

**TASK ORDER No. XX: Duck Lake Holistic Management Plan**  
**Pursuant to Agreement for Engineering Services**  
**Riley Purgatory Bluff Creek Watershed District and Barr Engineering Co.**  
**August 24, 2023**

This Task Order is issued pursuant to Section 1 of the above-cited engineering services agreement between the Riley Purgatory Bluff Creek Watershed District (RPBCWD) and BARR Engineering Company (Engineer) and incorporated as a part thereof.

1. Background

Duck Lake is a shallow, headwater lake that drains to Purgatory Creek and lies entirely within the boundaries of the City of Eden Prairie. The watershed area contributing to Duck Lake is 233 acres including the lake surface area of 41 acres. Duck Lake does not have any upstream lakes contributing flow. The flow from Duck Lake exits through a control structure into a storm sewer pipe that drains into Purgatory Creek. Most of the watershed underwent development from agricultural use to residential land use between the early-1960's and late-1980's.

The Duck Lake outlet structure was constructed in 1969 and consisted of a box weir structure upstream of a 15-inch CMP; the control elevation for the lake was 914.4. In 1979 the Department of Natural Resources denied an application to modify the structure. However, despite the denial, the outlet was modified sometime between 1979 and 2011 to remove the weir upstream of the outlet pipe and lower the control elevation to 913.45. In 2014 the city of Eden Prairie undertook the outlet replacement by surveying the elevation of the discharge pipe at the outlet and replacing it with a new discharge pipe at the same elevation (913.45). DNR staff indicated to RPBCWD that no DNR permit was applied for or issued to modify the Duck Lake outlet in 2014.

At the November 3, 2021, board meeting RPBCWD managers heard comments from several residents about the control elevation of Duck Lake and its potential impact on the ecology of the lake. Following the November 2021 board meeting Barr completed an environmental impact review (Barr, 2021) that consisted of reviewing the history of the lake outlet, the lake's water surface level, water quality, vegetation, and fisheries.

Findings were discussed with the city of Eden Prairie, RPBCWD, and DNR staff on October 11, 2022. The DNR confirmed that the DNR goal is to establish runout elevations for lakes, and since it has been in place for so long, the DNR cannot approve raising the outlet elevation back to the 1969 elevation (914.4) without a significant public engagement process and unanimous riparian owner support. The DNR mentioned they might be able to permit a revised outlet if the runout elevation was unchanged but would need additional technical information before advancing the discussion.

A Use Attainability Analysis (UAA) was completed in 2017 for Duck Lake that focused on nutrient cycling to develop a management approach for maintaining good water quality in the lake. Since the development of the UAA, Duck Lake water quality has been excellent. However, concerns such as shoreline changes as a result of water elevations, Curly-leaf pondweed, and other potential issues remain at the forefront for local stakeholders. To that end, the RPBCWD desires the development of a management plan to develop an understanding of the impacts from hydrologic changes to the ecological health of the lake and to develop a plan for managing Duck Lake.

2. Description of Services:

To address the concerns regarding the ecological health of Duck Lake and its watershed, we will develop a lake and watershed management plan to provide a management framework. We will build on

RPBCWD efforts to provide a holistic approach for managing, protecting, and restoring Duck Lake and its watershed. Other RPBCWD efforts that will build on in this plan include:

- 2017 Purgatory Creek UAA
- Watershed ecological health assessment
- Wetland functional assessment
- Eden Prairie's pond inspection program
- RPBCWD shoreline assessments

Using these prior studies, we will work with the RPBCWD to list the primary stressors affecting Duck Lake, develop strategies to mitigate these stressors, and provide a vision for Duck Lake at its highest attainable ecological health.

3. Scope of Services:

Engineer's services under this task order shall include:

**Task 1. Goal Setting, Visioning, and Plan Objectives**

The first step is to work with RPBCD staff and local stakeholders to develop a list of issues or concerns for the lake. Issues can range from water quality (phosphorus, nitrogen, chloride, or other emerging contaminants), aquatic invasive species, shoreline conditions, hydrology, fisheries, outlet revisions, or other issues. Issues can also include the watershed and may include wetland health, upland soils, or other land use issues. From there, we will work with the stakeholders to develop objectives for Duck Lake and its watershed including graphics for visioning healthy plant communities, healthy shorelines, and expectations for a healthy shallow lake. During this process, we will develop measurable, science-based targets for these communities to provide a framework for measuring progress toward the identified goal. For the watershed, we will rely on the Ecological Health Assessment Program, the Wetland Functional Assessment, and other RPBCWD programs to develop targets linked to lake health and ecosystem function.

