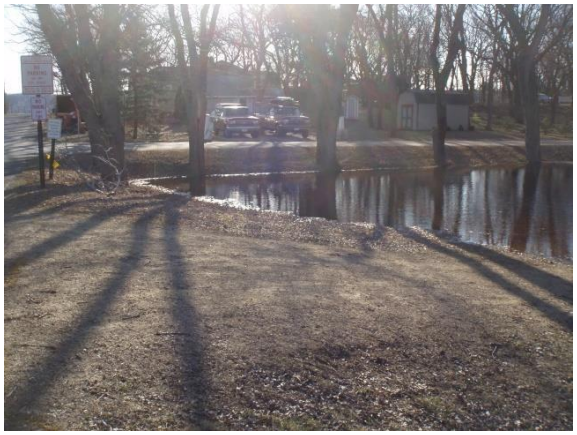
2010 Spring Flood March 25 Crest Date (River: 685.93)





Flapgate is covered with river water at time of crest

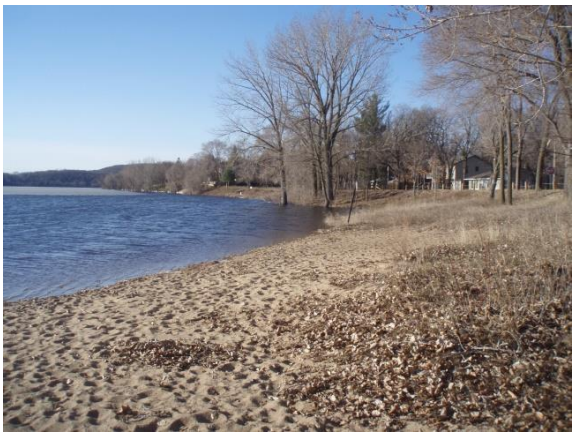
Height of river during crest looking northeast



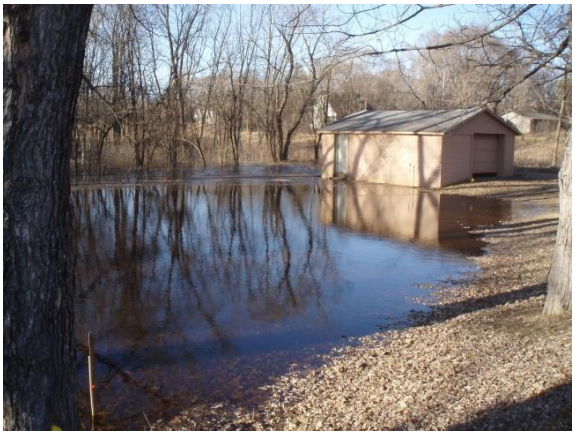
Height of inland water at city garage culvert area and remaining freeboard

Height of inland water at 20th St. beach parking lot culvert

Levee 1 performs as intended during this event

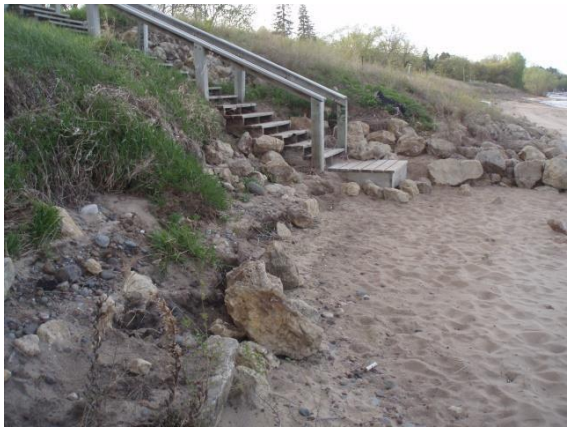


Height of river during crest looking southeast

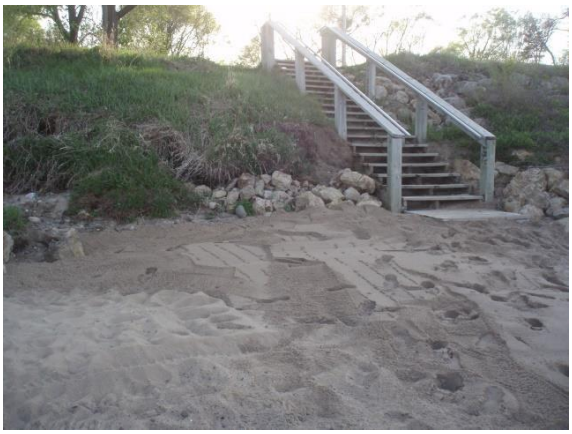


Inland water level with remaining freeboard (dry grade incline between water and road surface)

Height of river during crest at north beach stairway with wood platform removed or sandbagged

