Prepared by: EOR

For the: Comfort Lake-Forest Lake Watershed District

Tax Forfeit Wetland – Feasibility Study

3.17.2022

EOR water ecology community

SIGNATURE PAGE

Report Prepared and Reviewed By:

Kyle Crawford, PE
Engineer of Record
Emmons & Olivier Resources, Inc.

Kevin Biehn, RLA, CESC, LEED AP BD+C
Project Manager
Emmons & Olivier Resources, Inc.

REVISIONS REGISTRY

Identification	Date	Description of Issue and/or Revision
Draft Report	2.25.2022	District Engineer review (Greg Graske, PE)
Draft Report	3.4.2022	District Staff review (Mike Kinney & Blayne Eineichner)
Final Report	3.17.2022	Final Submission – Board Consideration

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. EXECUTIVE SUMMARY

EOR has completed a feasibility study of a wetland treatment facility at the District's 'Tax Forfeit' property along State Highway 61. The project detailed herein is estimated to reduce phosphorus by 81 lb./yr. at the project site (estimated 60 lb./yr. at Comfort Lake[1]), which exceeds a grant target of 54 lb./yr. at Comfort Lake. The project is designed to deliver additional habitat and water resource benefits (see sections 8 & 9).

Including contingency (20%) and the estimated accuracy range for this level of design the total construction cost ranges between $876,483 and $1,018,616.

Based on the estimated cost range the project will have an anticipated cost of $482 to $660 per pound of phosphorus removed over the lifetime of the project (30-year period). Recent similar District projects have ranged from $60/lb. to $675/lb. (FL Wetland, Moody Wetlands, Bone Lake NE Wetland). As a general industry rule of thumb, returns of < $1000/lb. are seen as favorable. As the District continues to implement major capital projects reducing phosphorus loading to area lakes, the concentrations and loading within the subwatersheds continue to decrease. As a result of this and increased construction costs, pollutant removal costs continue to trend upward. The proposed cost-benefit range above represents a strong project removal rate given construction cost trends and additional progress toward the District stated reduction goal for Comfort Lake (127 lb./yr).

Estimated construction cost exceed awarded Clean Water funding (see Section 2.3). The primary reason for the difference is as follows: 1) rising construction costs, 2) design challenges unearthed via this effort including depth of peat, 3) design intended to maximize use of the property and thus exceed grant targets. For comparison, the estimated construction cost of a project that just meets grant targets is between a range of $780,468.75 and $907,031.25. While this still results in a favorable cost-benefit range ($770/lb. to $848/lb.), there is a significant loss of efficiency.

Note that stated pollutant reductions are conservative estimates and therefore the project may outperform expectations stated herein. Furthermore, cost estimates are based on preliminary design, which warrants a substantial contingency of 20% at this stage. Project benefits and costs will be refined as design progresses should the District advance the project.

---

[1] *60lbs is a rough estimate of what phosphorous removals may be realized at Comfort Lake when considering the reduction of load that typically occurs along the stretch of the Sunrise River from Shallow Pond to the inlet of Comfort Lake. This load reduction directly to Comfort Lake is highly variable and past monitoring indicates that it is anywhere between 11% and 70%. For purposes of this report, we used 2019 stream monitoring data as a recent representative year and assumed a reduction of load of approximately 27% as the load transverses through shallow pond to Comfort Lake. Depending on precipitation, future conditions at shallow pond, and numerous other factors this number will be highly variable. The total reductions directly to the Sunrise River will be critical in both the water quality conditions in the Sunrise River and the protection to the treatment capacity of Shallow Pond.*

2. BACKGROUND

2.1. Location

The proposed project is in the City of Wyoming in the County of Chisago, Minnesota. As currently considered the project would occupy two parcels, both owned by CLFLWD (21.10653.00 & 21.10649.00). Infrastructure components would also occupy the MnDOT State Highway 61 Right of Way. No other property, public or private, is otherwise involve or impacted. The project location and drainage areas treated are identified in Figure 1.

2.2. Project Abstract

The purpose of this project is to address concentrated and polluted flows generated from a ditch that discharges to the Sunrise River downstream of both Bixby Park and the City of Forest Lake. The proposed project will modify an existing ditched wetland complex located on 41.7 acres of CLFLWD-owned tax forfeited property to increase water quality treatment potential and storage capacity. The proposed project diverts flow from Heims Lake out of the existing drainage ditch system at the Highway 61 culvert and diffuses the flow into the wetland complex located on the District Tax Forfeit property. The proposed project will result in the reduction of suspended solids, nutrients, and other surface water pollutants, helping to restore and protect Comfort Lake, which ultimately drains to the St. Croix River through the Sunrise River. Although not a known issue in this tributary the treatment wetland can also help with the removal of heavy metals and pathogens.

The proposed project was identified for targeted implementation through the District's 2012 Sunrise River Water Quality and Flowage Project, the District's 2012-2021 Watershed Management Plan, and the 2010 CLFLWD District Six Lakes TMDL Study.

2.3. Clean Water Fund Grant

The project is funded in part by a FY20 Clean Water Fund Grant. The total grant amount is $492,000; the required match is $123,000. The grant currently expires 12/31/2022. District Staff has garnered preliminary approval from the Minnesota Board of Water & Soil Resources to extend this timeline and will formally request an extension upon Board direction.

Per the Clean Water Grant application, the expected 54 lb./yr. reduction in phosphorus is 43% of the total reductions needed to meet the State water quality standard for growing season average phosphorus of 40 µg/L, and 17% of the watershed runoff reductions needed for Comfort Lake to achieve the District's long-term goal for growing season average phosphorus of 30 µg/L. The proposed project, with an expected 81 lb./yr. reduction in phosphorus (estimated 60 lb./yr. reduction at Comfort Lake) is 47% of the total reductions needed to meet the State standard and 19% of the reduction needed to meet the District's long-term goal.

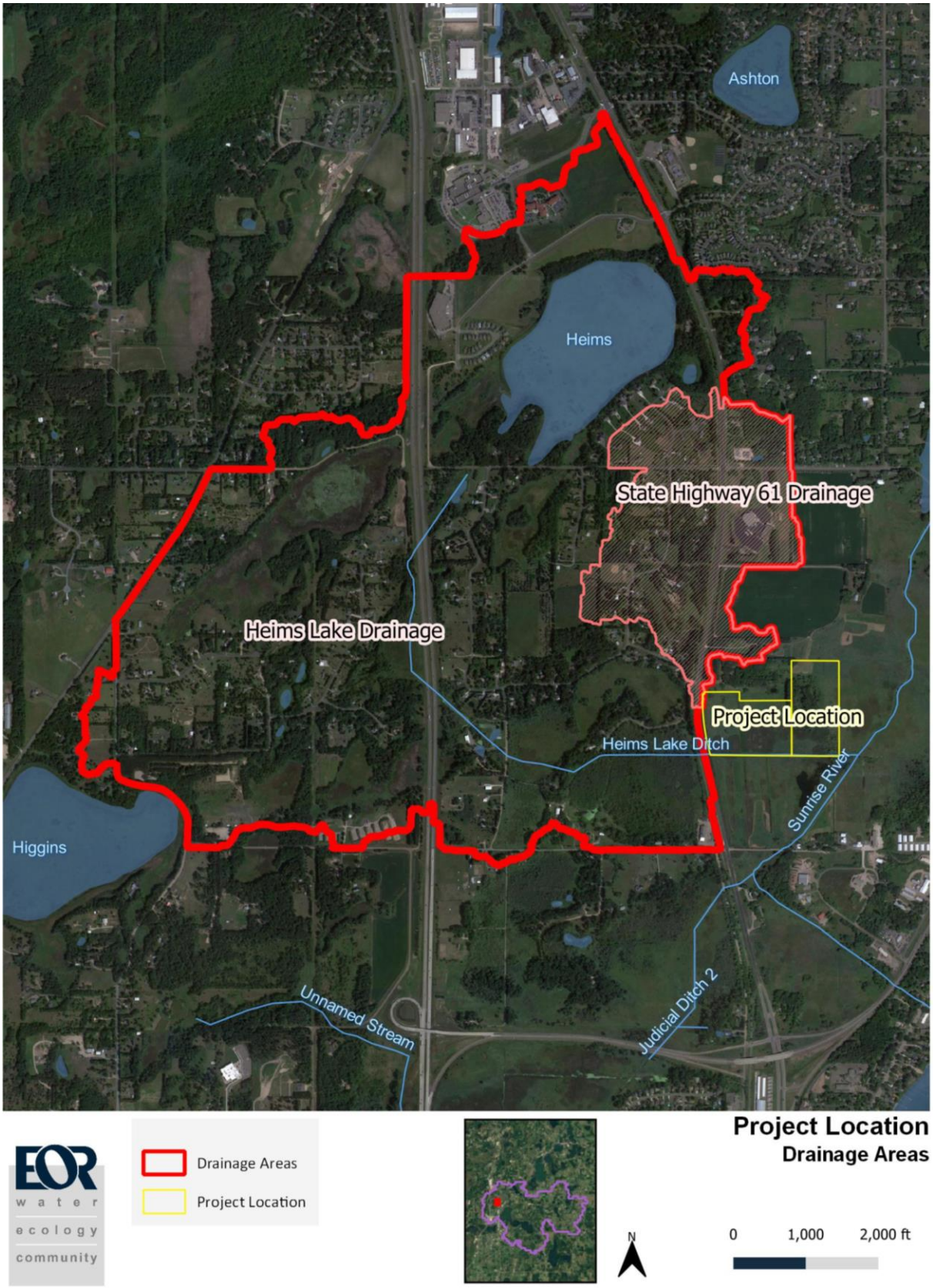


Figure 1. Project location and associated proposed drainage areas treated.

3. FIELD DATA COLLECTION

EOR collected field data necessary to determine the feasibility and specific design of the wetland treatment facility. Data collection included:

- Soil borings and geotechnical report,
- Soil phosphorus availability analysis,
- Wetland delineation,
- Surveying with utility locate.

3.1. Soil Geotechnical Analysis

A geotechnical analysis was completed to determine the type of material to be excavated in the wetland, the depth to water table and structural support recommendations for the diversion structure and embankment.

Braun Intertec performed three (3) soil borings and completed continuous sampling throughout the depth of the borings. Lab analysis of the soil samples was then compiled into a geotechnical factual report with recommendations and considerations for onsite improvements. The borings revealed significant depths of peat muck throughout the site. While peat was anticipated and planned for, the considerable depth the borings revealed created unexpected design constraints that needed to be accommodated. These constraints include increased depth of sheetpile embedment depth and greater sheetpile thickness and steel grade to prevent deflection and corrosion.

The soil borings will be used during the final design and construction to guide the proposed embankment and diversion structure engineering. The borings will also be included with the bidding and construction documents provided to prospective contractors.

The soil boring locations, boring logs and geotechnical report are included in Appendix A.

3.2. Wetland Soil Phosphorus Concentration Assessment

Testing was completed to estimate the available phosphorus from the native soils of the Tax Forfeit property. This analysis is conducted to more accurately estimate whether native soils can be a source or sink of phosphorus. Wetland sediment cores were collected and analyzed for extractable phosphorus using the Bray-1 method.

Typical Bray phosphorus (P) concentrations for wetland soils range from 10 to 200 ppm with a mean value of 30 ppm (Carbonell et al., 1998; Khalid et al., 1979). As a point of comparison, recent soil cores collected from the District's Moody Lake wetland enhancement project were consistently greater than this mean value of 30 ppm and were as high as 425 ppm.

According to a study conducted on the phosphorus sorption capacity of wetland soils, significant correlations were observed (under both aerobic and anaerobic conditions) between phosphorus sorption (the ability of wetland soils to bind phosphorus) and related soil properties, especially extractable Iron, Aluminum, and Calcium.

When the dissolved phosphorus concentration of water flowing into wetlands is greater than that present in the pore water of wetland soils, phosphorus is retained by Al (Aluminum), Fe (Iron), organic matter, and to a lesser extent by Ca (Calcium) complexes. However, with low P loadings, wetland soils can act as a phosphorus source, releasing phosphorus to the water column (Bostrom et al., 1982; Khalid et al., 1977).

Two wetland sediment cores were collected, one from the proposed stormwater basin and one from the existing ditch channel. Each sample was analyzed for extractable phosphorus using the Bray-1 method. Extractable phosphorus is the amount of phosphorus that can be extracted, or removed, from the soil by using one of a number of different types of chemical extractants. These extractants have been developed to remove certain forms of phosphorus from the soil and are considered to be a more accurate index of what might be actually available for uptake by plants or algae. Therefore, wetland soils with lower extractable phosphorus content are more likely to serve as sinks, rather than be sources of phosphorus. In addition to phosphorus content, samples were also analyzed for iron and calcium. Soils that are low in extractable phosphorus content and high in iron and calcium have a high phosphorus sorption capacity.

The soil profile within the ditch and the proposed stormwater basin consisted of peaty soils. At 36 inches, EOR observed shells of aquatic organisms and other calcium deposits – suggesting this area may have formerly been a lakebed. A review of the University of Minnesota's interactive D-1 Surficial Geology map confirmed this area contains calcareous glacial lake sediment. This finding was especially important because calcium binds phosphorus. In addition, the soils had a pH above 7, further validating that the soils were calcareous in nature. Calcareous soils with a high pH are capable of retaining and immobilizing phosphorus via precipitation and adsorption.

The proposed stormwater basin also had high concentrations of both iron and calcium, and notably low Bray-P concentrations that were well-below the average Bray-P concentration for wetland soils of 30 ppm. This finding suggests the proposed stormwater basin will have more phosphorus binding sites, in comparison to the existing ditch. Finally, the observed Bray P concentrations were significantly lower than observed Bray-P concentrations from 18 sediment samples collected from drainageways throughout the District in 2021 (Table 1).

Table 1. Tax Forfeit Property Sediment Core Results Comparison with Drainageway Samples

Sample ID	Location	Bray P (ppm)	Iron (ppm)	Calcium (ppm)	Texture	Organic Matter %	Notes
TFBA	Proposed Stormwater Basin	1	610	5,929	Peat	44	pH =7.4
TF Ditch	Existing Ditch	1	19	4,180	Peat	20.7	pH =7.5
Average 2021	18 CLFLWD Drainage Way Samples	51.4	494	2,356	N/A	N/A	N/A

Following the excavation of approximately 48" of sediment/soil, the exposed soils within the proposed stormwater basin are believed to be lacustrine (lake) sediments. These lake sediments are sometimes referred to as Marl or marlstone. Marl or marlstone is a carbonate-rich mud that consists of a mixture of clay and calcium carbonate, formed under freshwater conditions.

