#265201v2 – Racine Co HMP Chapter 5 Draft Text
500-1147
JED/KMM/mid
4/24/23; 3/6/23; 2/14/2023; 10/10/2022

SEWRPC Community Assistance Planning Report No. 266 (4th Edition)

RACINE COUNTY HAZARD MITIGATION PLAN UPDATE: 2023-2028

Chapter 5

HAZARD MITIGATION STRATEGIES

5.1 PLANNING FOR HAZARD MITIGATION MEASURES

Hazard mitigation planning may be defined as the systematic evaluation of the nature and vulnerability of hazards present, along with the development and implementation of sustained actions to reduce or eliminate long-term risks from hazards and their effect. Specific purposes of hazard mitigation include eliminating loss of life, lessening of danger to human health and safety, minimizing monetary damage to private and public property, reducing the cost of utilities and services, and minimizing disruption in community affairs. Hazard mitigation also involves avoiding both intensification of existing hazards and creation of new hazards.

The preparation of a hazard mitigation plan for Racine County involves the development and evaluation of alternative mitigation measure plan elements and the synthesis of the most effective elements into an integrated plan. Some of the mitigative measures described are ongoing or committed actions, which do not require the evaluation of alternative measures, but are proposed to be integrated into the mitigation plan as such. For other hazards, there may be only one or a number of integrated viable options. In these cases, alternatives are not presented, and cost-effectiveness is not specifically addressed, but is implied by the nature of the mitigation measures. In other instances, where there are viable alternatives, such alternatives are described and evaluated. This chapter describes the hazard mitigation measures considered to resolve the identified hazard problems within Racine County.

Measures have been identified and evaluated for each of the hazards for which a vulnerability analysis was developed as set forth in Chapter 3.

In preparing updates to the plan, the Racine County Hazard Mitigation Plan Local Planning Team reviewed and reevaluated the hazard mitigation goals for the County (see Chapter 4 of this report). This review included consideration of whether the goals of the initial plan were still applicable and whether additional goals should be added. In addition, the Local Planning Team also reviewed and reevaluated hazard conditions within the County (see Chapter 3 of this report). This review included reevaluation of the identification of the hazards likely to affect the County, updating the data upon which the profiles of the extent and severity of hazard events which occurred in the County were based, reassessment in light of the updated data of the vulnerability and risk associated with each type of hazard, and reevaluation as warranted by the updated assessments of the potential for changes in hazard severity and risk under future conditions. This review and reevaluation of hazard mitigation goals and hazard conditions, along with consideration of changes in conditions within Racine County since the drafting of the initial plan and progress in implementing the initial hazard mitigation plan and first plan update, served as the basis for the Local Planning Team's review and reevaluation of viable measures to reduce vulnerability to hazards identified in the updated risk assessment and its selection of priority mitigation measures to address those hazards. The activities of the Racine County Hazard Mitigation Plan Local Planning Team are documented in Appendix A of this report.

5.2 HAZARD MITIGATION PLAN COMPONENT FOR INLAND FLOODING (STORMWATER, RIVERINE, INLAND LAKE, DAM FAILURE)

The flooding and related stormwater drainage problem mitigation plan for Racine County consists of five elements: a floodplain and environmentally sensitive lands preservation element; a floodplain management element; a stormwater management element; a public information and education element; and an additional plan element. Each element of the plan is an important component of the overall strategy for reducing flood risk and flood damage. Some aspects of the overall plan are already being implemented in the form of existing and ongoing activities being carried out by the County and local units of government that contribute toward realizing the flood mitigation goals and objectives.

Floodplain and Environmentally Sensitive Lands Preservation Element

Floodplain management regulations and programs perform critical roles toward assuring that flood mitigation efforts are properly implemented. Racine County and the municipalities within the County currently have several pertinent floodplain management regulations and programs in place, most notably in the form of zoning regulations and other ordinances, and environmentally sensitive area and open space

preservation policies. A significant portion of the environmentally sensitive lands within the County, including wetlands, shorelands, and floodplains, are under protective ownership and/or zoning.

Floodplain Zoning and Wetland Preservation Zoning

Floodplain management regulations include the floodplain district zoning ordinances and shoreland or shoreland wetland zoning ordinances. The floodplain zoning ordinances are intended to preserve the floodwater conveyance and storage capacity of floodplain areas and to prevent the location of new flood-damage-prone development in flood hazard areas. The shoreland and wetland preservation zoning ordinances seek to maintain the stormwater and floodwater storage capacity of wetlands in the County and prohibits certain land uses detrimental to shoreland and wetland areas. More information regarding each of these ordinances is set forth in Chapter 2 of this report. Implementation of these ordinances on an ongoing basis is an integral part of the County flood mitigation strategy.

Environmentally Sensitive Area and Open Space Preservation Actions

The preservation of environmentally sensitive areas (i.e. environmental corridors and certain other important natural features) can assist in the prevention of increased flood flows and associated problems. These areas often include the most significant floodplains, shorelands, wetlands, surface waters, woodlands, and prairies within a given area. The preservation of wetlands is of particular importance because wetlands often afford natural filtration and floodwater storage. In addition, the intrusion of intensive urban land uses into environmentally sensitive areas may result in the creation of serious and costly problems, such as failing foundations for pavements and structures, wet basements, excessive operation of sump pumps, excessive clear-water infiltration into sanitary sewerage systems, and poor drainage. Destruction of ground cover may result in soil erosion, stream siltation, more rapid runoff, and increased flooding.

The regional land use plan described in Chapter 2 of this report includes provisions to preserve the environmentally sensitive areas comprised of primary environmental corridors, secondary environmental corridors, and isolated natural resource areas. This regional plan forms the framework for local land use planning by the local units of government in the County. In 2010, there were 34 park and open space sites owned by the County, encompassing 2,788 acres. In addition, there were 21 State owned recreation and open space sites within the County, totaling 3,863 acres. The current status of ownership of park and open space sites by the County and State is shown on Map 5.1. In 2013, the County completed an update to their park and open space plan which provides for the preservation of environmental corridors and isolated natural resource areas. The open space preservation element of that plan is summarized on Map 5.2. This

element recommends that 4,964 acres be acquired by Racine County, the State of Wisconsin, local governments within the County, and nonprofit conservation organizations operating in the County.

Racine County has been active in promoting and assisting local units of government in the County in preparing land use plans which are consistent with the Regional and County objectives for preservation of environmentally sensitive lands. In addition, all of the municipalities with significant areas of environmental corridors and/or isolated natural resource areas, have local land use and/or park and open space plans completed or underway which are consistent with the Regional and County plans with regard to preservation of environmentally sensitive lands.

Wetland Restoration to Reduce Crop and Property Damages

Wetlands and floodplains can provide natural storage areas for floodwaters during heavy rain events or melting snow. Restoring the natural function of former wetland areas can be an effective strategy to reduce potential flood damages in downstream areas. According to the USEPA, a one-acre wetland can typically store about three acre-feet of water, or one million gallons. Wetland vegetation can slow flood water down in addition to providing infiltration and evapotranspiration benefits. Increasing flood storage capacity in Racine County through restoration of wetlands may also help communities adapt to, and reduce, the potential impacts of climate change.

As discussed in Chapter 2 of this report, Racine County had a little over 19,000 acres of wetland in 2015 (see Table 2.5). However, this is only a fraction of the wetlands that existed in pre-settlement years. Urbanization and agricultural development have altered the landscape with regard to wetlands and surface water drainage characteristics in the County, leading to increased volumes of runoff and flooding. To facilitate drainage of wetland and other low lying areas for cultivation, drain tile were installed. Through channelization and installation of these drain tile systems, farmers attempted to protect their crops by lowering the groundwater table and increasing the capacity to convey water downstream. Channelization and diking of stream channels can also reduce the connection between the channel and the overbank areas during floods, causing higher flood levels and velocities.

Examination of the Racine County 1837 plat maps indicate that large swaths of land were covered in wetlands and open marsh, particularly in the Town of Norway. Field notes from the 1837 survey indicated that some areas of "open marsh" south and east of what is now Wind Lake were too deep for the surveyor to walk through. Today much of this area is cultivated, predominantly as sod farms.

In addition to storing flood waters and potentially reducing property damages due to flooding downstream, returning marginally productive agricultural lands to their original wetland or marsh condition would significantly reduce annual crop damages. In 2015, there were approximately 10,497 acres of agricultural land located within the 1-percent-annual-probability (100-year recurrence interval) flood hazard area in Racine County, making them susceptible to riverine flooding during large storm events. Despite the installation of extensive drain tile systems, some agricultural areas in the County continue to have poor drainage. As indicated in Table 3.4, over $8.8 million in crop damages have been reported due to flooding in Racine County from 2001 through 2021. The average annual reported damages are approximately $443,800 per year. It should be noted that economic losses resulting from damage to crops often go unreported and records of crop losses prior to 1989 are spotty. Therefore, these estimated economic losses clearly represent an underestimate of actual damages that have occurred in the County.

The WDNR has developed a digital dataset to identify areas of former wetlands that were drained and converted to agricultural uses. The WDNR refers to these areas as potentially restorable wetlands. To be considered a potentially restorable wetland, an area must have hydric soils, must not be currently mapped as a wetland, and have a land use compatible with restoration techniques. There are about 22,500 acres of potentially restorable wetlands in Racine County. Of the 22,500 acres of potentially restorable wetland, there are about 1,190 acres that are within the 1-percent-annual probability flood hazard area and were being farmed according to the SEWRPC 2015 land use inventory. The location of these areas are shown on Map 5.3.

Agricultural lands are prime candidates for wetland restoration because they are in undeveloped, open space uses, and because there are Federal and State programs available to support conversion of certain agricultural lands to wetlands. Conversion of agricultural lands could be done through land purchases, donation, or easements. Some programs provide a percentage of the restoration costs as well as an annual rental rate. In some instances, farmers may be able to plant a harvestable grass crop for hay. In other instances, land may be purchased or permanently placed into conservation easement by willing land owners, restricting development and eliminating the chance that these open areas may be placed into more impervious urban land uses in the future.

The floodprone agricultural areas in the Town of Norway drained by the Wind Lake Canal were analyzed in a 1975 drainage and water level control plan. That study indicated that there were approximately 4,200 acres of cropland subject to flooding or impaired drainage during a flood which would result from a 10-year recurrence interval rainfall event. Of these 4,200 acres, about 2,000 acres of land actually sustain crop

damage during flood events. The study estimated the average annual crop damages on those lands to be $186,000, or $92 per acre in 1975. Using the Consumer Price Index (CPI) to convert the damages to 2021 dollars, about $933,862 in damages are estimated to occur in this area annually, or about $466 per acre. This floodprone area makes up about two percent of the agricultural land in Racine County and accounts for over 53 percent of the County's annual average crop damages.

The restoration of selected wetlands currently in agricultural uses in Racine County is one alternative flood mitigation measure to be considered in addition to the structural flood mitigation measures that are discussed separately for each watershed below. The implementation of this alternative may affect decisions to implement other structural alternatives. In addition, some of the areas identified on Map 5.3 may also be recommended to be acquired by a governmental entity or nonprofit conservation organization as part of the environmentally sensitive areas and open space preservation element discussed in the section above.

If all of the areas shown on Map 5.3 were taken out of agricultural production, crop losses due to flooding could potentially be reduced by up to 11.3 percent, or about $50,311 per year based on reported losses. Additional mitigation of potential downstream property damage is also possible. Wetland restoration projects would potentially have the additional benefits of fish and wildlife habitat improvements, erosion control, water quality improvements, and recreational opportunities.

When opportunities present themselves on a particular tract of land, wetland restoration should be considered. This alternative would be implemented as a voluntary program, considered at the discretion of each individual property owner.

Floodplain Management Element

Mitigation measures specifically pertaining to floodplain management in each watershed in the County are described in the following subsections of this report. It should be noted that, as reported in Chapter 3, as of August 2022, there are six structures considered by the Federal Emergency Management Agency (FEMA) to be repetitive- or substantial-loss properties in Racine County. This represents no increase of structures since development of the last update to the County all hazards mitigation plan.

Floodplain Management Plan for the Fox River Watershed

In 1970, SEWRPC adopted a comprehensive plan for the physical development of the Wisconsin portion of the Fox River watershed. That plan was further amended as it affects Racine County in 1975 and 1995. In preparing that plan a concerted effort was made to offer for public evaluation a full range of physically

feasible alternative plan elements that might satisfy one or more agreed-upon watershed development objectives. Each alternative plan element was evaluated insofar as possible in terms of technical, economic, and legal feasibility, and public acceptability, as well as with respect to satisfaction of the watershed development objectives. The alternative plan elements can best be conceptualized in terms of various combinations of land use patterns and water control facilities. A number of alternatives incorporating both structural and nonstructural measures were explored in the preparation of the plan. The flood control alternatives considered for the Racine County portion of the Fox River watershed include: 1) floodplain evacuation; 2) levee and dike construction and channel improvement; 3) storage facility construction; and 4) lake level control.

Priority Mitigation Measures

After consideration of the technical and economic feasibility of the various alternatives, a final strategy for alleviating problems due to flooding in the Racine County portion of the Fox River watershed was developed and adopted by the Fox River Watershed Committee. Some of these measures were then adapted for current conditions for use in the current hazard mitigation planning program. The plan calls for the following measures:

- Preserve the remaining primary environmental corridor lands along the Fox River and its major tributaries in essentially natural open space uses (primary environmental corridors within Racine County are shown on Map 2.3). The corridors are to be preserved by a combination of public acquisition for parkway purposes and floodland and open space zoning.

- Reevaluate the need for dikes or additional floodwalls in the City of Burlington, considering the City redevelopment actions as well as the ongoing FEMA Risk MAP program. The 1970 Fox River study proposed a combination of earthen dikes and concrete floodwalls that would be constructed along both sides of the Fox River throughout most of the City, and along portions of both sides of the White River between the Echo Lake dam and the confluence with the Fox River. Floodwalls along the developed areas of downtown Burlington have been raised from the elevation of the 1-percent-annual-probability floodplain to six inches above that elevation. The Fox River study also recommended automatic backwater gates to be installed on existing storm sewer outfalls. The need for additional facilities should be reevaluated, given the recent City of Burlington downtown redevelopment actions which have been designed to alleviate flooding problems.

- Continue implementation of the emergency action plan for flooding that was developed in 1997 for the Town of Norway Sanitary District No. 1. About 32 percent of the land located within the Sanitary District's boundary is identified as floodplain. The emergency action plan sets forth procedures for maintaining a flood warning system for the township, including identification of pertinent emergency agencies, locations of emergency shelters, evacuation procedures, and procedures for maintaining services in the event of flooding.

- Structure floodproofing, relocation, or removal of up to 435 structures identified using geographic information system techniques and color orthophotography as potentially being located in the 1-percent-annual-probability floodplain. While this number of structures may include some agricultural structures, no garages or small outbuildings are included in this total. In this regard, when implementation of floodproofing, relocation, or removal measures is being considered, field surveys should be made of those structures identified as being located within the floodplain to obtain a more definitive assessment of their flood hazard status. Where LiDAR topographic data are available, applicants for Letters of Map Amendment (LOMA) may submit LiDAR data to FEMA in lieu of a certified elevation study by a professional engineer or land surveyor provided certain standards are met. Furthermore, this plan element is presented as an option, subject to the preference of the individual property owner. As noted in Chapter 3, there are six structures considered by FEMA to be repetitive- or substantial-loss properties in Racine County, four of which are located within the Fox River watershed. Projects involving acquisition and demolition of properties within the 1-percent-annual-probability floodplain are the highest priority for Wisconsin Emergency Management (WEM) when funding is available. Acquisition and demolition of repetitive- or substantial-loss properties should have highest priority, followed by other structures confirmed to be within the 1-percent-annual-probability floodplain after field survey.

- Replace two 20-foot-wide radial gates at the Waterford Dam.

- Maintenance removal of sediment and debris from the Fox River channel at selected locations upstream of the Waterford Impoundment.

- Purchase of up to 370 acres of agricultural land that is subject to frequent flooding and impaired drainage in the Town of Waterford.

- Installation of two additional 16-foot by five-foot radial gates in the Rochester Dam.

- Maintenance dredging along about 50 acres of shallow bays and other areas in the Waterford Impoundment.

- Complete channel clean out operations of the Wind Lake Drainage Canal every 20 to 25 years.

- Continued cleanout and maintenance of the Muskego Canal.

The following recommendations from the 1970 Fox River watershed study which were intended to protect flood-vulnerable agricultural areas, abate agricultural damages, and improve agricultural drainage should be reevaluated to consider current conditions and contemporary, environmentally sound flood mitigation approaches. One potential alternative is presented above in discussion related to wetland restoration of flood-prone agricultural lands shown in Map 5.3.

- Construction of about 211,000 linear feet of dikes along the Wind Lake Canal, the Goose Lake Branch Canal, and other tributary canals. About 40 pumping stations would also be installed.

- Construction of levees and channel widening and deepening along the lower reaches of Hoosier Creek to increase hydraulic capacity of the Creek. This recommendation was designed to contain the 10-year recurrence interval flood.

In addition to the measures outlined above, the floodland management element contains several accessory measures to meet special needs within the watershed. These include: 1) the standards set forth in Chapter 3 relative to bridge replacement to ensure that major streets and highways remain operable during flood events; 2) adoption of boating restrictions along the Fox River upstream from the Waterford Impoundment; 3) participation in the Federal Flood Insurance Program; 4) continuation of desirable lending institution policies concerning the sale of riverine properties; 5) maintain and consider expansion of the existing stream-gaging network in the watershed ; and 6) enforcement of floodplain regulations in the watershed.

As shown in Tables 5.1 and 5.2, the estimated capital cost of implementing the Fox River watershed portion of the Racine County floodland management plan element would be $88,888.1 (in 2021 dollars). Tables 5.1 and 5.2 also show the current implementation status of each plan element.

In 1977 the west spillway of the Waterford Dam was reconstructed with the control gates that were recommended in SEWRPC's 1970 Fox River comprehensive watershed report. In 1978 the east spillway was

reconstructed. Water level sensors and automated gate controls were also installed at that time. Due to operational problems, these sensors and gate controls were abandoned in 1980, with the gates now being operated manually. As discussed above, two radial gates and one actuator motor were replaced on the Waterford Dam in 2016.

The additional control gates that were recommended in SEWRPC's 1970 Fox River comprehensive watershed report have also been installed in the Rochester Dam. Some maintenance dredging has been carried out within the Waterford Impoundment, along with removal of debris from the Fox River channel. In 1993, the Muskego Canal was cleared and deepened as part of a lake rehabilitation project for Big Muskego Lake.

Floodplain Management Plan for the Root River Watershed

In 1966, SEWRPC adopted a comprehensive plan for the Root River watershed. That plan was further amended as it affects portions of Racine County in 1990. In preparing that plan a concerted effort was made to offer for public evaluation a full range of physically feasible alternative plan elements that might satisfy one or more agreed-upon watershed development objectives. Each alternative plan element was evaluated insofar as possible in terms of technical, economic, and legal feasibility, and public acceptability, as well as with respect to satisfaction of the watershed development objectives. The alternative plan elements can best be conceptualized in terms of various combinations of land use patterns and water control facilities. A number of alternatives incorporating both structural and nonstructural measures were explored in the preparation of the plan. The flood control alternatives considered include: 1) channel modification; 2) channel clearing and maintenance; 3) construction of peak flow diversion channels to Lake Michigan; 4) construction of a multi-purpose reservoir; 4) preservation of existing floodplain areas in essentially natural open uses; 5) structure floodproofing and 6) structure removal.

In addition to the Racine County portion of the Root River watershed, alternative floodplain management measures have also been evaluated that address upstream flooding problems in Milwaukee County through the Milwaukee Metropolitan Sewerage District's (MMSD) watercourse planning program. As part of the evaluation of those alternatives, including their potential impact on flooding in Racine County, flood discharges and stages were developed for the Root River main stem through Racine County. That evaluation was designed to ensure that measures implemented in Milwaukee County do not compound problems in Racine County. Flooding problems in the Milwaukee County portion of the Root River watershed are under the Milwaukee Metropolitan Sewerage District's (MMSD) jurisdiction. Additionally, SEWRPC is currently

conducting an update to floodplain mapping for the Milwaukee County Land Information Council and MMSD that includes hydrologic modeling for the Racine County portion of the Root River watershed.

FEMA is now emphasizing flood mitigation under Risk MAP; therefore, participating in the program may be an effective approach for Racine County to work with WDNR and FEMA to conduct flood mitigation planning to develop alternatives that address the concentrated flood problems in the County. The projected schedule for initiating the Risk MAP program in the Root River watershed has not yet been established. As was discussed in the previous paragraph, SEWRPC is developing a hydrologic model to compute flood flows for the Root River watershed. Flood flows from that hydrologic modeling could be coupled with hydraulic models developed under a potential Risk MAP program and applied to delineate revised floodplain boundaries and to analyze flood mitigation measures along the Root River mainstem and its tributaries in the County.

Priority Mitigation Measures

After consideration of the technical and economic feasibility of the various alternatives, a final strategy for alleviating problems due to flooding in the Racine County portion of the Root River watershed was developed and adopted by the Root River Watershed Committee. Selected mitigation measures were subsequently adapted for current conditions for use in the hazard mitigation planning program. The plan calls for the following measures:

- Preserve the remaining primary environmental corridor lands along the Root River and its major tributaries in essentially natural open space uses (primary environmental corridors within Racine County are shown on Map 2.3). The corridors are to be preserved by a combination of public acquisition for parkway purposes and floodland and open space zoning.

- Channel clearing and maintenance on the Root River Canal, including its east and west branches. Specifically, the plan proposes channel debrushing and cleaning along about 8.3 miles of the West Branch of the Root River Canal from a point one-half mile downstream of the CP Rail System bridge near the Village of Union Grove to the confluence with the East Branch, along 9.6 miles of the East Branch of the Root River Canal from CTH E in Kenosha County to its confluence with the Root River Canal, and along 4.0 miles of the Root River Canal from its confluence with the East and West Branches to County Line Road in Milwaukee County. The plan does not contemplate any major channel deepening or widening, but would improve the operation of agricultural drain tiles and, to a limited extent, reduce agricultural flood damages.