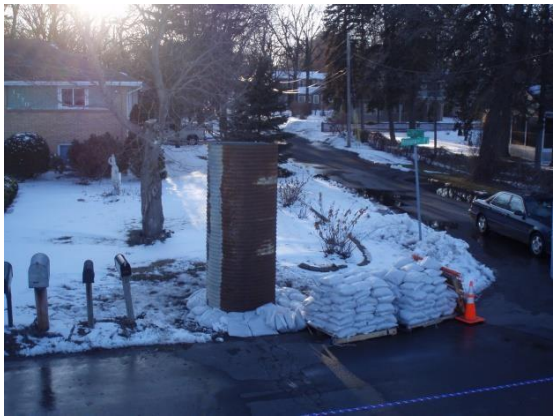


Post flood erosion damage to area around north beach stairway

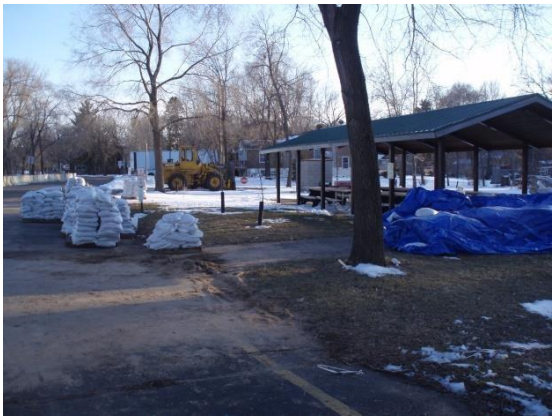


Erosion repair to stairway area

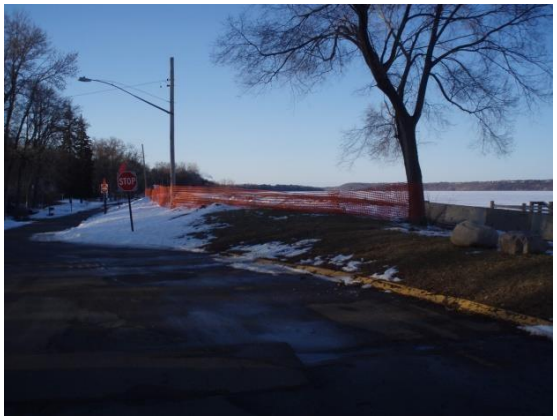
2011Spring Flood – Major Flood (Predicted 687.80)



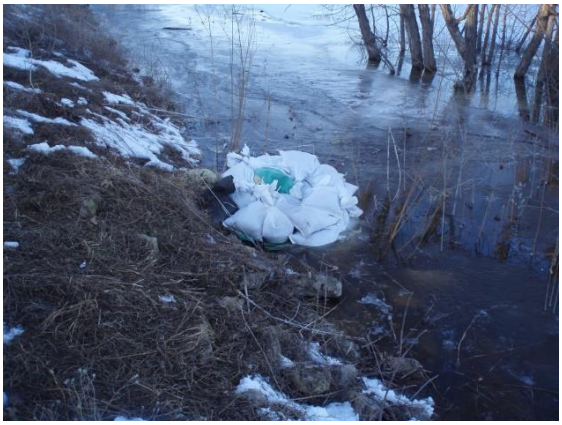
Height of river during crest looking northeast



Height of river during crest looking southeast

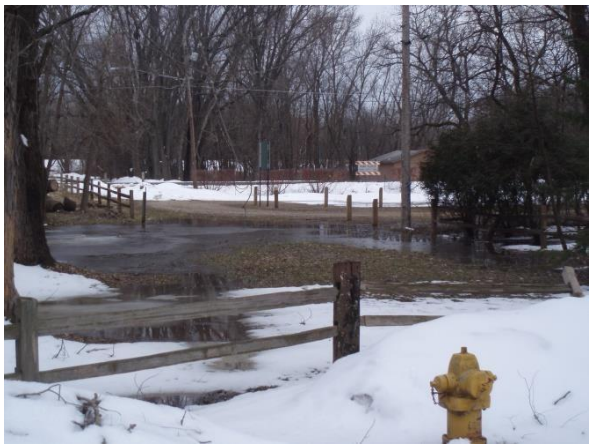


Fencing off of popular stretch of Levee

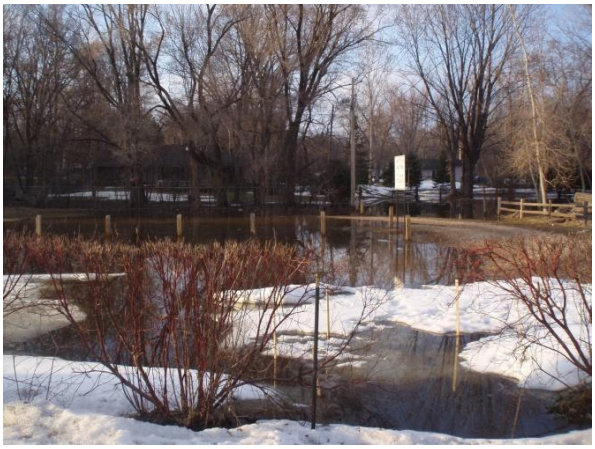


Sandbags hold down 17th St. flapgate

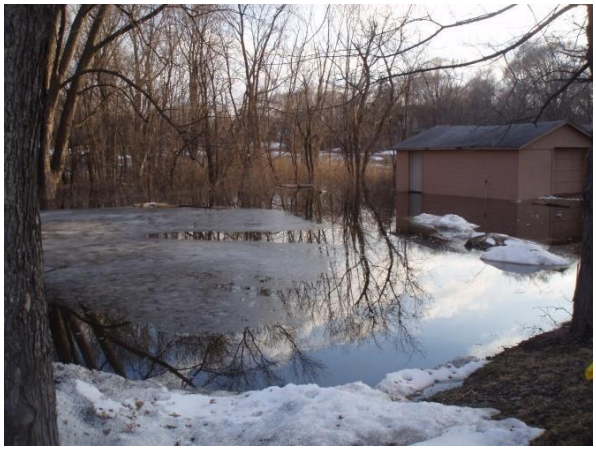
2011 Spring Flood March 31 Crest Date (River: 686.09)