Marl as lacustrine sediment is common in post-glacial lake-bed sediments. The mechanism for Marl formation is dependent on the presence of Chara. Chara is a macroalga also known as Muskgrass that

thrives in shallow lakes with high pH and alkalinity, where its stems and fruiting bodies become calcified. After the alga dies, the calcified stems and fruiting bodies break down into fine carbonate particles that mingle with silt and clay to produce marl.

Excavation of the proposed stormwater basin may expose this calcium rich material which, under ideal circumstances, could result in the formation of a pseudo- "Marl Pond" with high pH and alkalinity that is suitable for Chara growth. These marl ponds are ponds in areas of calcareous sediments/bedrock that become poor in nutrients (oligotrophic) due to precipitation of essential phosphate. While the pond may not meet all the criteria of a traditional "Marl Pond," the presence of lacustrine sediments that are rich in calcium and low in phosphorus suggests the proposed wetland treatment basin likely has the potential for additional phosphorus removal, above and beyond what might be expected in a traditional wetland facility. The likelihood for this facility to continue to provide this additional water quality benefit may rely on the establishment of Chara (muskgrass), a plant that is capable of precipitating phosphorus and binding it in sediments over time (see Section 9.1.3).

3.3. Wetland Delineation

EOR completed a wetland delineation of the property in 2018 as part of a wetland banking opportunity interest of the Watershed District. The property was found to be almost entirely wetland thereby eliminating it as a potential wetland banking site. Ideal wetland banking sites target former wetland areas that are no longer meet wetland requirements (soils, hydrology, vegetation) due to drainage or in some cases intensive agricultural crop production. The site is certainly a candidate for wetland restoration, but restoration of existing wetlands often does not garner enough wetland credits to cover fees associated with establishing the site as a bank. With this information, the District decided not to continue pursuit of a wetland bank at this site and instead focused on enhancing the habitat and water quality benefit potential.

Since the 2018 delineation was not formally submitted and approved this step will be required should the Board advance this project. The 2018 wetland delineation is included as Appendix B.

3.4. Surveying with Utility Locate

EOR completed a survey of the project area and requested existing utility information from local utility providers, including fiber optic, natural gas, electrical transmission lines and storm sewer infrastructure.

The proposed facilities were designed and located to minimize utility and infrastructure conflicts, relocations, and removal and reconstructions. However, conflicts with fiber optic and overhead electrical power appear to be unavoidable.

EOR met with the owner of the underground fiber optic conduit, Consolidated Communications, and discussed options to ensure the line was properly accommodated and protected both during and after construction. It was determined the best route for all parties would be to reroute the line west under Highway 61 and bypass the project area completely. This relocation is anticipated to occur Fall 2022, prior to the proposed project construction. The owner of the overhead transmission lines and utility pole, Xcel Energy, was also engaged during feasibility design as support guy lines for the utility

pole were in direct conflict with the project's inlet area and there was potential for the utility pole to be structurally compromised during construction. After discussion with Xcel Energy, it was agreed the best two options were relocating and resetting the support guy line in conflict or relocating the utility pole. EOR has completed the relocation application and the design is currently under review by Xcel Energy engineers.

Preliminarily, both utility owners have stated that they will incur any and all cost for relocation as the utilities are located within existing public right-of-way and the District project is publicly funded. An existing conditions plan with surveyed utilities is attached as Appendix C.

4. ALTERNATIVES CONSIDERED

Throughout the course of feasibility design, alternative designs and concepts have been investigated and reviewed collaboratively by EOR and District staff. These alternatives can be characterized by two categories: additional parcel acquisition and utilization, and alternative design components and infrastructure.

4.1. Additional Parcel Acquisition and Utilization

Due to the connectivity and flat topography of the wetland, the two wetland parcels immediately adjacent to the District-owned properties were investigated for potential acquisition. These parcels consisted of the 43.05-acre property to the south (PID 21.10657.00) and the 57.03-acre parcel immediately east and north (PID 21.10640.20). Ultimately, these properties were determined to not be cost-beneficial and/or acquirable within the stipulated grant deadline.

4.2. Alternative Designs

The vertical separation (elevation difference) between the Tax Forfeit wetland complex and the Heims Lake channel posed design challenges. Furthermore, utility conflicts and state right-of-way restrictions posed significant design obstacles. Numerous Heims Lake channel diversion options were explored before the recommended design variation was selected. Alternatives investigated included diversion culverts under Highway 61, existing highway culvert retrofits and hydraulic pumps. District staff deemed these options were not preferred due to capacity, constructability and operations and maintenance concerns.

5. CHARACTERIZATION OF PREFERRED CONCEPT

The project characterized herein can be separated into two components. The 'Base Project' is a Wetland Treatment Facility, which treats the 1,204-acre drainage from Heims Lake along with a 182-acre subdrainage along State Highway 61. An additional 'Add Alternate' component is a separate Wetland Treatment Facility, intended to intercept and more effectively treat the subdrainage along

State Highway 61 separately prior to reaching the Base Project. The two treatment drainage areas are illustrated in Figure 1 and concept articulated in Figure 2 and Figure 3.

While the 182-acre subdrainage of the Add Alternate facility is a part of the Base Project drainage and would ultimately be treated by this facility, the Add Alternate facility was advanced to determine if combined facilities would provide more cost-effective pollutant removal. Furthermore, the two drainages have different runoff regimes. The Base Project drainage has primarily perennial flow from the Heims Lake ditch, while the Add Alternate subdrainage only contributes runoff during larger precipitation events (≥1"). During even larger events (≥4"), some runoff bypasses the Base Project through the diversion weir, as discussed below. Routing the Add Alternate subdrainage to its own facility helps maximize the volume of runoff that can be treated in the system prior to bypassing. Given these dynamics, the 182-acre subdrainage may not be fully treated by the Base Project.

5.1. Primary Components and Function

The Heims Lake Drainage – Wetland Treatment Facility consists of a diversion structure and a multi-cell wetland complex. This diversion structure is proposed to be a galvanized steel sheetpile weir crossing the Heims Lake outlet channel. Flows will enter the site under Highway 61 through existing dual MnDOT 58" x 36" reinforced concrete arch pipes (RCAP) and the proposed weir will divert flow into the proposed wetland treatment facility to the northeast. The weir is designed to bypass high flows, which would utilize the existing ditch, to prevent upstream impacts. Flows diverted into the proposed wetland treatment facility will be routed first through a deeper forebay to allow sediment and other solids to settle out before flowing into a large shallow wetland facility for final treatment prior to re-entering the Heims Lake outlet channel on the downstream end of the project limits.

The North Highway 61 Drainage – Wetland Treatment Facility is designed to capture and treat runoff from the neighborhood north of the wetland site. Drainage would be diverted from the west ditch of Highway 61 via a 15" HDPE culvert bored under Highway 61 into a large wetland pool excavated northwest of the Heims Lake drainage wetland base project. Flows leave the wetland facility and are directed southeast into the primary wetland basin of the base project utilizing an onsite existing channel.

5.2. Operation & Maintenance Considerations

The wetland treatment facility is not anticipated to require an extensive operations and maintenance commitment. However, due to the difficult site conditions (open water, non-load bearing soils, state right-of-way), future site access and maintenance was considered as part of the feasibility design. As the forebay basin of the Heims Lake wetland facility is designed to collect settlement of solids, it is anticipated this basin may require mechanical cleanout of accumulated material on a 15-20 year estimated cycle. Anticipated operation and maintenance costs were included in the project life cycle costs and factored into the cost-benefit analysis detailed below. Removal logistics of this material will continue to be investigated and refined during final implementation.

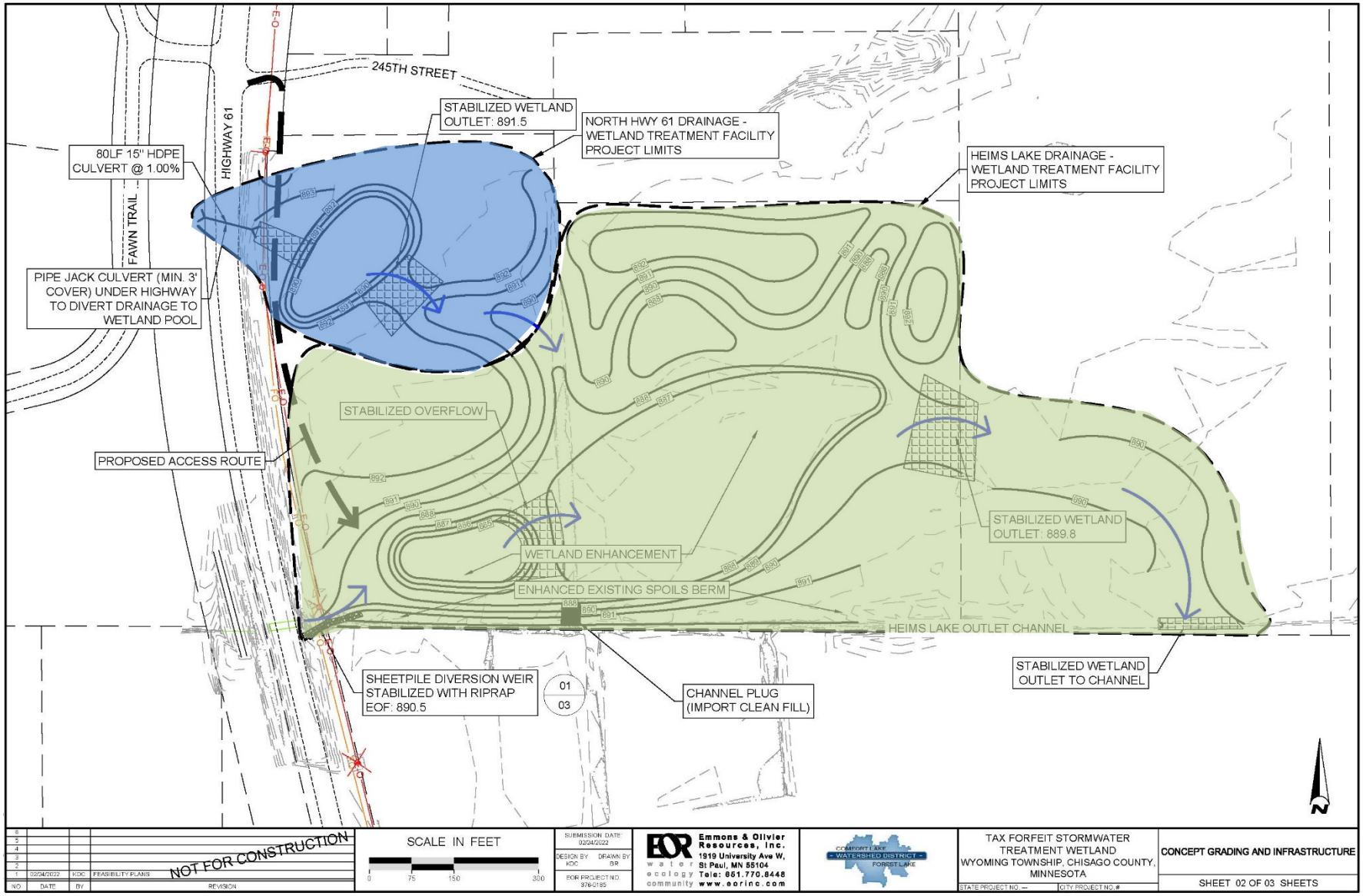


Figure 2. Concept grading and infrastructure plan – Base component footprint in green and Add Alternate component footprint in blue

Figure 3. Rendering of concept plan illustrating proposed wetland types and habitat.

6. ESTIMATE OF NECESSARY PERMITS, AGREEMENTS AND NOTIFICATIONS

EOR investigated the need for, and requirements of project permits from applicable permitting agencies, including Minnesota Pollution Control Agency (MPCA) regulated National Pollutant Discharge Elimination System (NPDES) and Stormwater Pollution Prevention Plan (SWPPP), City of Wyoming, Minnesota Department of Natural Resources (MDNR), Chisago County, Board of Water and Soil Resources (BWSR), and United States Army Corps of Engineers (USACE). A summary of the applicable permits and requirements are listed in Table 6-1. A NPDES construction stormwater permit and SWPPP, local and federal wetland permits, and local grading and erosion control permits are assumed to be needed for this project.

A construction stormwater permit is standard practice for these projects and will be submitted by the contractor. EOR will develop the construction SWPPP as part of the construction plan sheets.

An Environmental Assessment Worksheet is currently not expected to be required for this project.

6.1. Necessary MnDOT Agreement

Due to the diversion weir's location within the Highway 61 right-of-way, a cooperative agreement with the Minnesota Department of Transportation (MnDOT) will be required to clarify project considerations for operation and maintenance, access, restrictions, responsibilities, and future road improvements.

A dialog with MnDOT staff was initiated on June 11, 2020, and EOR along with District Staff have advanced discussions with MnDOT via 8/11/2020 and 11/19/2021 web conference meetings. Conceptual plans along with H&H modeling were sent to MnDOT on 11/22/2021 for their reviews.

EOR will assist District staff and Legal Counsel in the completion of a cooperative agreement with MnDOT. As part of preliminary approval of this project, MnDOT stated during discussions that any structure located within the state highway right-of-way must be considered "temporary" and can be removed with prior notice by the state. This is anticipated to occur only when and if the state widens the Highway 61 corridor and footprint. As of Fall 2021, widening of this road was not included within MnDOT's 20-year State Highway Improvement Plans (MNSHIP) and currently no plans have been made internally within MnDOT to widen this road in the future. Due to that, this should not be considered a project constraint.

6.2. City of Wyoming Notice

The proposed project is in the City of Wyoming and as such, District staff (Heinz) and Manager Anderson engaged the Wyoming's Park Advisory Commission (PAC) on 9/4/2020 about the project. A brief presentation was made, and questions addressed. The PAC vocalized concerns from residents regarding potential flooding impacts caused by the project to adjacent properties. Design iterations and associated modeling completed as part of this effort has confirmed that the proposed project does not alter flood elevation nor frequency (see Section 8.3). If the project is advanced the models will be further refined to ensure no offsite impacts. District staff are planning on hosting meeting(s) with the City of Wyoming to share updated information and address questions.

6.3. Bald Eagle Nest Acknowledgment

As recent as 2021 a pair of Bald Eagles (Haliaeetus leucocephalus) have been nesting on the 43.05-acre property immediately south (PID 21.10657.00) of the District's property.

Since populations have dramatically rebounded and research has shown that human activities aren't as disruptive to breeding eagles as once thought, construction disturbance is less of a concern.