- Structure floodproofing or removal of up to 196 structures identified using geographic information systems techniques as potentially being located in the 1-percent-annual-probability floodplain. While this number of structures may include some agricultural structures, no garages or small outbuildings are included in this total. In this regard, field surveys should be made of those structures identified as being located within the 1-percent-annual-probability floodplain to obtain a more definitive assessment of their flood hazard status. Where LiDAR topographic data are available, applicants for Letters of Map Amendment (LOMA) may submit LiDAR data to FEMA in lieu of a certified elevation study by a professional engineer or land surveyor provided certain standards are met. Furthermore, this plan element is presented as an option, subject to the preference of the individual property owner. The number of structures identified has increased substantially since the initial hazard mitigation plan as a result of revisions to the 1-percent-annual-probability floodplain. As noted in Chapter 3, there are six structures considered by FEMA to be repetitive- or substantial-loss properties in Racine County, two of which are located in the Root River watershed. Projects involving acquisition and demolition of properties within the 1-percent-annual-probability floodplain are the highest priority for Wisconsin Emergency Management (WEM) when funding is available. Acquisition and demolition of repetitive- or substantial-loss properties should have highest priority, followed by other structures confirmed to be within the 1-percent-annual-probability floodplain after field survey.

- Take actions to meet the established WDNR requirement to either increase the spillway capacity of the Horlick dam to safely pass the peak flow during a 1-percent-annual-probability flood, or demolish and remove the dam by 2024.

In addition to the measures outlined above, the floodplain management element contains several accessory measures to meet special needs within the watershed. These include: 1) application of the standards set forth in Chapter 4 relative to bridge replacement to ensure that major streets and highways remain operable during flood events, 2) participation in the Federal Flood Insurance Program, 3) continuation of desirable lending institution policies concerning the sale of riverine properties, 4) maintenance of the existing stream-gaging network in the watershed, and 5) enforcement of floodplain regulations in the watershed.

As shown in Table 5.3, the estimated capital cost of implementing the Root River watershed portion of the Racine County floodland management plan element would be $39,827,400 (2021 dollars). Table 5.3 also shows the current implementation status of each plan element.

Some elements of the floodland management plan that have been implemented to date include channel clearing along the east and west branches of the Root River Canal in the early 1980s and again in 2009 through 2015. A Racine County parkway acquisition program has also been established.

Floodland Management Plan for the Pike River Watershed

In 1983, SEWRPC adopted a comprehensive plan for the physical development of the Pike River watershed. That plan was further amended as it relates to Racine County in 1987, 1996, and 1997. In the preparation of that plan, a concerted effort was made to offer for public evaluation a full range of physically feasible alternative plan sub-elements that might satisfy one or more agreed-upon watershed development objectives. Each alternative floodland management sub-element was evaluated insofar as possible in terms of technical and economic impact, financial and legal feasibility, and public acceptability, as well as with respect to satisfaction of the watershed development objectives.

In a manner similar to that used in the preparation of the plans for the Fox and Root River watersheds, a number of alternatives were explored in the preparation of the floodland management element of the Pike River watershed plan. A total of five structural floodland management measures were identified for possible application, whether individually or in various combinations, to specific floodprone reaches of the watershed: 1) storage; 2) floodwater diversion; 3) dikes and floodwalls; 4) channel modification and enclosure; and 5) bridge and culvert alteration or replacement. A total of 12 nonstructural measures were likewise identified for possible inclusion in the floodland management element of the watershed plan: 1) reservation of floodlands for recreational and related open space use; 2) floodland regulations; 3) control of land use outside of floodlands; 4) community education programs; 5) flood insurance; 6) lending institution policies; 7) realtor policies; 8) community utility policies; 9) emergency programs; 10) structure floodproofing; 11) structure removal; and 12) channel maintenance. Various combinations of structural and nonstructural management measures were evaluated for each of the most floodprone reaches in the watershed.

Priority Mitigation Measures

After consideration of the technical and economic feasibility of the various alternatives, a final strategy for alleviating problems due to flooding in the Racine County portion of the Pike River watershed was developed and adopted by the Pike River Watershed Committee in the previous plan update. The watershed study was further refined in 1987, 1996, and 1997. Selected mitigation measures were subsequently adapted for current conditions for use in the current hazard mitigation planning effort. The plan calls for the following measures:

- Preserve of the remaining primary environmental corridor lands along the Pike River and its major tributaries in essentially natural open space uses (primary environmental corridors within Racine County are shown on Map 2.3). The corridors are to be preserved by a combination of public acquisition for parkway purposes and floodland and open space zoning.

- Complete the final phases of the Pike River improvement project. As of January 2017, the construction of all nine phases of the project have been substantially completed. Maintenance and monitoring of the project is currently underway. This project is described in more detail in the section above.

- Construct an earthen berm upstream of Old Spring Street to protect residential structures along the Bartlett Branch. The berm would be about 500 feet long, with an average height of about five feet.

- Replacement of the Chicory Road crossing of Sorenson Creek with a new clear-span bridge having a waterway opening of about 30 feet.

- Structure floodproofing or removal of up to 48 structures--identified using geographic information systems techniques and color orthophotographs as potentially being located within the 1-percent-annual-probability floodplain--that would not be removed through the structural measures noted above. This number was determined using the 2012 FEMA floodplain mapping which reflects construction of Phases 1 through 5 of the nine-phase project to restore the riverine environment and reduce flooding along the Pike River in the Village of Mount Pleasant. Phases 6 through 9 of the Pike River improvements project are not reflected in the 2012 FEMA floodplains. Construction that was completed after 2012 may remove additional structures from the 1-percent-annual-probability floodplain. While the 48 structures remaining within the floodplain may include some agricultural structures, no garages or small outbuildings are included in this total. At such future time that floodproofing or removal of those structures is considered, field surveys should be made of those structures to obtain a more definitive assessment of their flood hazard status. Where LiDAR topographic data are available, applicants for Letters of Map Amendment (LOMA) may submit LiDAR data to FEMA in lieu of a certified elevation study by a professional engineer or land surveyor provided certain standards are met. Furthermore, this plan element is presented as an option, subject to the preference of the individual property owner. Projects involving acquisition and demolition of properties within the 1-percent-annual-probability floodplain are the highest priority for Wisconsin Emergency Management (WEM) when funding is available. None of the six structures in Racine

County considered by FEMA to be repetitive- or substantial-loss properties are located in the Pike River watershed.

In addition to the measures outlined above, the floodland management element contains several accessory measures to meet special needs within the watershed. These include: 1) the standards set forth in Chapter 3 relative to bridge replacement to ensure that major streets and highways remain operable during flood events; 2) participation in the Federal Flood Insurance Program; 3) continuation of desirable lending institution policies concerning the sale of riverine properties; 4) maintain the existing stream-gaging network in the watershed ; and 5) enforcement of floodplain regulations in the watershed.

As shown in Table 5.4, the estimated capital cost of implementing the Pike River watershed portion of the Racine County floodland management plan element would be $33,154,200 (in 2021 dollars). Table 5.4 also show the current implementation status of each plan element. The capital cost for those elements that remain to be implemented is estimated at $10,624,800.

Elements of the floodland management plan that have been implemented to date include the construction of the earthen berm along the Bartlett Branch, and construction all nine phases of the Pike River improvement project from Spring Street (CTH C) to STH 11. As of January 2017, maintenance and monitoring of the project was underway. As of 2022, the project was completed.

Floodland Management Plan for the Des Plaines River Watershed

In 2003, SEWRPC adopted a comprehensive plan for the physical development of the Des Plaines River watershed. In the preparation of that plan, a concerted effort was made to offer for public evaluation a full range of physically feasible alternative plan elements that might satisfy one or more agreed-upon watershed development objectives. Each alternative floodland management sub-element was evaluated insofar as possible in terms of technical and economic impact, financial and legal feasibility, and public acceptability, as well as with respect to satisfaction of the watershed development objectives.

In a manner similar to that used in the preparation of the plans for the other watersheds in Racine County, a number of alternatives were explored in the preparation of the floodland management element of the Des Plaines River watershed plan. A total of five structural floodland management measures were identified for possible application, whether individually or in various combinations, to specific floodprone reaches of the watershed: 1) storage; 2) diversion; 3) dikes and floodwalls; 4) channel modification and enclosure; and 5) bridge and culvert alteration or replacement. A total of 11 nonstructural measures were likewise identified

for possible inclusion in the floodland management element of the watershed plan: 1) reservation of floodlands for recreational and related open space use; 2) floodland regulations; 3) control of land use outside of floodlands; 4) community education programs; 5) flood insurance; 6) lending institution policies; 7) community utility policies; 8) emergency programs; 9) structure floodproofing; 10) structure removal; and 11) channel maintenance. Various combinations of structural and nonstructural management measures were evaluated for each of the most floodprone reaches in the watershed.

Priority Mitigation Measures

After consideration of the technical and economic feasibility of the various alternatives, a preliminary strategy for alleviating problems due to flooding in the Des Plaines River watershed was developed and adopted by the Des Plaines River Watershed Committee (see Appendix A for committee member list). While there are no directly-flooded structures in the 1-percent-probability floodplain in the Racine County portion of the watershed, the following selected mitigation measures, adapted for current conditions for use in the hazard mitigation planning program, are applicable to management of stormwater runoff and minimization of possible future flooding in the Racine County portion of the watershed, and in downstream areas in Kenosha County. The plan calls for the following measures:

- Preservation of the remaining primary environmental corridor lands along the Des Plaines River and its major tributaries in essentially natural open space uses (primary environmental corridors within Racine County are shown on Map 2.3). The corridors are to be preserved by a combination of public acquisition for parkway purposes and floodland and open space zoning.

- Provision of onsite detention storage facilities for planned new development. Facilities would be designed to limit peak discharges for the 50-percent (two-year recurrence interval) and 1-percent-annual-probability storm events based on the following release rates: 0.04 cfs per acre of development for the two-year event, and 0.30 cfs per acre of development for the 1-percent-annual probability event.

- Restoration of prairie conditions on 6.0 square miles (watershed wide) on agricultural land.

- Restoration of wetland conditions on 3.1 square miles (watershed wide) of agricultural land in the 1-percent-annual-probability floodplain.

In addition to the measures outlined above, the preliminary floodland management element contains the following accessory measures to meet special needs within the Des Plaines watershed:

- Application of the standards set forth in Chapter 3 relative to bridge replacement to ensure that major streets and highways remain operable during flood events.

- Preparation of detailed sub-watershed wide stormwater management system plans for the Village of Union Grove and the urban areas of the Villages of Mt. Pleasant and Yorkville.

- Encouraging the use of floodland areas for outdoor recreation and related open space activities.

- Continued participation in the National Flood Insurance Program.

- Adoption of the 1-percent-annual-probability flood profiles and floodland maps developed for planned land use conditions under the watershed plan. Also updating of Federal Flood Insurance Studies to reflect these flood profiles and maps.

- Amendment of local floodland zoning ordinances to require the provision of compensatory floodland storage to offset the effects of the placement of fill in the floodplain.

- Purchase of Federal flood insurance by property owners in floodprone areas.

- Determination by lending institutions of the floodprone status of properties prior to granting a mortgage.

- Formulation, or continuation, of governmental and agency policies such that the location, use, and size of public utilities and facilities are consistent with the floodprone status of riverine areas identified in the watershed plan.

- Consideration by local communities of the potential hydrologic impact of proposed development or redevelopment and recognition that planned development should occur according to the land use plan presented in the watershed study.

- Revision of local policies and regulations to encourage low impact source controls and stormwater management practices designed to maintain pre-development hydrologic conditions.

- Provide property owners with information regarding the extent of flood hazard areas.

- Incorporate of channel maintenance functions in the operations of responsible governmental units.

- Maintain the U.S. Geological Survey stream gage on the Des Plaines River at Russell, Illinois, and adding, establishing and maintaining a continuous recording gage on the Des Plaines River near CTH K in Kenosha County.

As shown in Table 5.5, the estimated capital cost of implementing the overall Des Plaines River watershed floodland management plan elements would range from $10,487,200 to $12,559,300 (in 2021 dollars), depending on the techniques used for prairie and wetland restoration. This amount represents the cost of implementing those particular measures in both Racine and Kenosha Counties. The cost for Racine County is estimated to be at most $1,014,413 (2021 dollars) and is largely associated with the provision of stormwater detention for new development and conversion of rural lands to wetland and prairie conditions. Table 5.5 also shows the current implementation status of each plan element.

Stormwater Management Element

Because of the relationship between stormwater management and floodland management, stormwater management actions are an important element of the flood mitigation plan. This element of the plan includes the status of stormwater management planning and stormwater ordinances and related regulations.

Stormwater-Related Regulations and Stormwater Management Plans

Chapter 283 of the *Wisconsin Statutes* and Chapter NR 216 of the *Wisconsin Administrative Code* require certain municipalities to obtain State stormwater discharge permits to discharge stormwater to receiving streams and watercourses from municipal storm sewer systems. The *Statutes* and implementing Administrative Code require municipalities to file applications for the State permits. The permit applications must demonstrate that the municipality concerned has the legal authority to control pollutant contributions to storm sewer systems from various sources. The permit application must provide stormwater management-related data, most of which would be provided by a properly prepared, technically sound, stormwater management system plan.

In 2002 the WDNR issued Chapter NR 151 of the *Wisconsin Administrative Code*, outlining standards governing stormwater runoff from both agricultural and nonagricultural lands. Those standards include controls for both the quantity and quality of runoff from newly developed and redeveloped lands. These rules are administered by the WDNR through the Chapter NR 216 stormwater discharge permit system, although local municipalities have the option of adopting their own ordinances consistent with the Administrative Code. Chapter NR 152 of the Administrative Code contains model ordinances covering both agricultural and nonagricultural operations. Those communities that are required to obtain a stormwater discharge permit are required to have a stormwater management program which most often results in adoption of a stormwater management ordinance.

Communities with Wisconsin Pollution Discharge Elimination System (WPDES) stormwater discharge permits include the Cities of Racine and Burlington, the Village of Yorkville, and the Town of Norway. As a part of the permit application process, these communities also have adopted stormwater-related ordinances.

The remaining urban communities in the County are also encouraged to prepare stormwater management plans. In those townships that are anticipated to remain mostly rural under the adopted land use plan, stormwater management planning is considered to be needed only for certain site-specific areas where urbanization is expected or where isolated urban areas already exist and stormwater-related problems have developed.

Public Information and Education Element

Public information, education, and participation constitute an integral aspect of Racine County's flood mitigation and related efforts. This element includes two sub-element activities to be carried out, namely public education activities and public information programming and coordination associated with detailed stormwater and floodland management plans.

Public Education Activities

This sub-element involves preparation and distribution of educational and self-help materials and provision of educational programs. With regard to this sub-element, Racine County and the various municipalities will, as needed, collaborate to prepare and distribute various public informational and educational materials, including materials oriented toward homeowners and designed to help them consider and potentially undertake actions to mitigate damage caused by stormwater flooding and sanitary sewer backups. Methods available include, but are not limited to, social media, cable television, pamphlet development, individual

seminars, the internet, and community speaking engagements. The Wisconsin Department of Health Services has prepared a flooding toolkit for citizens. The toolkit provides general flood information, preparedness tips, and guidelines on cleaning up after a flood has occurred. A factsheet prepared by WEM explains the different types of flood watches and warnings and provides information on what citizens should do if a flood is likely to occur in their area.

In partnership with the City of Racine, Racine County has implemented the CodeRED® Emergency and Weather Notification System to deliver customized prerecorded messages directly to homes and businesses, or to persons traveling through the County via the free mobile app. This service uses a high-speed telephone calling system to a phone number in the CodeRED® database to alert users of significant incidents and events where timely notification of an affected population or geographic area is essential. The pre-recorded message may also provide instructions for action to be taken. Messages will only be sent to individuals and businesses that have registered their home, business, or cellular phone number with the service. Racine County residents who sign up for the additional CodeRED® Weather Warning will automatically receive calls when tornado, flash flood, and severe thunderstorm warnings are issued by the National Weather Service for addresses that are in the path of the storm.

In addition, the County has the capability to issue emergency alerts to cell phones through the Wireless Emergency Alerts (WEA) system. The WEA is a partnership including local and State public safety agencies, FEMA, the Federal Communications Commission (FCC), the Department of Homeland Security (DHS) and the National Weather Service (NWS). Under the WEA system, authorized County officials can send emergency messages to mobile devices of those that may be in harm's way without the need to download an app or subscribe to a service. WEAs are broadcast from area cell towers to mobile devices only in the specific area where there is a danger. These short messages are designed to get the recipient's attention in a critical situation and will look like a text message that will show the type and time of the alert, any action that recipients should take, and the agency issuing the alert. The WEA message includes a special tone and vibration that will be repeated twice. WEA will send alerts for extreme weather warnings including flash flood, tornado, and extreme wind warnings; local emergencies requiring evacuation or immediate action; AMBER Alerts; and Presidential alerts during a national emergency.

Public Participation Activities and Coordination with Other Agencies and Units of Government

The second sub-element of this program involves direct public participation and coordination with other agencies during detailed stormwater and floodland management plan development. One example of this is the active participation of local citizens and community groups in the technical advisory committees that

were formed to oversee the development of the four comprehensive watershed plans referenced above. In some of the watersheds, those committees, listed in Appendix A, continue to serve to help guide the implementation and refinement of those watershed plans. In the other watersheds, the Commission would reconstitute the committees as needed. In addition, public hearings were held to allow for public input into each of the comprehensive watershed plans.

Toward further informing the public regarding flood mitigation, stormwater and floodland management, and related issues, this hazard mitigation plan update calls for concerned units and agencies of government, including Racine County and all cities, villages, and towns within the County, to involve members of the general public and to seek public input in the preparation and implementation of recommendations regarding such issues.

Additional Plan Elements

In addition to the above recommended measures, several additional measures are included in the floodland management element. These additional measures are described below.

National Flood Insurance Program and Floodplain Map Updating Efforts

Racine County and all cities and villages with exception of the Village of Elmwood Park, have been designated by the Federal Emergency Management Agency as having flood hazard areas and have taken the steps needed to make residents eligible to participate in the National Flood Insurance Program (NFIP). Initial Flood Insurance Studies (FISs) have been completed by FEMA for Racine County and all municipalities identified by FEMA as having flood hazards. This plan calls for the continued participation of Racine County and the municipalities in the NFIP. This plan also calls for the County or incorporated municipalities to request FEMA to revise, as necessary, the local flood insurance studies to reflect new flood hazard data when such data become available. This plan also calls for owners of property in Racine County to purchase flood insurance to provide some financial relief for losses sustained in floods that may occur in floodprone areas where no flood control measures are called for or in other floodprone areas before the implementation of any flood mitigation measures called for under the plan. As of April 2016, 339 flood insurance policies were in effect in Racine County. The average cost of a premium in Racine County was $930 per year. Finally, as the flood control measures are implemented, this plan calls for FEMA to make the necessary revisions to the appropriate FISs. Participation in the NFIP by the communities in Racine County is summarized in Table 5.6.

FEMA has completed an update of the Racine County FIS as part of its Map Modernization program. The Map Modernization products include a countywide FIS and Digital Flood Insurance Rate Maps (DFIRM). The DFIRM uses an aerial photo base, and incorporates updated floodplain boundaries delineated by SEWRPC and others. The updated Racine County FIS and DFIRM became effective on May 2, 2012.

On November 13, 2012, initial FEMA Risk MAP program discovery meetings were held for the upper Fox River Watershed. This watershed encompasses portions of Kenosha, Racine, Walworth, and Waukesha Counties. Following this meeting, FEMA issued an initial discovery report. Additional discovery meetings were held with communities in the watershed in February 2014. A final discovery report was issued to further reflect additional comments from the communities. As part of the Risk MAP project, detailed studies are proposed for the mainstem of the Fox River and a portion of Eagle Creek in Racine County. As of October 2016, no decision has been made to fund DFIRM production for the upper Fox River watershed.

Community Rating System

The Community Rating System (CRS) is an additional program offered by FEMA as part of its NFIP. The CRS recognizes and encourages community floodplain management activities that go beyond the minimum NFIP standards. The program assigns a ranking to communities that participate based on voluntary floodplain management activities and outreach services that the community provides its residents. A high CRS ranking will offer citizens of that municipality reduced flood insurance premiums up to 45 percent. In addition to the benefit of reduced insurance rates, floodplain management and outreach activities associated with CRS aim to further enhance public safety, reduce damages to property and public infrastructure, avoid economic disruption and losses, reduce human suffering, and protect the environment. Participation in the CRS program can provide extra incentive for communities to maintain and improve their floodplain management program moving forward. Technical assistance related to design and implementation of some activities associated with the program are available at no charge.

There are currently no communities in Racine County that participate in the CRS program. It is recommended that municipalities consider participation in the CRS program based on the number of NFIP policies currently in effect in their community. All unincorporated communities would be eligible for premium discounts under Racine County's potential participation. Incorporated villages and cities are required to participate individually.

Lending Institution and Real-Estate-Agent Policies

This plan calls for lending institutions to continue their practice of determining the floodprone status of properties before mortgage transactions. To that end, these institutions should consult with the appropriate local zoning department to inquire about any additional flood hazard studies for areas not identified in the Federal flood insurance studies. The plan also calls for real-estate brokers and salespersons to continue to inform potential purchasers of property of any flood hazard that may exist at the site being sold in accord with the rules of the Wisconsin Department of Safety and Professional Services.

Stream Channel Maintenance

This plan calls for Racine County and local municipalities and drainage districts to work cooperatively to continue and expand programs for regular stream channel maintenance within their respective jurisdictions. These programs would include the periodic removal of sediment deposits, selected heavy vegetation, and debris from all watercourses in the County, including bridge openings and culverts, subject to obtaining any necessary local and State permits.

Stormwater Management Facilities Maintenance

The effectiveness of stormwater management conveyance and detention facilities and other management measures can be sustained only if proper operation, repair, and maintenance procedures are carefully followed. Important maintenance procedures include the periodic repair of storm sewers, clearing of sewer obstructions, maintenance of open channel vegetation, clearing debris and sediment from open channels, maintenance of the infiltration capacity of stormwater infiltration facilities, maintenance of detention facility inlets and outlets, maintenance of detention basin vegetative cover, and periodic removal of sediment accumulated in detention basins. This plan calls for these maintenance activities to be carried out on a continuing basis to maximize the effectiveness of the stormwater management facilities and measures and to protect the capital investment in the facilities.

