December 2022 version

Draft - Environmental Assessment Worksheet

This most recent Environmental Assessment Worksheet (EAW) form and guidance documents are available at the Environmental Quality Board's website at**:** https://www.eqb.state.mn.us**/** The EAW form provides information about a project that may have the potential for significant environmental effects. Guidance documents provide additional detail and links to resources for completing the EAW form.

Cumulative potential effects can either be addressed under each applicable EAW Item or can be addressed collectively under EAW Item 21.

Note to reviewers: Comments must be submitted to the RGU during the 30-day comment period following notice of the EAW in the *EQB Monitor*. Comments should address the accuracy and completeness of information, potential impacts that warrant further investigation and the need for an EIS.

1. **Project title:** **Buckingham Creek and Buckingham Tributary 2 Channel and Floodplain Restoration Project**

2. **Proposer:** South St. Louis Soil & Water Conservation District

Contact person: Tim Beaster
Title: Conservation Specialist
Address: 4215 Enterprise Circle
City, State, ZIP: Duluth, MN 55811
Phone: 218-723-4867
Fax: NA
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3. **RGU:** South St. Louis Soil & Water Conservation District

Contact person: Tim Beaster
Title: Conservation Specialist
Address: 4215 Enterprise Circle
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Phone: 218-723-4867
Fax: NA
Email: tim.beaster@southstlouisswcd.org

4. **Reason for EAW Preparation:** (check one)

Required:	Discretionary:
☐ EIS Scoping	☐ Citizen petition
X Mandatory EAW	☐ RGU discretion
	☐ Proposer initiated

If EAW or EIS is mandatory give EQB rule category subpart number(s) and name(s):
The proposed project will re-align some sections of Buckingham Creek and an unnamed tributary to Buckingham Creek (hereafter referred to as Tributary 2). Both are designated trout streams. The EAW is mandatory under the following rule category: Minnesota Rule: part 4410.4300, subpart 26. Stream diversion. For a diversion, realignment, or channelization of any designated trout stream, or affecting greater than 500 feet of natural watercourse with a total drainage area of ten or more square miles unless exempted by part 4410.4600, subpart 14, item E, or 17, the local government unit shall be the RGU. The South St. Louis Soil & Water Conservation District is the Local Government Unit and will serve as the RGU.

5. **Project Location:**

- County: St Louis county
- City/Township: Duluth
- PLS Location (¼, ¼, Section, Township, Range):
    - SW1/4 of SW1/4, Section 28, T50N, R14W
    - SE1/4 of SW1/4, Section 28, T50N, R14W
    - NE1/4 of SW1/4, Section 28, T50N, R14W

    - NW1/4 of NW1/4, Section 33, T50N, R14W
    - NE1/4 of NW1/4, Section 33, T50N, R14W
- Watershed (81 major watershed scale): St. Louis River
- GPS Coordinates: 46.781320, -92.129273
- Tax Parcel Number: 010-0870-00030, 010-2710-06520, 010-0870-00110, 010-0870-00020, 010-0870-00090, 010-2710-06470, 010-2710-06510, 010-2710-06530, 010-2710-06480, 010-2710-06500, 010-2710-08200

At a minimum attach each of the following to the EAW:

- County map showing the general location of the project: **Appendix 1**
- U.S. Geological Survey 7.5 minute, 1:24,000 scale map indicating project boundaries (photocopy acceptable): **Appendix 2**
- List of data sources, models, and other resources (from the Item-by-Item Guidance: *Climate Adaptation and Resilience* or other) used for information about current Minnesota climate trends and how climate change is anticipated to affect the general location of the project during the life of the project (as detailed below in item 7. Climate Adaptation and Resilience).
    - Current conditions as surveyed and assessed by South St Louis SWCD – **Appendix 3**
    - Temperature (**Appendix 4**) and Fish bio-sampling (**Appendix 5**) data collected in collaboration of the SWCD and Minnesota Pollution Control Agency
    - Minnesota Lake and Flood Elevations (web accessed 7/1/23) – **Appendix 6**
    - MN Geological Survey, Surficial Geology of MN (accessed 7/1/23) – **Appendix 7**
    - MN National Wetland Inventory (web accessed 12/11/23) – **Appendix 8**
    - Minnesota Well Index (version 2.1.3) – **Appendix 9**
    - *What's in My Neighborhood?* MPCA contaminants sites (web accessed 12/11/23) – **Appendix 10**
    - Minnesota Department of Health - Source Water Protection Web Map Viewer (accessed 6/26/2023)
    - Shoreland Management Lake, River and Stream Classifications, MN DNR (web viewer)– Accessed 6/26/2023
    - Population Vulnerability Assessment and Climate Adaptation Framework- City of Duluth/Pale Blue Dot/MPCA
    - Minnesota Climate Explorer- MNDNR
    - EPA Emissions Factors for Greenhouse Gas Inventories – 6/26/23 EPA Center for Corporate Climate Leadership - https://www.epa.gov/sites/default/files/2020-04/documents/ghg-emission-factors-hub.pdf
    - EPA Global Warming Potentials - https://www.govinfo.gov/content/pkg/CFR-2014-title40-vol21/pdf/CFR-2014-title40-vol21-part98-subpartA-appA.pdf
    - MnDOT Standard Specifications for Construction and Supplemental Specifications – Divisions I, II & III 2020 editions https://www.dot.state.mn.us/pre-letting/spec/
    - Invasive Species Prevention and Management – MNDNR – Approved 1/21//22 https://files.dnr.state.mn.us/assistance/grants/habitat/heritage/oporder_113.pdf
- Site plans showing all significant project and natural features. Pre-construction site plan and post-construction site plan: **Attachment 1**

6. Project Description:

a. Provide the brief project summary to be published in the *EQB Monitor*, (approximately 50 words).

The South St. Louis Soil and Water Conservation District and the City of Duluth propose to restore ecosystem function along 3,500 feet of Buckingham Creek and its tributary in Enger Park Golf Course in Duluth, MN. Natural stream and floodplain processes that maintain water quality, fish

passage, and diverse habitat are largely absent from Buckingham Creek and Tributary 2 where they flow through the golf course. The goal of the proposed project is to maximize the ecosystem and recreational services that Buckingham Creek provides to the community by reducing stressors to the coldwater fish assemblage and improving the stream's climate change resilience. The proposed project will achieve this goal by restoring the dimension, pattern, and profile of the stream to a more natural state, improving stream flow, water temperatures, fish passage, and habitat. Construction will occur in the summer of 2024.

b. Give a complete description of the proposed project and related new construction, including infrastructure needs. If the project is an expansion include a description of the existing facility. Emphasize: 1) construction, operation methods and features that will cause physical manipulation of the environment or will produce wastes, 2) modifications to existing equipment or industrial processes, 3) significant demolition, removal or remodeling of existing structures, and 4) timing and duration of construction activities

Project Location

The South St. Louis Soil and Water Conservation District (SWCD) and the City of Duluth propose to restore ecosystem function along 3,500 feet of Buckingham Creek and a cold-water tributary (hereinafter referred to as "Tributary 2") in Enger Park Golf Course, Duluth, MN (the "Project"). Both Buckingham and the tributary are MDNR-designated trout streams in the City of Duluth, St. Louis County (Appendix 1 – Location Map).

Project Construction

Construction will take place in the months of May-September 2024 and will occur within the project Boundary defined in Appendix 2. Work on this project will require earth moving, grading, filling and stream diversion in order to restore the stream channel. Bulldozers and 330-class (or smaller) excavators with hydraulic thumbs will be used to dig and shape the stream bed, banks and floodplains as well place in-stream structures. A smaller excavator (approx. class 305) will be needed to properly form the channel dimensions of the tributary. Articulated dump trucks and trailers will be used to transport materials with tracked vehicles primarily operating along the streambank. Access roads will minimize disturbance as much as possible utilizing pre-existing paths and access ways, including construction access in the vicinity of irrigation renovations. Any compaction as a result of equipment access will be scarified upon project completion and equipment retreat.

This project will require a breadth of approaches for minimizing sedimentation. The National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) Construction Stormwater Permit (CSW Permit) will apply to areas of the Project that are 1 acre or more located above the Ordinary High Water Level (OHWL) that are not subject to the Department of Natural Resources (DNR) Public Waters Permit. The Stormwater Pollution Prevention Plan (SWPPP) for the Project will include plans for redundant (double) down-gradient sediment control best management practices (BMPs) where soil disturbance occurs within 100 feet of the trout stream. The down-gradient sediment control BMPs will be located above the OHWL and in addition to in water BMPs used to control movement of sediment downstream. Redundant down gradient BMPs will also be required for soil disturbances within 50 feet of wetlands at the site.

Silt fences, seeding and mulching, erosion control blankets, and other appropriate erosion control measures (such as working during low-flow periods and limiting the amount of disturbed area and soils exposed at one time) will be incorporated into the construction phase of this project. In addition, the contractor will be required to have temporary cover available at the site that can be quickly applied to prevent sediment discharges from these areas during heavy rain events. Soil

stockpiles will need sediment controls at the base of the piles and will need to be covered within 7 days. As project construction progresses, disturbed sites will have the soil prepared for reseeding, be reseeded with appropriate vegetation, and be mulched to encourage rapid re-vegetation. Seeding will be accompanied by planting of trees and other native vegetation to offset those cleared as well as increase shading of the channel. The contractor will also be required to utilize tracking controls to prevent construction vehicles from transporting sediment if entering the stream.

Carving a new stream channel and valley around the irrigation pond will afford a rare opportunity to work in "in the dry," waiting to divert the stream from its old channel and into the new one only after it is finished. This completely avoids sedimentation and turbidity issues during construction but will have a larger temporary flush of sediment when routed through the new channel. Remaining portions of the Project will use an engineer-approved stream diversion. The temporary stream diversion shall convey water by means of a pump, open channel, or piped diversion system. The Contractor will submit a Temporary Stream Diversion System Plan to the Engineer for approval prior to the start of the work. Any dewatering activities that have sediment-laden discharge must discharge into a temporary or permanent sedimentation basin or through some form of BMP, such as a filter bag, to limit sediment from leaving the site and to ensure effluent water is free of sediment.

c. Project magnitude:

Description	Number
Total project acreage	2.5 acres
Linear project length	~3500ft
Number and type of residential units	0
Residential building area (in square feet)	0
Commercial building area (in square feet)	0
Industrial building area (in square feet)	0
Institutional building area (in square feet)	0
Other uses – specify (in square feet)	0
Structure height(s)	0

d. Explain the project purpose; if the project will be carried out by a governmental unit, explain the need for the project and identify its beneficiaries.

The Project is being carried out by the South St. Louis SWCD, which is the Local Government Unit.

Project Need

Buckingham Creek is 2.36 miles long with a 603-acre watershed and is entirely within the City of Duluth. Local resource professionals consider Buckingham Creek to have a high potential for maintaining cold water in the face of climate change due to an undeveloped headwaters and significant groundwater inputs. The City of Duluth has identified Buckingham Creek as an Ecologically Significant Area as part of its goals of supporting thriving trout streams, healthy watersheds and resilient ecosystems. However, data collected by the MN DNR and MPCA show that many impacts within the City of Duluth's Enger Park Golf Course are degrading ecosystem health and threatening the future of Brook Trout.

Natural stream and floodplain processes that maintain water quality, fish passage, and diverse habitat are largely absent from Buckingham Creek and Tributary 2 where they flow through the golf course (Appendix 3 – Current Conditions). Both of these streams have been ditched or piped

underground where they cross fairways. These reaches contain poor habitat because of a lack of sinuosity, planform diversity, and large woody debris. Stream impoundments are also common within the course. One of the ponds is used for irrigation, depriving Buckingham Creek of flow and impacting the systems natural hydrology. A diversion pipe the City installed in 2017 ensures that a component of baseflow always made it downstream of the pond while also keeping the stream cooler by bypassing the warm pond surface outflow. While this temporarily addressed the flow and temperature problems, the bypass does not provide fish passage or longitudinal connectivity for sediment and detritus.

There are two other in-line ponds on Buckingham Creek at the downstream end of the course and on Tributary 2 that capture baseflow, leading to evaporative loss and much higher stream temperatures. Stream temperature data collected by the MPCA in summer 2022 (Appendix 4 – Temperature Data) revealed that the temperature regime above the mainstem impoundment was very conducive to Brook Trout, with a summer average of 12.2 °C and 0.5% of temperature readings were within the stressful range for that species (defined by the MNDNR as between 20° and 25° C). Meanwhile, stream temperatures immediately below the impoundment had an average of 18.8° C, with 35% above stress levels and 0.5% in lethal conditions (greater than 25° C).

MPCA fish samples from 2022 show the dramatic impact that this stream temperature change has on the Buckingham Creek fish community. Above the pond, 52 Brook Trout were sampled (Appendix 5 – Fish Sampling Data). Below the pond, zero Brook Trout were sampled and the community was dominated by Smallmouth Bass and other tolerant fish species, indicating severe stream impairment.

Similar impacts to stream temperatures and fish populations are occurring because of the Tributary 2 impoundment. Immediately downstream of the pond, which is a water feature for the golf course, Tributary 2 water temperatures were within the Brook Trout stress threshold 49% of the time. Temperature data from the bottom of the pond, however, shows that bottom water was never observed to reach stressful temperatures.

In addition to the degradation caused by impoundments and ditching, six culverts at cart path crossings on the course are either perched or undersized, interrupting aquatic organism passage and sediment transport continuity.

Project Objectives and Methods

The goal of the Project is to maximize the ecosystem and recreational services that Buckingham Creek provides to the community by reducing stressors to the coldwater fish assemblage and improving the stream's climate change resilience.

The following objectives of the Project are organized using the five components of stream health (MN DNR Watershed Health Assessment Framework):

Geomorphology Objective: Restore geomorphic processes and stream function to improve habitat for all life stages of Brook Trout and associated coldwater aquatic organisms.

Hydrology Objective: Improve the natural hydrologic regime interactions to create a more resilient system. This is especially important in order to address the increasing magnitude of storm events and length of drought periods.

Connectivity Objectives: Restore stream and floodplain longitudinal connectivity and continuity for

aquatic organism passage and sediment transport. Restore stream-floodplain lateral connectivity and reestablish and protect healthy, diverse riparian areas where feasible. Improve vertical connectivity of the stream to groundwater by restoring a natural grade and channel complexity to the channel.

Water Quality Objectives: Decrease stream temperatures and suspended sediment concentrations. Increase dissolved oxygen concentrations.

Biology Objective: Protect and improve current Brook Trout populations and coldwater aquatic organism assemblages.

The Buckingham Creek and Buckingham Tributary 2 Channel and Floodplain Restoration Project will deliver measurable and sustainable results, such as fish passage, connectivity, habitat, and improved water quality. The Project will have far-reaching positive impacts on the long-term ecological integrity of the stream and the well-being of the surrounding community.

Several holistic restoration actions have been identified based on their effectiveness in achieving the project's goal and will be included in implementation (Attachment 1 – Project Plans):

1. Improve stream hydrology and water quality: The MN DNR is collaborating with the City of Duluth to decommission the water appropriation used to irrigate the golf course. The Project will also separate Buckingham Creek from in-line ponds that warm the stream, cause evaporative loss, and decrease dissolved oxygen. Temperature reductions will also be achieved through the installation of a bottom withdrawal structure in the Tributary 2 pond. Sediment input will be reduced by restoring the correct pattern and profile to the channel which will reduce shear stress to the stream banks and bed. These actions will greatly improve water quality and hydrologic conditions, both in Buckingham Creek itself and in Twin Ponds, an urban put-and-take Rainbow Trout pond that is annually stocked as an inner-city fishing opportunity.
2. Restore geomorphic processes: The Project will restore 3,500' of impounded, ditched, or piped stream channel using Natural Channel Design methods, which emulate the forms and processes of a natural, functioning, stable channel.

The design for the new channel and floodplain is based on characteristics of a nearby stable channel, called a reference reach. This reference reach is selected based on shared boundary conditions such as drainage area, channel slope, valley slope, floodplain width, channel substrate, sinuosity, etc. Two reference reaches have been chosen for this project. On the upstream steeper portions of Buckingham Creek and Tributary 2, Silver Creek upstream of the North Shore trail has been selected due to similar boundary conditions. Silver Creek has a slope of 0.0236 and a drainage area of 2.99mi^2 compared to Buckingham Creek's 0.5mi^2. On the downstream flatter portions of Buckingham Creek and Tributary 2, a site on McCarthy Creek off Laine Rd was selected with a matching slope of 0.0079 and a drainage area of 3.6 mi^2 compared to 0.6 mi^2.

The cross section, pattern and profile dimensions of the reference channel are then scaled to the restoration site based on the site's characteristics such as bankfull cross-sectional area and watershed drainage area. Natural structures will be added to the channel to facilitate channel stability. Features such as root wads, toe-brush and strategic boulders along the stream banks to provide aquatic habitat and stabilize the channel until floodplain vegetation can reestablish and provide long-term stabilization. When possible, vegetation transplants will be utilized re-using preexisting grasses and shrubs to kick start re-vegetation. Six different types of natural structures and sub-structures including toe-wood, toe-brush, gravel riffles, and habitat logs are being used in this project.

These methods are more completely laid out in detail in Chapter 11 of the Natural Resources Conservation Service (NRCS) Stream Restoration and Design National Handbook. These methods are widely used in Minnesota and have been successfully implemented many times by the SWCD. These actions will improve Brook Trout habitat, mitigate flood flows, increase groundwater storage, and reduce bank erosion.

3. Restore stream connectivity: The Project will replace six stream crossings that negatively affect stream function and/or fish passage with single-span bridges. This design follows MNDNR-recommended guidelines. The Project will also establish a passable stream channel through ditched fairways and around the middle pond. Overall, 4,500' of stream habitat will be reconnected.

The project beneficiaries are: the Brook Trout and other cold-water aquatic species living in the creek; species that live in this area of high biodiversity; golfers utilizing and interacting with water resources of the Enger Park grounds; local anglers who will be able to utilize this unique urban resource; and the citizens of Duluth, as healthy streams and watersheds are a goal for the City and its residents (City of Duluth Comprehensive Plan, 2016).

e. Are future stages of this development, including development on any other property planned orlikely to happen? ☐ Yes X No
If yes, briefly describe future stages, relationship to present project, timeline and plans for environmental review.

f. Is this project a subsequent stage of an earlier project? ☐ Yes X No
If yes, briefly describe the past development, timeline and any past environmental review.

7. Climate Adaptation and Resilience:

a. Describe the climate trends in the general location of the project (see guidance: *Climate Adaptation and Resilience*) and how climate change is anticipated to affect that location during the life of the project.
The Project aims to create a more resilient stream in the face of a changing climate. Local climate trends for the area point to overall warmer temperatures, the potential for increased precipitation and larger storm events. Stream temperatures are also projected to increase with rising air temps and changes in hydrology, but this project will hopefully offset those issues.

The Minnesota Climate Trends tool has data on temperature and precipitation as far back as 1895. This assessment summarizes annual trends for the Duluth area from 1985 to 2022 by using the local deer management area (182).

- Average daily mean temperatures have increased by 0.24°F per decade, with the trend rising from 36.69°F to 39.73°F.
- Average maximum temperatures have increased by 0.19° per decade, with the trend rising from 47.33°F to 49.68°F.
- Average minimum temperatures have increased by 0.29°F per decade, with the trend rising from 26.04°F to 29.78°F.
- Average annual precipitation has increased by 0.27" per decade, with the trend rising from 26.83" to 30.3"
- The Palmer Drought Severity Index is calculated by month rather than annually. For each month, the Index has risen has increased by an average 0.19 per decade, which suggests

fewer and/or less intense droughts.

The MN Climate Explorer Tool provides climate projections of temperature and precipitation using several climate prediction models for three different time periods and different greenhouse gas concentrations (MNDNR n.d.-b). The following tables show the range of outcomes for the Duluth area (Deer Permit Area 182).

Table 1. Average daily mean temperature (°F)

	Lower Range	Mean	Median	Upper Range
1980-1999 Modeled Present	36.99	39.74	39.46	43.18
2040-2059 Mid-Century (RCP 4.5)	40.53	43.31	43.01	47.22
2080-2099 Late-Century (RCP 4.5)	41.3	45.33	45.33	49
2080-2099 Late-Century (RCP 8.5)	46.1	49.29	49.11	53.08

Table 2. Average annual precipitation (Inches)

	Lower Range	Mean	Median	Upper Range
1980-1999 Modeled Present	15.92	31.29	27.81	62.56
2040-2059 Mid-Century (RCP 4.5)	15.83	30.76	27.71	62.35
2080-2099 Late-Century (RCP 4.5)	16.89	33.97	30.74	68.36
2080-2099 Late-Century (RCP 8.5)	19.31	36.15	32.35	77.33

b. For each Resource Category in the table below: Describe how the project's proposed activities and how the project's design will interact with those climate trends. Describe proposed adaptations to address the project effects identified.

Resource Category	**Climate Considerations** **(example text provided below isto be replaced with project-specific information)**	**Project Information**	**Adaptations**
Project Design	• Large floods (especially during and shortly after construction) could cause new bank failures and erosion. Flood impacts are also affected by stream conditions outside the Project areas.	• The Project will not change land cover or create any impervious surfaces. • The designed channel dimensions are appropriate for a stable stream. • The design connects the stream to its floodplain. The Project is expected to make the stream more resilient to future storm events and increased precipitation by creating a stable channel, creating floodplain access, improving riparian vegetation and	Best Management Practices (BMPs) will be followed during construction to minimize risks.

		repairing or removing damaged culvert infrastructure.	
Land Use	Heat stress and/or drought could make reestablishing vegetation difficult following construction	• The Project will not change land cover or create any impervious surfaces. • Some trees will need to be removed for site access as well as stream re-routing and bank re-grading • Forest type shift will be encouraged, replacing dying and dead black ash trees	• Tree removal will be kept to a minimum. • Disturbed areas will be covered with erosion control blanket, reseeded, and replanted soon after construction is completed to reduce the time bare soils are exposed. • Native species will be used to increase their chances of survival.
Water Resources	Address in item 12	Address in item 12	Address in item 12
Contamination/ Hazardous Materials/Wastes	Climate change is not expected to increase the risk of contamination from local sources	• The Project will not produce or store hazardous waste or materials.	• None
Fish, wildlife, plant communities, and sensitive ecological resources (rare features)	Address in item 14.	Address in item 14.	Address in item 14.

8. **Cover types:** Estimate the acreage of the site with each of the following cover types before and after development (utilizing the Duluth 1-Meter Land Cover Classification (Impervious Surface Focused) from U of M data repository 2016-08-01):

Cover Types	Before (acres)	After (acres)

Wetlands and shallow lakes (<2 meters deep)	0.63	0.43
Deep lakes (>2 meters deep)	0	0
Wooded/forest	4.06	4.06
Rivers/streams	0.58	0.89
Brush/Grassland	1.01	1.01
Cropland	0	0
Livestock rangeland/pastureland	0	0
Lawn/landscaping	2.69	2.58
Green infrastructure TOTAL (from table below*)	0	0
Impervious surface	0	0
Stormwater Pond (wet sedimentation basin)	0	0
Other (describe)	0	0
TOTAL	8.97	8.97

Note: the above table states that 0.63 acres of wetlands and shallow lakes are present pre- project and 0.43 acres will be present post-project, suggesting that 0.2 acres of wetlands will be impacted by the Project. However, this is not the case, because there will also be an increase of 0.31 acres in riverine wetlands (due to remeandering and removal of impoundments). This ultimately will result in zero net loss of wetlands (just type conversion) on the site. This project thus qualifies under a WCA no-loss per MN Rule 8420.0415D.

Green Infrastructure*	**Before (acreage)**	**After (acreage)**
Constructed infiltration systems (infiltration basins/infiltration trenches/ rainwater gardens/bioretention areas without underdrains/swales with impermeable check dams)	0	0
Constructed tree trenches and tree boxes	0	0
Constructed wetlands	0	0
Constructed green roofs	0	0
Constructed permeable pavements	0	0
Other (describe)	0	0
TOTAL*	0	0

Trees	**Percent**	**Number**
Percent tree canopy removed or number of mature trees removed during development	NA	32
Number of new trees planted	NA	750

9. Permits and approvals required: List all known local, state and federal permits, approvals, certifications and financial assistance for the project. Include modifications of any existing permits, governmental review of plans and all direct and indirect forms of public financial assistance including bond guarantees, Tax Increment Financing and infrastructure. *All of these final decisions are prohibited*

until all appropriate environmental review has been completed. See Minnesota Rules, Chapter 4410.3100.

Unit of Government	Type of Application	Status
MN DNR – Ecological Services	Public Waters Permit	Incomplete
MN DNR – Ecological Services	Natural Heritage Information System review	Incomplete
State Historic Preservation Office	Historic/Cultural Resource Review	Incomplete
U.S. Army Corps of Engineers	CWA Section 404	Incomplete
MN Pollution Control Agency	CWA Section 401 Water Quality Cert	Incomplete
MN Pollution Control Agency	NPDES Construction Stormwater	Incomplete
City of Duluth Engineering	Fill/Haul permit	To be submitted by contractor
City of Duluth Engineering	Shoreland Alteration	To be submitted by contractor
City of Duluth Engineering	Erosion/Sediment Control	To be submitted by contractor
City of Duluth Property Services	Use/Access License Agreement	Incomplete

Cumulative potential effects may be considered and addressed in response to individual EAW Item Nos. 10-20, or the RGU can address all cumulative potential effects in response to EAW Item No.22. If addressing cumulative effect under individual items, make sure to include information requested in EAW Item No. 21.

10. Land use:

a. Describe:

i. Existing land use of the site as well as areas adjacent to and near the site, including parks and open space, cemeteries, trails, prime or unique farmlands.

The project site is entirely within the Enger Park golf course from river miles 1 to 1.7. It is a mix of mowed open space/lawn and mixed forests. There are three ponds on the mainstem and a fourth on the tributary built as course features and/or for irrigation purposes. Adjacent land uses include forest and wetlands upstream of the golf course from river mile 1.7 to 2.4. Below the golf course, Twin Ponds constructed impoundments on Buckingham Creek built for public swimming and fishing.

ii. Plans. Describe planned land use as identified in comprehensive plan (if available) and any other applicable plan for land use, water, or resources management by a local, regional, state, or federal agency.

The City of Duluth has been very intentional about prioritizing open spaces and healthy waterways within city limits. The *Imagine Duluth 2035's Open Space* chapter prioritizes "preserving important natural habitats, supporting water resources, including stormwater management, water purification, and aquatic habitat, providing outdoor recreation, and offering scenic and cultural benefit." The Duluth's Natural Resources Management Program Plan specifically labels Enger Park as moderate in their "Significant Ecological Area" analyses in part because of its Trout Watershed status. The *Natural Resources Plan* goes on to specify the values held for open spaces.

- Preserving intact or restoring compromised native plant communities (NPCs)
- Maintaining thriving trout streams
- Supporting healthy watersheds
- Protecting sites with significant biodiversity
- Supporting more resilient ecosystems
- Maintaining a variety of functional habitats
- Supporting endangered, threatened, or special concern species
- Providing stormwater management and erosion control
- Mitigating and/or adapting for a changing climate

These ecological values serve as goals in maintaining the recreational space of Enger Park, but the ultimate focus is to perpetuate quality, affordable public golf in the City of Duluth. The city is consolidating golf courses and investing the resources of the closing course (Lester Golf Course) into renovations of the irrigation system, diversification of their water supply (addressed further in the water resources section), improved course playability and a new modern and accessible clubhouse. The restoration is to be done in tandem with course renovations and strive to implement the Natural Resource Plans goals/values for the aquatic and riparian ecosystems. There is the possibility of the City selling attached/adjacent land parcels for residential development to bring in additional revenue, but these areas would be outside the core park and outside the Buckingham Creek Watershed.

iii. Zoning, including special districts or overlays such as shoreland, floodplain, wild and scenic rivers, critical area, agricultural preserves, etc.

Floodplain and Shoreland Management

The Project will work within mapped 100- and 500-year floodplains (Appendix 6 – Flood Elevation Map). The shoreland management zone for Buckingham Creek and Tributary 2 are 'natural environment'. Buckingham and Tributary 2 are also designated as a 'cold water' shoreland management zone. Neither stream is designated as a wild and scenic river or a critical area.

Duluth Zoning

The project site and the entirety of Enger Park is zoned R-1 or traditional residential with no special zoning considerations. This means there is a possibility of greater development in the future, but this is unlikely as the City of Duluth has prioritized the Enger course over other city owned courses due to its 90+ year history and central location.

iv. If any critical facilities (i.e. facilities necessary for public health and safety, those storing hazardous materials, or those with housing occupants who may be insufficiently mobile) are proposed in floodplain areas and other areas identified as at risk for localized flooding, describe the risk potential considering changing precipitation and event intensity.

There are no critical facilities in the vicinity of the Project.

b. Discuss the project's compatibility with nearby land uses, zoning, and plans listed in Item 9a above, concentrating on implications for environmental effects.

The Project is compatible with the Enger Park Golf course and addresses course administrations concerns about water resources, course playability and fishing accessibility. Construction will be done in tandem with renovations to help minimize course closure and profit in peak golf season.

c. Identify measures incorporated into the proposed project to mitigate any potential incompatibility as discussed in Item 10b above and any risk potential.

One of the main goals of this project is to decrease the impacts of impoundments on the creek but the Project must also allay concerns about losing these irrigation sources and water hazard ponds. The Project will set stream channel elevations to maintain groundwater connections to ponds within the riparian zone, hopefully leading to zones of groundwater exchange to and from the creek. Construction will also be scheduled to ensure that restoration work is implemented in tandem with renovations, maintaining an open and playable subset of course holes.

11. Geology, soils and topography/land forms:

a. Geology - Describe the geology underlying the project area and identify and map any susceptible geologic features such as sinkholes, shallow limestone formations, unconfined/shallow aquifers, or karst conditions. Discuss any limitations of these features for the project and any effects the project could have on these features. Identify any project designs or mitigation measures to address effects to geologic features.

None of the above are within the project footprint.

b. Soils and topography - Describe the soils on the site, giving NRCS (SCS) classifications and descriptions, including limitations of soils. Describe topography, any special site conditions relating to erosion potential, soil stability or other soils limitations, such as steep slopes, highly permeable soils. Provide estimated volume and acreage of soil excavation and/or grading. Discuss impacts from project activities (distinguish between construction and operational activities) related to soils and topography. Identify measures during and after project construction to address soil limitations including stabilization, soil corrections or other measures. Erosion/sedimentation control related to stormwater runoff should be addressed in response to Item 12.b.ii.

The primary soil type identified on the United States Department of Agriculture Web Soil Survey is Ahmeek-Canosia-Rock outcrop complex (Appendix 7).

- Capable of 0-25% slopes
- Well Drained - Loamy material over dense loamy till
- Has a severe rutting/compaction potential

The nature of the Project involves impacts to the topography and soils; however, since this is a stream restoration project, we expect that those impacts will be positive, not negative. Approximately 4600 cubic yards of will be excavated but soils will serve as needed fill for the Project so project materials will be net zero soil on site. Approximately 2.5 acres of grading will be completed within the riparian corridor. Any compaction and rutting will be undone by grading and scarification of trails or equipment routes after which all exposed soils will be stabilized with erosion prevention blanketing and seeding/plantings.