Per consultation with the United States Fish and Wildlife Service (USFWS), a voluntary ≥ 100-foot buffer is recommended around the nest while the nest is occupied. Work within the 100-foot buffer can take place outside the bald eagle nesting season. When working near an eagle nest it is recommend that the eagles' behavior be monitored and if the eagles act nervous (flushing frequently, circling, screaming) that the activity cease or work with the USFWS to apply for an eagle disturbance permit.

As the project is currently designed no work is proposed within ≥ 175-feet of the 2021 nest. To the degree possible, work nearest the 2021 nest site will be specified to be substantially completed prior to the earliest possible nesting date for this part of the state (mid-February).

Table 6-1. Project permitting requirements

Permitting Agency	Permit	Application Requirements	Timeline
MPCA	NPDES/SDS construction stormwater permit for construction activities disturbing one acre or more of soil	SWPPP completed by EOR as part of construction drawings	Permit coverage begins 7 days after contractor completes and submits application electronically through MPCA e-Services
MDNR	Public Waters Work & Aquatic Plant Management	Online MPARS online application	Approval typical within 30 days but can vary depending on complexity of project.
Federal: USACE St. Paul District **State:** City of Wyoming is the Wetland Conservation Act LGU authority on behalf of BWSR	Wetland Delineation- The site will need a wetland delineation approved by WCA LGU & USACE. Wetland Permitting: Plan for either a No – Loss or Wildlife Exemption for excavation and associated habitat enhancement earthwork.	Joint Project Notification (JPN) Form, wetland delineation, demonstration of wetland enhancements and downstream water quality improvements resulting from the project, final construction plans, and language on how the project meets the no-loss or wildlife exemption.	JPN and supporting documentation can be submitted following completion of final site plans. WCA & USACE approval expected within 30- days of submittal. Mitigation permitting, if required, could extend permitting out to 120 days.
MnDOT	R/W access and work permit	90% design plans, model results to be reviewed and approved by MnDOT staff	Approval typical within 30 days but can vary depending on complexity of project.
Local: City of Wyoming	Grading Permit	Final Bid Plans to be submitted, reviewed by City	Approval typical within 2 weeks.

7. ESTIMATE OF CONSTRUCTION COST

EOR drafted a feasibility Engineer's Estimate of probable construction cost for this project. The unit prices for this estimate were developed using a variety of sources, including: 2020 Minnesota Department of Transportation average bid prices and recent local and Comfort Lake Forest Lake Watershed District bid results. The estimate was developed utilizing the ASTM Cost Estimate Classification System. The estimate was deemed to be a Class 2 Estimate (30% - 70% project definition). This class is recommended for feasibility level studies and cost estimates. A Class 2 Estimate recommends an accuracy range of 7.5% below the estimate and 7.5% above the estimate. In addition, the estimate contains a 20% construction contingency factor that is standard for this stage of engineering design.

For the benefit of articulating return on investments the Base Project (Heims Lake Drainage - Wetland Treatment Facility) is estimated separately from the Add Alternate (North Highway 61 Drainage - Wetland Treatment Facility). The unit prices utilized are reflective of constructing both components concurrently.

Final design will and associated costing estimating will reduce the contingency and create a tighter accuracy range. The full estimates are included as Appendix D.

7.1. Base Project (Heims Lake Drainage - Wetland Treatment Facility)

The current construction cost estimate is $789,625.00. Including contingency and the estimated accuracy range the total cost will likely range between $876,483.75 and $1,018,616.25.

7.2. Add Alternate (North Highway 61 Wetland Treatment Facility)

The current construction cost estimate is $75,080.00. Including contingency and the estimated accuracy range the total cost will likely range between $83,338.80 and $96,853.20.

8. WATER QUALITY & QUANTITY MODELING

Modeling of water quality and quantity was completed to maximize project benefits while preventing offsite impacts. Water quantity modeling was developed using the District's calibrated hydrologic & hydraulic model (PCSWMM) for the Sunrise River draining from Forest Lake to Comfort Lake completed by EOR in 2020. This base model was amended to include additional detail in the project area as discussed below.

Pollutant loading from the upstream subwatershed was estimated using monitoring data collected at the Heims Drainage Ditch (HDD) monitoring station, located upstream of the culvert under the Sunrise Prairie bike trail on the west side of State Highway 61. Phosphorus grab samples and continuous stream flow data were available for the years 2012, 2013, 2014, and 2020. Monitoring data was supplemented with empirical estimates of watershed loading developed from current land use data.

Phosphorus reduction from the project was estimated using the mass balance design model developed by Kadlec & Knight (1996) for surface flow treatment wetlands. This estimate was checked against the median phosphorus removal rate for constructed wetlands reported by the Minnesota Stormwater Manual. Removal of other pollutants was also estimated using the rates from the Stormwater Manual.

8.1. Watershed and Loading Characterization

Although the flow path from Heims Lake to the project site is primarily through a series of flow-through wetlands, there are a variety of land covers present in the contributing drainage area, which are summarized in Table 8-1 below. In addition to wetlands, the watersheds include residential development, highway impervious, forest, and row crop agriculture.

Table 8-1. Watershed Land Cover

Land Cover	Percent of Heims Lake Drainage	Percent of State Highway 61 Drainage	Percent of Total
Wetlands	33%	18%	31%
Developed	24%	34%	25%
Agriculture	22%	38%	24%
Forest	15%	10%	14%
Open Water	5%	0%	5%
Other	1%	0%	1%

As discussed above, phosphorus loading from the Heims Lake outlet channel was estimated from available monitoring data, which is summarized in Table 8-2 below. To examine the impacts of the proposed project, 2013 was chosen as the "average" year for analysis. While 2020 was closer to the mean value for total phosphorus flow-weighted mean concentration (FWMC), dissolved phosphorus data was not available in 2020. 2013 had below average total flow due to a dry fall, but this was counteracted by a higher-than-average phosphorus concentration, balancing out to an average total load for the year.

Table 8-2. HDD Phosphorus Loading

Year	Total Phosphorus FWMC (mg/L)	Dissolved Phosphorus FWMC (mg/L)	Flow Volume (ac-ft)	Total Phosphorus Load (lb/yr)	Dissolved Phosphorus Load (lb/yr)
2012	0.28	0.05	106	80	14
2013	0.76	0.14	155	320	58
2014	0.76	0.11	487	1011	145
2020	0.39	-	328	347	-
Mean	0.50	0.08	269	367	60

Since the HDD monitoring station is located upstream from the State Highway 61 drainage area, loading from the highway ditch was estimated using export coefficients developed by White et al (2015). Table 8-3 shows the annual phosphorus loading estimates along with the 10th and 90th percentile values from the export coefficient analysis in parentheses.

Table 8-3. Phosphorus Loading Estimate

Drainage Area	Phosphorus (lb)
Heims Lake Drainage	320[1]
State Highway 61 Drainage	34 (11 – 90)
Total	354 (331 – 410)

1. From 2013 monitoring data

8.2. Refinement & Calibration

The District's PCSWMM model was used to estimate flow to the project site both for design storm events and annually for 2013. The following changes were made to the model to better reflect drainage to the project site.

- Refined State Highway 61 drainage areas based on observed driveway culvert locations and knowledge of drain tiling in the fields east of State Highway 61.
- Discretized direct drainage to the project site from subcatchment draining directly to the ditch channel.
- Quantified ditch storage at upstream and downstream ends of the Sunrise Prairie bike trail and State Highway 61 culvert crossings.

The Sunrise River has an incredibly low slope along the channel section that runs from the outlet of Forest Lake downstream to Comfort Lake. Because of this, tailwater from the channel needed to be considered and it was necessary to estimate flows from Forest Lake when modeling the project site. For model simulation, outflow from Forest Lake was set to an observed peak flow (9/18/18) which corresponded with the 90% annual exceedance probability for the water elevation on Forest Lake. This flow was held constant while design storm events were run over the modeled drainage area to create a conservative scenario where water levels throughout the watershed are high prior to a given storm. To set antecedent conditions, the model was run for 4 weeks prior to the design storm, using historical rainfall data (8/21/18 – 9/18/18) that led to the observed peak flow referenced above.

To further refine estimation of phosphorus removal from the project, two sediment cores were taken, one within the footprint of the Heims Lake Drainage – Wetland Treatment Facility (Heims Lake Facility) and one in the existing ditch. These samples were analyzed for extractable phosphorus, iron content, and calcium content using the Bray-1 method. Results from the analysis indicated that low Bray phosphorus concentrations (1 ppm) and high concentrations of iron and calcium, which can bind to dissolved phosphorus and remove it from the water column. Average Bray P content for wetland soils is roughly 30 ppm. These results were used to refine the phosphorus removal estimate by eliminating background phosphorus concentration from the reduction equation.

8.3. Estimation of offsite Impacts

The project is expected to have no offsite impacts with the exception of increasing the normal water levels on the Heims drainage ditch between the Sunrise Prairie bike trail and State Highway 61. This is due to the establishment of an 889.8' normal water level within the Heims Lake Facility instead of current conditions where the culvert under the highway drains freely into the ditch. This normal water level was specifically chosen to prevent further upstream impacts beyond the public right of ways. Water levels further upstream are controlled by the culvert under the bike trail and will not be impacted by the increase in normal water level from the project. Table 8-4 and Table 8-5 summarize the water levels on either side of the State Highway 61 culvert while Table 8-6 summarizes water levels downstream at the confluence with the Sunrise River.

Table 8-4. Highway 61 - Upstream Water Levels

Storm Event	Existing Water Level (ft)	Proposed Water Level (ft)	Change (ft)
Normal Water Level	889.2	889.8	0.6
2-year, 24-hour (2.80")	890.4	890.3	-0.1
10-year, 24-hour (4.14")	890.8	890.7	-0.1
100-year, 24-hour (6.91")	891.9	891.8	-0.1

Table 8-5. Highway 61 - Downstream Water Levels

Storm Event	Existing Water Level (ft)	Proposed Water Level (ft)	Change (ft)
Normal Water Level	889.2	889.8	0.6
2-year, 24-hour (2.80")	890.4	890.3	-0.1
10-year, 24-hour (4.14")	890.8	890.7	-0.1
100-year, 24-hour (6.91")	891.8	891.7	-0.1

Table 8-6. Confluence with Sunrise River Water Levels

Storm Event	Existing Water Level (ft)	Proposed Water Level (ft)	Change (ft)
2-year, 24-hour (2.80")	890.1	890.1	0.0
10-year, 24-hour (4.14")	890.8	890.7	-0.1
100-year, 24-hour (6.91")	891.8	891.7	-0.1

The inclusion of the North Highway 61 Drainage – Wetland Treatment Facility (North Highway 61 Facility) results in negligible changes from the tables above given the small footprint of the facility and lesser annual runoff from the contributing drainage area.

8.4. Water Quality Returns

As noted above, the mass balance design model from Kadlec & Knight was used to estimate phosphorus loading for the two treatment facilities, both as independent projects and as a combined system. Based on the monitored data for the Heims Lake drainage ditch in 2013 along with estimated loading from the State Highway 61 drainage area, the project is expected to remove 81 pounds of phosphorus from the system annually, with the possibility of removing significantly more via iron and calcium uptake in wetland soils and Chara establishment. As a check on this method, phosphorus removal was also estimated using a uniform 38% removal rate for constructed wetlands per the Minnesota Stormwater Manual which yielded higher removal rates. Table 8-7 outlines the expected removals from both project options with the numbers in parentheses representing lower and upper bounds on removal based on the 10th and 90th percentile loading as outlined above.

Table 8-7. Estimated Phosphorus Removal

Project	Annual Phosphorus Removal – Kadlec & Knight (lbs)	Annual Phosphorus Removal – MN Stormwater Manual (lbs)
Heims Lake Drainage – Wetland Treatment Facility	81 (75-93)	134 (126 – 155)
North Highway 61 Drainage – Wetland Treatment Facility	5 (2 – 13)	13 (4 – 33)
Both Treatment Facilities Combined	87 (79-106)	142 (128 – 176)

Inclusion of the North Highway 61 Facility slightly improves the efficiency of the Heims Lake Facility by providing treatment to the highway ditch runoff and releasing cleaner water to the Heims Lake Facility, thus lowering the average inflow concentration. In addition to this treatment, the North Highway 61 Facility slightly reduces flow rates to the Heims Lake Facility, increasing the basin residence time and capacity for phosphorus treatment. It is important to note that the loading from the State Highway 61 ditch is a rough estimate based on empirical land cover loading rates, not on observed monitoring information. As such, there is higher uncertainty in the estimated loading, and therefore the estimated removal, from this drainage area.

It is recommended that post-project monitoring be implemented to confirm the effectiveness of the project. Not only will post-project monitoring confirm the phosphorus removal rate from the project, but it will also provide another local data point for estimating phosphorus removal from similar future projects in the watershed. Table 8-8 provides expected removal rates for additional pollutants based on average values provided in the Minnesota Stormwater Manual.

Table 8-8. Additional Pollutant Removal Rates

Pollutant	Removal Rate
Nitrogen	30%
Sediment	73%
Heavy Metals (zinc & copper)	70%
Pathogens	60%

Sediment reductions were further estimated based on available data at the HDD monitoring station. In combination with sediment loads from the State Highway 61 drainage area (estimated based on land cover), annual loading to the project is roughly 70,880 pounds. Using a 73% reduction for the proposed project, this results in an annual outflow load of 19,140 pounds, a reduction of 51,740 pounds. Factoring in reduction in sediment observed between Shallow Pond and the inlet to Comfort Lake (estimated at 64% based on 2019 monitoring data) this results in a reduction of 18,630 pounds realized at Comfort Lake.

8.5. Water Quantity Returns

Water levels downstream of the project are typically controlled by tailwater conditions along the Sunrise River. Since the project lengthens the flow path from Heims Lake by diverting water from the ditch to the treatment facility, peak flow rates are expected to be slightly reduced in addition to the slight reduction in water levels noted above. Total runoff volume from the system will be maintained compared to existing conditions with the exception of water lost due to evapotranspiration from the treatment facilities.

9. ADDITIONAL BENEFITS AND CONSIDERATIONS

9.1. Additional Benefits Reflected in Project

The following added benefits/values have been integrated into the project described herein and the cost to complete accounted for in the cost estimates provided. The additional functionality and benefits are intended to afford

- Enhanced aesthetics, in the form of vegetation inputs and unique/intentional landform, which will be visible from well-traveled Highway 61
- Greater water quality returns
- Unique opportunities for research and the advancement of wetland treatment

Note – the water quality or flood control returns of provisions described in this section are not reflected in the estimated returns described in Section 8. Therefore, any such benefits are above and beyond project estimates described herein.