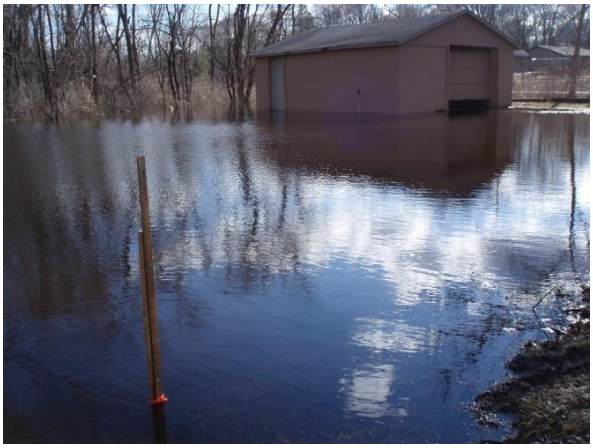
Rising inland water table reaches the surface at beach overflow parking lot



Ponding at beach parking lot due to inland water rise on crest of river

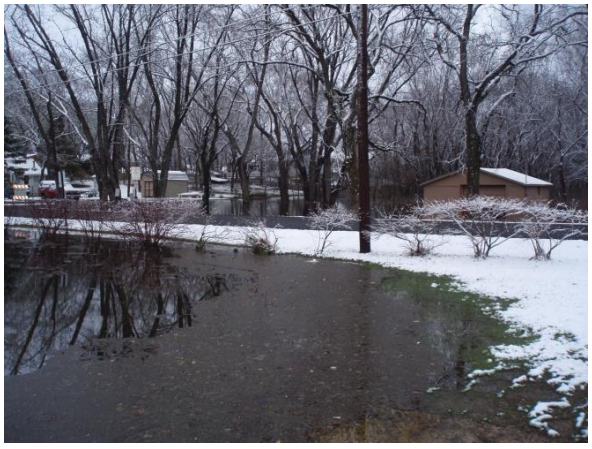


Rising inland water table at city garage lot with culvert located in foreground



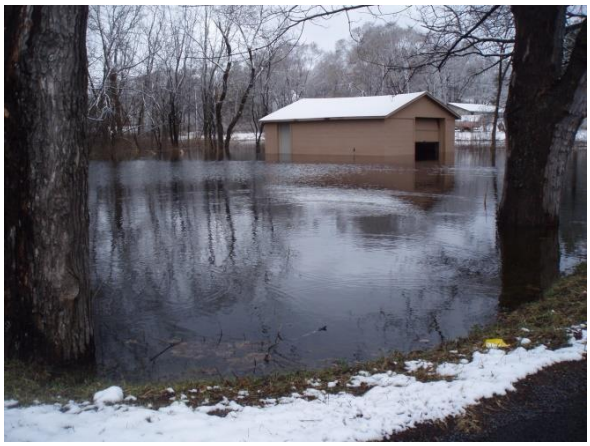
Garage lot inland up several inches from river crest 2 days earlier

2011 Spring Flood April 12 Crest Date (River: 687.28)

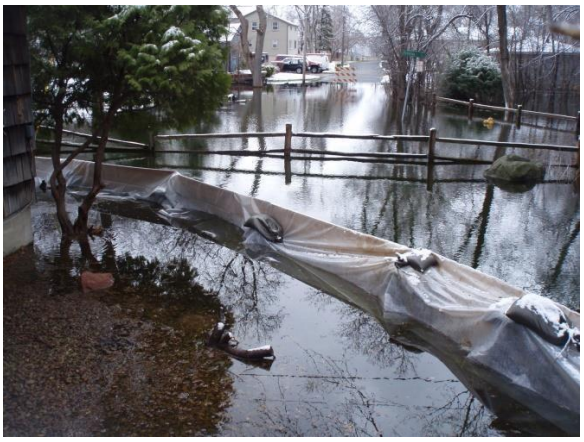


Second river crest pushing beach parking lot water higher and further

View of beach parking lot with pumping culvert area to the left of parking easement

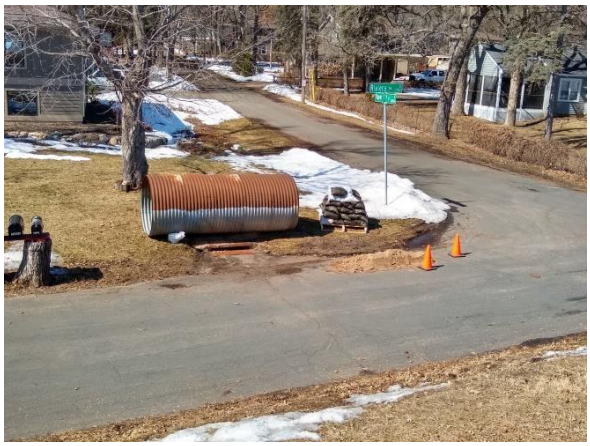


Inland water stops 3 days of river crest allowing a margin of available freeboard