*Deliverables: Graphical displays of a healthy lake including shorelines, aquatic plants, fisheries and other components. A list of issues and concerns with measurable targets and objectives.*

**Task 2. History and Background**

The next step is to develop a history of the lake and its watershed to develop an understanding of how the lake was formed, how the watershed changed over time, and how these changes might affect management options. A timeline of changes and past management actions will be developed for the lake. Here we will characterize the lake and its watershed including current conditions such as plants, hydrology, shorelines, and other physical or biological conditions.

*Deliverables: A visual timeline of the development and management of Duck Lake. A characterization of water quality and ecological conditions in Duck Lake.*

**Task 3. Evaluate Lake and Watershed Hydrology**

The purpose of this Task is to evaluate the hydrology of Duck Lake including modifications to the Duck Lake outlet that consist of maintaining the existing runoff elevation of 913.45, but better approximating the stage-duration curve before the outlet was modified in 2014. The RPBCWD stormwater model will be used to evaluate the variability in water levels over a continuous period of observed rainfall events. Results will be shared with the city of Eden Prairie and the DNR. Finally, a concept-level figure will be prepared to illustrate potential outlet modifications. Under this task, we will also assess watershed

hydrology and resiliency including impacts in upland areas such as compaction, earthworms, and other factors affecting hydrology.

### **Task 3.1. Evaluate Duck Lake Outlet Configurations**

Water levels in Duck Lake fluctuate due to variability in numerous variables including precipitation, groundwater, and evaporation. As a result, it is difficult to determine the impact of the outlet configuration on the water levels in the lake by modeling a single design rainfall event. Therefore, the RPBCWD stormwater model will be used to complete continuous simulations of observed rainfall to generate a times series of water levels in Duck Lake for the pre-2014 outlet condition and two potential outlet configurations.

Model simulations for the period between 1979 and 2014 will be complete assuming the outlet is free from debris and plugging, and assuming a partial plugged condition, if appropriate, to approximate observed lake levels between 1979 and 2014. While partial plugged conditions of the outlet may vary over time (i.e., more leaves and vegetation in the fall or ice blockage in the spring), model simulations will not simulate the variation in conditions at the outlet throughout the simulation. In other words, the model will assume a constant partial plugged condition for the duration of the simulation that best fits observed lake levels between 1979 and 2014. The two simulations will then be used to develop stage-duration curves for Duck Lake.

Barr will then modify the model to evaluate two outlet configurations:

1. One outlet configuration that approximates the stage-duration curve for Duck Lake assuming the outlet is fully open and free of debris between 1979 and 2014
2. One outlet configuration that approximates the stage-duration curve for Duck Lake accounting for partial plugging of the outlet between 1979 and 2014

While this methodology accounts for how the lake responds to past patterns of recorded rainfall that occurred over a wide range of climatic conditions and allows the duration curves to be based on consistent time step interval, it does not account for land-use changes over the simulation period. Barr assumes that the outlet configurations will be evaluated based on current land use within the watershed as well as the current Duck Lake Road configuration.

During the process of evaluating modifications to the Duck Lake outlet Barr will facilitate one working meeting with city of Eden Prairie and DNR staff to present results and solicit feedback on the findings. It is assumed that the meeting will be 2-hours and be virtual. Barr assumes that if needed, RPBCWD staff will coordinate with property owners, the railroad, and the Duck Lake Association, and Barr staff will not participate in those coordination discussions.

The assessment of modifications to the Duck Lake outlet structure will include a description and concept-level figures for up to 2 options.

1. One outlet configuration that approximates the stage-duration curve for Duck Lake assuming the outlet is fully open and free of debris between 1979 and 2014
2. One outlet configuration that approximates the stage-duration curve for Duck Lake accounting for partial plugging of the outlet between 1979 and 2014

*Note: Figures will include a cross section and plan view (if needed) for each concept evaluated.*

Barr will provide the RPBCWD a brief technical memorandum summarizing the stormwater model modifications and simulation results, stakeholder coordination, and concepts for modifications to the outlet control structure. The final documentation will be provided to the RPBCWD in electronic format.

