SUMMARY NOTES OF THE FEBRUARY 12, 2014, MEETING OF THE ROOT RIVER WATERSHED RESTORATION PLAN ADVISORY GROUP

INTRODUCTION

The February 12, 2014, meeting of the Root River Watershed Restoration Plan Advisory Group was convened at the Racine County Ives Grove Office Complex at 9:07 a.m. The meeting was called to order by Susan Greenfield, Executive Director of the Root-Pike Watershed Initiative Network (Root-Pike WIN). Attendance was taken by circulating a sign-in sheet.

In attendance at the meeting were the following individuals:

Advisory Group Members	
Susan S. Greenfield, Co-Chair	Executive Director, Root-Pike Watershed Initiative Network
Jeff Martinka, Co-Chair	Executive Director, Southeastern Wisconsin Watersheds Trust, Inc. (Sweet Water)
Michael G. Hahn, Secretary	Chief Environmental Engineer, Southeastern Wisconsin Regional Planning Commission
Joseph E. Boxhorn	Senior Planner, Southeastern Wisconsin Regional Planning Commission
Roger Chernik	Board of Directors President, River Bend Nature Center
Allison Chernouski	Program Coordinator, Root-Pike Watershed Initiative Network
Chris Clayton	Urban River Restoration, River Alliance of Wisconsin
Thomas Friedel	Administrator, City of Racine
Stevan M. Keith	Sustainability and Environmental Engineer, Milwaukee County Architecture, Engineering, and Environmental Services Division
Julie L. Kinzelman	Laboratory Director/Research Scientist, City of Racine Health Department
Michael A. Luba	NR Basin Supervisor, Wisconsin Department of Natural Resources
Matthew Magruder	Systems Data Technician, Milwaukee Metropolitan Sewerage District
Monte G. Osterman	Supervisor, Racine County Board of Supervisors
Brian Russart	Trails and Natural Areas Coordinator, Milwaukee County Parks
Chad Sampson	County Conservationist, Racine County
Melissa H. Warner	Commissioner, Village of Caledonia Storm Water Utility District
Guests	
Ann Dee Allen	Senior Public Involvement and Outreach Specialist, Southeastern Wisconsin Regional Planning Commission
Megan R. Bender	Engineer, Southeastern Wisconsin Regional Planning Commission

Ms. Greenfield welcomed the attendees to the meeting and thanked them for their participation and commitment to the process of developing the watershed restoration plan. Mr. Hahn also thanked the Advisory Group for their continued participation in this process.

REVIEW OF SUMMARY NOTES FROM NOVEMBER 13, 2013, MEETING OF THE ROOT RIVER WATERSHED RESTORATION PLAN ADVISORY GROUP

Mr. Hahn stated that he would review several parts of the November 2013 meeting summary notes.

Mr. Hahn pointed out that the first full Secretary's Note on page 3 of the Summary Notes includes a text insert to Chapter V that clearly states the SEWRPC staff's determination regarding the effect of the Horlick dam impoundment on attenuating large flood peaks.

He also called the Advisory Group members' attention to the Secretary's Note on page 4 which indicates SEWRPC's role in delineating a water supply service area for the City of Waukesha Water Utility as required under State Statute.

He said that the Secretary's Note on pages 7 and 8 documents additions to Chapter V addressing the issue of the potential costs of adding disinfection at wastewater treatment plants in the watershed, and he noted that this analysis supports the SEWRPC staff's conclusion that the large cost of such addition to the treatment processes would not be justified by the modest water quality benefits of adding disinfection. Ms. Warner mentioned that, at the recent public meeting on the Waukesha request for a Lake Michigan water supply, the Waukesha Water Utility representative said that a possible return flow of treated Waukesha wastewater to the Root River would be of higher water quality than the effluent from the existing wastewater treatment plants on tributaries to the River in Racine County. Mr. Hahn reminded the group that the restoration plan report would only specifically address issues related to a possible return flow from Waukesha to the Root River if the environmental impact statement (EIS) that is being developed by the Wisconsin Department of Natural Resources (WDNR) for the proposed Waukesha project were released soon enough for the SEWRPC staff to adequately review it and include discussion of the EIS in the report. Ms. Warner replied that her concern is that the public is made aware of the reasons why SEWRPC is not recommending disinfection. Mr. Hahn replied that the reasons would be made clear at one, or both, of the remaining public meetings.

He then proceeded to describe additional freeboard and cost analyses for Horlick dam that are documented on pages 13 through 16 of the Summary Notes and in a revised Table V-D, attached to the Notes as Exhibit D. Ms. Warner said that she was told by a Racine County Supervisor who served in the 1970s during the time when the dam was reconstructed that a fishway was not provided at that time because upstream property owners expressed concerns that a fishway would result in dead fish in the River upstream of the dam. Ms. Greenfield noted that she had referred recent reporter's calls regarding the Horlick dam to SEWRPC. Mr. Hahn said he had not received any recent inquiries from reporters on that issue.

He asked whether there were any questions or comments on the notes. No questions or comments were offered by the Advisory Group.

REVIEW OF PARTIAL PRELIMINARY DRAFT CHAPTER VI, "RECOMMENDED PLAN," OF SEWRPC COMMUNITY ASSISTANCE PLANNING REPORT NO. 316 (CAPR NO. 316), "*A RESTORATION PLAN FOR THE ROOT RIVER WATERSHED*"

Mr. Hahn then began the review of a partial preliminary draft of Chapter VI, which he noted was expected to be completed by the May Advisory Group meeting. The review covered the following subsections of the "Water Quality Management Recommendations," section:

- Development of Recommendations to Improve Water Quality
- Recommendations to Reduce Point Source Pollution

Mr. Hahn noted that a subsection on recommendations to reduce stormwater runoff pollution would be drafted prior to the May Advisory Group meeting.

Ms. Greenfield asked what were the primary sources of fecal coliform bacteria occurring in the streams of the watershed. Mr. Hahn replied that they were largely agricultural and urban nonpoint sources and could include urban illicit connections resulting from possible cross-connections between the sanitary and storm sewers systems and leaky sanitary sewer laterals. She asked if pet waste was not a significant source, and Mr. Hahn replied that it is a contributor, but not to the same degree as the other sources he listed.

With respect to possible sanitary sewer cross connections to storm sewers as a source of indicator bacteria, Mr. Hahn noted that in cases such as the City of Racine where combined sewers have been abandoned and replaced with separate sanitary and storm sewers, some cross connections may remain. Mr. Friedel said that the City has found cross connections and has dealt with them on a case-by-case basis, and he noted that the number of such cross connections that have been detected has decreased. Dr. Kinzelman added that the City Health Department monitors storm sewer outfalls to detect illicit connections and have found and fixed three of them.

Mr. Osterman asked what constitutes an illicit discharge. Mr. Hahn responded that it is any substance that gets into the stormwater system that should not be there, i.e., anything that is not runoff. Dr. Boxhorn noted that the term illicit discharge is defined in Chapter NR 216, "Storm Water Discharge Permits," of the *Wisconsin Administrative Code*, and in municipal separate storm sewer system (MS4) permits. Mr. Osterman indicated that, in a given area, the existence of illicit discharges is based on assumptions. Dr. Kinzelman replied that the SEWRPC regional water quality management plan update presented evidence of illicit discharges, and she said that the City of Racine's outfall monitoring program had detected such discharges.

Mr. Hahn noted the preliminary watershed restoration plan recommendation that the Yorkville Sewer Utility District No. 1 wastewater treatment plant be abandoned and the Sewer Utility District be connected to the City of Racine wastewater treatment plant when the Yorkville plant reaches the end of its useful life. Ms. Warner asked when that plant might reach the end of its useful life. Mr. Hahn said that it should be adequate for about the next five years, but requirements for compliance with the new State phosphorus rules might change the time frame. Mr. Luba mentioned that the ultimate status of the Yorkville plant was discussed when the most-recent Wisconsin Pollutant Discharge Elimination System permit for the plant was being developed. He said that it would be expensive for the plant to be upgraded to meet the phosphorus effluent limits under the new rules, and that the Town might have to consider negotiations regarding connecting to the Racine wastewater treatment plant. Ms. Warner then asked if five to 10 years was a reasonable time frame for the town to decide on a course of action, and Mr. Luba said that time frame would probably meet the schedule for compliance with the phosphorus rule.

[Secretary's Note: To address Ms. Warner's comments regarding disinfection at wastewater treatment plants as described in the fourth paragraph of the preceding section of these Summary Notes covering review of the November 13, 2013, Advisory Group meeting Summary Notes, the following footnote was added at the end of recommendation 9 on page 7:

"As described in Chapter V of this report: 1) disinfection of wastewater effluent is required only where the WDNR has made a determination that the discharge of wastewater poses a risk to human and animal health, 2) the WPDES permits for the three wastewater treatment plants in the watershed do not require disinfection of effluent, and 3) an evaluation by the SEWRPC staff concluded that adding disinfection to the treatment processes at the three wastewater treatment plants that discharge to surface waters of the Root River watershed would have only a small effect on concentrations of fecal indicator bacteria in the streams receiving discharges from these plants and on downstream waters and the expense of such modifications could be considerable. Therefore, consistent with the current WPDES permits, it is not recommended that the three plants disinfect their effluent.]

Dr. Boxhorn continued the review of Chapter VI, beginning with preliminary draft Table VI-Proj, "Site-Specific Management Measures for the Root River Watershed," and a map entitled "Projects within the Root River Watershed," both of which he noted were works in progress. He said that the table reflected the project suggestions from the December 4, 2013, public meeting; stormwater best management practice recommendations from reports prepared by AECOM consulting engineers for the Cities of Greenfield (December 2008) and Racine (December 2013); an appendix to the draft City of Racine Health Department Root River water quality report; and suggestions from municipalities in the watershed. Mr. Hahn noted that the information on the small-scale project map was also shown on three large-scale digital orthophotographs displayed in the meeting room, and he said that the SEWRPC staff was considering the possibility of providing similar large-scale maps to partners on the study to assist them in implementing the plan. Ms. Greenfield suggested, and Mr. Hahn agreed, that large-scale maps prepared by tributary stream subwatersheds would be useful.

Ms. Greenfield asked if the "Schedule" column in Table VI-Proj would be a timeline for project implementation. Mr. Hahn replied that it would be a prioritization, rather than a timeline, and he noted that tables with short lists of the top priority projects by focus area would be added to the report.

[Secretary's Note: The "Schedule" column heading in Table VI-Proj was changed to "Priority" (see Exhibit A).]

Dr. Boxhorn noted that the project map indicated the areal extent of certain Milwaukee County-owned lands that are candidate sites for riparian buffer habitat restoration or maintenance, rather than showing them as point features. He also noted that the SEWRPC staff was still looking for and assessing projects to be added to the table, and he asked the Advisory Group members to provide any suggestions that they may have.

Mr. Russart asked that the project map legend include a specific item for the County-owned lands delineated on the map, and that the location of Site ID No. MRR-04 on page three of the draft project table be given as "Franklin Savanna State Natural Area." He also said that there is a restoration plan for the Franklin Savanna, there is County-owned agricultural land adjacent to the Savanna that should be mapped, and the Savanna should be designated in the table and on the map as relating to the water quality (land surface erosion reduction) and habitat focus areas, as well as the recreational use and access focus area. He asked that Grobschmidt Park be added to the table and on the map, and that it be designated as addressing the habitat focus area. Finally, he requested that Milwaukee County be added as a responsible party for ID No. MRR-23, Hidden Oaks Savanna, on page four of the table, and that the management actions in the table for ID Nos. URR-14, Whitnall Park, and URR-15, Mangan Woods, be switched.

[Secretary's Note: Changes were made to Table VI-Proj and the accompanying project map, as indicated in the preceding paragraph (see Exhibits A and B).]

Ms. Warner asked that the ongoing "Weed-out Racine" invasive species management project be mentioned in the plan, noting that such a reference will help in obtaining grant funding. She said she would provide information on the program to Dr. Boxhorn. Mr. Martinka supported Ms. Warner's request, noting that funders look favorably on projects recommended under planning efforts such as this restoration plan.

Mr. Sampson said that he would provide the SEWRPC staff with information on Racine County agricultural management practices proposed to be implemented from 2014 through 2015.

[Secretary's Note: Mr. Sampson sent geographical information files related to proposed Racine County agricultural management practice to SEWRPC staff via electronic mail on March 19, 2014.]

Mr. Martinka asked if there was a deadline for submittal to SEWRPC of project suggestions. Mr. Hahn replied that it would be best to send suggestions in as soon as possible, but no later than the May 14, 2014, Advisory Group meeting.

[Secretary's Note: The "Weed-out Racine" invasive species management projects and the Racine County agricultural management practices were added to Table VI-Proj and the accompanying project map (see Exhibits A and B).]

Ms. Greenfield noted that the Village of Caledonia had not actively participated in the watershed restoration planning process, and she asked if the project table and map could be provided to the Village Engineer for review and comment. Ms. Warner said that she had sent the Village President (Robert Bradley) an electronic mail message about meeting with Mr. Hahn to discuss the watershed restoration plan. Mr. Hahn said he was contacted by one of the Village Trustees (Kathleen Trentadue), and he replied, with an offer to meet at her convenience, but he did not receive a response. He also noted that the Village has been receiving notices of the public information meetings for the watershed restoration plan.

[Secretary's Note: The Village Administrator, Mark Janiuk, attended the December 4, 2013, public meeting at which public input was received on potential projects. Ms. Warner sent an e-mail message to the Village President on December 9, Ms. Trentadue e-mailed Mr. Hahn on December 10, and Mr. Hahn replied by e-mail Ms. Trentadue, offering to meet, on December 13. An updated version of Table VI-Proj and the accompanying project map will be sent to the Village of Caledonia Engineer in the near future.]

Mr. Osterman noted that that on the third page of the project table, the municipality associated with ID No. LRJ-06C should be the City of Racine.

[Secretary's Note: The entry for LRJ-06C in the project table was revised to list the municipality as the City of Racine.]

Dr. Boxhorn then reviewed the "Recommended Water Quality Monitoring Plan" subsection. During review of the subsection describing existing monitoring and data collection programs, he asked if the Sierra Club was still providing volunteers for the University of Wisconsin-Extension (UWEX) Water Action Volunteers (WAV) program. Ms Warner said that Sierra Club volunteers may no longer be collecting data under that program.

[Secretary's Note: SEWRPC staff reviewed the data available for the Root River watershed in the WAV online database. The data available in the database indicated that four stations were sampled in the Root River watershed during the period 2010 through 2012, with the most recent sampling occurring in May 2012. The data available in the database did not include any samples collected at these sites in 2013.]

Mr. Chernik asked what water chemistry parameters were being monitored by WDNR at Johnson Park, and he said that a water quality monitoring program was being considered at the River Bend Nature Center, which is near Johnson Park. Dr. Boxhorn said that Kris Stepenuck is the UWEX staff person who oversees the WAV program and she might be able to assist with training and equipment. Ms. Warner said that Nancy Carlson, of the River Bend staff, has been in contact with Kris Stepenuck.

[Secretary's Note: SEWRPC staff reviewed records of recent water quality monitoring activities conducted by the WDNR at Johnson Park and provided Mr. Chernik a list of the water quality parameters that were monitored by electronic mail. A copy of electronic mail message to Mr. Chernik is attached herein as Exhibit C.]

In reference to the discussion regarding continuous monitoring stations, Dr. Kinzelman said that she could move her sonde that is currently in the Pike River into the Root River watershed. Dr. Boxhorn said that would help resolve questions regarding winter chloride concentrations.

Ms. Greenfield inquired whether Jason Dare's mussel study that was funded by the Root-Pike Watershed Initiative Network is a good baseline study. Dr. Boxhorn replied that the study is a qualitative assessment that is a reasonable start to assessing mussel populations. He said that for future studies it would be helpful to know the amount of time spent at each site. He also noted that a good quantitative study would result in disturbance of the streambed and of mussels in the stream, which would be undesirable.

[Secretary's Note: The following text was added to the end of the last full paragraph on page 12:

"It is suggested that future surveys record and report the amount of time spent surveying each sample site. This information would allow for the computation of the catch per unit effort at each site which would make it possible to compare relative population sizes among sites."]

Dr. Boxhorn said that it could take 10 to 20 years of monitoring and collection of a large amount of data to detect the effects on water quality of implementing plan recommendations; therefore, there is a need to establish other indicators of progress. He added that there is a preliminary recommendation that MMSD and Racine County track implementation of recommended projects.

[Secretary's Note: During discussion with Ms. Greenfield and Mr. Martinka following the meeting, it was suggested that the Root-Pike Watershed Initiative Network and the Southeastern Wisconsin Watersheds Trust, Inc. could play significant roles in tracking implementation of projects in the watershed. As a result of that discussion, the fourth and fifth full paragraphs on page 15 were revised as follows. (Added text is indicated in italics, which will be non-italicized in the final report):

It is recommended that the *Southeastern Wisconsin Watersheds Trust, Inc. (Sweet Water)* act as the entity overseeing monitoring of plan implementation for those portions of the watershed that are located within the *MMSD* planning area*, and* it is recommended that *the Root-Pike Watershed Initiative Network* act as the entity overseeing monitoring of plan implementation for those portions of the watershed *in Kenosha and Racine Counties* outside of the MMSD planning area.

It is further recommended that all organizations acting to implement this plan report the initiation and completion of projects implementing plan recommendations to the *entity* overseeing monitoring for the portion of the watershed in which the project is conducted.]

Ms. Greenfield asked if the plan included a recommendation on establishing a working relationship between the City of Racine Health Department and the Milwaukee Metropolitan Sewerage District (MMSD) for the collection of water quality data. Dr. Kinzelman said that the City and MMSD have worked together to coordinate sampling on the same days, and she asked that the plan recommend that ambient environmental data (e.g., rainfall, streamflow rates) be collected each time water samples are obtained.

[Secretary's Note: In response to Dr. Kinzelman's request regarding collection of ambient environmental data, the following Item 8 was added to the list under the "Expansion of Water Quality Monitoring Activities" subsection on page 12:

8. **Ambient environmental data should be collected or obtained from an appropriate source each time water quality samples are collected.** Such data should include rainfall, flow rates (where representative data are readily available), and general weather observations.]

Ms. Greenfield said that standardizing the collection of data between the City and MMSD would facilitate comparison of the data. Dr. Boxhorn noted that standardization of the City of Racine and MMSD water quality monitoring programs would be quite expensive for the City of Racine, which would have to expand their analyses to match MMSD's program, and Dr. Kinzleman added that the City does not have the equipment and staff to achieve such standardization. Ms. Greenfield suggested that the two units of government could work together to share resources. Mr. Magruder replied that there might be an opportunity to use the MMSD lab for analysis of samples collected by the City of Racine, but that it was probably not possible to use MMSD crews to collect samples for the City of Racine. Dr. Kinzelman asked what key indicators MMSD is monitoring that the City of Racine is not. Dr. Boxhorn said they would include total suspended solids, the full suite of nitrogen chemistry, and a variety of others. He said that specifics would be added to the watershed restoration plan report. Dr. Kinzelman said that the State Department of Health Services has funds set aside for analysis that could be leveraged. Mr. Clayton asked where funds for monitoring implementation would come from, and he noted that opportunistic monitoring might be accomplished when projects are implemented and the costs of such monitoring could be included in grant-funded design and planning costs. Dr. Kinzleman said that there are ways to accomplish the recommended monitoring program, and, once the program specifics are finalized, cost estimates could be prepared, including a determination of the cost per municipality.

[Secretary's Note: Table VI-Mon-2a, which presents a tiered list of water quality constituents, was added to Chapter VI. This table is included herein as Exhibit D. The following subsection was added to Chapter VI after the second full paragraph on page 13 (text given in bold should be bold within the report):

"WATER QUALITY CONSTITUENTS TO BE MONITORED

There are numerous indicators available for measuring and describing water quality including physical indicators such as water temperature, chemical indicators such as concentrations of dissolved substances, and biological indicators such as the abundance and taxonomic identities of the macroinvertebrates present. Historically, many different indicators have been used to assess the state of water quality in the Root River watershed. Table VI-Mon-2a lists those physical and chemical indicators that were routinely monitored in the Root River watershed by at least one monitoring program during the period 2010-2012.

As previously described, several agencies and organizations are currently conducting monitoring activities in the Root River watershed. While there is overlap among these monitoring programs in which water quality constituents they sample and analyze, each program monitors a unique suite of indicators. There are several reasons for this.

In part, this reflects the natures of the constituents. Some constituents, such as water temperature, pH, and water transparency, can be assessed relatively easily and inexpensively in the field. Others, such as total phosphorus and fecal indicator bacteria, require that water samples be transported to laboratory facilities for chemical or biological analysis. Sampling and analysis of some constituents, such as many metals and cyclic organic compounds may require the use of highly specialized sampling techniques and analytical equipment.

The differences in the constituents monitored by the different programs also reflect differences in the capacities of these programs. Some of the programs have greater analytical capabilities and more resources than others. It should also be noted that the need to use highly specialized techniques and equipment for sampling and analyzing some constituents imposes differences upon monitoring programs in their abilities to monitor these constituents. For example, programs that rely upon volunteers to conduct sampling will be less suited to monitoring constituents that require highly specialized sampling techniques than those that rely upon highly-trained professional staff.

Finally, it is important to recognize that each monitoring program has its own monitoring goals. These goals may differ from program to program and achieving different goals may require different monitoring strategies, including monitoring different constituents.

In an ideal situation, there would be coordination among monitoring programs such that a consistent set of water quality constituents would be monitored throughout the watershed. Because of the considerations discussed in the previous three paragraphs, it seems unlikely that this ideal could be achieved in the Root River watershed in the foreseeable future. Despite this, it should be possible to achieve some additional convergence among the sets of constituents monitored by the various programs active within the watershed.