9.1.1. Forested Wetland

A portion of the soils excavated from the proposed wetland treatment facilities are proposed to be embanked on low quality, Reed-canary grass dominated, sections of the site. The soils will be embanked in a manner so as to not convert to upland but create less common forested and shrub wetland types. These embankments sites (see Figure 3), will be planted with and readily colonized by the following representative native fast-growing species (see Table 9), with known high transpiration rates. The intentional landform and wetland planting is intended to maximize transpiration, as a means to provide volume control and water quality returns.

Table 9. Representative native species for forested wetlands with high transpirations rates

Shrub or Tree	Common Name	Scientific Name
tree	Black Willow	Salix nigra
tree	Cottonwood	Populus deltoides var. occidentalis
tree	Tamarack	Larix laricina
shrub	Sandbar willow	Salix exigua
shrub	Speckled Alder	Alnus incana
shrub	Red-osier dogwood	Cornus sericea stolonifera

9.1.2. Habitat Structures

A modest budget of $5,000 has been included to enhance the habitat benefit of this project. One such provision is the integration of turtle basking logs. The structures are inexpensive to construct (~$500 per basking log) and will utilize logs from necessary tree clearing. Furthermore, the public can readily recognize and appreciate these efforts to enhance habitat.

EOR has integrated these structures into similar projects and turtles readily utilize them, as turtles require basking features such as logs or other surfaces onto which they can easily climb onto and warm themselves (by thermoregulation) from their environment. Basking is a required part of a turtle's life history, and the lack of woody debris poses a problem for turtles. Basking raises a turtle's body temperature to a suitable level, which is required for foraging and mating. Raising the body temperature also helps the turtle digest its food, provides an essential source of Vitamin D, and helps reduce ectoparasites on the turtle's body.

Figure 4. Example of wildlife structures (L) Kestrel nesting box and (R) turtle basking logs suitable to the setting and inexpensive to incorporate.

9.1.3. Chara (Muskgrass) Restoration

Chara, also known as Muskgrass is categorized as submerged freshwater species and belongs to the division Charophyta, order Charales, and family Characeae. Muskgrass is native to Minnesota and possesses complex branching system with nodes and internodes that form beds up to a height of approximately 2-3 feet. Re-establishing a dense bed of chara within the proposed stormwater basin may provide the following additionalities:

Phosphorus Sink - Chara will directly utilize phosphorus from the water. In addition, some of the phosphorus can become "unavailable" to plants as co-precipitation of phosphorus with carbonate precipitation can result in the formation of marl that binds available phosphorus. Supporting literature:

1. Chara beds acting as nutrient sinks in shallow lakes - A review
2. Waushara County Lakes Study

Phytoremediation - Refers to the process of using plants to clean up contaminated sites. Chara has shown some promising results when used to treat industrial and agricultural effluent. Supporting literature:

1. Textile Effluent
2. Selenium contaminated agricultural drainage

EOR cannot guarantee that Chara will become established in the wetland nor that water quality benefits will be realized. However, the cost to implement is low (≤ $2,000) relative to the potential water quality benefits and industry knowledge gained.

9.2. Opportunities for Future Consideration

The following opportunities and considerations to garner additional returns from this project/parcel were informally discussed with District staff. The direction was to not pursue these prospects at this time, but they are included herein for posterity and future consideration.

- Explore the optimization of evaportranspiration, (the combined process of water surface evaporation, soil moisture evaporation, and plant transpiration, commonly referred to as ET) as a means to explore, monitor and research ET in volume control and water quality.
- Improve floristic diversity and quality by controlling Reed canary grass (Phalaris arundiacea), an invasive species prevalent across this parcel, via commitment to ongoing maintenance.
- Petition MNDOT to install a safe crossing of Highway 61 to permit Sunrise Prairie Trail users safe access to the site.
- Inclusion of soft surface trails, which would double as access routes for District operations and maintenance.

Figure 5. Photograph of equipment monitoring the transpiration rate of a specimen willow tree

9.3. Naming + Branding

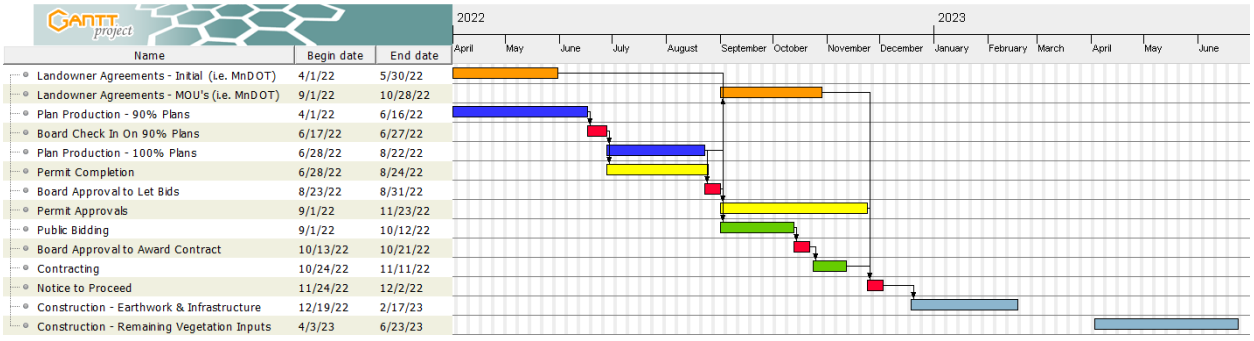
To date both the property and project have been associated with the former delinquent tax status. Since the 'Tax Forfeit' label is both nondescript and can carry a negative connotation, the District may want to consider renaming the project to more effectively brand & publicize the efforts of the District. The following naming inspirations are offered for consideration:

- Honor a former board member's service/legacy
- Indigenous land acknowledgment
- Former land use (i.e., sod farm)
- Iconic native plant or animal (i.e., Carex)

10. ESTIMATED IMPLEMENTATION SCHEDULE

A forecasted schedule, which details the primary remaining design, permitting, tendering, construction, and associated dependencies is illustrated in Figure 6. The schedule is responsive to a winter construction window, which under a typical year would be the most feasible season to complete most of the work. Under this schedule, the majority of the earthwork and infrastructure would be completed during the winter of 2022-23 with completion in the spring or summer of 2023 following site restoration. Contracted extended vegetation management is prudent for 3-5 years post completion to ensure adequate vegetation establishment. This vegetation management is included within the construction estimates, but this task is not reflected in this schedule.

To accomplish this timeline and best position the District for most favorable bid results, the project is ideally tendered by September 2022, which is reflected in Figure 6. Note that the schedule assumes that permits are being considered while the project is being tendered, which may mean that an addendum or change order may be required to reflect permit requirements not otherwise addressed at that time.



Name	Begin date	End date
Landowner Agreements - Initial (i.e. MnDOT)	4/1/22	5/30/22
Landowner Agreements - MOU's (i.e. MnDOT)	9/1/22	10/28/22
Plan Production - 90% Plans	4/1/22	6/16/22
Board Check In On 90% Plans	6/17/22	6/27/22
Plan Production - 100% Plans	6/28/22	8/22/22
Permit Completion	6/28/22	8/24/22
Board Approval to Let Bids	8/23/22	8/31/22
Permit Approvals	9/1/22	11/23/22
Public Bidding	9/1/22	10/12/22
Board Approval to Award Contract	10/13/22	10/21/22
Contracting	10/24/22	11/11/22
Notice to Proceed	11/24/22	12/2/22
Construction - Earthwork & Infrastructure	12/19/22	2/17/23
Construction - Remaining Vegetation Inputs	4/3/23	6/23/23

Figure 6. Estimated implementation schedule

11. SUMMARY

The Base Project (Heims Lake Drainage – Wetland Treatment Facility) will provide treatment of the drainage area identified in the FY2020 Clean Water Fund Application. 81 pounds of phosphorus are projected to be removed annually as part of this project (estimated 60-pound reduction at Comfort Lake), exceeding the 54 pounds stated in the grant application and providing 47% of the TMDL reduction goal for Comfort Lake (127 lb/yr). Utilizing the cost and phosphorus ranges listed above, the project will have an anticipated cost of $582 per pound of phosphorus removed over the lifetime of the project (30-years) with range of $482/lb. to $660/lb. As discussed earlier in the report, compared to industry and CLFLWD benchmarks, this ratio is a favorable cost-benefit return.

The Add Alternate (North Hwy 61 Drainage – Wetland Treatment Facility) is estimated to achieve an additional 5 lbs/yr reduction. This translates to an estimated cost of $1,094 per pound of phosphorus removed over the project lifespan, with a range of $403/lb. to $2,848/lb.

The estimated construction cost of the Base Project (Heims Lake Drainage – Wetland Treatment Facility) exceeds awarded Clean Water funding (see Section 2.3). This exceedance is due to 1) rising construction costs, 2) design challenges unearthed via this effort, including depth of peat, 3) design intended to maximize use of the property and thus exceed grant targets.

Note that stated pollutant reductions are conservative estimates and therefore the project may outperform expectations stated herein. Furthermore, cost estimates are based on preliminary design, which warrants a substantial contingency of 20% at this stage. Project benefits and costs will be refined as design progresses should the District advance the project.

12. RECOMMENDATION

Given the favorable but lower cost-benefit return of the Add Alternate (in comparison to the Base Project), the estimates that the Base project will likely address loading and the acknowledgement that the Add Alternate could be completed at a future phase, EOR and District Staff recommend that the Add Alternate component be passed on at this time.

EOR and District Staff recommend that the Board order the 'Tax Forfeit' Wetland Project, comprising of the just the Base Project component (Heims Lake Drainage – Wetland Treatment Facility) for final design and implementation.

APPENDIX A. GEOTECHNICAL

Geotechnical Evaluation Report

Land Acquisition Analysis - Banta
U.S. Highway 61, near 245th Street
Forest Lake, Minnesota

Prepared for

Emmons & Olivier Resources, Inc.

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Timothy J. Schappa, PE
Project Engineer
License Number: 40159
March 11, 2022

TIMOTHY J. SCHAPPA
LICENSED PROFESSIONAL ENGINEER
40159
STATE OF MINNESOTA

Project B2110683

Braun Intertec Corporation

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

March 11, 2022 Project B2110683

Mr. Kyle Crawford
Emmons & Olivier Resources, Inc.
7030 6th Street North
Oakdale, MN 55128

Re: Geotechnical Evaluation Report
Land Acquisition Analysis - Banta
U.S. Highway 61, near 245th Street
Forest Lake, Minnesota

Dear Mr. Crawford:

We are pleased to present this Geotechnical Evaluation Report for the above referenced project in Forest Lake, Minnesota. Please see the attached report for a detailed discussion on the field exploration results and our recommendations. The report should be read in its entirety.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Tim Schappa at 651.319.3091 (tschappa@braunintertec.com) or Josh Kirk 507.514.1348 (jkirk@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

Timothy J. Schappa, PE
Project Engineer

Joshua L. Kirk, PE
Account Leader, Senior Engineer

Table of Contents

Description **Page**

Appendix

A. Introduction

A.1. Project Description

This Geotechnical Evaluation Report addresses the conceptual design for the proposed land acquisition feasibility study for wetland improvements at the property located in the southeast quadrant of U.S. Highway 61 and 245th Street in Forest Lake, Minnesota.

Figure 1 shows the area being considered in the feasibility study for wetland improvements which will include site grading improvements such as ponding areas, along with a new diversion berm and outlet weir along the southern and southwestern portions of the property, respectfully.

Figure 1. Proposed Site Layout

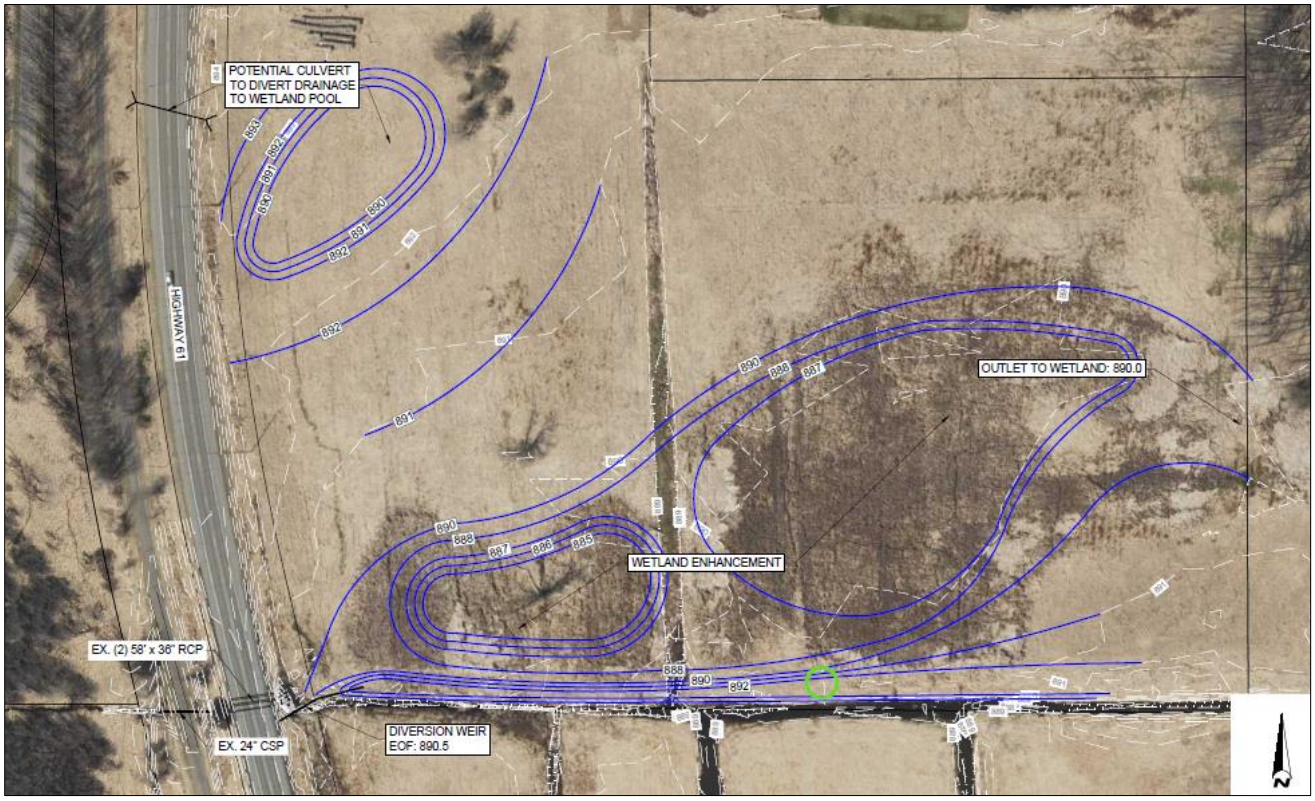


Image obtained from the Multi-cell Wetland Enhancement Gravity Flow Option plan prepared by Emmons & Olivier Resources, Inc. dated April 5, 2021.