Dam Safety

The increasing age of dams escalates the need to ensure dam owners understand their responsibilities and the risk a dam can pose to surrounding properties and infrastructure. The best method of avoiding a hazard situation involving a dam is proper operation, maintenance, and inspection. The owner of any sized dam should inspect their dam on a regular basis, including during and after any high water event. The inspection should look for any changes that may indicate the need for repairs or the existence of serious deficiencies that could lead to failure of the dam. The owners of large dams are required by law to hire an experienced professional to inspect their dams on a recurring basis depending on the hazard rating. High hazard large

dams require inspection every two years, significant hazard large dams require inspection every three to four years, and low hazard large dams require inspection every ten years.

Emergency action plans are required for all new and existing dams that meet the large dam criteria or pose a threat to life and property. These plans should address the coordination of necessary actions by the dam owner and the responsible local, State, and Federal emergency organizations and provide for timely notification, warning and evacuation in the event of an emergency at the dam. An emergency action plan must be developed in conjunction with the local community and emergency management agency and then be submitted to the WDNR Dam Safety staff for review and approval. These plans should be reviewed and updated regularly to reflect current conditions of the dam and the surrounding area.

In cases where private dams are old, unsafe, or unwanted, or where dam owners are unable to provide proper maintenance, the dam should be considered for removal. The 2015-2017 Wisconsin biennial budget provided $500,000 to fund dam removal projects for any owner who wishes to remove their dam. The Dam Removal Grant Program provides reimbursement for 100 percent of eligible project costs up to a maximum of $50,000 to remove a dam.

Survey of Buildings in and Near the 1-percent-Annual-Probability Floodplain

The extent of the 1-percent-annual-probability floodplain has been delineated on the Racine County large-scale topographic maps, and much of that information is reflected on the FEMA DFIRMs that have been prepared. While those maps are adequate in detail to identify the extent of flooding for planning and zoning purposes, they can only be considered approximate in regard to establishing building grades. Thus, this plan calls for Racine County or the appropriate municipality to survey the low-grade elevations adjacent to buildings and the first-floor elevations of buildings that have been identified as remaining in or near the 1-percent-annual-probability floodplain after all other structural floodland management plan elements called for in this plan have been implemented, and at such time that flood mitigation activities are being considered for those buildings remaining in the floodplain. Such surveys will provide a more definitive identification of the flood hazard for those properties, and will assist property owners in deciding upon a course of action regarding floodproofing or structure removal options. It should be noted that where LiDAR topographic data are available applicants for Letters of Map Amendment (LOMA) may submit LiDAR data to FEMA in lieu of a certified elevation study by a professional engineer or land surveyor provided that certain standards are met. This may allow for a more definitive assessment of a structure's flood hazard status to be obtained at a lower cost.

A review of the Letters of Map Change (LOMC) information on the FEMA website reveals that 217 LOMC have been revalidated for Racine County cases from 1992 to 2019. LOMC include two categories; Letters of Map Amendment (LOMA) and Letters of Map Revision (LOMR). LOMA include those cases that have completed a survey and under existing conditions are above the 1-percent-annual-probability floodplain. In Racine County 161 cases have effective LOMA from 2012 to 2021. There is currently one LOMR in Racine County. This LOMR covers a portion of Spring Brook in the City of Burlington.

5.3 HAZARD MITIGATION PLAN COMPONENT FOR SEVERE THUNDERSTORMS COMBINED HAZARDS (THUNDERSTORMS, HIGH STRAIGHT-LINE WINDS, HAIL, LIGHTNING)

As described in Chapter 3, thunderstorms, high straight-line winds, hail, and lightning are natural hazard events of significant concern to be considered in the Racine County hazard mitigation plan. This section describes alternate and selected strategies to mitigate these types of hazards. As part of the updating process, these strategies were reviewed and reevaluated by the Racine County Hazard Mitigation Plan Local Planning Team in light of the updated hazard mitigation goals and hazard conditions documented in Chapters 3 and 4.

Identification of Alternative Mitigation Strategies

All thunderstorm related hazards and high straight-line wind events are potentially dangerous and are the most common type of severe weather event compared to other natural hazards within Racine County as discussed in Chapter 3. About 10 percent of the thunderstorms and related hazard events that occur each year are classified as severe. Severe thunderstorm fronts can often be tracked, which generally provides ample warning for potentially affected areas to take preventative actions. In addition, when severe thunderstorms and related hazard events occur, they generally last for short periods of time.

While it may not be possible to accurately identify specific areas where there is significant risk from thunderstorm related hazard events or non-thunderstorm high-wind events, measures can be taken to reduce the potential damage caused wherever they may occur in the County. High-wind events associated with wind storms and thunderstorms are similar to tornadoes, except they are more common and usually less powerful.

Hailstorms tend to occur in conjunction with severe thunderstorms. A severe thunderstorm weather advisory or advance warning system may indicate that large or damaging hail is imminent. During a

hailstorm personal safety is the first priority and persons should seek shelter and stop driving to avoid accidents. Advance warning systems may allow some actions to reduce hail damage to vehicles and some property, but little can be done to protect structures or crops in the field.

Personal protection is paramount for lightning safety—many people incur injuries or are killed due to misinformation and inappropriate behavior during lightning storms. A few simple precautions can reduce many of the dangers posed by lightning. The individual is ultimately responsible for his/her personal safety and should take appropriate action when threatened by lightning.

Through review by the Racine County Hazard Mitigation Plan Local Planning Team, the following measures to reduce vulnerability to thunderstorm winds, non-thunderstorm high-winds, hail, and lightning have been identified as viable for the County hazard mitigation plan.

Nonstructural

- Review local building codes to determine if revisions are needed to improve the ability of structures to withstand greater wind velocities and impacts from hail

- Local fire departments should obtain and maintain equipment to help detect or mitigate lightning-related fires, such as thermal imaging devices

- Enforce existing local ordinances requiring adequate grounding of newly constructed buildings

- Continue the County's participation in the National Weather Service's (NWS) StormReady program. Requirements for this program include:

    - Establishing a 24-hour warning point and emergency operations center

    - Having multiple ways to receive severe weather warnings and forecasts to alert the public

    - Promoting the importance of public readiness through community seminars

    - Developing a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises

- Provide annual access to SKYWARN weather spotter training

- Ensure that mobile and manufactured housing is securely anchored

- Encourage agricultural producers to purchase crop insurance

Structural

- Maintain, update, and upgrade public early warning systems and networks. Consider expanding such systems as necessary. Desirable characteristics of a robust early warning system include:

    - Employing multiple means of communication to alert people of the imminent threat of severe weather. Examples of such means of communication include providing warnings and/or information through outdoor warning systems, broadcast media, cable and satellite media, electronic mail, SMS (text) messaging, social media, reverse-911 telephony, and apps for mobile devices, and

    - Being capable of reaching those who may be vulnerable to thunderstorm related hazards;

- Trim and maintain the health of trees near vulnerable infrastructure, such as utility lines, essential facilities and roads, as well as near homes and businesses. Communities should prepare for emerald ash borer infestation by developing a funding strategy for removal of infested ash trees. A well planned response can minimize the impact of infestation, reduce liability, and lessen the overall cost to a community. Ash trees should be removed at the first sign of infestation of the emerald ash borer;

- Promote planting windbreaks for farm crops;

- Work with municipalities and businesses to explore installation of community safe rooms and hardening projects for community facilities, businesses, and manufacturers. Priority should be considered for those facilities that are located in slab-on-grade structures and for those projects that can be completed as part of a newly planned building or building expansion;

- Provide model mobile home park regulations to municipalities for their consideration which require that community safe rooms (storm shelters) be provided for residents of new and expanding mobile

home parks. Based on community and landowner interest, pursue grant funding for installation of community safe rooms in existing mobile home parks;

- Bury and protect power and utility lines;

- Encourage the use of surge protectors on critical electronic equipment;

- Install lightning grade surge protection devices for critical electronic components used by government, public service, and public safety facilities, such as warning systems, control systems, communications, and computers; and

- Promote emergency back-up power at critical facilities.

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity of thunderstorm related hazards and non-thunderstorm high-wind hazards and distribute emergency preparedness information related to thunderstorm hazards. Such educational efforts should include promoting public awareness of proven lightning safety guidelines to reduce the risk of lightning hazards and the potential severity of hailstorms;

- Encourage residents to purchase NOAA All Hazards Weather Radios and register for emergency alert services such as CodeRED® and emergency preparedness and damage reporting mobile apps;

- Promote inclusion of safety strategies for severe weather events in driver education classes and materials;

- Encourage residents to develop a Family Emergency Preparedness Plan that include the preparation of a Disaster Supply Kit (see Appendix D);

- Produce and distribute emergency preparedness information related to thunderstorm related and high-wind hazards.

Current Programs

Federal and State Programs

The National Weather Service (NWS) issues severe thunderstorm warnings, watches and advisories when there is a threat of severe weather conditions. Several categories of warnings, watches, and advisories apply to hazards related to thunderstorms and non-thunderstorm high-wind events. The NWS Milwaukee/Sullivan office will issue a severe thunderstorm warning when either a spotter reports a thunderstorm producing winds that equal or exceed 58 miles per hour (mph) or hail of one inch or larger in diameter or a severe thunderstorm is detected by Doppler radar. The NWS Storm Prediction Center in Norman, Oklahoma will issue a severe thunderstorm watch when conditions are favorable for the development of severe thunderstorms in and close to the watch area. The NWS Milwaukee/Sullivan office will issue a high wind warning when sustained winds of 40 mph are expected to occur for an hour or more or wind gusts of 58 mph or more are expected to occur. The NWS Milwaukee/Sullivan office will issue a wind advisory when sustained winds of 30 mph are expected to occur for an hour or more or wind gusts of 45 mph to 57 mph or more are expected to occur. The office also issues a variety of wind related marine warnings for events in Lake Michigan.

Federal and State programs include awareness and education efforts. The National Weather Service also has an extensive public information program to educate people about the dangers of thunderstorms and related hazards and assist in preventing related deaths and injuries. WEM, in conjunction with the National Weather Service and State and local government agencies, provides both preparedness information and severe weather information to the public. Preparedness information is provided during three severe weather awareness campaigns conducted during the year, each focusing on the prevalent weather hazard at that time. The Wisconsin Department of Health Services has developed a severe thunderstorm and tornado tool kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to severe thunderstorms and tornadoes. Similarly, WEM has produced several educational resources regarding thunderstorms and related hazards including prerecorded radio and public service announcements, scripts for radio public service announcements, fliers, and educational materials for children. In addition, numerous other organizations, including the American Red Cross, provide public safety information regarding lightning.

Local Programs

Programs within Racine County include those conducted by the Racine County Office of Emergency Management. The Racine County Office of Emergency Management has a number of brochures, booklets, and pamphlets available for the public on severe weather safety and other general emergency

management-related topics. In addition, the Ready Racine County website contains factsheets listing specific information regarding what to do in the event of a tornado watch or warning as well as what residents can do before, during, and after, in the event that a severe thunderstorm was to occur in their area. The Racine County Office of Emergency Management also participates in all State sponsored severe weather awareness campaigns. In addition, a number of local emergency management and fire departments have instituted educational programs and communications on public safety.

Racine County currently relies on NOAA Weather Radio for severe thunderstorm and related hazard warnings and encourages all of the local citizens to have a weather radio. In 2002, NOAA Weather Radio installed a new transmitter at CTH KR and Wood Road in Racine County (frequency is 162.450 megahertz). This transmitter covers both Racine and Kenosha Counties. In addition, severe thunderstorm and related hazard warnings from NOAA Weather Radio are relayed to other media via the Federal Communication Commission's Emergency Alert System (EAS). The EAS allows officials to send emergency information targeted to specific geographical areas. The EAS sends alerts out to broadcast media, cable television providers, satellites, pagers, direct broadcast satellites, high-definition television, and video dial tone. This system uses the same digital protocols as NOAA Weather Radio. Nationally, the National Weather Service generates about 80 percent of EAS activations primarily for short-duration weather warnings and watches. Federal, State, and local emergency personnel can also access this system to disseminate non-weather emergency messages through the National Weather Service's HAZCollect system.

In partnership with the City of Racine, Racine County has implemented the CodeRED® Emergency and Weather Notification System to deliver customized prerecorded messages directly to homes and businesses, or to persons traveling through the County via the free mobile app. This service uses a high-speed telephone calling system to call a phone number in the CodeRED® database, alerting users of significant incidents and events where timely notification of an affected population or geographic area is essential. The pre-recorded message may also provide instructions for action to be taken. Messages will only be sent to individuals and businesses that have registered their home, business, or cellular phone number with the service. Racine County residents who sign up for the additional CodeRED® Weather Warning will automatically receive calls when tornado, flash flood, and severe thunderstorm warnings are issued by the National Weather Service for addresses that are in the path of the storm.

In addition, the County has the capability to issue emergency alerts to cell phones through the Wireless Emergency Alerts (WEA) system. The WEA is a partnership including local and state public safety agencies, FEMA, the Federal Communications Commission (FCC), the Department of Homeland Security (DHS) and

the National Weather Service (NWS). With WEA, authorized County officials can send emergency messages to mobile devices of those that may be in harm's way without the need to download an app or subscribe to a service. WEAs are broadcast from area cell towers to mobile devices only in the specific area where there is a danger. These short messages are designed to get the recipient's attention in a critical situation and will look like a text message that will show the type and time of the alert, any action that recipients should take, and the agency issuing the alert. The WEA message will include a special tone and vibration that will be repeated twice. WEA will send alerts for extreme weather warnings, local emergencies requiring evacuation or immediate action, AMBER Alerts, and Presidential alerts during a national emergency. Although the WEA does not issue alerts for severe thunderstorms, the service will alert for tornado, flash flood, and extreme wind warnings that are often associated with severe thunderstorms.

As described in Chapter 2, Racine County has developed a comprehensive emergency management plan which sets forth a hazard action plan. In addition, many of the local units of government have developed emergency operations plans and/or programs which complement the County plan and which also set forth procedures and actions to deal with a range of situations and events, including thunderstorms, high-wind, and hail events.

Analysis of the vulnerability of humans, infrastructure, and economic production to thunderstorm related hazard events and non-thunderstorm high-wind events demonstrates that the provision of advanced warning systems, as well as public informational and educational programming, are the most important mitigation actions to be considered. Racine County contains a total of 24 warning and communication siren systems, with 14 located within the City of Racine; three within the City of Burlington; two each within the Villages of Sturtevant, Waterford, and Union Grove; and one within the Town of Waterford. These sirens are regularly tested and maintained. New battery powered emergency sirens were installed at two sites in the City of Racine and the electronics on two sirens in the Village of Union Grove were upgraded since the last plan update.

Racine County was redesignated by the National Weather Service as a StormReady® community in 2021. This designation is valid for three years. StormReady® is a national community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather. In general, a community must possess a solid communication network and provide verification of its multi-hazard emergency operations plan to qualify for this designation. Specifically, to become StormReady® a community must:

- Establish a 24-hour warning point and emergency operations center

- Have multiple methods to receive and disseminate severe weather warnings and information for their community

- Have various methods to monitor weather conditions locally

- Promote the importance of public readiness

- Develop a formal hazardous weather action plan, including severe weather spotter training and drills

Evaluation of Alternatives and Identification of Mitigation Actions

Based upon review of the above by the Racine County Hazard Mitigation Plan Local Planning Team as part of the updating process, refinement and expansion of current ongoing programs continues to represent a major component of the planned mitigation action with regard to early warning systems. The existing warning systems should continue to rely upon the use of multiple means of communication to alert people to the threat of severe weather. Developed urban areas located within unincorporated areas, such as major lake developments, should also be considered as areas needing outdoor warning systems. In addition, informing the public of the significance of thunderstorm watches and warnings so that they take thunderstorm warnings and related hazards seriously and know where to seek shelter in emergency situations, is an important, ongoing component for minimizing the risks associated with these natural hazards. Community- and school-based informational programs should also continue to be conducted by the County in partnership with Federal, State and local authorities.

Promoting the provision of adequate safe places for people to seek shelter during severe storms constitutes an additional approach to mitigating some impacts of severe storms in Racine County. Residents of mobile home parks represent a segment of the County's population that lacks access to adequate shelters. Encouraging and promoting the construction of community safe rooms to provide shelter from severe storms to these vulnerable populations constitutes an important addition to this hazard mitigation plan.

Similarly, severe storm events can cause economic losses especially to agricultural producers through damage to crops. Providing agricultural producers with information regarding Federal crop insurance programs and encouraging them to purchase crop insurance constitutes a means of providing them with some protection against such losses.

Finally, other feasible, nonstructural and structural mitigation actions include surge protection for sensitive electronic equipment; and other precautions that will limit possible future bodily injuries, deaths, or property damages due to severe weather events. The majority of these measures are currently in place, indicating an emphasis on informational programming and enforcement.

Multi-Jurisdictional Considerations

Thunderstorms and their related hazards can potentially impact all municipalities within the County. In addition, these severe events can potentially cause multiple damages to a variety of infrastructure including, transmission lines, communication lines, and transportation routes due to flooding, as well as damage to buildings from flooding, lightning, and/or high winds. Hence, Racine County, municipalities, and relevant businesses should coordinate hazard mitigation activities through a cooperative County and local government partnership in countywide disaster planning and response mechanisms. Such measures are already well underway through the comprehensive emergency management planning program involving the Racine County Office of Emergency Management and coordinated local community emergency operations programs and should be continued.

Priority Mitigation Measures

Based upon the foregoing evaluation, consideration of risk, and review and action by the Racine County Hazard Mitigation Plan Local Planning Team as a part of the updating process (see Appendix A), the following mitigation measures related to thunderstorm wind, non-thunderstorm high-wind, hail, and lightning events are included in the Racine County hazard mitigation plan:

- Maintain, update, and further develop the early warning and communication systems including coverage of NOAA All Hazard Weather Radios; Emergency Alert System (EAS) capabilities; and emerging technologies, such as the County's targeted Wireless Emergency Alerts (WEA) system, and the CodeRED® Emergency and Weather Notification System;

- Promote educational and informational programming, especially related to the early warning network, including NOAA All Hazard Weather Radio, EAS broadcasts, WEA system, and the CodeRED® Emergency and Weather Notification System;

- Encourage residents to develop a Family Emergency Preparedness Plan including the preparation of a Disaster Supply Kit (see Appendix D);

- Encourage the provision of safe rooms for public buildings, major industrial sites, mobile home parks, and other large businesses or complexes such as shopping malls, fairgrounds, and other vulnerable public areas. Approaches to achieve this recommendation may include:

    - Working with municipalities and businesses to explore installation of community safe rooms and hardening projects for community facilities, businesses, and manufacturers,

    - Consideration by municipalities of adopting model mobile home park regulations which require that community safe rooms be provided for residents of new and expanding mobile home parks, and

    - Based on community and landowner interest, pursue grant funding for installation of community safe rooms in existing mobile home parks;

- Provide annual access to SKYWARN weather spotter training;

- Encourage agricultural producers to purchase crop insurance; and

- Continued coordination of emergency operations and response plans among governmental units and first responders.

The Local Planning Team decided to add the above listed components related to safe rooms and crop insurance to the hazard mitigation plan. Because the remaining measures are intended to be ongoing efforts, the Local Planning Team decided to retain them in the updated plan.

5.4 HAZARD MITIGATION PLAN COMPONENT FOR TORNADOES

As described in Chapter 3, tornadoes are natural hazard events of moderate concern to be considered in this update of the Racine County hazard mitigation plan. This section describes alternate and selected strategies to mitigate this type of hazard. As part of the updating process, these strategies were reviewed and reevaluated by the Racine County Hazard Mitigation Plan Local Planning Team in light of the updated hazard mitigation goals and hazard conditions documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

All tornadoes are potentially dangerous hazards within Racine County as discussed in Chapter 3. However, tornadoes have been shown to impact Racine County about once every two to three years and these are most likely to be an EF1 magnitude or less. In addition, when tornadoes and related hazard events occur, they generally last for short periods of time and impact relatively small areas upon the landscape.

While it may not be possible to accurately identify specific areas where there is significant risk from tornado events, or the number or severity of the events, measures can be taken to reduce the potential damage caused by tornado and related hazards wherever they may occur in the County. Based upon review by the Racine County Hazard Mitigation Plan Local Planning Team as part of the updating process, the following measures to reduce vulnerability to tornadoes have been identified as viable for this update of the Racine County hazard mitigation plan.

Nonstructural

- Review local building codes to determine if revisions are needed to improve the ability of structures to withstand greater wind velocities

- Conduct of an inventory and inspection of facilities to ensure the quality, quantity, and accessibility of adequate tornado shelters

- Continue the County's participation in the National Weather Service's (NWS) StormReady program

- Provide annual access to SKYWARN weather spotter training

- Organize a local tornado spotter network

- Ensure that mobile and manufactured housing is securely anchored

- Establish safe and appropriate locations for temporary debris disposal sites

Structural

- Maintain, update, and upgrade public early warning systems and networks. Consider expanding such networks as necessary. Desirable characteristics of a robust early warning system include:

- Employing multiple means of communication to alert people of the imminent threat of severe weather. Examples of such means of communication include providing warnings and/or information through outdoor warning systems, broadcast media, cable and satellite media, electronic mail, SMS messaging, social media, apps for mobile devices, and reverse-911 telephony; and

- Being capable of reaching those who may be vulnerable to tornadoes;

- Retrofit existing or install new structures to ensure adequate shelters from tornadoes for public buildings, major industrial sites, mobile home parks, and other large businesses or complexes such as shopping malls, fairgrounds, and other vulnerable public areas;

- Work with municipalities and businesses to explore installation of community safe rooms and hardening projects for community facilities, businesses, and manufacturers. Priority should be considered for those facilities that are located in a slab-on-grade structure and for those projects that can be completed as part of a newly planned building or building expansion;

- Provide model mobile home park regulations to municipalities for their consideration which requires that community safe rooms (storm shelters) be provided for residents of new and expanding mobile home parks. Based on community and landowner interest, pursue grant funding for installation of community safe rooms in existing mobile home parks;

- Trim and maintain the health of trees near vulnerable infrastructure, such as utility lines, essential facilities and roads, as well as near homes and businesses. Communities should prepare for emerald ash borer infestation by developing a funding strategy for removal of infested ash trees. A well planned response can minimize the impact of infestation, reduce liability, and lessen the overall cost to a community. Ash trees should be removed at the first sign of infestation of the emerald ash borer; and

- Bury and protect power and utility lines.