Barr assumes that one draft memorandum will be provided, and that RPBCWD staff, and project stakeholders complete concurrent reviews of the draft memorandum. A final technical memorandum will be prepared following receipt of comments from all reviewers.

*Deliverables: A stakeholder meeting to discuss the outlet structure and model results. Two scenarios for modifying the outlet. A technical memorandum summarizing the results.*

### *Task 3.2 Watershed Hydrology and Resiliency*

The RPBCWD is responsible for planning and managing water resources within the watershed. The RPBCWD recently completed a floodplain vulnerability evaluation to identify flood-risk areas in Eden Prairie. One of the outcomes was identifying potentially flood-prone structures and road crossings during the 100-year 24-hour rainfall event for mid-century conditions. Barr will work with RPBCWD staff to identify locations in the Duck Lake watershed for flood-risk mitigation projects to address flood-risk identified within the Duck Lake watershed, develop planning-level opinions of cost, and summarizing the information in a table that can be referenced by the RPBCWD during the Plan refresh process. Flood-risk areas identified will be reviewed with RPBCWD staff to identify areas that should be considered a RPBCWD responsibility and included in the RPBCWD's plan.

After identifying flood-risk areas, figure will be developed that illustrate the location of each area and potentially impacted structures.

There are several factors that affect the cost of implementing a flood-risk reduction project:

- The volume of stormwater that must be stored within the watershed or conveyed downstream
- Potential to acquire property
- Potential to retrofit existing stormwater infrastructure

Project cost is also dependent on the selected approach for mitigating flood-risk. For example, the cost of reconstructing an emergency overflow maybe significantly greater than developing a strategy to temporarily reduce risks (i.e., providing additional storage via active management or modifying outlet structures), or work to restore the altered hydrology of green space.

Barr will review information available at this time including results from the recent modeling updates (RPBCWD Task Order 35), storm sewer information provided by the Cities, and Hennepin County property records. Following a review of available information Barr will develop a planning level opinion of cost for each flood-risk area identified. A standardized methodology will be developed and applied to each area identified. It is assumed a planning-level opinion of cost will be developed for no more than two locations as well assessing the potential benefits of mitigating the altered hydrology of public green space via decompaction, vegetation alterations, etc.

At this planning stage, much of the information required to develop an accurate opinion of cost is unknown. Much information at these planning level stages have several factors/costs that are simply unknown (i.e., property acquisition requirements, acceptable overflow conveyance routes, etc.). Considering that each of these factors can have a significant effect on the cost of implementing a flood-risk reduction project, it is assumed that the RPBCWD will complete detailed feasibility studies to evaluate the preferred feasible alternative to reduce flood-risk and refine the planning level opinion of cost developed based on available information.

## **Task 4. Watershed Water Quality Modeling and Assessment**

### *Phosphorus and Nitrogen Modeling*

A P8 water quality model was developed for Duck Lake in 2016 as a part of the Purgatory Creek UAA. Since the development of that model, the City of Eden Prairie inspected ponds in the Duck Lake watershed providing more precise pond bathymetry. We will update the P8 model to determine watershed nutrient loading. Our understanding of stormwater pond P cycling is evolving rapidly and has bypassed the basic settling processes in P8. We will review if any pond monitoring data are available for the watershed and if any ponds are showing signs of internal phosphorus loading. We will also review pond hydraulics to provide a cursory review if pond hydraulics are limiting P retention. If internal loading is suspected, sediment cores may need to be collected from the pond to measure sediment P release. Sediment cores were not included in this budget. Wetlands in the watershed will also be reviewed for P release potential. However, no new data will be collected.

### *Chloride Loading*

Another potential stressor to the Duck Lake system is chloride loading from the use of road salt in winter months. We will quantify watershed chloride loading based on application records from the City and County.