We have described our understanding of the proposed design and site to the extent others reported it to us and based on our cursory document review. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

A.2. Site Conditions and History

The property being considered in the feasibility study is currently grassed covered and contains marshy areas. As shown in Figure 2, the site topography is relatively flat and is gently sloping from the northwest portion of the site to the southern and eastern portions of the site. Elevations range from about 898 feet near the intersection of 245th Street and U.S. Highway 61 down to about 890 in the central, southern and eastern portions of the site. A swale exists in the central portion of the site that runs north to south into another swale running west to east along the southern portion of the property. Offsite stormwater discharge enters the site from existing culverts under U.S. Highway 61 at the southern property corner.

Figure 2. Existing Site Topography

Obtained from the Minnesota Department of Natural Resources surface topography website.

A.3. Purpose

The purpose of our geotechnical exploration was to characterize near surface geologic conditions at selected exploration locations, evaluate their impact, and provide recommendations for use in EOR's conceptual design to be included in the land acquisition feasibility study for wetland improvements.

A.4. Background Information and Reference Documents

We were provided and/or reviewed the following documentation:

- Aerial photographs of the project site from Google Earth®, used to evaluate site access, previous site conditions and usage history.
- Minnesota Department of Natural Resources (MnTOPO) surface topography website which is a web application for viewing high-resolution elevation data.
- University of Minnesota Surficial Geology Map for Chisago County by Gary N. Meyer and Howard C. Hobbs. The map is denoted as Miscellaneous Map Series Map M-116, Plate 1, and is dated 2001.
- Multi-cell Wetland Enhancement Gravity Flow Option plan prepared by Emmons & Olivier Resources, Inc. (EOR) dated April 5, 2021.
- An undated Diversion Weir (MNDOT R/W) plan prepared by EOR.

A.5. Scope of Services

We performed our scope of services for the project in general accordance with our Proposal for Geotechnical Evaluation (QTB121275) dated June 3, 2021. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.

- Staking and coordinating clearing the exploration locations of underground utilities. We staked the exploration locations based on the general areas requested by EOR. We acquired the surface elevations and locations with Global Positioning System (GPS) technology using the State of Minnesota's permanent GPS base station network.

- Just prior to drilling, it was determined that the site would not support an all-terrain vehicle (ATV) drill rig that was proposed to access the requested two standard penetration test (SPT) borings. Instead, hand auger (HA) borings were performed at three locations as shown in the Soil Boring Location Sketch included in the Appendix. We advanced the Hand Auger borings to nominal depths of about 8 1/2 to 20 feet below existing grade to measure the thickness of the swamp deposits and to determine the general composition of the underlying granular soils.

- Preparing this report containing a boring location sketch, logs of hand augers, a summary of the soils encountered, and provide recommendations for use in a conceptual design for the stormwater management improvement feasibility study.

Our scope of services did not include environmental services or testing, and we did not train the personnel performing this evaluation to provide environmental services or testing.

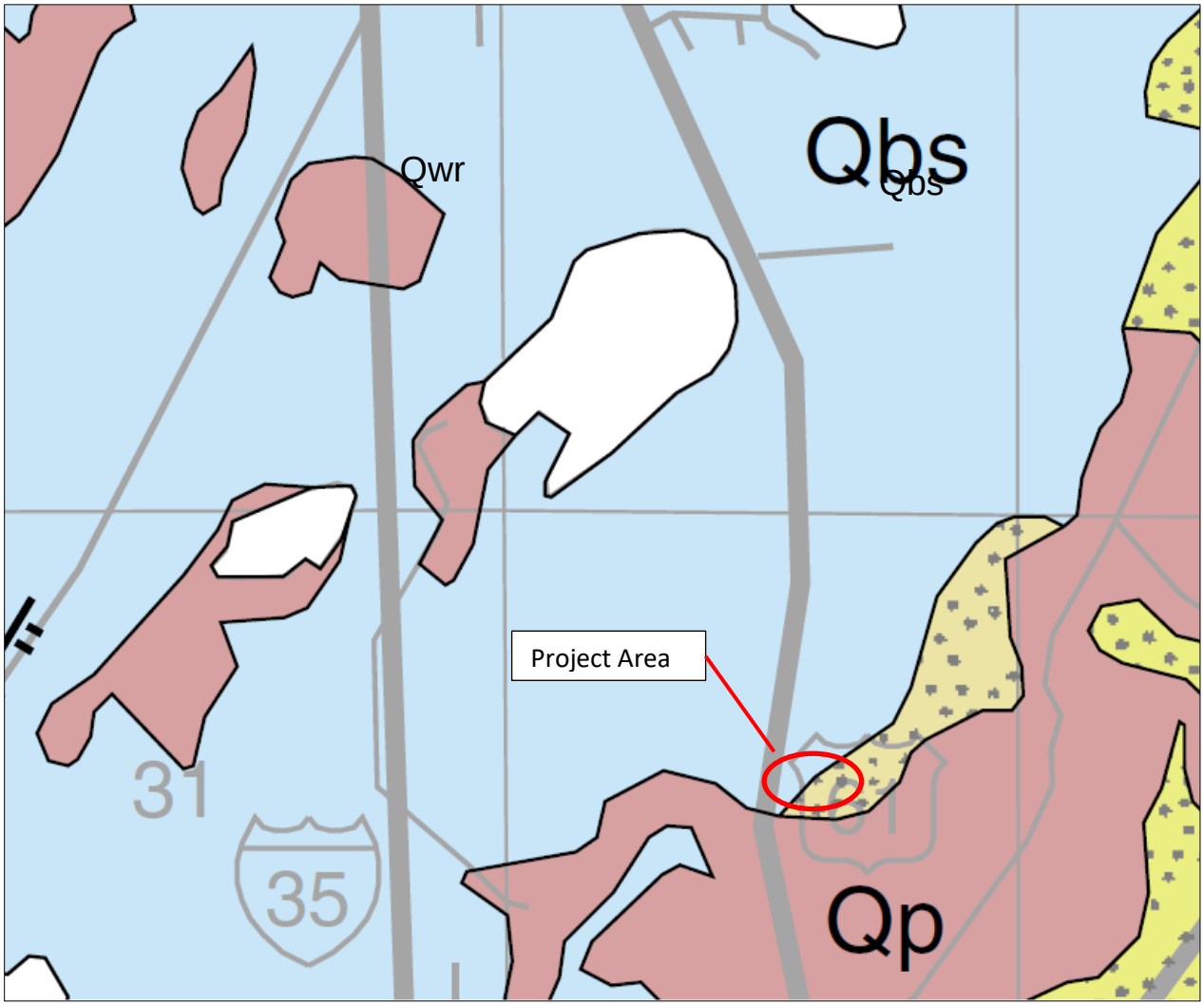
B. Results

B.1. Geologic Overview

Geologic origins were not assigned to the borings as the retrieved soil samples were often too disturbed to accurately discern the geologic origins of native soils.

Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site. Based on a review of the Chisago County Geologic Atlas, the site is generally underlain by peat deposits associated with marshes (map unit "Qp") and stream-deposited sands (map unit "Qbs" below) associated with the New Ulm Formation, or glacial, fluvial, and lacustrine sediment of Riding Mountain provenance deposited by ice and meltwater of the Grantsburg sublobe of the Des Moines lobe.

Figure 3. Surficial Geology



Partial image extracted from Plate 1 of the Chisago County Geologic Atlas.

B.2. Subgrade Strata

Table 1 provides a summary of the Hand Auger results; in the general order we encountered the strata. Please refer to the Log of Hand Auger sheets in the Appendix for additional details. The Descriptive Terminology sheet in the Appendix include definitions of abbreviations used in Table 1.

Table 1. Subsurface Profile Summary

Strata	Soil Type - ASTM Classification	Commentary and Details
Swamp Deposits	PT	▪ Encountered to depths of about 8 to 13 feet below the existing surface. Boring HA-3 terminated within the swamp deposits at about 10 1/2 feet due to the extent of equipment length. ▪ Black in color. ▪ Frozen to about 3 to 6 inches then wet.
Sand Deposits	SP, SP-SM	▪ Encountered below the swamp deposits in Borings HA-1 and HA-2. ▪ Brown in color. ▪ Contain layers of silt and organic clay. ▪ Moisture condition wet.

B.3. Laboratory Test Results

We performed laboratory testing on select samples including moisture content (MC) tests per ASTM D2216, organic content (OC) tests per ASTM D2974, and grain size tests per ASTM D1140 to evaluate the percent of particles passing the #200 sieve (P200). The tests results are summarized below in Table 2.

Table 2. Laboratory Classification Test Results

Location	Sample Depth (feet)	Classification (USCS)	MC (%)	OC (%)	P200 (%)
HAB-1	12	Peat (PT)	256	26	---
	14	Poorly Graded sand with Silt (SP-SM)	---	---	11
	16	Organic Clay (OH) layer	---	36	---
	18	Poorly Graded Sand (SP)	---	---	5

The Log of Hand Auger sheets attached in the Appendix present the results of the MC tests in the “MC” column and list the results of OC and P200 tests in the “Tests or Remarks” column.

C. Recommendations

C.1. Site Challenges and Preliminary Design Discussion

C.1.a. Site Challenges

Due to the marshy areas, including deeper deposits of very soft peat deposits and high groundwater, the site presents challenges to both design and construction. Design challenges will primarily consist of 1.) controlling and/or accommodating large settlements of the earthen berm due to consolidation of the deeper peat deposits from the weight of the new fill and continued decomposition of the organic materials; and 2.) economizing the design of the sheet pile weir to minimize embedment depth and deflection. Construction challenges will primarily consist of subgrade stability for accessing the site with construction equipment for earthwork grading, in particular backfilling and filling for the diversion berm which will likely require geofabric and geotextiles, along with access roadways for cranes to install the sheet pile weir.

C.1.b. Preliminary Design

The proposed grading for the wetland improvement appears to generally consist of developing multiple ponding areas, along with a diversion berm and outlet weir along the southern and southwestern portions of the site. The bottoms of these ponding areas are preliminary set between about 2 to 5 feet below existing grades. The new diversion berm is proposed to be located immediately north of the existing east-west drainage swale located on the south side of the property. It appears raises in grade will generally be less than about 2 to 3 feet, except where up to about 5 feet will be needed to fill the existing north-south swale under the berm alignment. A sheet pile weir is being considered at the southwestern portion of the property that will extend between the new diversion berm and the existing U.S. Highway 61 embankment.

C.1.c. Berm Stability and Settlement

Performing limit equilibrium analysis to understand the stability of the proposed berm and settlement analyses were not part of our scope of work. Based on our experience, small berms such as proposed typically pose minor risks from a slope stability standpoint and that risk can be reduced by construction sequencing of the berm fill placement. The inherent risk to construction of berms over weak swamp deposited soils is the development of a failure plane within the soft soils. Once the failure plane has occurred or is developed, it is difficult to place additional load, or fill, without reactivating the failure.

Settlements induced by raise in grades could be handled throughout the project life by adding additional fill as needed to maintain design heights. To help limit the amount of post construction observations and maintenance, the initial berm height could be raised above the required grade to account for the projected long-term settlements. Additionally, partial excavation of the peat and replacement with engineered fill over fabric and/or geotextile could be considered under the berm to help reduce overall settlements and ease of construction.

C.1.d. Sheet Pile Weir

The sheet pile weir is anticipated to be about 35 feet in length and will have an outlet or top of wall elevation of about 4 feet above the proposed grade. Both the upstream pool and downstream outlet channel will be lined with riprap. Soil parameters obtained from our Hand Augers was used to develop a preliminary sheet pile design based on the Army Corps of Engineers design manual to help EOR determine material and construction costs.

C.2. Site Preparation Considerations and Preliminary Design Results

C.2.a. Subgrade Preparation and Berm Soils

Based on our site reconnaissance, it appears that the area within the vicinity of the proposed diversion may contain spoils from the existing drainage swale. To help provide a more stable embankment, we recommend that any spoil pile be removed and a minimum of 2-feet of organic material be subexcavated beneath existing grade to establish a 10-foot wide keyed-in embankment. Where applicable, leaving the existing vegetation in-place below the new embankment backfill and/or fill can be considered to help provide a more stable subgrade from construction equipment.

We recommend that the backfill and fill used to construct the berm consist of clayey soils which will need to be imported to the site and the use of a geo-fabric and/or geotextile be used as necessary for constructability on the exposed soils that are anticipated to be extremely soft and wet. We recommend spreading engineered backfill and fill in loose lifts of approximately 8 inches thick. For the initial three lifts, we do not recommend compacting these lifts with anything more than the equipment spreading the soil. However, prior to placement of the subsequent fourth lift, the clay backfill placed in the subsequent lift should be scarified to a depth of about 12 inches, moisture conditioned within +/- 3 percentage points above the soils' optimum moisture content and recompacted to a minimum of 95 percent of the material's Standard Proctor maximum dry density (determined in accordance with ASTM D698). This same process should be used for the remaining lifts of soil.

The project documents should not allow the contractor to use frozen material as engineered fill. We recommend performing density tests in engineered fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

C.2.b. Sheet Pile Weir Preliminary Design

The preliminary design was performed using the Shoring Suite (V8.13a) program. A safety factor of 2 was used but maximum acceptable deflection limits were not provided. The following design parameters were utilized for our analyses:

- The embedment depth into the competent sandy soils is assumed to be an elevation of about 874 feet, or 16 feet below the existing surface based on Hand Auger-1 which encountered a 3-foot layer of sand containing organic clay immediately below the peat.
- The maximum water pooling depth of 4 feet based on a bottom of pond elevation of about 897 feet and a top of weir elevation of 890 1/2 feet.
- A maximum ice load of 1,000 pounds per linear foot.
- A friction angle of 30 which is typical for the sands encountered in our Hand Augers.
- Limiting the deflection at the top of the sheet pile weir.

After several iterations, it appears that the largest NZ sheet pile (Skyline NZ-42 Gr. 60 -) will be required to help limit deflections at the top of the sheet pile weir that is embedded a minimum of 35 feet below the organic soils, or a bottom of sheet pile elevation of 839 feet. With an embedment depth of approximately 35 feet below the peat/organic soils, and a maximum exposure height of 16 1/2 feet, we estimate a maximum deflection of about 4 inches could occur at the top of the wall. These deflections could increase slightly after repeated loads as they are mostly a result of wall rotation due to the soil and not short-term elastic bending within the structural steel member.

It is our experience that once your exposure height exceeds approximately 10 feet, additional design features such as a whaler beam and tie-back system are incorporated to help economize the design while maintaining minimal deflections or other design methods are evaluated.