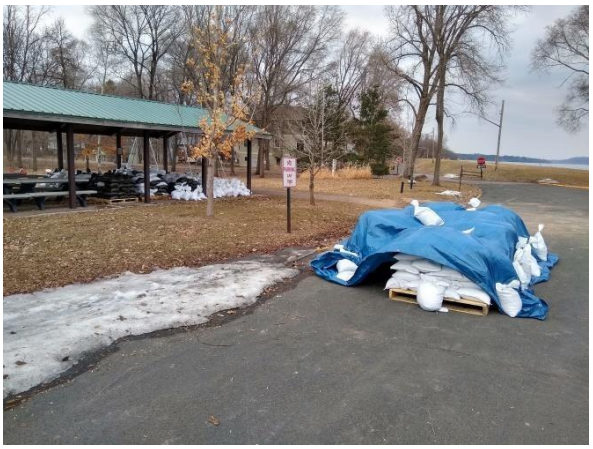


Inland flooding crest level at Redwing Av. S. and Upper 19th St.

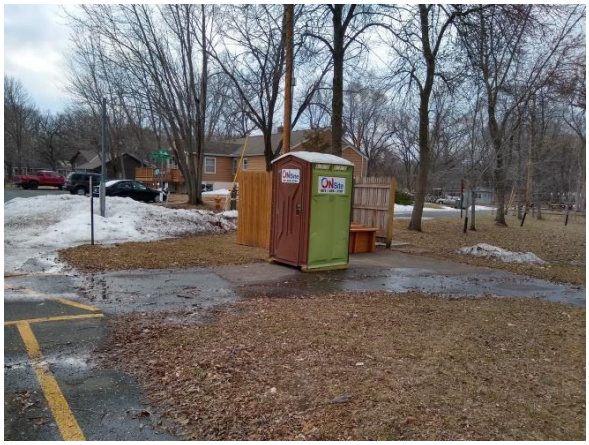
2019 Spring Flood – Major Flood (Predicted 689.00)



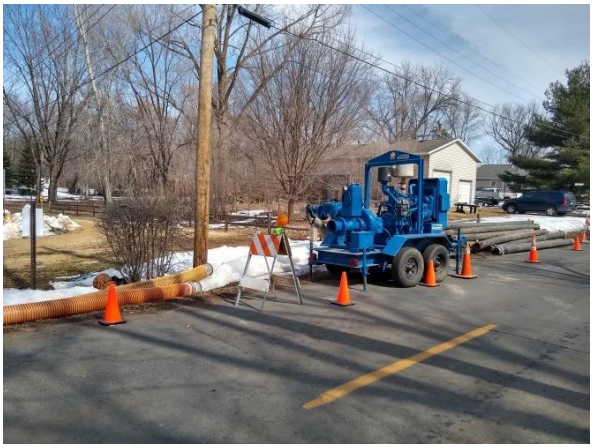
17TH St. culvert tube is staged with pallet of sandbags if needed to set-up



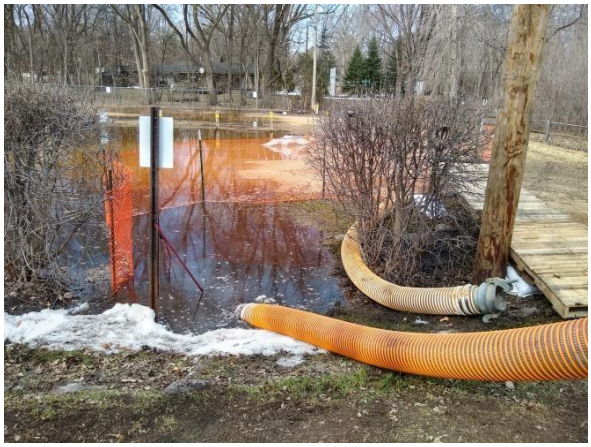
Sandbags are positioned under pavilion and covered so they don't absorb rain



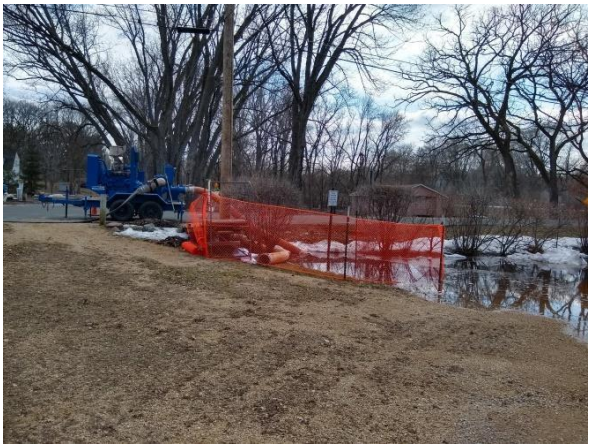
Portable toilet is stationed at the beach park



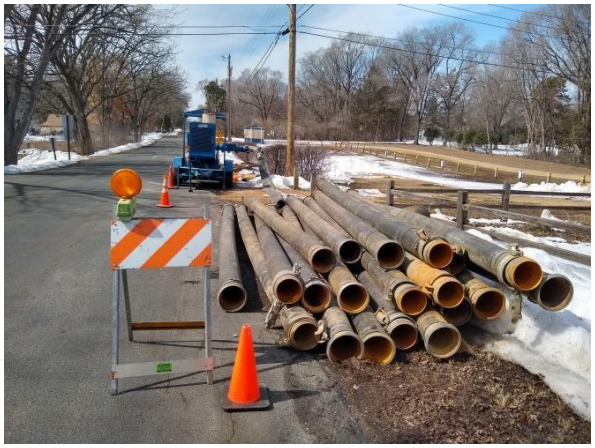
8" pump is delivered with more than 400 feet of intake and discharge hose