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity of tornadoes

- Encourage residents to purchase NOAA All Hazards Weather Radios and register for emergency alert services such as CodeRED® and emergency preparedness and damage reporting mobile apps

- Promote inclusion of safety strategies for severe weather events in driver education classes and materials

- Encourage residents to develop a Family Emergency Preparedness Plan which would include the preparation of a Disaster Supply Kit (see Appendix D)

- Produce and distribute emergency preparedness information related to tornado hazards

Current Programs

Federal and State Programs

The National Weather Service issues warnings, watches, and advisories when there is a threat of severe weather conditions. The National Weather Service issues tornado watches when conditions are favorable for the development of thunderstorms that have a strong capability of producing tornadoes and issues tornado warnings when a tornado has been spotted by a trained observer or Doppler radar has indicated a developing tornado.

Federal and State programs include awareness and educational activities. The National Weather Service has an extensive public information program to educate people about the dangers of tornadoes and related hazards and assist in preventing related deaths and injuries. WEM, in conjunction with the National Weather Service and State and local government agencies, provides both preparedness information and severe weather information to the public. Preparedness information is provided during three severe weather awareness campaigns conducted during the year, each focusing on the prevalent weather hazard at that time. The Wisconsin Department of Health Services has developed a severe thunderstorm and tornado tool kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to severe thunderstorms and tornadoes. Similarly, WEM has produced several educational resources regarding tornadoes including prerecorded radio public service announcements, scripts for radio public service announcements, fliers, and educational materials for children. In addition, numerous other organizations, including the American Red Cross, provide public safety information regarding tornadoes.

Local Programs

The Racine County Office of Emergency Management has a number of brochures, booklets, and pamphlets available for the public on tornado safety and other general emergency management-related topics. In addition, the Ready Racine County website contains factsheets listing specific information regarding what to do in the event of a tornado watch or warning as well as what residents can do before, during, and after, in the event that a tornado occurs in their area. A number of local emergency management and fire departments have also instituted educational programs and communications on public safety. The Racine County Office of Emergency Management participates in all State sponsored severe weather awareness campaigns.

Racine County has undertaken a tornado shelter assessment of the public and nonpublic schools within the County. As a result of the assessment, school officials will be able to develop or revise emergency procedures and plans, and initiate educational programs. The County is active in promoting mitigation through events such as safety fairs and workshops. The County has produced a coloring book to teach children how to stay safe during a natural hazard event. In addition, in 2000, the Housing Authority of Racine County in partnership with Racine County built a Safe Room in a new home. In this unique partnership, the County of Racine donated the vacant parcel to the Housing Authority of Racine County, a nonprofit organization that builds homes for certain first-time buyers. The County worked with the local technical college to conduct a survey of selected County residents to determine resident's opinions, attitude and preparedness in the event of a disaster within the County. The information gathered from the survey was used to develop public awareness campaigns as well as other hazard mitigation planning-related efforts.

Racine County currently relies on NOAA Weather Radio for tornado and related hazard warnings and encourages all local citizens to have a weather radio. In 2002, NOAA Weather Radio installed a new transmitter at CTH KR and Wood Road in Racine County (frequency is 162.450 megahertz), which covers both Racine and Kenosha Counties. In addition, tornado and related hazard warnings from NOAA Weather Radio are relayed to other media via the Federal Communication Commission's Emergency Alert System (EAS). The EAS allows officials to send emergency information targeted to specific geographical areas. The EAS sends alerts out to broadcast media, cable television providers, satellites, pagers, direct broadcast satellites, high-definition television, and video dial tones. This system uses the same digital protocols as NOAA Weather Radio. Nationally, the National Weather Service generates about 80 percent of EAS activations primarily for short-duration weather warnings and watches.

A variety of methods are used to warn people in Racine County of emergency situations, including tornadoes. These warning systems are described in the section of this chapter related to thunderstorm wind, non-thunderstorm high-winds, hail, and lightning hazards.

As described in Chapter 2, Racine County has developed a comprehensive emergency management plan which sets forth a hazard action plan. In addition, many of the local units of government have developed emergency operations plans and/or programs which complement the County plan and which also set forth procedures and actions to deal with a range of situations and events, including tornado and related hazard events.

Analysis of the vulnerability of humans, infrastructure, and economic production to tornadoes and related hazard events demonstrates that the provision of advanced warning systems; availability of adequate shelters for public buildings, major industrial sites, and other large businesses or complexes such as shopping malls; as well as public informational and educational programming are the most important mitigation actions to be considered. Racine County contains a total of 24 warning and communication siren systems, with 14 located within the City of Racine; three within the City of Burlington; two each within the Villages of Sturtevant, Waterford, and Union Grove; and one within the Town of Waterford. These sirens are regularly tested and maintained. New battery powered emergency sirens were installed at two sites in the City of Racine and the electronics on two of the sirens in the Village of Union Grove were upgraded since the last plan update.

Racine County was redesignated by the National Weather Service as a StormReady® community in 2021. This designation is valid for three years. The program is described in the previous section on hazard mitigation plan components for thunderstorm wind, high straight-line winds, hail, and lightning hazards.

Evaluation of Alternatives and Identification of Mitigation Actions

Based upon review of the above, refinement and expansion of the current ongoing programs represent a major component of the planned mitigation action with regard to early warning systems. The existing warning systems should continue to rely upon the use of multiple means of communication to alert people to the threat of severe weather. Developed urban areas located within unincorporated areas, such as major lake developments, should also be considered as needing early outdoor warning systems. The best shelters are specifically designed tornado shelters or safe rooms. Lacking such shelters, taking refuge in a basement near supporting walls or pillars, and away from windows, or, if there is no basement, taking shelter in smaller interior, windowless rooms, such as hallways or closets, can offer some protection and is the next best

option. Cars, mobile homes, garages, and outbuildings are not safe shelters from tornadoes. Thus, promoting the provision of adequate safe places to seek shelter during tornadoes constitutes an additional approach to mitigating some impacts of severe storms in Racine County. Residents of mobile home parks, in particular, represent a segment of the County's population that lacks access to adequate shelters. Encouraging and promoting the construction of community safe rooms to provide shelter from tornadoes to these vulnerable populations constitutes an important addition to this hazard mitigation plan.

In addition, informing the public of the significance of tornado watches and warnings so that they take tornado warnings seriously and know where to seek shelter in emergency situations, are important, ongoing components for minimizing the risks associated with these natural hazards. Community- and school-based informational programs should also continue to be conducted by the County in partnership with Federal, State and local authorities.

Finally, other feasible, nonstructural and structural mitigation actions include incorporation of wind resistant construction methods for the protection of buildings and infrastructure; and other precautions that will limit possible future bodily injuries, deaths, or property damages due to tornado and related hazard events.

Multi-Jurisdictional Considerations

Tornadoes and their related hazards can potentially impact all municipalities within the County. In addition, these severe events can potentially cause multiple damages to a variety of infrastructure including transmission lines, communication lines, and transportation routes, as well as destroyed buildings from high winds. Hence, Racine County, municipalities, and relevant businesses should coordinate hazard mitigation activities through a cooperative County and local government partnership in countywide disaster planning and response mechanisms. Such measures are already well underway through the coordinated emergency management planning program involving the Racine County Office of Emergency Management and coordinated local community emergency operations programs.

Priority Mitigation Measures

Based upon the foregoing evaluation, consideration of risk, and review and action by the Racine County Hazard Mitigation Plan Local Planning Team (see Appendix A), the following mitigation measures related to tornado hazard events are included in the updated Racine County hazards mitigation plan:

- Maintain, update, and further develop the early warning and communication systems including coverage of NOAA All Hazard Weather Radios; Emergency Alert System (EAS) capabilities; and

emerging technologies, such as the County's targeted Wireless Emergency Alerts (WEA) system, and the CodeRED® Emergency and Weather Notification System

- Promote educational and informational programming, especially related to the early warning network, including NOAA All Hazard Weather Radio, EAS broadcasts, WEA system, and the CodeRED® Emergency and Weather Notification System

- Encourage residents to develop a Family Emergency Preparedness Plan including the preparation of a Disaster Supply Kit (see Appendix D)

- Encourage the provision of safe rooms for public buildings, major industrial sites, mobile home parks, and other large businesses or complexes such as shopping malls, fairgrounds, and other vulnerable public areas. Approaches to achieve this recommendation may include:

    - Working with municipalities and businesses to explore installation of community safe rooms and hardening projects for community facilities, businesses, and manufacturers

    - Consideration by municipalities of adopting model mobile home park regulations which require that community safe rooms be provided for residents of new and expanding mobile home parks

    - Based on community and landowner interest, pursue grant funding for installation of community safe rooms in existing mobile home parks

- Provide annual access to SKYWARN weather spotter training

- Encourage agricultural producers to purchase crop insurance

- Enforcement of building code ordinance requirements

- Continue coordination of emergency response and operations plans among governmental units and first responders

Because these measures are intended to be ongoing efforts, the Local Planning Team decided to retain them in the updated plan.

5.5 HAZARD MITIGATION PLAN COMPONENT FOR EXTREME TEMPERATURES (EXTREME HEAT, EXTREME COLD)

As described in Chapter 3, extreme temperatures are natural hazard events of moderate concern to be considered in the Racine County hazard mitigation plan. This section describes alternate and selected strategies to mitigate these types of hazards. As part of the updating process, these strategies were reviewed and reevaluated by the Racine County Hazard Mitigation Plan Local Planning Team in light of the updated hazard mitigation goals and hazard conditions documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

Extreme temperature events pose a serious threat to Racine County and should be expected with each summer and winter season. Extreme heat and cold events do not typically occur suddenly and are generally connected to a weather system that can be forecast days in advance, making this a hazard for which plans to mitigate injury, loss of life, and property damage can be activated with sufficient advanced warning. When temperature extreme events do occur, they commonly last for extended periods of time (days or weeks) and impact entire areas larger than Racine County.

While it may not be possible to accurately identify specific areas where there is significant risk from extreme temperature, extreme heat will have the greatest impact in the large, urbanized areas of the County. Demographically, older adults, disabled populations, low income popluations, or those experiencing homelessness are most vulnerable to excessive heat and cold. Fatalities are usually related to age because excessive heat is stressful and can overwhelm those who are weakened because of age or illness. Measures can be taken to reduce the potential injuries and fatalities caused by temperature extremes wherever they may occur in the County. Based upon review by the Racine County Hazard Mitigation Plan Local Planning Team as part of the updating process, the following measures to reduce vulnerability to extreme temperature events have been identified as viable for this update of the Racine County hazard mitigation plan.

Nonstructural

- Maintain, update, and upgrade public early warning systems and networks. Consider expanding such networks as necessary. Desirable characteristics of a robust early warning system include:

    - Employing multiple means of communication to alert people of the imminent threat of extreme temperatures. Examples of such means of communication include providing warnings and/or

information through outdoor warning systems, broadcast media, cable and satellite media, electronic mail, SMS messaging, social media, apps for mobile devices, and reverse-911 telephone calls; and

  - Being capable of reaching those who may be vulnerable to extreme heat or cold; and

- Organize neighborhood outreach groups to assist those who may be vulnerable to extreme heat or cold;

- Continue to provide special arrangements for payment of heating bills;

- Designate sites to be used as public cooling/heating shelters during extreme temperature events. In addition:

  - Conduct an inventory and inspection of these facilities to ensure their quality, quantity, and accessibility for use as heating and/or cooling shelters;

  - Extend hours at these sites during extreme temperature events, and

  - Promote transportation options to assist those who may be vulnerable to extreme heat or cold to reach these sites during extreme temperature events;

- Reschedule public events to avoid large outdoor gatherings during periods of extreme heat or cold;

- Extend public swimming pool hours during extreme heat events;

- Establish and promote a donation program of functional window air conditioner units and fans that are no longer in use and distribute these items to those who may be vulnerable to extreme heat or cold; and

- Promote and expand winter weather clothing drives (coats, hats, mittens) where people can drop off unused winter clothing for distribution to those who may be vulnerable to extreme heat or cold.

Structural

- Promote measures to reduce heat island effects in urban areas. Examples of such measures include:

    - Increase the amount of green space throughout urban areas

    - Increase tree plantings around buildings, parking lots, and along public right-of-ways to shade surfaces that contribute to heat island formation

    - Encourage the use of "cool roofing" products made of highly reflective and emissive materials

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity of extreme temperature events and distribute emergency preparedness information related to such events

- Encourage residents to purchase NOAA All Hazards Weather Radios and register for emergency alert services such as CodeRED® and emergency preparedness and damage reporting mobile apps

- Increase awareness of public cooling/heating shelters that are available during extreme heat and cold events. Post the locations of these shelters online, and in newsletters

- Produce and distribute emergency preparedness information related to the safe operation of generators, space heaters, fireplaces, and wood stoves

Current Programs

Federal and State Programs

The NWS issues warnings, watches, and advisories when there is a threat of severe weather conditions. Several categories of warnings, watches, and advisories apply to extreme temperature conditions and associated hazards. The NWS Milwaukee/Sullivan office will issue an excessive heat warning when daytime high temperatures of 105°F or higher and night time temperatures of 75°F or higher are expected to occur over a 48-hour period or when high temperatures of 100°F or more are expected over four or more consecutive days. The office will issue a heat advisory when daytime high temperatures of 100°F or higher are expected or when daytime high temperatures are expected between 95°F and 99°F for four or more consecutive days. The NWS office will issue wind chill warnings for Racine County when wind chill values reach -35°F or colder, with wind speeds of at least four mph that are expected to occur for three hours or

more. A wind chill advisory is issued when wind chill values will reach -20°F to -34°F, with wind speeds of 4 mph or more.

Heat waves cannot be prevented, therefore, it is important to provide notice of adverse conditions so that the public can anticipate and avoid health-threatening situations. Excessive heat alert thresholds specific to major metropolitan centers are determined based on research results that link unusual amounts of heat-related deaths to city-specific meteorological conditions. The alert procedures are:

- Include Heat Index values in zone and city forecasts

- Issue Special Weather Statements and/or Public Information Statements presenting a detailed discussion of 1) the extent of the hazard including Heat Index values, 2) who is most at risk, and 3) safety guidelines for reducing the risk

- Assist State and local health officials in preparing civil emergency messages in severe heat waves. Meteorological information from Special Weather Statements will be included, as well as medical information, advice, and names and telephone numbers of health officials

- Release to the media and over the NOAA Weather Radio all of the above information

State programs include awareness and education efforts. WEM, in conjunction with the National Weather Service and State and local government agencies, provides both preparedness information and severe weather information to the citizens of Wisconsin. Preparedness information is provided during three severe weather awareness campaigns conducted during the year, each focusing on the prevalent weather hazard at that time. The Wisconsin Department of Health Services has developed an extreme heat toolkit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to extreme heat events. Similarly, the Department has developed a winter weather toolkit to provide information about winter weather, including extreme cold. WEM has produced several educational resources regarding extreme heat and winter weather, such as extreme cold, including prerecorded radio public service announcements, scripts for radio public service announcements, fliers, and educational materials for children. In addition, numerous other organizations, such as the American Red Cross, provide public safety information.

Local Programs

Programs within Racine County include those conducted by the Racine County Office of Emergency Management. The Racine County Office of Emergency Management has information available for the public on extreme temperatures and other general emergency management-related topics, and also participates in all State sponsored severe weather awareness campaigns. The City of Racine Health Department and the Racine County Public Health Division maintain a list of warming centers and cooling centers available throughout the County that provide safe environments to prevent adverse effects from extreme temperatures. Individuals are encouraged to contact the specific location to verify their operating hours before visiting. During extreme heat events, some locations may have extended hours.

Racine County was redesignated by the National Weather Service as a StormReady® community in 2021. This designation is valid for three years. This program, which includes actions related to extreme temperature conditions, is described in the section above on hazard mitigation plan components for thunderstorm, high-wind, hail, and lightning hazards.

A variety of methods are used to warn people in Racine County of emergency situations, including extreme temperatures. These warning systems are described in the section of this chapter related to thunderstorm wind, non-thunderstorm high-winds, hail, and lightning hazards.

As described in Chapter 2, Racine County has developed a comprehensive emergency management plan which sets forth a hazard action plan. In addition, many of the local units of government have developed emergency operations plans and/or programs which complement the County plan and which also set forth procedures and actions to deal with a range of situations and events, including extreme temperature hazard events.

Evaluation of Alternatives and Identification of Mitigation Actions

Based upon review of the above, the current ongoing informational and educational programs represent a major component of the planned mitigation action. Racine County should promote basic strategies to reduce injuries and fatalities, hazard awareness, and community involvement. Temperature hazards are faced by Racine County residents annually and the ability to make positive decisions concerning exposure limits will depend on safety awareness. Analysis of the vulnerability of humans, infrastructure, and economic production caused by extreme temperature events demonstrates that the provision of advanced weather forecasting systems; availability of adequate shelter from the heat and cold in public buildings, major industrial sites, and other large businesses or complexes such as shopping malls; and public informational

and educational programming are the most important mitigation actions to be considered. Public service announcements regarding avoiding heat stress help to minimize exposure. Racine County supports measures presently implemented by the National Weather Service; national, State, and local health organizations; and the media preceding and during excessively hot weather. It is also important to continue to encourage concern and awareness of neighbors, especially of those who are older adults, disabled, whose incomes are below the federal poverty threshold, or are experiencing homelessness. Outreach to these people to inform them of the availability and location of heating and cooling shelters within the County is also an important component to keeping safe those who are vulnerable to extreme temperature events. Community and school-based informational programs should also continue to be conducted by the County in partnership with Federal, State and local authorities.

Multi-Jurisdictional Considerations

Extreme temperature events are primarily a public health concern for all communities within the County and ultimately prevention should fall to the neighborhood watch groups and local authorities. These events can affect all individuals in the County, however, they are particularly dangerous for those who are older adults, disabled, whose incomes are below the federal poverty threshold, or are experiencing homelessness who cannot access shelter with adequate heat or air conditioning. A coordinated effort involving the Racine County Office of Emergency Management and local community emergency operations programs will be needed to identify and protect individuals vulnerable to temperature-related hazards.

Priority Mitigation Measures

Based upon the foregoing evaluation, consideration of risk, and review and action by the Racine County Hazard Mitigation Plan Local Planning Team (see Appendix A), the following mitigation measures related to extreme temperature events are included in the updated hazard mitigation plan for Racine County:

- Organize neighborhood outreach groups to assist those who may be vulnerable to extreme heat or cold

- Designate sites to be used as public cooling/heating shelters during extreme temperature events. In addition:

    - At the request of the sites' owners, conduct inventories and inspections of these facilities to ensure their quality, quantity, and accessibility for use as heating and/or cooling shelters

- Encourage the sites' owners to extend hours at these sites during extreme temperature events

- Promote transportation options to assist those who may be vulnerable to extreme heat or cold to reach these sites during extreme temperature events

- Increase awareness of public cooling/heating shelters that are available during extreme heat and cold events. Post the locations of these shelters online, and in newsletters

- Continue to provide special arrangements for payment of heating bills

- Maintain, update, and further develop the early warning and communication systems including coverage of NOAA All Hazard Weather Radios; Emergency Alert System (EAS) capabilities; and emerging technologies, such as the County's targeted Wireless Emergency Alerts (WEA) system, and the CodeRED® Emergency and Weather Notification System

- Promote educational and informational programming, especially related to the early warning network, including NOAA All Hazard Weather Radio, EAS broadcasts, WEA system, and the CodeRED® Emergency and Weather Notification System

- Produce and distribute emergency preparedness information related to the safe operation of generators, space heaters, fireplaces, and wood stoves

Because these measures are intended to be ongoing efforts, the Local Planning Team decided to retain them in the updated plan.

5.6 HAZARD MITIGATION PLAN COMPONENT FOR LAKE MICHIGAN COASTAL HAZARDS

As described in Chapter 3, Lake Michigan bluff recession, shoreline erosion, flooding, and shoreline protection structure damages are natural hazard events of moderate concern to be considered in the Racine County hazard mitigation plan. This section describes alternate and selected strategies to mitigate these types of hazards. As part of the updating process, these strategies were reviewed and reevaluated by the Racine County Hazard Mitigation Plan Local Planning Team in light of the updated hazard mitigation goals and hazard conditions documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

As reported in Chapter 3, a number of studies and planning programs have been carried out relating to Lake Michigan coastal erosion and related hazards. A review of those plans and materials developed under the State of Wisconsin Coastal Management Program indicates a range of alternative shoreline erosion control mitigation measures. In the review by the Racine County Hazard Mitigation Plan Local Planning Team as part of the updating process, the following measures to reduce the vulnerability to shoreline erosion and related hazards were considered as viable for incorporation into this update of the Racine County hazard mitigation plan.

Nonstructural

- Conduct an updated assessment of the condition and effectiveness of shoreline protection structures in the County. Such an assessment of structures along Lake Michigan in Racine County was last conducted in 2005;

- Consider a study to update bluff recession rates along the Lake Michigan coast and compare these rates to past reports. Bluff recession rates as reported in the 1982 Lake Michigan coastal erosion management study are used for the delineation of non-structural setback overlay erosion risk distance and stable slope distances as set forth in Chapter 20, Division 36 and 37 of the Racine County Code. The 1982 Lake Michigan coastal erosion management study recommends that bluff recession rates be remeasured at approximately 10-year intervals, as appropriate aerial photography becomes available. An updated study of bluff recession rates could determine any correlation of these rates with fluctuating Lake Michigan water levels, and potential effects on bluff recession due to climate change;

- Continue ongoing programs to update, refine, and map shoreline erosion risk data using geographic information system mapping. Such mapping would include shoreline erosion risk areas along with property and other cadastral features mapping;

- Continue working with Wisconsin Coastal Management Program (WCMP) through the Coastal Natural Hazards Work Group to review existing zoning ordinances, other regulations, and comprehensive plans to evaluate the effectiveness of existing local regulations and identify opportunities to better address coastal hazards;

- Develop, adopt, and enforce shoreland zoning ordinances incorporating bluff setback provisions for new development or redevelopment (Guidance on setback provisions is available from the Wisconsin Coastal Management Program); and

- Continue to review wastewater treatment plant outfall capacity to determine capacity at high lake levels. The Racine Utility has completed a wastewater treatment facility plan which included a hydraulic capacity evaluation and includes recommendations for a new additional outfall to provide adequate hydraulic capacity. The new outfall was completed in 2005.