- NOTE: For silica sand projects, the EAW must include a hydrogeologic investigation assessing the potential groundwater and surface water effects and geologic conditions that could create an increased risk of potentially significant effects on groundwater and surface water. Descriptions of water resources and potential effects from the project in EAW Item 12 must be consistent with the geology, soils and topography/land forms and potential effects described in EAW Item 11.

12. Water resources:

a. Describe surface water and groundwater features on or near the site in a.i. and a.ii. below.

i. Surface water - lakes, streams, wetlands, intermittent channels, and county/judicial ditches. Include any special designations such as public waters, shoreland classification and floodway/floodplain, trout stream/lake, wildlife lakes, migratory waterfowl feeding/resting lake, and outstanding resource value water. Include the presence of aquatic invasive species and the water quality impairments or special designations listed on the current MPCA 303d Impaired Waters List that are within 1 mile of the project. Include DNR Public Waters Inventory number(s), if any.

The Project will affect approximately 2,500 feet of the existing Buckingham Creek channel, a MDNR designated trout stream (S-002-000.5) and 1,200 ft of Tributary 2 (S-002-000.5-002). Buckingham Creek and Tributary 2 (0.3 miles long) together contain 2.66 miles of cold-water trout stream which is currently fragmented by a handful of anthropogenic barriers this project proposes to address. The existing channel in this stretch of the stream has been modified by constructing a dam to create a pond, creation of an in-line pond which degrades the cold-water habitat, channel straightening, several fish passage barrier culverts, removal of riparian vegetation, and water appropriation for irrigation. Despite the negative human impacts on this stretch, the stream has the potential to be restored to a healthy cold-water community, including a healthy and climate resilient Brook Trout population, while still meeting the recreational goals of the golf course.

Golf Course Pond (water body ID 69-1345-00) is within the project area and has two water quality impairments. The water body was added to Minnesota's impaired waters list in 1998 with an impairment to aquatic consumption due to mercury in fish tissue. This impairment was addressed in 2008 through the Statewide Mercury Total Maximum Daily Load (TMDL). A second impairment was identified in 2002 to aquatic consumption due to polychlorinated biphenyls (PCBs) in fish tissue and requires a TMDL be completed to address this impairment. It is not anticipated that the project will contribute to these water quality impairments and instead should improve overall water quality and habitat conditions in Buckingham Creek.

At the bottom of the golf course Buckingham Creek empties into Twin Ponds which is a designated trout lake. Twin Ponds suffers from warm water inputs from lower Buckingham Creek and this project would serve to benefit this stocked urban fishery by cooling water temperatures and increasing dissolved oxygen concentrations.

Wetlands within the project area include water hazard ponds which are identified by the NWI as open water shallow ponds (Appendix 8 – Wetlands NWI viewer) and riparian floodplain forest and sedge meadow within the mapped floodplain (Appendix 6 – Lake and Flood elevations online map). Impacts to the wetlands are for restoration purposes to restore previously dredged wetlands to Type one floodplains, therefore falling under WCA no-loss per MN Rule 8420.0415D.

ii. Groundwater – aquifers, springs, seeps. Include: 1) depth to groundwater; 2) if project is within a MDH wellhead protection area; 3) identification of any onsite and/or nearby wells, including unique numbers and well logs if available. If there are no wells known on site or nearby, explain the methodology used to determine this.

The ground water is expected to be very near the surface in many places intersecting either the stream or the valley wall. Indeed, several notable seeps and springs drive baseflow for Buckingham and Tributary 2 within the golf course. The majority of Buckingham baseflow prior to the confluence with Tributary 2 is driven by a valley wall seep in the wooded portion of the course upstream of the irrigation impoundment. The tributary flow is driven by a spring as well

as one of the water hazard ponds which intersects the groundwater.

A search of the Minnesota Department of Health's County Well Index online (Appendix 9a – MN Well Index) identified four irrigation wells to the north of the project site. The closest well (ID 469520) is approximately 1,200 ft north of the top of the project limits near the previously mentioned valley wall seep but outside of the creek's valley. The ground elevation is 1128, well depth is 209 feet with a depth to water of 26.9 and 40ft to bedrock (see Appendix 9b for well log).

The project site is not in a MDH wellhead protection area.

b. Describe effects from project activities on water resources and measures to minimize or mitigate the effects in Item b.i. through Item b.iv. below.

i. Wastewater - For each of the following, describe the sources, quantities and composition of all sanitary, municipal/domestic and industrial wastewater produced or treated at the site.

1) If the wastewater discharge is to a publicly owned treatment facility, identify any pretreatment measures and the ability of the facility to handle the added water and waste loadings, including any effects on, or required expansion of, municipal wastewater infrastructure.

Not applicable.

2) If the wastewater discharge is to a subsurface sewage treatment systems (SSTS), describe the system used, the design flow, and suitability of site conditions for such a system. If septic systems are part of the project, describe the availability of septage disposal options within the region to handle the ongoing amounts generated as a result of the project. Consider the effects of current Minnesota climate trends and anticipated changes in rainfall frequency, intensity and amount with this discussion.

Not applicable.

3) If the wastewater discharge is to surface water, identify the wastewater treatment methods and identify discharge points and proposed effluent limitations to mitigate impacts. Discuss any effects to surface or groundwater from wastewater discharges,taking into consideration how current Minnesota climate trends and anticipated climate change in the general location of the project may influence the effects.

Not applicable.

ii. Stormwater - Describe changes in surface hydrology resulting from change of land cover. Describe the routes and receiving water bodies for runoff from the project site (major downstream water bodies as well as the immediate receiving waters). Discuss environmental effects from stormwater discharges on receiving waters post construction including how the project will affect runoff volume, discharge rate and change in pollutants. Consider the effects of current Minnesota climate trends and anticipated changes in rainfall frequency, intensity and amount with this discussion. For projects requiring NPDES/SDS Construction Stormwater permit coverage, state the total number of acres that will be disturbed by the project and describe the stormwater pollution prevention plan (SWPPP), including specific best management practices to address soil erosion and sedimentation during and after project construction. Discuss permanent stormwater management plans,

including methods of achieving volume reduction to restore or maintain the natural hydrology of the site using green infrastructure practices or other stormwater management practices. Identify any receiving waters that have construction-related water impairments or are classified as special as defined in the Construction Stormwater permit. Describe additional requirements for special and/or impaired waters.

As this is a stream restoration project, there is no increase in runoff anticipated because of landcover change from the Project. Once the new riparian vegetation has established overland flow will be reduced with increased infiltration. Proper bankfull channel dimensions will also serve to reduce peak flows by increasing floodplain access and increased channel roughness during floods.

iii. Water appropriation - Describe if the project proposes to appropriate surface or groundwater (including dewatering). Describe the source, quantity, duration, use and purpose of the water use and if a DNR water appropriation permit is required. Describe any well abandonment. If connecting to an existing municipal water supply, identify the wells to be used as a water source and any effects on, or required expansion of, municipal water infrastructure. Discuss environmental effects from water appropriation, including an assessment of the water resources available for appropriation. Discuss how the proposed water use is resilient in the event of changes in total precipitation, large precipitation events, drought, increased temperatures, variable surface water flows and elevations, and longer growing seasons. Identify any measures to avoid, minimize, or mitigate environmental effects from the water appropriation. Describe contingency plans should the appropriation volume increase beyond infrastructure capacity or water supply for the project diminish in quantity or quality, such as reuse of water, connections with another water source, or emergency connections.

The golf course currently appropriates water from Buckingham Creek from the impoundment made in the channel. By disconnecting the stream, the golf course will not be able to continue appropriating from the stream. The golf course will instead be building additional irrigation ponds to be maintained with alternative water supplies from runoff, water table intersection, well water, or city water.

The stream restoration work will require several instances of dewatering/pumping to divert flows around work in channel. These impacts will be temporary and occur only during construction activities between the months of May and September, 2024.

iv. Surface Waters

a) Wetlands - Describe any anticipated physical effects or alterations to wetland features such as draining, filling, permanent inundation, dredging and vegetative removal. Discuss direct and indirect environmental effects from physical modification of wetlands, including the anticipated effects that any proposed wetland alterations may have to the host watershed, taking into consideration how current Minnesota climate trends and anticipated climate change in the general location of the project may influence the effects. Identify measures to avoid (e.g., available alternatives that were considered), minimize, or mitigate environmental effects to wetlands. Discuss whether any required compensatory wetland mitigation for unavoidable wetland impacts will occur in the same minor or major watershed and identify those probable locations.

By disconnecting and rerouting the stream around the ponds there will be a 0.2 acre decrease of wetland and shallow lake area. However, this will be offset through

added stream length, sinuosity and floodplain access which will add 0.31 acres of riverine wetland. Additionally, the reconnection of the stream to the floodplain will likely raise the water table which will benefit the floodplain ecosystems as well as enable recharge to adjacent pond features.

b) Other surface waters- Describe any anticipated physical effects or alterations to surface water features (lakes, streams, ponds, intermittent channels, county/judicialditches) such as draining, filling, permanent inundation, dredging, diking, stream diversion, impoundment, aquatic plant removal and riparian alteration. Discuss direct and indirect environmental effects from physical modification of water features, taking into consideration how current Minnesota climate trends and anticipated climate change in the general location of the project may influence the effects. Identify measures to avoid, minimize, or mitigate environmental effects to surface water features, including in-water Best Management Practices that are proposed to avoid or minimize turbidity/sedimentation while physically altering thewater features. Discuss how the project will change the number or type of watercraft on any water body, including current and projected watercraft usage.

Effects and Alterations:

Stream restoration inherently alters the surface waters by excavating new portions of channel and changing interactions between surface waters; however, the purpose of the Project is to improve the long-term water quality of these surface waters. See Section 6.b for a full description of anticipated physical alterations to surface water features.

Climate:

The restoration of Buckingham Creek will serve to strengthen and add resilience to the cold-water ecosystems of Buckingham, Tributary 2 and Twin Ponds. It is likely that groundwater exchange with adjacent ponds will increase as a result of raising the stream in locations and adding sinuosity and structures, in turn adding resilience to the shallow ponds/wetlands. See section 7.b for a full description of anticipated climate interactions and benefits.

BMPs:

All permanent direct and indirect environmental effects of restoring Buckingham Creek and Tributary 2 will be wholly beneficial. The stream channels will be restored to an appropriate pattern, profile and dimension, habitat will be created where it was formerly limited, and the riparian areas and will be planted with native plant communities. There may be temporary turbidity impacts to Buckingham Creek, but we do not expect the levels or the duration of this impact to be any greater than the impacts that would occur during a bankfull (~1.2 year recurrence) flood event. The following measures will be taken to limit impacts to the creek during construction:

- The Project will be constructed during low (summer) flows.
- Flow will be diverted/pumped around the active construction areas.
- Soil stockpiles will be stabilized with straw mulch and silt fencing or a similar best management practice to ensure that no soils are washed into the creek.
- Work will be suspended during rain events at the Engineer's discretion

Other:

There is no known watercraft usage on Buckingham Creek or Tributary 2.

13. Contamination/Hazardous Materials/Wastes:

a. Pre-project site conditions - Describe existing contamination or potential environmental hazards on or in close proximity to the project site such as soil or ground water contamination, abandoned dumps, closed landfills, existing or abandoned storage tanks, and hazardous liquid or gas pipelines. Discuss any potential environmental effects from pre-project site conditions that would be caused or exacerbated by project construction and operation. Identify measures to avoid, minimize or mitigate adverse effects from existing contamination or potential environmental hazards. Include development of a Contingency Plan or Response Action Plan.

According to *What's In My Neighborhood* database (Appendix 10), MPCA Leak Site LS0007387 is located proximate to the golf course clubhouse buildings. While MPCA site closure occurred in 1995, there remains a possibility that residual contamination may still be present. Since future development of the property and surrounding area are planned, it should be assumed that contamination may still be present.

b. Project related generation/storage of solid wastes - Describe solid wastes generated/stored during construction and/or operation of the project. Indicate method of disposal. Discuss potential environmental effects from solid waste handling, storage and disposal. Identify measures to avoid, minimize or mitigate adverse effects from the generation/storage of solid waste including source reduction and recycling.

We do not expect there to be any solid waste generated by the Project. There may however be minor amounts of waste, such as plastic and paper containers, fabrics, and packaging. All waste will be collected, bagged, and properly disposed of at the end of each work day.

c. Project related use/storage of hazardous materials - Describe chemicals/hazardous materials used/stored during construction and/or operation of the project including method of storage. Indicate the number, location and size of any new above or below ground tanks to store petroleum or other materials. Indicate the number, location, size and age of existing tanks on the property that the project will use. Discuss potential environmental effects from accidental spill or release of hazardous materials. Identify measures to avoid, minimize or mitigate adverse effects from the use/storage of chemicals/hazardous materials including source reduction and recycling. Include development of a spill prevention plan.

Possible Hazardous materials used in the project work would include fuels, oils and lubricants for the construction machinery during the construction phase of the Project. Accidental spills or leakages are possible from machinery during work or the refueling process and could have negative impacts on the soils/ecosystem. The amount of these fluids will be limited and any refueling or maintenance will be done a specified, safe distance from the stream or other surface waters. The Project will not need or generate any other hazardous chemicals or materials.

A Spill Prevention Control and Countermeasure plan (SPCC plan) will be prepared prior to beginning the construction phase of the Project. The SPCC plan will require:

- Proper equipment, spill kits, methods and trained personnel on site at all times to minimize the potential for spills and mitigate spills if they do occur
- A site-specific health and safety plan for use by workers during construction
- Fueling and maintenance to be conducted at least 100 feet from any surface waters

- Any spill or release of hazardous materials of hazardous materials be reported to the construction site supervisor who will immediately take actions to minimize the potential for contamination of surface or ground waters
- In the event of a significant spill or release of a hazardous material or a petroleum product, or if contamination is encountered during project work, the construction site supervisor will immediately deploy on-site equipment and supplies to contain the spill and contact the MDNR, MPCA and the Minnesota Duty Officer at (651) 649-5451, according to emergency procedures identified in Minnesota Rules, part 7045.0574
- Temporary storage of fuels will not be allowed within the 100 year floodplain
- Below ground storage tanks will not be allowed

d. Project related generation/storage of hazardous wastes - Describe hazardous wastes generated/stored during construction and/or operation of the project. Indicate method of disposal. Discuss potential environmental effects from hazardous waste handling, storage, and disposal. Identify measures to avoid, minimize or mitigate adverse effects from the generation/storage of hazardous waste including source reduction and recycling

The Project will not generate or store hazardous wastes during construction.

14. Fish, wildlife, plant communities, and sensitive ecological resources (rare features):

a. Describe fish and wildlife resources as well as habitats and vegetation on or in near the site.

Fish

In 2022 fish surveys were completed for three sites on Buckingham Creek and one on Tributary 2 (Appendix 5 – Fish Data). The lowest reach just upstream of Twin Ponds (Site 22LS014) found Jonny Darter, White Sucker and 15 Smallmouth Bass, roughly 80% of which were young of year (YOY). Below the irrigation impoundment (Site 22LS011), sampling found 52 Brook Trout (60% were YOY) and one White Sucker. The reach upstream of the project site (22LS012) found 66 Brook Trout that were on average more mature with 33% being YOY. Tributary 2 (Site 222LS011) contained 5 Brook Trout with some Fathead Minow and White Sucker.

The reach upstream of the project site contains the most intact coldwater fish community and suggests the resilience of the aquatic ecosystem in that reach, and the potential for the reaches within the project site. This is likely a result of the groundwater sources, healthy shading canopy and good in-stream pool habitat and large woody debris cover. The poorer communities in the lower sites suggest that there is degradation of the cold-water habitat. The main driver of this is pond temperatures (see section 6.b and 6.d) but the straightened, uniform channel through the golf course fairways are also a driver, with a lack of shade and woody debris. Tributary 2 had a moderate community, with a mix of Brook Trout and warm water fish since it is a wooded/shaded channel with strong cold baseflow but lacks habitat complexity, is ditched and has seasonally stressing warm temperatures because of pond-dominated flow in peak summer months.

Wildlife

Resident wildlife species include white-tailed deer, black bears, furbearers (coyotes, bobcats, raccoon and mink), cottontail rabbits and a variety of small mammals (mice, bats, voles, shrews). A wide variety of bird species frequent the area including raptors (bald eagles, hawks, and owls), waterfowl (wood ducks, mallards, and Canada geese), waterbirds (kingfishers, great blue herons) and songbirds. Reptiles and amphibians are also known to frequent the area with several turtle species residing in the golf course ponds, twin ponds and neighboring wetlands.

Vegetation

The Project is located within the North Shore Highlands subsection of the Northern Superior Uplands as determined by the Ecological Classification System of Minnesota. Historically the forest type in the area was likely comprised of species within the Northern Rich Mesic Hardwood Forest, such as Sugar Maple, White Cedar, and Yellow Birch. Today the project area is dominated by a deciduous hardwood forest with dead or dying ash trees, invasive species (Buckthorn and European Mountain Ash), and the mowed grasses of the golf course.

b. Describe rare features such as state-listed (endangered, threatened or special concern) species, native plant communities, Minnesota Biological Survey Sites of Biodiversity Significance, andother sensitive ecological resources on or within close proximity to the site. Provide the license agreement number (LA-____) and/or correspondence number (MCE_____) from which the data were obtained and attach the Natural Heritage Review letter from the DNR. Indicate if any additional habitat or species survey work has been conducted within the site and describe the results.

The MDNR's Natural Heritage Information System was accessed as part of a Conservation Partners Legacy grant proposal in August, 2023 to determine if any rare plant or animal species or significant natural features are known to occur within a one mile radius of the proposed project area (Appendix 11 – NHIS Review). Three rare or special concern species were identified which may be adversely affected by the proposed project: American Eel (Anguilla rostrate), Lake Chub (Couesius plumbeus), and Blanding's Turtle (Emydoidea blandingii). American Eel and Lake Chub reside in the St. Louis River Estuary or Lake Superior and thus won't be adversely affected by this project. However, it is possible that Blanding's Turtle reside within or in close proximity to the project site. If review by the Natural Heritage Program reveals that Blanding's Turtle presence is likely, the following MNDNR guidelines will be followed:

- An informational flyer (Appendix 12 – Blanding's Turtle Flyer) will be posted on site and provided to the construction crew.
- Turtles which are in imminent danger should be moved, by hand, out of harms' way. Turtles which are not in imminent danger should be left undisturbed.
- If a Blanding's turtle nests in the area, the nest will not be disturbed
- Silt fencing will be set up to keep turtles out of construction areas. Silt fencing will be removed after the area has been revegetated.

c. Discuss how the identified fish, wildlife, plant communities, rare features and ecosystems may be affected by the project including how current Minnesota climate trends and anticipated climate change in the general location of the project may influence the effects. Include a discussion on introduction and spread of invasive species from the project construction and operation. Separately discuss effects to known threatened and endangered species.

The Project will have minor temporary impacts on fish and wildlife communities. There may be a temporary displacement of certain species and because of earth moving and dewatering there may be harm to small fish, macroinvertebrates and other species that cannot easily leave the project area. Noise, tree removal and other activity may also disturb terrestrial wildlife. There will, however, only be positive impacts in the long term given the projects' goals of restoring ecosystem function, increasing riparian habitat, reducing stream temperatures and improving connectivity.

Impacts to plant communities are anticipated to be positive, as most of the project site consists of turf grass, invasive species, or declining ash forest. These plant communities will be replaced with native species of the Wet Meadow / Shrub Carr plant community or the Northern Rich Mesic

Hardwood Forest plant community. Some plants will be destroyed in the making of access paths and re-grading the streambanks and floodplain, but tree removal will be kept to a minimum. These areas will be stabilized to prevent future erosion and reseeded with native grasses, forbs, and sedges. Native shrubs and trees will also be planted where possible. No change in cover type is anticipated.

The Project is not anticipated to have any negative impacts when considering future climate trends. The Project will make the stream channels and riparian areas more stable and therefore resilient to larger and more frequent storm and flood events which would be beneficial to fish, wildlife, and plant communities.

d. Identify measures that will be taken to avoid, minimize, or mitigate the adverse effects to fish, wildlife, plant communities, ecosystems, and sensitive ecological resources.

Short-term impacts to fish and wildlife resources and habitats in downstream areas will be minimized using the following measures:

- Channel excavation scheduling will minimize areas disturbed at one time.
- Constructing and stabilizing the new stream channels prior to the re-introduction of flow, thereby reducing erosion at the sites and minimizing downstream water quality effects.
- Use of erosion control blankets on all newly constructed stream channels, and rapid re-vegetation of areas affected by construction with native plants will minimize sediment transport off site and reestablish better wildlife habitat.
- Stockpiles of dirt, rock, and/or toe wood will be stored away from the stream and surrounded by silt fence to prevent sedimentation.
- Plantings and in-stream habitat structures such as rock vanes and cross rock vanes will minimize long-term erosion of streambanks.

Though there are no known occurrences of Northern Long-eared Bat roosts or hibernacula within one mile of the project area, tree clearing will be minimized on site and timed to avoid hibernation season. Trees will be cleared only as needed for construction and construction access.

As described in MDNR Operational Order 113 on Invasive Species, the following project management BMPs will be applied:

- Before arriving at a work site, inspect the equipment and remove visible plants, seeds, mud, dirt clods, and animals. All machinery will be thoroughly pressure washed before entering the project area to avoid the introduction of invasive species; using a broom or brush will be sufficient when moving within a work site.
- Before leaving a work site, inspect the equipment and remove visible plants, seeds, mud, dirt clods, and animals.
- Do not plant or introduce prohibited or regulated invasive species or other listed invasive species as listed on the DNR website and the “Op Order 113 Invasive Species List” unless by permit.
- Use only mulch, soil, gravel, etc. that is free of invasive species or remove the top six inches of material to reduce the likelihood invasive species will be introduced or spread. Certified weed-free products such as weed-free seed or hay will be used.
- Do not move soil, dredge material, or raw wood products that may harbor invasive species from infested sites except under contract specifications, permit or compliance agreements.
- Inspect transplanted vegetation for signs of invasive species that may be attached to the vegetation and remove them (i.e. other plant material and animals, etc.).
- Post-project treat any new infestations promptly where feasible to prevent populations from spreading.

Additional standard DNR protocols include:

- Work from the upper to the lower waters within a watershed.
- Minimize soil disturbance with equipment.
- Minimize number of access points to site.
- Carry boot brush in all vehicles and clean boots and clothing (in a controlled area) before leaving any site. Disinfect boot brush between sites.
- Avoid parking in or moving through existing patches of invasive species when getting to and from the work site. When unavoidable, clean vehicle of all visible evidence of soil and vegetation when leaving the parking site.

Further procedures used to meet Operational Order 113 and FAW discipline standards include:

- No sediment or water should be moved between water bodies.
- Any water pumped out of a water body should be released into the same water body or drained on land where it cannot enter surface water.
- Aquatic vegetation cannot be transported from any water listed as infested.
- Construction equipment should be cleaned and disinfected according to specific Operational Order guidelines prior to leaving site.

The spread of invasive species in the project site will also be addressed with a 3-year vegetation maintenance plan which will be included in the project contract, as follows:

1. The project area will be monitored by the Contractor once per month during the growing season. It will be inspected for germination and/or growth of desired natives, presence of non-native weeds, damage to erosion control materials or bioengineering structures, plant material or protective structures, or the presence of damage from flooding or drought. Any concerns and recommended actions should be reported to the Funding Agency (South St. Louis SWCD) upon inspection.
2. During the first growing season, the project area may need to be mowed to control annual weed development. If a "closed" canopy of weed cover develops, it should be mowed to aid in the growth of the seedlings by reducing competition. Mowing may also be necessary if the weeds are about to set seed. Optimum cutting height, depending on the species present, is typically 4 to 6 inches.
3. In years following the first growing season, management services could include site monitoring, mowing, spot spraying, spot mowing, and herbicide wicking or hand-weeding.

Projected Management Procedures, by Year:

Year 1 Project Monitoring (1 per month during active growing season)
Complete site mowings to control annual weed canopy (2 or 3 mowings as needed)

Year 2 Project Monitoring (1 per month during active growing season)
Complete site mowing (if needed)
Integrated Plant Management (IPM) – includes spot spraying, spot mowing, wicking, hand-weeding, and other techniques to control weeds and invasive species (4 visits)

Year 3 Project monitoring (1 per month during active growing season.
Complete site mowing (if needed)
Management (IPM) (4 visits)

At the end of the maintenance period, the Project will have at least 80% overall coverage with the planted native species, and no greater than 20% non-native weeds or invasive species. Tree and shrub plantings will be showing adequate growth to provide functional stabilization. At the completion of the

maintenance period, the vegetation will meet the guarantee standards, or the Contractor will be required to continue maintaining the vegetation at no cost to the Funding Agency or Owner(s), and/or re-seed and re-plant as necessary to achieve the standards.

15. Historic properties:

Describe any historic structures, archeological sites, and/or traditional cultural properties on or in close proximity to the site. Include: 1) historic designations, 2) known artifact areas, and 3) architectural features. Attach letter received from the State Historic Preservation Office (SHPO). Discuss any anticipated effects to historic properties during project construction and operation. Identify measures that will be taken to avoid, minimize, or mitigate adverse effects to historic properties.

A Phase 1 archaeological survey was completed in the fall of 2023. Personal communication with the licensed archaeologist revealed that no indications of archaeological sites were found since most areas are floodplain or previously disturbed and so were not testable. The Phase 1 Survey Report is forthcoming and NHPA Section 106 review/determination process will proceed once the report is complete.

16. Visual:

Describe any scenic views or vistas on or near the project site. Describe any project related visual effects such as vapor plumes or glare from intense lights. Discuss the potential visual effects from the project. Identify any measures to avoid, minimize, or mitigate visual effects.

The aesthetics of the golf course will be temporarily impacted by the construction and equipment but work will be done in tandem with City renovation of the irrigation system to minimize impact and playability of the course. Project construction might be temporarily visible from the nearby Enger Tower, but the Project is on the upland side of the tower opposite from the view of Lake Superior, Downtown Duluth and the Twin Ports harbor. Ultimately the Project will improve course and stream aesthetics by daylighting portions of piped stream, re-meandering ditched portions and restoring native vegetation and riparian habitat.

17. Air:

a. Stationary source emissions - Describe the type, sources, quantities and compositions of any emissions from stationary sources such as boilers or exhaust stacks. Include any hazardous air pollutants, criteria pollutants. Discuss effects to air quality including any sensitive receptors, human health or applicable regulatory criteria. Include a discussion of any methods used assess the project's effect on air quality and the results of that assessment. Identify pollution control equipment and other measures that will be taken to avoid, minimize, or mitigate adverse effects from stationary source emissions.

   No stationary source emissions will be generated by the Project.

b. Vehicle emissions - Describe the effect of the project's traffic generation on air emissions. Discuss the project's vehicle-related emissions effect on air quality. Identify measures (e.g. traffic operational improvements, diesel idling minimization plan) that will be taken to minimize or mitigate vehicle-related emissions.

   Construction-related emissions will be exempt as de minimus and they will meet the conformity

requirements under Section 176 (c) of the Clean Air Act, and 40 CFR 93.153. Emissions from heavy machinery and vehicles such as excavators, loaders, and trucks will be minor and temporary. Fuel exhaust emissions contain pollutants including carbon monoxide, nitrogen oxides, reactive organic gases, sulfur dioxide, and suspended particulate matter, all of which carry some associated health risks.

c. Dust and odors - Describe sources, characteristics, duration, quantities, and intensity of dust and odors generated during project construction and operation. (Fugitive dust may be discussed under item 17a). Discuss the effect of dust and odors in the vicinity of the project including nearby sensitive receptors and quality of life. Identify measures that will be taken to minimize or mitigate the effects of dust and odors.

Some dust may be created but most work will occur in the damp floodplain or work in wet channel/pond so dust should be minimal. If conditions become dry and create dust, dust reduction measures will be taken such as covering loads during transportation, placing mulch and erosion control on exposed soils and stockpiles and watering access routes and exposed soils in dry conditions.

18. Greenhouse Gas (GHG) Emissions/Carbon Footprint

a. GHG Quantification: For all proposed projects, provide quantification and discussion of project GHG emissions. Include additional rows in the tables as necessary to provide project-specific emission sources. Describe the methods used to quantify emissions. If calculation methods are not readily available to quantify GHG emissions for a source, describe the process used to come to that conclusion and any GHG emission sources not included in the total calculation.

Greenhouse gas emissions related to the Project are only expected to stem directly to the construction phase since there will be no permanent infrastructure or ongoing operations to emit operational GHGs. The construction is slated to run from May 2024 to September 2024. For this assessment construction GHG emissions included:

- On-road vehicle emissions: haul trucks, etc.
- Off-road vehicle emissions: earthmoving equipment (excavators, loaders, etc.)

On Road vehicle emissions will largely consist of haul truck traffic which will be needed to bring equipment and supplies to the project site.

Off Road vehicles will consist of construction equipment that will remain on the project site for the duration of the Project. This includes earthmoving equipment such as excavators and dozers. The exact equipment to be used will left to the contractor to select so for this assessment we will assume two diesel powered off-road construction vehicles. These will be operated for the duration of the construction period of 85 days for the hours of 7:00am to 7:00pm. There may be some variation in operating hours due to seasonal worktime fluctuation or inclement weather but this assessment will assume the maximum allowable hours for this project timeframe.

According to our assessment, carbon emission related to on road vehicle emissions will be approximately 11.6 metric tonnes and construction vehicle emissions will be 156.2 metric tonnes. Total carbon emissions will be 167.8 metric tonnes.

The following tables are examples; other layouts are acceptable for providing GHG quantification results

Construction Emissions

On- road Equipment	Trucks/hr	Hrs/day	Days	Miles	Est. miles	miles/gal	Est. gals	Emission Factors[1]			Emissions			
								CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2e^2
								kg/gal	g/mile	g/mile	MT	MT	MT	MT
Diesel Haul Trucks	1	2	85	40	6,800	6	1,133	10.21	0.0095	0.0431				
Diesel Construction Equipment	2	12	85	1	2,040	.13	15,300	10.21	0.2	0.47				

[1] EPA Emission Factors for Greenhouse Gas Inventories Tables 2, 3, and 4 (updated March 26, 2020)
https://www.epa.gov/sites/production/files/2020-04/documents/ghg-emission-factors-hub.pdf
[2] CO2e emissions calculated using Global Warming Potentials from 40 CFR Part 98 Subpart A Table A-1 (CO2e= 1*CO2+25*CH4+298*N2O)

b. GHG Assessment
   i. Describe any mitigation considered to reduce the project's GHG emissions.
   ii. Describe and quantify reductions from selected mitigation, if proposed to reduce the project's GHG emissions. Explain why the selected mitigation was preferred.
   iii. Quantify the proposed projects predicted net lifetime GHG emissions (total tons/#of years) and how those predicted emissions may affect achievement of the Minnesota Next Generation Energy Act goals and/or other more stringent state or local GHG reduction goals.