It is recommended that each of the programs conducting water quality monitoring within the Root River watershed continue monitoring the constituents that they are currently monitoring.

The list of physical and chemical indicators given in Table VI-Mon-2a is meant to provide guidance to monitoring programs in the Root River watershed when they consider adding constituents to the suites of constituents they currently monitor. The table lists these in five tiers that roughly correspond to the priority for adding them to the suite of constituents in an existing program, with Tier 1 representing constituents of the highest priority for addition and Tier 5 representing constituents of the lowest priority.

The constituents listed in Tier 1 are either easy enough to sample or important enough to sample that it is desirable that they be sampled by all monitoring programs in the watershed. Several of the constituents listed in Tier 1 can be assessed in the field using hand-held meters or other field techniques. The main exceptions to this generalization are fecal indicator bacteria and total suspended solids which require that samples be transported to a laboratory for analysis. It should be noted that turbidity and water transparency assess the same factor. While assessment of turbidity gives a more precise measure, it generally requires that samples be transported to a laboratory for analysis. Water transparency can be measured in the field using a turbidity tube at stream and river sites or a secchi disk at lake and pond sites. As part of Tier 1, one of these two constituents should be assessed.

The constituents listed in Tier 2 represent the minimum set of additional water quality constituents that would be necessary to make assessments of those water quality that are most critical to the water quality focus area of this plan. Assessing these constituents requires that samples be transported to a laboratory for analysis. As noted in Chapter V of this report, the major approach that his plan takes to address the chronically low dissolved oxygen concentrations found in much of the Root River is to reduce phosphorus inputs into the surface water system. Monitoring of total phosphorus allows for a direct evaluation of the success of this approach. Monitoring five-day biochemical oxygen demand and chlorophyll-*a* provides a check on this because these constituents address other factors that can potentially impact dissolved oxygen concentrations in surface waters. Finally, monitoring chloride concentrations would both fill the data gap related to chloride concentrations in surface waters of the watershed and allow for the refinement of statistical models relating specific conductance to chloride.

The constituents listed in Tier 3 comprise those constituents needed to give a complete picture of the status of major plant nutrients within the surface water system and several constituents whose chemistries affect the chemistry of other substances in water. Assessing these constituents requires that samples be transported to a laboratory for analysis. There are three issues that should be noted about the nitrogen-related constituents in this tier. First, the toxicity of ammonia to fish and other aquatic organism depends upon ambient water temperature and pH, as well as the ambient concentration of ammonia. Whenever sampling is conducted for ammonia, sampling should also be conducted for water temperature and pH. Second, some laboratories analyze and report combined concentrations of nitrate and nitrite. In order to get a complete picture of nitrogen conditions, sampling should be conducted either for combined nitrate-plus-nitrite or for both nitrate and nitrite. Third, complete characterization of nitrogen conditions within surface waters requires that ammonia, Kjeldahl nitrogen, nitrate, and nitrite be sampled simultaneously. This allows for the calculation of organic nitrogen and total nitrogen. These four constituents should be sampled together.

Tier 4 includes those constituents not included in higher priority tiers required to characterize conditions related to minor plant nutrients, solids, and several toxic metals in surface waters. Assessing these constituents requires that samples be transported to a laboratory for analysis. Assessment of several of these constituents also requires the use of highly specialized techniques and equipment for conducting sampling and analysis. It should be noted that the toxicity of cadmium, chromium, copper, lead, nickel, and zinc to fish and other aquatic organisms depends upon the pH of the water, as well as the concentration of the metal. Whenever sampling is conducted for these metals, sampling should also be conducted for pH.

The constituents listed in Tier 5 consist of toxic cyclic organic compounds that are classified either as polycyclic aromatic hydrocarbons (PAHs), individual polychlorinated biphenyl compounds (PCB congeners), or commercial mixtures of PCB congeners. Assessing these constituents requires both that samples be transported to a laboratory for analysis and the use of highly specialized techniques and equipment for conducting sampling and analysis.

While this watershed management plan envisions that monitoring programs will add constituents to the suites they sample on a tier-by-tier basis, it recognizes that particular management issues and the goals and objectives of individual monitoring programs may require that some constituents be added to sampling suites without regard to their locations in this tiered list. **It is recommended that, in the absence of other such considerations, monitoring programs in the Root River watershed follow this tiered scheme when adding constituents to the suite of constituents that they sample and analyze.**"]

Mr. Hahn proceeded with review of the "Racine County Flooding Recommendations" section, noting the preceding placeholders for future sections on "Recommendations for Recreational Use and Access" and "Recommendations for Habitat."

Following that, Mr. Hahn reviewed the “Horlick Dam” section. He noted that it was appropriate that Racine County decide what approach to take for modification or removal of Horlick dam and that the SEWRPC staff would not be making a specific recommendation to the County in that regard. He said that a reference to Horlick dam would be added to the projects table. Mr. Martinka asked that the reference include information on WDNR statements regarding the dam, including the maximum 10-year time frame to take action in response to the anticipated WDNR order regarding the dam.

[Secretary’s Note: Table VI-Proj and the accompanying project map were revised to include the Horlick dam (see Exhibits A and B).]

Ms. Greenfield noted that the preliminary draft report includes a table comparing the effects of implementation of each of the alternatives for the dam. Mr. Martinka said that type of information should be included in the report even if SEWRPC does not recommend a specific alternative. Ms. Warner said the County has to decide a course of action regarding the dam. Mr. Friedel asked if the alternatives analyses set forth in the watershed restoration plan report provide enough data for the County to make a decision and move the process along. Mr. Osterman said it is important that SEWRPC make a recommendation about the dam going or staying, noting that SEWRPC is viewed as the definitive authority. He concluded by saying that he wants the dam to be removed and a recommendation from SEWRPC could provide back up for a decision by the County. Mr. Hahn responded that he would not make a direct comment at this time, but would consider the comments from the Advisory Group.

Ms. Warner asked if SEWRPC could comment on the effect of the dam on the plan focus issues. Mr. Hahn replied that such a comparative analysis is already included in preliminary draft Chapter V of the report. Mr. Friedel inquired whether a summary statement could be made based on the information provided for the dam alternatives considered. Ms. Greenfield posed the question: What would SEWRPC do if the County Executive asked for a recommendation from SEWRPC? Mr. Luba said that he recalled that the County Executive did inquire about SEWRPC’s recommendation, and that SEWRPC provided additional information to assist the County, but did not offer an opinion regarding a recommended alternative. He also noted that more analysis would be required to develop firm cost estimates. Ms. Greenfield said that a recommendation from SEWRPC would carry a lot of weight with the public. Mr. Hahn said that SEWRPC wants to be helpful to the County, but does not want to insert itself inappropriately into the County’s decision-making process, and he noted that the County appears satisfied with the information SEWRPC has provided to date.

[Secretary’s Note: Shortly after the February 12, 2014, Advisory Group meeting, the Racine County Executive spoke with the SEWRPC Acting Executive Director, and requested that the SEWRPC staff include a recommendation regarding the Horlick dam in the watershed restoration plan report. The SEWRPC staff has been working on that recommendation, including coordination with WDNR staff regarding to application of the WDNR January 1, 2014 “Fish Passage Guidance.” As of the date of release of these Summary Notes, that coordination was still in progress, and a preliminary draft SEWRPC recommendation had not been formulated. If the WDNR/SEWRPC coordination regarding aquatic organism passage issues proceeds to a point at which the SEWRPC staff can formulate a recommendation prior to the May 14, 2014, Advisory Group meeting, the SEWRPC staff will do so, and will present that recommendation at the meeting. If not, the recommendation will be provided to the Advisory Group at a later date.]

Mr. Romeis asked where more information could be obtained on the items listed in Table VI-Proj. Dr. Boxhorn said 1) that the SEWRPC staff notes from the December 4, 2013, public meeting at which specific project ideas were obtained from the public indicate which of the attendees suggested a given project and 2) that he developed an in-house spreadsheet that provides more information on specific projects included in the table.

ADJOURNMENT

There being no further business, the meeting was adjourned by unanimous consent at 11:08 a.m.

REVISIONS TO HORLICK DAM ALTERNATIVES SUBSECTION IN CHAPTER V TO REFLECT APRIL 2014 WDNR DETERMINATION THAT THE DAM HAS A LOW HARD RATING

WDNR review comments on the Horlick dam failure analysis submitted by Racine County were provided in an April 22, 2014, letter from WDNR to the County (see Exhibit E). Based on their review, the Department assigned a low hazard classification to the dam. The SEWRPC staff analyses conducted prior to the date of the WDNR letter were based on the assumption that the dam would be classified as significant hazard. The SEWRPC staff revised the "Horlick Dam Alternatives" subsection in Chapter V of the Root River watershed restoration plan to reflect the low hazard rating as set forth in Exhibit F of these Summary Notes. A low hazard dam is required to have a spillway capacity at least equal to the peak one-percent-annual-probability (100-year recurrence interval) flood flow. The Horlick dam alternatives were originally developed assuming the dam would have to be upgraded to have an 0.2-percent-annual-probability (500-year recurrence interval) flood discharge capacity as required for a significant hazard dam. In Exhibit F, paragraphs that were substantially revised are highlighted to assist the Advisory Group members in locating changes to the "Horlick Dam Alternatives" subsection.

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Exhibit A

Table VI-Proj

SITE-SPECIFIC MANAGEMENT MEASURES FOR THE ROOT RIVER WATERSHED

ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Site Information			Management Action	Annual Pollutant Reductions			Responsible Party	Costs (dollars)[a-1]		Potential Funding Sources	Potential Technical Assistance	Schedule
		Location	Municipality	Owner		TSS (pounds)	Total Phosphorus (pounds)	Fecal Coliform Bacteria (trillion cells)		Capital	Annual O&M			
GFD-01	Water Quality	Northeast of W. Morgan Avenue and S. 106th Street	City of Greenfield	Milwaukee County	Installation of stormwater pond with 0.5 acre permanent pool	8,000	15[b]		City of Greenfield	$ 267,000				
GFD-02	Water Quality	Northwest of W. Coldspring Road and S. 104th Street along Root River	City of Greenfield	Milwaukee County	Installation of stormwater pond with 0.3 acre permanent pool	4,200	7[b]		City of Greenfield	185,000				
GFD-03	Water Quality	East of I-43/US-45 intersection near north end of W. Spring Green	City of Greenfield	Milwaukee County	Installation of stormwater pond with 0.3 acre permanent pool	3,800	6[b]		City of Greenfield	169,000				
GFD-05	Water Quality	Intersection of I-43 and US-45	City of Greenfield	State of Wisconsin	Installation of stormwater pond with 0.3 acre permanent pool	4,400	8[b]		City of Greenfield	177,000				
GFD-06	Water Quality	Northwest of W. Coldspring Road and S. 84th Street at St. John School	City of Greenfield		Installation of stormwater pond with 0.8 acre permanent pool	14,000	27[b]		City of Greenfield	658,000				
GFD-09	Water Quality	Southwest of W. Coldspring Road and S. 92nd Street, Wisconsin Electric Power	City of Greenfield	We Energies	Installation of stormwater pond with 0.2 acre permanent pool	4,400	8[b]		City of Greenfield	234,000				
GFD-10	Water Quality	Northwest of W. Coldspring Road and S. 100th Street on drainage right-of-way	City of Greenfield	City of Greenfield	Installation of stormwater pond with 0.4 acre permanent pool	6,800	12[b]		City of Greenfield	153,000				
GFD-11	Water Quality	East of S. 84th Street and north of I-43	City of Greenfield	Milwaukee County	Installation of stormwater pond with 0.4 acre permanent pool	7,800	14[b]		City of Greenfield	225,000				
GFD-15	Water Quality	Northwest of W. Howard Avenue and S. 116th Street along Root River	City of Greenfield	City of Greenfield	Installation of stormwater pond with 0.3 acre permanent pool	4,200	7[b]		City of Greenfield	120,000				
GFD-16	Water Quality	North of W. Beloit Road along Wildcat Creek near S. 119th Street	City of Greenfield	City of Greenfield	Installation of stormwater pond with 1.0 acre permanent pool	16,200	31[b]		City of Greenfield	358,000				
GFD-17	Water Quality	Northeast of W. Howard Avenue and S. 116th Street along the Root River	City of Greenfield	City of Greenfield	Installation of stormwater pond with 0.2 acre permanent pool	3,400	6[b]		City of Greenfield	129,000				
GFD-19	Water Quality	East of I-894 north of W. Coldspring Road in Wisconsin Electric Power Company right-of-way	City of Greenfield	We Energies	Installation of stormwater pond with 1.9 acre permanent pool	37,000	73[b]		City of Greenfield	1,527,000				
LRC-01	Habitat	Hoods Creek–entire length	Village of Mt. Pleasant	Various	Reiterate Village master plan recommendation for minimum development setback of 150 feet from tributaries and 75 feet from other navigable streams	- -	- -	- -	Village of Mt. Pleasant					
LRC-02	Habitat	Hoods Creek–entire length	Village of Mt. Pleasant	Various	Remeander channelized stream reaches, address tile drainage	- -	- -	- -	Private landowner					
LRC-03	Habitat	Nicholson Wildlife Refuge	Village of Caledonia	Village of Caledonia	Remove invasive plants species, restore site	- -	- -	- -	Village of Caledonia					
LRC-04	Water Quality	Husher Creek south of 5 Mile Road	Village of Caledonia	- -	Add water quality monitoring station	- -	- -	- -	City of Racine Health Depart-ment or WAV Program					

PRELIMINARY DRAFT – WORK IN PROGRESS

Table VI-Proj (continued)

ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Site Information: Location	Municipality	Owner	Management Action	Annual Pollutant Reductions: TSS (pounds)	Total Phosphorus (pounds)	Fecal Coliform Bacteria (trillion cells)	Responsible Party	Costs (dollars)[a-1]: Capital	Annual O&M	Potential Funding Sources	Potential Technical Assistance	Schedule
LRC-05	Habitat	Unnamed tributary flowing north into the Root River	Village of Caledonia		Stream rehabilitation, naturalization, or bank stabilization project to address severe erosion along 75-linear foot section of tributary	67,500[c]	- -[d]							
LRC-07	Habitat, Water Quality, Recreational Use and Access	Husher Creek at 7 Mile Road	Village of Caledonia		Stream rehabilitation, naturalization, or bank stabilization project to address eroding streambanks Investigation to find source of human *Bacteroides* in water quality samples	 - -	 - -	 Unknown					City of Racine Health Department	
LRC-08	Habitat	Husher Creek south of 7 Mile Road	Village of Caledonia		Remeandering of channelized reaches including addition of buffer and canopy cover									
LRC-10	Habitat, Water Quality, Recreational Use and Access	Linwood Park	Village of Caledonia	Village of Caledonia	Bank stabilization to address erosion of streambank. Adjust mowing protocol to leave unmowed area along streambank. Add designated fishing area				Village of Caledonia					
LRC-11	Habitat, Water Quality, Recreational Use and Access	Johnson Park Dog Park	City of Racine	City of Racine	Bank stabilization to address severe erosion along 15-foot high 75-linear foot steep embankment. Place fence along embankment to reduce access	110,000[e]	- -[d]		City of Racine					
LRC-12	Habitat, Water Quality	Hoods Creek Watershed	Village of Caledonia, Village of Mt. Pleasant, Racine		Modify drain tiles and establish vegetation to create wetlands				Private landowners				Racine County Land Conservation Division	
LRC-14	Recreational Use and Access	Trout Ponds Prairie	Village of Caledonia	Caledonia Conservancy	Map horse and walking trails for public recreational access	- -	- -	- -	Caledonia Conservancy					
LRC-15	Habitat	Wetland located north of STH 20 and east of I-94	Village of Mt. Pleasant		Connect wetland to Hoods Creek through a natural area	- -	- -	- -	Village of Mt. Pleasant					
LRC-16	Habitat, Recreational Use and Access	Floodplain that extends along Hoods Creek between CTH C and STH 20 and along Ives Grove Ditch west to CTH V	Village of Mt. Pleasant		Acquire and place this floodplain in parkland/natural area	- -	- -	- -	Village of Mt. Pleasant					
LRC-17	Habitat	Wetland east of I-94 and north of Kraut Road	Village of Mt. Pleasant		Preserve this area in its natural condition as the surrounding area is developed	- -	- -	- -	Village of Mt. Pleasant					
LRC-23	Water Quality	Husher Creek at 5 Mile Road	Village of Caledonia		Investigate to determine cause of low dissolved oxygen concentrations at this site during summer	- -	- -	- -	WDNR					
LRC-26	Habitat, Water Quality	Hoods Creek upstream from Brook Road	Village of Caledonia		Stream rehabilitation, naturalization, or bank stabilization project to address erosion and channel incision									
LRC-29	Habitat, Water Quality	Root River south of Nicholson Road Bridge	Village of Caledonia	Racine County	Shoreline restoration and installation of guard rail, gate, and signage to address high erosion from off-road vehicles				Racine County	8,000				2014
LRC-30	Habitat	Tabor Woods	Village of Caledonia	Caledonia Conservancy	Removal and management of invasive plant species	- -	- -	- -	Caledonia Conservancy	3,149				2014
LRJ-01	Recreational Use and Access	Root River at STH 31	Village of Caledonia	Racine County	Install canoe landing on west side of the road and north side of the River	- -	- -	- -	Racine County					
LRJ-03	Habitat, Water Quality	Johnson Park Dog Park	City of Racine	City of Racine	Address dog waste accumulation problem along access corridor from STH 38	- -	- -	Unknown	City of Racine					
LRJ-04	Habitat, Water Quality	Johnson Park Golf Course	City of Racine	City of Racine	Bank stabilization to address bank erosion along Root River mainstem through the golf course				City of Racine					
LRJ-06A	Recreational Use and Access	Island Park	City of Racine	City of Racine	Promote handicap accessible River and canoe access	- -	- -	- -	City of Racine					

PRELIMINARY DRAFT – WORK IN PROGRESS

Table VI-Proj (continued)

ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Site Information: Location	Municipality	Owner	Management Action	Annual Pollutant Reductions: TSS (pounds)	Total Phosphorus (pounds)	Fecal Coliform Bacteria (trillion cells)	Responsible Party	Costs (dollars)[a-1]: Capital	Annual O&M	Potential Funding Sources	Potential Technical Assistance	Schedule
LRJ-06B	Recreational Use and Access	Lincoln Park	City of Racine	City of Racine	Promote handicap accessible River and canoe access	- -	- -	- -	City of Racine					
LRJ-06C	Recreational Use and Access	Horlick Park	City of Racine	Racine County	Promote handicap accessible River and canoe access	- -	- -	- -	Racine County					
LRJ-07	Water Quality	Memorial Drive and Albert Street	City of Racine		Include installation of water quality and stormwater management facilities as an element in redevelopment of this site				City of Racine/ private landowners					
LRJ-08	Water Quality	Downtown Racine	City of Racine		Include installation of water quality and stormwater management facilities as an element in redevelopment of this area				City of Racine/ private landowners					
LRJ-12	Recreational Use and Access	Green Bay Road and Kennedy Avenue	Village of Caledonia	Private landowner	Access to public land could be provided for foot and snowmobile by a mown path through an area between apartment buildings that is overrun with invasive species	- -	- -	- -	Village of Caledonia/ private landowners					
LRJ-14	Recreational Use and Access	Linwood Park	Village of Caledonia	Village of Caledonia	Install canoe landing	- -	- -	- -	Village of Caledonia					
LRJ-15	Recreational Use and Access	Root River at upstream crossing of 4 Mile Road at Blue River Reserves	Village of Caledonia	Blue River Preserves	Install canoe landing	- -	- -	- -	Blue River Preserves/ Kenosha-Racine Land Trust					
LRJ-16	Habitat	Property west of Holy Cross Cemetery and west of STH 32 at 4 1/2 Mile Road (extended)	Village of Caledonia	Barbara and Royse Myers	Currently under conservation easement, acquire for protective ownership when owner wants to sell or donate	- -	- -	- -	Kenosha-Racine Land Trust					
LRJ-19	Recreational Use and Access	Downtown Racine	City of Racine		Expand bicycle path system in downtown along the Root River	- -	- -	- -	City of Racine					
MPC-01	Habitat	Grobschmidt Park	City of Franklin	Milwaukee County	Address gullies in park by implementing diversions to redirect water flow, stabilizing the interior or gullies, and/or planting native plants to stabilize the soil				Milwaukee County Parks					2015, 2018
MPC-02	Habitat	Grobschmidt Park	City of Franklin	Milwaukee County	Install erosion control practices such as water bars along hiking trails				Milwaukee County Parks					
MPC-03	Habitat	Grobschmidt Park	City of Franklin	Milwaukee County	Remove invasive plant species and replant with native species	- -	- -	- -	Milwaukee County Parks	17,874[f]				2014-2020
MPC-04	Recreational Use and Access	Grobschmidt Park	City of Franklin	Milwaukee County	Construct handicap-accessible elevated viewing platform overlooking Mud Lake	- -	- -	- -	Milwaukee County Parks					
MPC-05	Recreational Use and Access	Grobschmidt Park	City of Franklin	Milwaukee County	Construct and install educational kiosk at trail head along S. 35th Street				Milwaukee County Parks					
MRR-03	Habitat	Root River Parkway downstream of and along Oakwood Park Tributary	City of Franklin	Milwaukee County	Establish riparian buffers on Milwaukee County lands that are currently leased and farmed				Milwaukee County					
MRR-04	Recreational Use and Access	Franklin State Natural Area	City of Franklin	Milwaukee County	Provide recreational access to Franklin State Natural Area through Milwaukee County-owned land to the north, west, or south	- -	- -	- -	Milwaukee County					
MRR-05	Habitat	Milwaukee County lands along Oakwood Tributary, Ryan Creek, and the Root River south of Ryan Road	City of Franklin	Milwaukee County	Establish riparian buffers on Milwaukee County lands that are currently leased and farmed				Milwaukee County					