*Deliverables: An updated P8 model with recently collected data. A summary of chloride loading to Duck Lake. A review of water quality data for the stormwater ponds draining to Duck Lake. A cursory assessment of internal P loading potential in the ponds.*

## **Task 5. Lake Water Quality Modeling and Assessment**

Following the update of the watershed P8 model, we will develop a lake response model for Duck Lake to assess lake response to changes in nutrient loading. Internal phosphorus loading from sediments will also be assessed during this task using data collected by the City of Eden Prairie. The water quality response model will help identify the impacts of changes in nutrient loading or water levels on water quality. The model will also provide insight into management actions such as aquatic plant management impacts on water quality.

*Deliverables: A lake response model for nitrogen and phosphorus in Duck Lake. A chloride mass balance for Duck Lake and its watershed.*

## **Task 6. Nutrient and Chloride Management**

Using the lake response model and the watershed model, we will develop a list of potential nutrient and chloride management projects in the watershed. Projects will include previous work in the UAA as well as new areas identified as a result of the model update.

*Deliverables: A list of potential nutrient and chloride reduction projects including estimated reductions and costs.*

## **Task 7. Aquatic Plant Management**

There are four primary steps to develop the Aquatic Plant Management Plan for Duck Lake. These steps include:

1. Compile aquatic vegetation data and current management for Duck Lake and identify any data gaps
2. Describe current conditions and trends in the vegetation community
3. Develop goals and ecosystem service assessments for the vegetation community and
4. Development and adaptive management framework for managing aquatic vegetation in Duck Lake

In addition to these steps, Barr will use the Minnesota DNR's lake vegetation database to develop reference lakes similar to Duck Lake. We will use these lakes to describe potential conditions in Duck Lake, what a healthy lake vegetation community looks like, and how vegetation in Duck Lake could be managed to achieve these goals.

#### ***Task 7.1. Summarize Aquatic Vegetation Data, Conditions, Management Activities, and Trends***

The first task is to review all relevant data, reports and plans to identify available data, management actions, and analyses to support the development of the review. We will also acquire readily available data at this stage including GIS files, Biobase files, relevant data, DNR permits, and relevant reports. Barr staff will also review data for primary stressors including fisheries, water quality, and water elevations. Following the data review, Barr staff will summarize the list of current issues and any potential data gaps for assessing the vegetation management activities.

The next step is to summarize the current vegetation conditions and trends in the lakes using metrics such as species richness, floristic quality, and indicator species. Trends in diversity and floristic quality will be evaluated as well as the extent and biovolume of the community. The goal of this task is to evaluate recent management actions effectiveness in making progress toward established vegetation goals. This task will also include a discussion of the current perception of the plant communities with residents, lake associations, and lake users.

#### ***Deliverables***

- Data summary for vegetation community, management actions, and potential stressors
- Summarized management activities conducted since the development of the management plans
- List of identified data gaps
- Summary of current lake vegetation community condition and trends
- Summary of local perceptions of the lake vegetation community

#### ***Task 7.2. Review and Update Aquatic Vegetation Management Goals and Vision***

Significant advances in our understanding of healthy aquatic vegetation communities have been developed in recent years. Statewide reference databases are now available from the MNDNR as well as recent studies highlighting reasonable expectations for healthy, diverse aquatic plant communities. Barr staff will use these databases to develop reference lakes to develop a better understanding of potential outcomes for lake management. Barr will also use recent studies to develop an understanding of the lakes' provision of ecosystem services. This task also includes some "visioning" for the aquatic plant community to visualize the goals and help residents understand the goals of the plan.

Included in the recent advances in our understanding of aquatic plant communities is a more developed understanding of the factors controlling plant diversity and health. Barr staff will highlight the factors that may be limiting aquatic plant diversity in these lakes to help guide management actions. While not all of these factors are well understood, they provide reasonable guidance for managing the aquatic vegetation community.

#### *Deliverables*

- Updated targets for the aquatic vegetation communities
- Visualizations of the current and potential aquatic vegetation communities
- Summary of stressors that may be affecting the aquatic vegetation plant community

#### **Task 7.3. Develop Adaptive Management Framework to Achieve Aquatic Vegetation Community Targets**

Barr will review the current management approach and develop a list of potential long-term aquatic vegetation management options for pursuing the goals as outlined in the management plan. Methods deemed feasible after review with the RPBCWD will then be developed as management options. Response variables necessary to gauge performance of each management method will also be identified. Once the potential lake response and management options are identified, Barr will develop a decision matrix to provide a framework for guiding adaptive management based on monitoring data and the feasible management options.