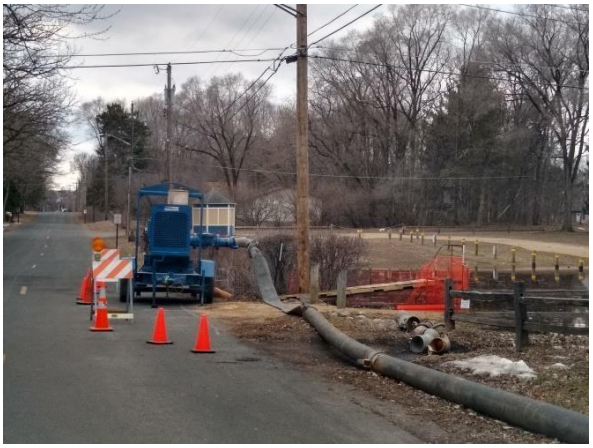
Intake hose is station and set-up at beach parking lot culvert



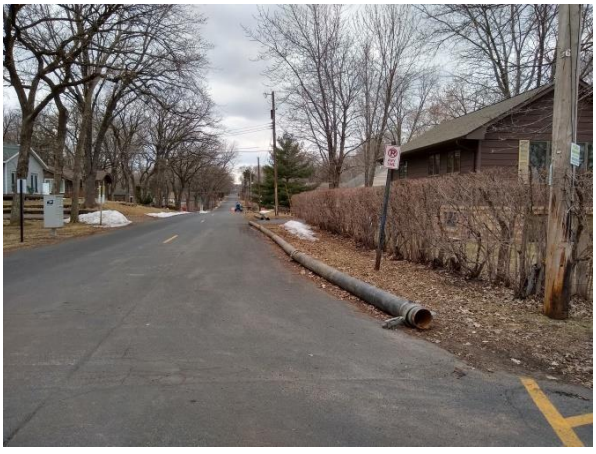
Fencing is placed around suction area to hold back debris from entering intake



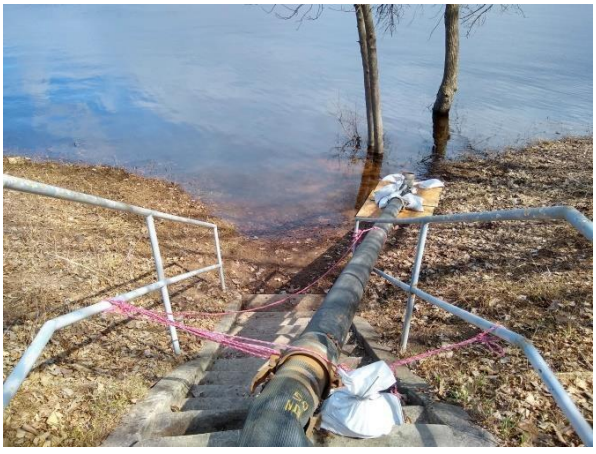
Hard casing discharge hose is stationed and ready for deployment when needed



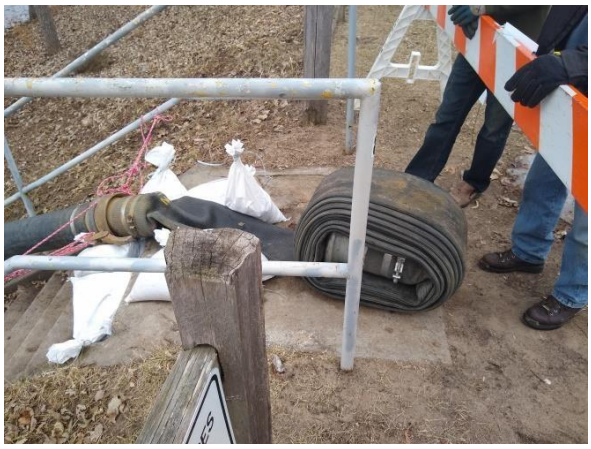
Collapsible hose is connected to discharge port and then connected to hard casing discharge hose



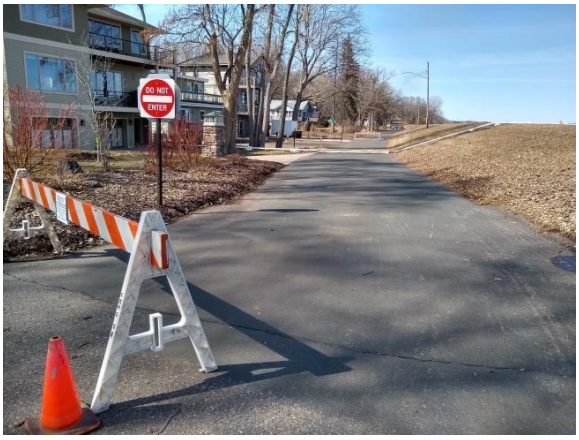
Discharge hose is positioned on edge of street leading to riverbank stairway