Future consideration of a reduction in of the safety factor to 1.5 could be given if the maximum water pooling depth is anticipated to be a temporary condition.

C.3. Additional Exploration and Analysis

Design plans for this site have not been established at this time. The geotechnical considerations provided in this report are preliminary in nature for use in conceptual design and construction planning purposes for this project. We recommend a more detailed geotechnical evaluation, including additional/deeper soil boring(s) be performed once final design is established. A deeper boring could be performed on the shoulder of U.S. Highway 61 directly west of the proposed sheet pile weir to address site accessibility issues. We also note that the sheet pile installation contractor may request/require a deeper boring to better evaluate subgrade conditions within the anticipated installation depth to help identify any potential installation issues.

We are available to discuss the scope of the additional geotechnical evaluation with you once the project has advanced toward final design. Final recommendations and full geotechnical evaluation report for this project can be provided once the design of the proposed development has progressed and additional geotechnical evaluation has been performed.

D. Procedures

D.1. Manual Exploration

We performed the Hand Augers with a 1 1/2-inch-diameter screw auger. We pushed the Hand Auger down through the swamp deposits and then advanced the HA in 3- to 6-inch increments to depths of between 8 and 20 feet below subgrade elevations or excavation bottoms. We then withdrew the auger from the borehole to obtain cuttings. We made preliminary estimates of soil consistency and density based on resistance to penetration of the Hand Auger and the turning resistance. Groundwater measurements were not taken during advancement due to the limited access and observation within the small diameter borehole.

D.2. Log of Hand Auger Sheets

The Appendix includes Log of Hand Auger sheets. The Hand Auger sheets also present the results of laboratory tests performed on the soil cuttings retrieved. We inferred strata boundaries from changes in the auger cuttings. Because the auger cuttings are disturbed and may become contaminated with the

overlying samples during withdrawal, the strata boundary depths are only approximate. The boundary depths likely vary away from the Hand Auger locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

D.3. Visual and Manual Classification

We visually classified the geologic materials encountered based on ASTM D2488. The Appendix includes a chart explaining the classification system we used.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. Variations in subsurface conditions present between hand auger locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

E.1.b. Groundwater Levels

We made groundwater observations under the conditions reported herein and shown on the Hand Auger logs, and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design

correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

E.2.b. Additional Geotechnical, Construction Observations and Testing

We recommend retaining us to perform any additional geotechnical exploration and analysis and required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions encountered during additional drilling and exposed during construction with those encountered by the Hand Augers and provide professional continuity from the design phase to the construction phase. If we do not perform the additional geotechnical evaluation and observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and any addition reports performed by others used to develop the detailed design documents and to accept the construction-related geotechnical engineer-of-record responsibilities.

E.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

DENOTES APPROXIMATE LOCATION OF HAND AUGER SOIL BORING

100' 0 200'

SCALE: 1"= 200'

F:\2021\B2110683\CAD\B2110683.dwg,Geotech,2/20/2022 11:43:49 AM

BRAUN INTERTEC
The Science You Build On.
11001 Hampshire Avenue S
Minneapolis, MN 55438
952.995.2000
braunintertec.com

Drawing Information

Project No:	B2110683
Drawing No:	B2110683
Drawn By:	JAG
Date Drawn:	11/12/21
Checked By:	TJS
Last Modified:	1/10/22

Project Information

CLFLWD Tax Forfeit

245th Street

Forest Lake, Minnesota

Soil Boring Location Sketch

BRAUN INTERTEC
The Science You Build On.

LOG OF HAND AUGER

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2110683
Geotechnical Evaluation
CLFLWD Tax Forfeit Geotechnical
245th Street
Forest Lake, Minnesota

HAND AUGER: **HA-1**

LOCATION: See attached sketch

NORTHING:	101501	EASTING:	524642
OPERATOR: J. Kirk	LOGGED BY: J. Kirk	START DATE: 01/31/22	END DATE: 01/31/22
SURFACE ELEVATION: 890.2 ft	METHOD: Hand Auger	SURFACING: Vegetation	WEATHER: Sunny, 30°F

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
		PEAT (PT), black, wet					
5							
10							
877.2						256	OC=26%
13.0		POORLY GRADED SAND with SILT (SP-SM), fine-grained, with layers of Silt and Organic Clay, brownish gray, wet					P200=11%
15							Test performed on Organic Clay layer at 16 feet: OC=36%
874.2							
16.0		POORLY GRADED SAND with SILT (SP-SM), fine-grained, with layers of Silt and lenses of Organic Clay, brown and gray, wet					P200=5%
870.2							
20							
20.0		END OF HAND AUGER					

BRAUN INTERTEC
The Science You Build On.

LOG OF HAND AUGER

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2110683
Geotechnical Evaluation
CLFLWD Tax Forfeit Geotechnical
245th Street
Forest Lake, Minnesota

HAND AUGER: **HA-2**

LOCATION: See attached sketch

NORTHING:	101505	EASTING:	525286
OPERATOR: T. Schappa	LOGGED BY: T. Schappa	START DATE: 01/17/22	END DATE: 01/17/22
SURFACE ELEVATION: 889.0 ft	METHOD: Hand Auger	SURFACING: Vegetation	WEATHER: Cloudy, 15°F

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
		PEAT (PT), black, wet					
5							
881.2 / 7.8		POORLY GRADED SAND with SILT (SP-SM), fine-grained, brownish gray, wet					
880.7 / 8.3		END OF HAND AUGER					
10							
15							
20							

BRAUN INTERTEC
The Science You Build On.

LOG OF HAND AUGER

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2110683
Geotechnical Evaluation
CLFLWD Tax Forfeit Geotechnical
245th Street
Forest Lake, Minnesota

HAND AUGER: **HA-3**

LOCATION: See attached sketch

NORTHING:	101492	EASTING:	524940
OPERATOR: T. Schappa	LOGGED BY: T. Schappa	START DATE: 01/17/22	END DATE: 01/17/22
SURFACE ELEVATION: 889.0 ft	METHOD: Hand Auger	SURFACING: Vegetation	WEATHER: Cloudy, 15°F

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
		PEAT (PT), black, wet					
5							
10							
878.5							
10.5		END OF HAND AUGER					
15							
20							

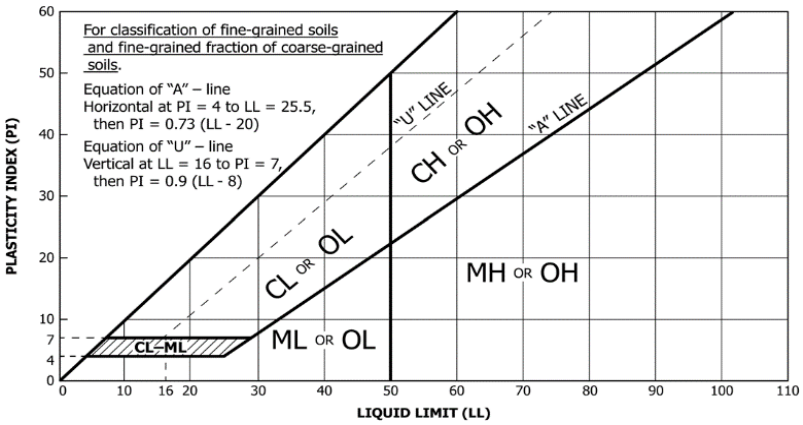
BRAUN INTERTEC
The Science You Build On.

Descriptive Terminology of Soil

Based on Standards ASTM D2487/2488
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines[C])	$C_u \geq 4$ and $1 \leq C_c \leq 3$[D]	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E F G]
			Fines Classify as CL or CH	GC	Clayey gravel[E F G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3$[D]	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[I]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F G I]
			Fines classify as CL or CH	SC	Clayey sand[F G I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OL	Organic clay[K L M N] / Organic silt[K L M O]
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OH	Organic clay[K L M P] / Organic silt[K L M Q]
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
   GW-GM well-graded gravel with silt
   GW-GC well-graded gravel with clay
   GP-GM poorly graded gravel with silt
   GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
   SW-SM well-graded sand with silt
   SW-SC well-graded sand with clay
   SP-SM poorly graded sand with silt
   SP-SC poorly graded sand with clay
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
N. PI ≥ 4 and plots on or above "A" line.
O. PI < 4 or plots below "A" line.
P. PI plots on or above "A" line.
Q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	**q_p**	Pocket penetrometer strength, tsf
WD	Wet density, pcf	**q_U**	Unconfined compression test, tsf
P200	% Passing #200 sieve	**LL**	Liquid limit
MC	Moisture content, %	**PL**	Plastic limit
OC	Organic content, %	**PI**	Plasticity index

Particle Size Identification

Boulders..... over 12"
Cobbles..... 3" to 12"
Gravel
   Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)
   Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
   Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)
   Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)
   Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt..... No. 200 (0.075 mm) to .005 mm
Clay..... < .005 mm

Relative Proportions[L, M]

trace..... 0 to 5%
little..... 6 to 14%
with..... ≥ 15%

Inclusion Thicknesses

lens..... 0 to 1/8"
seam..... 1/8" to 1"
layer..... over 1"

Apparent Relative Density of Cohesionless Soils

Very loose ..... 0 to 4 BPF
Loose ..... 5 to 10 BPF
Medium dense..... 11 to 30 BPF
Dense..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft	0 to 1 BPF	< 0.25 tsf
Soft	2 to 4 BPF	0.25 to 0.5 tsf
Medium	5 to 8 BPF	0.5 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

Recovery: Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (▽), at the end of drilling (▼), or at some time after drilling (▼).

Sample Symbols

Standard Penetration Test
Rock Core
Modified California (MC)
Thinwall (TW)/Shelby Tube (SH)
Auger
Texas Cone Penetrometer
Grab Sample
Dynamic Cone Penetrometer

APPENDIX B. WETLAND ASSESSMENT

Appendix B-1: 2018 Delineation of the Site

APPENDIX C. PRELIMINARY PLAN SHEETS

Appendix C-1: Existing Conditions Plan Sheet

Appendix C-2: Concept Pond Layout Plan Sheet

Appendix C-3: Diversion Structure Detail Plan Sheet

NO	DATE	BY	REVISION
6			
5			
4			
3			
2			
1	02/24/2022	KDC	FEASIBILITY PLANS

SCALE IN FEET
75 150 300

NOT FOR CONSTRUCTION

SUBMISSION DATE: 02/24/2022

DESIGN BY KDC | DRAWN BY BR

EOR PROJECT NO. 376-0185

Emmons & Olivier Resources, Inc.
1919 University Ave W,
St Paul, MN 55104
Tele: 651.770.8448
www.eorinc.com
water ecology community

COMFORT LAKE ~ WATERSHED DISTRICT ~ FOREST LAKE

TAX FORFEIT STORMWATER TREATMENT WETLAND
WYOMING TOWNSHIP, CHISAGO COUNTY, MINNESOTA

STATE PROJECT NO. --- | CITY PROJECT NO. #

EXISTING CONDITIONS & REMOVALS

SHEET 01 OF 03 SHEETS

Plot Date: 02/24/2022
Drawing name: X:\Clients_WD\0376_CLFLWD\0185_Tax_Forfeit_Wetland_Resto\09_GIMS\dwg\376-0185_CD.dwg
Xrefs:: 376-0185_pbase2, 376-0185_xbase

245TH STREET

HIGHWAY 61

FAWN TRAIL

80LF 15" HDPE CULVERT @ 1.00%

PIPE JACK CULVERT (MIN. 3' COVER) UNDER HIGHWAY TO DIVERT DRAINAGE TO WETLAND POOL

STABILIZED WETLAND OUTLET: 891.5

NORTH HWY 61 DRAINAGE - WETLAND TREATMENT FACILITY PROJECT LIMITS

HEIMS LAKE DRAINAGE - WETLAND TREATMENT FACILITY PROJECT LIMITS

STABILIZED OVERFLOW

PROPOSED ACCESS ROUTE

WETLAND ENHANCEMENT

ENHANCED EXISTING SPOILS BERM

STABILIZED WETLAND OUTLET: 889.8

HEIMS LAKE OUTLET CHANNEL

STABILIZED WETLAND OUTLET TO CHANNEL

SHEETPILE DIVERSION WEIR STABILIZED WITH RIPRAP EOF: 890.5

01
03

CHANNEL PLUG (IMPORT CLEAN FILL)

N

NO	DATE	BY	REVISION
6			
5			
4			
3			
2			
1	02/24/2022	KDC	FEASIBILITY PLANS

NOT FOR CONSTRUCTION

SCALE IN FEET

0 75 150 300

SUBMISSION DATE: 02/24/2022

DESIGN BY KDC | DRAWN BY BR

EOR PROJECT NO. 376-0185

Emmons & Olivier Resources, Inc.
1919 University Ave W,
St Paul, MN 55104
Tele: 651.770.8448
www.eorinc.com

water ecology community

COMFORT LAKE - WATERSHED DISTRICT - FOREST LAKE

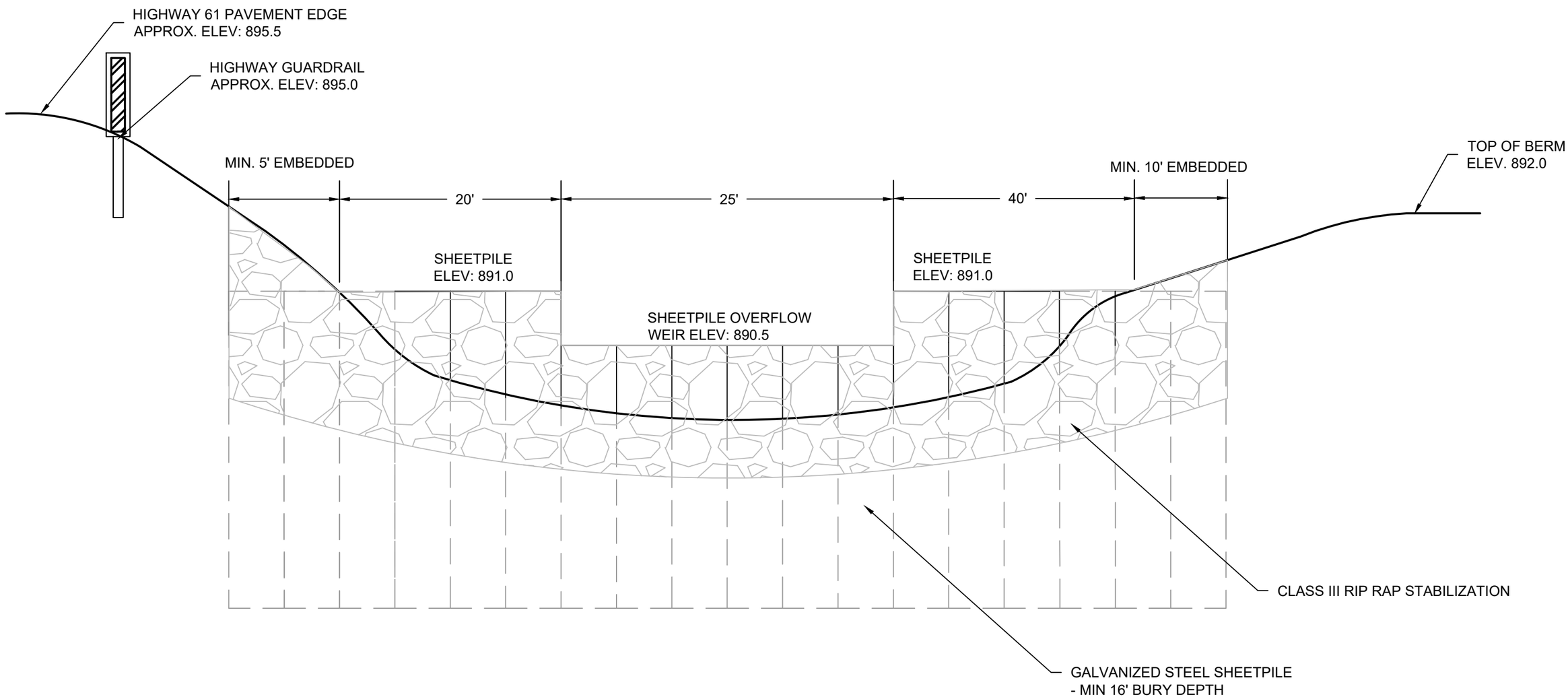
TAX FORFEIT STORMWATER TREATMENT WETLAND
WYOMING TOWNSHIP, CHISAGO COUNTY, MINNESOTA