Table VI-Proj (continued)

ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Site Information			Management Action	Annual Pollutant Reductions			Responsible Party	Costs (dollars)[a-1]		Potential Funding Sources	Potential Technical Assistance	Schedule
		Location	Municipality	Owner		TSS (pounds)	Total Phosphorus (pounds)	Fecal Coliform Bacteria (trillion cells)		Capital	Annual O&M			
MRR-06	Habitat	Payne & Dolan Quarry east of the Root River and south of W. Rawson Avenue	City of Franklin	Payne & Dolan	Potential future restoration project				Payne & Dolan					
MRR-07	Recreational Use and Access	Root River Parkway Pond east and downstream from Koepmier lake	City of Franklin	Milwaukee County	Provide boardwalk for recreational access across lower lake at narrow point	- -	- -	- -	Milwaukee County Parks					
MRR-11	Habitat, Water Quality	Legend Creek near S. 76th Street and W. Drexel Avenue	City of Franklin		Stream rehabilitation, naturalization, or bank stabilization to address eroding streambanks. Could be done in conjunction with upcoming reconstruction of S. 76th Street									
MRR-14	Recreational Use and Access	Victory Creek Park	City of Franklin	City of Franklin	Connect the City of City of Franklin Victory Trail to Milwaukee County trails at W. Drexel Avenue and S. 35th Street through undeveloped park	- -	- -	- -	City of Franklin					
MRR-17	Habitat, Water Quality	Dale Creek in Dale Creek Parkway	Village of Greendale	Milwaukee County	Remove failing drop structures and perform stream rehabilitation, naturalization, or bank stabilization to address eroding streambanks.				Milwaukee County					
MRR-22	Water Quality	Stormwater basis at S. 68th Street and W. Rawson Avenue	City of Franklin	Milwaukee County	Retrofit basin to either add mechanical treatment or convert to wet bottom pond				Milwaukee County					
MRR-23	Habitat, Water Quality	Hidden Oaks Savanna along Root River north of W. Ryan Road and west of S. 60th Street	City of Franklin	Milwaukee County	Project to restore 15 acres of wetland, prairie, and oak savanna; remove invasive species, and reduce runoff into Root River				Hunger Task Force and Milwaukee County Parks	70,316				
RAC-01	Water Quality	Case Equipment property near Ontario Street	City of Racine	Case Equipment Company	Installation of stormwater pond with 0.7 acre permanent pool	12,000	16		City of Racine	358,000	3,400			
RAC-02	Water Quality	Colonial Park adjacent to W. High Street	City of Racine	City of Racine	Installation of stormwater pond with 0.7 acre permanent pool	12,200	23		City of Racine	213,000	3,500			
RAC-03	Water Quality	Open space between Racine County Club and Quarry Lake Park	City of Racine and Village of Caledonia		Installation of stormwater pond with 0.7 acre permanent pool	24,800	39		City of Racine	240,000	3,500			
RAC-04	Water Quality	Graceland Cemetery at Graceland Boulevard and Osbourne Boulevard	City of Racine	City of Racine	Expansion of existing wet pond to 0.8 acre permanent pool. Would need to be supported by potential Lockwood North and Lockwood South wet ponds to get full benefit	4,200	3		City of Racine	201,000	3,500			
RAC-05	Water Quality	Hantschal Park south of 16th Street and west of Perry Avenue	City of Racine	City of Racine	Installation of stormwater pond with 0.7 acre permanent pool in existing undeveloped depression	8,400	17		City of Racine	105,000	3,400			
RAC-06	Water Quality	Humble Park at 21st Street and Cleveland Avenue	City of Racine	City of Racine	Installation of stormwater pond with 1.5 acre permanent pool	28,400	47		City of Racine	560,000	5,700			
RAC-07	Water Quality	Lockwood Park West at Graceland Boulevard and Ohio Street	City of Racine	City of Racine	Conversion of existing dry detention facility to stormwater pond with permanent pool of 4.5 acres[h]	25,200	46		City of Racine	645,000	14,700			
RAC-08	Water Quality	Lockwood Park North at Graceland Boulevard and Ohio Street	City of Racine	City of Racine	Installation of stormwater pond with 1.5 acre permanent pool[h]	11,000	13		City of Racine	404,000	5,700			
RAC-09	Water Quality	Lockwood Park South at Graceland Boulevard and Ohio Street	City of Racine	City of Racine	Installation of stormwater pond with 0.4 acre permanent pool[h]	5,600	10		City of Racine	230,000	5,700			
RAC-10	Water Quality	Memorial Drive brownfield at 1442 N. Memorial Drive	City of Racine	City of Racine	Installation of stormwater pond with 1.6 acre permanent pool	26,400	39		City of Racine	568,000	6,200			

PRELIMINARY DRAFT – WORK IN PROGRESS

Table VI-Proj (continued)

ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Site Information			Management Action	Annual Pollutant Reductions			Responsible Party	Costs (dollars)[a-1]		Potential Funding Sources	Potential Technical Assistance	Schedule
		Location	Municipality	Owner		TSS (pounds)	Total Phosphorus (pounds)	Fecal Coliform Bacteria (trillion cells)		Capital	Annual O&M			
RAC-11	Water Quality	Michigan Boulevard brownfield at 1149 Michigan Boulevard	City of Racine	City of Racine	Installation of stormwater pond with 2.1 acre permanent pool	36,400	67		City of Racine	553,000	7,500			
RAC-12	Water Quality	Spring Street east of Riverbrook Drive	City of Racine	City of Racine	Installation of stormwater pond with 0.9 acre permanent pool[i]	6,000	14		City of Racine	202,000	3,800			
RAC-13	Water Quality	Starbuck Middle School 1516 Ohio Street	City of Racine	Racine Unified School District	Installation of stormwater pond with 2.8 acre permanent pool	30,400	49		City of Racine	1,220,000	9,700			
RAC-14	Water Quality	Washington Park between 12th Street, Horlick Park Drive, and the Root River	City of Racine	City of Racine	Installation of stormwater pond with 1.5 acre permanent pool	31,000	56		City of Racine	365,000	5,700			
RHD-01	Habitat, Water Quality	Legend Creek at S. 68th Street	City of Franklin		Stream rehabilitation, naturalization, or bank stabilization to address eroding streambanks									
RHD-02	Habitat, Water Quality	Legend Creek at S. 68th Street	City of Franklin	Tuckaway Country Club	Investigate golf course for grassed buffers to convert to long-rooted vegetation				Tuckaway Country Club					
RHD-03	Habitat	West Branch Root River Canal at 67th Road	Village of Union Grove, Town of Yorkville		Investigate reaches upstream and downstream of this site for remeandering	- -	- -	- -	Yorkville-Raymond Drainage District					
RHD-04	Habitat, Water Quality	Raymond Creek at 4 Mile Road	Town of Raymond	Private landowners	Increase width and extent of buffer strips along nearby farm fields				Private landowners				Racine County Land Conservation Division	
RHD-05	Habitat, Water Quality	West Branch Root River Canal at 4 Mile Road	Town of Raymond	Private landowners	Increase width and extent of buffer strips along nearby farm fields				Private landowners				Racine County Land Conservation Division	
RHD-06	Habitat	East Branch Root River Canal at 4 Mile Road	Town of Raymond		Investigate areas to remeander within channelized canal reaches	- -	- -	- -	Yorkville-Raymond Drainage District					
RHD-07	Habitat, Water Quality	Root River Canal at 6 Mile Road	Town of Raymond	Private landowners	Increase width and extent of buffer strips along nearby farm fields				Private landowners				Racine County Land Conservation Division	
RHD-08	Habitat, Water Quality	Husher Creek at 7 Mile Road	Village of Caledonia	Private landowners	Increase width and extent of buffer strips along nearby farm fields				Private landowners				Racine County Land Conservation Division	
RHD-09	Habitat	Root River at STH 38	Village of Caledonia		Investigate bank stabilization on upstream banks									
RHD-12	Habitat, Water Quality, Recreational Use and Access	Root River at Johnson Park	City of Racine	City of Racine	Convert grass buffer on north bank along golf course to long-rooted native vegetation to discourage geese from congregating	- -	- -	Unknown	City of Racine					
RHD-13	Habitat	Root River at STH 31 and 4 Mile Road	Village of Caledonia		Investigate bank stabilization on upstream banks									
RHD-14	Habitat	Root River at WDNR Steelhead Facility	City of Racine	WDNR, City of Racine	Investigate bank stabilization on upstream west banks				WDNR, City of Racine					
RHD-15	Habitat, Water Quality	Root River at WDNR Steelhead Facility	City of Racine	WDNR, City of Racine	Convert grass buffer to long-rooted native vegetation				WDNR, City of Racine					

PRELIMINARY DRAFT – WORK IN PROGRESS

Table VI-Proj (continued)

ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Site Information			Management Action	Annual Pollutant Reductions			Responsible Party	Costs (dollars)[a-1]		Potential Funding Sources	Potential Technical Assistance	Schedule
		Location	Municipality	Owner		TSS (pounds)	Total Phosphorus (pounds)	Fecal Coliform Bacteria (trillion cells)		Capital	Annual O&M			
RHD-16	Water Quality	West Branch Root River Canal at 4 Mile Road	Town of Raymond	Private landowners	Investigate agricultural drain tiles that may benefit from a filtration system				Private landowners				Racine County Land Conservation Division	
RHD-17	Water Quality	East Branch Root River Canal at STH 11	Town of Yorkville		Investigation to find and remedy source of human *Bacteroides* in water quality samples upstream from Fonk's Mobile Home Park WWTP	- -	- -	Unknown					City of Racine Health Department	
RHD-18	Water Quality	Root River Canal at 6 Mile Road	Town of Raymond	Private landowners	Investigate agricultural drain tiles that may benefit from a filtration system				Private landowners				Racine County Land Conservation Division	
RHD-19	Water Quality	Husher Creek at 7 Mile Road	Village of Caledonia		Investigation to find and remedy source of human *Bacteroides* in water quality samples upstream from sampling station	- -	- -	Unknown					City of Racine Health Department	
RHD-20	Water Quality	Husher Creek at 7 Mile Road	Village of Caledonia	Private landowners	Investigate agricultural drain tiles that may benefit from a filtration system				Private landowners				Racine County Land Conservation Division	
RHD-21	Water Quality	Root River at Island Park Bridge to Liberty Street	City of Racine		Continue monitoring of stormwater outfall in which sanitary sewer minsconnection was found and remedied	- -	- -		City of Racine				City of Racine	
RRC-01	Habitat, Water Quality	East Branch Root River Canal south of STH 11	Town of Yorkville		Stream rehabilitation, naturalization, or bank stabilization project to address steep eroding banks on East Branch Root River Canal									
RRC-02	Habitat, Water Quality	Unnamed Tributary to East Branch Root River Canal	Town of Yorkville	Town of Yorkville	Installation of stormwater pond, wetland, and grassed waterway	?			Town of Yorkville					
RRC-03	Habitat	Agricultural field east of West Branch Root River Canal and north of 2 Mile Road	Town of Raymond	Private landowner	Expand and naturalize ephemeral wetland that is within the field and connect it to the West Branch Root River Canal through buffers or grassed waterways				Private landowner				Racine County Land Conservation Division	
RRC-04	Habitat	West Branch Root River Canal north of 2 Mile Road	Town of Raymond		Stream rehabilitation with two-stage channel design				Yorkville-Raymond Drainage District					
RRC-05	Habitat, Water Quality	East Branch Root River Canal North of 4 Mile Road	Town of Raymond		Stream rehabilitation, naturalization, or bank stabilization project to address bare and eroding banks on East Branch Root River Canal				Yorkville-Raymond Drainage District					
RRC-06	Habitat, Water Quality	Town of Raymond Creek south of 4 Mile Road	Town of Raymond		Stream rehabilitation, naturalization, or bank stabilization project to address erosion along cliff on Town of Raymond Creek				Yorkville-Raymond Drainage District					
RRC-08	Water Quality	Kilbournville Tributary south of 6 1/2 Mile Road	Town of Raymond		Install riparian connection between stormwater detention basin that is being built on east bank and the tributary	- -	- -	- -						
RRC-10	Water Quality	Root River Canal both north and south of 7 Mile Road	Town of Raymond		Stream rehabilitation, naturalization, or bank stabilization project to address bank erosion along the Root River Canal									
RWO-01	Habitat	Colonial Park 2300 W. High Street	City of Racine	City of Racine	Continue ongoing invasive plant species removal and management activities				Racine Weed Out!					
RWO-02	Habitat	Barbee Park 215 N. Memorial Drive	City of Racine	City of Racine	Continue invasive plant species management activities				Racine Weed Out!					
RWO-03	Habitat	Clayton Park 1843 Clayton Avenue	City of Racine	City of Racine	Continue invasive plant species management activities				Racine Weed Out!					

Table VI-Proj (continued)

ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Site Information: Location	Site Information: Municipality	Site Information: Owner	Management Action	Annual Pollutant Reductions: TSS (pounds)	Annual Pollutant Reductions: Total Phosphorus (pounds)	Annual Pollutant Reductions: Fecal Coliform Bacteria (trillion cells)	Responsible Party	Costs (dollars)[a-1]: Capital	Costs (dollars)[a-1]: Annual O&M	Potential Funding Sources	Potential Technical Assistance	Schedule
RWO-04	Habitat	Cedar Bend Park 33 McKinley Avenue	City of Racine	City of Racine	Continue invasive plant species management activities				Racine Weed Out!					
RWO-05	Habitat	Island Park 1700 Liberty Street	City of Racine	City of Racine	Continue invasive plant species management activities				Racine Weed Out!					
RWO-06	Habitat	Lee Park 1926 Glen Street	City of Racine	City of Racine	Continue invasive plant species management activities				Racine Weed Out!					
RWO-07	Habitat	Riverside Park 110 Riverside Drive	City of Racine	City of Racine	Continue invasive plant species management activities				Racine Weed Out!					
RWO-08	Habitat	Root River Environmental Education Community Center 1301 W. 6th Street	City of Racine	City of Racine, UW-Parkside	Invasive plant species removal and management				Racine Weed Out!					
RWO-09	Habitat	Horlick Park	City of Racine	Racine County	Invasive plant species removal and management				Racine Weed Out!					
URR-01	Water Quality	Root River between W. Cleveland Avenue and W. National Avenue and Hale Creek	City of West Allis		Illicit discharge detection and elimination effort to locate and eliminate the source of the water quality hot spot at W. National Avenue	- -	- -	Unknown	City of West Allis					
URR-03	Water Quality	W. Grange Avenue	Village of Greendale	Village of Greendale	Expand W. Grange Avenue bio-swale westward during reconstruction of W. Grange Avenue				Village of Greendale					
URR-05	Habitat	Wildcat Creek and Root River upstream and downstream from Wildcat Creek	City of Greenfield		Streambank stabilization or rehabilitation project to address erosion and debris jams									
URR-07	Water Quality	City of New Berlin Hills Golf Course	City of New Berlin	City of New Berlin	Install wet detention basins				City of New Berlin					
URR-08	Water Quality	Hale Creek between W. Lincoln Avenue and W. Cleveland Avenue	City of West Allis		Install wetland treatment system in wooded riparian area east of West Allis Hale High School				City of West Allis					
URR-11	Habitat	Upper reaches of Tess Corners Creek	City of Muskego, City of New Berlin	Private landowners	1. As this area develops, leave a corridor for remeandering channelized stream reaches 2. Restore/remeander channelized stream reaches	- - - -	- - - -	- - - -	Private landowners				Waukesha County Land and Water Conservation Division	
URR-13	Habitat, Water Quality	Root River in parkway upstream from confluence with 104th Street Branch	City of Greenfield	Milwaukee County	Remove low-quality ash wood and restore the area as a wetland	- -	- -	- -	Milwaukee County Parks					
URR-14	Habitat, Water Quality	Whitnall Park	City of Franklin, Village of Greendale	Milwaukee County	Project to remove invasive species that are colonizing this site				Milwaukee County Parks					
URR-15	Habitat	Mangan Woods	Village of Greendale	Milwaukee County	Address gully erosion	- -	- -	- -	Milwaukee County Parks					
URR-16	Water Quality	Southridge Mall	Village of Greendale	Simon Property Group	Install stormwater detention, infiltration, or other practices as buildings are developed in mall parking lot				Simon Property Group					
URR-17	Habitat, Water Quality	Wildcat Creek at Kulwicki Park	City of Greenfield	Milwaukee County	Streambank stabilization				City of Greenfield					2015
URR-19	Habitat, Water Quality	Whitnall Park Creek from S. 124th Street to northeast of W. Godsell Road	Village of Hales Corners		Stream rehabilitation, naturalization, or bank stabilization to address eroding streambanks				Village of Hales Corners					

Table VI-Proj (continued)

		Site Information				Annual Pollutant Reductions				Costs (dollars)[a-1]				
ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Location	Municipality	Owner	Management Action	TSS (pounds)	Total Phosphorus (pounds)	Fecal Coliform Bacteria (trillion cells)	Responsible Party	Capital	Annual O&M	Potential Funding Sources	Potential Technical Assistance	Schedule
URR-20	Habitat, Water Quality	Whitnall Park Creek from Janesville Road to 300 feet upstream from the confluence with North Branch Whitnall Park Creek	Village of Hales Corners		Stream rehabilitation, naturalization, or bank stabilization to address eroding streambanks				Village of Hales Corners					
URR-21	Habitat, Water Quality	North Branch Whitnall park Creek from stormwater pond south of W. Grange Avenue to confluence with Whitnall Park Creek	Village of Hales Corners		Stream rehabilitation, naturalization, or bank stabilization to address eroding streambanks				Village of Hales Corners					
LRJ-04a	Habitat, Water Quality	Area within Johnson Park Golf Course, south bank adjacent to golf hole #10.	City of Racine	City of Racine	Bank stabilization to address bank erosion along 125 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization				City of Racine	38,000				
AER-1	Habitat, Water Quality	Area within Johnson Park , south bank approximately 400 feet downstream of the eastern cart bridge	City of Racine	City of Racine	Bank stabilization to address bank erosion along 1,100 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization				City of Racine	377,000				
AER-2	Habitat, Water Quality	Area within Johnson Park , west bank approximately 2,500 feet downstream of the eastern cart bridge	City of Racine	City of Racine	Bank stabilization to address bank erosion along 80 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization				City of Racine	28,000				
AER-3	Habitat, Water Quality	Four small isolated areas ranging in length from 25 to 100 feet (225 feet total), along both banks within Colonial Park	City of Racine	City of Racine	Bank stabilization to address bank erosion along 225 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization				City of Racine	67,000				
AER-4	Habitat, Water Quality	625 feet of the south bank, south of Lincoln Park, immediately upstream of the WDNR Steelhead Facility	City of Racine	City of Racine and private landowners	Bank stabilization to address bank erosion along 625 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization. (Note: the City is already in process of designing improvements in this area with construction planned in 2014)				City of Racine (majority) and private landowners	175,000				
AER-5	Habitat, Water Quality	A small section of failing bulkhead wall (40 feet) along the south bank, adjacent to Spring Street, across from Lincoln Park	City of Racine	Private landowners	Rebuilding 40 feet of retaining wall				Private landowners	51,000				
AER-6	Habitat, Water Quality	A 550-foot portion of the bulkhead section on the south bank at Azarian Marina	City of Racine	Azarian Marina	Rebuilding 550 feet of bulkhead retaining wall				Azarian Marina (could be incorporated in future riverwalk improvements)	406,000				
AER-7	Habitat, Water Quality	A 500-foot section of the north bank on the Case Corporation property, southeast of the intersection of Liberty and Superior Streets	City of Racine	Case Corporation	Bank stabilization to address bank erosion along 500 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization.				Case Corporation	182,000				

Table VI-Proj (continued)

ID Number (see Map VI-Proj-1)[a]	Focus Areas Addressed	Site Information: Location	Municipality	Owner	Management Action	Annual Pollutant Reductions: TSS (pounds)	Total Phosphorus (pounds)	Fecal Coliform Bacteria (trillion cells)	Responsible Party	Costs (dollars)[a-1]: Capital	Annual O&M	Potential Funding Sources	Potential Technical Assistance	Schedule
AER-8	Habitat, Water Quality, Recreational Access	A 1,500-foot section of the northern/western bank adjacent to Mound Avenue between Marquette and 6th Streets	City of Racine	City of Racine and private landowners	Bank stabilization to address bank erosion along 1,500 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization. This area has also been identified as an area to connect/expand the City's bike/pedestrian path and add park space. (Note: the City/County are already in process of planning improvements in this area)				City of Racine and private landowners??	538,000				
AER-9	Habitat, Water Quality	1,200 feet on both banks along a bend in the River within Washington Park, northwest of Park High School	City of Racine	City of Racine	Bank stabilization to address moderate to high bank and ravine erosion along 1,200 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization. (Note: the City are already in process of designing improvements in this area with construction planned in 2014)				City of Racine	435,000				
AER-10	Habitat, Water Quality	About 250 feet of isolated areas on both banks within Island and Lincoln Parks.	City of Racine	City of Racine	Bank stabilization to address bank erosion along 1,500 feet of Root River mainstem. Suggested treatments include regrading and revegetating banks as well as rock toe stabilization.				City of Racine	77,000				
AER-11	Water Quality	Outfall on eastern bank of the mainstem Root River, just upstream of the STH 38 overpass	City of Racine	Private	Pipe replacement with riprap and end section				Private owner	3,500				
AER-12	Water Quality	Outfall on eastern bank of the mainstem Root River, just upstream of the STH 38 overpass (next to outfall described above)	City of Racine	City of Racine	Pipe replacement with riprap and end section				City of Racine	4,500				
AER-13	Water Quality	Outfall on eastern bank of the mainstem Root River adjacent to Horlick Park at the end of Parkview Drive	City of Racine	City of Racine	Pipe replacement with riprap and end section				City of Racine	3,000				
AER-14	Water Quality	Outfall on southern bank of bend adjacent to Cedar Bend Park and 12th Street	City of Racine	City of Racine	Pipe replacement with riprap and end section				City of Racine	20,000				
AER-15	Water Quality	Outfall on southern bank of bend adjacent to Cedar Bend Park and 12th Street (next to outfall described in (AER-14)	City of Racine	City of Racine	Pipe replacement with riprap and end section				City of Racine	30,000				
AER-16	Water Quality	Outfall on northern bank of bend within Cedar Bend Park (directly across from outfalls described in AER-14 and AER-15)	City of Racine	City of Racine	Pipe replacement with riprap and end section				City of Racine	3,500				
AER-17	Water Quality	Outfall on northern bank of bend within Lincoln Park immediately downstream of the WDNR Steelhead Facility	City of Racine	City of Racine	Pipe replacement with riprap and end section				City of Racine	3,000				