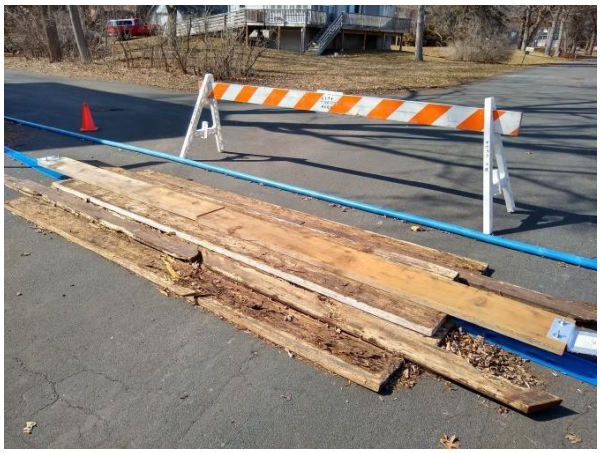
Last section of hard casing discharge hose is secured to staircase with 90 degree elbow pointed up attached at end



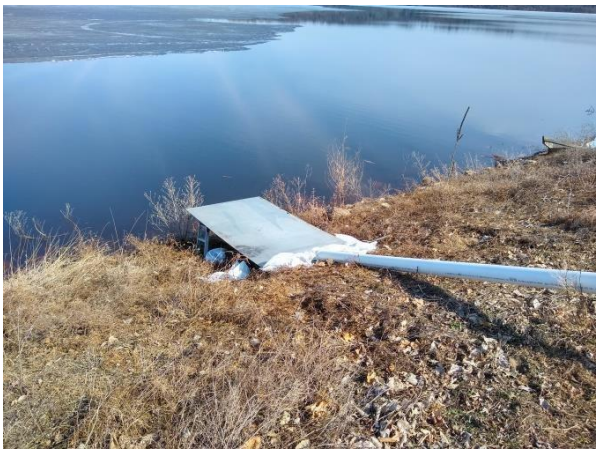
Collapsible hose is rolled up until required to be connected to discharge hose



Barricades at two points along Riviera Av. S. help with local pumping discharge

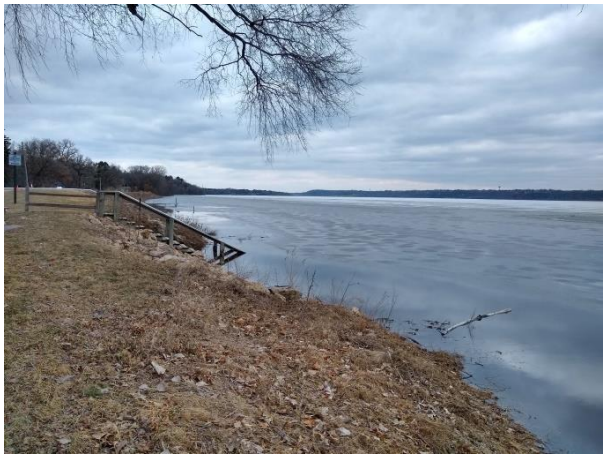


Neighbors protect their pumping efforts with planks in addition to city barricades