Structural

- Construct and maintain shoreline protection structures and bluff stabilization measures where urban development commitments have been made dictating the need for structures. Effective shore protection requires a combination of bluff stabilization, surface water and subsurface water control, and bluff toe protection. The following considerations should be evaluated prior to any project (Table 5.7 sets forth minimum criteria to use as a basis for structure design.):

    - Structural shore protection measures should be installed if other less invasive measures are inadequate in reducing shoreline erosion and if it can be shown that such measures will effectively reduce shoreline erosion while not adversely affecting adjacent sections of the shoreline.

    - Fish and wildlife preservation measures to limit any adverse impacts during construction should be considered and implemented;

    - Assistance from a geotechnical engineer or geologist trained in slope stabilization, an engineer trained in shore protection design, and a qualified marine contractor should be involved throughout the stabilization project; and

    - It can often be more economical and effective to plan and implement shoreline protection or bluff stability projects in concert with design and implementation of such measures for neighboring properties.

- The WDNR may allow the placement of temporary emergency material in public waters if the landowner makes a request in writing to protect a structure or infrastructure from an eroding shoreline or bluff. Such a request must include descriptions of the type and amount of material that

will be used, where this material will be placed, and how the material will be put into place. A letter authorizing the placement of temporary emergency structures may then be sent by the WDNR to the landowner. If such authorization is granted, the landowner may proceed with placing the temporary measures, subject to the condition that the landowner must actively work toward planning, designing, and implementing a permanent shoreline protection solution through the State permitting process set forth in Chapter 30, "Navigable Waters, Harbors, and Navigation," of the *Wisconsin Statutes*;

- Relocate buildings within a high-risk area. (The Racine County coastal erosion management plan suggests this option as viable in instances where the building can be moved by conventional methods at a cost equal to, or less than, 30 percent of the value of an equivalent building located on secure ground); and

- In circumstances where buildings cannot be relocated safely or economically, or where bluff recession has progressed to the point where the risk of catastrophic failure of the slope is imminent, or where there is an imminent threat of failure within five years, acquisition and demolition of structures should be considered. This plan element is presented as an option, subject to the preference of the individual property owner.

Public Informational and Educational Programming

- Work with WCMP to develop, refine, and distribute guidance and education to local decision makers, permitting staff, developers, consultants, and homeowners related to coastal hazards

- Work with WCMP to conduct public outreach and to provide technical assistance to decision-makers and landowners regarding best management practices to prevent shoreline erosion and bluff recession including shoreline protection structures, planting proper vegetation, and stormwater/groundwater drainage practices

- Provide information on shoreland erosion related hazards to serve as a "fair warning" guide for groups such as realtor-brokers, shoreline property owners, developers, lending institutions, and prospective buyers

- Encourage residents to purchase NOAA All Hazards Weather Radios and register for emergency alert services such as CodeRED® and emergency preparedness and damage reporting mobile apps

Current Programs

Federal Programs

The USACE exercises some control over lake levels through the use of water controls, such as locks and dams. However, these impacts are minimal compared to the impacts due to climatic influence.

FEMA produced a Draft Great Lakes Coastal Guidelines Update, dated March 2009, which includes new methodology to determine flood hazard zones within the FEMA Region V coastal zone. Final guidelines were issued in 2014. Future steps include pilot studies to evaluate the new methodologies at specific Great Lakes locations followed by a prioritization of coastal mapping needs within the FEMA region for future analyses. The ultimate goal of these efforts will be a remapping of flood hazards along the Great Lakes coastal areas that would subsequently be reflected in revised Federal flood insurance studies.

In cooperation with the University of Wisconsin-Madison's Sea Grant Institute, Department of Civil and Environmental Engineering, Land Information and Computer Graphics Facility, the WDNR, several private consultants and agencies from the State of Michigan, the USACE organized the Lake Michigan Potential Damages Study (LMPDS). The objective of this research project, which took place between 1996 and 2000, was to create a modeling procedure and engineering-management tool for predicting future shoreline retreat and estimating economic effects of lake level changes and related social, environmental, and cultural impacts.

The Great Lakes Coastal Flood Study (GLCFS) is a multi-year project led by FEMA to determine what physical processes would need to be included in updated FEMA coastal flood hazard mapping of the Great Lakes coastal communities. These flood maps and related information will be tools that can help communities identify high-risk areas and guide land use planning and capital investments to mitigate future losses.

In May 2016, the Village of Mount Pleasant asked the USACE to consider conducting a study for an emergency bluff stabilization project to protect public infrastructure on a 900-foot-long stretch along the Lake Michigan coast from the old fire department station near the intersection of Sheridan Road and Walter Avenue, north to Graceland Avenue. Section 14 of the Flood Control Act of 1946 authorized the USACE to construct emergency streambank and shoreline erosion protection to protect public infrastructure such as public buildings, roads, and utilities that are endangered by flood-caused bank or shoreline erosion. The USACE has agreed to study whether there is a viable project that fits the Section 14 authority and protects public property in the Village of Mount Pleasant. Suggestions from the USACE on long-term solutions to slow or stop the bluff erosion will be the product of the roughly two-year feasibility phase study. During

the feasibility phase, Federal interest is determined by evaluating different alternatives, comparing costs and benefits, and identifying potential environmental affects. If a project is deemed to be viable for Section 14 funding, the study will recommend proceeding to the design and implementation phase. The first $100,000 of the feasibility phase is provided by the Federal government and costs exceeding $100,000 must be cost-shared 50/50 with a non-Federal project sponsor. Costs for the design and implementation phase of a project would be shared 65 percent Federal and 35 percent non-Federal. Each project is limited to a total Federal cost of $5 million. Portions of the non-Federal costs can be in the form of lands, easements, right-of-ways, relocations, and disposal areas.

State Programs

Wisconsin's Shoreland Management Program is a partnership between State and local government that requires the adoption of County shoreland zoning ordinances to regulate development near navigable lakes and streams, in compliance with statewide minimum standards. These minimum statewide standards are set forth in Chapter NR 115, *Wisconsin Administrative Code*.

The Wisconsin Coastal Management Program (WCMP), which is part of the Wisconsin Department of Administration, Division of Intergovernmental Relations, oversees management of the State's coastal resources and strives to maintain a balance between preservation and economic needs. Established in 1978 under the Federal Coastal Zone Management Act, the WCMP works to preserve, protect, and wisely use the resources of the Lake Michigan and Lake Superior coastline for this and future generations. The WCMP provides guidance and grants to encourage the management and protection of Wisconsin's coastal resources and to increase public access to the Great Lakes. The WCMP has constituted an interagency coastal hazards work group formed by staff from the WDNR, University of Wisconsin-Madison's Sea Grant Institute, State Cartographer's Office, and the Wisconsin Emergency Management Program as a forum to coordinate initiatives related to coastal management in the State.

The WCMP created a web-based tool that allows users to examine photos from the late 1970s and compare them to corresponding photos from 2007 and 2008 to assess changes to the shoreline. GIS layers for shore structures, beach protection, and bluff conditions for each time frame allow for more detailed analysis of shoreline and bluff changes.

The University of Wisconsin Sea Grant is a statewide program of basic and applied research, education, outreach and technology transfer dedicated to the stewardship and sustainable use of the Great Lakes. The

Sea Grant staff has, over the years, provided substantial support to Racine County in dealing with Lake Michigan shoreline management issues.

Local Programs

As reported in Chapter 1, Racine County, the City of Racine, and the Villages of Caledonia, Mount Pleasant, and Wind Point have adopted shoreland zoning regulations which apply to the Lake Michigan shoreland area. The Racine County regulations related to Lake Michigan bluff setbacks are set forth in Chapter 20, Division 36 (structural setback overlay district) and Division 37 (nonstructural setback overlay district) of the Racine County Code. The County bluff setback regulations continue to apply to lands annexed by the City of Racine after May 7, 1982. The Villages of Caledonia and Mount Pleasant have adopted the County's bluff setback requirements by reference into the Village zoning ordinances. Although the Village of Wind Point zoning ordinance does not include specific bluff setback regulations, the Village ordinance applies a shoreland overlay zoning district within 1,000 feet of the Lake Michigan shoreline. The overlay district generally requires approval of a conditional use permit for alterations of steep slopes within the shoreland area.

The current County shoreland regulations regarding Lake Michigan setbacks for development and shore protection, which have been incorporated into Caledonia and Mount Pleasant ordinances, are sound and represent current planning recommendations. The ordinances provide for the use of shoreline protection, bluff stabilization structural measures, and bluff setbacks for development along portions of the Lake Michigan shoreline where urban shoreline development exists or is envisioned, and provides for a larger setback for development in areas where structural protection is not envisioned to be used due to limited planned urban development. County regulations adopted as part of the Caledonia and Mount Pleasant ordinances also provide for specific procedures for the design and review of shore protection measures. These shoreline regulations were developed under the guidance of a County Technical Subcommittee and are documented in a 1982 Lake Michigan coastal erosion management plan. Village of Wind Point regulations for development of steep slopes within the shoreland overlay district require an engineer's report and review and approval of the report by the Village.

A variety of methods are used to warn people in Racine County of emergency situations, including Lake Michigan coastal hazards. These warning systems are described in the section of this chapter related to thunderstorm wind, non-thunderstorm high-winds, hail, and lightning hazards.

Racine County has an ongoing program of inspection and maintenance of shoreline protection structures owned by the County. In addition, the effectiveness and condition of the shoreline protection structures along the lakefront in Racine County was assessed in 2005, and the report was published in 2008.

Evaluation of Alternatives and Identification of Mitigation Actions

A review of the alternative measures noted above and the status of ongoing programs indicates that all of the measures noted above are considered to be appropriate for inclusion in the Racine County hazard mitigation plan. The measures noted have been developed, evaluated, and recommended in other studies and programs.

Multi-Jurisdictional Considerations

The plan elements for Lake Michigan shoreline erosion and related problems correspond only to the City of Racine; the Villages of Caledonia, Mt. Pleasant, North Bay, and Wind Point.

Priority Mitigation Measures

Based upon the foregoing evaluation, consideration of risk, and review and action by the Racine County Hazard Mitigation Plan Local Planning Team (see Appendix A), the following mitigation measures related to Lake Michigan coastal hazards are included in the updated Racine County Hazard Mitigation Plan:

- Continue to enforce and review the County shoreland regulations and policies relating to setbacks for new development or redevelopment and structural shoreline erosion protection and bluff stabilization measures.

- Review of Lake Michigan shoreline municipal shoreland ordinances to assess the need for updating to be consistent with the Wisconsin Coastal Management Program guidance for development setbacks and structural shoreline erosion protection and bluff stability measures.

- Reevaluate the effectiveness of Lake Michigan shoreline protection structures in the County at a 10-year interval, building from the 2005 cooperative program involving Racine County, the Coastal Management Program, the WDNR, and the University of Wisconsin Sea Grant Institute.

- Where possible, relocate buildings within a high-risk area. In circumstances where buildings cannot be relocated safely or economically, or where bluff recession has progressed to the point where the risk of catastrophic failure of the slope is imminent, or where there is an imminent threat of failure

within five years, acquisition and demolition of structures should be considered. This plan element is presented as an option, subject to the preference of the individual property owner.

- Continue maintenance and construction of new shoreline protection structures to protect urban development in selected areas of the County and under the provisions provided for under the County Lake Michigan coastal erosion management plan.

- Continue ongoing programs to update and refine coastal hazard area data using geographic information system technology.

- Provide public informational and educational programming on shoreline erosion hazards and allowable property owner shoreline and bluff management actions.

5.7 HAZARD MITIGATION PLAN COMPONENT FOR SEVERE WINTER STORMS (HEAVY SNOWSTORM, BLIZZARD, ICE STORM)

As described in Chapter 3, winter storms are natural hazard events of moderate concern to be considered in the Racine County hazard mitigation plan. This section describes alternate and selected strategies to mitigate this type of hazard. As part of the updating process, these strategies were reviewed and reevaluated by the Racine County Hazard Mitigation Plan Local Planning Team in light of the updated hazard mitigation goals and hazard conditions documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

Severe winter weather can include blizzards, freezing rain, sleet, ice, and dangerous combinations of temperatures and wind. Winter storms may last for days completely shutting down businesses and government, while isolating residents in their homes. Extreme cold temperatures, often connected to winter storm events, is the number two natural hazard cause of deaths in the State. Additionally, indirect injuries and fatalities from activities associated with winter storms include heart attacks while shoveling snow, automobile accidents, and improper use of space heaters. Severe winter storm fronts can often be tracked, which generally provides ample warning for potentially affected areas to take preventative actions.

While it may not be possible to accurately predict the number or severity of winter storm events, measures can be taken to reduce the potential damage caused by winter storms and their related hazards whenever they may occur in the County. High wind, freezing rain, sleet, ice, and snow may be associated with a winter

storm. In the review by the Racine County Hazard Mitigation Plan Local Planning Team as part of the updating process, the following measures to reduce vulnerability to these dangers have been identified as viable for this update of the Racine County hazard mitigation plan.

Nonstructural

- Review local building codes to determine if revisions are needed to improve the structure's ability to withstand greater wind velocities and snow weight

- Review the energy efficiency and winter readiness of critical facilities and housing in the community

- Ensure that the necessary amount of snow removal, anti-icing, and deicing equipment is available and operational

Structural

- Maintain, update, and upgrade public early warning systems and networks. Consider expanding such networks as necessary. Desirable characteristics of a robust early warning system include:

    - Employing multiple means of communication to alert people of the imminent threat of severe weather. Examples of such means of communication include providing warnings and/or information through outdoor warning systems, broadcast media, cable and satellite media, electronic mail, text messaging, social media, apps for mobile devices, and reverse-911 telephone calls; and

    - Being capable of reaching those who may be vulnerable to winter storm related hazards;

- Work with utility companies to assess and improve, as needed, electric service systems reliability;

- Consider burying utilities at critical and vulnerable junctions to avoid power loss due to downed lines;

- Trim and maintain the health of trees near vulnerable infrastructure, such as utility lines, essential facilities and roads, as well as near homes and businesses. Communities should prepare for emerald ash borer infestation by developing a funding strategy for removal of infested ash trees. A well planned response can minimize the impact of infestation, reduce liability, and lessen the overall cost

to a community. Ash trees should be removed at the first sign of infestation of the emerald ash borer; and

- Promote planting windbreaks and installing snow fences to protect farm crops and highways.

Public Informational and Educational Programming

- Promote winter hazard awareness, including home and travel safety measures, such as avoiding travel during winter storms; having a shovel, sand, warm clothing, food, and water, if travel cannot be avoided; and installing a back-up heating system in at least one room in the home

- Encourage residents to purchase NOAA All Hazards Weather Radios and register for emergency alert services such as CodeRED® and emergency preparedness and damage reporting mobile apps

- Promote inclusion of safety strategies for severe weather events in driver education classes and materials

- Encourage residents to develop a Family Emergency Preparedness Plan including the preparation of a Disaster Supply Kit (see Appendix D)

- Produce and distribute emergency preparedness information related to winter storm hazards

- Maintain and update shelter sites that have back-up emergency power sources

Current Programs

Federal and State Programs

The NWS issues warnings, watches, and advisories when there is a threat of severe weather conditions. Several categories of warnings, watches, and advisories apply to winter weather conditions and associated hazards. The NWS Milwaukee/Sullivan office will issue a winter storm warning when one or more of the following weather events are expected to occur over a period of 12 or fewer hours:

- Snowfall greater than six inches

- Sleet accumulations of two or more inches

- Intermittent blowing snow that reduces visibility below one-half mile with winds of 25 to 34 mph or closed roads

- Less than one-quarter inch of freezing rain accompanied by another winter event

NWS forecasters also have discretion to issue winter storm warnings for events that may not officially reach warning criteria, but are expected to have a significant impact on the public. The NWS Milwaukee/Sullivan office will issue a winter weather advisory when one or more of the following weather events are expected to occur over 12 or fewer hours:

- Snowfall of three to six inches

- Sleet accumulations of less than two inches

- Intermittent blowing snow that reduces visibility below one-half mile with winds of less than 25 mph

- Less than one-quarter inch of freezing rain accompanied by another winter event

The NWS office will issue a blizzard warning under conditions of sustained winds or frequent gusts of 35 mph or more and falling or blowing snow which reduces visibility to one-quarter mile or less for three or more hours. The office will issue an ice storm warning when ice accumulations of one-quarter inch or more are expected over a period of 12 or fewer hours and a freezing rain advisory when ice accumulations of less than one-quarter inch are expected over a period of 12 or fewer hours.

Cold, dry air passing over warmer waters of Lake Michigan can produce snow squalls in downwind shoreline communities of Racine County. The NWS office will issue a lake effect snow warning when more than six inches of heavy lake effect snow squall accumulations are expected within a period of 12 hours. A lake effect snow advisory will be issued when three to six inches of lake effect snow squall accumulations are expected over a period of 12 hours or less.

The NWS bulletins are disseminated over a number of telecommunication channels, including the NOAA Weather Radio All Hazard radio network, the NOAA All Hazards Weather Wire, and the State law enforcement TIME system, and through an emergency e-mailing network. In addition, these bulletins are

relayed to other local media via the Federal Communication Commission's Emergency Alert System (EAS) which rebroadcast the weather bulletins over public and private television and radio stations.

Federal and State programs include awareness and education activities. WEM, in conjunction with the National Weather Service, other State agencies, and local emergency management organizations, provides awareness and preparedness information to the public. This information is provided in three severe weather awareness campaigns conducted annually, each focusing on the prevalent weather hazard at that time. In November each year, Winter Awareness Week focuses on informing and educating people concerning the hazards presented by severe winter weather and information on preparedness for extreme weather conditions during winter. The Wisconsin Department of Health Services has developed a weather took kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to winter storm events. Similarly, the Wisconsin Department of Emergency Management has produced several educational resources regarding winter weather, including prerecorded radio public service announcements, scripts for radio public service announcements, fliers, and educational materials for children.

The Wisconsin Building Code specifies design requirements to minimize vulnerability to winter storms by setting the load capacity of roofs by region based on likely maximum snowfall. The National Weather Service reports that 70 percent of winter storm fatalities occur in automobiles, therefore, listening to weather advisories and avoiding travel during winter storms would help prevent many fatalities.

Local Programs

The Racine County Office of Emergency Management has a number of brochures, booklets, and pamphlets available for the public on winter weather safety and other general emergency management-related topics. In addition, the Ready Racine County website contains factsheets listing specific information regarding what to do in the event of a winter storm watch or warning as well as what residents can do before, during, and after a winter storm occurs in their area. The Racine County Office of Emergency Management also participates in all State sponsored severe weather awareness campaigns.

Community strategies include plowing, salting and sanding roads, maintaining the health of urban trees to minimize damage from ice storms, and promoting sound levels of home insulation. Older homes can be vulnerable to heat loss and any home is vulnerable to power loss, therefore, possession of a safe alternative heat and power source is a consideration in protecting against winter storm hazards.

As described in Chapter 2, Racine County has developed a comprehensive emergency management plan, which sets forth a hazard action plan. In addition, many of the local units of government have developed emergency operations plans and/or programs which complement the County plan and which also set forth procedures and actions to deal with a range of situations and events, including winter storm events.

Racine County was redesignated by the National Weather Service as a StormReady® community in 2021. This designation is valid for three years. The program is described in the previous section on hazard mitigation plan components for thunderstorm wind, non-thunderstorm high-wind, hail, and lightning hazards.

A variety of methods are used to warn people in Racine County of emergency situations, including winter storms. These warning systems are described in the section of this chapter related to thunderstorm wind, non-thunderstorm high-winds, hail, and lightning hazards.

Evaluation of Alternatives and Identification of Mitigation Actions

Analysis of the vulnerability of humans, infrastructure, and economic production to winter storms and related hazard events demonstrates that the provision of advanced weather forecasts and warning systems, as well as public informational and educational programming, are the most important mitigation actions to be considered. In addition, informing the public of the significance of winter storm watches and warnings so that they take these events seriously and know where to seek shelter in emergency situations, are important, ongoing components to minimizing the risks associated with these natural hazards. The formation of a neighborhood outreach program to assist those who may be vulnerable to winter storms is an important element in ensuring that everyone is protected during these events and assistance is available to those who need help clearing away snow or ice after these events. Community and school based informational programs are currently being conducted by the County in partnership with Federal, State and local authorities.

Multi-Jurisdictional Considerations

Winter storms and their related hazards can potentially impact all municipalities within the County. In addition, these severe events can potentially cause multiple damages to a variety of infrastructure including transmission lines, communication lines, and transportation routes due to slippery conditions and reduced visibility. Racine County, the local units of government and relevant businesses need to coordinate hazard mitigation activities through local government participation in countywide disaster planning and response mechanisms. Such measures are already well underway through the coordinated emergency management

planning program involving the Racine County Office of Emergency Management and coordinated local community emergency operations programs.

Priority Mitigation Measures

Based upon the foregoing evaluation, consideration of risk, and review and action by the Racine County Hazard Mitigation Plan Local Planning Team (see Appendix A), the following mitigation measures related to winter storm events are included in the updated hazard mitigation plan for Racine County:

- Organize neighborhood outreach groups to assist those who may be vulnerable to winter storm related hazards;

- Identify and advertise a list of available heated shelters in the immediate area;

- Maintain, update, and further develop the early warning and communication systems including coverage of NOAA All Hazard Weather Radios; Emergency Alert System (EAS) capabilities; and emerging technologies, such as the County's targeted Wireless Emergency Alerts (WEA) system and the CodeRED® Emergency and Weather Notification System

- Promote educational and informational programming, especially related to the early warning network, including NOAA All Hazard Weather Radio, EAS broadcasts, WEA system, and the CodeRED® Emergency and Weather Notification System

- Encourage residents to develop a Family Emergency Preparedness Plan including the preparation of a Disaster Supply Kit (see Appendix D);

- Ongoing review and enforcement of building code ordinance requirements;

- Work with agencies, such as the American Red Cross, to establish a system to provide for short-term shelters and shelter operations during severe winter storm event situations;

- Continued coordination of emergency response plans among governmental units and first responders;

- Continue and refine State, County, and local road maintenance programs; and

- Work with utilities to assess and improve, as needed, electrical service systems reliability. Such improvements should include consideration of burying utilities at critical and vulnerable junctions to avoid power loss due to downed lines.