STATE PROJECT NO. --- | CITY PROJECT NO. #

CONCEPT GRADING AND INFRASTRUCTURE

SHEET 02 OF 03 SHEETS

Plot Date: 02/24/2022
Drawing name: X:\Clients_WD\00376_CLFLWD\0185_Tax_Forfeit_Wetland_Reste\09_GIMS\dwg\376-0185_CD.dwg
Xrefs: 376-0185_phase2_376-0185_xbase



01
03

DIVERSION WEIR

NO	DATE	BY	REVISION
6			
5			
4			
3			
2			
1	02/24/2022	KDC	FEASIBILITY PLANS

NOT FOR CONSTRUCTION

SUBMISSION DATE: 02/24/2022

DESIGN BY KDC | DRAWN BY BR

EOR PROJECT NO. 376-0185

Emmons & Olivier Resources, Inc.
1919 University Ave W,
St Paul, MN 55104
Tele: 651.770.8448
www.eorinc.com

COMFORT LAKE - WATERSHED DISTRICT - FOREST LAKE

TAX FORFEIT STORMWATER TREATMENT WETLAND
WYOMING TOWNSHIP, CHISAGO COUNTY, MINNESOTA

STATE PROJECT NO. --- | CITY PROJECT NO. #

STORMWATER DIVERSION STRUCTURE

SHEET 03 OF 03 SHEETS

Plot Date: 02/24/2022
Drawing name: X:\Clients_WD\0376_CLFLWD\0185_Tax_Forfeit_Wetland_Reste\09_GIMS\dwg\376-0185_CD.dwg
Xrefs: 376-0185_pbase2, 376-0185_xbase

APPENDIX D. PRELIMINARY COST ESTIMATE

Appendix D-1: Heims Lake Drainage – Wetland Treatment Facility Opinion of Probable Cost

Item	MnDOT Reference	Unit	Estimated (Filter item)	Estimated Unit Cost	Extended Cost
Mobilization	2021.501	LS	1.00	50,000.00	$ 50,000.00
Common Excavation (EV)	2105.507	CY	34,650.00	10.00	$ 346,500.00
Common Borrow (CV)	2105.507	CY	150.00	20.00	$ 3,000.00
Dewatering	2105.601	LS	1.00	20,000.00	$ 20,000.00
Steel Sheet Piling	2452.618	SF	3,200.00	60.00	$ 192,000.00
Geotextile Filter, Type IV	2511.504	SY	300.00	3.00	$ 900.00
Random Riprap, Class III	2511.507	CY	200.00	90.00	$ 18,000.00
Traffic Control	2563.601	LS	1.00	10,000.00	$ 10,000.00
Chara vulgaris "water quality" plantings	2571.621	LS	1.00	3,000.00	$ 3,000.00
Landscape Improvements	2571.521	LS	1.00	20,000.00	$ 20,000.00
Erosion Control Supervisor	2573.501	LS	1.00	5,000.00	$ 5,000.00
Stabilized Construction Exit	2573.501	EA	1.00	3,000.00	$ 3,000.00
Floatation Silt Curtain, Type TB	2573.503	LF	50.00	50.00	$ 2,500.00
Sediment Control Log Type Wood Fiber	2573.503	LF	1,000.00	5.00	$ 5,000.00
Temporary Erosion & Sediment Control Allowance	2573.601	LS	1.00	5,000.00	$ 5,000.00
Erosion Control Blanket, Category 25	2575.504	SY	4,500.00	2.25	$ 10,125.00
Seeding	2575.505	ACRE	8.00	3,500.00	$ 28,000.00
Hydraulic Bonded Fiber Matrix	2575.508	LB	20,000.00	1.50	$ 30,000.00
Seed, Mixture 34-171	2575.508	LB	44.00	400.00	$ 17,600.00
Native Vegetation 2-Year Extended Warranty	2575.601	LS	1.00	15,000.00	$ 15,000.00
Habitat Structures	2577.601	LS	1.00	5,000.00	$ 5,000.00
Construction Totals				**Refined Total**	**$ 789,625.00**
CONSTRUCTION CONTINGENCY			**20.00%**	**$**	**157,925.00**
TOTAL CONSTRUCTION COST				**$**	**947,550.00**
ESTIMATED ACCURACY RANGE* **			**-7.5%**	**$**	**876,483.75**
			7.5%	**$**	**1,018,616.25**

***This **Feasibility-level (Class 2, 30 to 70% design completion per ASTM E 2516-06)** cost estimate is based on feasibility-level designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of completion of design, but are not included at this level of project definition. **The estimated accuracy range for the Total Project Cost as the project is defined is -7.5% to +7.5%.** The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. **The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency.** Operation and Maintenance costs are not included.

PARAMETERS FOR ACCURACY RANGE		
Estimate Class	**LEVEL OF PROJECT DEFINITION (% ENGINEERING**	**ACCURACY RANGE**
5	0% to 2%	-25% to +40%
4	1% to 15%	-15% to +25%
3	10% to 40%	-10% to +15%
2	30% to 70%	-7.5% to +7.5%
1	50% to 100%	-4% to +6.5%

PARAMETERS FOR CONSTRUCTION CONTINGENCY		
PHASE OF PROJECT	PERCENTAGE ENGINEERING COMPLETED	APPLICABLE CONSTRUCTION CONTINGENCY PERCENTAGE (%)
FUNDING, SCOPE AND BUDGET	0 TO 5%	30.00%
SCHEMATIC DESIGN	5% TO 15%	25.00%
PRELIMINARY	15% TO 60%	20.00%
FINAL	60% TO 100%	10.00%
CONSTRUCTION	100%	5.00%
***THIS PROJECT PHASE		

Appendix D-2: North Highway 61 Drainage – Wetland Treatment Facility Opinion of Probable Cost

Item	MnDOT Reference #	Unit	Estimated	Estimated Unit Cost	Extended Cost
Common Excavation (EV)	2105.507	CY	4,500.00	10.00	$ 45,000.00
15" HDPE Pipe Sewer - Pipe Jacking	2504.603	LF	80.00	100.00	$ 8,000.00
Geotextile Filter, Type IV	2511.504	SY	10.00	3.00	$ 30.00
Random Riprap, Class III	2511.507	CY	10.00	100.00	$ 1,000.00
Erosion Control Blanket, Category 25	2575.504	SY	1,600.00	4.00	$ 6,400.00
Seeding	2575.505	ACRE	1.00	3,500.00	$ 3,500.00
Hydraulic Bonded Fiber Matrix	2575.508	LB	2,500.00	1.50	$ 3,750.00
Seed, Mixture 34-171	2575.508	LB	6.00	400.00	$ 2,400.00
Native Vegetation 3-Year Extended Warranty	2575.601	LS	1.00	5,000.00	$ 5,000.00
Construction Totals				**Refined Total**	**$ 75,080.00**
CONSTRUCTION CONTINGENCY			**20.00%**	**$**	**15,016.00**
TOTAL CONSTRUCTION COST				**$**	**90,096.00**
ESTIMATED ACCURACY RANGE* **			**-7.5%**	**$**	**83,338.80**
			7.5%	**$**	**96,853.20**

***This **Feasibility-level (Class 2, 30 to 70% design completion per ASTM E 2516-06)** cost estimate is based on feasibility-level designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of completion of design, but are not included at this level of project definition. **The estimated accuracy range for the Total Project Cost as the project is defined is -7.5% to +7.5%.** The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. **The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency.** Operation and Maintenance costs are not included.

PARAMETERS FOR ACCURACY RANGE		
Estimate Class	**LEVEL OF PROJECT DEFINITION (% ENGINEERING**	**ACCURACY RANGE**
5	0% to 2%	-25% to +40%
4	1% to 15%	-15% to +25%
3	10% to 40%	-10% to +15%
2	30% to 70%	-7.5% to +7.5%
1	50% to 100%	-4% to +6.5%

PARAMETERS FOR CONSTRUCTION CONTINGENCY		
PHASE OF PROJECT	PERCENTAGE ENGINEERING COMPLETED	APPLICABLE CONSTRUCTION CONTINGENCY PERCENTAGE (%)
FUNDING, SCOPE AND BUDGET	0 TO 5%	30.00%
SCHEMATIC DESIGN	5% TO 15%	25.00%
PRELIMINARY	15% TO 60%	20.00%
FINAL	60% TO 100%	10.00%
CONSTRUCTION	100%	5.00%
***THIS PROJECT PHASE		

technical memo - comfort lmd

Project Name |	Tax Forfeit Wetland	**Date** |	3/17/2022
To / Contact info |	CLFLWD Board of Managers		
Cc / Contact info |	Mike Kinney, CLFLWD Administrator Blayne Eineichner, CLFLWD Project Manager Greg Graske, CLFLWD Engineer		
From / Contact info |	Kevin Biehn, PLA & Kyle Crawford, PE - EOR		
Regarding |	Project Basis and Funding		

Background

The District has been actively seeking out and implementing projects to improve water quality in the Comfort Lake watershed. The District has two tax forfeiture properties adjacent to the Heims Lake outlet ditch and has been investigating stormwater treatment options for this area. 2018 and 2020 water quality monitoring of the Heims Lake outlet channel near the Tax Forfeit property further confirmed a significant phosphorus load entering the Sunrise River, thus indicating that a wetland rehabilitation would make progress towards achieving the 127 lb/yr reduction needed to meet the TMDL water quality goal of 40 µg TP/L for Comfort Lake and progress toward its long-term water quality goal of 30 µg TP/L.

Project Feasibility

In 2020 and 2021 the District conducted a feasibility study for the proposed project. The proposed wetland treatment facility will create approximately 30,000 cubic yards of treatment volume and create an open-water area of up to 5 acres in the wetland for diverted flows from the Heims Lake outlet channel. The proposed wetland restoration is expected to reduce 81 lb TP/yr to the Sunrise River.

The feasibility report summarized the following feasibility components necessary to implement the Tax Forfeit Wetland Project:

- Permitting Needs
  - Permitting needs assessment
  - Wetland delineation
- Field Data Collection
  - Surface water quality monitoring
  - Existing conditions base CADD drawings
  - Soil coring results
- Design Recommendations
  - Wetland restoration preliminary design
  - Concept CADD drawings
  - Preliminary cost estimates
  - Operation and maintenance considerations

Project Cost

The table below itemizes estimated Base Project (Heims Lake Drainage – Wetland Treatment Facility) cost for implementation:

Phase	Description	Contractor	Engineering	Legal/ Admin	Total	Grant	Match
1	Grant Administration			$3,000	$3,000		$3,000
2	Feasibility Design		$67,390	$20,000	$87,390	$40,000	$47,390
3	Final Design/ Construction	$947,550	$99,746	$20,000	$1,067,296	$452,000	$615,296
	Subtotal	$947,550	$167,136	$43,000	**$1,157,686**	$492,000	$665,686

Project Funding

The Comfort Lake Forest Lake Watershed District (CLFLWD) was awarded a FY20 Clean Water Fund grant from BWSR to implement the Sunrise River Drained Wetland Restoration Project. The total grant amount is $492,000 and the required match is $123,000.

Summary

Implementation of the Tax Forfeit Wetland Project will improve water quality in the Sunrise River and Comfort Lake. The project is expected to reduce phosphorus loading to the Sunrise River by approximately 81 lb/yr and to Comfort Lake by approximately 60 lb/yr. The total cost of the project is estimated at $1,157,686. With an assumed lifespan of 30 years, the life cycle cost benefit is expected to be $482 - $660/lb/yr. The project is being funded primarily by Clean Water Fund grant dollars. The total expected cost to the CLFLWD for feasibility, final design and construction is $665,686.

memo

Project Name |	Tax Forfeit [EOR #00376-0185]	**Date** |	03/17/2022
To / Contact info |	CLFLWD Board of Managers		
Cc / Contact info |	Mike Kinney, CLFLWD Administrator Blayne Eineichner, CLFLWD Project Manager Greg Graske, CLFLWD Engineer		
From / Contact info |	Kevin Biehn & Kyle Crawford - EOR		
Regarding |	Engineering SOW and associated fee request		

INTRODUCTION/BACKGROUND

The Comfort Lake Forest Lake Watershed District (CLFLWD or District) was awarded a FY20 Clean Water Fund Grant from the Board of Water and Soil Resources (BWSR) to implement the Sunrise River Drained Wetland Restoration project. The total grant amount is $492,000, with a required District match of $123,000. The grant application had a stated goal of 54 pounds of phosphorus removed per year for the project.

At the District's regularly scheduled board meeting on April 23, 2020, the Board of Managers approved the Feasibility Study work plan for a total cost of $67,390 ($52,390 engineering + $15,000 geotechnical), to provide preliminary design plans, costs, and benefits.