#### *Deliverables*

- Adaptive management matrix to guide aquatic plant management in Duck Lake

#### **Task 8. Shoreline Management**

Healthy shorelines support water quality, healthy aquatic vegetation communities, fisheries, and other habitat. In conjunction with the vegetation plan, we will summarize shoreline conditions for Duck Lake using RPBCWD collected data. Using this data, we will identify deficiencies in shoreline conditions and plant communities and develop strategies for lakeshore owners to improve shoreline conditions.

In addition to developing conceptual shoreline conditions, we will evaluate the impact of lake bounce and elevation on the shoreline plant community using the scenarios developed with the outlet structure. This will provide guidelines for hydrologic conditions that support native shoreline plant communities.

*Deliverables: A summary of shoreline conditions. Concept designs of healthy shorelines. Hydrologic conditions to support native shorelines.*

#### **Task 9 Fisheries Management**

To develop a fisheries management approach for Duck Lake, we will start by compiling any available fisheries data for Duck Lake. It is our understanding that neither the RPBCWD nor the Minnesota DNR has conducted a fish survey in Duck Lake. The DNR does have stocking information for the lake. We will start by visiting the local fisheries office and looking through their files for Duck Lake. We will also recommend that the RPBCWD perform a fish survey wither through electrofishing or trap nets to get a sense for the fishery. Nearshore seining may also provide information on problematic species such as fathead minnows. This will also help identify if any invasive fish are present.

Once we have defined the fishery, we will work with the Minnesota DNR to describe the preferred fishery type for management. For example, since the lake is shallow and susceptible to fish kill, a likely management option will be to manage the lake as a panfish lake. Relying on the Minnesota DNR, we will develop management strategies for the lake. We will also develop an aquatic invasive species (AIS) status and management plan for the lake to promote a healthy native fishery. To complete this task, we

will conduct a literature review of the impacts of goldfish on shallow lakes to better understand their potential impacts and management needs. We will also provide management options if required.

*Deliverables: A description of the current fishery in Duck Lake. Management strategies based on the defined fishery type.*

### **Task 10. Capital Improvement Plan**

After management strategies are developed for nutrients, aquatic vegetation, shorelines, and fisheries, management actions and capital projects need to be summarized including cost estimates. We will build off of other completed studies such as the UAA, to develop a project list for managing Duck Lake. The projects will be at the concept level to develop a list of appropriate practices aimed at eliminating or reducing the stressors.

*Deliverables: A capital improvement summary table listing projects, recommended management actions, and monitoring with costs at the concept level.*

### **Task 11. Public input process**

An important part of the development of the lake management plan is a stakeholder process to ensure all of the issues are summarized and addressed and to develop support among the shoreline owners, city, RPBCWD, and other entities. We assume the RPBCWD will lead the public input process with our support. We also envision supporting the RPBCWD in developing partnerships with stakeholders including the Lake Association and City of Eden Prairie to provide a plan for communication and collaboration. To support the public input process, we assume the following meetings.

- A kick-off stakeholder meeting to discuss current conditions, issues and concerns
- A stakeholder meeting to discuss shallow lake ecology and management
- A stakeholder meeting to discuss assessment results and management options

*Deliverables: Preparation for and attendance at 3 stakeholder meetings. We assume a Barr led presentation at each meeting.*

### **Task 12. Reporting**

We will develop a draft and final management plan for Duck Lake including results from the previous tasks. The plan will include capital projects, monitoring, in-lake management, and opportunities to collaborate among stakeholders. An electronic version of the draft report, with an executive summary of 2-4 pages, will be provided for RPBCWD Administrator and Managers to review. Revisions will be made to the report based on the feedback and comments received.

*Deliverables: A draft and final lake management plan for Duck Lake.*

### **Task 13. Project Management, Meetings, and Presentations**

Project Management is a key component to help meet project milestones and will help to ensure the work meets the expectations of RPBCWD staff and other stakeholders, and that it is completed in a satisfactory manner, within the project timeline and within the agreed-upon budget. Barr will provide updates to the project team that document project progress and coordinate tasks. We will provide

monthly progress reports and budget status updates as part of the monthly invoicing process. We will solicit feedback from the Administrator on an ongoing basis to ensure clear and timely communication.