No mitigation is proposed to offset the project's GHG emissions. Any emissions that stem from construction will be exempt as de minimis and will meet the conformity requirements under Section 176 (c) of the Clean Air Act, and 40 CFR 93.153. There will not be any operational GHG emissions and the selected contractor will be encouraged to reduce GHG emissions from construction, which may include minimizing idling equipment or encouraging carpooling to the site by equipment operators.

19. Noise

Describe sources, characteristics, duration, quantities, and intensity of noise generated during project construction and operation. Discuss the effect of noise in the vicinity of the project including 1) existing noise levels/sources in the area, 2) nearby sensitive receptors, 3) conformance to state noise standards, and 4) quality of life. Identify measures that will be taken to minimize or mitigate the effects of noise.

Noise generated from the Project will be temporary and will only occur during construction hours. Earth-moving equipment will generate noise such as engine noise, rock on metal and backup safety alarms. This equipment will generate noise during workday daytime hours and will occur for a time between July 1st and September 15th.

The contractor will be required to minimize noise effect by:
- Restrict equipment operation only during daylight hours (6am – 7 pm), Monday-Saturday.
- Require all equipment to have properly operating muffler systems.
- Restrict idling time for inactive equipment to 15 minutes.

There are no nearby residences, schools or hospitals that qualify as sensitive receptors. There may be some noise considered disruptive for golfers as golf will also be happening largely during operating hours. Disruption will be minimized though by timing work to coincide with course renovations and equipment work being conducted by the city/golf course. Golf play will only be allowed on certain holes further minimizing possible contact/proximity.

20. Transportation

a. Describe traffic-related aspects of project construction and operation. Include: 1) existing and proposed additional parking spaces, 2) estimated total average daily traffic generated, 3) estimated maximum peak hour traffic generated and time of occurrence, 4) indicate source of

trip generation rates used in the estimates, and 5) availability of transit and/or other alternative transportation modes.

1) No additional parking spaces will be necessary during project operations. Construction crews will park vehicles at proposed staging areas, removed from public roadways and golf access points.

2) Movement of crews, the acquisition of construction materials, and refueling may generate a temporary traffic increase in the vicinity.

3) Off-site vehicle movements will occur mostly at the start and end of the work day but hauling of materials, equipment or fuel could occur at any time during the hours of equipment operation from 7:00 AM to 7:00 PM.

4) Normally less than 20 daily trips are anticipated.

5) There will be no need for any alternative transportation.

b. Discuss the effect of traffic congestion on affected roads and describe any traffic improvements necessary. The analysis must discuss the project's impact on the regional transportation system. *If the peak hour traffic generated exceeds 250 vehicles or the total daily trips exceeds 2,500, a traffic impact study must be prepared as part of the EAW.* Use the format and procedures described in the Minnesota Department of Transportation's Access Management Manual, Chapter 5 *(available at: http://www.dot.state.mn.us/accessmanagement/resources.html)* or a similar local guidance.

No project-related congestion is expected, and the Project will not generate an additional 250 vehicles or 2,500 trips per day on affected roads. During construction, six to eight vehicle trips per day will be required, including 2-3 trips per day for the workday, plus 1-2 trips per day as required by the site construction crew.

c. Identify measures that will be taken to minimize or mitigate project related transportation effects.

No significant project-related transportation effects are anticipated. Signs indicating construction activity or trucks entering/hauling will be posted on Skyline Parkway as needed.

21. **Cumulative potential effects:** (Preparers can leave this item blank if cumulative potential effects are addressed under the applicable EAW Items)

    a. Describe the geographic scales and timeframes of the project related environmental effects that could combine with other environmental effects resulting in cumulative potential effects.

    The proposed project will occur over a period of 4 months, during 2024 low flow (summer) conditions and in a project area of 8.5 acres within Enger Park Golf course. This is designed to coincide with course renovations being done by the city to minimize disturbance to park/golf operations but this could potentially lead to compounded environmental stressors on local wildlife. Cumulative impacts such as additive noise, emissions or other activity could startle or disturb wildlife more than one of these projects on their own.

    b. Describe any reasonably foreseeable future projects (for which a basis of expectation has been laid) that may interact with environmental effects of the proposed project within the geographic scales and timeframes identified above.

    There are no other future projects in the Buckingham Creek project area but there are other upcoming projects on adjacent Coffee Creek within the golf course boundaries. These efforts are currently being led by MNDNR and will have different timelines and EAWs from work on Buckingham creek.

    c. Discuss the nature of the cumulative potential effects and summarize any other available information relevant to determining whether there is potential for significant environmental effects due to these cumulative effects.

    The SWCD anticipates minor and temporary negative cumulative effects including emissions, fuel use, noise and turbidity, all of which have been addressed in this EAW.

    The long term positive effects from implementing this restoration work should provide far greater benefits to the cold-water ecosystem in Buckingham Creek and downstream Twin Ponds. These benefits will improve cold water temperature conditions, quantity, quality and diversity of habitat, longitudinal connectivity, riparian and aquatic vegetation and aesthetics of the creek and golf course.

22. **Other potential environmental effects:** If the project may cause any additional environmental effects not addressed by items 1 to 19, describe the effects here, discuss the how the environment will be affected, and identify measures that will be taken to minimize and mitigate these effects.

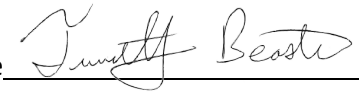
    All potential environmental impacts have been addressed.

RGU CERTIFICATION. *(The Environmental Quality Board will only accept **SIGNED** Environmental Assessment Worksheets for public notice in the EQB Monitor.)*

I hereby certify that:

- The information contained in this document is accurate and complete to the best of my knowledge.
- The EAW describes the complete project; there are no other projects, stages or components other than those described in this document, which are related to the project as connected actions or phased actions, as defined at Minnesota Rules, parts 4410.0200, subparts 9c and 60, respectively.

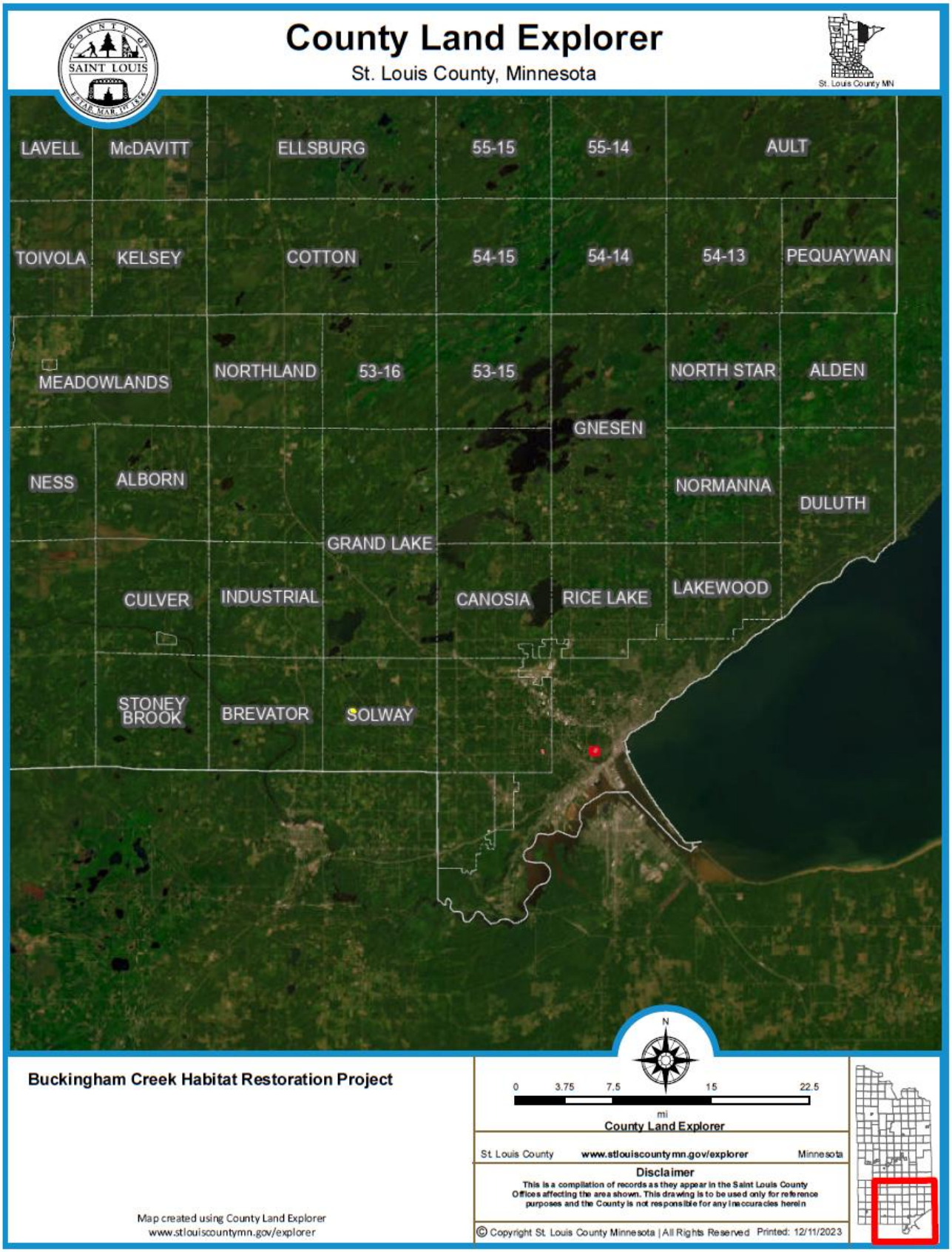
- Copies of this EAW are being sent to the entire EQB distribution list.

Signature  Date 12/12/2023

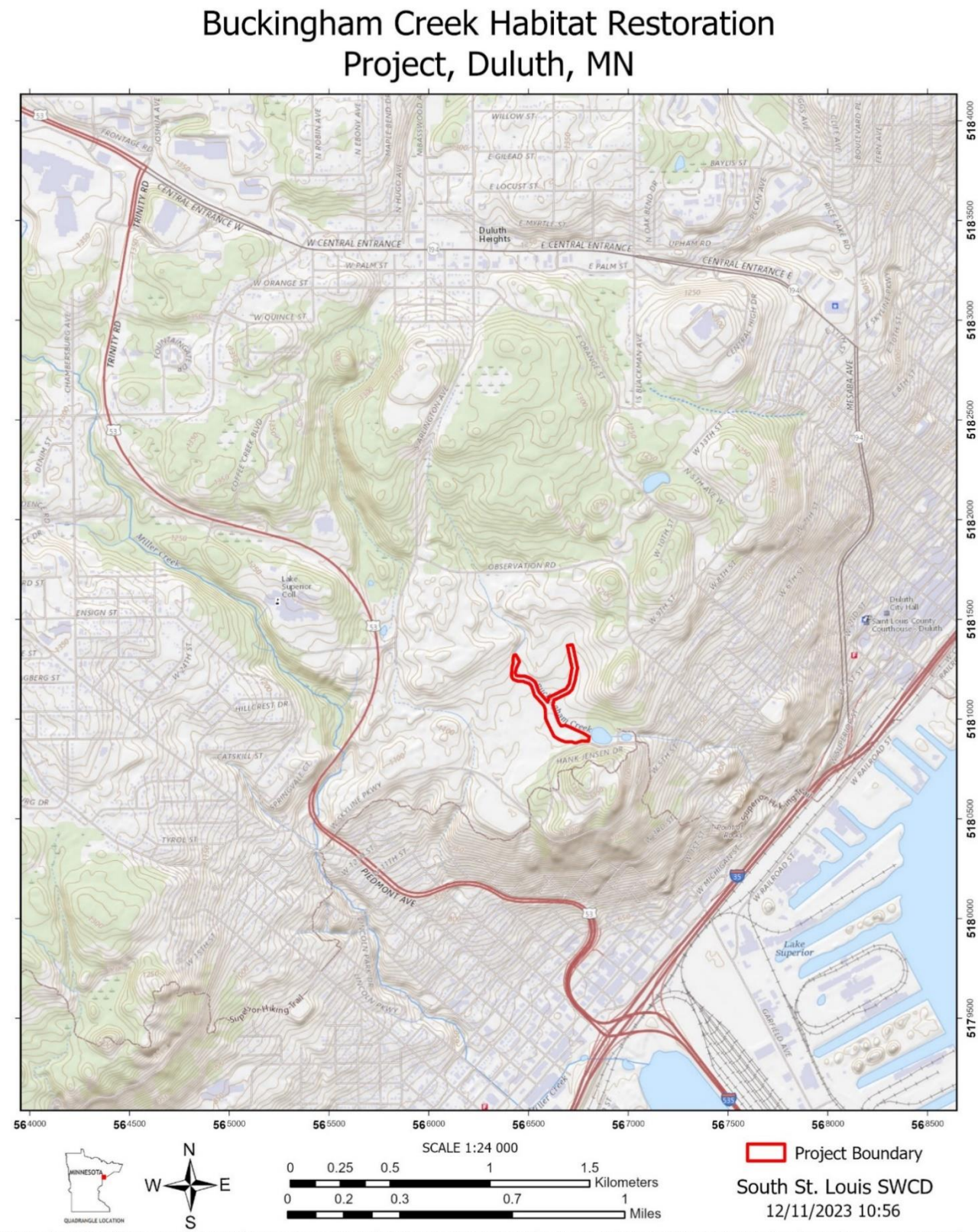
Title Conservation Specialist

Appendices

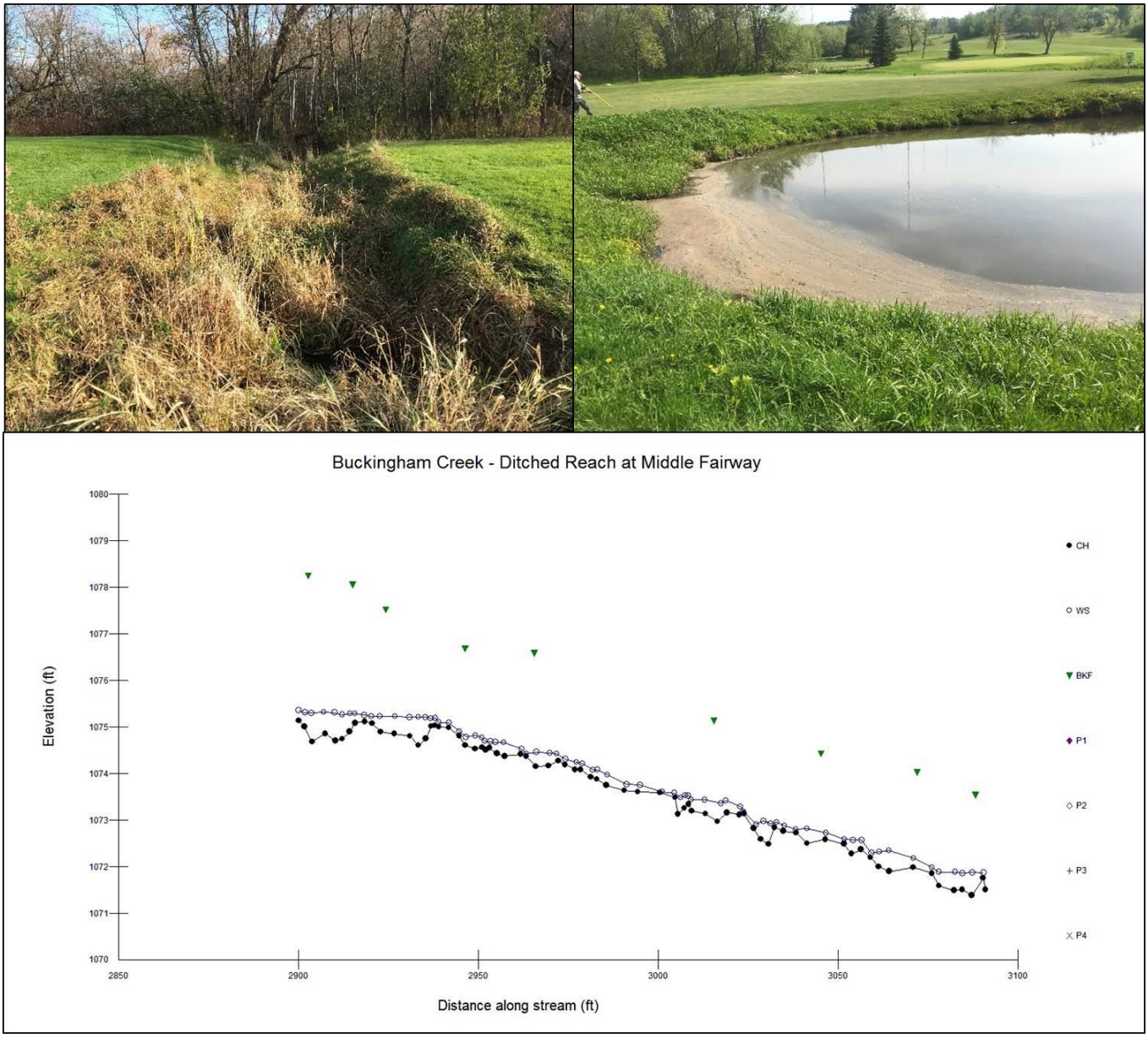
1. **Site Map**



2. USGS 1:24k site map

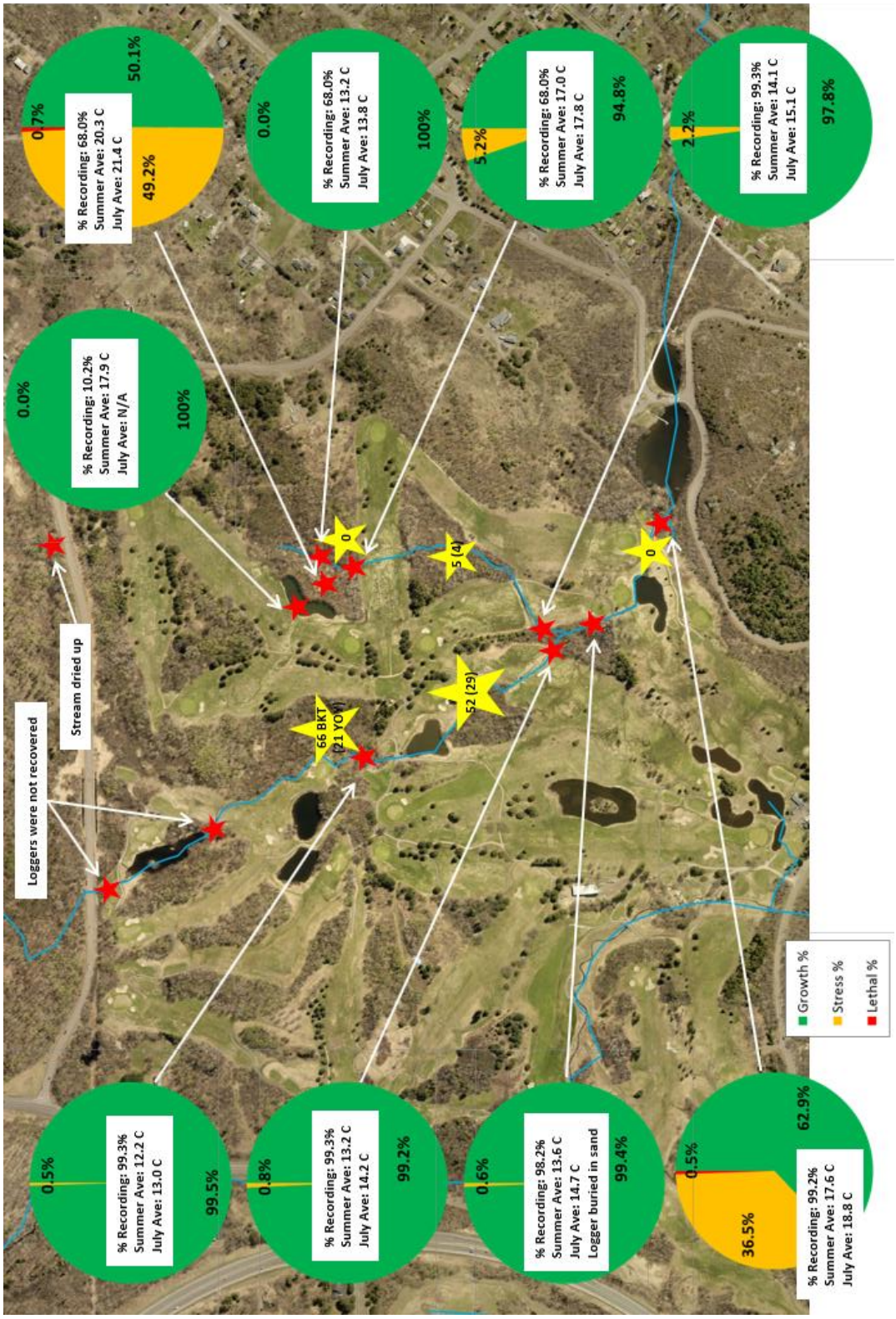


3. Current Conditions as Assessed by South St Louis SWCD June 2023



Upper Left: Photo of a ditched portion of Bucking Creek overrun with Reed Canary Grass and minimal riparian vegetation buffer or shading. Upper Right: Photo of the lowermost in-line pond that is the largest temperature-degrading feature in the golf course. Bottom: Longitudinal profile of one of the ditched reaches, showing very little planform diversity and a lack of pool habitat.

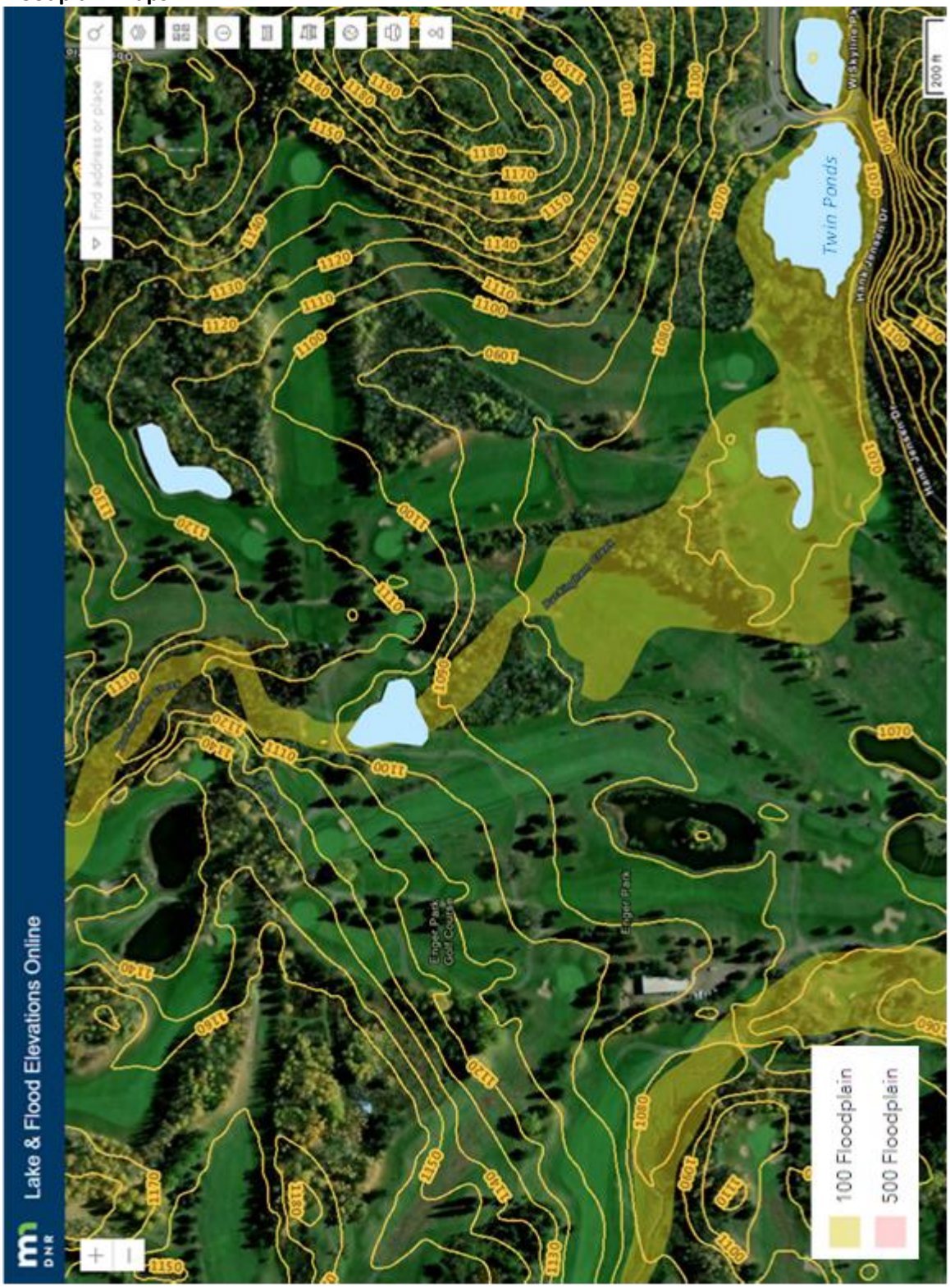
4. Temperature Data – collected 2022 season in collaboration with MPCA



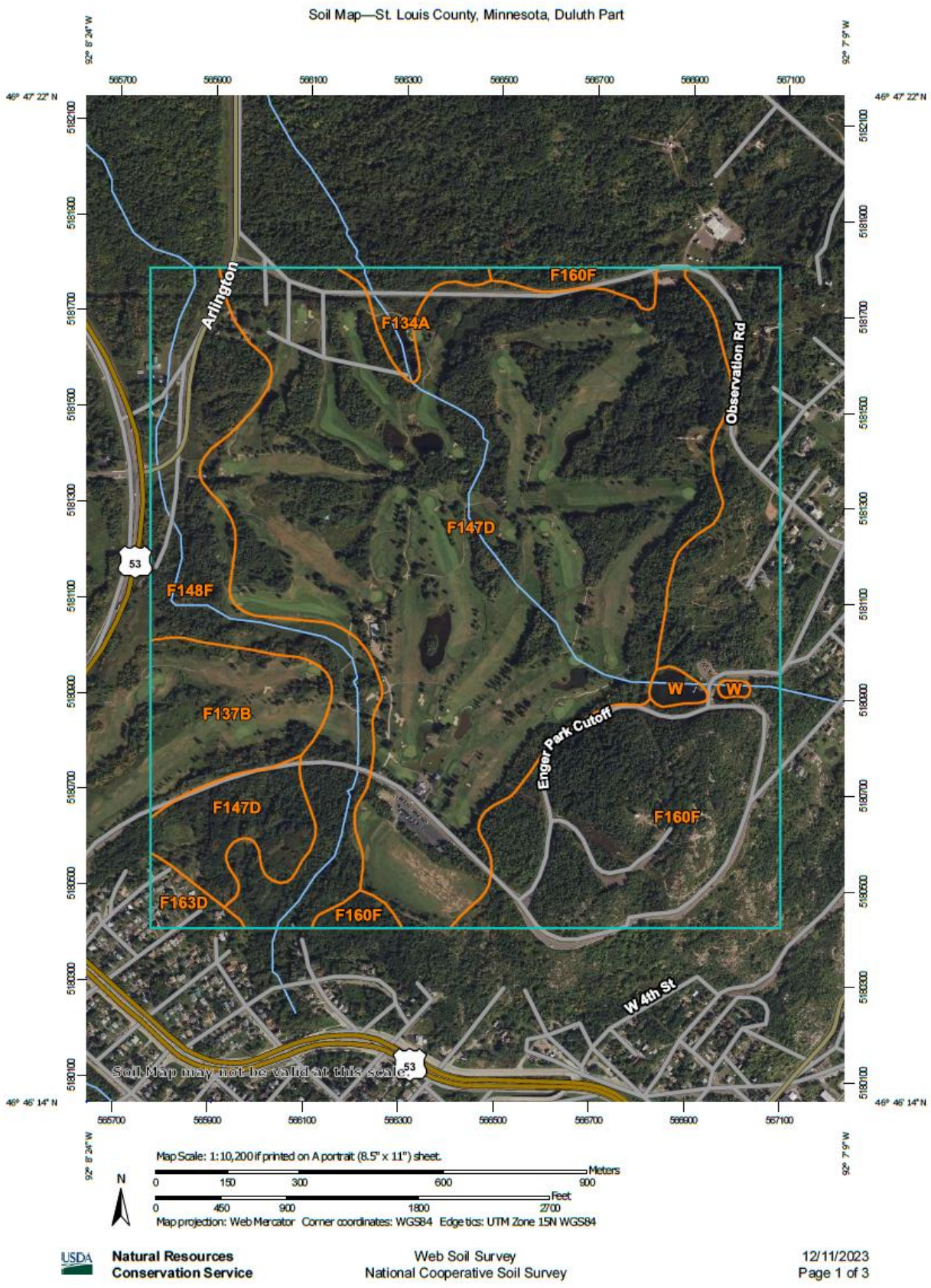
5. Fish Bio-sampling Data and bio-sites map – 2022 collected in collaboration with MPCA

STATION							
22LS012	Species	Number	Length Range (mm)	Batch Wt. (g)	YOY**	YOY %	DELT*
	Brook Trout	63	63-205	1211	20	32%	None observed
	No other species sampled in pass 1						
	Pass #2 – Brook Trout Only						
	Brook Trout	3	70-138	55	1	33%	None observed
22LS010	Species	Number	Length Range (mm)	Batch Wt. (g)	YOY**	YOY %	DELT*
	Brook Trout	42	60-173	871	23	58%	1 Spinal Deformity
	White Sucker	1	157-157	34	-	-	None observed
	Pass #2 – Brook Trout Only						
	Brook Trout	10	60-162	132	6	60%	None observed
22LS014	Species	Number	Length Range (mm)	Batch Wt. (g)	YOY**	YOY %	DELT*
	Johnny Darter	81	36-74	109	40	49%	None observed
	White Sucker	22	40-262	320	14	64%	None observed
	Smallmouth Bass	15	57	57	12	80%	2 – Tumors/Lesions
22LS011	Species	Number	Length Range (mm)	Batch Wt. (g)	YOY**	YOY %	DELT*
	Brook Trout	5	61-160	62	4	80%	None observed
	Fathead Minnow	20	57-71	59	-	-	None observed
	White Sucker	1	71-71	4	-	-	None observed

6. **Floodplain Maps**



7. NRCS Soils map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: St. Louis County, Minnesota, Duluth Part
Survey Area Data: Version 21, Sep 10, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 30, 2020—Sep 18, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