Because most of these measures are intended to be ongoing efforts, the Local Planning Team decided to retain them in the updated plan.

5.8 HAZARD MITIGATION PLAN COMPONENT FOR DROUGHT

As described in Chapter 3, droughts are natural hazard events of limited concern to be considered in the Racine County hazard mitigation plan. This section describes alternate and selected strategies to mitigate this type of hazard. As part of the updating process, these strategies were reviewed and reevaluated by the Racine County Hazard Mitigation Plan Local Planning Team in light of the updated hazard mitigation goals and hazard conditions documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

Stresses on the water resources of Racine County include: a growing population, increased competition for available water, and loss of groundwater recharge areas due to development. Severe droughts result from extended periods of limited or no rainfall, which generally provides ample warning for potentially affected areas to take preventative actions. When drought events do occur, they commonly last for extended periods of time (weeks or months) and impact a relatively large area.

While it may not be possible to accurately predict specific areas where there is significant risk from extreme drought, droughts have the greatest impact on agricultural producers. Racine County has 115,737 acres of farmland, and even droughts of limited duration can significantly reduce crop growth and yields, adversely affecting farm income. More substantial events can decimate croplands and result in total loss, negatively impacting the individual producers and the local economy. Although nothing can prevent a drought, measures can be taken to reduce the potential loss caused by droughts wherever they may occur in the County. In review by the Racine County Hazard Mitigation Plan Local Planning Team as part of the updating process, the following measures to reduce vulnerability to drought events have been identified as viable for this update of the Racine County hazard mitigation plan.

Nonstructural

- Encourage the development and maintenance of drought emergency plans for local utilities and local communities. Such plans should include:

    - Development of criteria for triggering drought-related actions, and

    - Specification of water use regulations to be initiated during drought conditions;

- Encourage the development of local water conservation programs. Such programs may include provisions such as:

    - Water supply system efficiency actions including water audits, meter testing, leak detection and repair, water main maintenance and replacement, water system audits, and water production system refinement,

    - Public information and education programming, distribution of educational materials, and presentations to schools and civic groups;

    - Outdoor watering reduction measures such as the use of rain barrels or implementation of lawn and landscape plant watering restrictions when a severe drought is occurring,

    - Development and use of water conservation rate structures, and/or

    - Fixture and plumbing system retrofits;

- Protect areas of high and very high groundwater recharge potential from inappropriate development and promote regional activities to protect groundwater recharge areas outside of the County boundaries;

- Identify areas with potential groundwater level problems and inspect wells in those areas for adequate depth and construction;

- Promote the use of agricultural methods that reduce evaporation and/or promote infiltration. Such methods may include planting windbreaks for farm crops, planting cover crops, use of no-till or reduced-till methods, and contour plowing;

- Encourage the use of drought-resistant landscaping practices using native plantings;

- Promote the use of green infrastructure and other stormwater management practices that facilitate aquifer recharge, such as rain gardens, permeable pavement, and soil amendments;

- Support agricultural programs that promote soil health, preserve soil moisture, and help to minimize loss of crops and topsoil during drought conditions;

- Consider farm drought management strategies that include monitoring soil moisture levels and planting crops that will tolerate low moisture levels;

- Maintain and support the University of Wisconsin-Extension Farmer to Farmer Hay, Forage, and Corn List;

- Support ordinances to prioritize or control water use during drought conditions;

- Design and plan for water supply infrastructure systems that are not vulnerable to drought events;

- Promote enrollment of agricultural producers into Federal crop insurance programs

Structural

- Consider implementing the recommendations made in the regional water supply plan for additional water supply facilities and programs to meet forecast water use demands

- Where opportunities exist, consider development of interconnections between adjacent water utilities to ensure provision of water in the event of a loss of water supply due to severe drought

- Continue operation and monitoring of stream gaging stations and groundwater monitoring wells by the WDNR, U.S. Geological Survey, National Weather Service, and U.S. Army Corps of Engineers

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity of drought events;

- Produce and distribute emergency preparedness information related to droughts; and

- Encourage farmers to report crop and/or livestock losses to the appropriate officials, including the Racine County Office of Emergency Management.

Current Programs

Federal and State Programs

The continuous monitoring of hydrologic conditions is important to identify and assess drought conditions. The U.S. Geological Survey operates a stream gaging program with local cooperators throughout the State. In Southeastern Wisconsin, this program is coordinated by the WDNR and SEWRPC. The Racine Wastewater Utility is a local cooperator. The Wisconsin Geological and Natural History Survey also monitors a statewide network of groundwater elevation monitoring wells.

The National Drought Mitigation Center (NDMC), based at the University of Nebraska-Lincoln, provides assistance in the development and implementation of measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management. Most of the NDMC's services are directed to State, Federal, regional, and tribal governments that are involved in drought and water supply planning. The NDMC's activities include maintaining an information clearinghouse and drought portal; drought monitoring, including participation in the preparation of the U.S. Drought Monitor and maintenance of the web site; drought planning and mitigation; drought policy; advising policy makers; collaborative research; K-12 outreach; workshops for Federal, State, and foreign governments and international organizations; organizing and conducting seminars, workshops, and conferences; and providing data to and answering questions for the media and the general public.

The U.S. Drought Monitor, a joint effort of the U.S. Department of Agriculture (USDA), the National Oceanic and Atmospheric Administration (NOAA), and the National Drought Mitigation Center, provides monitoring of drought conditions and forecasting of seasonal conditions throughout the United States.

The USDA's Farm Service Agency (FSA) provides information about conservation, commodity programs, crop insurance, and farm loans, along with State and county contacts. It also administers several programs which can provide emergency assistance to agricultural producers in the event of natural disasters such as

drought. These programs include the Emergency Conservation Program, the Emergency Forest Restoration Program, the Emergency Loan Program, the Livestock Forage Disaster Program, the Noninsured Crop Disaster Assistance Program and the Tree Assistance Program. The FSA's electronic Hay and Grazing Net Ad Service (eHayNet) is an internet based service allowing farmers and ranchers to share "Need Hay" and "Have Hay" ads online.

Farmers in the County that irrigate can also use the Wisconsin Irrigation Scheduling Program (WISP). This research-based computer program provided by the University of Wisconsin-Extension can assist growers in determining frequency and amounts of irrigation throughout the growing season. Irrigation scheduling provided by this program can be extremely helpful during a drought.

The Farmer to Farmer Hay, Forage and Corn List sponsored by the University of Wisconsin-Extension puts Wisconsin farmers in touch with one another for the purpose of buying and/or selling corn and forage. The farmer to farmer list is free of charge to both buyers and sellers.

Federal and State programs also include awareness and education activities. The Wisconsin Department of Health Services has developed a drought tool kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to drought events.

Chapter NR 852, "Water Conservation and Water Use Efficiency", of the *Wisconsin Administrative Code* establishes mandatory water conservation and efficiency measures for withdrawals in the Great Lakes Basin and water loss approvals throughout the State. The requirements set forth in this chapter apply to all persons within the Great Lakes Basin applying for a diversion or a new or increased withdrawal averaging 100,000 gallons per day (gpd) or more and all persons within the State applying for withdrawals that will result in a water loss averaging more than 2,000,000 gpd. The chapter establishes three tiers of requirements based upon the size of the withdrawal and the amount of water not returned to the basin from which it is withdrawn as a result of a diversion or consumptive use. The chapter requires that persons applying for a new or increased withdrawal, diversion, or water loss approval submit a water conservation plan meeting specified requirements with their application. In addition, written documentation must accompany the application showing that water conservation and efficiency measures (CEM) that do not require retrofitting have been implemented or completed. The specific CEMs required vary according to the water use sector and tier to which the application is assigned.

Local Programs

As described in Chapter 2, Racine County has developed a comprehensive emergency management plan which sets forth a hazard action plan. In addition, many of the local units of government have developed emergency operations plans and/or programs which complement the County plan and which also set forth procedures and actions to deal with a range of situations and events, including instances of drought.

Multi-Jurisdictional Considerations

Droughts and their related hazards can potentially impact all municipalities within the County, however, those communities that depend on groundwater as a source of water supply experience the most severe impacts from drought events. Racine County, the local units of government, and relevant businesses need to coordinate hazard mitigation activities through the local government participation in countywide disaster planning and response mechanisms.

Priority Mitigation Measures

Based upon the foregoing evaluation, consideration of risk, and review and action by the Racine County Hazard Mitigation Plan Local Planning Team (see Appendix A), the following mitigation measures related to drought events are included in the updated hazard mitigation plan for Racine County:

- Encourage the development and maintenance of drought emergency plans for local utilities and local communities;

- Encourage the development of local water conservation programs;

- Encourage multi-agency approaches to drought planning, water conservation, drought prediction and stream and groundwater monitoring;

- Promote educational and informational programming relating to water conservation;

- Support agricultural programs that promote soil health, preserve soil moisture, and help to minimize loss of crops and topsoil in the event of a drought. Such programs should promote the use of agricultural methods that reduce evaporation and/or promote infiltration;

- Evaluate and design water supply systems that are not vulnerable to drought events;

- Encourage farm operators evaluate the economics of crop insurance programs; and

- Encourage development practices that promote preservation of areas of high and very high groundwater recharge potential and promote stormwater management practices that facilitate aquifer recharge.

Because these measures are intended to be ongoing efforts, the Local Planning Team decided to retain them in the updated plan.

5.9 SUMMARY

Based upon the foregoing evaluation of each of the natural hazards above, the priority mitigation measures identified to be included in the Racine County hazard mitigation plan are summarized in Table 5.8. Table 5.8 provides an evaluation of the mitigation measures identified in each hazard category based upon estimated capital costs and annual operation and maintenance, likely direct and indirect benefits of implementation, and a list of communities affected. Table 5.8 also indicates those mitigation measures that are related to continued compliance with the National Flood Insurance Program.

There are several potential issues inherent in the prioritization or ranking of the mitigation measures, which were considered in development of the recommended ranking of priority mitigation measures summarized below. First, the Racine County hazard vulnerabilities are different for loss of life and injury versus property damages, which may affect prioritization of costs to be incurred. For the purposes of this plan, priority or emphasis was placed upon preventing loss of life and injury.

The costs of avoidance of a particular hazard may not be quantifiable, but the cost of occurrence of the hazard often is—for example, most hazards have been quantified by insurance underwriters in the issuance of property and life insurance policies. Conversely, the benefit of any particular mitigation measure may also not be quantifiable or realized. For example, continued coordination of emergency response and operation plans among governmental units and first responders will directly enhance preparedness and protection of the communities involved; however, this action may or may not ultimately result in reduced property damage, injuries, or death if the hazard does not occur. Similarly, in the case of flood mitigation, upstream actions may result in downstream benefit even if the immediate benefits at the location where the mitigation measure was applied may be less than optimal.

Another potential issue is whether the hazard ranking reflects public health concerns for which mitigation is possible. For example, the vulnerability to hazards such as extreme heat and lightning are very much a matter of personal exposure. Mitigation in the traditional sense (strengthening a structure or moving a structure away from the hazard such as in flood mitigation) is of little use for these hazards. Neither extreme heat nor lightning are emergency management issues in terms of operations. Reducing the risk of mortality from lightning or temperature extremes requires public health information and hazard awareness so that individuals take precautions to limit their exposure to the hazard. While hazard awareness and public safety information are important for any type of hazard, it is especially important for hazards such as temperature extremes, lightning, tornadoes, and severe thunderstorms.

Ranking of Priority Mitigation Measures

The mitigation measures identified in each hazard category were evaluated based upon relative cost, direct benefits, and likely indirect benefits as shown in Table 5.8. Consideration was given to the likelihood of occurrence of each type of hazard as set forth in the hazard prioritization analysis. Greatest priority is recommended to be given to those mitigation measures that directly or indirectly resulted in minimized loss of life or injury.

Estimated Cost of Implementation

Where possible, Table 5.8 includes a summary of the estimated capital cost and average annual operation and maintenance cost for each mitigation measure. There are many mitigation measures, especially for hazards other than flooding and related stormwater drainage problems, where a meaningful direct monetary cost analysis was not possible. Therefore, mitigation measures were also assigned a classification of low-, moderate-, and high-cost to categorize the relative expense of implementing the measure (see Table 5.8). The three categories are generally defined as including:

Low-Cost (less than $100,000)

- Educational and informational programming
- Ongoing enforcement of ordinances
- Plan Development
- Continued coordination/mutual aid/interagency agreements

Moderate-Cost (greater than $100,000 and less than $1,000,000)

- Addition of new staff
- Additional staff hours budgeted

Additional equipment

New ordinance development

New programs/task force

High-Cost (greater than $1,000,000)

Major construction

New buildings (infrastructure)

Capital programs

This cost assessment allows the mitigation measures to be prioritized with particular regard to cost effectiveness by comparing the estimated low-, moderate-, and high-cost to the number of both direct and indirect benefits identified.

Direct and Indirect Benefits

The benefits from implementation of a mitigation measure can be classified as direct, or measurable, and as indirect, or intangible. Direct benefits were defined in terms of enhanced preparedness/protection of individuals or communities, reduced property damage, reduced injuries and reduced mortalities. Although the exact numbers or amounts of such direct benefits are often not known, these would be a direct result of implementation of a particular mitigation measure. In contrast, indirect benefits represent a range of potential benefits that may occur as a result of the implementation of specific management actions. For example, implementation of informational programming, while not directly saving lives, may ultimately result in people having the knowledge necessary to save lives and protect property. These intangible benefits cannot be readily quantified and range from increased awareness to reduced loss of life and property, and have been assessed using the following relative cumulative scale:

1 = Increased awareness/preparedness

2 = Enhanced quality of life/social benefits

3 = Reduced property damage

4 = Increased environmental and recreational benefits/ecosystems services

5 = Reduced loss of life and injury with associated benefits for economic productivity

Similar to cost analysis, direct monetary benefits are difficult to assess for most mitigation measures. For example, while constructing a safe room at a mobile home park may save lives during a severe thunderstorm or tornado event, it is difficult to allocate a monetary benefit to avoiding injury or loss of life. Likewise,

although it can be assumed that the restoration of farmland that often floods back to its historical wetland state will have the likely benefit of the reduction in crop losses, crop insurance indemnity payouts, crop insurance premiums, and the potential to decrease downstream flood damages, more rigorous modelling would be required to estimate these monetary benefits. Conversely, SEWRPC staff has analyzed the estimated flood damages that would be sustained to structures within the 1-percent-annual-probability (100-year) floodplain in the event of a ten-, two-, and 1-percent-annual-probability flood. Estimated benefits from implementation of the recommendation related to acquisition and demolition, or floodproofing of these structures, are estimated as the annual structural flood damages avoided, as shown in Table 5.9.

Direct and indirect benefits are summarized in Table 5.8. The greatest indirect benefit should be allocated to those mitigation measures that may ultimately result in minimized loss of life or injury. Table 5.8 also indicates a list of the communities affected for each hazard and their corresponding priority mitigation measure.

Chapter 5

HAZARD MITIGATION STRATEGIES

TABLES

Table 5.1
Principal Features and Costs of the Floodplain Management Plan Element for the Fox River Watershed

Component Description	Capital Cost[a]		Annual Operation and Maintenance Cost (thousands of dollars)	Implementation Status
	Component Details	Cost (thousands of dollars)[b]		
1. Preserve remaining riparian buffer areas, specifically primary environmental corridor lands along the Fox River and its major tributaries	Primary environmental corridors should be preserved in essentially natural open space uses. Corridors should be preserved by a combination of public acquisition for parkway purposes and floodplain and open space zoning	--	--	Partially implemented
2. Structure floodproofing, relocation, or removal of 435 structures[c]	Remove up to 337 residential structures; relocate or demolish up to 54 mobile home structures; and floodproof up to 19 agricultural buildings, 18 commercial buildings, 6 utility structures, and 1 other structure	76,314.6[d]	--	Not implemented[e]
3. Installation of gates at Waterford Dam	Replacement of two 20-foot-wide radial gates, replacement of one actuator motor, and concrete repair to the dam structure	110.6	10.5	Implemented[f]
4. Installation of gates at Rochester Dam	Two 16-foot by five-foot radial gates	477.6	4.4	Implemented
5. Channel clean out in Fox River upstream from Waterford Impoundment	Remove selected sediment and debris from channel	19.6	0.2	Not implemented
6. Land acquisition	Purchase 370 acres of agricultural land in Town of Waterford	1,645.0	--	Not implemented
7. Maintenance dredging within Waterford Impoundment	Dredge along 50 acres	1,445.0	--	Partially implemented
8. Channel clean out of Wind Lake Drainage Canal	Clear 7.0 miles of Wind Lake Drainage Canal, 40.0 miles of lateral canals	1,131.0	25.8	Partially implemented
9. Channel clean out and deepening along Muskego Canal	Remove debris and deepen by three feet 0.6 mile of canal	62.7	3.6	Implemented
	Total	81,206.1	44.5	--

Note: The management measures in this table originate from strategies recommended in a comprehensive plan for the Fox River Watershed (*SEWRPC Planning Report No. 12, February 1970*) and further amended as it affects Racine County in 1975 (*SEWRPC Community Assistance Planning Report No. 5, May 1975*) and 1995 (*SEWRPC Memorandum Report No. 102, March 1995*). The floodland management measures as they appear in this table were adapted to reflect current conditions for use in the current hazard mitigation planning program.

[a] *Includes engineering, administration, and contingencies. Costs are shown in 2021 dollars.*

[b] *City of Burlington needs and components are recommended to be reevaluated, given the extensive recent downtown area improvements which include flood mitigation actions.*

[c] *This number reflects the structures determined to be within the one-percent-annual-probability (100-year recurrence interval) floodplain utilizing the most recent FEMA floodplains, effective May 2012, geographic information system techniques, and orthophotographs from April 2015. Field surveys of these structures would provide a more definitive assessment of their flood hazard status.*

Table continued on next page.

Table 5.1 (Continued)

[d] *For the purpose of this analysis, it was assumed that all residential structures located within the one-percent-annual-probability (100-year recurrence interval) floodplain would be acquired and demolished. The cost for removal of the residential structures includes an estimated average fair market property value plus $10,000 per property for demolition expenses. Floodproofing or elevating some residential structures, if found to be feasible based on specific factors, could be more cost effective. If floodproofing or elevation is considered at a specific structure, or a group of structures, field surveys of these structures should be conducted to obtain a more definitive assessment of their flood hazard status. All other categories of buildings (agricultural, commercial, utility, governmental, and other) were assumed to be floodproofed for the purpose of this analysis.*

[e] *Structure floodproofing/removal to be carried out at discretion of property owners.*

[f] *A contractor was hired by Racine County in 2016 to replace two 20-foot-wide radial dam gates and one actuator motor on the Waterford Dam. In addition, concrete repair to the dam structure was planned. The project was expected to be completed in January 2017.*

Source: SEWRPC

Table 5.2
Features and Costs of the Floodplain Management Plan Element for the Fox River Watershed that are Recommended to be Reevaluated

Component Description	Component Details	Capital Cost[a] Cost (thousands of dollars)	Annual Operation and Maintenance Cost (thousands of dollars)	Implementation Status
1. Construction of dikes and floodwalls in City of Burlington[b]	a. Earth dikes (12,500 feet)[b]	454.8	--	--
	b. Concrete floodwalls (2,100 lineal feet)[b]	1,962.8	--	--
	c. 22 automatic drainage gates[b]	34.2	--	--
	d. Miscellaneous items[b]	1,203.6	--	--
	Subtotal	3,655.4[b]	5.2[b]	Partially implemented
2. Construction of levees and channel improvements along Hoosier Creek	a. Channel improvement (49,000 feet)	763.3		--
	b. Earth dikes (20,600 feet)	171.4		--
	c. 66 surface water inlets	199.5		--
	d. Revegetation (112 acres)	214.9		--
	e. Miscellaneous items	1,161.2		--
	Subtotal	2,510.3	28.9	Not implemented
3. Construct agricultural dikes along Wind Lake Drainage Canal and tributaries	a. 211,000 lineal feet of earth dike, install 40 pumping stations	1,516.3	25.8	Not implemented
	Total	7,682.0	60.0	--

[a] *Includes engineering, administration, and contingencies. Costs are shown in 2021 dollars.*

[b] *City of Burlington needs and components are recommended to be reevaluated, given the extensive recent downtown area improvements which include flood mitigation actions.*

Source: SEWRPC

Table 5.3
Principal Features and Costs of the Floodplain Management Plan Element for the Root River Watershed

Component Description	Capital Cost[a]		Annual Operation and Maintenance Cost (thousands of dollars)	Implementation Status
	Component Details	Cost (thousands of dollars)		
1. Preserve remaining riparian buffer areas, specifically primary environmental corridor lands along the Fox River and its major tributaries	Primary environmental corridors should be preserved in essentially natural open space uses. Corridors should be preserved by a combination of public acquisition for parkway purposes and floodplain and open space zoning	--	--	Partially implemented
2. Channel clearing and maintenance along the Root River Canal	Clear 21.9 of canal	740.5	24.4	Partially implemented
3. Structure floodproofing or removal of 196 structures[b]	Remove up to 170 residential structures and floodproof up to 12 agricultural buildings, 3 government structures, and 11 "other" structures	39,086.9[c]	--	Not implemented[d]
	Total	39,827.4	24.4	--

[a] *Includes engineering, administration, and contingencies. Costs are shown in 2021 dollars.*

[b] *This number reflects the structures determined to be within the one-percent-annual-probability (100-year recurrence interval) floodplain utilizing the most recent FEMA floodplains, effective May 2012, geographic information system techniques, and orthophotographs from April 2015. Field surveys of these structures would provide a more definitive assessment of their flood hazard status.*

[c] *For the purpose of this analysis, it was assumed that all residential structures located within the one-percent-annual-probability (100-year recurrence interval) floodplain would be acquired and demolished. The cost for removal of the residential structures includes an estimated average fair market property value plus $10,000 per property for demolition expenses. Floodproofing or elevating some residential structures, if found to be feasible based on specific factors, could be more cost effective. If floodproofing or elevation is considered at a specific structure, or a group of structures, field surveys of these structures should be conducted to obtain a more definitive assessment of their flood hazard status. All other categories of buildings (agricultural, commercial, utility, governmental, and other) were assumed to be floodproofed for the purpose of this analysis.*