We assume the following meetings.

- Up to four staff meetings to discuss results, review management approaches, and provide input
- Up to two Board presentations to discuss results of the outlet analysis and management planning

*Deliverables: Meetings to update and collaborate with RPBCWD staff and the Board. Monthly summaries of activities completed.*

### **Assumptions**

We have made several assumptions in preparing the scope of work for each work item in this agreement. Assumptions relating to individual work tasks are listed along with the detailed description. The proposed scope, schedule and budget may need to be adjusted at a future time as emerging details about the available data help to clarify the most appropriate modeling tool(s) to fit the available data. However, additional assumptions that do not correspond with a single work task are listed below:

- The RPBCWD will be responsible for providing shoreline conditions for Duck Lake. Barr will not be conducting any fieldwork.
- RPBCWD staff will provide all available aquatic vegetation data
- RPBCWD staff will provide all monitoring cost estimates and level of effort
- All meetings will be held virtually or at RPBCWD's office and last no more than 2 hours.
- Meeting scheduling and coordination will be performed by RPBCWD staff
- Barr will provide supporting data to RPBCWD; however, it will not be comprehensively included in the summary memorandum.
- The proposed budget includes costs for mileage reimbursement for meetings, site visits, and site observation.
- The RPBCWD and stakeholders will provide all available and applicable GIS and CAD files to Barr in native electronic format.
- Barr has allotted time for a single round of review comment on the draft report by the RPBCWD
- Unless previously subject to more detailed design, watershed restoration measures proposed for this study will be conceptual in order to evaluate the relative benefit and develop planning level costs
- Supplemental studies and field investigation (wetland/waterbody delineation, Phase I archeology, Phase I environmental, etc) will not be completed with this Task Order.
- Technical advisory committee representatives and other stakeholders will provide all pertinent monitoring and infrastructure data (such as as-built drawings, surveys, models, etc.) that they have collected.
- The RPBCWD or City of Eden prairie will provide bathymetric mapping of Duck Lake connected to NGVD29 datum.
- Only minor revisions will be needed to finalize the report.

4. **Budget:**

Services under this Task Order will be compensated for in accordance with the engineering services agreement and will not exceed \$154,400 without written authorization by the Administrator. The following table provides a breakdown of the anticipated cost for major tasks associated with scope of services described above. The scope and level of effort associated with the various tasks may need to be adjusted as additional information becomes available to maintain the overall objectives within the allotted budget.

Task	Task Description	Anticipated Budget	Tentative Completion Date
1	Goal Setting	\$4,200	November 2023
2	History and Background	\$9,800	December 2023
3	Watershed Hydrology, Outlet Modification, and Resiliency	\$24,600	March 2024
4	Watershed Water Quality Modeling	\$14,000	February 2024
5	Lake Water Quality Response	\$14,700	April 2024
6	Nutrient and Chloride Management BMPs	\$5,700	May 2024
7	Aquatic Plant Management	\$9,900	May 2024
8	Shoreline Management	\$8,000	May 2024
9	Fisheries Management	\$11,900	June 2024
10	Capital Improvements	\$10,100	July 2024
11	Public Process	\$5,900	February/June/July 2024
12	Reporting	\$23,200	August 2024
13	Meetings, Presentations & Management	\$14,400	Throughout
<b>Task Order ## Total</b>		<b>\$156,400</b>	

5. Schedule and Assumptions Upon Which Schedule is Based

The proposed schedule (above) assumes project initiation will occur in August 2023. The schedule may be modified depending on actual initiation of project work, when information is provided by the Cities, or if project outcomes warrant an extension to the timeline.

**IN WITNESS WHEREOF**, intending to be legally bound, the parties hereto execute and deliver of this Agreement.

**CONSULTANT**

**RILEY PURGATORY BLUFF CREEK  
WATERSHED DISTRICT**

By \_\_\_\_\_

By \_\_\_\_\_

Its Vice President \_\_\_\_\_

Its \_\_\_\_\_

Date:

Date:

APPROVED AS TO FORM & EXECUTION

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DRAFT