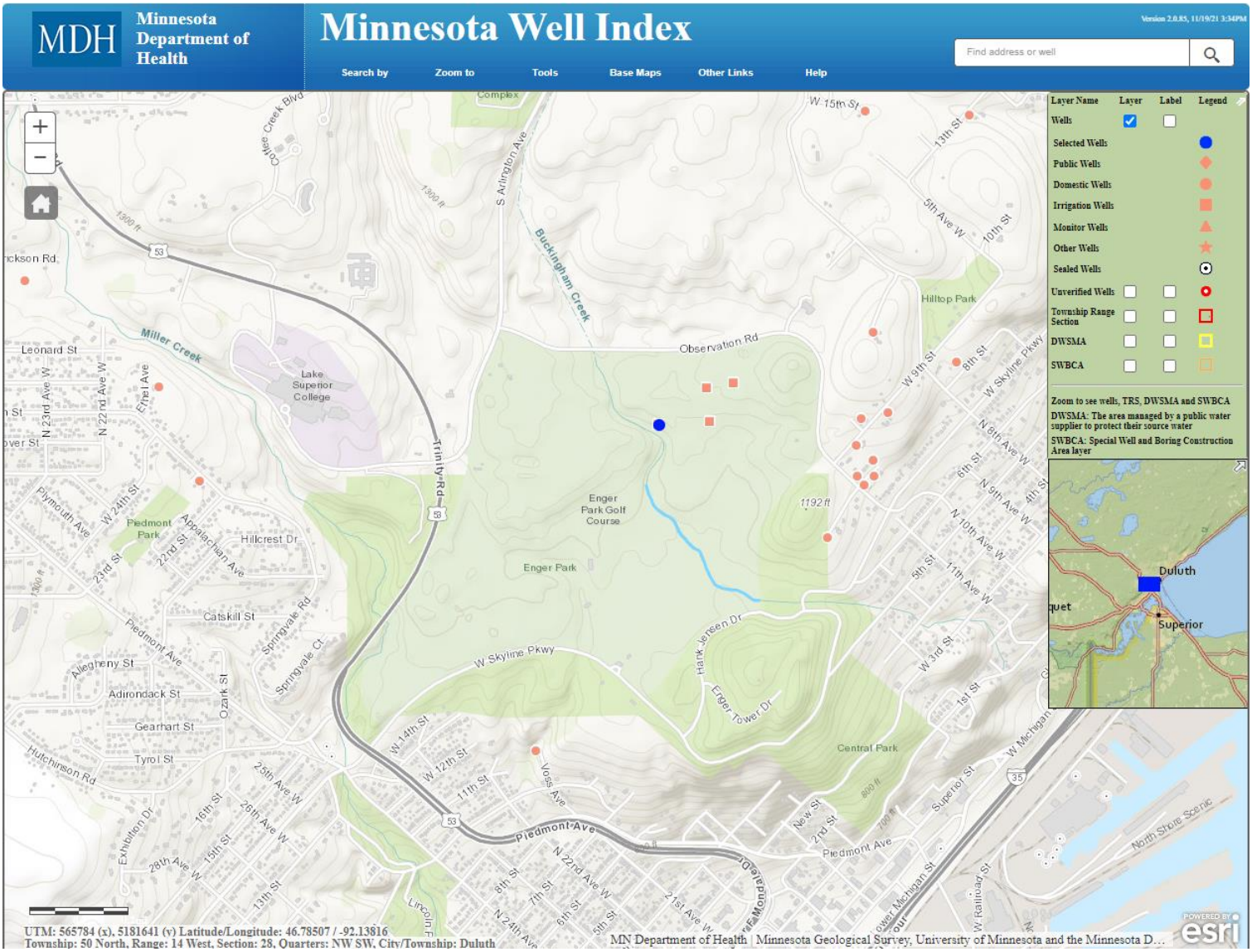
Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
F134A	Giese muck, depressional, 0 to 1 percent slopes	6.6	1.5%
F137B	Normanna-Canosia-Hermantown complex, 0 to 8 percent slopes	24.4	5.4%
F147D	Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes	246.2	54.4%
F148F	Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes	59.0	13.0%
F160F	Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes	110.1	24.3%
F163D	Urban land-Mesaba-Rock outcrop complex, 1 to 18 percent slopes	4.3	0.9%
W	Water	2.3	0.5%
Totals for Area of Interest		**452.9**	**100.0%**

8. National Wetland Inventory

9. **Minnesota Well Index**

   a. **Well Locations**



b. Well Log of selected Enger Irrigation Well

Minnesota Unique Well Number: **469520**

County: St. Louis
Quad: Duluth
Quad ID: 244C

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING REPORT
Minnesota Statutes Chapter 1031

Entry Date: 05/10/1991
Update Date: 12/05/2019
Received Date:

Well Name	Township	Range	Dir Section	Subsection
CITY OF	50	14	W 28	CBDBBC

Elevation: 1128 Elev. Method: LiDAR 1m DEM (MNDNR)

Address
Contact: 100 CITY HALL DULUTH MN 55802-1189
Well: 1802 SKYLINE BL W DULUTH MN 55806

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
SAND, CLAY, ROCKS	0	30	BROWN	HARD
SAND & GRAVEL	30	35	BROWN	MEDIUM
CEMENTED GRAVEL	35	40	RED	HARD
LEDGE	40	70	GRAY	HARD
LEDGE	70	78	RED/BLK	MEDIUM
LEDGE	78	90	GRAY	SOFT
LEDGE	90	189	GRAY	HARD
LEDGE	189	209	GRY/WHT	MEDIUM

Remarks
WELL NO. 4.
CASING: THREADED/WELDED.

Well Depth: 209 ft. **Depth Completed:** 209 ft. **Date Well Completed:** 11/14/1990
Drill Method: Air Rotary **Drill Fluid:** Water
Use: irrigation **Status:** Active
Well Hydrofractured? Yes ☐ No ☐ From To
Casing Type: Single casing **Joint:** Threaded
Drive Shoe? Yes ☒ No ☐ **Above/Below:** 2 ft.

Casing Diameter	Weight	Hole Diameter
6 in. To 41 ft.	20 lbs./ft.	6 in. To 41 ft.
		6 in. To 209 ft.

Open Hole From 41 ft. To 209 ft.
Screen? ☐ **Type:** **Make:**

Static Water Level
26.9 ft. land surface Measure 12/15/1990

Pumping Level (below land surface)
27.7 ft. 24 hrs. Pumping at 103 g.p.m.

Wellhead Completion
Pitless adapter manufacturer: Model:
☐ Casing Protection ☒ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

Grouting Information Well Grouted? ☐ Yes ☒ No ☐ Not Specified

Nearest Known Source of Contamination
740 feet Northeas Direction Septic tank/drain field Type
Well disinfected upon completion? ☒ Yes ☐ No

Pump ☒ Not Installed Date Installed
Manufacturer's name:
Model Number: HP: Volt:
Length of drop pipe: ft Capacity: g.p. Typ:

Abandoned
Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

Variance
Was a variance granted from the MDH for this well? ☐ Yes ☐ No

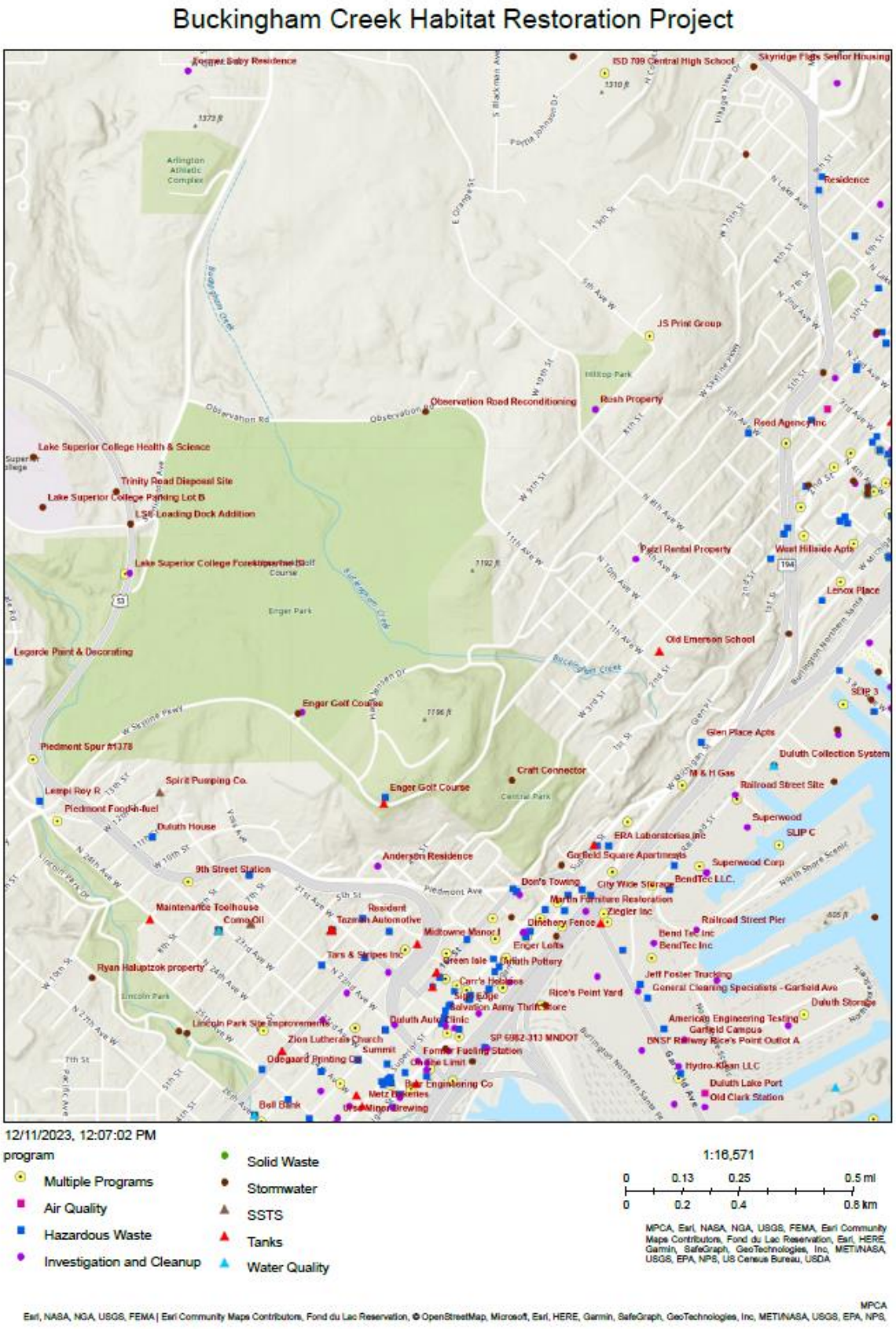
Miscellaneous
First Bedrock: Duluth Cplx-anorth.series Aquifer: Duluth Complex
Last Strat: Duluth Complex Depth to Bedrock: 40 ft
Located by: Minnesota Geological Survey
Locate Method: GPS SA Off (averaged) (15 meters)
System: UTM - NAD83, Zone 15, Meters X: 566463 Y: 5181495
Unique Number Verification: Tax Records Input Date: 10/11/2017

Angled Drill Hole

Well Contractor
Petersen Well Co. 69183 PETERSEN, D.
Licensee Business Lic. or Reg. No. Name of Driller

Minnesota Well Index Report | **469520** | Printed on 06/26/2023 HE-01205-15

10. MPCA Contaminants site viewer "*What's in My Neighborhood?"*



11. Natural Heritage Info System (NHIS) Review

These NHIS records were identified on or within 1 mile of the proposed project area

Vertebrate Animal

Scientific name	Common name	State status
Anguilla rostrata	American Eel	SPC
Couesius plumbeus	Lake Chub	SPC
Emydoidea blandingii	Blanding's Turtle	THR

Lakes of Biodiversity Significance		Significance Rank
69129100	St. Louis River Estuary	Outstanding

STATE STATUS - KEY
END - endangered
THR - threatened
SPC - special concern

STATE STATUS - KEY (Native Plant Communities)
S1: Critically Imperiled
S2: Imperiled
S3: Vulnerable
S4: Apparently Secure
S5: Secure

SEE MORE INFORMATION AND MAP BELOW

Links for more information:

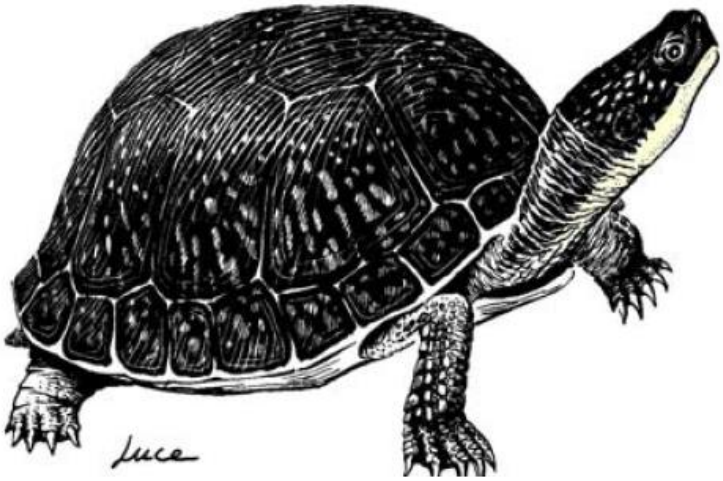
Click here to learn more about the Natural Heritage Information System (NHIS)

Here's a link to the MN DNR's Rare Species Guide

For more information about MN's Native Plant Communities

12. Blanding's Turtle Flyer

CAUTION



BLANDING'S TURTLES
MAY BE ENCOUNTERED IN THIS AREA

The unique and rare Blanding's turtle has been found in this area. Blanding's turtles are a State Threatened species and are protected under Minnesota Statute 84.095, Protection of Threatened and Endangered Species. Please be careful of turtles on roads and in construction sites. For additional information on turtles, or to report a Blanding's turtle sighting, contact the DNR Nongame Specialist nearest you: Bemidji (218-308-2641); Grand Rapids (218-327-4518); New Ulm (507-359-6033); Rochester (507-280-5070); or St. Paul (651-259-5764).

DESCRIPTION: The Blanding's turtle is a medium to large turtle (5 to 10 inches) with a black or dark blue, dome-shaped shell with muted yellow spots and bars. The bottom of the shell is hinged across the front third, enabling the turtle to pull the front edge of the lower shell firmly against the top shell to provide additional protection when threatened. The head, legs, and tail are dark brown or blue-gray with small dots of light brown or yellow. A distinctive field mark is the bright yellow chin and neck.

Illustration by Don Luce, from Turtles in Minnesota, Natural History Leaflet No. 9, June 1989, James Ford Bell Museum of Natural History

SUMMARY OF RECOMMENDATIONS FOR AVOIDING AND MINIMIZING IMPACTS TO BLANDING'S TURTLE POPULATIONS

(see Environmental Review Fact Sheet Series for full recommendations)

- A flyer with an illustration of an adult Blanding's turtle should be given to all contractors working in the area. Homeowners should also be informed of the presence of Blanding's turtles in the area.
- Turtles which are in imminent danger should be moved, by hand, out of harms way. Turtles which are not in imminent danger should be left undisturbed to continue their travel among wetlands and/or nest sites.
- If a Blanding's turtle nests in your yard, do not disturb the nest, and do not allow pets near the nest.
- Blanding's turtles do not make good pets. It is illegal to keep this threatened species in captivity.
- Silt fencing should be set up to keep turtles out of construction areas. It is critical that silt fencing be removed after the area has been revegetated.
- Small, vegetated temporary wetlands should not be dredged, deepened, or filled.
- All wetlands should be protected from pollution; use of fertilizers and pesticides should be avoided, and run-off from lawns and streets should be controlled. Erosion should be prevented to keep sediment from reaching wetlands and lakes.
- Roads should be kept to minimum standards on widths and lanes.
- Roads should be ditched, not curbed or below grade. If curbs must be used, 4" high curbs at a 3:1 slope are preferred.
- Culverts under roads crossing wetland areas, between wetland areas, or between wetland and nesting areas should be at least 36 in. diameter and flat-bottomed or elliptical.
- Culverts under roads crossing streams should be oversized (at least twice as wide as the normal width of open water) and flat-bottomed or elliptical.
- Utility access and maintenance roads should be kept to a minimum.
- Because trenches can trap turtles, trenches should be checked for turtles prior to being backfilled and the sites should be returned to original grade.
- Terrain should be left with as much natural contour as possible.
- Graded areas should be revegetated with native grasses and forbs.
- Vegetation management in infrequently mowed areas -- such as in ditches, along utility access roads, and under power lines -- should be done mechanically (chemicals should not be used). Work should occur fall through spring (after October 1st and before June 1st).

Compiled by the Minnesota Department of Natural Resources Division of Ecological Resources, Updated March 2008
Endangered Species Environmental Review Coordinator, 500 Lafayette Rd., Box 25, St. Paul, MN 55155 / 651-259-5109

Attachment 1 – Project Plans

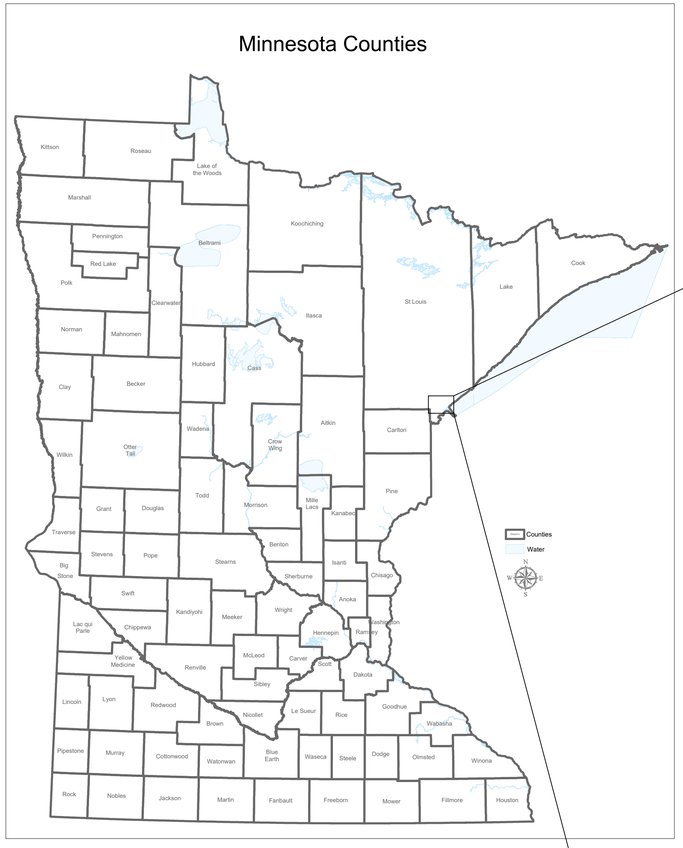
60% NOT FOR CONSTRUCTION

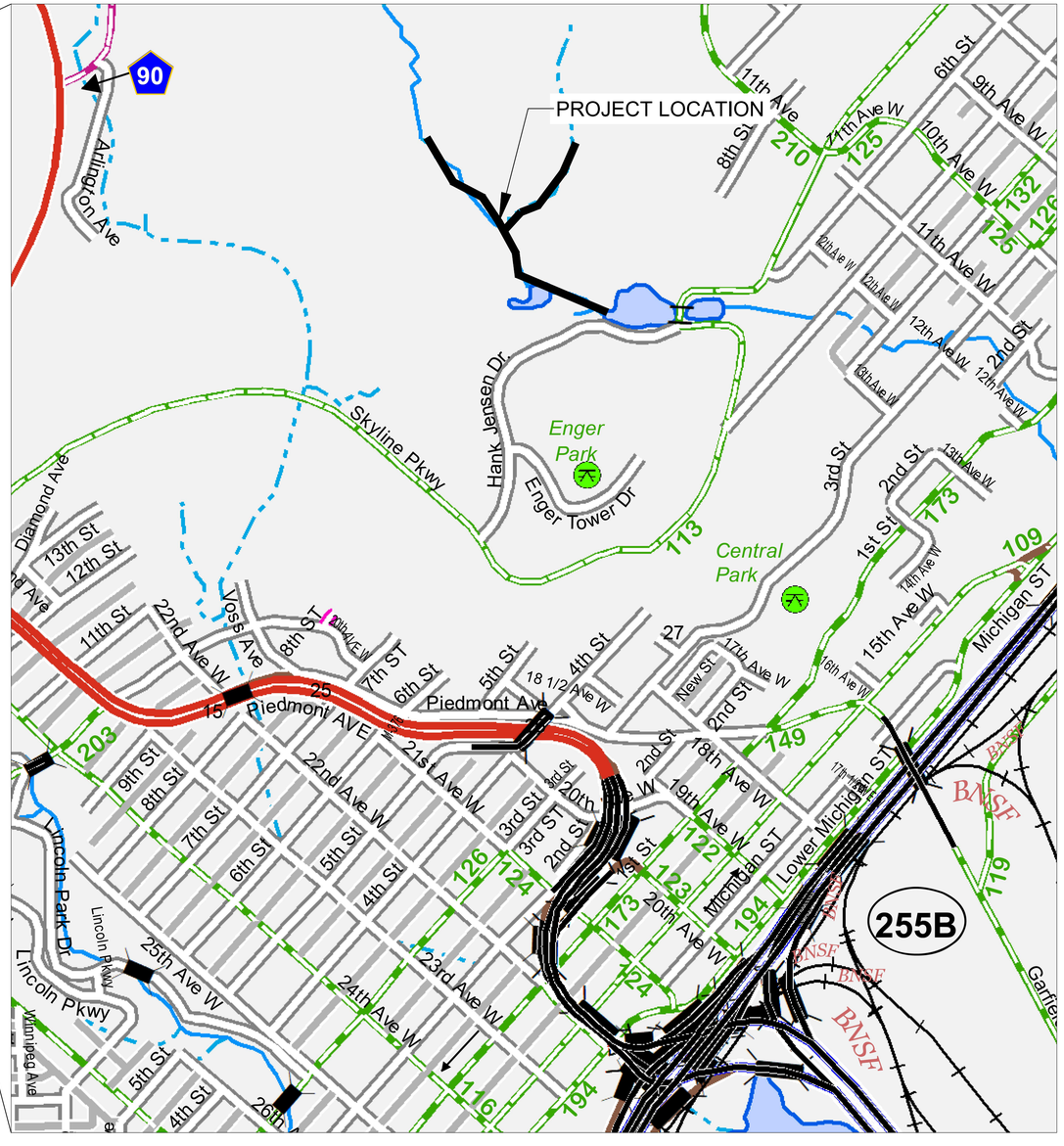
BUCKINGHAM CREEK
ENGER PARK GOLF COURSE

CITY OF DULUTH

ST. LOUIS COUNTY, MN

12/01/2023





Sheet List Table	
Sheet Title	Sheet Number
COVER	1
QUANTITIES AND SPECIFICATIONS	2
OVERVIEW	3
REMOVAL SHEET 1	4
REMOVAL SHEET 2	5
MAINSTEM - B CHANNEL PP - (1)	6
MAINSTEM - B CHANNEL PP - (2)	7
MAINSTEM - C CHANNEL PP - (1)	8
MAINSTEM - C CHANNEL PP - (2)	9
MAINSTEM - C CHANNEL PP - (3)	10
TRIBUTARY - B CHANNEL PP - (1)	11
TRIBUTARY - C CHANNEL PP - (1)	12
TRIBUTARY - C CHANNEL PP - (2)	13
TRIBUTARY - C CHANNEL PP - (3)	14
TRIBUTARY MORPHOLOGY	15
MAINSTEM BUCKINGHAM MORPHOLOGY	16
MAINSTEM BUCKINGHAM STRUCTRE SHEET	17
TRIBUTARY STRUCTRE SHEET	18
BRIDGE OVERVIEW SHEET (1)	19
BRIDGE OVERVIEW SHEET (2)	20
MAINSTEM BRIDGE 1 PP - (1)	21
MAINSTEM BRIDGE 2 PP - (1)	22
MAINSTEM BRIDGE 3 PP - (1)	23
MAINSTEM BRIDGE 4 PP - (1)	24
TRIBUTARY BRIDGE 1 PP - (1)	25
TRIBUTARY BRIDGE 2 PP - (1)	26
MAINSTEM - B CHANNEL SECTIONS - (1)	27
MAINSTEM - C SECTION - (1)	28
TRIBUTARY SECTIONS - (1)	29
DETAILS - BUCKINGHAM DIMENSIONS	30
DETAILS - TRIBUTARY DIMENSIONS	31
DETAILS - GRAVEL RIFFLE	32
DETAILS - BOULDER RIFFLE	33
DETAILS - TOE WOOD	34
VEGETATION OVERVIEW (1)	35
VEGETATION OVERVIEW (2)	36
VEGETATION DETAILS (1)	37
VEGETATION DETAILS (2)	38

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South St. Louis SOIL & WATER CONSERVATION DISTRICT

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

NOTES:

GENERAL CONSTRUCTION NOTES:

1. THE WORK ON THIS PROJECT SHALL ADHERE TO THE FOLLOWING SPECIFICATIONS, STANDARDS AND/OR REGULATIONS: MN DOT STANDARD SPECIFICATIONS FOR CONSTRUCTION, DIVISION 2 AND 3, 2016 EDITION, THE FOLLOWING SPECIFICATIONS EITHER MODIFY OR REPLACE APPROPRIATE MN DOT TECHNICAL SPECIFICATIONS.
2. INSTREAM STRUCTURES SHALL BE INSTALLED AS THE CHANNEL IS BEING CONSTRUCTED AND NOT POST CONSTRUCTION. FILTER FABRIC INSTALLED AS PART OF THE INSTREAM STRUCTURE SHALL BE MIRAFI 170N SERIES NONWOVEN GEOTEXTILE, OR ENGINEER'S APPROVED ALTERNATIVE, UNLESS OTHERWISE SPECIFIED IN STRUCTURE DETAILS OR SPECIFICATIONS.
3. WHERE PRACTICABLE, EXISTING TREES AND VEGETATION SHOULD BE LEFT IN PLACE TO FACILITATE NATURAL REGENERATION AND SOIL STABILIZATION.
4. DEFINITIONS:
   A. BANKFULL ELEVATION IS THE POINT OF INCIPIENT FLOODING IN AN ALLUVIAL CHANNEL. THIS ELEVATION IS THE REFERENCE FOR DEPTHS ON OR ALONG THE CHANNEL PROFILE AND STRUCTURES DESCRIBED IN THESE SHEETS.
   B. THE BANKFULL BENCH IS A CONSTRUCTED FLOODPLAIN ADJACENT TO THE CHANNEL. THE BANKFULL BENCH IS CONSTRUCTED AT THE BANKFULL ELEVATION.
   C. THE THALWEG IS THE LOWEST PORTION OF THE CHANNEL.
   D. THE VANE LENGTH IS THE STRAIGHT LINE DISTANCE BETWEEN THE VANE ARM AND A LINE TANGENT TO THE STREAMBANK AT THE POINT WHERE THE VANE ARM INTERSECTS THE STREAMBANK.
   E. THE VANE ANGLE IS THE ANGLE BETWEEN THE VANE ARM AND A LINE TANGENT TO THE STREAMBANK AT THE POINT WHERE THE VANE ARM INTERSECTS THE STREAMBANK.

5. THE ENGINEER WILL STAKE OUT THE CENTERLINE OF THE CHANNEL AND BE ON SITE FOR IMPLEMENT CONSTRUCTION OF STRUCTURE AND TO CONFIRM ELEVATIONS. THE CONTRACTOR SHALL HAVE SURVEY LEVEL EQUIPMENT ON SITE TO SET STRUCTURES AND BE RESPONSIBLE FOR ANY AND ALL ELEVATIONS. ANY COST ASSOCIATED WITH CHANGING STRUCTURE LOCATIONS OR ALIGNMENT SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION. STAKING MAY BE OMITTED FOR PORTIONS OF THE STREAM WHEN SURVEY-GRADE GPS IS USED TO CONSTRUCT THE CHANNEL. IF GPS IS USED IN LIEU OF STAKING THE CHANNEL IN THE FIELD, THE CONTRACTOR ASSUMES ALL RESPONSIBILITY FOR THE STREAM BEING CONSTRUCTED AS DESIGNED, INCLUDING ANY ISSUES RELATED TO PROJECTIONS, BASE POINTS OR CONVERSION OF DIGITAL TERRAIN MODELS.
6. PRIOR TO CLEARING AND GRUBBING, THE ENGINEER WILL MARK THE LIMITS OF CLEARING NEAR TREES. SOME MINOR ADJUSTMENT OF CHANNEL ALIGNMENT MAY BE REQUIRED TO PRESERVE TREES OR MINIMIZE IMPACT TO TREES.
7. ANY HARVESTING OF WILLOWS AND SOD FROM ONSITE MUST BE APPROVED BY THE ENGINEER.
8. CONTRACTOR SHALL MINIMIZE, TO THE MAXIMUM EXTENT POSSIBLE, IMPACTS TO THE ADJACENT TREES. CONSTRUCTION EQUIPMENT TRACKS AND PATHWAYS SHALL BE GRADED AND RECONTOURED AFTER CONSTRUCTION TO PREVENT RILL AND GULLY EROSION.
9. THE PROPOSED GRADING IS SHOWN ON THESE PLAN SHEETS. THE CONTRACTOR MAY EXTEND THE LIMITS OF DISTURBANCE ONLY WITH THE APPROVAL OF THE ENGINEER.
10. CONTRACTOR SHALL USE AN EXCAVATOR WITH A HYDRAULIC THUMB TO INSTALL INSTREAM STRUCTURES.
11. CHANNEL RELOCATION WORK SHALL BE COMPLETED AND STABILIZED PRIOR TO ALLOWING FLOW TO ENTER INTO THE NEWLY CONSTRUCTED STREAM CHANNEL. THE CONTRACTOR SHALL NOT OPEN UP MORE THAN 200 FEET OF CHANNEL WITHOUT EROSION CONTROL BLANKET IN PLACE OR BY APPROVAL OF THE ENGINEER.
12. IF THE EXISTING GROUND IS LESS THAN 0.2 FEET HIGHER THAN THE PROPOSED BANKFULL ELEVATION, IT IS NOT NECESSARY TO EXCAVATE MATERIAL TO THE PROPOSED ELEVATION SHOWN ON THE PROFILE.
13. THE SURFACE OF ALL INSTREAM STRUCTURES SHALL BE FINISHED TO A SMOOTH LINE IN ACCORDANCE WITH THE LINES, GRADES, AND CROSS SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. THE DEGREE OF FINISH FOR THE VANE SLOPES AND INVERT ELEVATIONS SHALL BE WITHIN 0.1 VERTICAL FEET OF THE GRADES AND ELEVATIONS INDICATED. ALL GAPS OR VOIDS BETWEEN THE ROCKS SHALL BE PLUGGED WITH SMALL GRAVEL TO FORM A TIGHT-FITTING SEAL.
14. CONSTRUCTION SPECIFICATIONS FOR BANKFULL CHANNEL DIMENSIONS OR CROSS SECTIONS WILL BE HELD TO THE DIMENSIONS SHOWN ON THE TYPICAL CROSS SECTIONS. ELEVATIONS SHALL BE CONSTRUCTED WITHIN 0.1 VERTICAL FEET; WIDTHS AND MEAN DEPTHS MUST FALL WITHIN THE RANGES SHOWN IN THE DRAWINGS.
15. THE IN-STRUCTURE BID ITEMS SHALL INCLUDE ALL LABOR AND MATERIALS NECESSARY TO CONSTRUCT THE STRUCTURE. AFTER THE STRUCTURE IS COMPLETE AND FLOW IS RESTORED TO THE CHANNEL, SOME ADJUSTMENT TO THE STRUCTURE OR ADDITIONAL STABILIZATION MEASURES MAY BE NECESSARY TO ACHIEVE DESIRED EFFECT. ANY COSTS ASSOCIATED WITH THESE ADJUSTMENTS SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
16. EXCESS SPOIL MATERIAL MAY BE SPREAD AND GRADED ONSITE ON THE ACCESS TRAIL AS APPROVED BY THE ENGINEER. PLACEMENT OF ANY ON-SITE OR OFF-SITE SPOIL MATERIAL SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
17. SPOIL AREAS SHALL BE SEEDED WITHIN 1 DAY WITH TEMPORARY VEGETATION AND COMPLETED WITHIN 7 DAYS FOLLOWING GRADING.
18. CONTRACTOR SHALL CALL GOPHER STATE ONE CALL FOR UTILITY MARKING AT LEAST 48 HOURS PRIOR TO START OF CONSTRUCTION. THE LOCATIONS OF THE UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE ONLY (UTILITY QUALITY LEVEL D) AND MAY NOT BE ACCURATE. LOCATING UTILITIES IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR. THE ENGINEER AND PROJECT OWNER WILL NOT BE RESPONSIBLE FOR ANY DAMAGES TO UTILITIES.
19. CONTRACTOR SHALL UTILIZE NATIVE MATERIAL FROM THE SITE WHERE AVAILABLE AND ALLOWED BY THE ENGINEER. NATIVE MATERIAL THAT CAN BE FOUND ON SITE INCLUDE TREES THAT CAN PROVIDE LIVE STAKES AND TREES THAT CAN BE USED FOR LOG STRUCTURES, BOULDERS FOR STRUCTURES, AND WOOD DEBRIS.
20. AFTER CONSTRUCTION, THE ACCESS ROADS LEADING TO THE PROJECT SITE SHALL BE RESTORED TO AS GOOD OR BETTER CONDITION THAN BEFORE CONSTRUCTION AT THE ENGINEER'S DISCRETION.
21. FOOTER DEPTH ON ALL STRUCTURES REQUIRING FOOTERS SHALL BE AT LEAST 6 TIMES GREATER THAN THE DROP BETWEEN THE STRUCTURE AND THE FOOTERED STRUCTURE DIRECTLY UPSTREAM OR APPROVED BY THE ONSITE ENGINEER.