The 3.17.2022 Engineer's Report details a Base project and Add Alternate component. The 'Base Project' is a Wetland Treatment Facility, which treats the 1,204-acre drainage from Heims Lake along with a 182-acre subdrainage along State Highway 61. An additional 'Add Alternate' component is a separate Wetland Treatment Facility, intended to intercept and more effectively treat the subdrainage along State Highway 61 separately prior to reaching the Base Project. The two treatment drainage areas are illustrated in Figure 1. This memo is intended to characterize the remaining engineering cost to complete a project at the Tax Forfeit property.

WORK PLAN

There is a difference in engineering cost associated with an individual Base Project and Base + Add Alternate Project, as the later requires more analysis, design, permitting and oversight.

PROJECT	*ENGINEERING FEE + EXPENSE*
Base (Heims Lake Drainage – Wetland Treatment Facility)	$99,746
Add Alternate (Hwy 61 North Drainage – Wetland Treatment Facility	$13,080
Sum (if both components are advanced concurrently):	$112,826

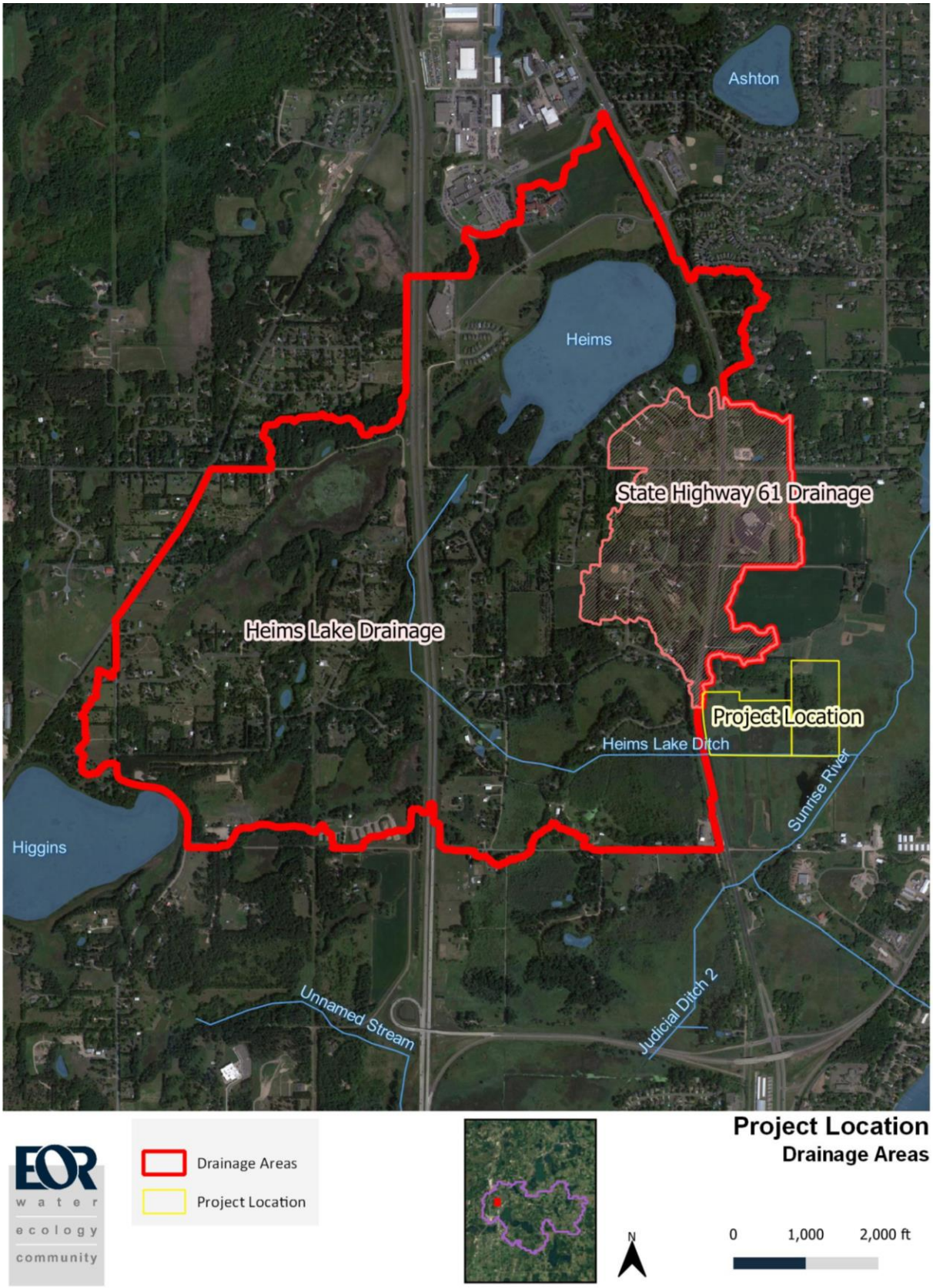


Figure 1. Project location and associated proposed drainage areas treated.

Unless otherwise stated, the work is estimated based on EOR covering all components. There are probable roles for District staff to lead and thus reduce the engineer cost, which are called to attention herein. The hours and cost itemized by task do not include Add Alternate time and expense.

1. <u>Supplementary Data Collection</u>
   EOR staff will collect additional field data that is necessary to refine the final design and modeling of the project. Geotechnical information has already been obtained and utilized to frame the feasibility design. If the North Highway 61 Drainage alternate is pursued, additional soil borings and geotechnical analysis will be required to design and specify the diversion storm pipe under Highway 61. A wetland delineation was performed previously to analyze suitability of the site for a wetland banking feasibility study; a new wetland delineation will be completed in 2022 to ensure all current conditions are accounted for. Existing utility information within the project area has been requested from the City of Wyoming and known private utilities. This information will continue to be refined as meetings and planned utility relocations are completed.
   a) Utility locate refinement & confirmation
   b) Survey topographical/infrastructure – onsite to inform project design
   c) Survey topographical/infrastructure – offsite to better define modeling, offsite impacts
   d) Utility pole and fiber optic line relocation
   e) Wetland delineation and related documentation and approvals

   District Staff Role:
   - Coordinate and complete landowner notifications
   - Potential Deduct
     - Wetland delineation/completion

   Deliverables:
   - Existing Conditions Plan
   - Utility Relocation plans
   - Wetland Delineation

   Estimated Hours & Fee:
   - Base: 48 hours / $7,922

2. <u>Draft Construction Documents</u>
   This task will include completion of 60% and 90% design of the wetland treatment facility and supporting documents. Following completion of both 60% and 90% designs, EOR will review project design, construction cost estimates (Engineer's Opinion of Probable Cost – EOPC) and benefit summary with District staff. EOR will also coordinate legal review of the project specifications with District legal counsel. This task will include design calculations, specification drafting, water, phosphorus and other pollutant budget modeling, CADD drawing, landscape planning, and updated cost estimating.
   a) 60% & 90% draft plan sets
   b) 60% & 90% cost estimate
   c) 60% & 90% benefits summary
   d) 60% & 90% specifications – coordinate with legal staff for review
   e) 60% & 90% reviews with District staff
   f) Board update (presentation preparation accounting for one engagement)

District Staff Role:

- 60% and 90% draft product review
- Landowner & stakeholder communication and education

Deliverables:

- 60% Design Plans, Specifications, EOPC, Project Benefits Summary
- 90% Design Plans, Specifications, EOPC, Project Benefits Summary

Estimated Hours & Fee:

- Base: 155 hours / $22,129

3. <u>Final Construction Documents</u>
   This task will include final design and specifications for the wetland treatment facility project in preparation for project bidding. District staff, with EOR support, will host meetings with stakeholders to gather additional input on permitting requirements, site constraints, and operational needs prior to completion of final design. This task will include final refinements to design calculations, water budget modeling, pollutant reduction estimates, CAD drawings, site restoration, and cost estimating.
   a) Final plan set
   b) Cost estimate
   c) Benefits summary
   d) Specifications
   e) Updated (from Feasibility) an rendering for District communications and branding
   f) Draft O&M Manual
   g) Review with District staff
   h) Board presentation (review & approval to let bids)

   District Staff Role:
   - Final project review
   - Landowner outreach and education

   Deliverables:
   - Final Bid Plans, Specifications, EOPC, Benefits Summary
   - Plan rendering

   Estimated Hours & Fee:
   - Base: 116 hours / $17,149

4. <u>MnDOT Agreement Assistance</u>
   EOR will provide support and technical assistance for completion of the Cooperative Agreement between the District and the Minnesota Department of Transportation (MnDOT) required for this project. It is anticipated that this process will require multiple project coordination meetings between District, EOR and MnDOT staff to finalize the technical details of the agreement.
   a. Attend up to two meetings
   b. Provide MnDOT requested supplementary modeling and/or design input

   District Staff Role:
   - Coordinate process & agreement execution
   - Review and provide comments on MnDOT agreement (Staff and Legal Counsel)

   Deliverables:
   - Project Cooperative Agreement between District and MnDOT (via MnDOT)

Estimated Hours & Fee:

- Base: 32 hours / $4,566

5. <u>Permitting</u>

EOR and District staff will complete and submit permit applications to relevant permitting agencies. Agencies may include (but not be limited to) City of Wyoming, Minnesota Department of Transportation, Minnesota Department of Natural Resources, Board of Water and Soil Resources, and US Army Corps of Engineers. EOR will coordinate with local, state, and federal wetland agencies on permit requirements for activities proposed within regulated wetlands.

   a. No Loss Wetland Permit
   b. Joint Waters Permit
   c. City of Wyoming Grading Permit
   d. MnDOT R/W Permit
   e. MnDOT Drainage Permit (specific to North Hwy 61 Drainage – Wetland Treatment Facility Add Alternate)

District Staff Role:

- Project support and signatory
- Permit fees

Deliverables:

- Approved Wetland Delineation
- No Loss Wetland Permit
- City of Wyoming Grading Permit
- MnDOT R/W Permit
- MnDOT Drainage Permit (specific to North Hwy 61 Drainage – Wetland Treatment Facility Add Alternate)

Estimated Hours & Fee:

- Base: 42 hours / $5,980

6. <u>Public Construction Bidding Administration</u>

This task will include advertising for public bids or quotes, conducting a pre-bid meeting, responding to bidder questions, drafting, and issuing necessary addenda, conducting a bid opening, bid review, and preparing a Recommendation for Award for the Board of Managers.

   a. Post and administer public bid
   b. Pre-bid meeting
   c. Response to questions
   d. Issue any necessary addendums
   e. Bid opening & bid documentation
   f. Board Meeting preparation (recommend for award)

District Staff Role:

- Bidding support (coordinating contractor site access, local newspaper advertisement, bid tabulation review)

Deliverables:

- Final Bid Package
- Pre-Bid Meeting Minutes
- Bid Tabulation
- Recommendation for Award

Estimated Hours & Fee:

- Base: 52 hours / $7,298

7. <u>Construction Administration</u>

This will include reviewing contractor submittals, conducting a pre-construction meeting, onsite construction oversight to ensure project compliance, conducting an as-built survey, preparing record plans, reviewing, and approving contractor payment applications, conducting final punchlist walkthroughs and coordinating project closeout with the contractor and the District. EOR will attend landowner meetings as necessary and provide support to the District for outreach efforts.

An extended vegetation management period (3-5 years post completion) will likely be necessary to adequately achieve project goals. Construction administration to oversee this work is not included herein.

a. Review submittals
b. Review & administer pay requests
c. Administer change orders as warranted and approved
d. Construction meetings & construction observation
e. Punch list
f. As-Built documentation
g. Finalize O&M manual
h. Capture drone video & aerial photographer for District use in education and public relations
i. Project closeout
j. Board meetings (preparation for up to three formal engagements, including closeout)

District Staff Role:

- Supplement onsite observation
- Landowner outreach and meetings

Deliverables:

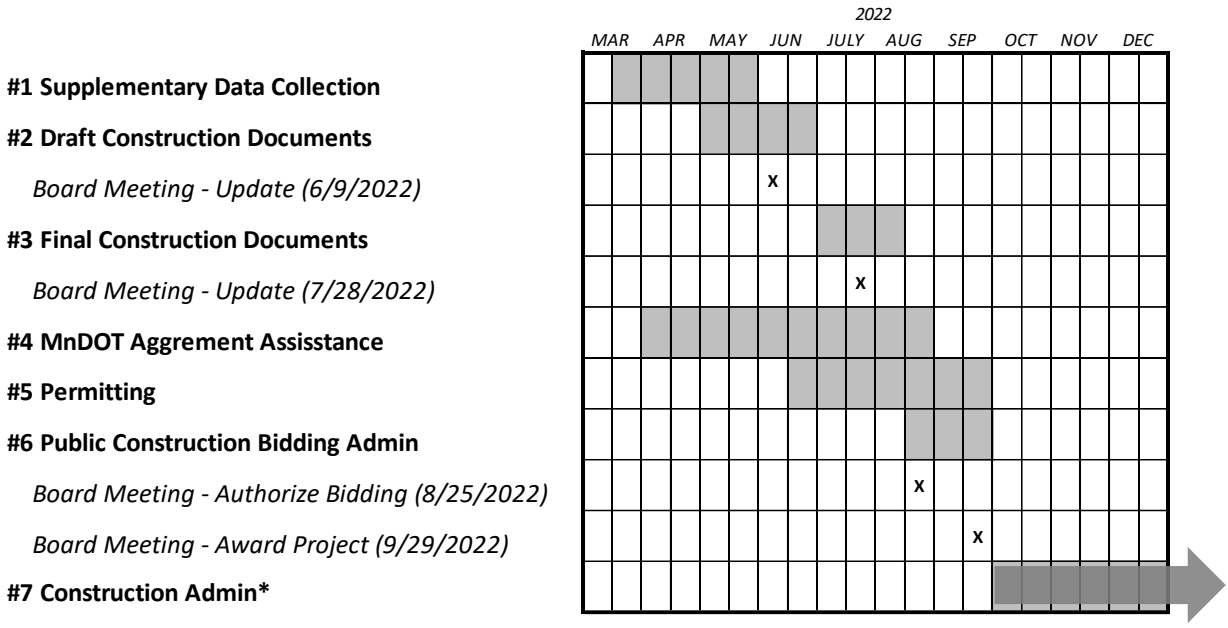
- Construction progress updates
- Reviewed Contractor payment applications
- Record Plans

Estimated Hours & Fee:

- Base: 248 hours / $34,702

SCHEDULE

The following schedule is responsive to commencing construction by the winter of 2022/23.



* Construction administration will commence in earnest upon project award. Actual construction not likely to commence until after 12/15/2022, with substantial completion required by 2/28/2023. Construction administration will carry through the maintenance and management periods, which is two years from acceptance of completion.