[d] *Structure floodproofing/removal to be carried out at discretion of property owners.*

Source: SEWRPC

Table 5.4
Principal Features and Costs of the Floodplain Management Plan Element for the Pike River Watershed

Component Description	Capital Cost[a]		Annual Operation and Maintenance Cost (thousands of dollars)	Implementation Status
	Component Details	Cost (thousands of dollars)[b]		
1. Preserve remaining riparian buffer areas, specifically primary environmental corridor lands along the Fox River and its major tributaries	Primary environmental corridors should be preserved in essentially natural open space uses. Corridors should be preserved by a combination of public acquisition for parkway purposes and floodplain and open space zoning	--	--	Partially implemented
2. Pike River channel enlargement and rehabilitation	Construct 5.25 miles of channel modifications and four wetland/storage basins	22,365.5[b]	29.3	Implemented
3. Berm along Bartlett Branch	500-foot-long earth berm	163.9	1.3	Implemented
4. Chicory Road culvert replacement along Sorenson Creek	Install new clear-span bridge with 30-foot opening width	390.6	0.0	Not implemented
5. Structure floodproofing or removal of 48 structures[c]	Remove up to 42 residential structures and floodproof up to 6 commercial/industrial structures	10,234.2[d]	--	Not implemented[e]
	Total	33,154.2	30.6	--

[a] *Includes engineering, administration, and contingencies. Costs are shown in 2021 dollars.*

[b] *About $4 million of this total cost was paid for in a variety of grants. In addition, the U.S. Army Corps of Engineers contributed about $5 million to the project.*

[c] *This number reflects the structures determined to be within the one-percent-annual-probability (100-year recurrence interval) floodplain utilizing the most recent FEMA floodplains, effective May 2012, geographic information system techniques, and orthophotographs from April 2015. Field surveys of these structures would provide a more definitive assessment of their flood hazard status.*

[d] *For the purpose of this analysis, it was assumed that all residential structures located within the one-percent-annual-probability (100-year recurrence interval) floodplain would be acquired and demolished. The cost for removal of the residential structures includes an estimated average fair market property value plus $10,000 per property for demolition expenses. Floodproofing or elevating some residential structures, if found to be feasible based on specific factors, could be more cost effective. All other categories of buildings (agricultural, commercial, utility, governmental, and other) were assumed to be floodproofed for the purpose of this analysis. If floodproofing or elevation is considered at a specific structure, or a group of structures, field surveys of these structures should be conducted to obtain a more definitive assessment of their flood hazard status.*

[e] *Structure floodproofing/removal to be carried out at discretion of property owners.*

Source: Village of Mt. Pleasant Utility District and SEWRPC

Table 5.5
Principal Features, Costs, and Benefits of the Recommended Floodplain Management Plan for the Des Plaines River Watershed

Component Description	Capital Cost[a,b]		Annual Operation and Maintenance Cost (thousands of dollars)	Implementation Status
	Component Details	Cost (thousands of dollars)		
1. Preserve remaining riparian buffer areas, specifically primary environmental corridor lands along the Fox River and its major tributaries	Primary environmental corridors should be preserved in essentially natural open space uses. Corridors should be preserved by a combination of public acquisition for parkway purposes and floodplain and open space zoning	--	--	Partially implemented
2. Provide onsite detention storage facilities for planned new development	Detention facilities, including land cost	9,307.8[c]	94.8[c]	Partially implemented
3. Restore prairie conditions on 6.0 square miles of agricultural land	Prairie restoration	937.5 to 2,644.8[d]	1.5 to 106.6[d]	Not implemented
4. Restore wetland conditions on 3.1 square miles of agricultural land in the 100-year floodplain	Wetland restoration	241.9 to 606.7[d]	0.5 to 27.5[d]	Not implemented
	Total	10,487.2 to 12,559.3	96.8 to 228.9	--

[a] *A breakdown of costs between Kenosha and Racine Counties is not available. Thus, total costs for both Counties are listed. It is estimated that the capital cost range for measures in Racine County would be relatively small, ranging from $852,124 to $1,014,413.*

[b] *Includes engineering, administration, and contingencies. Costs are shown in 2021 dollars.*

[c] *Incremental cost between control of two-year and 100-year events.*

[d] *Cost reflects range from minimal wetland and prairie operation and maintenance to active management.*

Source: SEWRPC

Table 5.6
Participation in the National Flood Insurance Program by Racine County Jurisdictions

Civil Division	Participating in Racine County Hazard Mitigation Plan	Participating in National Flood Insurance Program	Date Initial Flood Hazard Boundary Map Identified	Date Initial Flood Insurance Rate Map (FIRM)	Current Effective Map Date	Entry Date into National Flood Insurance Program
Cities						
Burlington	Y	Y	10/05/1973	05/15/1978	05/02/2012	05/15/1978
Racine	Y	Y	--	06/01/1973	02/01/2019	06/01/1973
Villages						
Caledonia	Y	Y	--	04/01/1982	02/01/2019	12/05/2008
Elmwood Park	Y	N[a]	--	--	--	--
Mt. Pleasant	Y	Y	--	04/01/1982	02/01/2019	04/28/2008
North Bay	Y	N[a]	--	--	05/02/2012	09/06/1975
Raymond	Y	Y	05/20/1977	04/01/1982	05/02/2012	04/01/1982
Rochester	Y	Y	01/09/1974	01/02/1981	05/02/2012	01/02/1981
Sturtevant	Y	Y	05/24/1974	06/04/1980	02/01/2019	04/08/2008
Union Grove	Y	Y	--	06/17/1986	05/02/2012	06/17/1986
Waterford	Y	Y	12/17/1973	01/02/1981	05/02/2012	01/02/1981
Wind Point	Y	Y	06/28/1974	09/30/1980	05/02/2012	09/30/1980
Yorkville	Y	Y	05/20/1977	04/01/1982	05/02/2012	04/01/1982
Towns						
Burlington	Y	Y	05/20/1977[b]	04/01/1982[b]	05/02/2012[b]	04/01/1982[b]
Dover	Y	Y	05/20/1977[b]	04/01/1982[b]	05/02/2012[b]	04/01/1982[b]
Norway	Y	Y	05/20/1977[b]	04/01/1982[b]	05/02/2012[b]	04/01/1982[b]
Waterford	Y	Y	05/20/1977[b]	04/01/1982[b]	05/02/2012[b]	04/01/1982[b]
County						
Racine County	Y	Y	05/20/1977	04/01/1982	05/02/2012	04/01/1982

[a] *There are no floodplains mapped in the Villages of Elmwood Park and North Bay.*

[b] *In Wisconsin, towns are covered under county eligibility in the National Flood Insurance Program.*

Source: Federal Emergency Management

Table 5.7
Minimum Criteria for Shore Protection Structures Adapted from Criteria Recommended by the Racine County Technical Subcommittee on Shoreland Development Standards

Category	Criteria Required to be Met
Support Information	1. Determine lake bottom profiles offshore of proposed structure and 300 feet on both sides of the structure, from the structure out to a water depth of at least 12 feet 2. Identify existing and planned septic tank systems on the property to be protected and on adjacent properties, and consider the impact of the systems on bluff stability 3. Consider design wave height, wave direction, and the erosive impacts of wave action on the proposed structure
Structural Design	1. Size structure for design waves expected for a two-percent-annual-probability lake level, or 584.2[a] feet above the National Geodetic Vertical Datum (1929)[b] 2. Provide measures to protect the base of the structure against wave scouring 3. Design loose rubble revetment structures with a slope not greater than one vertical on two horizontal 4. Avoid structural damage or erosion on the landward side of the structure by preventing the overtopping of the structure by storm waves, or by providing for the positive drainage of any water which overtops the structure 5. Provide measures to prevent excessive erosion along the flanks of the structure 6. Provide adequate bedding materials to prevent undercutting of the structure
Bluff Stabilization	1. Regrade the bluff to a one on two and one half slope; unless detailed site-specific engineering analyses indicate that a different slope would be stable 2. If the groundwater level is occasionally higher than the lake level and threatens bluff stability, provide subsurface drainage facilities to intercept the groundwater, if necessary 3. If necessary, provide for interception drainage of surface water runoff to prevent surface erosion and saturation of the soils in the bluff 4. Provide adequate vegetative cover of the bluff slope after regrading

[a] *U.S. Army Corps of Engineers Detroit District, Revised Phase I Report on the Great Lakes Open-Coast Flood Levels, April 1988.*

[b] *The Technical Subcommittee established the 2-percent-annual-probability elevation based on Lake Michigan levels available at the time. That elevation has been superseded by the U.S. Army Corps of Engineers 1988 report.*

Source: SEWRPC and the Racine County Technical Subcommittee on Shoreland Development Standards, Recommendations of the Racine County Technical Subcommittee on Shoreland Development Standards for the Racine County Land Use Committee, *1982.*

Table 5.8
Cost-Benefit Analysis Summary of Measures Included in the Racine County Hazard Mitigation Plan

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Inland Flooding (Stormwater, Riverine, Inland Lake, Dam Failure)											
Floodplain and Environmentally Sensitive Land Preservation Element											
Floodplain and wetland zoning[d]	--[e]	--[e]	X	--	--	X	X	X	X	5	Racine County; Cities of Burlington and Racine; and Villages of Caledonia, Mt. Pleasant, Rochester, Sturtevant, Union Grove, Waterford, and Wind Point
Environmentally sensitive area and open preservation action[d]	34,911.8[f]	--[f]	--	--	X	X	X	--	--	4	Racine County; Cities of Burlington and Racine; and Villages of Caledonia, Elmwood Park, Mt. Pleasant, North Bay, Rochester, Sturtevant, Union Grove, Waterford, and Wind Point
Wetland Restoration of up to 6,800 acres of agricultural land to reduce flood-related agricultural and property damages	--[s]	--[s]	--	--	X	X	X			4	Racine County; City of Burlington; Villages of Caledonia, Mt. Pleasant, Rochester, Sturtevant, Union Grove, and Waterford; and Towns of Burlington, Dover, Norway, Raymond, Waterford, and Yorkville
Floodplain Management Plan Element											
Fox River Watershed											
Construction of dikes and floodwalls in City of Burlington[g]	3,196.1[g]	4.6[g]	--	--	X	X	X	--	--	--	City of Burlington
Structure floodproofing or removal[d]	76,314.7[h]	--	--	--	X	X	X	--	--	4	Racine County; City of Burlington; Towns of Burlington, Dover, Norway, and Waterford; and Villages of Rochester and Waterford
Replacement of two 20-foot-wide radial gates and one actuator motor at Waterford Dam[i]	110.6	9.2	--	X	--	X	X	--	--	3,5	Racine County and Village of Waterford
Installation of gates at Rochester Dam	477.6	3.8	--	X	--	X	X	--	--	3,4,5	Racine County and Village of Rochester
Channel clean out in Fox River upstream from Waterford Impoundment	19.6	0.1	X	--	--	X	X	--	--	4	Town of Waterford
Land acquisition[d]	1,645.0	--	--	--	X	X	X	--	--	4	Racine County and Town of Waterford
Maintenance dredging within Waterford Impoundment	1,445.0	--	--	--	X	X	X	--	--	4	Racine County, Town of Waterford, and Village of Waterford

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Table 5.8 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Inland Flooding (Stormwater, Riverine, Inland Lake, Dam Failure) (continued)											
Floodplain Management Plan Element (continued)											
Fox River Watershed (continued)											
Channel clean out of Wind Lake Drainage Canal	1,131.0	22.6	--	--	X	X	X	--	--	--	Racine County; Towns of Dover and Norway; and Village of Rochester
Channel clean out and deepening along Muskego Canal	62.7	3.1	X	--	--	X	X	--	--	--	Racine County and Town of Norway
Construct agricultural dikes along Wind Lake Drainage Canal and tributaries[j]	1,325.8	22.6	--	--	X	X	X	--	--	--	Racine County; Towns of Dover, Norway; and Village of Rochester
Construction of levees and channel improvements along Hoosier Creek[j]	2,194.8	25.3	--	--	X	X	X	--	--	5	Racine County and Town of Burlington
Root River Watershed											
Channel clearing and maintenance along the Root River Canal	740.5	21.8	--	X	--	X	X	--	--	4	Racine County and Towns of Raymond and Yorkville
Structure floodproofing or removal[d]	39,086.9[h]	--	--	--	X	X	X	--	--	4	Racine County; City of Racine; Villages of Caledonia and Mt. Pleasant; and Towns of Raymond, and Yorkville
Increase spillway capacity or remove of Horlick Dam	413.8 to 1,073.5[k]	0.8 to 3.2	--	X	--	X	X	--	--	4,5	Racine County and City of Racine
Pike River Watershed											
Pike River channel enlargement and rehabilitation	22,365.5	29.3	--	--	X	X	X	--	--	2,3,4	Racine County and Village of Mt. Pleasant
Berm along Bartlett Branch	163.9	1.3	--	X	--	X	X	--	--	3	Racine County and Village of Mt. Pleasant
Chicory Road culvert replacement along Sorenson Creek	390.6	0.0	--	X	--	X	X	--	--	3	Racine County and Village of Mt. Pleasant
Structure floodproofing or removal[d]	10,234.2[h]	--	--	--	X	X	X	--	--	4	Racine County, City of Racine, and Villages of Mt. Pleasant and Sturtevant
Des Plaines River Watershed[l]											
Provide onsite detention storage facilities for planned new development[d]	9,307.8[m]	94.8[m]	--	--	X	X	X	--	--	3	Racine County, Town of Yorkville, and Villages of Mt. Pleasant and Union Grove
Prairie restoration[d]	937.5 to 2,644.83	1.5 to 106.6	--	X	--	--	X	--	--	4	Racine County, Town of Yorkville, and Villages of Mt. Pleasant and Union Grove
Wetland restoration[d]	241.9 to 606.7[n]	0.5 to 27.5	--	X	--	--	X	--	--	4	Racine County, Town of Yorkville, and Village of Mt. Pleasant

Table continued on next page.

Table 5.8 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Inland Flooding (Stormwater, Riverine, Inland Lake, Dam Failure) (continued)											
Stormwater Management Plan Element											
Stormwater management plans[d]	--[o]	--[o]	X	--	--	X	X	--	--	3, 4	Racine County; Cities of Burlington and Racine; and Villages of Caledonia, Elmwood Park, Mt. Pleasant, North Bay, Rochester, Sturtevant, Union Grove, Waterford, and Wind Point
Stormwater-related regulations[d]	--[p]	--[p]	X	--	--	X	X	--	--	3, 4	Racine County; Cities of Burlington and Racine; and Villages of Caledonia, Elmwood Park, Mt. Pleasant, North Bay, Rochester, Sturtevant, Union Grove, Waterford, and Wind Point
Public Information and Education Element	--[q]	--[q]	X	--	--	X	--	--	--	2, 3, 5	Racine County and all local jurisdictions[r]
Additional Plan Elements											
National Flood Insurance Program and map updating[d]	--[e]	--[e]	--	X	--	X	X	--	--	3	Racine County; Cities of Burlington and Racine; Towns of Burlington, Dover, Norway, Raymond, Waterford, and Yorkville; and Villages of Caledonia, Mt. Pleasant, Rochester, Sturtevant, Union Grove, and Waterford
Lending institution and real estate agent policies[d]	--[e]	--[e]	X	--	--	X	X	--	--	3	Racine County; Cities of Burlington and Racine; Towns of Burlington, Dover, Norway, Raymond, Waterford, and Yorkville; and Villages of Caledonia, Mt. Pleasant, Rochester, Sturtevant, Union Grove, and Waterford
Channel maintenance	--[e]	--[e]	X	--	--	X	X	--	--	3, 4	Racine County; Cities of Burlington and Racine; Towns of Burlington, Dover, Norway, Raymond, Waterford, and Yorkville; and Villages of Caledonia, Mt. Pleasant, Rochester, Sturtevant, Union Grove, and Waterford
Stormwater management facilities maintenance[d]	--[e]	--[e]	--	X	--	X	X	--	--	3	Racine County; Cities of Burlington and Racine; Towns of Burlington, Dover, Norway, Raymond, Waterford, and Yorkville; and Villages of Caledonia, Mt. Pleasant, Rochester, Sturtevant, Union Grove, and Waterford
Dam inspections, emergency action plans, and removals	--[s]	--	X	--	--	X	--	--	--	3, 4, 5	Racine County; Cities of Burlington and Racine; Towns of Burlington, Dover, Norway, Raymond, Waterford, and Yorkville; and Villages of Caledonia, Mt. Pleasant, Rochester, Sturtevant, Union Grove, and Waterford

Table continued on next page.

Table 5.8 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Inland Flooding (Stormwater, Riverine, Inland Lake, Dam Failure) (continued)											
Additional Plan Elements (continued)											
Survey of buildings near flood hazard area[d]	917.0	--	X	--	--	X	X	--	--	1, 3	Racine County; Cities of Burlington and Racine; Towns of Burlington, Dover, Norway, Raymond, Waterford, and Yorkville; and Villages of Caledonia, Mt. Pleasant, Rochester, Sturtevant, Union Grove, and Waterford
Severe Thunderstorms Combined (Thunderstorms, High Straight-Line Winds, Hail, Lightning)											
Maintain, update, and further develop early warning systems and networks including use of NOAA All Hazard Weather Radios, EAS broadcasts, WEA system, *CodeRED*® Emergency and Weather Notification System	--[s]	--[s, t]	--	X	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Promote educational and informational programming, especially related to the early warning network, and to individual actions to protect citizens, property, and businesses	--[q]	--[q]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Enforce building code ordinances requirements	--[e]	--[e]	X	--	--	X	X	X	X	--	Racine County; Cities of Burlington and Racine; and Villages of Caledonia, Elmwood Park, Mt. Pleasant, North Bay, Rochester, Sturtevant, Union Grove, Waterford, and Wind Point
Encourage provision of safe rooms and retrofit existing or install new structures to ensure adequate shelters from severe thunderstorms (combined) for vulnerable communities	--[s]	--[s]	--	X	--	X	--	X	X	5	Racine County and all local jurisdictions[r]
Work with municipalities and businesses to explore installation of community safe rooms and hardening projects for community facilities, businesses, and manufacturers	--[u]	--[u]	--	X	--	X	--	X	X	5	Racine County and all local jurisdictions[r]
Consideration by municipalities of adopting mobile home park regulations which require that community safe rooms be provided for residents of new and expanding mobile home parks	--[s]	--[s]	X	--	--	X	--	X	X	5	Racine County and all local jurisdictions[r]
Pursue grant funding for installation of safe rooms in existing mobile home parks, based on community and landowner interest	--[u]	--[u]	--	X	--	X	--	X	X	5	Racine County, Villages of Caledonia, Mt. Pleasant, and Waterford; Towns of Burlington, Dover, and Yorkville

Table continued on next page.

Table 5.8 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Severe Thunderstorms Combined (Thunderstorms, High Straight-Line Winds, Hail, Lightning) (continued)											
Encourage agricultural producers to purchase crop insurance	--[s]	--[s]	X	--	--	X	X	--	--	1, 3	Racine County
Continue to conduct annual weather spotter training	--[s]	--[s]	X	--	--	X	--	--	--	5	Racine County
Continued coordination of emergency operations and response plans among governmental units and first responders	--[e]	--[e]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Tornadoes											
Maintain, update, and further develop early warning systems and networks including use of NOAA All Hazard Weather Radios, EAS broadcasts, WEA system, *CodeRED*® Emergency and Weather Notification System	--[s]	--[s, t]	--	X	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Retrofit existing or install new structures to ensure adequate shelters from tornadoes for public buildings, major industrial sites, and other large businesses or complexes such as shopping malls, fairgrounds, mobile home parks, and other vulnerable public areas	--[v]	--[v]	--	X	--	X	X	X	X	5	Racine County and all local jurisdictions[r]
Work with municipalities and businesses to explore installation of community safe rooms and hardening projects for community facilities, businesses, and manufacturers	--[u]	--[u]	--	X	--	X	--	X	X	5	Racine County and all local jurisdictions[r]
Consideration by municipalities of adopting mobile home park regulations that require that community safe rooms be provided for residents of new and expanding mobile home parks	--[s]	--[s]	X	--	--	X	--	X	X	5	Racine County and all local jurisdictions[r]
Pursue grant funding for installation of safe rooms in existing mobile home parks, based on community and landowner interest	--[u]	--[u]	--	X	--	X	--	X	X	5	Racine County, Villages of Caledonia, Mt. Pleasant, and Waterford; Towns of Burlington, Dover, and Yorkville
Promote educational and informational programming, especially related to the early warning network, and to individual actions to protect citizens, property, and businesses	--[q]	--[q]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]

Table continued on next page.

Table 5.8 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Tornadoes (continued)											
Enforce building code ordinances requirements	--[e]	--[e]	X	--	--	X	X	X	X	5	Racine County; Cities of Burlington and Racine; and Villages of Caledonia, Elmwood Park, Mt. Pleasant, North Bay, Rochester, Sturtevant, Union Grove, Waterford, and Wind Point
Continue to conduct annual weather spotter training	--[s]	--[s]	X	--	--	X	--	--	--	5	Racine County
Continue coordination of emergency response and operation plans among governmental units and first responders	--[e]	--[e]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Extreme Temperatures (Extreme Heat, Extreme Cold)											
Organize neighborhood outreach groups to assist those who may be vulnerable to extreme heat or cold	--[s]	--[s]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Identify and advertise a list of available heating and or cooling shelters in the immediate area	--[q]	--[q]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Continue to provide special arrangements for payment of heating bills	--[s]	--[s]	X	--	--	X	--	--	--	5	Utilities, Racine County and all local jurisdictions[r]
Maintain, update, and further develop early warning systems and networks including use of NOAA All Hazard Weather Radios, EAS broadcasts, WEA system, *CodeRED*® Emergency and Weather Notification System	--[s]	--[s, t]	--	X	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Promote educational and informational programming	--[q]	--[q]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Lake Michigan Coastal Hazards											
Continued enforcement of County shoreland zoning ordinance[d]	--[e]	--[e]	X	--	--	X	X	X	X	3, 5	Racine County; City of Racine; and Villages of Caledonia, Mt. Pleasant, North Bay, and Wind Point
Review Lake Michigan shoreline municipal shoreland ordinances[d]	--[e]	--[e]	X	--	--	X	X	X	X	3, 5	Racine County; City of Racine; and Villages of Caledonia, Mt. Pleasant, North Bay, and Wind Point
Update assessment of the effectiveness of Lake Michigan shoreline protection structures in the County every 10 years	67.7	--	X	--	--	X	X	X	X	3, 5	Racine County; City of Racine; and Villages of Caledonia, Mt. Pleasant, North Bay and Wind Point
Continued construction and maintenance of shoreline protection structures	--[u]	--[u]	--	X	--	X	X	--	--	3	Racine County; City of Racine; and Villages of Caledonia, Mt. Pleasant, North Bay and Wind Point

Table continued on next page.