Table VI-Proj (continued)

[a-1]*Costs reflect 2013 conditions, based on an* Engineering News-Record *Construction Cost Index of 12,210.*

[a]*Prefixes indicate the general area or source of the project:*

AER = AECOM study of erosion for City of Racine
GFD = City of Greenfield Study
LRC = Lower Root River-Caledonia and Hoods Creek Assessment Areas
LRJ = Lower Root River-Johnson Park and Lower Root River-Racine Assessment Areas
MPC = Milwaukee County Department of Parks, Recreation and Culture
MRR = Middle Root River and East Branch Root River Assessment Areas
MUS = Sediment Transport Study
RAC = City of Racine Study of TMDL options
RHD = City of Racine Health Department
RRC = Root River Canal System Assessment Areas
RWO = Racine Weed Out!
URR = Upper Root River and Whitnall Park Creek Assessment Areas

[b]*Total phosphorus reductions were calculated based upon a linear regression model developed using the TSS and total phosphorus reduction estimates given for stormwater ponds in the City of Racine given in AECOM,* Storm Water Quality Management Plan Update/TMDL Preparedness Assessment, *Final Report to the City of Racine, December 2013.*

[c]*Estimate assumes a soil unit weight of 90 pounds per cubic foot and a 10-foot average height for the erosional area which recedes at a rate of one foot per year.*

[d]*Reduction of phosphorus loading was not computed, but is assumed to be proportional to reduction in TSS loading.*

[e]*Estimate assumes a soil unit weight of 90 pounds per cubic foot and that the erosional area recedes at a rate of one foot per year.*

[f]*Estimated capital cost is for projects recommended over the period 2011-2020.*

[g]*Estimated capital cost is for projects recommended over the period 2013-2022.*

[h]*Past history of this park as a fill site indicates that the site would need to be investigated for contaminated soils.*

[i]*Floodplain impacts would need to be evaluated. The potential of a willing seller of an adjacent property may expand the area available for this project.*

Source: AECOM, City of Racine, City of Greenfield, Milwaukee County Department of Parks, Recreations and Culture, Root River Watershed Restoration Plan Advisory Group, Root River Restoration Planning Group, Racine Health Department, and SEWRPC.

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05/05/14

Exhibit B

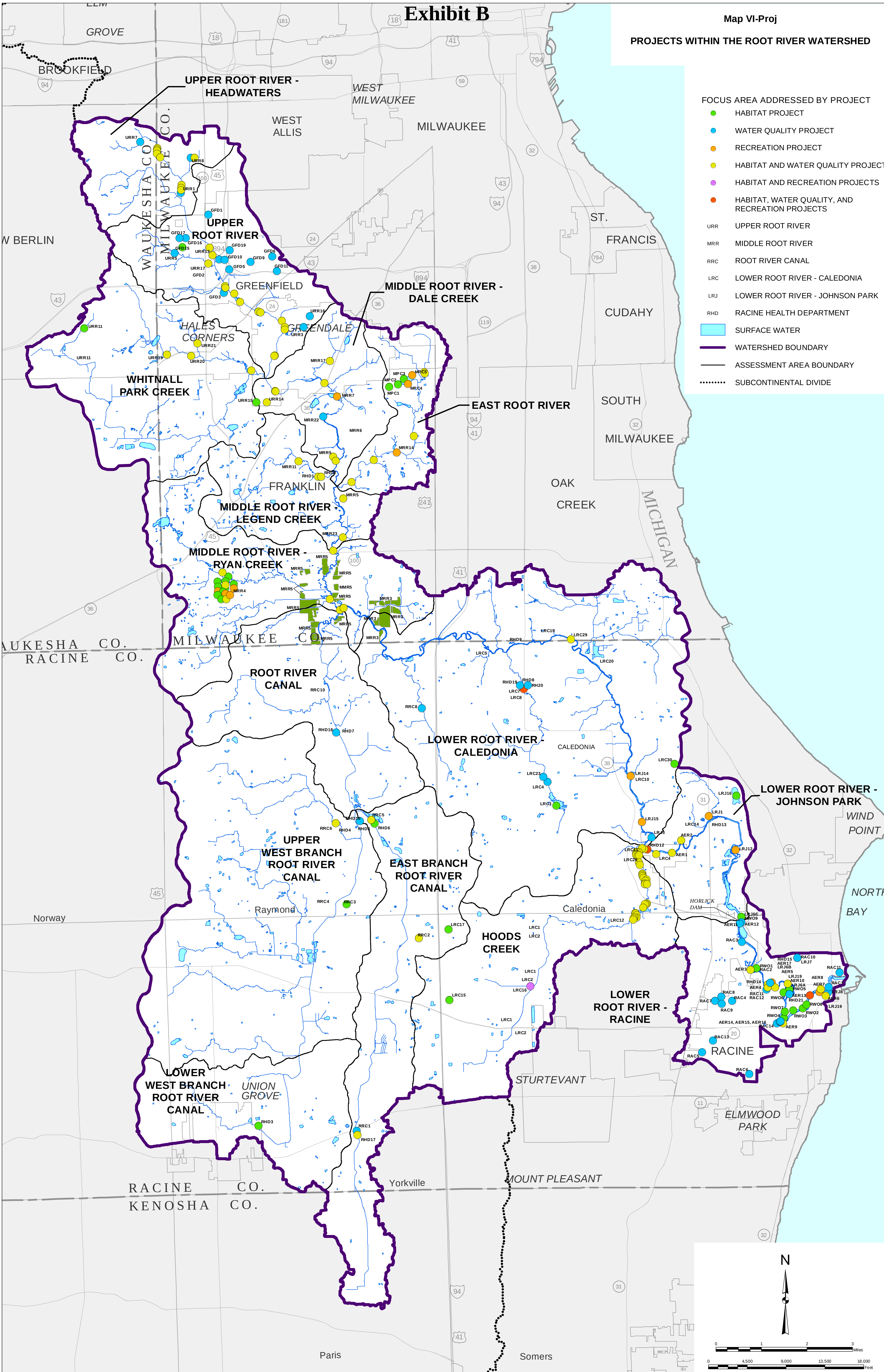
Map VI-Proj
PROJECTS WITHIN THE ROOT RIVER WATERSHED
FOCUS AREA ADDRESSED BY PROJECT
HABITAT PROJECT
WATER QUALITY PROJECT
RECREATION PROJECT
HABITAT AND WATER QUALITY PROJECTS
HABITAT AND RECREATION PROJECTS
HABITAT, WATER QUALITY, AND RECREATION PROJECTS
URR UPPER ROOT RIVER
MRR MIDDLE ROOT RIVER
RRC ROOT RIVER CANAL
LRC LOWER ROOT RIVER - CALEDONIA
LRJ LOWER ROOT RIVER - JOHNSON PARK
RHD RACINE HEALTH DEPARTMENT
SURFACE WATER
WATERSHED BOUNDARY
ASSESSMENT AREA BOUNDARY
SUBCONTINENTAL DIVIDE
UPPER ROOT RIVER - HEADWATERS
UPPER ROOT RIVER
MIDDLE ROOT RIVER - DALE CREEK
WHITNALL PARK CREEK
EAST ROOT RIVER
MIDDLE ROOT RIVER - LEGEND CREEK
MIDDLE ROOT RIVER - RYAN CREEK
ROOT RIVER CANAL
LOWER ROOT RIVER - CALEDONIA
LOWER ROOT RIVER - JOHNSON PARK
UPPER WEST BRANCH ROOT RIVER CANAL
EAST BRANCH ROOT RIVER CANAL
HOODS CREEK
LOWER ROOT RIVER - RACINE
LOWER WEST BRANCH ROOT RIVER CANAL
GROVE
BROOKFIELD
WEST MILWAUKEE
WEST ALLIS
MILWAUKEE
ST. FRANCIS
CUDAHY
GREENFIELD
HALES CORNERS
GREENDALE
SOUTH MILWAUKEE
FRANKLIN
OAK CREEK
MICHIGAN
WAUKESHA CO.
MILWAUKEE CO.
RACINE CO.
KENOSHA CO.
CALEDONIA
Raymond
Caledonia
Norway
HORLICK DAM
WIND POINT
NORTH BAY
RACINE
STURTEVANT
UNION GROVE
ELMWOOD PARK
Yorkville
MOUNT PLEASANT
Paris
Somers
N
Miles
Feet
Source: SEWRPC.

Exhibit C

Boxhorn, Joseph E.

Subject: FW: River Bend Canoe/Kayak Rentals

From: ROGER Chernik [mailto:rkchernik@gmail.com]
Sent: Thursday, November 07, 2013 4:11 PM
To: Boxhorn, Joseph E.
Subject: Re: River Bend Canoe/Kayak Rentals

Joe,

We had 1-1/2 hours of fishing on the Root River for each of 320 children attending our summer camps. There were and are on an on-going basis, water science programs using the ox-bow pond which is essentially part of the Root River. I can quantify if you are interested. We are also doing much land restoration on upland and wetland areas and beginning run-off control and infiltration. It is vey labor intensive as you know. I will attempt to quantify next month as we retire for the season but I believe we dealt with at least 5-7 acres this year. Two additional rain gardens and a bio-swale were built this fall.

Roger

Roger
On Thu, Nov 7, 2013 at 8:37 AM, Boxhorn, Joseph E. <jboxhorn@sewrpc.org> wrote:

Hi Roger,

Thanks for sending the data on rentals. We'll incorporate it into the report.

At last week's meeting you indicated that there was other usage of the River at River Bend that did not involve rentals. Do you have any data on that? If you don't have data, could you send me a description of what it encompasses and about how much of it is happening.

Thanks,

Joe

===

Joseph E. Boxhorn, Ph.D. Senior Planner
Southeastern Wisconsin Regional Planning Commission
N239 W1812 Rockwood Drive
P.O. Box 1607
Waukesha, WI 53187-1607

Phone: 262-547-6722 ext. 244
Fax: 262-547-1103
E-mail: jboxhorn@sewrpc.org
Web: www.sewrpc.org
===

From: ROGER Chernik [mailto:rkchernik@gmail.com]
Sent: Friday, November 01, 2013 4:30 PM
To: Boxhorn, Joseph E.
Subject: River Bend Canoe/Kayak Rentals

Joe,

Use for 2013, mid-May through October at River Bend was 966 hours of rental to 1256 individuals. Roughly, for the 24 week period that is 40 hours per week and 52 people per week.

The people visiting us in the first half of June were given accurate information to that date but usage picked up dramatically as summer camp, school vacations and warm weather came about. We expect greater usage next year as word of River Bend spreads in the community.

Hope this helps.

Please note one of your UW Extension colleagues, Murali Vedula is on the River Bend Board of Directors.

Roger Chernik

Exhibit D

Table VI-Mon-3

TIERED LIST OF CHEMICAL AND RELATED WATER QUALITY CONSTITUENTS FOR MONITORING

Tier 1			
Dissolved Oxygen	pH	Suspended solids, total	Water temperature
Fecal indicator bacteria[a]	Specific conductance	Turbidity	Water transparency
Tier 2			
5-day biochemical oxygen demand	Chloride	Chlorophyll-*a*	Phosphorus, total
Tier 3			
Alkalinity, total	Hardness	Kjeldahl nitrogen, total[b]	Nitrate-nitrogen[b,d]
Ammonia-nitrogen[b,c]	Dissolved phosphorus, total	Magnesium, total	Nitrite-nitrogen[b,d]
Calcium, total			
Tier 4			
20-day biochemical oxygen demand	Copper, total[e]	Nickel, total[e]	Silver, total
Arsenic, total	Dissolved silica, total	Mercury, total	Solids, total
Cadmium, total[e]	Dissolved solids, total	Organic carbon, total	Volatile solids, total
Carbon, total	Inorganic carbon, total	Organic carbon, total dissolved	Zinc, total[e]
Chromium, total[e]	Lead, total[e]	Selenium, total	
Tier 5			
Acenaphthene	Fluoranthene	2,2',4,4'-tetrachloorbiphenyl	2,2',3,3',4,5,5',6'-octachlorobiphenyl
Acenaphthylene	Fluorene	3,3',4,5'-tetrachlorobiphenyl	2,2',3,3',4,5,6',6'-octachlorobiphenyl
Anthracene	Indeno-(1,2,3-c,d)-pyrene	2,2',3',4,6-pentachlorobiphenyl	PCB-1016
Benzo-(a)-anthracene	Naphthalene	2,2',4,5',6-pentachlorobiphenyl	PCB-1221
Benzo-(a)-pyrene	Phenanthrene	3,3',4,4',5-pentachlorobiphenyl	PCB-1232
Benzo-(b)-fluoranthene	Pyrene	2,2',3,4,5,5'-hexachlorobiphenyl	PCB-1242
Benzo-(g,h,i)-perylene	2,3-dichlorobiphenyl	2,2'4,4'5,6'-hexachlorobiphenyl	PCB-1248
Benzo-(k)- fluoranthene	2,4,5-trichlorobiphenyl	3,3'4,,4',5,5'-hexachlorobiphenyl	PCB-1254
Chrysene	3,3',5-trichlorobiphenyl	2,2',3,3',4,4',6'-heptachlorobiphenyl	PCB-1260
Dibenzo-(a,h)-anthracene			

Table VI-Mon-3 (continued)

[a]*Fecal indicator bacteria include fecal coliform bacteria and* Escherichia coli*, which have both been routinely monitored in the Root River watershed, and* Enterococcus*, which has not been routinely monitored in the Root River watershed.*

[b]*In order to fully characterize nutrient conditions related to nitrogen, ammonia, total Kjeldahl nitrogen, nitrate, and nitrite should be collected together.*

[c]*The toxicity of ammonia to fish and other aquatic organisms is dependent upon temperature and pH. Because of this, always sampling for temperature and pH when ammonia samples are collected would aid in the interpretation of ammonia concentration data.*

[d]*Some monitoring programs sample for and report a combined total concentration of nitrate plus nitrite.*

[e]*The toxicity of cadmium, chromium, copper, lead, nickel, and zinc to fish and other aquatic organisms is dependent upon the hardness of the water. Because of this, always sampling for hardness when samples are collected for any of these metals would aid in the interpretation of the metal concentration data.*

Source: SEWRPC.

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02/20/14

Exhibit E

APRIL 22, 2014, WDNR HORLICK DAM FAILURE ANALYSIS APPROVAL AND HAZARD RATING ASSIGNMENT LETTER

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
101 S. Webster Street
Box 7921
Madison WI 53707-7921

Scott Walker, Governor
Cathy Stepp, Secretary
Telephone 608-266-2621
FAX 608-267-3579
TTY Access via relay - 711

Tuesday, April 22, 2014

Racine County
C/o Mr. Nathan Plunkett,
Project Engineer
14200 Washington Ave.,
Sturtevant, WI 53177

Expedited delivery via email: nathan.plunkett@goracine.org

Subject: Horlicks Dam. Field file 51.03, Key sequence # 288, dam failure analysis approval and hazard rating assignment, Racine County.

Dear Mr. Plunkett:

We are sending you this approval of the dam failure analysis and setting the hazard rating for the Horlicks Dam. The hazard rating is being set as Low Hazard. As a dam having an assigned low hazard rating, the structure must be capable of passing the 100-year flood without overtopping. The dam, as currently configured, does not have sufficient capacity to meet the requirements of chapter NR 333 Wisconsin Administrative Code, for a low hazard dam.

If you have questions about this approval, please give me a call at 608 266-1925. If you have other questions pertaining to the operation and maintenance of your dam please contact Nathan Zoch at 262 574-2188, or via email at nathan.zoch@wisconsin.gov.

Thank you for your continued cooperation.

Sincerely,

Konny Margovsky, P.E.
Dam Safety Engineer
Bureau of Watershed Management

cc. Nathan Zoch – DNR, Waukesha office, via email
Ryan Kloth, P. E. – GRAEF-USA, via email
Michael Hahn, P. E. – SEWRPC, via email

BEFORE THE
DEPARTMENT OF NATURAL RESOURCES

IN THE MATTER of the assignment of the Hazard Rating for the Horlicks Dam, located across the Root River, Racine County. Field File 51.03

FINDINGS OF FACT

1. The Department of Natural Resources (Department) has examined the dam failure analysis, for the Horlicks Dam, located in the NW ¼ of the NE ¼ of Section 6, Township 3 North, Range 23 East, Racine County, across the Root River.

2. The Horlicks Dam is owned and operated by the Racine County.

3. The dam failure analysis was performed by GRAEF-USA and the final version submitted to the Department on 04/08/2014.

4. GRAEF-USA has determined that due to convergence of the dam failure and dam nonexistent profiles immediately downstream of the dam, a rating of Low Hazard would be appropriate for the dam.

5. The current Flood Insurance Study (FIS) (FIRM Panel Numbers 55101C0114D and 55101C0227D with the effective date 05/02/2012) zoning in place downstream from the dam appears to be adequate in providing sufficient protection of life, health and property in areas below the Horlicks Dam.

6. Design flood routing completed by your consultant as part of the dam failure analysis, determined that the dam is not able to pass the 100-year flood without overtopping through its spillway as defined by NR 333, for a low hazard dam.

7. The analysis was performed in compliance with Wisconsin Administrative Codes NR 333, and NR 116.

8. The hazard rating meets the standards of Section NR 333.06, Wisconsin Administrative Code.

CONCLUSIONS OF LAW

1. The review has been conducted in accordance with Chapter 31, Wisconsin Statutes, and Chapters NR 333 and NR 116, Wisconsin Administrative Codes.

2. The Department has authority under Chapter 31, Wisconsin Statutes, and Chapter NR 333, Wisconsin Administrative Code, to assign a hazard rating.

ASSIGNMENT OF THE HAZARD RATING

1. The hazard rating of Low Hazard is hereby assigned to the dam.

2. An Emergency Action Plan (EAP) is required for your dam. Please submit an EAP to Nathan for review and approval by September 1, 2014.

3. The spillway capacity of the dam must be brought into compliance with NR 333, Wisconsin

Administrative Code within 10 years from the date this document was mailed, or otherwise served by the Department.

4. Capacity upgrade design elements will have to be incorporated into the currently approved dam failure analysis as well as any available additional and/or newly developed riverine hydrologic and hydraulic information. The analysis then will need to be re-run and submitted to the DNR for review and approval.

NOTICE OF APPEAL RIGHTS

If you believe that you have a right to challenge this decision, you should know that the Wisconsin statutes and administrative rules establish time periods within which requests to review Department decisions must be filed. For judicial review of a decision pursuant to sections 227.52 and 227.53, Wis. Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to file your petition with the appropriate circuit court and serve the petition on the Department. Such a petition for judicial review must name the Department of Natural Resources as the respondent.

To request a contested case hearing pursuant to section 227.42, Wis. Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to serve a petition for hearing on the Secretary of the Department of Natural Resources. All requests for contested case hearings must be made in accordance with section NR 2.05(5), Wis. Adm. Code, and served on the Secretary in accordance with section NR 2.03, Wis. Adm. Code. The filing of a request for a contested case hearing does not extend the 30 day period for filing a petition for judicial review.

This decision was emailed on 04/22/2014.

STATE OF WISCONSIN DEPARTMENT OF NATURAL RESOURCES
For the Secretary

By ______________________________

Konny Margovsky, P.E.
Dam Safety Engineer
Bureau of Watershed Management

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Exhibit F

SEWRPC Community Assistance Planning Report No. 316

A RESTORATION PLAN FOR THE ROOT RIVER WATERSHED

Chapter V

DEVELOPMENT OF TARGETS AND ALTERNATIVE MEASURES

INSERTS

[NOTE: Significant changes from the preceding version provided to the Advisory Group are indicated with yellow highlighting.]

Horlick Dam Alternatives

Introduction

An inventory of information on the Horlick dam was compiled in Chapter IV. The Horlick dam spillway does not meet WDNR requirements for a Low Hazard dam.[67] Due to the inadequate spillway capacity, structural modifications to the dam would be necessary if the dam is to be maintained. Thus, a "no action" alternative is not a viable option for the Horlick dam. Therefore, in this chapter alternatives were developed to meet the regulatory requirements associated with the dam hazard rating and the effects of implementation of those alternatives on the Root River corridor in the vicinity of the dam were addressed. First, issues of concern for evaluating the current conditions and dam alternatives are summarized, next the baseline Horlick dam condition is described, and finally three potential categories of dam alternatives are detailed.