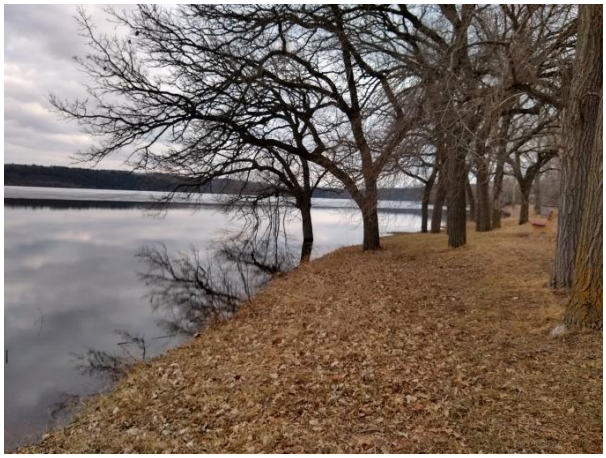


Neighborhood pumping efforts include shielding riverbank from erosion

2019 Spring Flood April 1 Crest Date #1 (River: 688.74)

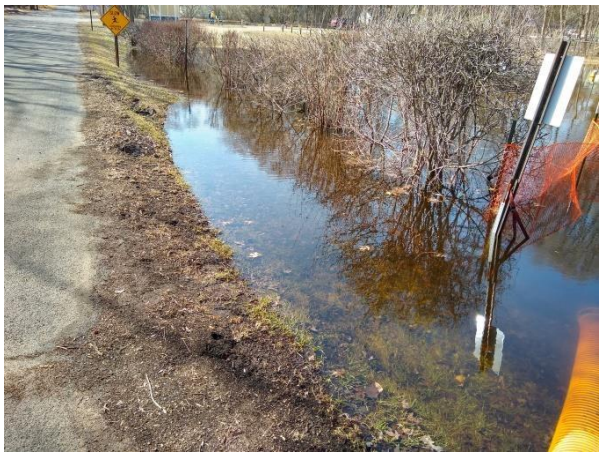


River crest elevation at north beach wood stairway showing ample freeboard

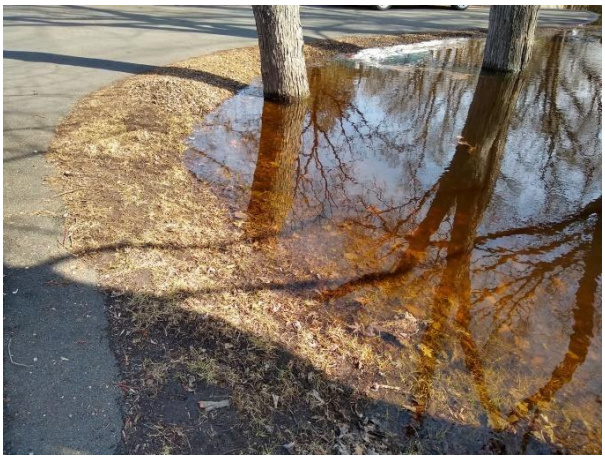


Southward view of river crest elevation and freeboard in front of beach park

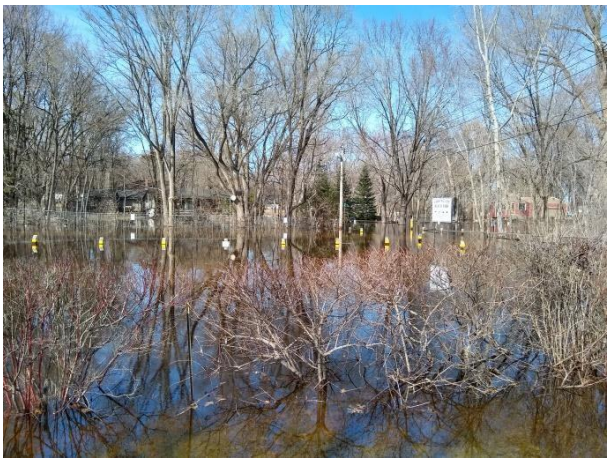
2019 Spring Flood April 3 Crest Date #1 (Inland Crest)



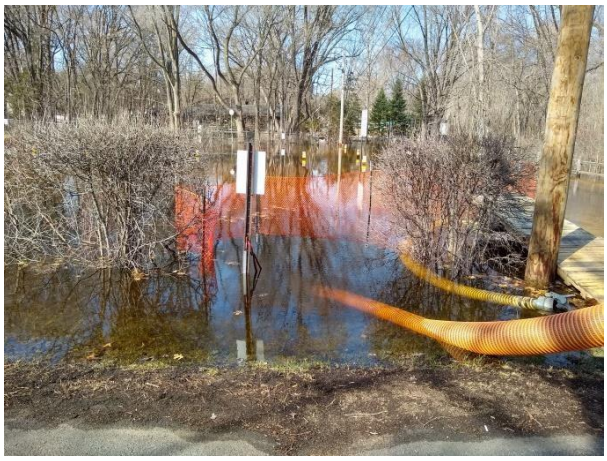
Inland crest shows maximum limit of beach parking lot freeboard without pumping



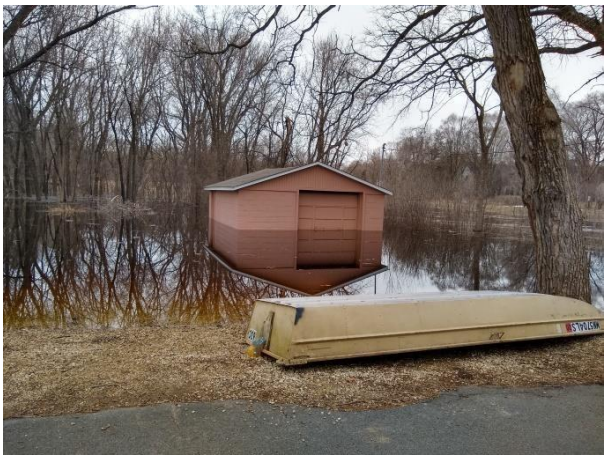
Inland crest level at garage lot culvert area showing maximum freeboard limit



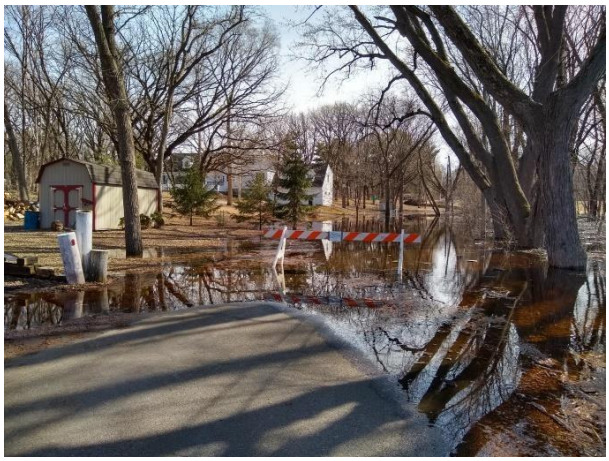
Inland water level at beach parking lot



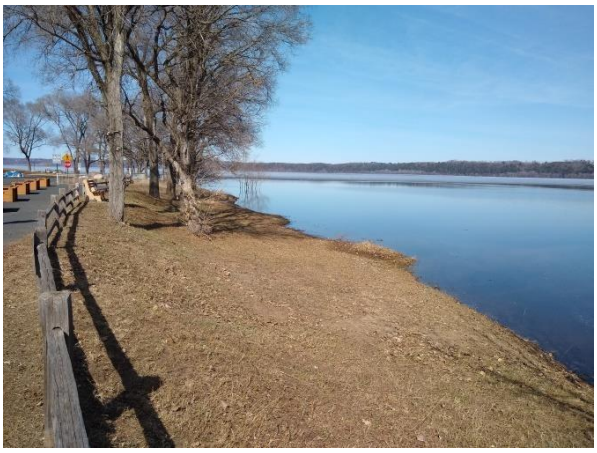
Beach parking lot culvert pumping station showing flexible intake hose