Table 5.8 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Lake Michigan Coastal Hazards (continued)											
Where possible, relocate buildings within a high-risk area. In circumstances where buildings cannot be relocated safely or economically, or where bluff recession has progressed to the point where the risk of catastrophic failure of the slope is imminent, or where there is an imminent threat of failure within five years, acquisition and demolition of structures should be considered. This plan element is presented as an option, subject to the preference of the individual property owner.	--[u]	--	--	X	--	X	X	X	X	3, 5	Racine County; City of Racine; and Villages of Caledonia, Mt. Pleasant, North Bay and Wind Point
Continue ongoing programs to update and refine coastal hazard area data using geographic information system technology[d]	23.0	--	X	--	--	X	--	--	--	3	Racine County; City of Racine; and Villages of Caledonia, Mt. Pleasant, North Bay and Wind Point
Review water and wastewater treatment plant and outfall capacity and level of protection under range of Lake Michigan water levels	--[u]	--[u]	--	X	--	X	--	--	--	4	City of Racine
Public informational and educational programming	--[q]	--[q]	X	--	--	X	--	--	--	5	Racine County; City of Racine; and Villages of Caledonia, Mt. Pleasant, North Bay and Wind Point
Severe Winter Storms (Heavy Snowstorm, Blizzard, Ice Storm)											
Organize neighborhood outreach groups to assist those who may be vulnerable to winter storm related hazards	--[s]	--[s]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Identify and advertise a list of available heated shelters in the immediate area	--[q]	--[q]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Maintain, update, and further develop early warning systems and networks including use of NOAA All Hazard Weather Radios, EAS broadcasts, WEA system, *CodeRED*® Emergency and Weather Notification System	--[s]	--[s,t]	--	X	--	X	--	--	X	5	Racine County and all local jurisdictions[r]
Promote educational and informational programming	--[q]	--[q]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Encourage residents to develop a Family Emergency Preparedness Plan including the preparation of a Disaster Supply Kit	--	--	X	--	--	X	--	--	--	1	Racine County and all local jurisdictions[r]

Table continued on next page.

Table 5.8 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Severe Winter Storms (Heavy Snowstorm, Blizzard, Ice Storm) (continued)											
Ongoing enforcement of building code ordinance requirements	--[e]	--[e]	X	--	--	X	X	X	X	5	Racine County; Cities of Burlington and Racine; and Villages of Caledonia, Elmwood Park, Mt. Pleasant, North Bay, Rochester, Sturtevant, Union Grove, Waterford, and Wind Point
Work with agencies to establish a system for short-term sheltering	--[s]	--[s]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Continued coordination of emergency response plans among governmental units and first responders	--[e]	--[e]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Continue and refine State, County, and local road maintenance programs	--[e]	--[e]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Work with utilities to assess and improve electrical service reliability	--[e]	--[e]	X	--	--	X	--	--	--	5	Racine County and all local jurisdictions[r]
Drought Events											
Encourage the development and maintenance of drought emergency plans for local utilities and communities	--[s]	--[s]	X	--	--	X	--	--	--	4	Racine County and all local jurisdictions[r]
Encourage development of local water conservation programs	--[s]	105.9[w]	X	--	--	X	--	--	--	4	Cities of Racine and Burlington; Villages of Caledonia, Elmwood Park, Mt. Pleasant, North Bay, Sturtevant, Union Grove, Waterford, Wind Point; Towns of Burlington, Norway, Raymond, and Yorkville; and the Wisconsin Southern Center
Encourage multi-agency approaches to water conservation, drought planning, and stream and ground water monitoring	--[s]	--[s]	X	--	--	X	--	--	--	4	Racine County and all local jurisdictions[r]
Promote educational and informational programming	--[q]	--[q]	X	--	--	X	--	--	--	3	Racine County and all local jurisdictions[r]
Support agricultural programs that promote soil health, preserve soil moisture, and help to minimize loss of crops and topsoil in event of a drought. Such programs should promote the use of agricultural methods that reduce evaporation and/or promote infiltration	--[e]	--[e]	X	--	--	X	--	--	--	3	Racine County and all local jurisdictions[r]
Evaluate and design water supply systems which are not vulnerable to drought	--[s]	--[s]	X	--	--	X	--	--	--	3	Racine County and all local jurisdictions[r]
Encourage farm operators to evaluate economics of crop insurance	--[u]	--[u]	X	--	--	X	X	--	--	3	Racine County and all local jurisdictions[r]

Table continued on next page.

Table 5.8 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Direct Benefits				Indirect Benefits[c]	Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities		
Drought Events (continued)											
Encourage development practices that promote preservation of areas of high and very high groundwater recharge potential and promote stormwater management practices that facilitate aquifer recharge	--[s]	--[s]	X	--	--	X	X	--	--	4	Racine County and all local jurisdictions[r]

[a] *All cost expressed in 2021 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	*Moderate*	*High*
Educational and informational programming	*Addition of new staff*	*Major construction*
Ongoing enforcement of ordinances	*Additional staff hours budgeted*	*New buildings (infrastructure)*
Plan Development	*Additional equipment*	*Capital programs*
Continued coordination/mutual aid/interagency agreements	*New ordinance development*	
	New programs/task force	

[c] *Indirect benefits represent a continuum of potential benefits that may occur as a result of the implementation of specific management actions. For example, implementation of informational programming, while not directly saving lives, may ultimately result in people having the knowledge necessary to save lives and protect property. These intangible benefits cannot be readily quantified and range from increased awareness to reduced loss of life and property, and have been assessed using the following relative cumulative scale:*

1 = Increased awareness/preparedness
2 = Enhanced quality of life/social benefits
3 = Reduced property damage
4 = Increased environmental and recreational benefits/ecosystems services
5 = Reduced loss of life and injury with concomitant benefits for economic productivity

[d] *This mitigation measure is related but not essential to continued compliance with the requirements of the National Flood Insurance Program.*

[e] *Costs covered under ongoing activity.*

[f] *Costs are included under Racine County Park and Open Space Plan Implementation. The costs are based on purchasing all land recommended for parks and open space (4,964 acres). It should be noted that the protection of these areas could also be accomplished through conservation through conservation easements, conservation subdivisions, donations, and purchase or transfer of development rights. To the extent that the costs are reduced through the use of alternative methods of land acquisition, and through the use of available State and Federal funds for acquisition, the costs to the County and local governments could be significantly reduced.*

[g] *Flood mitigation measures and project costs to be reviewed and refined to reflect ongoing City of Burlington downtown redevelopment program.*

[h] *Structure floodproofing or removal to be evaluated on a site-by-site basis and to be carried out at the discretion of property owners. Field surveys should be conducted for structures proposed to be floodproofed or removed to obtain a more definitive assessment of their flood hazard status. For the purpose of this analysis, it was assumed that all residential structures located within the 1-percent-annual-probability (100-year recurrence interval) floodplain would be acquired and demolished. The cost for removal of the residential structures includes an estimated average fair market property value plus $10,000 per property for demolition expenses. Floodproofing or elevating some residential structures, if found to be feasible based on specific circumstances, could be more cost effective. All other categories of buildings (agricultural, commercial, utility, governmental, and other) were assumed to be floodproofed for the purpose of this analysis.*

[i] *A contractor was hired by Racine County in 2016 to replace two 20-foot-wide radial dam gates and one actuator motor on the Waterford Dam. In addition, concrete repair to the dam structure was conducted. The project was completed in January 2017.*

Table continued next page.

Table 5.8 (Continued)

[j] *Flood mitigation measures should be reviewed to reflect RiskMAP findings and current flood mitigation best management practices.*

[k] *Capital costs for these alternatives are based upon year 2013 conditions. These are systems-level planning costs and the WDNR has indicated that even after the final design stage, the average dam reconstruction change order amount is 40 percent of the initial capital cost estimate, mainly due to unforeseen site conditions once construction begins.*

[l] *A breakdown of costs between Kenosha and Racine Counties is not available. Thus, total costs for both Counties are listed. It is estimated that the capital cost range for measures in Racine County would be relatively small, ranging from $762,000 to $907,000.*

[m] *Incremental cost between control of two-year and 100-year events.*

[n] *Cost reflects range from minimal wetland and prairie operation and maintenance to active management.*

[o] *Costs to be determined by each community based upon logical subwatershed area. Estimated cost is from $1,318,355 to $1,608,635 countywide.*

[p] *Cost of ordinance development is covered under ongoing programs. Cost of implementation is not determined.*

[q] *Portion of costs included in ongoing program and construction project implementation programs. The additional cost of all of the hazard mitigation and public informational and educational programs is estimated to be $21,800 per year.*

[r] *Jurisdictions include general purpose units of government—Cities, Towns, and Villages—and special purpose units of government such as School Districts, Sanitary and Utility Districts, Public Inland Lake Protection and Rehabilitation Districts and Agricultural Drainage Districts.*

[s] *Costs to be determined. Partially covered under ongoing programs.*

[t] *Costs include an estimated annual subscription fee of $12,000 for the CodeRED® targeted alert notification service.*

[u] *Costs are site-specific and survey is needed for countywide estimate.*

[v] *To be conducted as part of next needed facility planning program.*

[w] *Costs shown are the estimated annual costs of water supply conservation programs for existing water utilities in the County as reported in SEWRPC PR No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, December 2010.

Source: SEWRPC

#266966 – Racine Co HMP Table 5.9
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3/7/2023; 2/13/2023

Table 5.9
Estimated Flood Damages Avoided with the Acquisition and Demolition or Floodproofing of Structures Within Mapped Floodplains: 2021

Annual Probability of Flood Occurrence	Estimated Structural Flood Damages Avoided ($)[a]		
	Fox River Watershed	Root River Watershed	Pike River Watershed
1 Percent	10,756,710	6,638,840	1,914,970
2 Percent	8,548,910	2,154,530	823,000
10 Percent	4,295,070	414,970	325,030
Estimated Annual Average Flood Damages Avoided	2,661,670	422,300	231,020

[a] *Estimated structural damages avoided are based upon the reduction in flood damages within the Racine County portion of the watersheds in the event of a 1-, 2-, and 10-percent-annual-probabilty flood event. The damage estimates were developed by SEWRPC staff based upon assessed 2021 structure values, estimated content value, and depth of flooding data.*

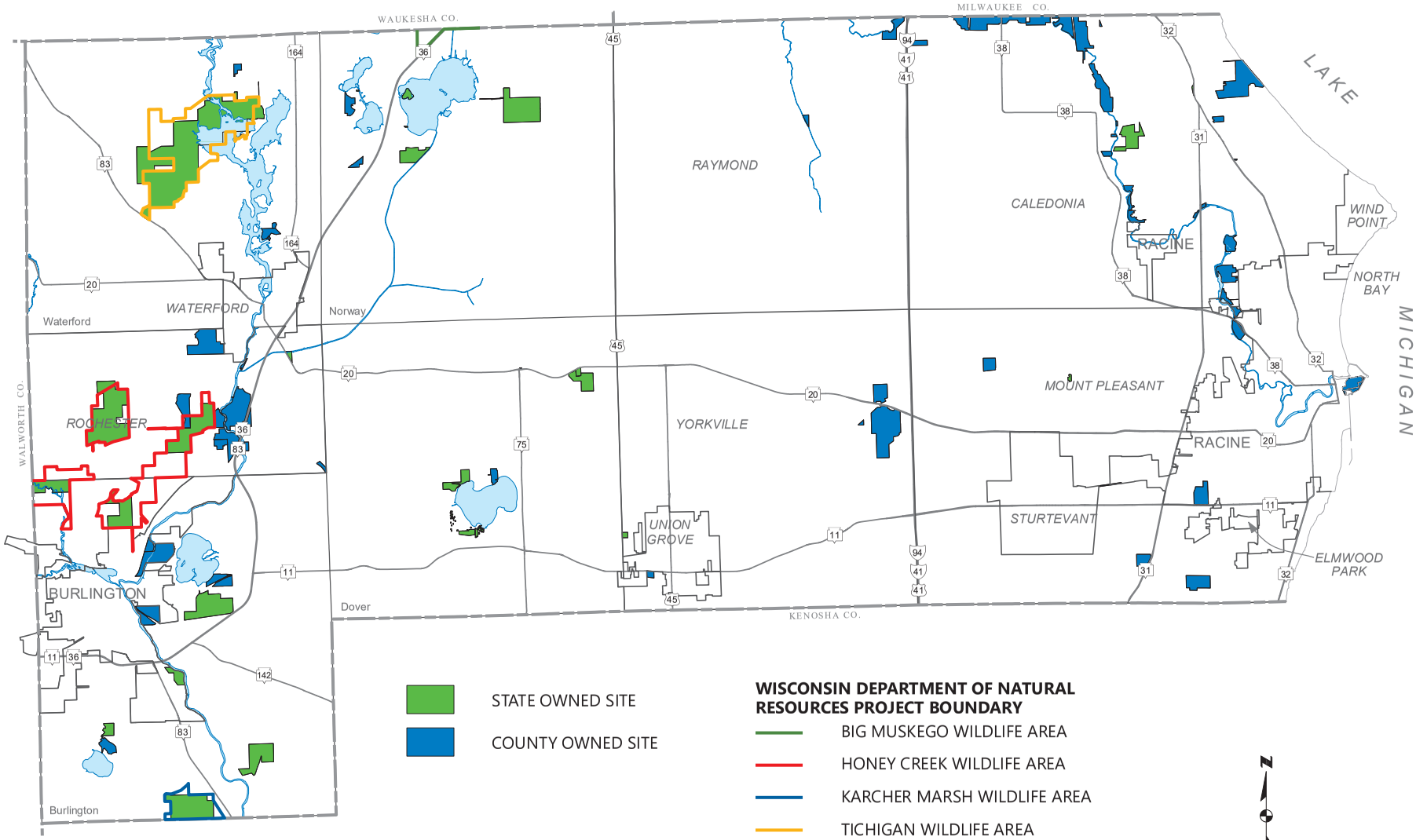
Source: SEWRPC

Chapter 5

HAZARD MITIGATION STRATEGIES

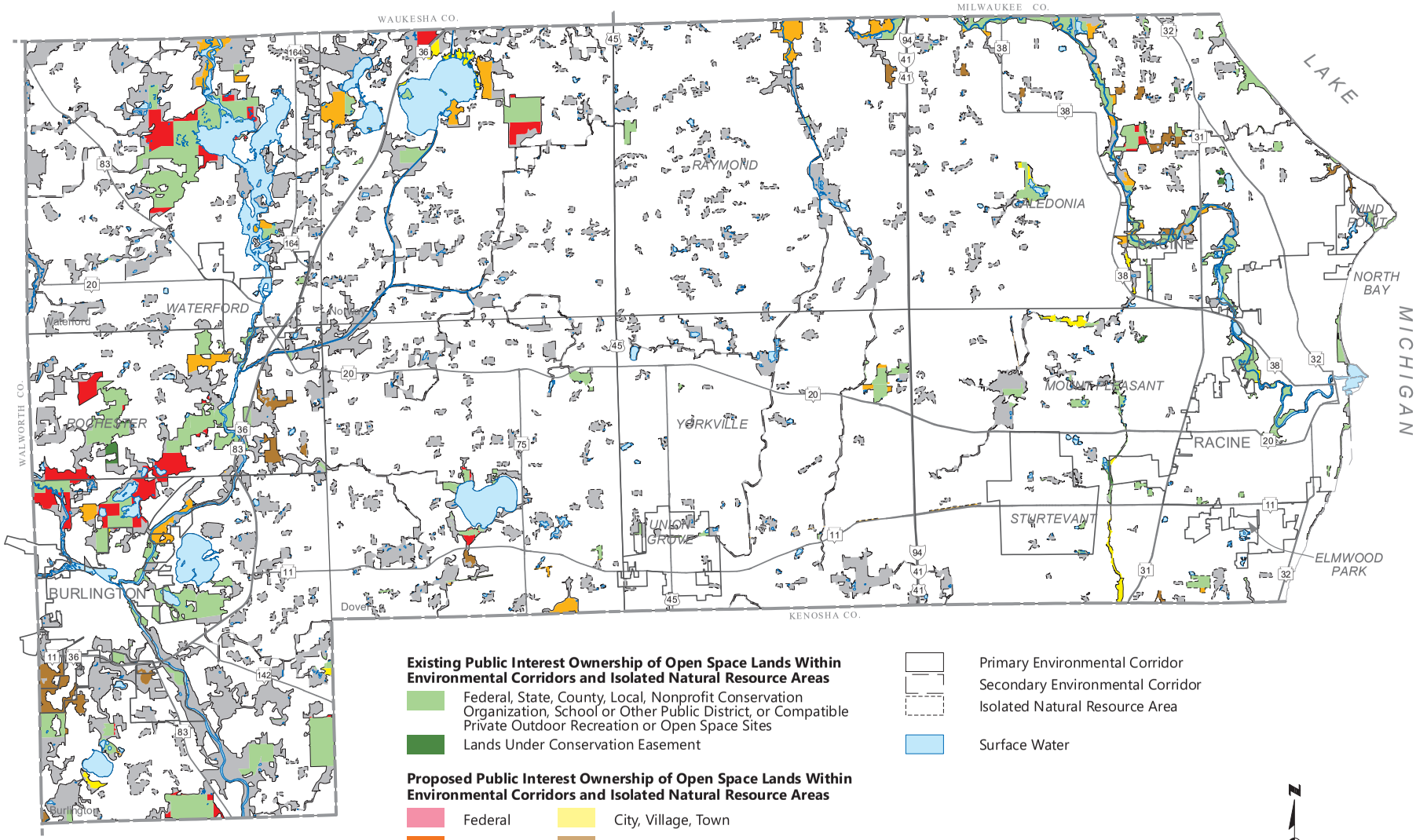
MAPS

Map 5.1
Racine County and State of Wisconsin Park and Open Space Sites: 2020



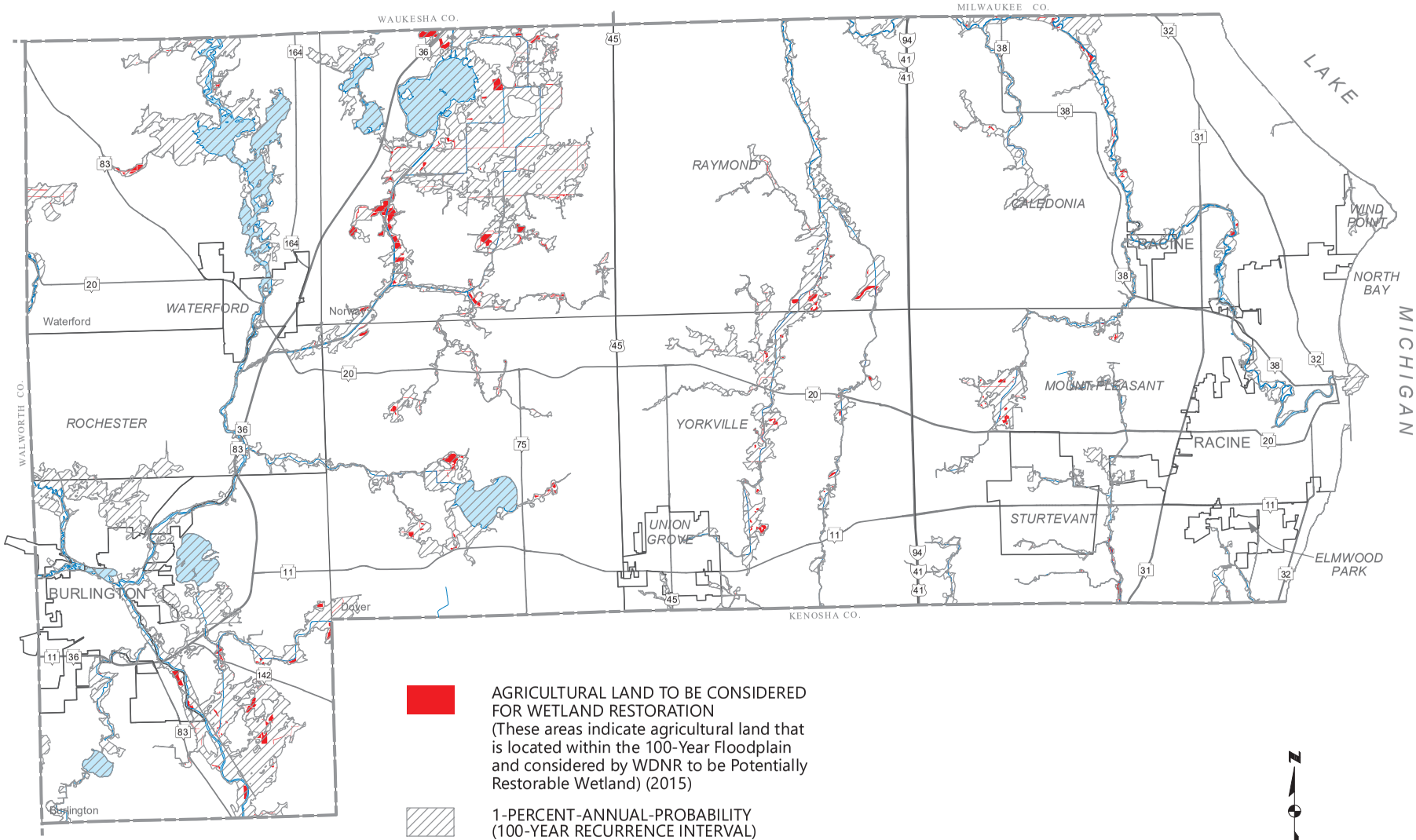
Source: Wisconsin Department of Natural Resources, Racine County, and SEWRPC

Map 5.2
Protection of Environmental Corridors and Isolated Natural Resource Areas in Racine County: 2035



Source: SEWRPC

Map 5.3
Agricultural Land to be Considered for Wetland Restoration



Source: Federal Emergency Management Agency and SEWRPC