Issues of Concern

Surface Water and Groundwater Quantity Considerations

Water quantity issues for this dam evaluation encompass floods, normal flow, and groundwater contributions. The effect of the Horlick dam and its impoundment in attenuating large flood peaks would be expected to be negligible (i.e., there would be no significant difference in peak flows between conditions with the dam in place and with the dam removed) because during floods the runoff volume from the approximately 190-square mile

[67] *An April 27, 2014, letter from the WDNR to Racine County established a Low Hazard rating for the dam, based on a dam failure analysis prepared for the County by GRAEF-USA. That letter established additional requirements, including the need to bring the spillway discharge capacity into compliance with Chapter NR 333 of the* Wisconsin Administrative Code *within 10 years from the date of the letter.*

watershed tributary to the dam would be very large relative to the active storage volume above the normal impoundment level. Thus, within the range of dam modifications considered under the alternatives described below, including modifications to increase spillway discharge capacity and modifications to fully or partially remove the dam, no significant difference in flood peaks would be expected. During nonflood or normal flow times, it is of interest to compare how the river corridor functions for the various alternatives. And finally, the impoundment may affect the shallow groundwater table in its vicinity. The dam impoundment could either be a source to shallow groundwater or a sink for water from the shallow groundwater.[68,69]

Water Quality

The water quality issues of concern for the Horlick dam alternatives include dissolved oxygen, nutrients, temperature, sediment, and large woody debris. Dissolved oxygen is an important characteristic for fish and aquatic biota health. For most impoundments dissolved oxygen levels decrease with thermal stratification, and then increase by aeration as water flows over the dam spillway.[70] The limiting nutrient of greatest concern for water quality is phosphorus, and for most impoundments the main phosphorus input is the suspended sediment.[71] Typically the dam impoundment raises water temperatures by slowing the water and increasing the water surface exposed to the sun.[72] Contaminated sediments are of significant concern if they exist, as any modifications to the dam may alter sediment transport characteristics. Large woody debris is often caught at the dam crest during floods, and then either removed or moved downstream during nonflood times. Large woody debris is considered vital for fish and wildlife habitat and disruption of the natural movement of the debris downstream would be considered a negative from a fishery standpoint.[73] From the view of protection of downstream infrastructure, the large woody debris capture at the dam may be considered a positive.

Natural Resources

The natural resource considerations for the Horlick dam area include the fishery, terrestrial biota, and aquatic invasive species. In almost all cases, a dam is considered a barrier to aquatic species movement. The dam often blocks not only the river but the riverine corridor, disconnecting the system at the dam location.[74] This system disconnection may also be considered positive by preventing upstream movement of aquatic invasive species, assuming that the dam provides sufficient obstruction during all flows.

Another consideration for aquatic invasive species is the ability to move upstream past the dam by another method, such as intentional or unintentional human actions or passage on another species. Unfortunately, this aided transport method is difficult to predict or control, but has been widespread in the dispersal of multiple

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[68]*Nancy D. Gordon, Thomas A McMahon et al.,* Stream Hydrology, An Introduction for Ecologists, 2nd Edition, *John Wiley & Sons, Ltd., 2004.*

[69]*Robert G. Wetzel,* Limnology, 2nd Edition, *Sanders College Publishing, 1983.*

[70]*James H. Thrall and Rimas J. Banys,* op. cit.

[71]*Gyles Randall et al., "Phosphorus Transport and Availability in Surface Waters,"* University of Minnesota-Extension Publication WW-06796, *2002.*

[72]*James H. Thrall and Rimas J. Banys,* op. cit.

[73]*Jeff Operman et al., "Maintaining Wood in Streams: A Vital Action for Fish Conservation,"* ANR Publication 8157, *University of California, Division of Agriculture and Natural Resources, 2006.*

[74]*James H. Thrall and Rimas J. Banys,* op. cit.

invasive species including zebra mussel, quagga mussel, Eurasian water milfoil, and purple loosestrife, among others. This is why the WDNR has invested in programs such as Clean Boats, Clean Waters programs to promote information and education on invasive species and how to prevent their expansion into other waterbodies.

Social

Social issues related to dams include aesthetics, safety, and recreation. Aesthetics encompasses how the river corridor looks in the area of the dam, and often are of a very personal nature. Safety includes both the safety of boaters and fisherman in the river, and those onshore and downstream. With the dam in place there is the danger that the dam will fail and a large amount of water and sediment will flow downstream suddenly. Recreational considerations include boating, fishing, biking, hiking, bird watching, and many other uses that can be enjoyed along a river corridor.

Cost

Two costs will be evaluated for each Horlick dam alternative: 1) the capital costs of construction/demolition and 2) maintenance costs. Construction or demolition costs are onetime costs incurred in the dam area to either modify or remove the dam structure. Maintenance costs associated with a structure remaining at the Horlick dam location may include inspections, repairs, studies, dredging, and instream debris management.

Maintenance costs for dam removal may include habitat enhancements and impoundment area restoration. Future structural maintenance costs are somewhat difficult to accurately represent, as some work will depend on how the dam performs and the severity and frequency of future floods.

Baseline Condition

This section discusses the existing state of the Horlick dam for the issues of concern described above.

Surface Water and Groundwater Quantity Considerations

As noted previously in the “Issues of Concern” subsection, the Horlick dam and impoundment as currently configured (see Figure V-A) do not significantly attenuate peak flood flows. The water surface profile during a flood drops significantly from the upstream side of the dam to the downstream side, but peak flows are not significantly reduced with the fixed dam crest and minimal storage available in the impoundment area.

To evaluate peak and base flow profiles at the Horlick dam, a U.S. Army Corps of Engineers (USCOE) Hydrologic Engineering Center (HEC-RAS) river analysis system model[75] was developed, using the USCOE HEC-2 water surface profiles model developed by the SEWRPC staff under a 1990 drainage and flood control plan for the Milwaukee Metropolitan Sewerage District.[76] The hydraulic model was also modified to reflect a 1977 dam survey and WisDOT plans for STH 38 and STH 31. Model cross sections were modified in the impoundment area to match the 2012 SEWRPC channel soundings described in Chapter IV. Flows for which water surface profiles were computed are listed in Table V-A. The Horlick dam HEC-RAS model results were checked for reasonableness versus the observed June 2008 and April 2013 flood elevations at STH 38, the Horlick dam, and USGS gage 04087240 just downstream of the dam.

Hydraulic model results for the existing Horlick dam indicate that the current spillway capacity is equal to the peak flow rate during the 10-percent-annual-probability (10-year recurrence interval) flood. This means that larger floods are not contained by the Horlick dam spillway, overflowing the left[77] and right abutments and walkways.

[75]*Version 4.1.0.*

[76]*SEWRPC Community Assistance Planning Report No. 152,* A Stormwater Drainage and Flood Control System Plan for the Milwaukee Metropolitan Sewerage District, *December 1990.*

[77]*References to left and right are based on looking downstream.*

Based on model results, the water surface elevation just downstream of the dam (also called the tailwater elevation) is approximately at the top of the existing spillway crest (629.9 feet above National Geodetic Vertical Datum, 1929 adjustment (NGVD 29)) for the 0.2-percent-annual-probability (500-year recurrence interval) flood. The 0.2-percent-annual-probability velocity at the dam spillway crest is approximately 11.0 feet per second (fps). The one-percent-annual-probability (100-year recurrence interval) flood tailwater elevation is approximately three feet below the existing spillway crest, with a spillway crest velocity of approximately 9.0 fps. The two-percent-annual-probability (50-year recurrence interval) flood tailwater elevation is approximately four feet below the existing spillway crest, with a spillway crest velocity of approximately 8.0 fps.

Normal or base flows on the Root River are fairly small (10 to 56 cfs) as discussed in Chapter IV. What this means for the current Horlick dam configuration is that the residence time in the impoundment is between two and eight days. It also means that the dam is minimally overtopped during normal flow times (one to three inches), making fish passage downstream over the spillway difficult. During base flow conditions, the pool created by backwater from the Horlick dam extends upstream to STH 31, a length of approximately 3.4 miles.

The Horlick dam impoundment most likely raises the shallow groundwater table in the immediate area. Thus, maintenance of the dam in place may be beneficial to shallow private wells in the vicinity of the impoundment if they are still being utilized. However, if upgrading the spillway capacity of the dam to meet State requirements necessitates lowering the permanent pond elevation, as indicated by several alternatives that are described below, the positive effect of the permanent pond on groundwater levels would be reduced somewhat. Map V-A includes all private well log data found on the Wisconsin Department of Natural Resources (WDNR) website for the three U.S. Public Land Survey sections encompassing the Horlick impoundment.[78] The numerous wells with standing water less than 25 feet below the ground surface (highlighted in yellow) are of particular concern because their water levels would be most likely to be affected by fluctuations in the impoundment level. It is unknown which wells included in Map V-A are still in use.

Water Quality

Water quality data for the Root River in the vicinity of the Horlick dam are set forth in Chapter IV. Unfortunately, the more comprehensive water quality data sets were at Johnson Park which is at approximate river mile 11.5 and at the gage just below the Horlick dam at river mile 5.9 (see Table IV-10). Thus, there are no known water quality data explicitly representing the Horlick dam impoundment.

What can be determined from the available water quality data is that dissolved oxygen concentrations are very good just downstream of the Horlick dam (see Figure IV-1 and Table IV-17). This may be due to re-aeration over the dam spillway or the fact that the flow over the dam is from the top layer of the impoundment which has direct interaction with the air surface. Root River total phosphorus levels both five miles upstream and just downstream of the Horlick dam are above the 0.075 mg/l warmwater fish and aquatic life criterion for a significant portion of the water quality dataset (see Figure IV-28 and Table IV-17). The river temperature dataset is not continuous, thus comparisons to the sublethal and acute standards for small warmwater communities is not possible (see Tables IV-17 and IV-12). However, if the temperature data in Figure IV-14 is compared between the upstream and downstream gages that are closest to the Horlick dam at river miles 11.5 (Johnson Park) and 5.9 (just downstream of Horlick dam) there does appear to be a consistent upward trend in temperature between the upstream and downstream gage, which may be indicative of the rise in water temperatures that would be expected to occur because of the increased residence time and larger water surface area within the Horlick dam impoundment. The only exception to this upward temperature trend between the two gages is the period from 1987 through 1993. The temperature data included in Figure IV-14 are from grab samples, thus it is assumed the samples at the upstream and downstream gages were taken on the same day for comparison purposes.

[78]http://dnr.wi.gov/topic/groundwater/data.html.

The Horlick dam impoundment has captured significant sediment since its original construction in 1834, as evidenced by the streambed/accumulated sediment profile shown in Figure IV-K. This sediment capture may have caused erosion downstream of the dam as the river attempted to regain sediment equilibrium.[79] But sediment capture in the Horlick impoundment may have benefitted the harbor with reduced sediment volumes at the Root River mouth. It was documented in Chapter IV that contaminated sediment in the impoundment does not appear to be a concern based on testing to date.

As evidenced by WDNR inspections, the Horlick dam does catch large woody debris at its crest, although an annual estimate of large woody debris accumulation at the Horlick dam is not available. Some large woody debris also settles in the upstream impoundment depending on flow conditions and the size of the debris. The WDNR has recommended facilitating downstream movement of debris caught at the dam crest on an ongoing basis. Thus, the Horlick dam does essentially pass large woody debris, albeit often after the flood flows have receded when downstream sections are less able to convey it further downstream until the next major flood.

Natural Resources

A meeting was held between Commission staff and WDNR staff on June 13, 2013, to discuss the Horlick dam and the Root River. A summary of the meeting discussion can be found in Appendix G. Guidance from the WDNR related to the Horlick dam and the Root River fishery and aquatic invasive species discussed in subsequent sections is documented in those meeting notes. In addition the January 1, 2014, "Fish Passage Guidance" document issued by WDNR was considered in evaluating considerations related to passage of fish, and aquatic invasive species and the possible transmission of viral hemorrhagic septicemia (VHS) within the watershed.[80] That document was discussed during an April 24, 2014, meeting between the WDNR and SEWRPC staffs.

Lake Michigan aquatic invasive species are blocked from the upper Root River by the Horlick dam the majority of the time. The WDNR has indicated that the Root River Steelhead Facility, located downstream in Lincoln Park, is not considered a barrier as the flashboards are fully removed for most of the year. The Steelhead Facility flashboards are in place during the annual salmon spawning runs from about early September to November and then from early March to mid/late April. The WDNR considers both VHS and the aquatic invasive species of sea lamprey and round goby to be of greatest concern for the Root River. To stop the movement of the aquatic invasive sea lamprey, the U.S. Fish and Wildlife Service (USFWS) has recommended at other dam facilities a crest to tailwater difference of at least 1.5 feet for a step ladder fishway design for the 10-percent-annual-probability (10-year recurrence interval) flood. To determine if the Horlick dam is a complete barrier to the migration of aquatic organisms, the WDNR has recommended in their fish passage guidance[81] utilizing the one-percent-annual-probability (100-year) flood.

During the 10-percent-annual-probability flood, the hydraulic modeling results indicate that the Horlick dam tailwater elevation is approximately six feet below the spillway crest. During the one-percent-annual-probability flood, the hydraulic modeling results indicate that the Horlick dam tailwater elevation is approximately three feet below the spillway crest. Thus, the dam appears to be a barrier to sea lamprey movement during floods up to, and including, the 10-percent-probability flood and may still be a barrier at the one-percent-annual probability flood.

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[79]*Angela T. Bednarek, "Undamming Rivers: A Review of the Ecological Impacts of Dam Removal,"* Environmental Management*, Vol. 27, No. 6, 2001.*

[80]*Wisconsin Department of Natural Resources, Bureaus of Fisheries Management, Water Quality, and Watershed Management, "Fish Passage Guidance," January 1, 2014.*

[81]Ibid.

It should be noted that the tailwater elevation is approximately at the top of the existing spillway crest (629.9 feet above NGVD 29) for the 0.2-percent-annual-probability (500-year) flood, meaning that the dam is no longer a barrier for invasive aquatic species for this extreme flood.

To determine if the dam is a barrier to fish passage for the 0.2- and one-percent-annual-probability floods, a comparison of hydraulic modeling results to the swimming capacities of three fish species was completed. Smallmouth bass were selected as a smaller native sport species potentially occurring in the Root River. Based on recent dam modification analyses completed at other southeastern Wisconsin locations, northern pike were selected to represent the native fishery for the evaluation of fish passage conditions. Chinook salmon were the third species reviewed, as they are the largest WDNR stocked salmonid population in Lake Michigan. Available prolonged and burst speed data for these three fish species is included in Table V-B. Based on the burst speeds listed in Table V-B, both the northern pike and Chinook salmon could pass the Horlick dam spillway for the modeled 0.2-percent-annual-probability flood, while the smallmouth bass most likely could not get past the dam spillway. Based on the leaping ability of Chinook salmon and the Horlick dam spillway configuration, Chinook should also be able to jump the dam during a two-percent-annual-probability (50-year recurrence interval) flood and any larger event. As the Chinook salmon is considered an aquatic invasive fish species, the current Horlick dam would be deemed an incomplete barrier based on the WDNR Fish Passage Guidance.[82] A summary of fish passage issues for the Baseline Condition and all alternatives is included in Table V-C.

Social

The Horlick dam is not in a high profile location in the City of Racine and a bit difficult to view, with the best view being from the STH 38 bridge immediately downstream. Views of the dam and impoundment can also be enjoyed by patrons of the Riverside Inn on the right side of the dam as well. Views and access from Horlick Park on the left side of the dam are limited, with difficult foot access to the walkway over the former fishway via a narrow unmarked path along the park fence line. Access to the impoundment is good, with a boat launch and pier in Horlick Park. Immediately downstream of the dam, access is again difficult along an unmarked path at the end of Rapids Court behind the River Run Family Restaurant.

Safety issues at the current Horlick dam include periodic high flows, the possibility of dam failure, boater and fisherman safety, and access hazards by the public. During high flows, the water can approach the walkways on either end of the dam and be quite turbulent downstream of the dam. Falling or being swept into the Root River at the Horlick dam during high flows would be dangerous. Dam failure could be caused by instability during large floods, resulting in a structural failure. The possible significant downstream effects to property resulting from loss of the dam are described in Chapter IV. Boater safety is a concern near the crest of the dam, which is marked with warning signs only. Fishermen predominately fish downstream of Horlick dam during the salmon runs in spring and fall. The water is typically very shallow during the salmon runs, and most fisherman use waders and walk along the River bottom. Foot access below the dam is probably the biggest safety concern for fisherman.

As previously discussed, recreational opportunities at the Horlick dam and impoundment include small watercraft use in the impoundment, fishing, and bird watching. Although birds are attracted to the impoundment and river corridor, bird hunting is not allowed. For most individuals, the almost complete obstruction of fish movement across the dam from downstream to upstream as discussed previously would be considered a negative, but for those enjoying the salmon run, the downstream side of the Horlick dam is a popular fishing spot.

Land ownership along the Root River corridor upstream of the Horlick dam to STH 31 is indicated on Map V-B. Publicly owned lands are shaded in green, and property boundaries are shown in black. Privately-owned property that includes a portion of the Horlick dam impoundment is indicated with a yellow boundary. It is important to

[82]Ibid. *See Appendix 4 of the WDNR Fish Passage Guidance.*

note that the majority of the Horlick dam impoundment is not in private ownership, and the majority of the private property lines end at the water's edge of the current impoundment.

Cost

The Horlick dam was reconstructed in late 1975, making the current configuration of the dam about 39 years old. Based on recent inspections by WDNR, there do not appear to be any substantial concerns with the condition of the dam. Maintenance and future study costs (in 2013 dollars) for the current Horlick dam were estimated by Racine County and SEWRPC staff as outlined below. The majority of these items were called for in the 2008 and 2011 WDNR inspection reports (Appendix C). The cost of implemented actions called for under the WDNR Horlick dam inspection totals $6,000, the ongoing yearly costs are estimated at $1,000, and efforts yet to be completed as required by WDNR total $68,000.

- Woody debris passage—ongoing cost estimated at $1,000/year
- Dam break analysis—(completed 2014) $5,000
- Take out sign and benchmark establishment—(completed) $1,000
- Outstanding requested actions from WDNR inspections:
    - Preparation of plans and a condition report for stop logs, sill plate, and embedded slots—$5,000
    - Installation of a bridge operation deck and mechanism for stop log removal—$25,000
    - Development of an Emergency Action Plan—$5,000
    - Development of an Inspection, Operation, and Maintenance Plan—$3,000
    - Investigation of concrete condition—$10,000
    - Preparation of scour study—$10,000
    - Bank Repairs—$10,000

Conceptual Alternatives

Three categories of conceptual alternatives for the Horlick dam were developed as outlined below, with the goals of enhancing spillway capacity, providing fish passage, or removing the dam. Four specific alternatives are described, and additional information needs to be addressed during preliminary engineering are identified.

As documented in Chapter IV, the analyses presented in this report are based on the fact that the dam has a Low Hazard rating. For a Low Hazard dam, Chapter NR 333, "Dam Design and Construction," of the *Wisconsin Administrative Code* requires that the spillway safely convey the one-percent-annual-probability (100-year) flood flow. Under the current Horlick dam configuration, the one-percent-annual-probability flow is not contained within the spillway as discussed above, overtopping the right and left observation decks at the dam and causing erosion and failure concerns at both locations.

Due to the inadequate Horlick dam spillway capacity discussed in the Baseline Condition section, structural modifications to the dam would be necessary if the dam is to be maintained. Thus, a "no action" alternative is not a viable option for the Horlick dam. As noted above, the WDNR staff has stated that Racine County will have 10 years to implement modifications to the dam to meet spillway requirements. Another option available to the County would be removal of the dam.

As described in the Baseline Condition section, the Horlick dam is currently a barrier to fish passage to the upstream watershed for all but the most extreme floods. Downstream fish passage may occur over the dam crest, but during normal flow times is also difficult due to the shallow overtopping depth. As noted above, the Horlick dam is considered an incomplete barrier to aquatic invasive species.

The hydraulic effects of each of the alternatives were evaluated using the HEC-RAS model developed for the Baseline Condition. Modifications to the hydraulic model were made only at the dam location to represent each of the alternative configurations.

The provision of freeboard during the one-percent-annual-probability spillway design flood was established based on the more restrictive of the following two criteria:[83]

- Providing one foot of freeboard to the tops of the existing, or proposed depending on the alternative, left and right concrete abutments for the maximum one-percent-annual-probability flood elevation.

- Containing the 0.2-percent-annual-probability flood event within the dam spillway with the upstream water surface elevation at the top of the lowest abutment.

For all the alternatives but full removal (Alternative 5) (i.e., for all alternatives under which the dam would be kept in place), the 0.2-percent-annual-probability flood freeboard criterion governs the design.

Alternatives that Modify the Dam to Enhance Spillway Capacity

ALTERNATIVE 1—FULL NOTCH OF CURRENT DAM SPILLWAY FOR ONE-PERCENT-ANNUAL-PROBABILITY (100-YEAR) FLOOD CAPACITY

SURFACE WATER AND GROUNDWATER QUANTITY CONSIDERATIONS

This alternative modifies the dam to safely pass the one-percent-annual-probability (100-year recurrence interval) flood. Lowering the entire dam spillway by 3.3 feet to elevation 626.6 feet above NGVD 29 would enable safe conveyance of the one-percent-annual-probability flood within the dam spillway (see Figure V-B).[84] Under Alternative 1 the 0.2-percent-annual-probability flood would be just contained within the dam spillway, and there would be approximately two feet of freeboard to the top of the existing left concrete abutment for the maximum one-percent-annual-probability flood elevation.