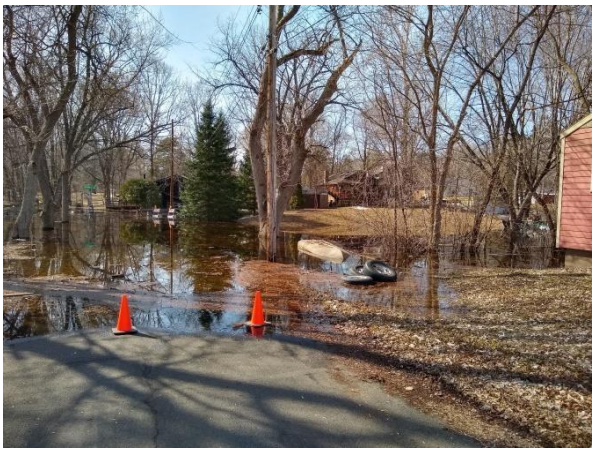
Inland crest level at city garage



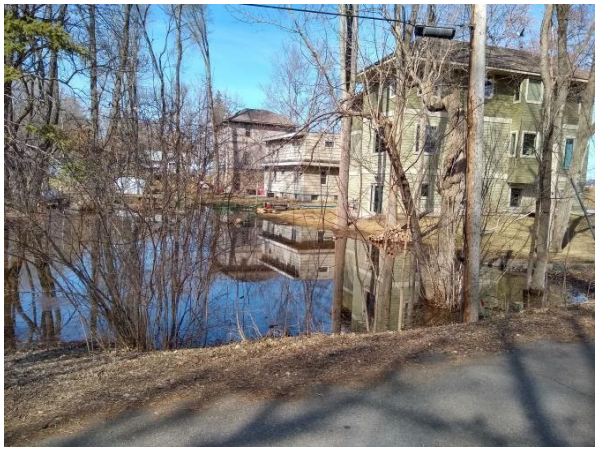
Inland crest level spreads over Redwing Av. S. just south of 20th St. by city garage



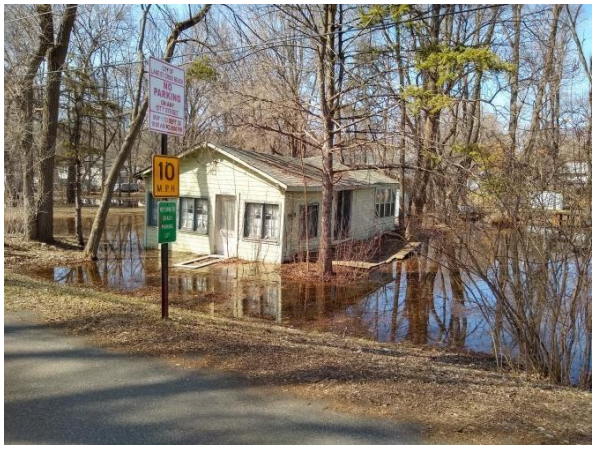
River level (at inland crest) covering all of public beach area



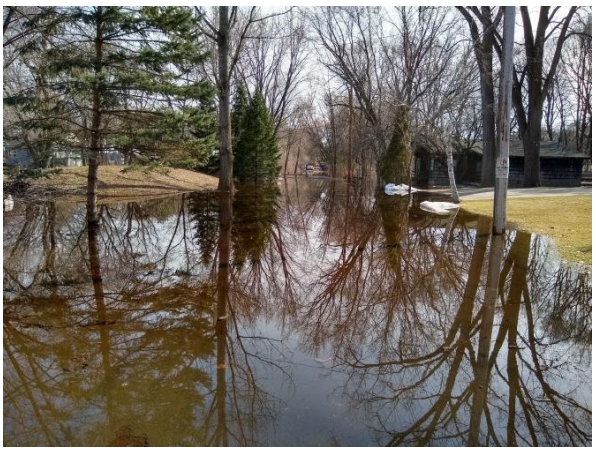
Inland crest level spreads over Redwing Av. S. and Upper 19th St.



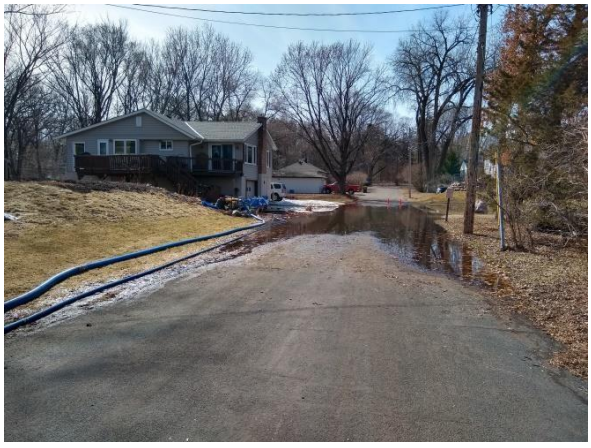
Inland crest level behind Riviera homes and along 19th St. (They pump over Levee 1)



Inland crest level includes area next to Riviera homes and along 19th St.



Inland crest level covering Redwing Av. S. just south of 19th St.



Inland crest level includes small low-laying area along 18th St.