EROSION/SEDIMENTATION CONTROL NOTES:

1. ALL CONTROL MEASURES SHALL BE CHECKED, AND REPAIRED AS NECESSARY, EVERY 7 DAYS IN DRY PERIODS, AND WITHIN 24 HOURS AFTER ANY RAINFALL AT THE SITE OF .50 INCHES OR GREATER WITHIN A 24 HOUR PERIOD. DAILY CHECKING AND, IF NECESSARY, REPAIRING SHALL BE DONE DURING PROLONGED RAINFALLS. THE PERMITTEE SHALL MAINTAIN WRITTEN RECORDS OF SUCH CHECKS AND REPAIRS ON-SITE AT ALL TIMES, AND RECORDS SHALL BE SUBJECT TO INSPECTION AT ANY REASONABLE TIME.
2. THE CONSTRUCTION ACCESS POINTS SHALL BE MAINTAINED AS REQUIRED TO PREVENT SILT/SEDIMENT FROM LEAVING THE SITE. THIS INCLUDES BUT IS NOT LIMITED TO WASH DOWN OF THE CONSTRUCTION ACCESS POINTS, INSTALLING AND UTILIZING A VEHICLE WASH DOWN AREA, INSTALLING ADDITIONAL STONE, ETC.
3. TEMPORARY DIVERSION OF RUNOFF/RUNON WATER SHALL BE INSTALLED AS NEEDED TO FACILITATE CONSTRUCTION OR AS DIRECTED ON-SITE BY THE ENGINEER. AT NO TIME SHALL WATER BE SHUT OFF TO THE STREAM FOR GREATER THAN 5 MINUTES.
4. ALL DISTURBED AREAS SHALL BE PERMANENTLY STABILIZED IMMEDIATELY AFTER THE COMPLETION OF THE GRADING OPERATION. AREAS REQUIRING COCONUT COIR MATTING SHALL BE SEEDED AND MULCHED FOR STABILIZATION PRIOR TO THE INSTALLATION OF THE MATTING.
5. TEMPORARY STABILIZATION OF DISTURBED AREAS MUST BE INITIATED IMMEDIATELY WHENEVER WORK TOWARD PROJECT COMPLETION AND FINAL STABILIZATION OF ANY PORTION OF THE SITE HAS TEMPORARILY CEASED AND WILL NOT RESUME FOR A PERIOD EXCEEDING FOURTEEN (14) CALENDAR DAYS. THOSE AREAS SHALL BE SEEDED AND MULCHED IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS.
6. NECESSARY MEASURES SHALL BE TAKEN TO PRODUCE AND MAINTAIN AN ACCEPTABLE STAND OF GRASS. SAID MEASURES TO INCLUDE (BUT NOT LIMITED TO) WATERING, RE-SEEDING, REGRADING ERODED AREAS, RE-FERTILIZING, ETC.
7. CONTRACTOR IS RESPONSIBLE FOR KEEPING MUD AND DEBRIS OFF CITY/STATE STREETS AND ROW. CLEANUP IS REQUIRED DAILY.
8. ALL HAZARDOUS SUBSTANCES USED FOR THIS PROJECT (PAINT, OIL, GREASE, AND OTHER PETROLEUM PRODUCTS) SHALL BE STORED IN ACCORDANCE WITH SPCC REGULATIONS. THESE SUBSTANCES SHALL BE STORED AWAY FROM DRAINS AND DITCHES IN WATERTIGHT CONTAINERS. DISPOSAL OF THESE SUBSTANCES SHALL BE IN ACCORDANCE WITH MPCA REGULATIONS. DAILY INSPECTIONS SHALL BE PERFORMED FOR LEAK DETECTION. IF LEAKS OCCUR, APPROPRIATE ACTION SHALL BE TAKEN TO CONTAIN AND REMEDIATE THE SPILL. ADEQUATE TRASH CONTAINERS SHALL BE KEPT ON SITE FOR THE DISPOSAL OF CONSTRUCTION MATERIALS WASTE. NECESSARY MEASURES SHALL BE TAKEN TO PREVENT ANY TRASH OR OTHER POLLUTANTS FROM ENTERING "WATERS OF THE UNITED STATES."
9. ALL TEMPORARY MEASURES SHALL BE REMOVED ONCE ACCEPTABLE PERMANENT STABILIZATION IS ACHIEVED. THE ENGINEER SHALL DETERMINE IF THE PERMANENT STABILIZATION IS ACCEPTABLE.

SPECIAL NOTES:

THE ELEVATIONS SHOWN HEREIN ARE BASED ON DATA SURVEY THAT ENCOMPASSES THE EXISTING GROUND SURFACE FROM WHICH ALL COMPUTATIONS FOR CUT/FILL ARE BASED. SLIGHT DISCREPANCIES BETWEEN THE EXISTING GROUND DIGITAL SURFACE AND FIELD CONDITIONS CAN RESULT IN SIGNIFICANT VARIATIONS IN TOTAL EXCAVATED QUANTITIES. THUS, THE CONTRACTOR SHALL COMPARE QUANTITIES OF MATERIAL EXCAVATED TO THOSE SHOWN ON THE DRAWINGS TO MANAGE THE MOVEMENT OF MATERIAL ACROSS THE SITE.

TOPOGRAPHIC INFORMATION:

EXISTING GROUND SURFACES ARE BASED ON A SURVEY COMPLETED IN 2022 BLENDED WITH STATE OF MN LIDAR. BENCHMARKS WERE SET THROUGHOUT THE SITE AND CAN BE PROVIDED AT ANY TIME. CHANGES IN EXISTING SURFACES SHALL BE INCIDENTAL TO CONSTRUCTION.

TREE PLANTING

1. TREES AND SHRUBS SHALL BE WATERED UPON PLANTING AND DURING DRY PERIODS DURING THE SUMMER AND FALL OF 2024
2. PROVIDE WARRANTY FOR SURVIVAL OF 100 PERCENT OF THE TREE STOCK FOR A PERIOD OF ONE YEAR AFTER PLANTING. REPLACE TREES THAT DO NOT SURVIVE IN THE WARRANTY PERIOD

APPROVED BY: XX | CHECKED BY: XX | DRAWN BY: XXX

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

QUANTITIES AND SPECIFICATIONS

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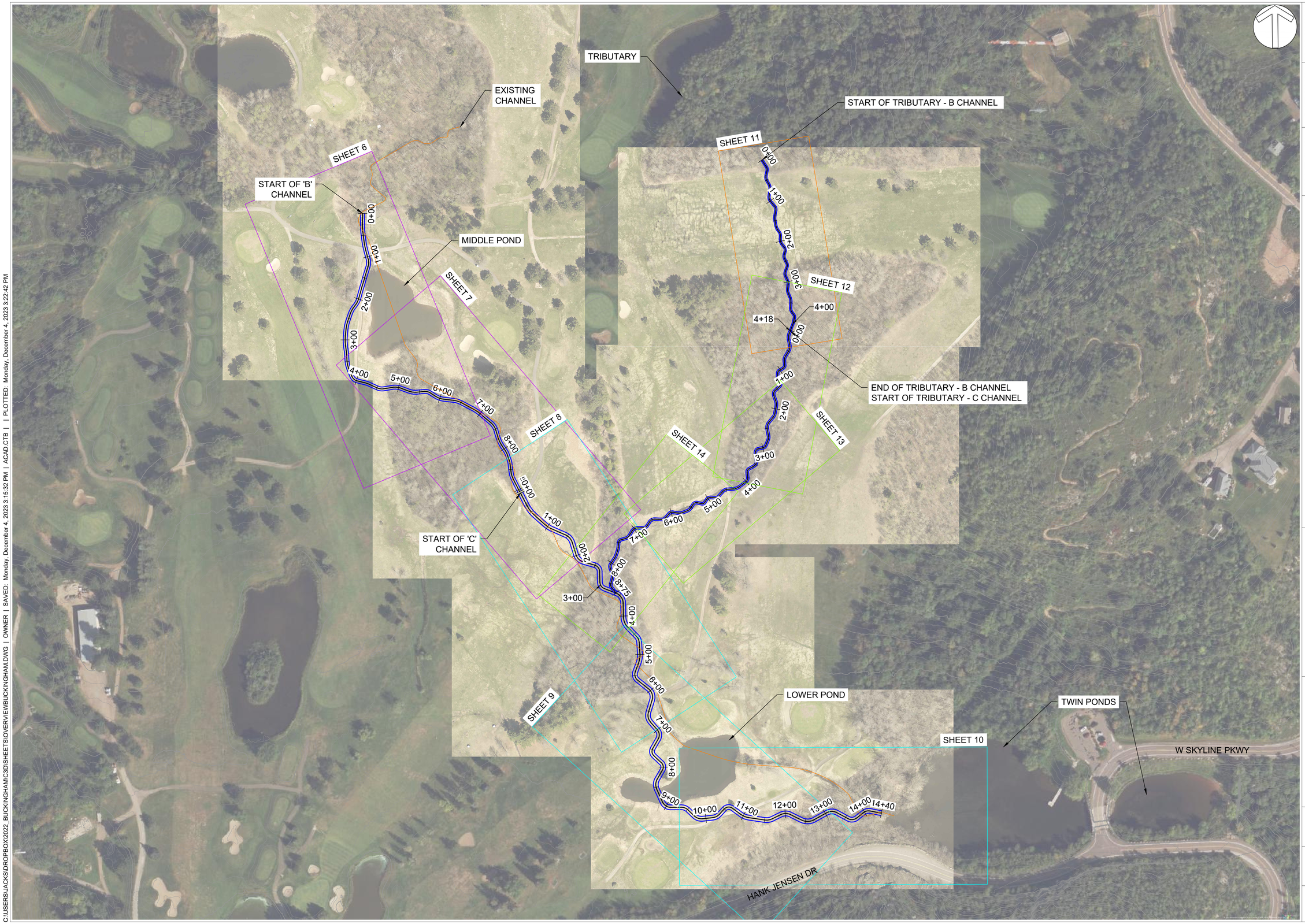
PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023

SHEET NUMBER
2 OF 26



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BUCKINGHAM CREEK
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CITY OF DULUTH
ST. LOUIS COUNTY, MN

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OVERVIEW

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DATE: 12/01/2023
SCALE (34"X22"): 1" = 100'
SCALE (17"X11"): 1" = 200'

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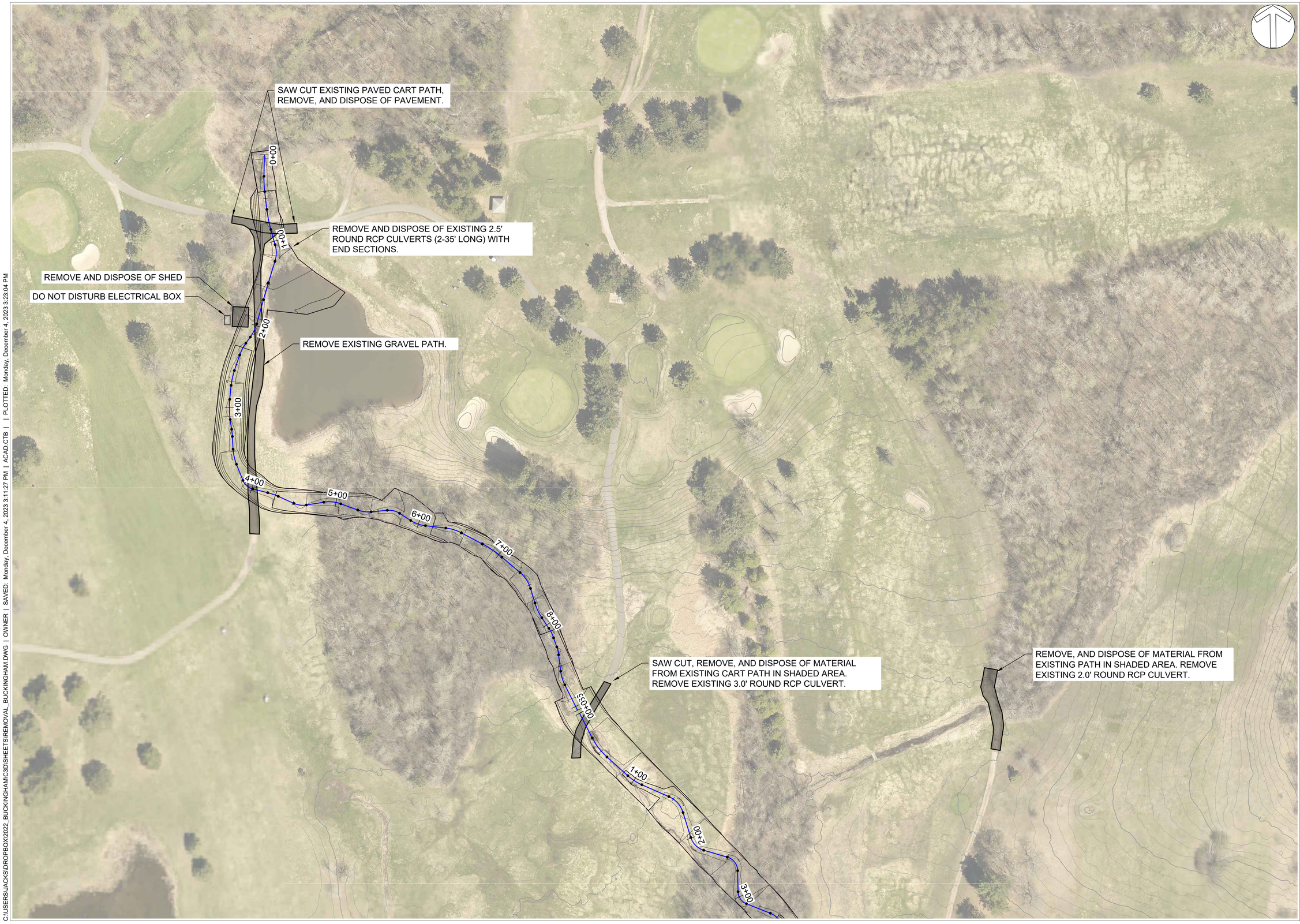
3 OF 36



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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

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REMOVAL SHEET (1)

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SIGNATURE:

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DATE: 12/01/2023
SCALE (34"X22"): 1" = 50'
SCALE (17"X11"): 1" = 100'

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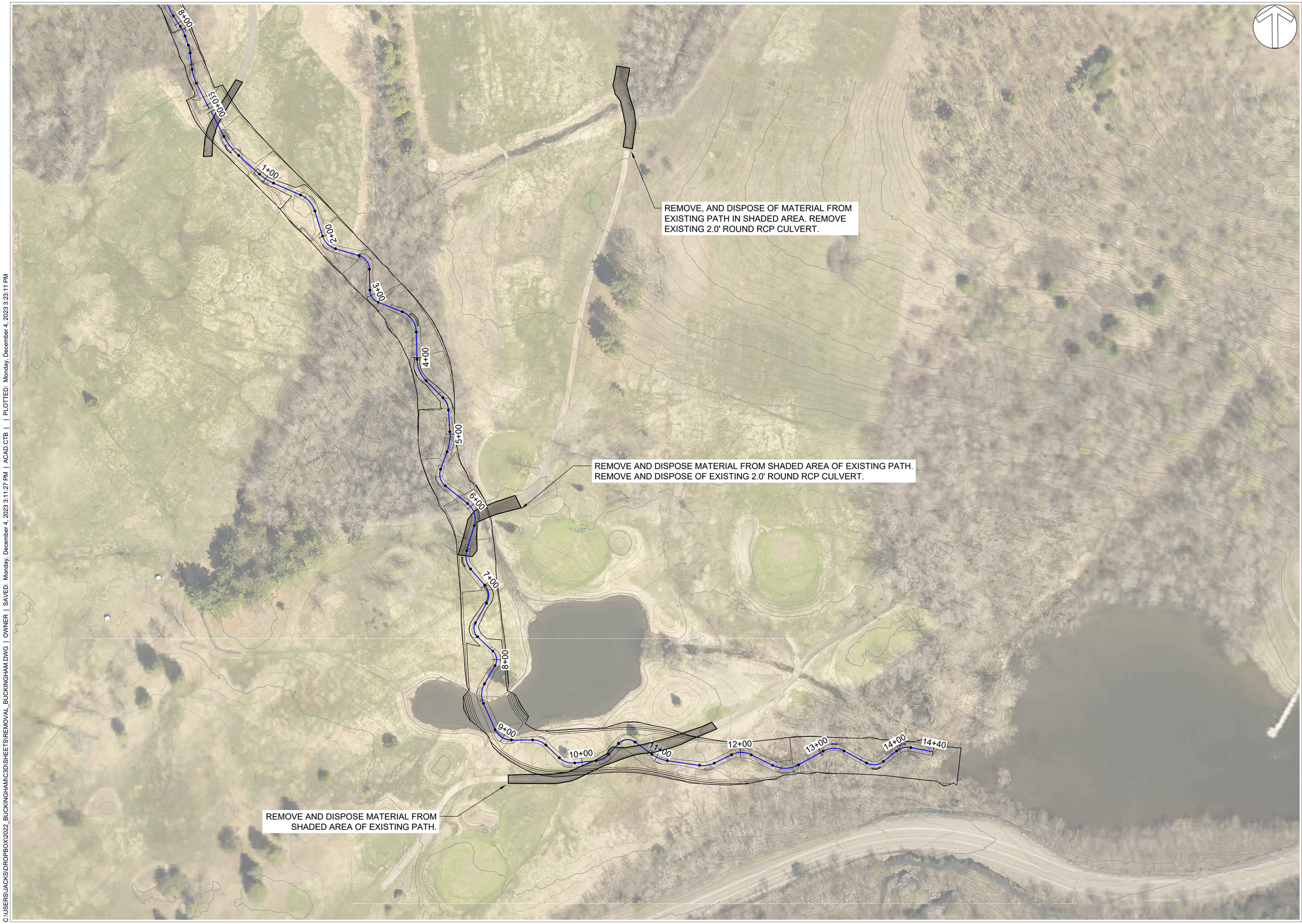
SCALE IN FEET

SHEET NUMBER
4 OF 36



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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

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REMOVAL SHEET (2)

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DATE: 12/01/2023
SCALE (34"X22"): 1" = 50'
SCALE (17"X11"): 1" = 100'

0 50 100
SCALE IN FEET

SHEET NUMBER
5 OF 36

PLAN LEGEND

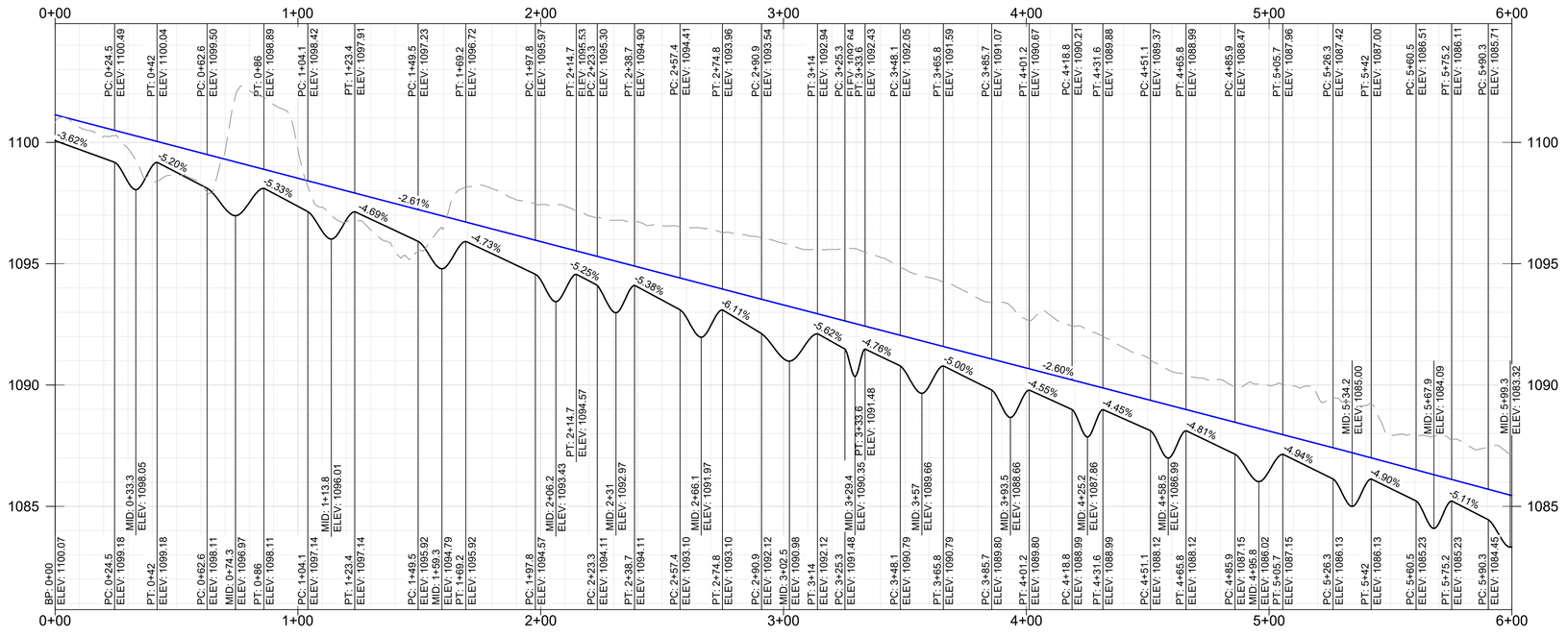
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND

STRUCTURE LEGEND

- GRAVEL RIFFLE
- BOULDER RIFFLE
- TOE WOOD
- TOE BRUSH



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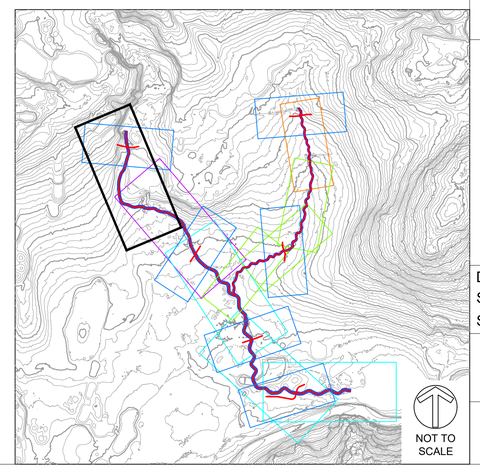

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM - B CHANNEL
PLAN AND PROFILE - (1)
STA 0+00 TO 6+00

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DATE: 12/01/2023
SCALE (34"X22"): 1" = 30'
SCALE (17"X11"): 1" = 60'

0 30 60
SCALE IN FEET

SHEET NUMBER
6 OF 36

PLAN LEGEND

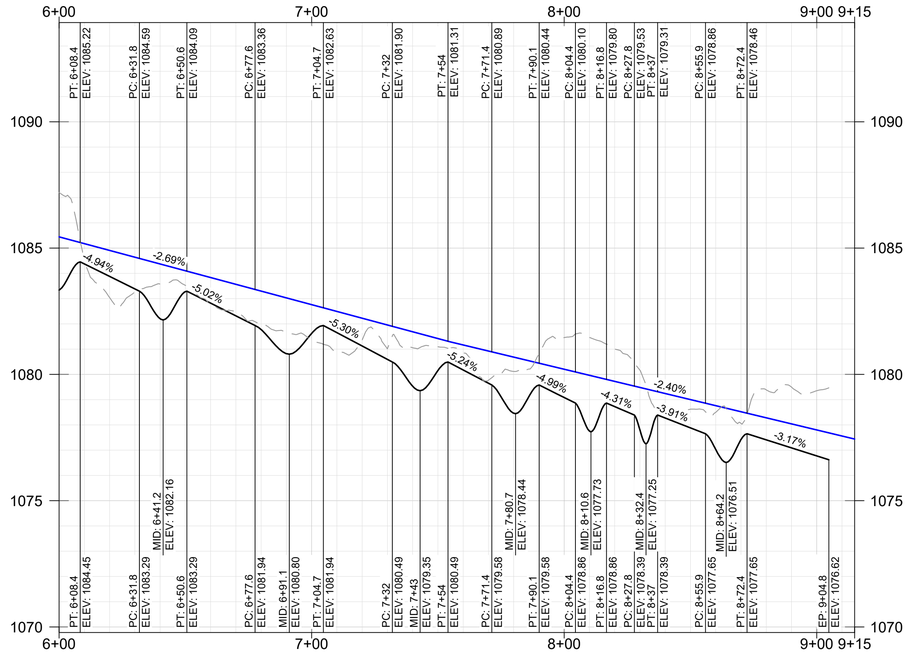
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND

STRUCTURE LEGEND

- GRAVEL RIFFLE
- BOULDER RIFFLE
- TOE WOOD
- TOE BRUSH



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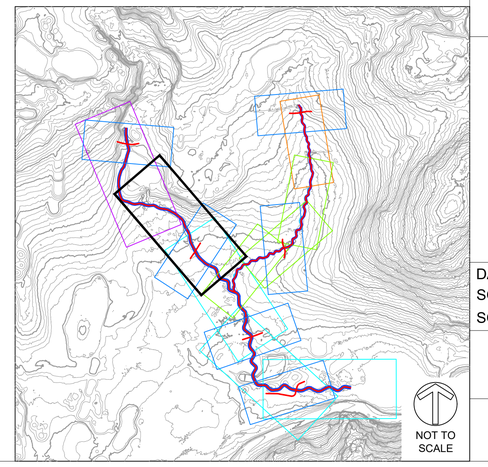

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM - B CHANNEL
PLAN AND PROFILE - (2)
STA 6+00 TO 9+15

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SCALE (17"X11"): 1" = 60'

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SHEET NUMBER
7 OF 36

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PLAN LEGEND

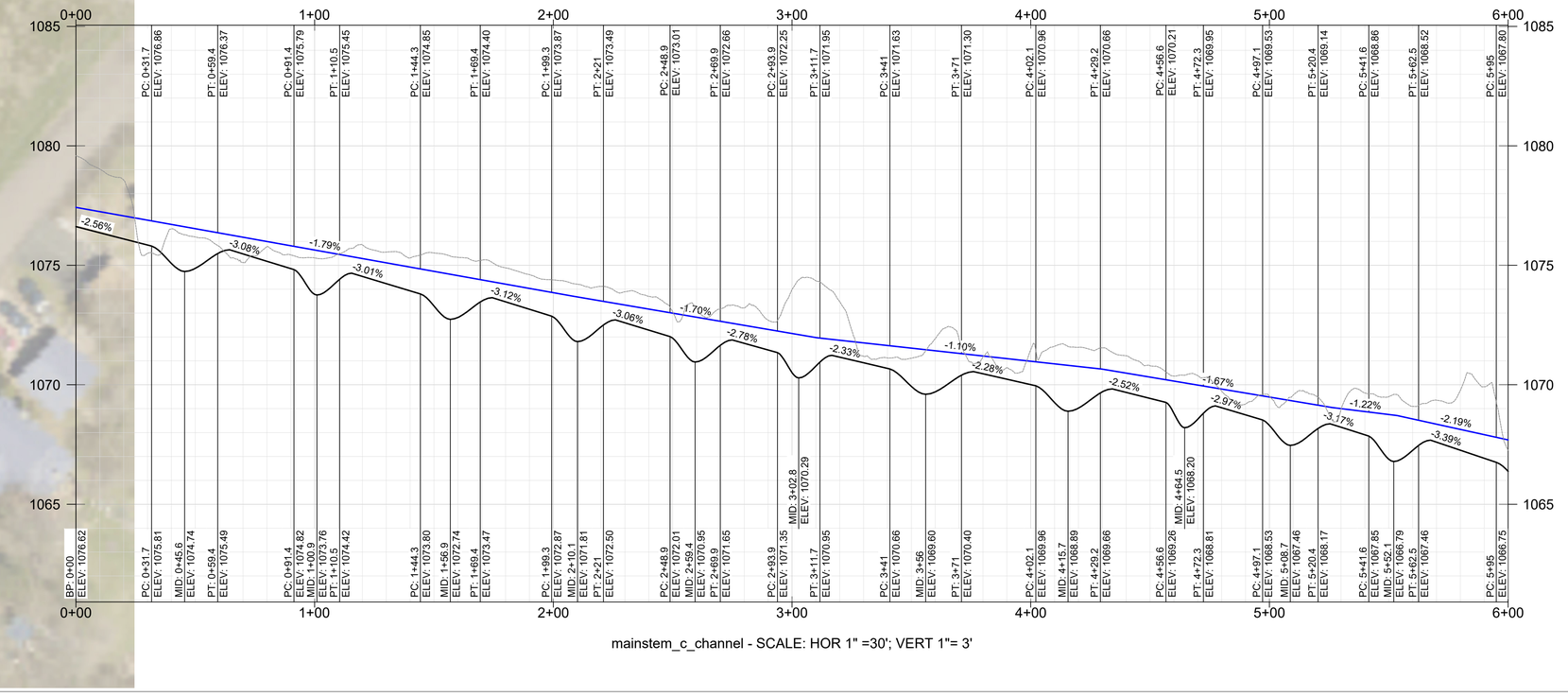
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND

STRUCTURE LEGEND

- GRAVEL RIFFLE
- BOULDER RIFFLE
- TOE WOOD
- TOE BRUSH



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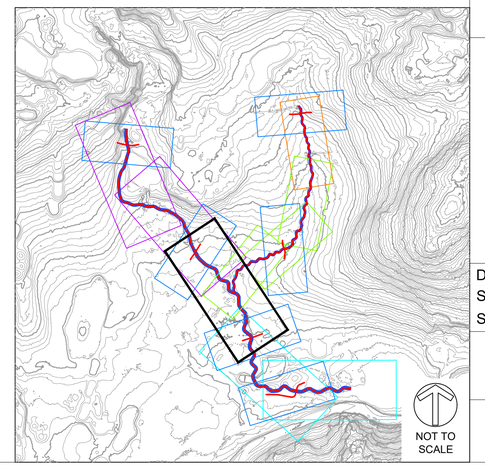

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM - C CHANNEL
PLAN AND PROFILE - (1)
STA 0+00 TO 6+00

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SCALE (34"X22"): 1" = 30'
SCALE (17"X11"): 1" = 60'

0 30 60
SCALE IN FEET

SHEET NUMBER
8 OF 36

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND

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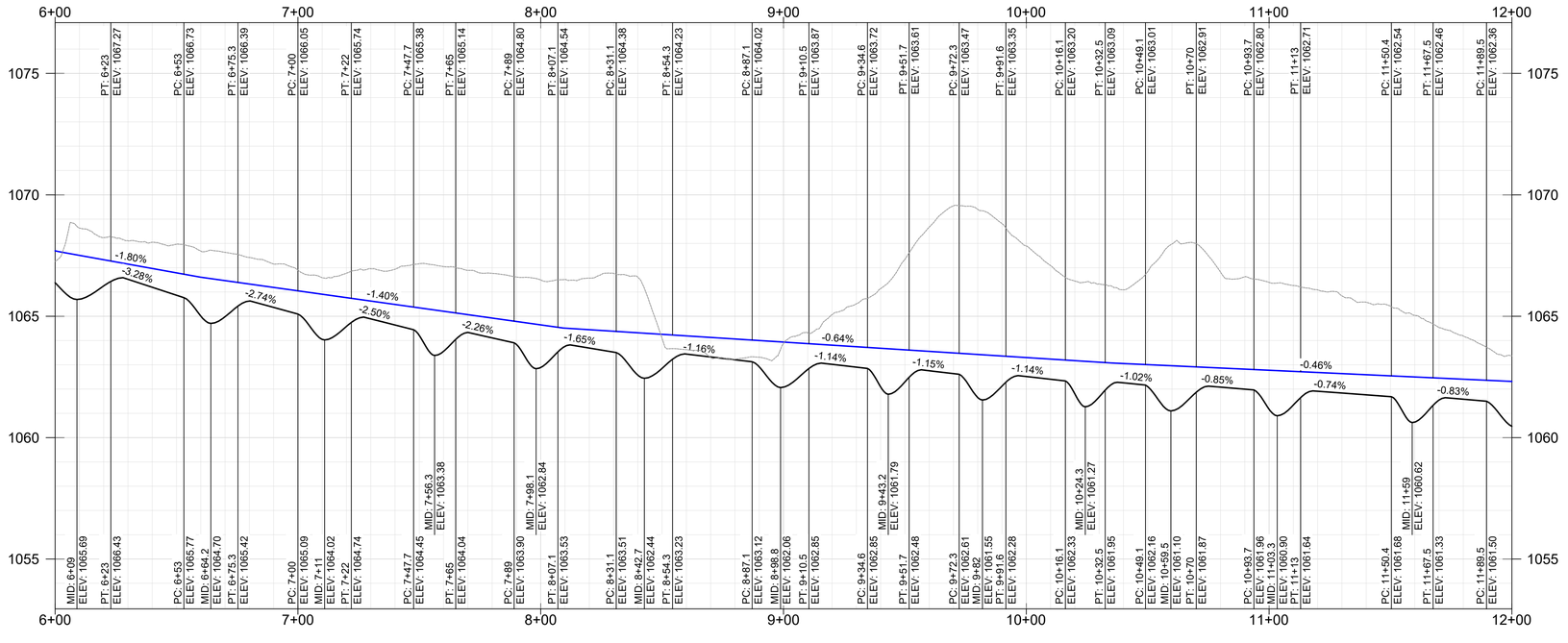
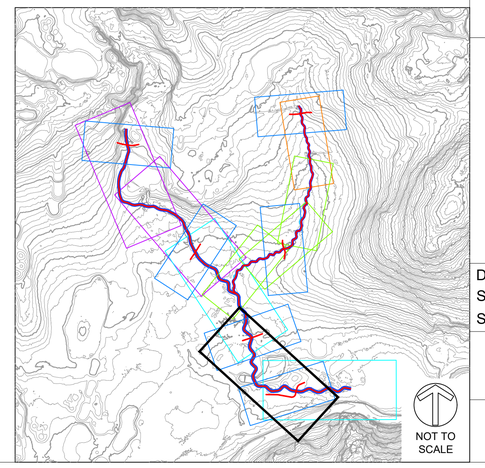
- TOE WOOD
- TOE BRUSH



mainstem_c_channel - SCALE: HOR 1" =30'; VERT 1"= 3'



NOT TO SCALE

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM - C CHANNEL
PLAN AND PROFILE - (2)
STA 6+00 TO 12+00

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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.

PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 30'
SCALE (17"X11"): 1" = 60'

0 30 60
SCALE IN FEET

SHEET NUMBER
9 OF 36

C:\USERS\JACKS\DROPBOX\2022_BUCKINGHAM\C3D\SHEETS\CCHANNELPP.DWG | JACKS | SAVED: Monday, December 4, 2023 3:12:38 PM | ACAD.CTB | | PLOTTED: Monday, December 4, 2023 3:25:11 PM

PLAN LEGEND

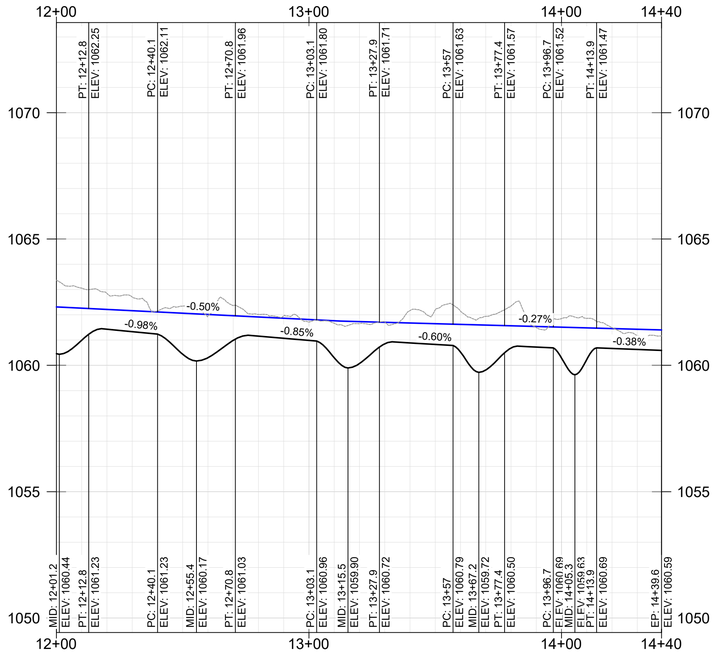
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

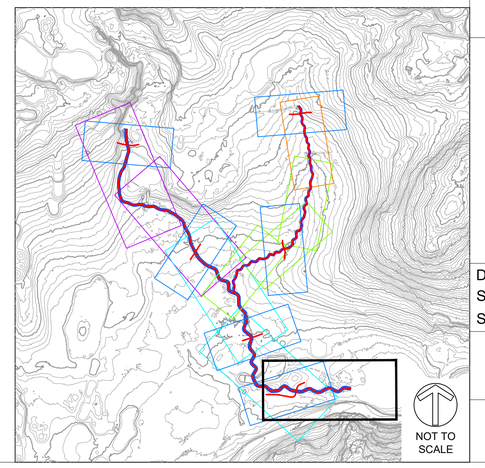
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND

STRUCTURE LEGEND

- GRAVEL RIFFLE
- BOULDER RIFFLE
- TOE WOOD
- TOE BRUSH



mainstem_c_channel - SCALE: HOR 1" =30'; VERT 1"= 3'



NOT TO SCALE

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM - C CHANNEL
PLAN AND PROFILE - (3)
STA 12+00 TO 14+40

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 30'
SCALE (17"X11"): 1" = 60'

0 30 60
SCALE IN FEET

SHEET NUMBER
10 OF 36

PLAN LEGEND

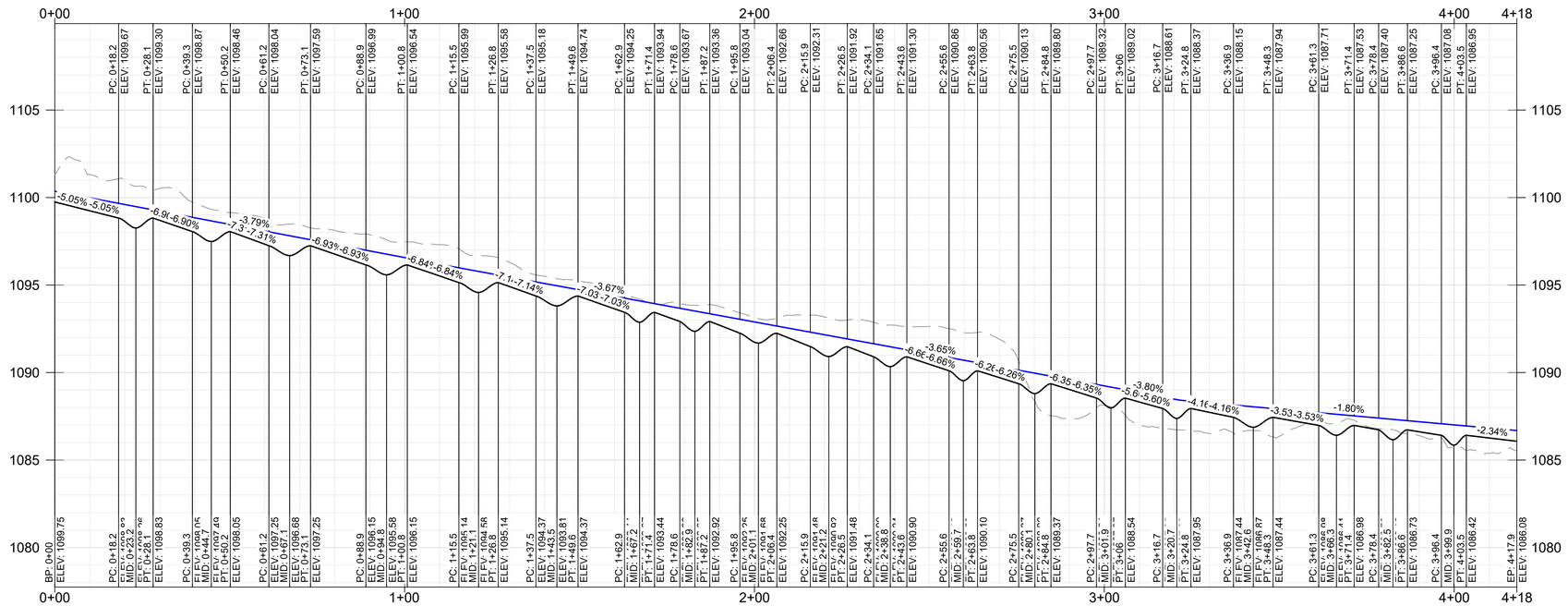
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

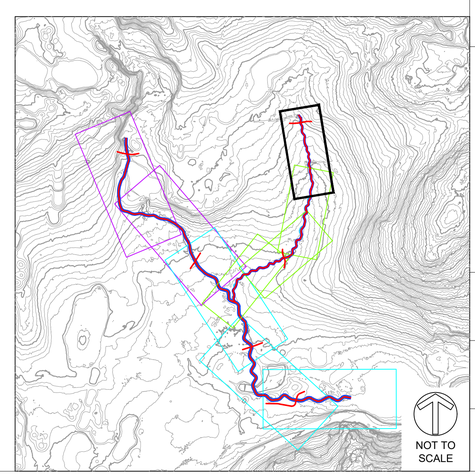
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND

STRUCTURE LEGEND

- GRAVEL RIFFLE
- BOULDER RIFFLE
- TOE WOOD
- TOE BRUSH



Tributary b channel - SCALE: HOR 1" =20'; VERT 1"= 4'



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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
TRIBUTARY - B CHANNEL
PLAN AND PROFILE - (1)
STA 0+00 TO 4+18

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

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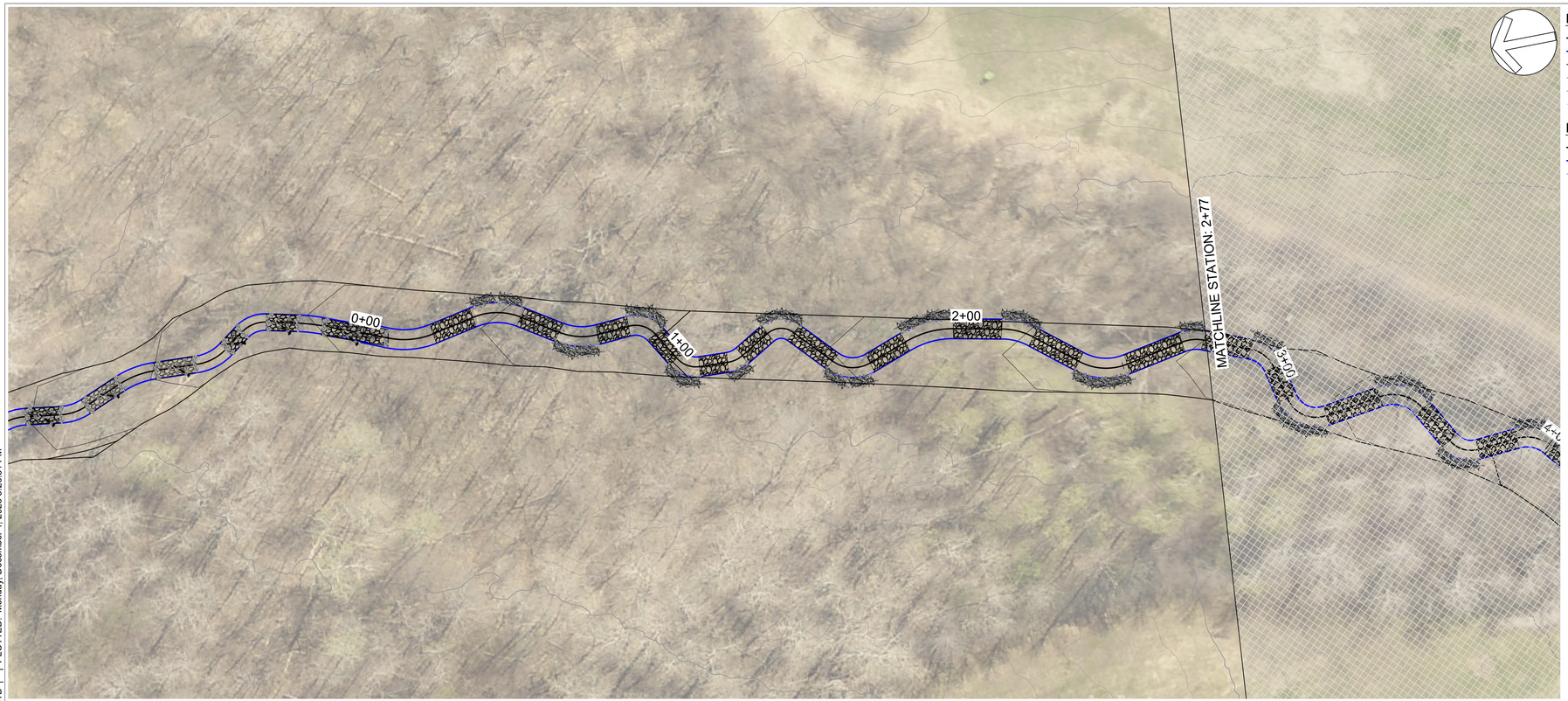
SCALE IN FEET

SHEET NUMBER
11 OF 36

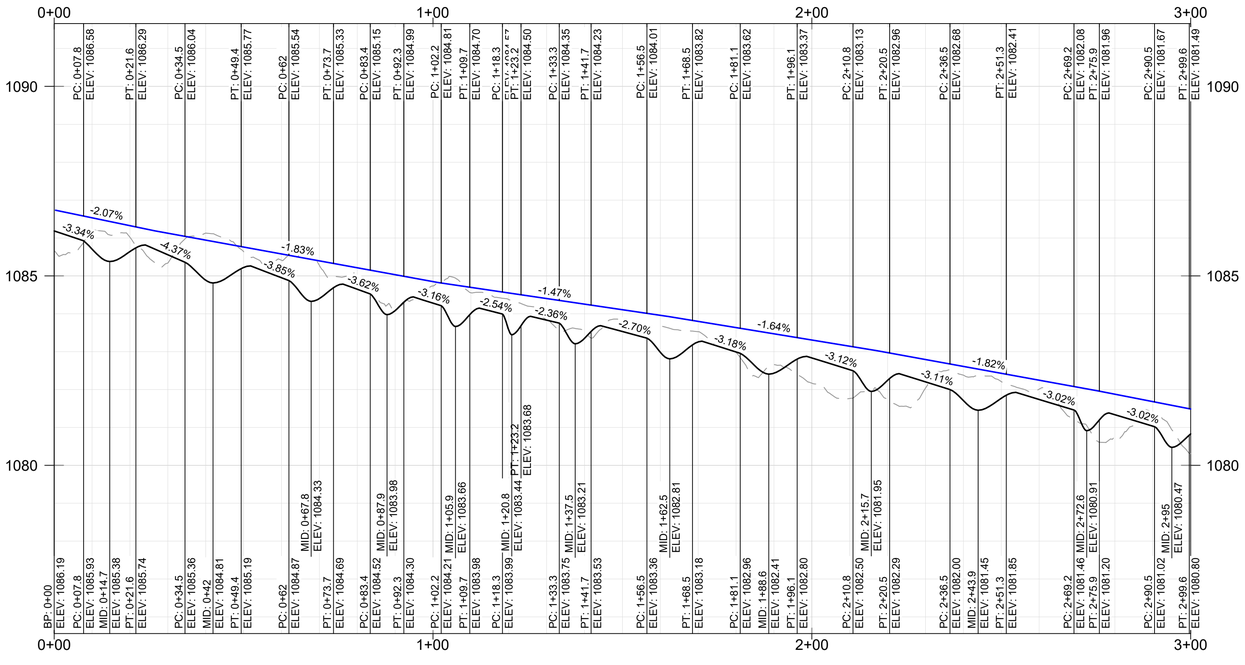


PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND



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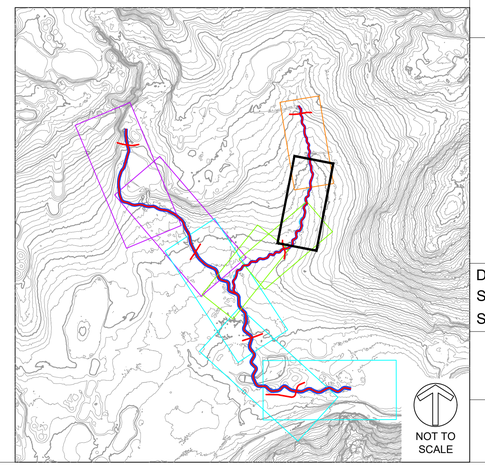

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
TRIBUTARY - C CHANNEL
PLAN AND PROFILE - (1)
STA 0+00 TO 3+00

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South St. Louis SOIL & WATER CONSERVATION DISTRICT

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PRINTED NAME: KEITH ANDERSON

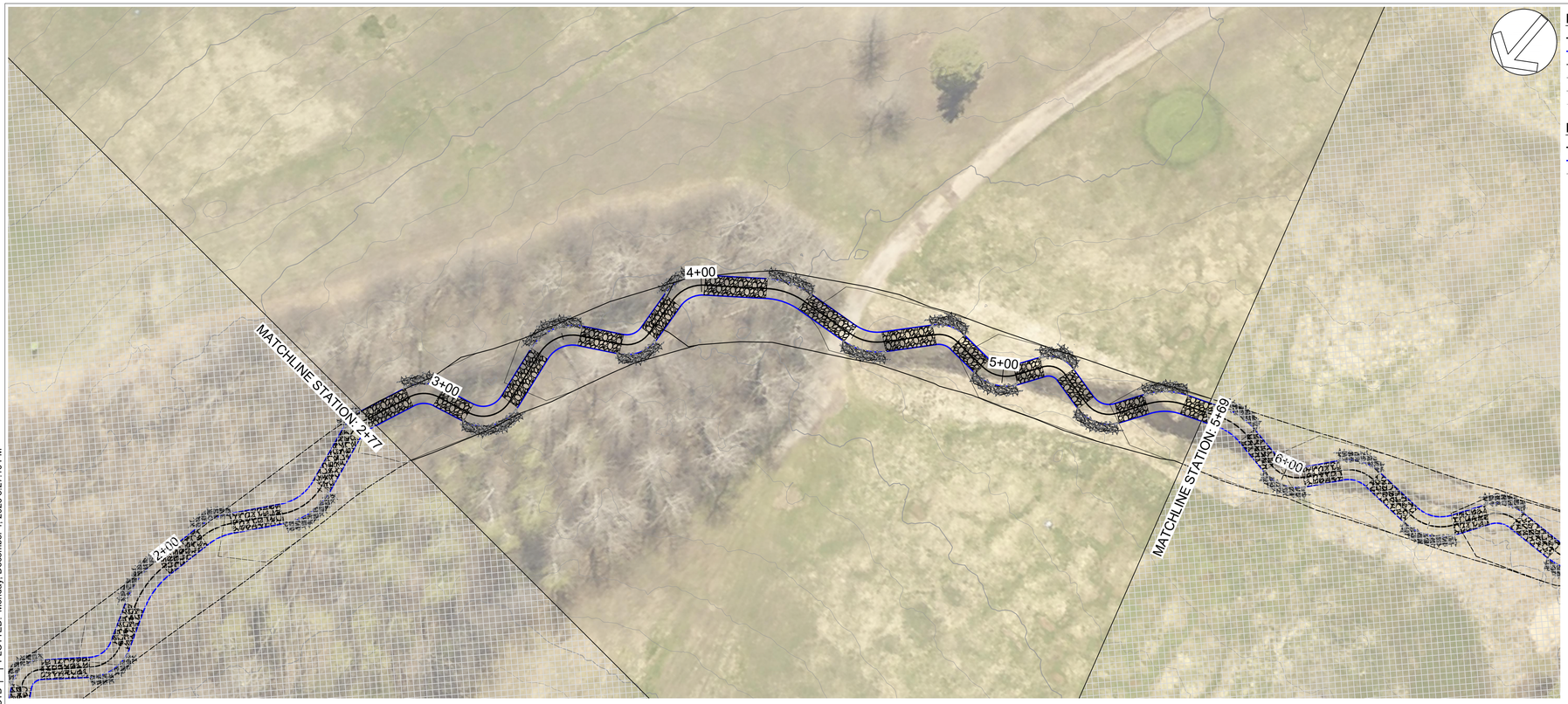
SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

0 20 40
SCALE IN FEET

SHEET NUMBER
12 OF 36

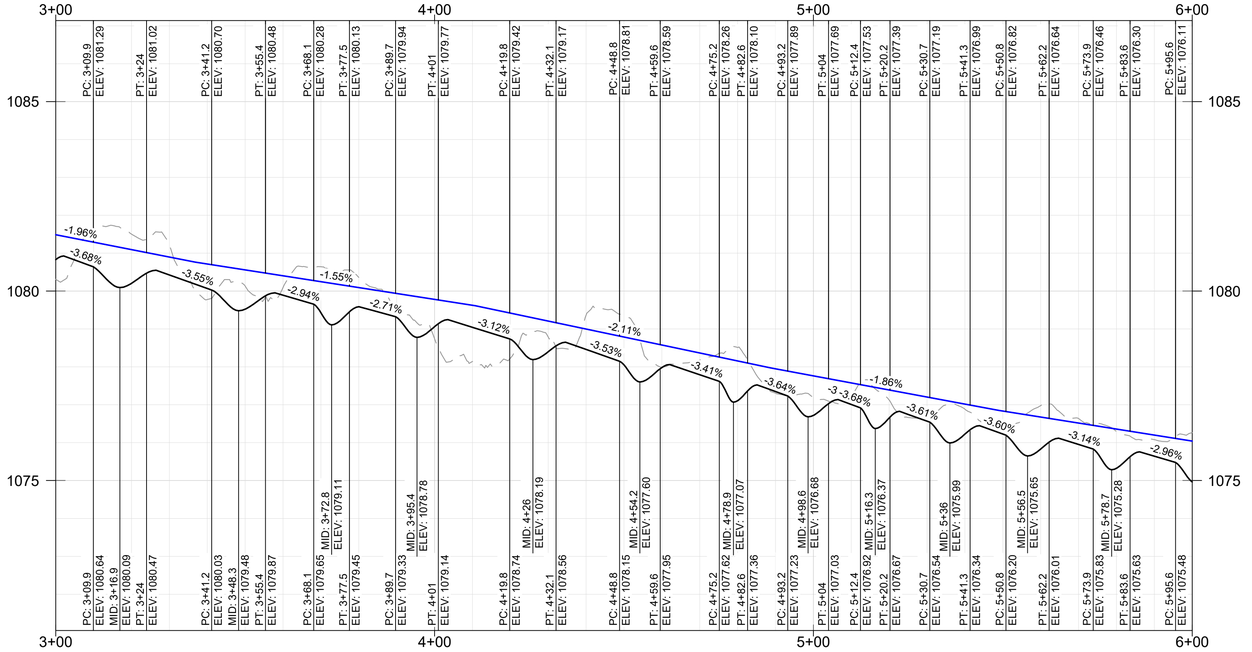


PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND



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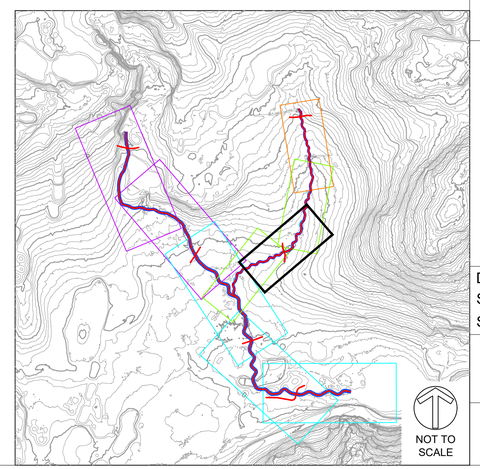

NOT TO SCALE

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
TRIBUTARY - C CHANNEL
PLAN AND PROFILE - (2)
STA 3+00 TO 6+00

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SCALE (17"X11"): 1" = 40'

0 20 40
SCALE IN FEET

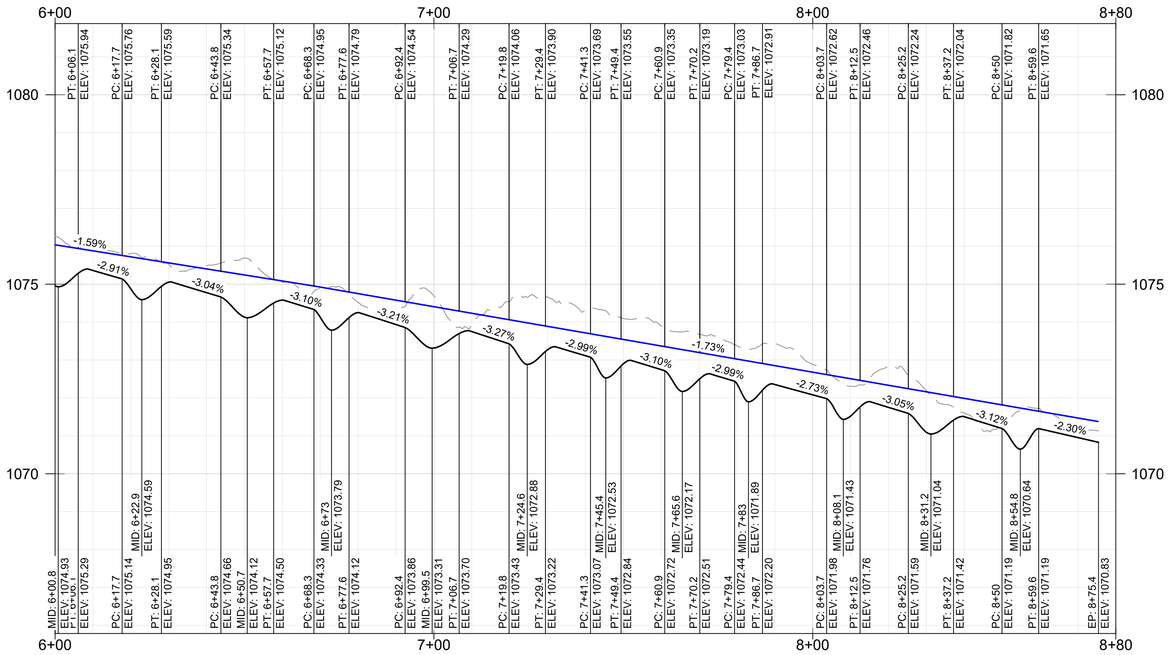
SHEET NUMBER
13 OF 36

PLAN LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND



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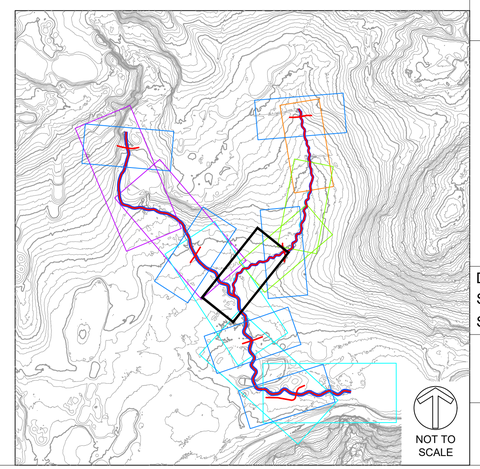

NOT TO SCALE

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
TRIBUTARY - C CHANNEL
PLAN AND PROFILE - (1)
STA 6+00 TO 8+80

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0 20 40
SCALE IN FEET

SHEET NUMBER
14 OF 36

STREAM MORPHOLOGY
STREAM NAME: BUCKINGHAM CREEK B-CHANNEL TRIBUTARY

TYPICAL SECTION - POOL			
DESIGN PARAMETERS	MINIMUM (FT)	MEAN (FT)	MAXIMUM (FT)
BANKFULL WIDTH	5.60	5.90	6.10
MAX DEPTH	0.87	0.99	1.12