The modifications included under Alternative 1 would significantly alter both the flood and normal flow profiles upstream of the dam to STH 31. The one-percent-annual-probability profile would be lowered approximately three feet at the dam crest from Baseline Conditions, while the 0.2-percent-annual-probability (500-year recurrence interval) flood would be lowered approximately 2.6 feet. Dam tailwater elevations associated with this alternative would remain the same as the Baseline Condition. The one-percent-annual-probability flood effects of Alternative 1 are not as pronounced upstream at STH 31, with the water surface elevation upstream of the bridge

[83]*Freeboard is the difference between the water surface elevation on the upstream side of Horlick dam and the top of the dam abutments. Freeboard provides a level of safety against overtopping of the abutments, since such overtopping could potentially cause structural and safety concerns for the dam.*

[84]*The requirement to safely pass the one-percent-annual-probability (100-year recurrence interval) flood could also be attained by a gate-type system modification to the Horlick dam. But this would be significantly more expensive to construct, and would also require active operation to safely convey flood flows. Such active operation normally is not desirable as timing of operations can be difficult to predict, so this is not considered a viable option and was not considered further in this study.*

for Alternative 1 only 0.3 foot lower than the elevations for the Baseline Condition. The 0.2-percent-annual-probability water surface elevation upstream of the STH 31 bridge for Alternative 1 would also be only 0.3-foot lower than the Baseline Condition.

Based on hydraulic model results, the tailwater elevation for Alternative 1 is approximately at the top of the lowered spillway crest (626.6 feet above NGVD 29) for a flood condition between the one- and two-percent-annual-probability (100 and 50-year recurrence interval) floods. The one- and two-percent-annual-probability velocities at the dam spillway crest are approximately 9.8 and 9.1 fps, respectively. The significance of the tailwater elevation being at or just above the Alternative 1 spillway crest is that the dam structure would essentially no longer be a barrier to fish and aquatic species passage for the flows between the one- and two-percent-annual-probability floods. The one-percent-annual-probability flood tailwater elevation is approximately 0.4 foot above the modified spillway crest. The 0.2-percent-annual-probability (500-year) flood tailwater elevation is approximately 3.3 feet above the modified spillway crest, with a spillway crest velocity of approximately 11.5 fps. And finally, the 10-percent-annual-probability (10-year recurrence interval) flood tailwater elevation is approximately 2.5 feet below the modified spillway crest, with a crest velocity of approximately 8.0 fps.

With the reduction in spillway elevation to 626.6 feet above NGVD 29, the extent of the impoundment area will be significantly reduced during normal, or base, flow times. It is estimated that the impoundment will extend approximately 1.5 miles upstream, or only encompass the lower half of the original impoundment area. This means that base flow residence times will be lower in the impounded area, which should improve water quality overall. And the upper reach between the alternative impounded area and STH 31 will experience flooded overbanks less frequently, which may allow surface vegetation to establish and improve terrestrial habitat in this area.

With a reduced impoundment area at a lower elevation during normal flow times, shallow groundwater levels most likely will also be lowered. This may adversely affect the still active groundwater wells developed in the shallow aquifer previously discussed and depicted in Map V-A.

WATER QUALITY

Water quality impacts associated with Alternative 1 cannot be definitively predicted, but as was discussed earlier, the size of the impoundment would be reduced with this alternative, which should reduce base flow residence times and reduce phosphorus deposition and water temperature in the impoundment area. Dissolved oxygen concentrations may not change dramatically as there would still be an opportunity for aeration over the lower dam spillway. It is very likely that the sediment which has accumulated on the bed of the impoundment over time may be partially flushed out of the downstream portion of the impoundment under this alternative with the lower spillway elevation. It is difficult to predict if this sediment flush would happen all at once or over time, but in all likelihood there would be an adverse impact to downstream reaches. It would be best to lower the dam in small increments over time in such a way as to minimize the potential for a large-scale loss of settled sediment downstream. The lower spillway crest will also more easily facilitate large woody debris passage during high flow times which may be an adverse impact for downstream reaches as compared to the Baseline Condition.

NATURAL RESOURCES

During the 10-percent-annual-probability flood, the hydraulic modeling results for Alternative 1 indicate that the Horlick dam tailwater elevation is approximately 2.5 feet below the altered spillway crest (626.6 feet above NGVD 29). During the one-percent-annual-probability flood, the hydraulic modeling results indicate that the Horlick dam tailwater elevation is approximately 0.4 feet above the spillway crest. Thus, under this alternative the dam appears to be a barrier to sea lamprey movement during floods up to, and including, the 10-percent-probability flood, but no longer a barrier at the one-percent-annual probability flood or larger floods.

Based on the fish burst speeds listed in Table V-B, northern pike and Chinook salmon could pass the modified Horlick dam spillway for the modeled one- and two-percent-annual-probability floods, while smallmouth bass most likely could not get past the dam spillway. Based on the leaping ability of Chinook salmon and the modified

Horlick dam spillway configuration of Alternative 1, Chinook should also be able to jump the modified dam for the 50-percent-annual-probability (2-year recurrence interval) flood and any larger event. As the Chinook salmon is considered an aquatic invasive fish species, under Alternative 1, the dam would be deemed an incomplete barrier based on the WDNR Fish Passage Guidance. A summary of fish passage issues for the baseline and all alternatives is included in Table V-C.

SOCIAL

Alternative 1 does leave a portion of the dam spillway in place, thus the cascading nature of the flows is maintained to a smaller degree. Therefore, the aesthetics are not changed dramatically at the dam. Upstream impoundment area changes would be expected to occur as discussed previously.

Boating and paddling safety issues are still a concern for this alternative as a portion of the dam will remain in place and the drop between the impoundment and the downstream reach will still occur. Thus the safety concerns that were included in the Baseline Condition still exist, but perhaps to a smaller degree with 3.3 feet less of dam height. The original hydraulic height of the dam is approximately 12 feet, and Alternative 1 would have a hydraulic height of approximately nine feet, which is still significant from the perspective of safety of paddlers and fishers in the vicinity of the dam.

Implementation of Alternative 1 would alter recreational opportunities in the dam and impoundment area in numerous ways. There would be opportunities for new riparian trails and passive recreation as the impoundment area would be reduced. Passive recreation would ultimately be dependent on ownership status for the exposed land. Small watercraft use would still be viable, but on a much smaller impoundment area. Fishing would also be somewhat altered in the smaller impoundment, and under high flow conditions the dam may no longer be a full barrier to fish passage and fish normally stopped at the dam may now move farther upstream. This would be considered a positive from a fishery perspective, but possibly a negative for salmon fishing just downstream of the dam. Alternative 1 may affect watercraft access at River Bend Nature Center, but should not adversely affect the access at Horlick Park.

Map V-D includes a comparison of the approximate Baseline Condition for the impoundment as represented on the 2010 SEWRPC digital color orthophotograph, and the estimated extent of the River during normal flow conditions with Alternative 1 implemented. Also shown on Map V-D are several field-surveyed cross sections along the impoundment for comparison purposes between the existing impoundment and estimated normal water surface elevations under Alternative 1. The comparison indicates that the aesthetics of the former impoundment area will change under Alternative 1 with a more riverine look to the corridor between the River Bend Nature Center and STH 31.

With the lowered and reduced extent of the area impounded under Alternative 1, land ownership in this area would be affected. The nine properties highlighted in yellow on Map V-B would gain some dry land with Alternative 1, which would most likely be considered a positive effect. However, the majority of the private landowners between the dam and STH 31, would most likely would no longer have their properties abut the Root River under normal flow conditions. This effect would be most pronounced in the immediate impoundment area, and less so upstream where the River is more confined. A final determination of changes to Horlick impoundment property boundaries would require a review of the individual deed language.

COST

A systems planning-level cost estimate for Alternative 1 was completed in 2013 dollars. Construction cost information was obtained from R.S. Means Heavy Construction Cost Data.[85] Components included in the preliminary cost estimate for Alternative 1 include concrete removal, provision of a slide gate in the existing stop

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[85] *R.S. Means Company, Inc.,* RSMeans Heavy Construction Cost Data, *23rd Annual Edition, 2009.*

log area to enable drawdown of the impoundment, seeding of the impoundment area, and final finishing to elevation 626.6 feet above NGVD 29. It was assumed that seeding would only be required in the bays of the existing impoundment as depicted in Map V-C. Base costs were increased by 35-percent to account for engineering, administration, and contingencies. Based on these assumptions, the systems-level present worth cost estimate, including capital cost and operation and maintenance is $411,000. While a significant effort has been made under this system-plan to collect field data and to characterize the anticipated costs associated with this alternative, at the systems-planning level there are many uncertainties in estimating costs relative to alterations of existing dams. Those uncertainties are reduced and estimated costs are refined after an alternative is selected for implementation and preliminary engineering and final design are conducted; however, it should be noted that 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.

Under Alternative 1 a portion of the dam structure is retained, thus ongoing maintenance costs will also be incurred for this conceptual alternative. Maintenance costs assumed include debris passage, inspection every 10 years, the development of an emergency action plan, an operation and maintenance plan, and minor bank repairs. A summary of all Alternative 1 costs are included in Table V-D.

The above preliminary cost estimate does not include dredging of sediment from the Horlick impoundment. It was assumed the Alternative 1 dam lowering would be done in small increments over time or in such a way as to minimize the potential for a large-scale loss of settled sediment downstream. If dredging were required, it was calculated that approximately 72,300 cubic yards (CY) would need to be removed above elevation 620.0 feet above NGVD 29 for an Alternative 1 pilot channel. The elevation of 620.0 feet above NGVD 29 was chosen as that is the elevation of the observed natural shelf upstream of the Horlick dam. With the above assumptions, the preliminary cost estimate in 2013 dollars to dredge the upstream impoundment ranges from $1.5 to $3.6 million. The estimated cost range of sediment removal is only provided for information because different approaches to minimizing sediment release downstream of the dam site are recommended for all alternatives.

Alternative that Modifies the Dam to Enable Fish Passage under Low and High Flow Conditions

ALTERNATIVE 2—MODIFY CURRENT FISHWAY IN ADDITION TO ALTERNATIVE 1 CHANGES

To provide full fish passage at the Horlick dam, this alternative examines how the current fishway could be modified to allow fish passage during base flow conditions. By definition, the dam would be an incomplete barrier. Alternative 2 includes the modifications of Alternative 1 for providing additional spillway capacity, as it was envisioned that the modified fishway gate would be closed during flood times (see Figure V-C). As was noted previously, the dam configuration under Alternative 1 does not present a barrier to aquatic invasive species passage during the one-percent-annual-probability (100-year recurrence interval) flood, according to the criterion in the January 1, 2014, WDNR fish passage guidance. The dam configuration under Alternative 1 would be considered to present a barrier to sea lamprey passage during a 10-percent-probability flood. Because of the provision of a fishway, that might no longer be the case under Alternative 2. If this alternative were considered for implementation, the fishway design would require close coordination with regulatory agencies, who should be involved at the start of the process.

The gated fishway evaluated under this alternative would be a stair-step structure six feet wide with 10 one-foot high drops, spaced approximately 16 feet apart. The overall fishway length would be approximately 160 feet. The current fishway is approximately 100 feet long, so under this alternative, the fishway would be extended and its alignment modified as indicated on Figure V-C. The upstream elevation for the fishway sill at the gated structure would be 625.0 feet above NGVD 29, which would be 1.6 feet below the dam spillway crest elevation of 626.6 feet above NGVD 29. This would allow base flows to be conveyed through the fishway, bypassing the spillway. This configuration would require blasting through approximately four feet of rock along most of the existing fishway alignment, and then creating the lower 60 feet of fishway using concrete and large rocks.

Surface Water and Groundwater Quantity Considerations

The hydraulic model results for flood flows for Alternative 2 are the same as for Alternative 1, as it was assumed the fishway gate would be closed during high flow times to protect the structure. An evaluation of normal or base flow conditions was done for Alternative 2 to evaluate adequate fish passage conditions for smallmouth bass. The smaller flows in Table V-A were applied to evaluate velocities and depths over the fishway steps. For the 90-percent-exceedence flow[86] (10 cfs) the velocity over the steps is approximately 2.6 fps with a water depth of approximately eight inches. The 90-percent-exceedence flow would not pass over the main spillway, while for all larger flows the main dam spillway is utilized along with the Alternative 2 fishway. For the 50-percent-exceedence flow (56 cfs) the velocity over the steps is approximately 4.2 fps at a depth of 1.7 feet. For the March-June maximum mean daily flow (1,000 cfs) which would be split between the spillway and the fishway, the depth over the steps is 3.3 feet with a velocity of 5.8 fps.

Water Quality

The reduction in impoundment area and upstream impact of the dam for water quality would be the same as Alternative 1 during for floods. A slight reduction in impoundment area from that estimated under Alternative 1 would be expected under baseflow conditions as the controlling elevation (the elevation of the spillway crest under Alternative 1, but the elevation of the sill at the upstream end of the fishway under this alternative) has been lowered 1.6 feet. As is the case for all of the other alternatives, under this alternative it is envisioned that the dam would be lowered in small increments over time in such a way as to minimize the potential for a large-scale loss of settled sediment downstream, thus, dredging of accumulated sediment in the impoundment is not called for. Shallow groundwater effects would also essentially be the same as Alternative 1.

Natural Resources

Based on the fish burst speeds listed in Table V-B, all three fish species could pass the modified fishway for the base flow conditions of 10 to 1,000 cfs. The shallower overtopping depth for the 10 cfs event may be a concern, but the velocities are all below or within listed burst speeds.

Social

Aesthetic changes to the dam and impoundment are similar to Alternative 1, with the only exception being the fishway protruding into the Root River. Under extremely low flow conditions (10 cfs) flow may only be through the fishway, with a dry downstream face at the main dam spillway.

Safety considerations are similar to Alternative 1, with the added complication of the fishway structure. The fishway structure may be an attraction to fisherman as well as children, and may pose a slip/trip/fall hazard if walked along.

As would be the case for Alternative 1, implementation of Alternative 2 could produce opportunities for new riparian trails and passive recreation, depending on the ownership status for the exposed land along the impoundment. Recreational opportunities under Alternative 2 would be changed from those under Alternative 1 by the ability of fish to bypass the dam during a larger range of flow conditions. The impoundment size reduction would be very similar to Alternative 1, thus the use of small watercraft would still be viable on the smaller impoundment. Fishing would change dramatically as fish would no longer be completely stopped at the downstream side of the dam, and they could travel upstream along the mainstem and tributaries. Opening up additional habitat to the native and sport fishery would be considered positive.

Private property ownership changes would be very similar under Alternatives 1 and 2, with a slightly smaller impoundment footprint due to the lower controlling elevation at the Alternative 2 fishway.

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[86]*This is the Root River flow that would occur 10 percent or less of the time (90 percent of the flows exceed this value), based on long-term streamflow gaging by the USGS.*

COST

A preliminary cost estimate for Alternative 2 was completed in 2013 dollars. Components included in the preliminary cost estimate for Alternative 2 include the features called for under Alternative 1 plus creation of the gated fishway. The base cost was increased by 35 percent to account for engineering, administration, and contingencies. Based on these assumptions, the systems-level present worth cost estimate, including capital cost and operation and maintenance is $555,000. While a significant effort has been made under this system-plan to collect field data and to characterize the anticipated costs associated with this alternative, at the systems-planning level there are many uncertainties in estimating costs relative to alterations of existing dams. Those uncertainties are reduced and estimated costs are refined after an alternative is selected for implementation and preliminary engineering and final design are conducted; however, it should be noted that 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.

Under Alternative 2 a portion of the dam structure is retained in addition to enhancement of the fishway, thus ongoing maintenance costs will also be incurred for this conceptual alternative. Maintenance costs assumed include debris passage, inspection every 10 years, the development of an emergency action plan, an operation and maintenance plan, and minor bank repairs. A summary of all Alternative 2 costs is included in Table V-D.

The above preliminary cost estimate does not include dredging of sediment from the Horlick impoundment. As noted above, different approaches to minimizing sediment release downstream of the dam site are called for under this alternative.

Alternatives that Modify the Dam to Enhance Spillway Capacity

ALTERNATIVE 3—LENGTHEN CURRENT DAM SPILLWAY AND RAISE ABUTMENTS FOR ONE-PERCENT-ANNUAL-PROBABILITY (100-YEAR) FLOOD CAPACITY

SURFACE WATER AND GROUNDWATER QUANTITY CONSIDERATIONS

This alternative modifies the dam to safely pass the one-percent-annual-probability (100-year recurrence interval) flood by lengthening the spillway crest and raising the top of both abutments.[87] This alternative maintains the spillway crest at elevation 629.9 feet above NGVD 29 and lengthens the crest by approximately 20 feet, utilizing the old fishway area, to a total crest length of 140 feet. Both the left and right abutments would be rebuilt to a top elevation of 636.0 feet above NGVD 29, providing approximately 1.4 feet of freeboard to the tops of the abutments based on the maximum one-percent-annual-probability flood elevation. Also included in this alternative is raising Old Mill Drive to elevation 640.0 feet above NGVD 29 which is described later in this section. These changes would enable safe conveyance of the 0.2-percent-annual-probability flood within the dam spillway (see Figure V-D).

Modifications associated with Alternative 3 would minimally alter both the flood and normal flow profiles between the dam and STH 31 in comparison to the Baseline Condition. The 0.2- and one-percent-annual-probability (500-year and 100-year recurrence interval, respectively) flood stage elevations would be lowered approximately 0.6 foot at the dam crest relative to the corresponding flood elevations under the Baseline Condition. The one- and 0.2-percent-annual-probability flood profiles under Alternative 3 are essentially the same as under the Baseline Condition in the vicinity of STH 31. Dam tailwater elevations associated with this alternative would remain the same as under the Baseline Condition.

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[87]*The possibility of maintaining the Horlick dam spillway crest at its current elevation and raising the dam structures on either side of the spillway was raised during the August 28, 2013, public meeting to review alternatives relative to the dam. In a September 3, 2013, electronic mail message to the SEWRPC staff, Julie Anderson, Racine County Public Works and Development Services Director, asked on behalf of County Executive James Ladwig that such an additional alternative be considered.*

The hydraulic model water surface elevation just downstream of the dam is approximately at the top of the existing spillway crest (629.9 feet above NGVD 29) for the 0.2-percent-annual-probability flood. The 0.2-percent-annual-probability velocity at the dam spillway crest is approximately 12.1 feet per second (fps). The one-percent-annual-probability flood tailwater elevation is approximately three feet below the existing spillway crest, with a spillway crest velocity of approximately 9.7 fps. The two-percent-annual-probability (50-year recurrence interval) flood tailwater elevation is approximately four feet below the existing spillway crest, with a spillway crest velocity of approximately 9.0 fps.

With the same dam crest elevation as under the Baseline Condition, conditions under Alternative 3 during normal flow periods would be almost identical to those for the Baseline. The impoundment size and width would be the same, and the minimal depth over the spillway during normal flow times would still be an impediment to downstream fish passage.

With the impoundment area maintained during normal flow times, no change from the Baseline Condition would be expected for shallow groundwater levels or for the shallow wells depicted in Map V-A.

WATER QUALITY

The modifications to the dam under Alternative 3 maintain the upstream impoundment, thus, there should be no change in water quality as compared to the Baseline Condition. It is very likely that the accumulated sediment in the impoundment area would not be flushed downstream with this alternative, and that would be considered positive. The maintenance of the spillway crest at elevation 629.9 feet above NGVD 29 would still be a barrier to large woody debris passage downstream as it is under the Baseline Condition.

NATURAL RESOURCES

During the 10-percent-annual-probability flood, the hydraulic modeling results indicate that under Alternative 3 the tailwater elevation would be approximately six feet below the spillway crest. During the one-percent-annual-probability flood, the hydraulic modeling results indicate that the tailwater elevation would be approximately three feet below the spillway crest. Thus, under Alternative 3, the dam would appear to be a barrier to sea lamprey movement during floods up to, and including, the 10-percent-probability flood and may still be a barrier at the one-percent-annual probability flood. It should be noted that the tailwater elevation is approximately at the top of the existing spillway crest (629.9 feet above NGVD 29) for the 0.2-percent-annual-probability (500-year) flood, meaning that the dam is no longer a barrier for invasive aquatic species for this extreme flood.

The modifications included under Alternative 3 utilize a portion of the existing fishway as part of the spillway. To provide an adequate hydraulic transition for this condition, the conceptual design and associated cost estimate assume removal of a top layer of the rock ledge at the former fishway location. At the systems planning level, this is considered to be an adequate provision for hydraulic purposes and to reduce the tailwater elevation in the vicinity of the former fishway in an effort to avoid fish passage.

Based on the fish burst speeds listed in Table V-B, northern pike and Chinook salmon could pass the lengthened Horlick dam spillway during the modeled 0.2-percent-annual-probability flood, while smallmouth bass most likely could not get past the dam spillway. Based on the leaping ability of Chinook salmon and the lengthened Horlick dam spillway configuration under Alternative 3, Chinook should also be able to jump the modified dam for the two-percent-annual-probability flood and any larger event. As the Chinook salmon is considered an aquatic invasive fish species, under Alternative 3, the dam would be deemed an incomplete barrier based on the WDNR Fish Passage Guidance. A summary of fish passage issues for the baseline and all alternatives is included in Table V-C.

SOCIAL

Under Alternative 3 the spillway crest would be lengthened and the crest shape would be maintained. Thus, the cascading nature of the flows is maintained as compared to the Baseline Condition, and the aesthetics are not changed appreciably at the dam. The upstream impoundment area will not change as described previously.

Boating and paddling safety issues are still a concern for this alternative as under the Baseline Condition. The original hydraulic height of the dam is maintained, so under Alternative 3 the dam would also have a hydraulic height of 12 feet, which is significant from the perspective of safety of paddlers and fishers in the vicinity of the dam.

Alternative 3 would maintain the Baseline Condition recreational opportunities at the dam and impoundment area. There would be no opportunity for new riparian trails and passive recreation as no lowering of the impoundment would occur. Under all but the most extreme floods, fish migration upstream would be continue to be stopped at the dam under the Alternative 3.

With the impoundment area maintained under Alternative 3, additional unsubmerged land would not be created, and land ownership in this area would not be an issue (see Map V-B).

COST

A systems planning-level cost estimate for Alternative 3 was completed in 2013 dollars. Construction cost information was obtained from R.S. Means Heavy Construction Cost Data.[88] Components included in the preliminary cost estimate for Alternative 3 include abutment concrete removal, concrete construction, provision of a slide gate in the existing stop log area to enable drawdown of the impoundment, and road raise and reconstruction. Base costs were increased by 35-percent to account for engineering, administration, and contingencies. Based on these assumptions, the systems-level present worth cost estimate, including capital cost and operation and maintenance is $998,000. While a significant effort has been made under this system plan to collect field data and to characterize the anticipated costs associated with this alternative, at the systems-planning level there are many uncertainties in estimating costs relative to alterations of existing dams. Those uncertainties are reduced and estimated costs are refined after an alternative is selected for implementation and preliminary engineering and final design are conducted; however, it should be noted that 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.

Under Alternative 3, the dam structure is retained, thus, ongoing maintenance costs would also be incurred for this conceptual alternative. Maintenance costs assumed include debris passage, inspection every 10 years, the development of an emergency action plan, an operation and maintenance plan, and minor corridor maintenance. A summary of all Alternative 3 costs are included in Table V-D.

The only vehicular access for 15 homes and three condominium buildings located west of the impoundment is along Old Mill Drive at STH 38. Based on the current Federal Emergency Management Agency Flood Insurance Study (FIS) for Racine County, the one- and 0.2-percent-annual-probability floods would be expected to overtop Old Mill Drive under current (Baseline) conditions. It is expected that those two floods would also overtop Old Mill Road to maximum depths of 0.4 to 2.6 feet, respectively, under Alternative 3 conditions. Under the other conceptual alternatives evaluated for the Horlick dam under this plan, the one- and 0.2-percent-annual-probability flood profiles would be reduced sufficiently to avoid overtopping of Old Mill Drive. Thus, an ancillary benefit of implementing any of those alternatives would be improvement of access to the buildings along Old Mill Drive during large floods. To provide emergency service access to Old Mill Drive during large floods under either current conditions, or Alternative 3 conditions, consideration should be given to raising the grade of the Drive. The above preliminary cost estimate includes raising Old Mill Drive to 640.0 feet above NGVD 29 to eliminate roadway overtopping during the one- and 0.2-percent-annual-probability floods. The cost estimate assumes the road would require a maximum rise of 4 feet and the total length of road raise and new roadway pavement would be approximately 800 feet. A new longer culvert would also be required in this road section to serve a small tributary area to the immediate west of the Drive.

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[88] *R.S. Means Company, Inc.,* RSMeans Heavy Construction Cost Data, *23rd Annual Edition, 2009.*

It should also be noted that the hotel immediately west of the dam embankment is in close proximity to the right dam abutment. If the modifications included in Alternative 3 are selected for further review, the ability to raise and modify the right abutment and not adversely affect the hotel would need to be evaluated in greater detail.

Alternatives for Partial and Full Removal of the Dam

Two dam removal options were evaluated, one that retained a portion of each end of the dam to protect the hotel and park abutments (Alternative 4),[89] and the other being full removal of the dam structure (Alternative 5). Both of these alternatives set the controlling elevation to the top of the existing channel bottom at 620.0 feet above NGVD 29.[90] No additional survey of streambed elevations was made downstream of the existing Horlick dam from what was included in the original CAPR 152 HEC-2 model. Thus the exact slope of the Root River bottom between the dam crest and the model cross section 25 feet downstream is not known and the ability of fish to swim upriver is only evaluated based on tailwater heights and crest velocities at the former dam location.

ALTERNATIVE 4—COMPLETE NOTCH OF CURRENT DAM SPILLWAY

Alternative 4 includes a two level notch to both contain the one-percent-annual-probability (100-year recurrence interval) flood within the original dam spillway, and allow fish passage at the natural channel invert elevation of 620.0 feet above NGVD 29 (see Figure V-E). The shape of the spillway opening is a Cipolletti notch, with the sloping portion of the notch openings designed to offset the contraction of the water around the structure. This design would include approximately 54 feet of the original spillway at elevation 629.9 feet above NGVD 29, 50 feet of crest length at elevation 621.9 feet above NGVD 29, and a 6-foot opening at the Root River bottom of 620.0 feet above NGVD 29. The notch would all be to the right of the stoplog structure. The modifications included under Alternative 4 provide approximately 2.6 feet of freeboard to the tops of the existing left and right concrete abutments for the maximum one-percent-annual-probability flood elevation. The modifications included in Alternative 4 also just contain the 0.2-percent-annual-probability flood within the dam spillway. Under this design the remaining dam structure would no longer serve as a control for base flows, and it would have a significantly reduced effect at flood flows as compared to the Baseline Condition or Alternatives 1, 2 and 3. The tailwater elevations would remain the same as under the Baseline Condition.

SURFACE WATER AND GROUNDWATER QUANTITY CONSIDERATIONS

Based on hydraulic model results, the tailwater elevation for Alternative 4 is approximately at the top of the natural ledge (620.0 feet above NGVD 29) for the March-June maximum mean daily flow of 1,000 cfs. This flow is between the 99-percent-annual-probability (one-year recurrence interval) and 50-percent-annual probability (two-year recurrence interval) floods. This flow would pass over both the low notch at 620.0 and mid-level notch at 621.9 feet above NGVD 29. The mean velocity at the Alternative 4 opening for the March-June mean daily flow is approximately 5.6 fps. Only the 90 percent exceedence flow of 10 cfs is wholly contained within the six-foot-wide low opening, with a velocity of approximately 2.6 fps. A review of tailwater elevations indicates that the 10-percent exceedence flow (410 cfs) has a tailwater elevation approximately 1.5 feet below the crest at elevation 620.0 feet above NGVD 29, which meets the USFWS criterion for inhibiting passage of sea lamprey.

Based on hydraulic model results the one-percent-annual-probability (100-year recurrence interval) water surface elevation at the dam under Alternative 4 is approximately four feet lower than the Baseline Condition and 0.6 foot lower than under Alternative 1. The one-percent-annual-probability flood effects of Alternative 4 are not as pronounced upstream at STH 31, with water surface elevations upstream of the bridge for Alternative 4 being only 0.3 foot lower than the Baseline Condition and essentially the same as Alternative 1.

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[89]*Under this alternative, the remaining structure may still be considered a dam by WDNR for regulatory purposes.*

[90]*This was determined to be the approximate top of the shelf immediately upstream of the Horlick dam, as well.*

With this partial removal of a structural barrier on the Root River, the impoundment area will essentially be eliminated under low flow conditions. Based on hydraulic modeling results, it is concluded that the natural shelf at elevation 620.0 feet above NGVD 29 that extends upstream of the dam for approximately 1,000 feet will control hydraulic profiles for smaller flows. Along the entire corridor between the Horlick dam location and STH 31, flow would be expected to be within the banks for more floods, allowing overbank vegetation to establish and improve terrestrial habitat.

Elimination of the impoundment during normal flow times would most likely lower shallow groundwater levels in the immediate area. This may adversely affect the still active groundwater wells developed in the shallow aquifer previously discussed and depicted in Map V-A.

WATER QUALITY

With the elimination of the impoundment under Alternative 4, water quality should improve for all the constituents of concern (dissolved oxygen, phosphorus, and temperature). Normal flows will no longer be impounded and the conversion to a free-flowing river should result in better aeration of the water in the formerly-impounded reach upstream from the dam site. This should help improve water quality during larger floods as well, with filtering through and deposition of sediments in overbank vegetation now a viable option to remove and store sediments and contaminants during higher overbank flows.

Under Alternative 4 the notched configuration may provide the added benefit of helping to prevent settled sediment from being transported downstream and to maintain a vegetated flood bench. Nevertheless, it is very likely that some of the settled sediment may be flushed out of the impoundment area for this alternative with the elimination of a complete barrier. It is difficult to predict if this sediment flush would happen all at once or over time, but in all likelihood in the absence of mitigation would be an adverse impact to downstream reaches. It would be best to lower the dam in small increments over time in such a way as to minimize the potential for a large-scale loss of settled sediment downstream. Thus, dredging of sediment accumulated in the impoundment is not called for under this alternative. The two level spillway crest with a large section set at elevation 621.9 feet above NGVD 29 will also more easily facilitate large woody debris passage during high flow times, which may be an adverse impact for downstream reaches as compared to the Baseline Condition.

NATURAL RESOURCES

During the 10-percent-annual-probability flood, the hydraulic modeling results for the dam under Alternative 4 indicate that the Horlick dam tailwater elevation is approximately 4.0 feet above the low sill elevation of 620.0 feet above NGVD 29. Thus, the structure configuration under Alternative 4 would not be a barrier to sea lamprey or round goby movements. As was indicated earlier, the tailwater elevation is approximately at the top of the natural shelf (620.0 feet above NGVD 29) for the March-June maximum mean daily flow of 1,000 cfs,[91] indicating that the dam would most likely no longer be a barrier for invasive aquatic species for anything larger than this flow rate. Using the USFWS preliminary 1.5 foot criterion for sea lamprey passage, under Alternative 4 the structure would no longer be a barrier to sea lamprey for any events larger than the 10-percent-exceedence flow rate of 410 cfs.

Using the fish burst speeds listed in Table V-B, all three fish species could pass the modified Horlick dam spillway for the March-June maximum mean daily flow of 1,000 cfs when the tailwater elevation would be above the spillway crest. To allow sufficient depth downstream for Chinook salmon to jump, it was assumed that a minimum of two feet of depth was required, which translates to the 50-percent exceedence flow rate of 56 cfs under Alternative 4. The 90 percent exceedence flow of 10 cfs is wholly contained within the six-foot-wide low opening, with a velocity of approximately 2.6 fps, which should be passable for all three fish species.

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[91]*This flow is between the 99-percent-annual-probability (one-year recurrence interval) and 50-percent-annual probability (two-year recurrence interval) floods.*

Unfortunately, the streambed configuration immediately downstream of the dam is not fully known, thus depths at this low flow rate may minimize fish passage. In other words, this area downstream may be too wide under baseflow conditions to provide adequate water depths for fish passage. This area may need to be reconstructed to promote fish passage for Alternative 4. Under Alternative 4, the dam would be deemed an incomplete barrier based on the WDNR Fish Passage Guidance. A summary of fish passage issues for all alternatives is set forth in Table V-C.

SOCIAL

Alternative 4 does leave a portion of the dam structure in place, thus the cascading nature of the flows is maintained for larger floods. For smaller floods, the flows will utilize the Root River channel bottom only. Thus, the aesthetics of the dam will change significantly for Alternative 4. The upstream impoundment area will also be eliminated and the corridor between the dam and STH 31 will have a more riverine look.

Safety issues are a relatively small concern for this alternative as a portion of the dam structure will remain in place but the abrupt drop between the impoundment and the downstream reach will be eliminated. The original hydraulic height of the dam is approximately 12 feet and, under Alternative 4, there would be a naturally sloping five-foot streambed drop between the dam location and STH 38 downstream, which is a significantly-reduced safety hazard compared to Alternatives No. 1, 2 and 3.

Implementation of Alternative 4 would significantly alter recreational opportunities at the dam and impoundment area. There would be opportunities for new riparian trails and passive recreation as the impoundment has been eliminated. Passive recreation would ultimately be dependent on ownership status for the exposed land. With the elimination of the impoundment, the ability to float small watercraft would be dependent on flow conditions. Fishing would become riverine exclusive and under most flow conditions the structure configuration under Alternative 4 would no longer present a full barrier to fish passage and fish normally stopped at the dam might now move farther upstream. Fishing would change dramatically as fish would no longer be completely stopped at the downstream side of the dam, and they could travel upstream along the mainstem and tributaries. Opening up additional habitat to the native and sport fishery would be considered positive. This would be considered a positive from a general fishery perspective and the ecological integrity of the entire Root River system,[92] but possibly a negative for salmon fishing just downstream of the Horlick dam where the dam would no longer serves as a barrier that concentrates the fish. Under Alternative 4 recreational boat access would also be adversely affected at River Bend Nature Center and Horlick Park as under most flow conditions there would be no impoundment and the current launch locations would be farther from the Root River.

With the elimination of the impoundment area, land ownership in this area would be affected. The nine properties highlighted in yellow on Map V-B would gain some dry land under Alternative 4, which would most likely be considered a positive effect. But for the majority of the private landowners between the dam and STH 31, their properties would most likely no longer be immediately adjacent to the Root River. This effect would be most pronounced in the impoundment area nearest the former dam site, and less so upstream where the Root River is narrower. A final determination of changes to Horlick impoundment property boundaries would require a review of the individual deed language.

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[92]*Victor J. Santucci, Jr. et al, "Effects of Multiple Low-Head Dams on Fish, Macroinvertebrates, Habitat, and Water Quality in the Fox River, Illinois,"* North American Journal of Fisheries Management, *Vol. 25, 2005* and *Thomas M. Slawski et al, "Effects of Tributary Spatial Position, Urbanization, and Multiple Low-Head Dams on Warmwater Fish Community Structure in a Midwestern Stream,"* North American Journal of Fisheries Management, *Vol. 28, 2008.*

Cost

A preliminary cost estimate for Alternative 4 was completed in 2013 dollars. Sources of cost information included RSMeans Heavy Construction Cost Data and summary dam removal costs received from WDNR. Components included in the preliminary cost estimate for Alternative 4 include concrete removal, removal of the old dam, seeding of impoundment area, and final finishing to elevation 620.0 feet above NGVD 29. It was assumed that seeding would only be required in the bays of the existing impoundment as depicted in Map V-C. The base cost was increased by 35 percent to account for engineering, administration, and contingencies. Based on these assumptions, the systems-level present worth cost estimate, including capital cost and operation and maintenance is $483,000. While a significant effort has been made under this system-plan to collect field data and to characterize the anticipated costs associated with this alternative, at the systems-planning level there are many uncertainties in estimating costs relative to alterations of existing dams. Those uncertainties are reduced and estimated costs are refined after an alternative is selected for implementation and preliminary engineering and final design are conducted; however, it should be noted that 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.

Under Alternative 4, a portion of the dam structure is retained, thus ongoing maintenance costs will be incurred for this conceptual alternative. Maintenance costs assumed include debris passage, inspection every 10 years, and minor bank repairs. A summary of all Alternative 4 costs are included in Table V-D.

The above preliminary cost estimate does not include dredging of sediment from the Horlick impoundment. As noted above, different approaches to minimizing sediment release downstream of the dam site are called for under this alternative.

Alternative 5—Full Removal of Dam

Alternative 5 calls for removal of the Horlick dam as depicted in Figure V-F. The left side walkway and portion of the spillway were retained as they are somewhat integral with the natural rock on that side of the Horlick dam. Under this alternative, the structure would be removed as a control for all flows. This means that the natural 1,000-foot shelf at elevation 620.0 feet above NGVD 29 would control the flow profiles upstream from the site of the former dam. The tailwater elevations would remain the same as the Baseline Condition.

Alternative 5 provides approximately four feet of freeboard to the tops of the remaining left and right concrete abutment sections of the Horlick dam based on the maximum 0.2-percent-annual-probability flood elevation. However, while unlikely, failure of one or both abutments under the Alternative 5 configuration would not be expected to create a significant uncontrolled release of water, since there would be no impoundment of water under this condition.

Surface Water and Groundwater Quantity Considerations

Based on hydraulic model results, the tailwater elevation for Alternative 5 is approximately at the top of the natural ledge (620.0 feet above NGVD 29) for the March-June maximum mean daily flow of 1,000 cfs. This flow is between the 99-percent-annual-probability (one-year) and 50-percent-annual probability (two-year recurrence interval) floods. The mean velocity for Alternative 5 for the March-June mean daily flow is approximately 6.8 fps. The 90 percent exceedence flow (10 cfs) is very shallow across the fully exposed natural ledge with a depth at the dam location of less than a tenth of a foot. A review of tailwater elevations indicates that the 10-percent exceedence flow (410 cfs) has a tailwater elevation approximately 1.5 feet below the natural ledge at elevation 620.0 feet above NGVD 29, which meets the USFWS criterion for inhibiting passage of sea lamprey.

Based on hydraulic model results the one-percent-annual-probability (100-year recurrence interval) water surface elevation at the dam for Alternative 5 is approximately eight feet lower than the Baseline Condition or four feet lower than Alternative 4. The one-percent-annual-probability flood effects of Alternative 5 are not as pronounced upstream at STH 31, with water surface elevations upstream of the bridge for Alternative 5 only 0.3 foot lower than the Baseline Condition and essentially the same as Alternatives 1 and 4.

With the full removal of a structural barrier on the Root River, the impoundment area will be eliminated. Based on hydraulic modeling, the natural shelf at elevation 620.0 feet above NGVD 29 that extends approximately 1,000 feet upstream of the dam location would control hydraulic profiles for all flows. Along the entire corridor between the Horlick dam location and STH 31, flow will be within the banks for more floods, allowing overbank vegetation to establish and improve terrestrial habitat.

Elimination of the impoundment during normal flow times would most likely lower shallow groundwater levels in the immediate area. This may adversely affect the still active groundwater wells developed in the shallow aquifer previously discussed and depicted in Map V-A.

WATER QUALITY

With the elimination of the impoundment, water quality should improve for all the constituents of concern (dissolved oxygen, phosphorus, temperature) for Alternative 5. Normal flows will no longer be impounded and should be better aerated by movement through the corridor in a more stream-like setting. This should improve water quality for larger floods as well, with filtering through and deposition of sediments in overbank vegetation now a viable option to remove and store sediments and contaminants during higher overbank flows. It is very likely that the Baseline Condition settled sediment may be flushed out of the impoundment area for this alternative with dam removal. It is difficult to predict if this sediment flush would happen all at once or over time, but in all likelihood in the absence of mitigation would be an adverse impact to downstream reaches. It would be best to lower the dam in small increments over time in such a way as to minimize the potential for a large-scale loss of settled sediment downstream. Thus, dredging of sediment accumulated in the impoundment is not called for under this alternative. Alternative 5 will also not impede large woody debris passage, which may be an adverse impact for downstream reaches as compared to the Baseline Condition. Hence, now the Root River will function like a natural river.

NATURAL RESOURCES

During the 10-percent-annual-probability flood, the hydraulic modeling results for the removal under Alternative 5 indicate that the tailwater elevation is approximately 4.0 feet above the low sill elevation of 620.0 feet above NGVD 29. Thus, the dam removed configuration under Alternative 5 would not be a barrier to sea lamprey or round goby movements. As was indicated earlier, the tailwater elevation is approximately at the top of the natural shelf (620.0 feet above NGVD 29) for the March-June maximum mean daily flow of 1,000 cfs,[93] indicating that the dam would most likely no longer be a barrier for invasive aquatic species for anything larger than this flow rate. Using the WDNR preliminary 1.5 foot criterion for sea lamprey passage, under Alternative 5 the structure would no longer be a barrier to sea lamprey for any events larger than the 10-percent-exceedence flow rate of 410 cfs.

Using the fish burst speeds listed in Table V-B, all three fish species could pass the former dam site for the tailwater-submerged March-June maximum mean daily flow of 1,000 cfs. To allow sufficient depth downstream for Chinook salmon to jump, it was assumed that a minimum of two feet of depth was required, which translates to the 50-percent exceedence flow rate of 56 cfs for Alternative 5. The 90 percent exceedence flow of 10 cfs has minimal depth at the controlling ledge as discussed previously, thus, the ledge may be impassible for all three fish species. A summary of fish passage issues for all alternatives is included in Table V-C.

SOCIAL

Alternative 5 removes the dam structure from the river corridor, thus the cascading nature of the flows is most likely no longer possible for even larger floods. For smaller floods, the flows will utilize the Root River channel bottom only for Alternative 5. Map V-D includes a comparison of the approximate Baseline Condition for the impoundment as represented on the 2010 SEWRPC digital color orthophotograph, and the estimated extent of the

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[93]*This flow is between the 99-percent-annual-probability (one-year recurrence interval) and 50-percent-annual probability (two-year recurrence interval) floods.*

River during normal flow conditions with Alternative 5 implemented. Also shown on Map V-D are several field-surveyed cross sections along the impoundment for comparison purposes between the existing impoundment and estimated normal water surface elevations under Alternative 5. The comparison indicates that the aesthetics of the former impoundment area will change significantly under Alternative 5 with a more riverine look to the corridor between the site of the former dam and STH 31.

Safety issues would be minimal for this alternative, as only the left side portion of the dam structure will remain in place. The abrupt drop between the impoundment and the downstream reach will be eliminated, improving safety at the dam. The original hydraulic height of the dam is approximately 12 feet and Alternative 5 has a naturally sloping five-foot hydraulic height between the dam location and STH 38 downstream, which would represent a significantly reduced safety hazard as well.

Implementation of Alternative 5 would significantly alter recreational opportunities at the dam and impoundment area. There would be opportunities for new riparian trails and passive recreation as the impoundment has been eliminated. Passive recreation would ultimately be dependent on ownership status for the exposed land. With the elimination of the impoundment, the ability to float small watercraft would be dependent on flow conditions. Fishing would become riverine exclusive and under all flow conditions the minimal structure configuration under Alternative 5 would no longer present a barrier to fish passage and fish and other aquatic life normally stopped at the dam might now move farther upstream and downstream as necessary. Fishing would change dramatically as fish would no longer be completely stopped at the downstream side of the dam, and they could travel upstream along the mainstem and tributaries. Opening up additional habitat to the native and sport fishery would be considered positive. This would be considered a positive from the perspective of the general fishery and the ecological integrity of the entire Root River system, but possibly a negative for salmon fishing just downstream of the Horlick dam where the dam would no longer serves as a barrier that concentrates the fish. Under Alternative 5 recreational boat access would also be adversely affected at River Bend Nature Center and Horlick Park as under most flow conditions there would be no impoundment and the current launch locations would be farther from the Root River.

With the elimination of the impoundment area, land ownership in this area would be affected. The nine properties highlighted in yellow on Map V-B would gain some dry land under Alternative 5, which would most likely be considered a positive effect, but the properties of the majority of the private landowners between the dam and STH 31 would most likely no longer be immediately adjacent to the Root River. This effect would be most pronounced in the impoundment area closest to the former dam site, and less so upstream where the Root River is more confined. A final determination of changes to Horlick impoundment property boundaries would require a review of the individual deed language.

COST

A preliminary cost estimate for Alternative 5 was completed in 2013 dollars. Sources of cost information included RSMeans Heavy Construction Cost Data and summary dam removal costs received from WDNR. Components included in the preliminary cost estimate for Alternative 5 include concrete removal, removal of the old dam, and seeding of impoundment area. It was assumed that seeding would only be required in the bays of the existing impoundment as depicted in Map V-C. A contingency of 35-percent was added to the base cost estimate to account for minor items, engineering, and permitting. Based on these assumptions, the systems-level present worth cost estimate, including capital cost and operation and maintenance is $551,000. While a significant effort has been made under this system-plan to collect field data and to characterize the anticipated costs associated with this alternative, at the systems-planning level there are many uncertainties in estimating costs relative to alterations of existing dams. Those uncertainties are reduced and estimated costs are refined after an alternative is selected for implementation and preliminary engineering and final design are conducted.

Under Alternative 5 almost all of the dam structure would be removed, thus structural maintenance requirements have essentially been eliminated. It was assumed that reseeding of portions of the former impoundment area would be required after structural removal. A summary of all Alternative 5 costs are included in Table V-D.

The above preliminary cost estimate does not include dredging of sediment from the Horlick impoundment. As noted above, different approaches to minimizing sediment release downstream of the dam site are called for under this alternative.

Comparison of Alternative Plans
A summary of all five conceptual alternatives for the major issues of concern is included in Table V-E.

Additional Work/Information Required
The decision regarding which of the Horlick dam alternatives is to be implemented ultimately rests with Racine County as the owner of the dam. There are numerous additional elements of information to be considered during the preliminary engineering phase for whichever alternative the County chooses to pursue. The informational needs listed below are not meant to be comprehensive, but are a good starting point for future analysis:

- Determination by WDNR of aquatic invasive species of concern.[94]
- Additional sampling of impoundment sediment for potential contamination.
- Evaluation of structural integrity of right dam abutment at Riverside Inn under Alternative 5, "Full Removal of Dam."
- Evaluation of structural issues related to lowering or notching the current Horlick dam structure.
- Investigation of the structural integrity of the rock in the fishway area.
- Determination of the prevalence of active shallow private wells in the impoundment area that would be affected by impoundment modifications.
- The exact nature of the natural 1,000-foot shelf—related to unknowns for impoundment area to predict sediment movement and riparian restoration potential.
- Collection of additional detailed survey data in the reach between the dam and STH 38 to determine if water depths and streambed slopes will allow fish and aquatic invasive species to migrate upstream.

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[94]*That determination would be made according to the criteria of the WDNR fish passage guidance.*

Chapter V

DEVELOPMENT OF TARGETS AND ALTERNATIVE MEASURES

TABLES

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Table V-C

HORLICK DAM ALTERNATIVE SUMMARY—FISH PASSAGE AND INVASIVE SPECIES

Alternative	Spillway Crest Elevation (feet above NGVD 29)	Tailwater Elevation Event at Crest (recurrence interval)	Chinook Passage Event (recurrence interval)	Invasive Species Passage Event[a] (recurrence interval)	Barrier to Invasive Species[b]
Baseline Condition	629.9	500-year	50-year	500-year	Incomplete
Alternative 1–Lower Crest for 100-Year Capacity	626.6	Between 50 and 100-year	2-year	50-year	Incomplete
Alternative 2[c]–Alt 1 with Fishway	626.6	Between 50 and 100-year	2-year	50-year	Incomplete
Alternative 3–Lengthen Spillway for 100-Year Capacity	629.9	500-year	50-year	500-year	Incomplete
Alternative 4–Full Notch of Dam for 500-Year Capacity	620.0	Between 1 and 2-year[d]	50 percent exceeds	10 percent exceeds	Incomplete
Alternative 5–Dam Removal	620.0	Between 1 and 2-year[d]	50 percent exceeds	10 percent exceeds	No

[a]*Species other than Chinook salmon.*

[b]*The January 2014 WDNR* Fish Passage Guidance *defines an incomplete barrier as: "A man made or natural structure which allows the migration of aquatic organisms upstream during events less than the 100 year event."*

[c]*Assumes fishway closed for larger flood events.*

[d]*This condition represents the March through June maximum mean daily flow of 1,000 cfs.*

Source: SEWRPC.

Table V-D

HORLICK DAM ALTERNATIVE SUMMARY—COSTS

Alternative	Capital Cost[a,b] (dollars)	Annual Operation and Maintenance (dollars)[c]	Total Present Worth Cost (dollars)
Alternative 1–Lower Crest for 100-Year Capacity	$370,000	$2,600	$411,000
Alternative 2–Alt 1 with Fishway	$510,000	$2,900	$555,000
Alternative 3–Lengthen Spillway for 100-Year Capacity	$960,000[d]	$2,400	$998,000
Alternative 4–Full Notch of Dam for 100-Year Capacity	$450,000	$2,100	$483,000
Alternative 5–Dam Removal	$540,000	$ 700	$551,000

[a]*Capital costs based upon year 2013 conditions. Engineering News-Record Construction Cost Index: 12,208.*

[b]*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.*

[c]*Based on an interest rate of 6 percent and a project life of 50 years.*

[d]*Capital cost includes $240,000 for raising Old Mill Drive.*

Source: SEWRPC.

PRELIMINARY DRAFT

Table V-E

HORLICK DAM ALTERNATIVE SUMMARY—MAJOR ISSUES OF CONCERN

Alternative	Flooding Upstream of Dam	Water Quality	Fish Passage and Overall Fish Community Improvement	Aquatic Invasive Species and VHS Upstream of Dam	Downstream Movement of Sediment in Impoundment	Safety	Recreation: Paddling	Recreation: New Riparian Recreational Opportunities[a]	Recreation: Fishing Upstream of Dam	Recreation: Recreational Salmon Fishing Immediately Downstream of Dam	Access to River by Riparian Land Owners[b]	Total Present Worth Costs (dollars)[c]
Baseline Condition[d] ...	0	0	0	0	0	0	0	0	0	0	0	N/A[e]
Alternative 1—Lower Crest for 100-Year Capacity	+	+	+	-	-	+	–	+	+	0	–	$411,000
Alternative 2—Alt 1 with Fishway...........	+	+	++	--	-	+	–	+	++	–	–	$555,000
Alternative 3—Lengthen Spillway for 100-Year Capacity	0	0	0	0	0	0	0	0	0	0	0	$998,000
Alternative 4—Full Notch of Dam for 100-Year Capacity..	++	++	++	---	--	++	– –	++	+++	– –	– –	$483,000
Alternative 5—Dam Removal	++	+++	+++	---	---	+++	– –	++	+++	– –	– –	$551,000
Basis for Evaluation....	Reduction/ removal of structure will lower upstream flood elevations	Reduction in impounded water should improve water quality	Elimination of structure in River or addition of fishway improves passage	Elimination of structure in River or addition of fishway increases likelihood of passage	Elimination of structure in River lowers or eliminates impoundment and exposes sediment	Reduction/ elimination of structure in River improves public safety	Loss of impound-ment area reduces consistent paddling water levels	New options within dewatered impoundment area for trails and passive recreation	Improved fish passage will improve fishing upstream	With addition of fishway or removal of dam, fish would no longer congregate on downstream side of dam	Reduction in water level removes direct access to River	N/A

[a]*The ability to realize enhanced recreational opportunities depends on ownership of lands exposed with a lower or eliminated impoundment.*

[b]*Based on property boundaries provided by Racine County.*

[c]*Based on an interest rate of 6 percent and a project life of 50 years.*

[d]*Alternatives are rated relative to the potential changes from the Baseline Condition which is designated neutrally as "0". Positive (+) or negative (–) signs indicate a more positive or negative effect on the issue of concern as compared to the Baseline Condition.*

[e]*Not applicable.*

Source: SEWRPC.

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A RESTORATION PLAN FOR THE ROOT RIVER WATERSHED

Chapter V

DEVELOPMENT OF TARGETS AND ALTERNATIVE MEASURES

FIGURES

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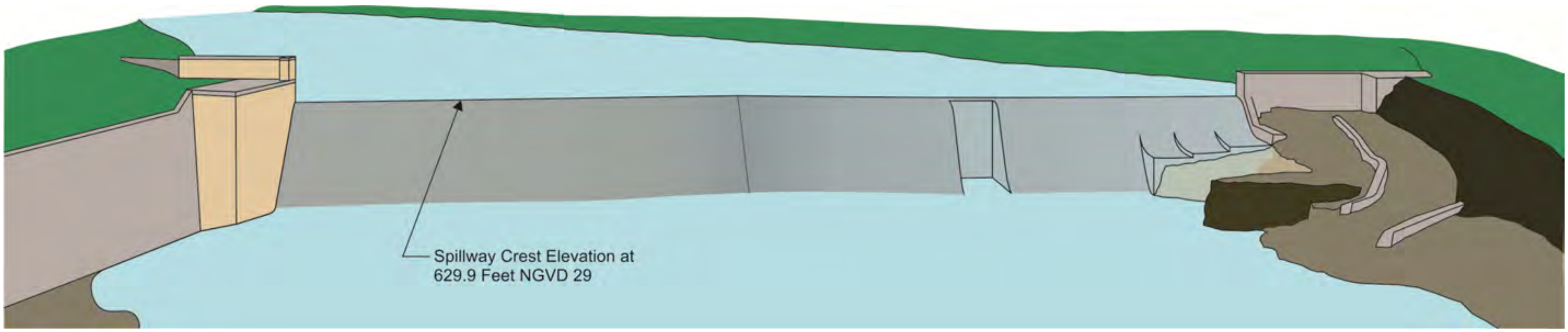
Figure V-A

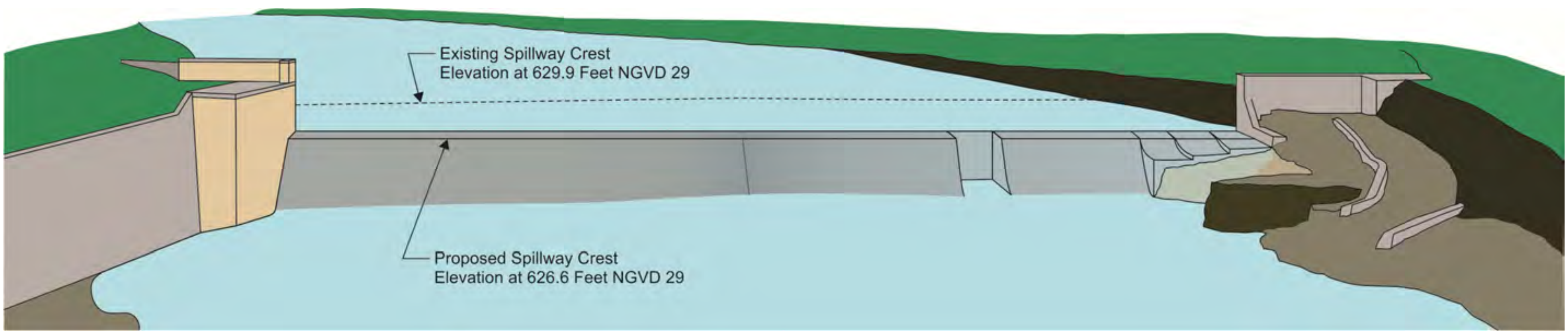
EXISTING CONDITIONS OF HORLICK DAM – LOOKING NORTH (UPSTREAM)



Source: SEWRPC.

Figure V-B

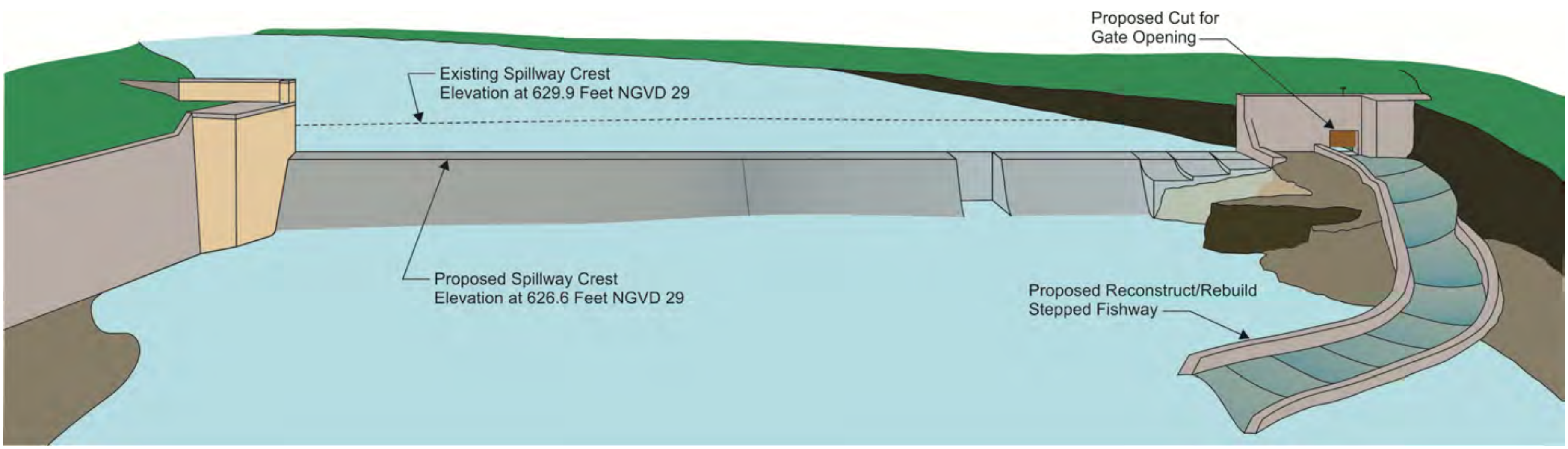
CONCEPTUAL ALTERNATIVE 1
ENHANCE SPILLWAY CAPACITY OF HORLICK DAM – LOOKING NORTH (UPSTREAM)



Source: SEWRPC.

Figure V-C

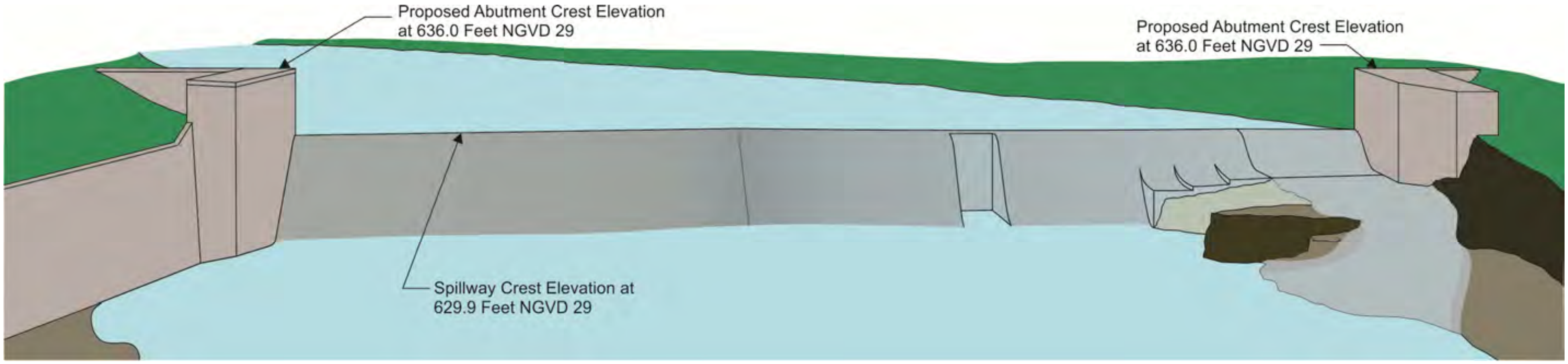
CONCEPTUAL ALTERNATIVE 2
ENHANCE SPILLWAY CAPACITY AND MODIFY FISHWAY OF HORLICK DAM – LOOKING NORTH (UPSTREAM)



Source: SEWRPC.

Figure V-D

CONCEPTUAL ALTERNATIVE 3
LENGTHEN HORLICK DAM SPILLWAY AND RAISE ABUTMENTS – LOOKING NORTH (UPSTREAM)

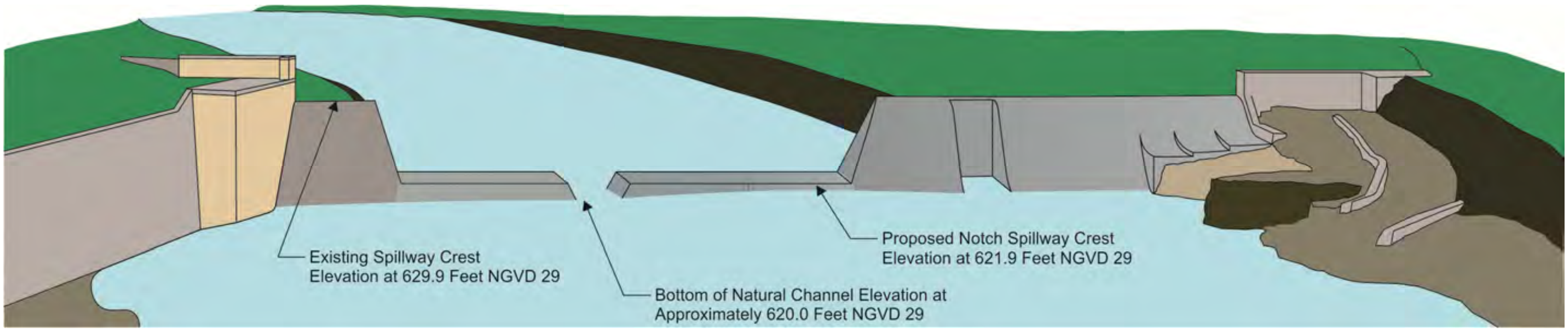


Source: SEWRPC.

PRELIMINARY DRAFT

Figure V-E

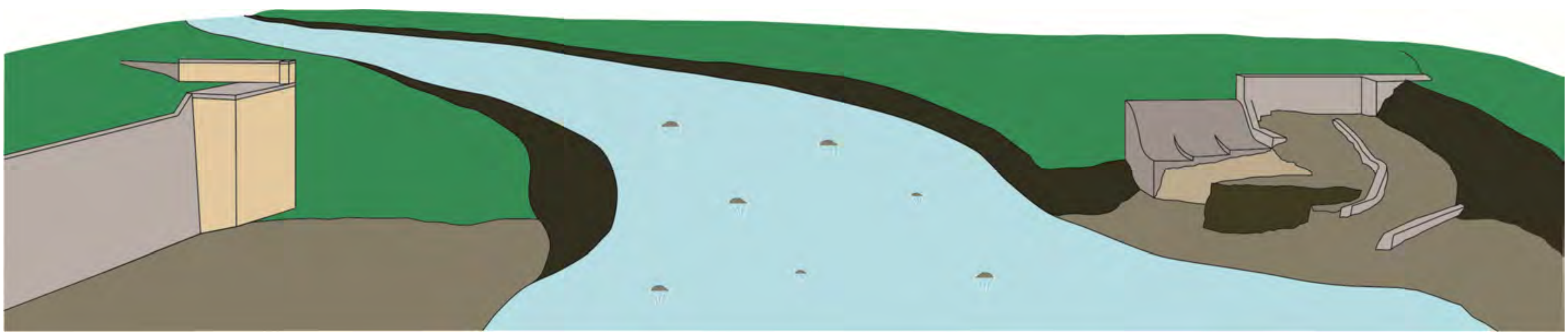
CONCEPTUAL ALTERNATIVE 4
COMPLETELY NOTCHED SPILLWAY OF HORLICK DAM – LOOKING NORTH (UPSTREAM)



Source: SEWRPC.

Figure V-F

CONCEPTUAL ALTERNATIVE 5
HORLICK DAM REMOVED – LOOKING NORTH (UPSTREAM)



Source: SEWRPC.

Chapter V

DEVELOPMENT OF TARGETS AND ALTERNATIVE MEASURES

MAPS

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Map V-D

CONCEPTUAL ALTERNATIVES: APPROXIMATE EXTENT OF FLOODPLAIN DURING BASEFLOW (50% EXCEEDENCE, 56 CFS)