TYPICAL SECTION - RIFFLE			
DESIGN PARAMETERS	MINIMUM (FT)	MEAN (FT)	MAXIMUM (FT)
BANKFULL WIDTH	3.90	5.10	5.90
MAX DEPTH	0.34	0.39	0.51

STREAM NAME	BUCKINGHAM CREEK B-CHANNEL TRIBUTARY		
STREAM TYPE	B3		
DRAINAGE AREA, DA (SQ MI)	0.09		
DESIGN PARAMETERS	MINIMUM	MEDIAN	MAXIMUM
MEAN RIFFLE DEPTH, D_{BKF} (FT)	0.34	0.39	0.51
RIFFLE WIDTH, W_{BKF} (FT)	3.90	5.1	5.90
WIDTH-TO-DEPTH RATIO, [W_{BKF}/D_{BKF}]	7.70	12	17.60
RIFFLE CROSS-SECTION AREA, A_{BKF} (SQ FT)		2	
MAX RIFFLE DEPTH, D_{MAX} (FT)	0.54	0.59	0.63
POOL WIDTH, W_{BKFP} (FT)	5.60	5.90	6.10
POOL CROSS-SECTION AREA, A_{BKFP} (SQ FT)	3.10	3.40	3.90
MAX POOL DEPTH, D_{MAXP} (FT)	0.87	1.0	1.12
RIFFLE LENGTH, L_{RIF} (FT)	4.1	11	16.8
POOL LENGTH, L_P (FT)	7.7	9.1	10.6
ENTRENCHMENT RATIO, ER [W_{FPA}/W_{BKF}]		3.00	
RADIUS OF CURVATURE, RC (FT)		17	
POOL-TO-POOL SPACING, P-P (FT)	12.2	21.9	27.0
VALLEY SLOPE, VS (FT/FT)	2-4%		
WATER SURFACE SLOPE, WS (FT/FT)	varies		
SINUOSITY, K = SL/VL (FT/FT)			

STREAM MORPHOLOGY
STREAM NAME: BUCKINGHAM CREEK C-CHANNEL TRIBUTARY

TYPICAL SECTION - POOL			
DESIGN PARAMETERS	MINIMUM (FT)	MEAN (FT)	MAXIMUM (FT)
BANKFULL WIDTH	6.70	7.90	9.10
MAX DEPTH	0.84	0.86	0.88

TYPICAL SECTION - RIFFLE			
DESIGN PARAMETERS	MINIMUM (FT)	MEAN (FT)	MAXIMUM (FT)
BANKFULL WIDTH	5.30	5.50	5.80
MAX DEPTH	0.34	0.36	0.38

STREAM NAME	BUCKINGHAM CREEK C-CHANNEL TRIBUTARY		
STREAM TYPE	C4		
DRAINAGE AREA, DA (SQ MI)	0.09		
DESIGN PARAMETERS	MINIMUM	MEDIAN	MAXIMUM
MEAN RIFFLE DEPTH, D_{BKF} (FT)	0.34	0.36	0.38
RIFFLE WIDTH, W_{BKF} (FT)	5.30	5.5	5.80
WIDTH-TO-DEPTH RATIO, [W_{BKF}/D_{BKF}]	13.00	13	16.90
RIFFLE CROSS-SECTION AREA, A_{BKF} (SQ FT)		2	
MAX RIFFLE DEPTH, D_{MAX} (FT)	0.52	0.57	0.62
POOL WIDTH, W_{BKFP} (FT)	6.70	7.90	9.10
POOL CROSS-SECTION AREA, A_{BKFP} (SQ FT)	2.90	3.10	3.40
MAX POOL DEPTH, D_{MAXP} (FT)	0.84	0.86	0.88
RIFFLE LENGTH, L_{RIF} (FT)	4.1	11	16.8
POOL LENGTH, L_P (FT)	9.0	10.8	11.9
ENTRENCHMENT RATIO, ER [W_{FPA}/W_{BKF}]		3.00	
RADIUS OF CURVATURE, RC (FT)		15.0	
POOL-TO-POOL SPACING, P-P (FT)	19.5	22.7	28.9
VALLEY SLOPE, VS (FT/FT)	2-4%		
WATER SURFACE SLOPE, WS (FT/FT)	varies		
SINUOSITY, K = SL/VL (FT/FT)			

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APPROVED BY: XX | CHECKED BY: XX | DRAWN BY: XXX

BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

TRIBUTARY MORPHOLOGY

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 1'
SCALE (17"X11"): 1" = 2'

0 1 2
SCALE IN FEET

SHEET NUMBER
15 OF 36

STREAM MORPHOLOGY
STREAM NAME: BUCKINGHAM CREEK B-CHANNEL

TYPICAL SECTION - POOL			
DESIGN PARAMETERS	MINIMUM (FT)	MEAN (FT)	MAXIMUM (FT)
BANKFULL WIDTH	9.00	10.30	10.60
MAX DEPTH	1.50	1.70	1.94

TYPICAL SECTION - RIFFLE			
DESIGN PARAMETERS	MINIMUM (FT)	MEAN (FT)	MAXIMUM (FT)
BANKFULL WIDTH	6.80	8.80	10.30
MAX DEPTH	0.90	1.00	1.10

STREAM NAME	BUCKINGHAM CREEK B-CHANNEL		
STREAM TYPE	B3		
DRAINAGE AREA, DA (SQ MI)	0.80		
DESIGN PARAMETERS	MINIMUM	MEDIAN	MAXIMUM
MEAN RIFFLE DEPTH, D_{BKF} (FT)	0.58	0.68	0.89
RIFFLE WIDTH, W_{BKF} (FT)	6.80	8.8	10.30
WIDTH-TO-DEPTH RATIO, [W_{BKF}/D_{BKF}]	7.70	12	17.60
RIFFLE CROSS-SECTION AREA, A_{BKF} (SQ FT)		6	
MAX RIFFLE DEPTH, D_{MAX} (FT)	0.94	1.0	1.09
POOL WIDTH, W_{BKFP} (FT)	9.0	10.3	10.6
POOL CROSS-SECTION AREA, A_{BKFP} (SQ FT)	9.40	10.2	11.80
MAX POOL DEPTH, D_{MAXP} (FT)	1.51	1.7	1.94
RIFFLE LENGTH, L_{RIF} (FT)	7.1	19	29.2
POOL LENGTH, L_P (FT)	13.3	15.7	18.4
ENTRENCHMENT RATIO, ER [W_{FPA}/W_{BKF}]		3.75	
RADIUS OF CURVATURE, RC (FT)		29	
POOL-TO-POOL SPACING, P-P (FT)	21.0	37.9	46.8
VALLEY SLOPE, VS (FT/FT)			
WATER SURFACE SLOPE, WS (FT/FT)	varies		
SINUOSITY, K = SL/VL (FT/FT)			

STREAM MORPHOLOGY
STREAM NAME: BUCKINGHAM CREEK C-CHANNEL

TYPICAL SECTION - POOL			
DESIGN PARAMETERS	MINIMUM (FT)	MEAN (FT)	MAXIMUM (FT)
BANKFULL WIDTH	12.40	14.80	17.10
MAX DEPTH	1.56	1.60	1.64

TYPICAL SECTION - RIFFLE			
DESIGN PARAMETERS	MINIMUM (FT)	MEAN (FT)	MAXIMUM (FT)
BANKFULL WIDTH	9.80	10.40	10.90
MAX DEPTH	0.97	1.06	1.16

STREAM NAME	BUCKINGHAM CREEK B-CHANNEL TRIBUTARY		
STREAM TYPE	C4		
DRAINAGE AREA, DA (SQ MI)	0.80		
DESIGN PARAMETERS	MINIMUM	MEDIAN	MAXIMUM
MEAN RIFFLE DEPTH, D_{BKF} (FT)	0.64	0.68	0.71
RIFFLE WIDTH, W_{BKF} (FT)	9.80	10.4	10.90
WIDTH-TO-DEPTH RATIO, [W_{BKF}/D_{BKF}	13.00	13.8	16.90
RIFFLE CROSS-SECTION AREA, A_{BKF} (SQ FT)		7	
MAX RIFFLE DEPTH, D_{MAX} (FT)	0.97	1.06	1.16
POOL WIDTH, W_{BKFP} (FT)	12.40	14.80	17.10
POOL CROSS-SECTION AREA, A_{BKFP} (SQ FT)	13.10	19.00	28.70
MAX POOL DEPTH, D_{MAXP} (FT)	1.56	1.6	1.64
RIFFLE LENGTH, L_{RIF} (FT)	16.9	20	22.3
POOL LENGTH, L_P (FT)	9.0	21.8	32.5
ENTRENCHMENT RATIO, ER [W_{FPA}/W_{BKF}]			
RADIUS OF CURVATURE, RC (FT)		29	
POOL-TO-POOL SPACING, P-P (FT)	36.4	42.4	54.1
VALLEY SLOPE, VS (FT/FT)	2-4%		
WATER SURFACE SLOPE, WS (FT/FT)	varies		
SINUOSITY, K = SL/VL (FT/FT)			

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

MAINSTEM MORPHOLOGY

BEAVER RIVER CONSULTING

South St. Louis
SOIL & WATER CONSERVATION DISTRICT

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NOT FOR
CONSTRUCTION

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.

PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 1'
SCALE (17"X11"): 1" = 2'

0 1 2
SCALE IN FEET

SHEET NUMBER
16 OF 36

RIFFLE TABLE C-CHANNEL BUCKINGHAM

#	START STATION	END STATION	START ELEVATION	TOP OF GLIDE ELEVATION	END ELEVATION	LENGTH
1	0+00'	0+32'	1076.6'	1076.6'	1075.8'	31.7'
2	0+59'	0+91'	1075.5'	1075.7'	1074.8'	32.0'
3	1+11'	1+44'	1074.4'	1074.7'	1073.8'	33.8'
4	1+69'	1+99'	1073.5'	1073.7'	1072.9'	29.9'
5	2+21'	2+49'	1072.5'	1072.7'	1072.0'	27.9'
6	2+70'	2+94'	1071.7'	1071.9'	1071.4'	24.0'
7	3+12'	3+41'	1071.0	1071.2'	1070.7'	29.3'
8	3+71'	4+02'	1070.4'	1070.6'	1070.0'	31.1'
9	4+29'	4+57'	1069.7	1069.8'	1069.3'	27.4'
10	4+72'	4+97'	1068.8'	1069.1'	1068.5'	24.8'
11	5+20'	5+42'	1068.2'	1068.4'	1067.9'	21.3'
12	5+63'	5+95'	1067.5'	1067.7'	1066.8'	32.5'
13	6+23'	6+53'	1066.4'	1066.6'	1065.8'	30.1'
14	6+75'	7+00'	1065.4'	1065.6'	1065.1'	24.7'
15	7+22'	7+48'	1064.7'	1065.0'	1064.5'	25.6'
16	7+65'	7+89'	1064.0'	1064.3'	1063.9'	24.1'
17	8+07'	8+31'	1063.5'	1063.8'	1063.5'	24.0'
18	8+54'	8+87'	1063.2'	1063.5'	1063.1'	32.8'
19	9+11'	9+34'	1062.9'	1063.1'	1062.9'	24.1'
20	9+52'	9+72'	1062.5'	1062.8'	1062.6'	20.6'
21	9+92'	10+16'	1062.3'	1062.6'	1062.3'	24.5'
22	10+32'	10+49.'	1062.0'	1062.3'	1062.2'	16.6'
23	10+70'	10+94'	1061.9'	1062.1'	1062.0'	23.8'
24	11+13'	11+50'	1061.6'	1061.9'	1061.7'	37.4'
25	11+68'	11+90'	1061.3'	1061.6'	1061.5'	22.0'
26	12+13'	12+40'	1061.2'	1061.5'	1061.2'	27.2
27	12+71'	13+03'	1061.0'	1061.2'	1061.0	32.2
28	13+28'	13+57'	1060.7'	1060.9'	1060.8'	29.2'
29	13+77'	13+97'	1060.5'	1060.8'	1060.7'	19.3'
30	14+14'	14+40'	1060.7'	1060.7'	1060.6'	25.7'

RIFFLE TABLE B-CHANNEL BUCKINGHAM

#	START STATION	END STATION	START ELEVATION	END ELEVATION	LENGTH
1	0+00'	0+25'	1100.1'	1099.2'	24.5'
2	0+42'	0+63'	1099.2'	1098.1'	20.6'
3	0+86'	1+04'	1098.1'	1097.1'	18.1'
4	1+23'	1+50'	1097.1'	1095.9'	26.1'
5	1+69'	1+98'	1095.9'	1094.6'	28.7'
6	2+15'	2+23'	1094.6'	1094.1'	8.7'
7	2+39'	2+57'	1094.1'	1093.1'	18.7'
8	2+75'	2+91'	1093.1'	1092.1'	16.1'
9	3+14'	3+25'	1092.1'	1091.5'	11.3'
10	3+34'	3+48'	1091.5'	1090.8'	14.6'
11	3+66'	3+86'	1090.8'	1089.8'	19.9'
12	4+01'	4+19'	1089.8'	1089.0'	17.7'
13	4+32'	4+51'	1089.0'	1088.1'	19.6'
14	4+66'	4+86'	1088.1'	1087.2'	20.1'
15	5+06'	5+26'	1087.2'	1086.1'	20.7'
16	5+42'	5+61'	1086.1'	1085.2'	18.5'
17	5+75'	5+90'	1085.2'	1084.5'	15.1'
18	6+08'	6+32'	1084.5'	1083.3'	23.5'
19	6+51'	6+78'	1083.3'	1081.9'	27.0'
20	7+05'	7+32'	1081.9'	1080.5'	27.3'
21	7+54'	7+71'	1080.5'	1079.6'	17.4'
22	7+90'	8+04'	1079.6'	1078.9'	14.4'
23	8+17'	8+28'	1078.9'	1078.4'	11.0'
24	8+37'	8+56'	1078.4'	1077.7'	18.9'
25	8+72'	9+05'	1077.7'	1076.6'	32.4'

TOE WOOD TABLE C-CHANNEL BUCKINGHAM

#	START STATION	END STATION	D.S. GLIDE ELEVATION	TOE WOOD, LOW WATER ELEVATION	BASE SUBCUT ELEVATION	LENGTH
1	0+32'	0+59'	1075.7'	1075.9'	1072.9'	27.5'
2	0+91'	1+11'	1074.7'	1074.9'	1071.9'	19.1'
3	1+44'	1+69'	1073.6'	1073.8'	1070.9'	24.3'
4	1+99'	2+21'	1072.7'	1072.9'	1069.9'	20.8'
5	2+49'	2+70'	1071.9'	1072.1'	1069.1'	19.7'
6	2+94'	3+12'	1071.2'	1071.4'	1068.4'	16.8'
7	3+41'	3+71'	1070.6'	1070.8'	1067.8'	28.3'
8	4+02'	4+29'	1069.8'	1070.0'	1067.0'	26.4'
9	4+57'	4+72'	1069.1'	1069.3'	1066.3'	15.4'
10	4+97'	5+20'	1068.4'	1068.6'	1065.6'	23.1'
11	5+42'	5+63'	1067.7'	1067.9'	1064.9'	19.6'
12	5+95'	6+23'	1066.6'	1066.8'	1063.8'	26.4'
13	6+53'	6+75'	1065.6'	1065.8'	1062.8'	21.3'
14	7+00'	7+22'	1065.0'	1065.2'	1062.2'	20.6'
15	7+48'	7+65'	1064.3'	1064.5'	1061.5'	16.1'
16	7+89'	8+07'	1063.8'	1064.0'	1061.0'	16.8'
17	8+31'	8+54'	1063.5'	1063.6'	1060.7'	22.3'
18	8+87'	9+11'	1063.1'	1063.3'	1060.3'	22.1'
19	9+35'	9+52'	1062.8'	1063.0	1060.0'	16.7'
20	9+72'	9+92'	1062.6'	1062.8'	1059.8'	18.6'
21	10+16'	10+32'	1062.3'	1062.5'	1059.5'	16.0'
22	10+49'	10+70'	1062.1'	1062.3'	1059.3'	19.1'
23	10+94'	11+13'	1061.9'	1062.1'	1059.1'	19.0'
24	11+50'	11+68'	1061.6'	1061.8'	1058.8'	16.9'
25	11+90'	12+13'	1061.5'	1061.7'	1058.7'	22.5'
26	12+40'	12+71'	1061.2'	1061.4'	1058.4'	29.6'
27	13+03'	13+28'	1060.9'	1061.1'	1058.1'	23.8'
28	13+57'	13+77'	1060.8'	1061.0'	1058.0'	19.3'
29	13+97'	14+14'	1060.7'	1060.9'	1057.9'	16.6'

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX	
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

MAINSTEM STRUCTURE SHEET

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42627

DATE: 12/01/2023
SCALE (34"X22"): 1" = 1'
SCALE (17"X11"): 1" = 2'

0 1 2
SCALE IN FEET

SHEET NUMBER
17 OF 36

RIFFLE TABLE C-CHANNEL TRIBUTARY

#	START STATION	END STATION	START ELEVATION	TOP OF GLIDE ELEVATION	END ELEVATION	LENGTH
1	0+00'	0+08'	1086.2'		1085.9'	7.8'
2	0+22'	0+35'	1085.7'	1085.8'	1085.4'	13.0'
3	0+49'	0+62'	1085.2'	1085.3'	1084.5'	12.6'
4	0+74'	0+83'	1084.7'	1084.8'	1084.5'	9.7'
5	0+92'	1+02'	1084.3'	1084.4'	1084.2'	9.9'
6	1+10'	1+18'	1084.0'	1084.2'	1084.0'	8.6'
7	1+23'	1+33'	1083.7'	1083.9'	1083.8'	10.1'
8	1+42'	1+57'	1083.5'	1083.7'	1083.4'	14.7'
9	1+69'	1+81'	1083.2'	1083.3'	1083.0'	12.6'
10	1+96'	2+11'	1082.8'	1082.9'	1082.5'	14.7'
11	2+21'	2+37'	1082.3'	1082.4'	1082.0'	15.9'
12	2+51'	2+69'	1081.9'	1081.9'	1081.5'	17.9'
13	2+76'	2+91'	1081.2'	1081.4'	1081.0'	14.6'
14	3+00'	3+10'	1080.8'	1080.9'	1080.6'	10.3'
15	3+24'	3+41'	1080.5'	1080.6'	1080.0'	17.2'
16	3+55'	3+68'	1079.9'	1080.0'	1079.7'	12.7'
17	3+78'	3+90'	1079.5'	1079.6'	1079.3'	12.2'
18	4+01'	4+20'	1079.1'	1079.3'	1078.7'	18.8'
19	4+32'	4+49'	1078.6'	1078.7'	1078.2'	16.7'
20	4+60'	4+75'	1077.6'	1078.1'	1077.6'	15.6'
21	4+83'	4+93'	1077.4'	1077.5'	1077.2'	10.6'
22	5+04'	5+12'	1077.0'	1077.1'	1076.9'	8.5'
23	5+20'	5+31'	1076.7'	1076.8'	1076.5'	10.5'
24	5+41'	5+51'	1076.3'	1076.5'	1076.2'	9.5'
25	5+62'	5+74'	1076.0'	1076.1'	1075.8'	11.6'
26	5+84'	5+96'	1075.6'	1075.8'	1075.5'	12.0'
27	6+06'	6+18'	1075.3'	1075.4'	1075.1'	11.6'
28	6+28'	6+44'	1075.0'	1075.1'	1074.7'	15.7'
29	6+58'	6+68'	1074.5'	1074.6'	1074.3'	10.6'
30	6+78'	6+92'	1074.1'	1074.3'	1073.9'	14.8'
31	7+07'	7+20'	1073.7'	1073.8'	1073.4'	13.2'
32	7+29'	7+41'	1073.2'	1073.4'	1073.1'	11.9'
33	7+49'	7+61'	1072.9'	1073.0'	1072.7'	11.5'
34	7+70'	7+79'	1072.5'	1072.6'	1072.4'	9.2'
35	7+87'	8+04'	1072.2'	1072.4'	1072.0'	16.9'
36	8+13'	8+25'	1071.8'	1071.9'	1071.6'	12.7'
37	8+37'	8+50'	1071.4'	1071.5'	1071.2'	12.8'
38	8+60'	8+75'	1071.2'	1071.2'	1070.8'	15.8'

RIFFLE TABLE B-CHANNEL TRIBUTARY

#	START STATION	END STATION	START ELEVATION	END ELEVATION	LENGTH
1	0+00'	0+18'	1099.8'	1098.8'	18.3'
2	0+28'	0+39'	1098.8'	1098.1'	11.2'
3	0+50'	0+61'	1098.1'	1097.3'	11.0'
4	0+73'	0+89'	1097.3'	1096.2'	15.8'
5	1+01'	1+16'	1096.2'	1095.1'	14.7'
6	1+27'	1+38'	1095.1'	1094.4'	10.8'
7	1+50'	1+63'	1094.4'	1093.4'	13.3'
8	1+71'	1+79'	1093.4'	1092.9'	7.2'
9	1+87'	1+96'	1092.9'	1092.3'	8.6'
10	2+06'	2+16'	1092.3'	1091.5'	9.6'
11	2+27'	2+34'	1091.5'	1090.9'	7.5'
12	2+44'	2+56'	1090.9'	1090.1'	12.1'
13	2+64'	2+76'	1090.1'	1089.4'	11.8'
14	2+85'	2+98'	1089.4'	1088.9'	13.0
15	3+06'	3+17'	1088.9'	1088.0'	10.7'
16	3+25'	3+37'	1088.0'	1087.4'	12.2'
17	3+48'	3+61'	1087.4'	1087.0'	13.0'
18	3+71'	3+78'	1087.0'	1086.7'	7.0'
19	3+87'	3+96'	1086.7'	1086.4'	9.7'
20	4+04'	4+18'	1086.4'	1086.1'	14.4'

TOE WOOD TABLE C-CHANNEL TRIBUTARY

#	START STATION	END STATION	D.S. GLIDE ELEVATION	TOE WOOD, LOW WATER ELEVATION	BASE SUBCUT ELEVATION	LENGTH
1	0+07.8'	0+21.6'	1085.82'	1085.97'	1083.97'	13.8'
2	0+34.5'	0+49.4'	1085.26'	1085.41'	1083.41'	14.8'
3	0+62.0'	0+73.7'	1084.78'	1084.93'	1082.93'	11.8'
4	0+83.4'	0+92.3'	1084.44'	1084.59'	1082.59'	8.9'
5	1+02.2'	1+09.7'	1084.15	1084.30'	1082.30'	7.5'
6	1+18.4'	1+23.2'	1083.93'	1084.08'	1082.08'	4.9'
7	1+33.3'	1+41.8'	1083.69'	1083.84'	1081.84'	8.4'
8	1+56.5'	1+68.5'	1083.28'	1083.43'	1081.43'	12.1'
9	1+81.1'	1+96.2'	1082.88'	1083.03'	1081.03'	15.0'
10	2+10.9'	2+20.5'	1082.42'	1082.57'	1080.57'	9.7'
11	2+36.5'	2+51.3'	1081.93'	1082.08'	1080.08'	14.9'
12	2+69.2'	2+75.9'	1081.38'	1081.53'	1079.53'	6.7'
13	2+90.5'	2+99.6'	1080.93'	1081.08'	1079.08'	9.2'
14	3+09.9'	3+24.0'	1080.55'	1080.70'	1078.70'	14.0'
15	3+41.2'	3+55.4'	1079.96'	1080.11'	1078.11'	14.2'
16	3+68.1'	3+77.6'	1079.59'	1079.74'	1077.74'	9.4'
17	3+89.7'	4+01.0'	1079.25'	1079.40'	1077.40'	11.3'
18	4+19.8'	4+32.1'	1078.65'	1078.80'	1076.80'	12.3'
19	4+48.8'	4+59.6'	1078.06'	1078.21'	1076.21'	10.7'
20	4+75.2'	4+82.6'	1077.53'	1077.68'	1075.68'	7.5'
21	4+93.2'	5+04.0'	1077.14'	1077.29'	1075.29'	10.7'
22	5+12.4'	5+20.2'	1076.83'	1076.98'	1074.98'	7.8'
23	5+30.7'	5+41.3'	1076.45'	1076.60'	1074.60'	10.6'
24	5+50.8'	5+62.2'	1076.12'	1076.27'	1074.27'	11.4'
25	5+73.9'	5+83.6'	1075.76'	1075.91'	1073.91'	9.7'
26	5+95.6'	6+06.1'	1075.41'	1075.56'	1073.56'	10.5'
27	6+17.7'	6+28.1'	1075.06'	1075.21'	1073.21'	10.4'
28	6+43.8'	6+57.7'	1074.59'	1074.74'	1072.74'	14.0'
29	6+68.3'	6+77.6'	1074.25'	1074.40'	1072.40'	9.3'
30	6+92.4'	7+06.7'	1073.78'	1073.93'	1071.93'	14.2'
31	7+19.8'	7+29.4'	1073.35'	1073.50'	1071.50'	9.6'
32	7+41.3'	7+49.4'	1073.00'	1073.15'	1071.15'	8.1'
33	7+60.9'	7+70.2'	1072.64'	1072.79'	1070.79'	9.3'
34	7+79.4'	7+86.7'	1072.37'	1072.52'	1070.52'	7.4'
35	8+03.7'	8+12.5'	1071.90'	1072.05'	1070.05'	8.8'
36	8+25.2'	8+37.2'	1071.51'	1071.66'	1069.66'	11.9'
37	8+50.0'	8+59.6'	1071.19'	1071.34'	1069.34'	9.7'

APPROVED BY: XX | CHECKED BY: XX | DRAWN BY: XXX

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

TRIBUTARY STRUCTURE SHEET

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

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SCALE (34"X22"): 1" = 1'
SCALE (17"X11"): 1" = 2'

0 1 2
SCALE IN FEET

SHEET NUMBER
18 OF 36

C:\USERS\JACKS\DROPBOX\2022_BUCKINGHAM\C3D\SHEETS\BRIDGE_OVERVIEW_BUCKINGHAM.DWG | JACKS | SAVED: Monday, December 4, 2023 3:14:35 PM | ACAD.CTB | | PLOTTED: Monday, December 4, 2023 3:28:07 PM

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX	
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

BRIDGE OVERVIEW SHEET (1)

BEAVER RIVER CONSULTING

South St. Louis
SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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SIGNATURE:

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DATE: 12/01/2023
SCALE (34"X22"): 1" = 50'
SCALE (17"X11"): 1" = 100'

0 50 100
SCALE IN FEET

SHEET NUMBER
19 OF 36

C:\USERS\JACKS\DROPBOX2022_BUCKINGHAMC3D\SHEETS\BRIDGE_OVERVIEW_BUCKINGHAM.DWG | JACKS | SAVED: Monday, December 4, 2023 3:14:35 PM | ACAD.CTB | | PLOTTED: Monday, December 4, 2023 3:28:17 PM

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX	
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

BRIDGE OVERVIEW SHEET (2)

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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.

PRINTED NAME: KEITH ANDERSON

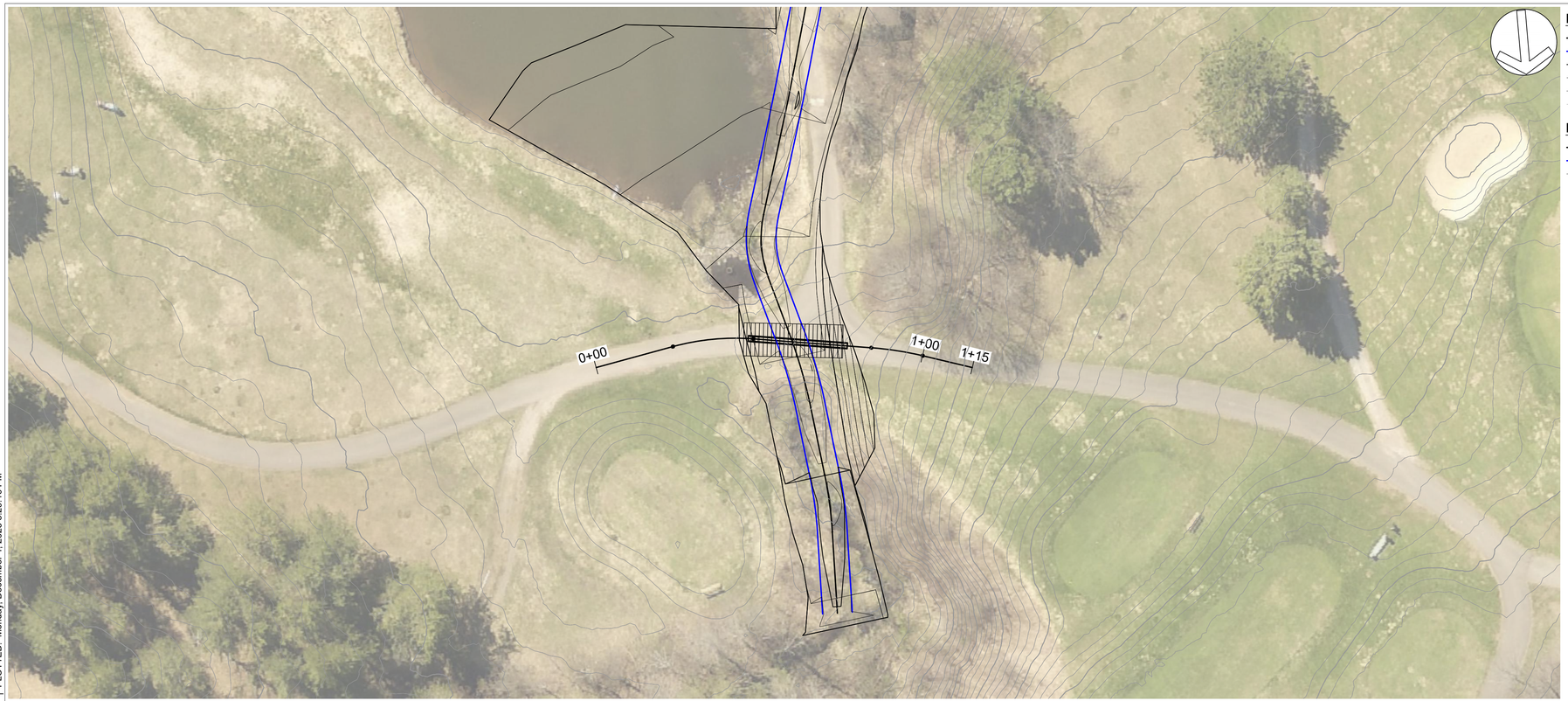
SIGNATURE:

DATE: LIC. NO 42627

DATE: 12/01/2023
SCALE (34"X22"): 1" = 50'
SCALE (17"X11"): 1" = 100'

0 50 100
SCALE IN FEET

SHEET NUMBER
20 OF 36

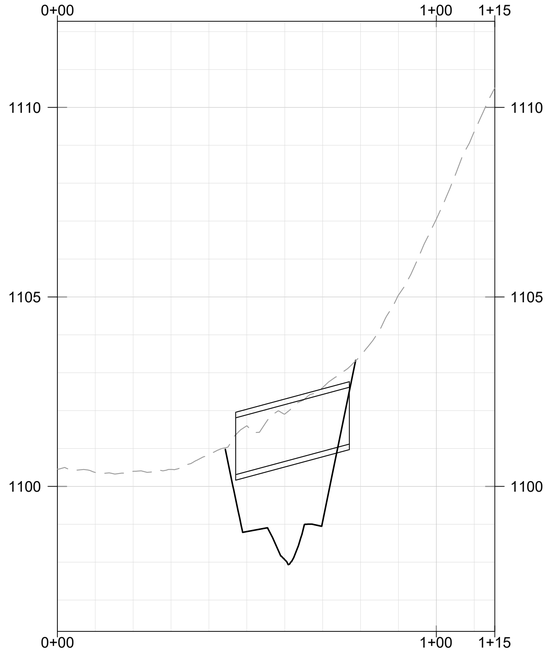


PLAN LEGEND

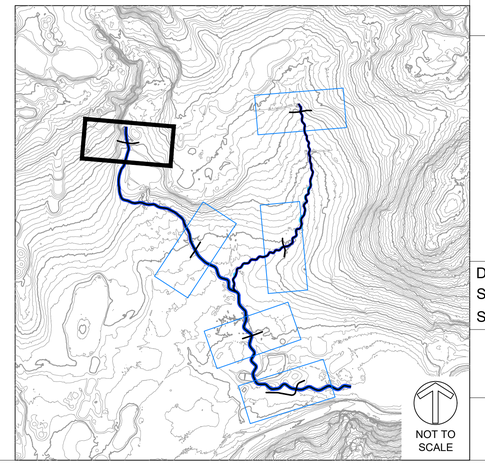
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND
- PROPOSED BRIDGE



mainstem bridge #1 - SCALE: HOR 1" =20'; VERT 1"= 2'



NOT TO SCALE

APPROVED BY: XX | CHECKED BY: XX | DRAWN BY: XXX

REV	DESCRIPTION	APPRV
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM BRIDGE #1
PLAN AND PROFILE - (1)
STA 0+00 TO 1+00

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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.

PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

0 20 40
SCALE IN FEET

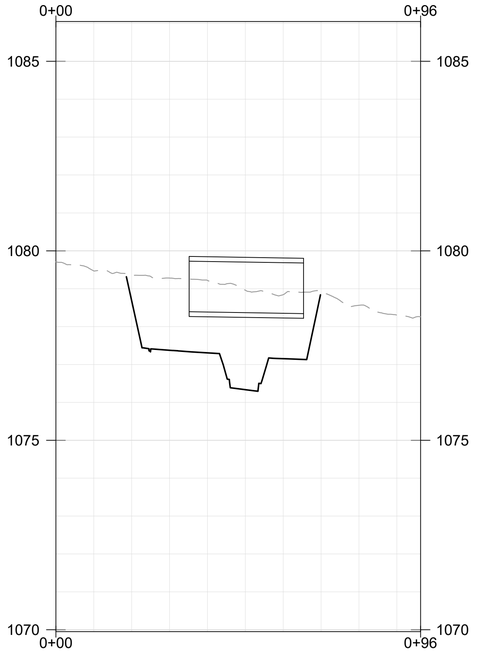
SHEET NUMBER
21 OF 36

PLAN LEGEND

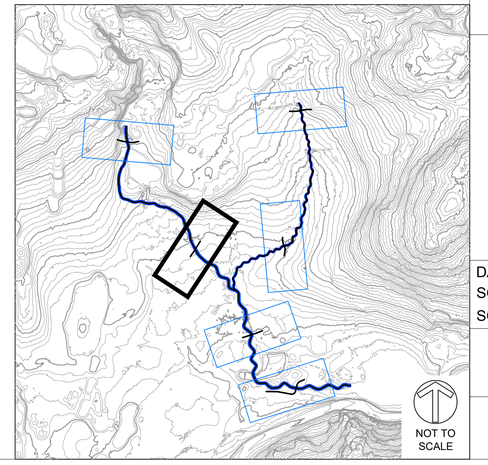
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND
- PROPOSED BRIDGE



Mainstem Bridge #2 - SCALE: HOR 1" =20'; VERT 1"= 2'



NOT TO SCALE

APPROVED BY: XX | CHECKED BY: XX | DRAWN BY: XXX

REV	DESCRIPTION	APPRV
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM BRIDGE #2
PLAN AND PROFILE - (1)
STA 0+00 TO 0+96

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

0 20 40
SCALE IN FEET

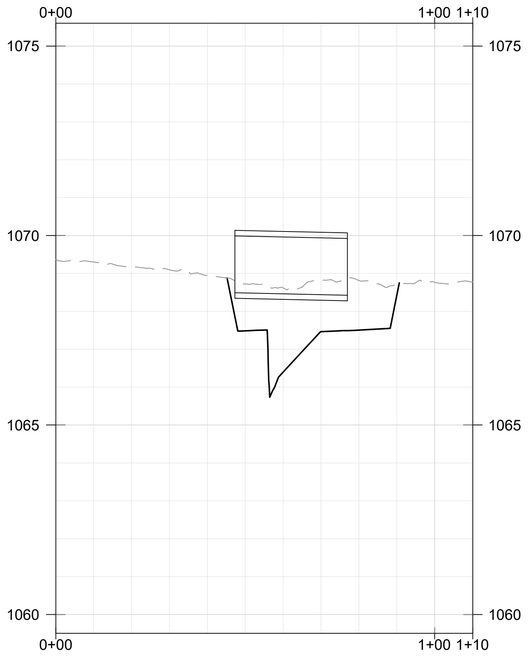
SHEET NUMBER
22 OF 36

PLAN LEGEND

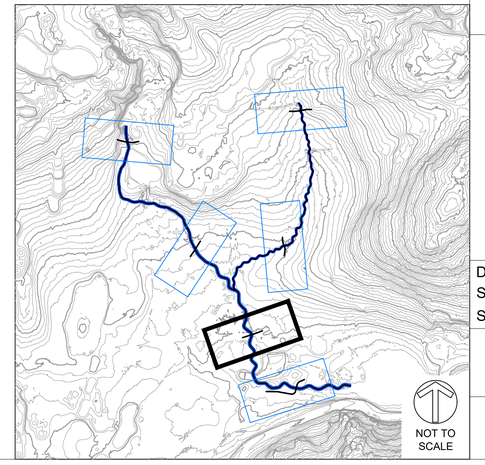
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND
- PROPOSED BRIDGE



Mainstem Bridge #3 - SCALE: HOR 1" =20'; VERT 1"= 2'



APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX

REV	DESCRIPTION	APPRV
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM BRIDGE #3
PLAN AND PROFILE - (1)
STA 0+00 TO 1+00

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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.

PRINTED NAME: KEITH ANDERSON

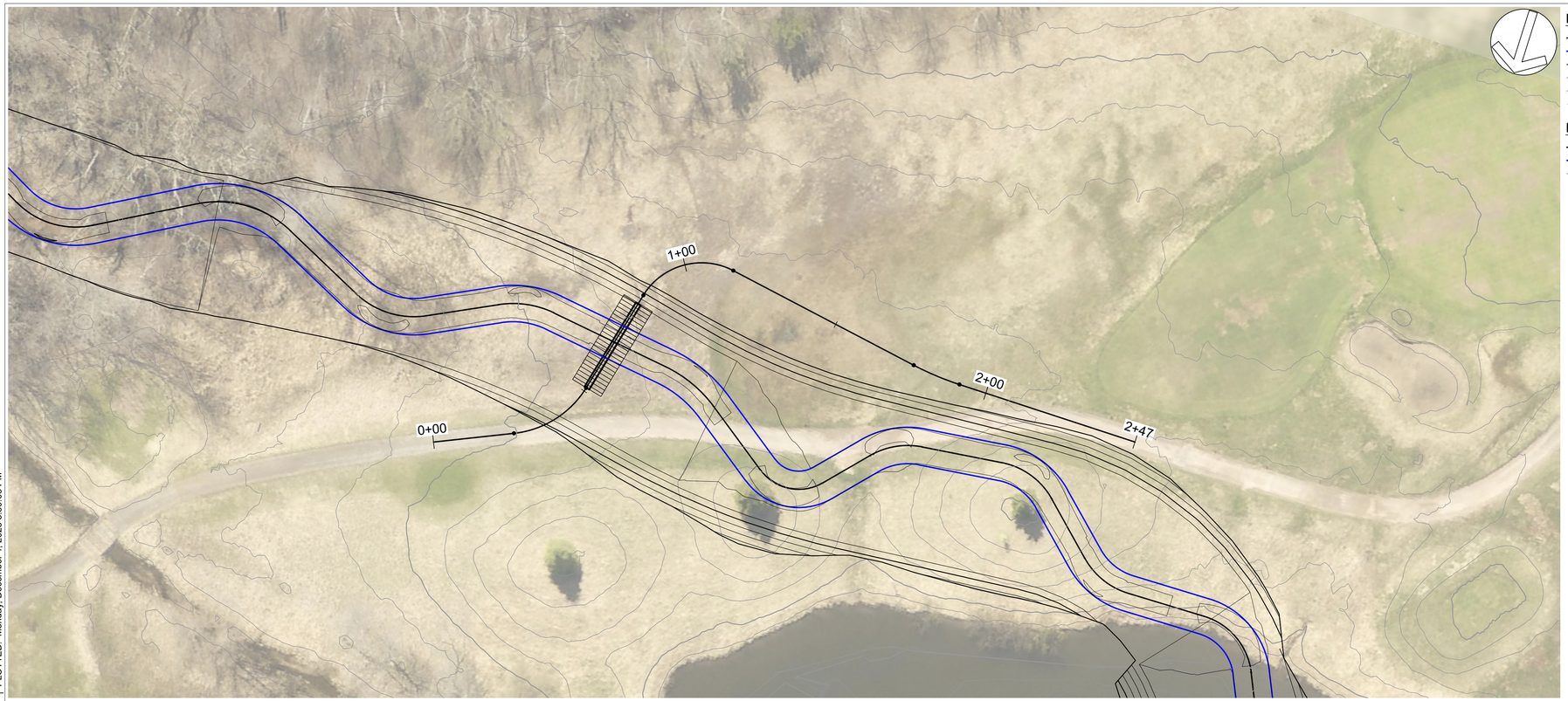
SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

0 20 40
SCALE IN FEET

SHEET NUMBER
23 OF 36

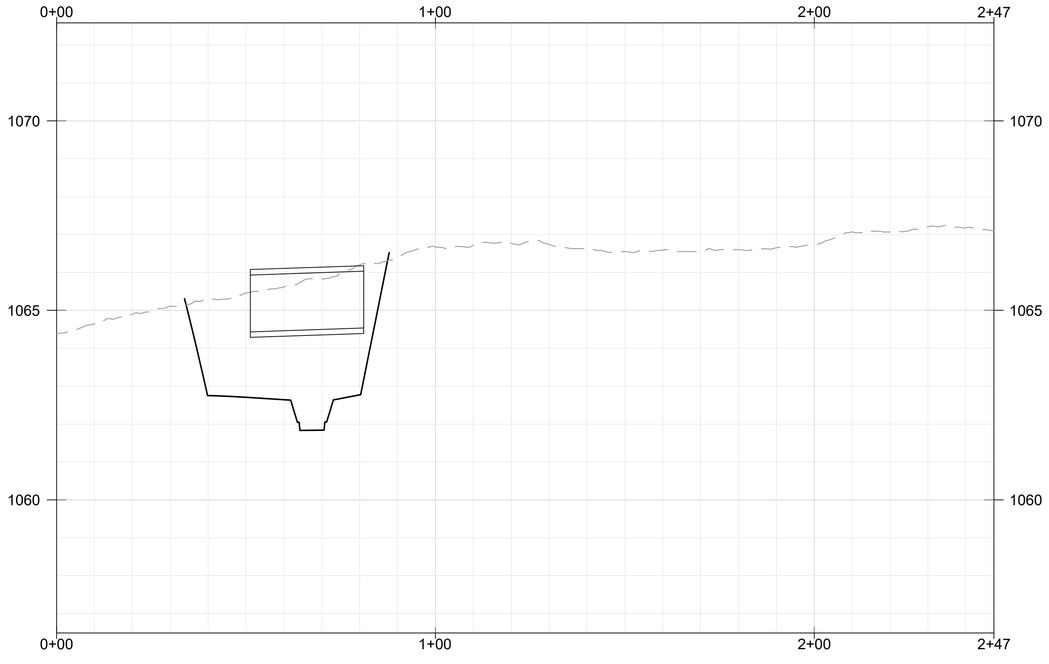


PLAN LEGEND

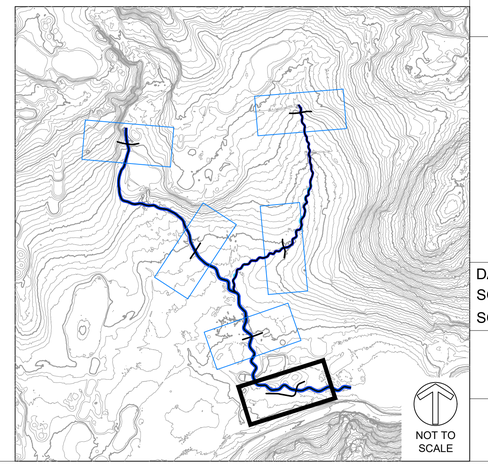
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND
- PROPOSED BRIDGE



Mainstem Bridge #4 - SCALE: HOR 1" =20'; VERT 1"= 2'



APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX

REV	DESCRIPTION	APPRV
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM BRIDGE #4
PLAN AND PROFILE - (1)
STA 0+00 TO 2+47

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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.

PRINTED NAME: KEITH ANDERSON

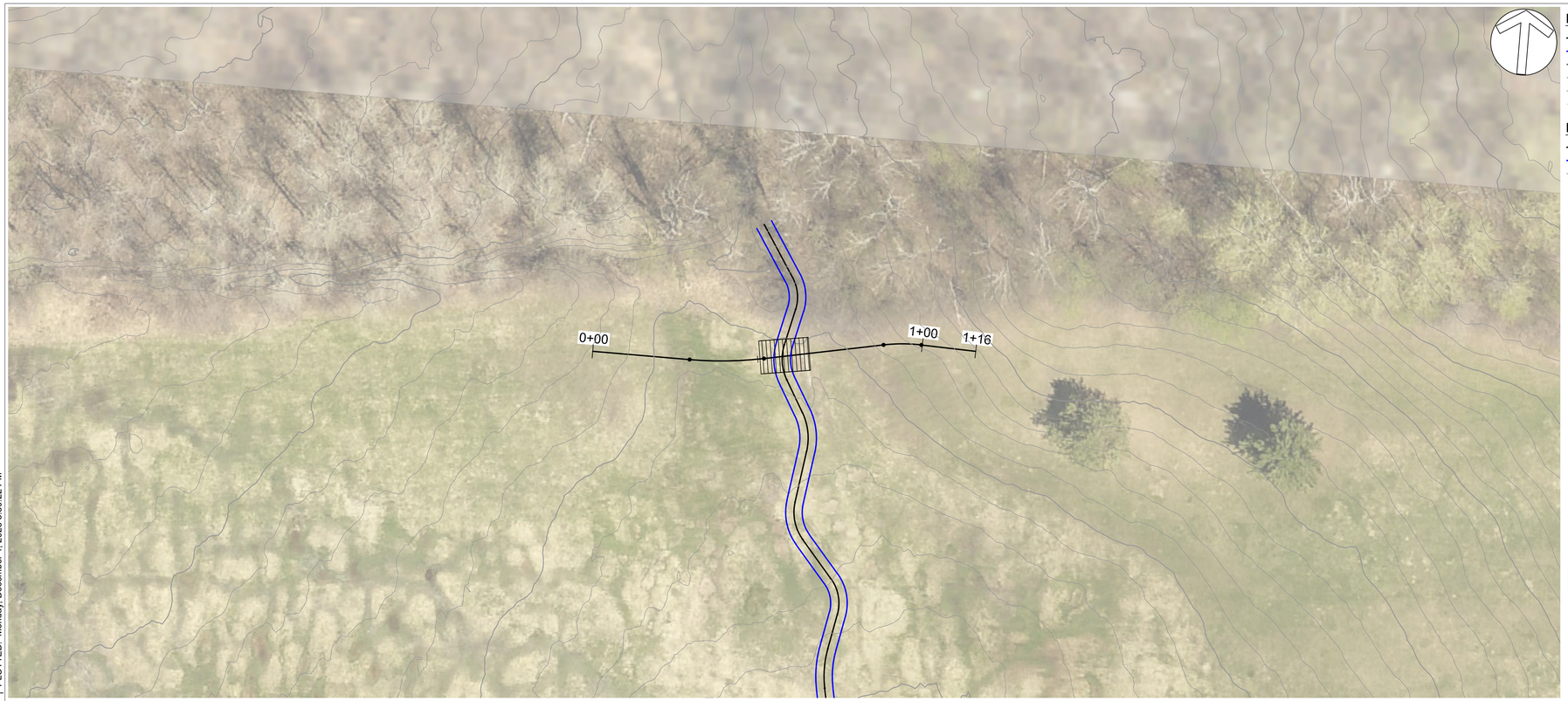
SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

0 20 40
SCALE IN FEET

SHEET NUMBER
24 OF 36

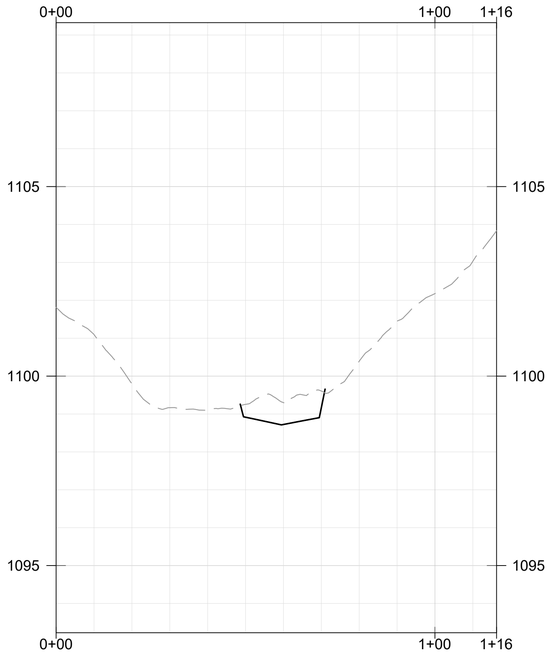


PLAN LEGEND

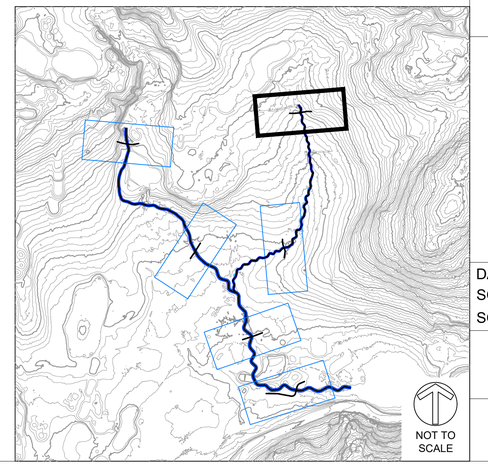
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND
- PROPOSED BRIDGE



Tributary Bridge #1 - SCALE: HOR 1" =20'; VERT 1"= 2'



APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX

REV	DESCRIPTION	APPRV
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
TRIBUTARY BRIDGE #1
PLAN AND PROFILE - (1)
STA 0+00 TO 1+16

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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PRINTED NAME: KEITH ANDERSON

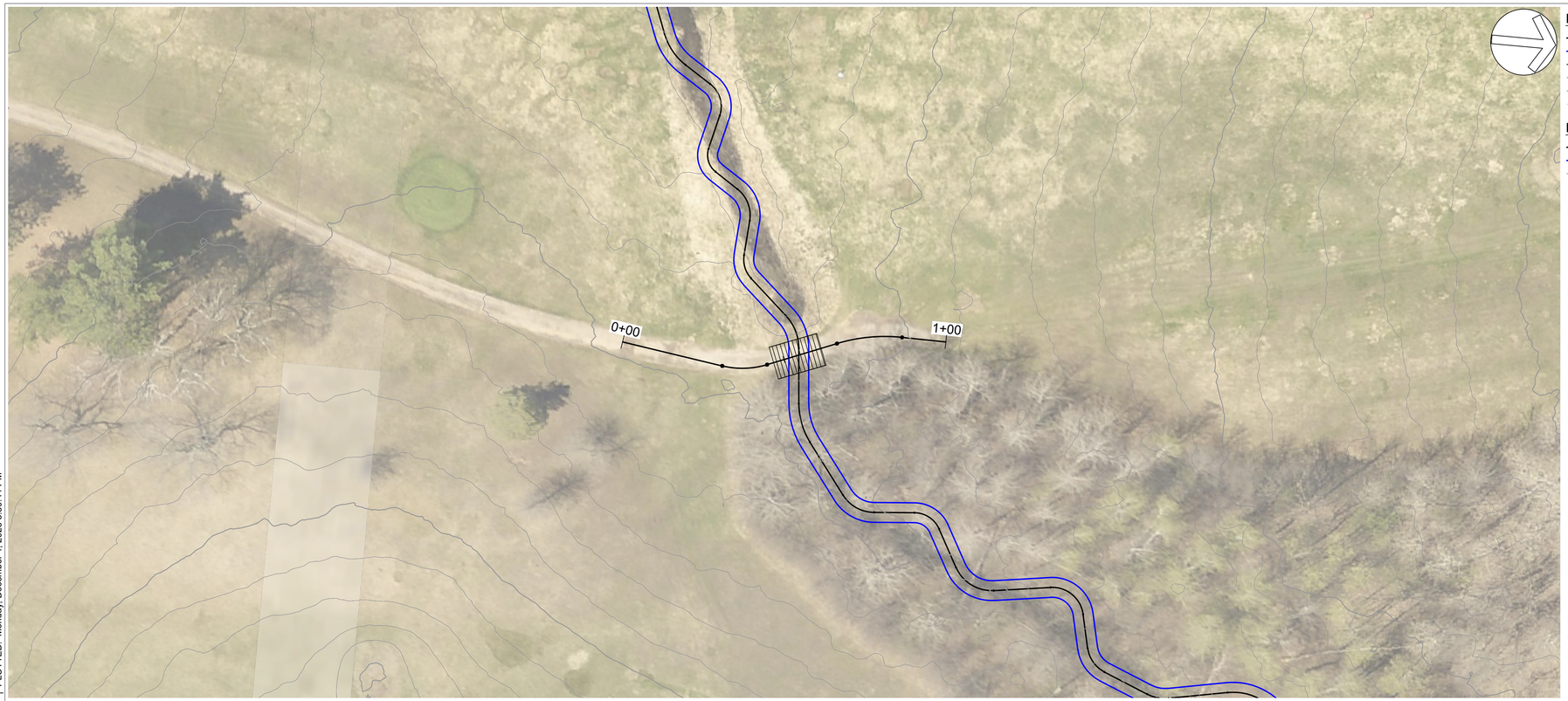
SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

0 20 40
SCALE IN FEET

SHEET NUMBER
25 OF 36

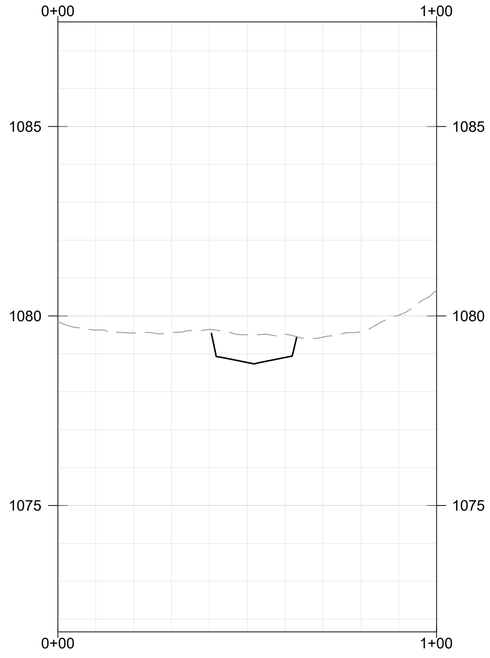


PLAN LEGEND

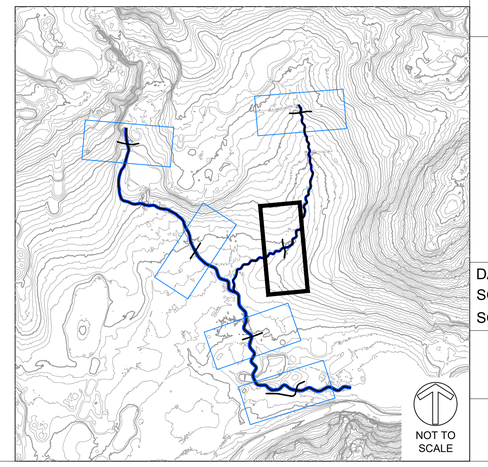
- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- (483) PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 479 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

PROFILE LEGEND

- PROPOSED STREAM CENTER LINE
- PROPOSED BANKFULL
- EXISTING GROUND
- PROPOSED BRIDGE



Tributary Bridge #2 - SCALE: HOR 1" =20'; VERT 1"= 2'



APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX

REV	DESCRIPTION	APPRV
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
TRIBUTARY BRIDGE #2
PLAN AND PROFILE - (1)
STA 0+00 TO 1+00

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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PRINTED NAME: KEITH ANDERSON

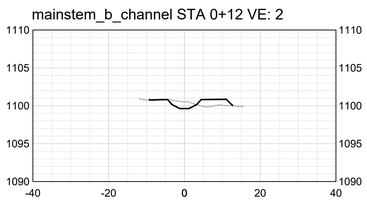
SIGNATURE:

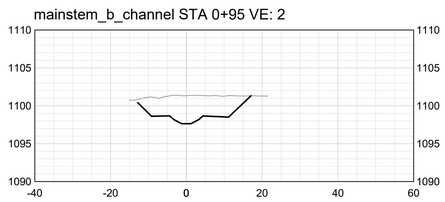
DATE: LIC. NO 42827

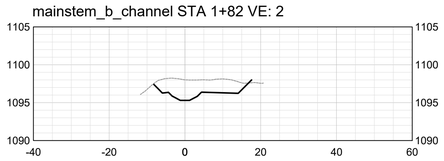
DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

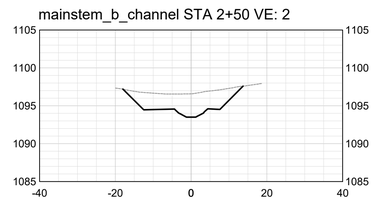
0 20 40
SCALE IN FEET

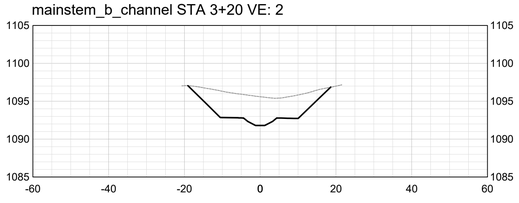
SHEET NUMBER
26 OF 36

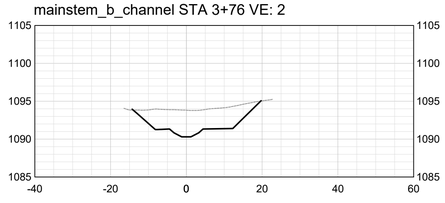


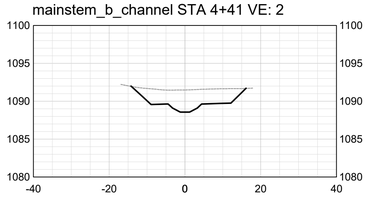


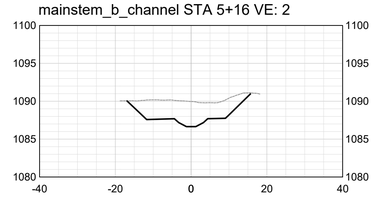


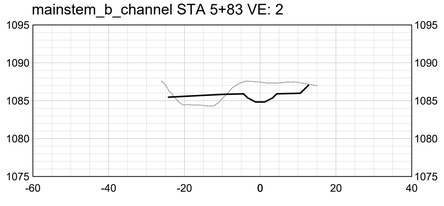


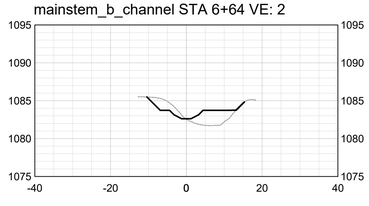


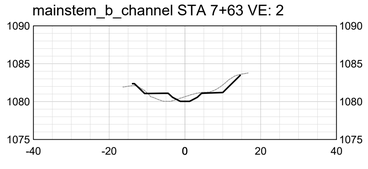


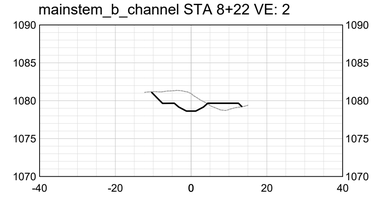


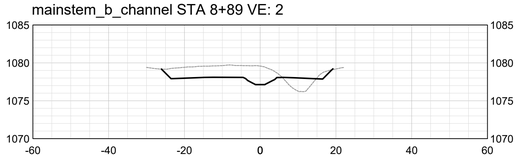












SECTION LEGEND

DESIGN SURFACE

EXISTING GROUND

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX
REV	DESCRIPTION	APPRV
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM - B CHANNAL
SECTIONS - (1)
STA 0+12 TO 8+89

BEAVER RIVER CONSULTING

South St. Louis
SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

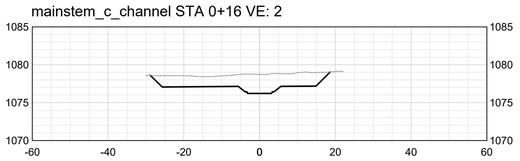
DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

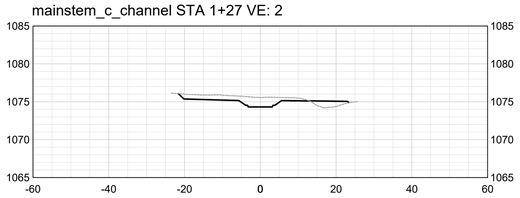
0 20 40
SCALE IN FEET

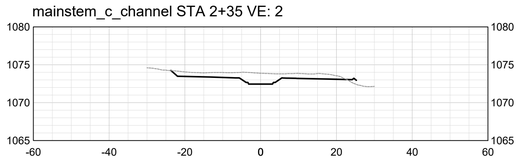
SHEET NUMBER
27 OF 36

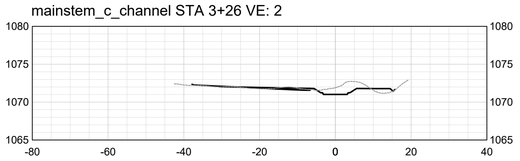
SECTION LEGEND

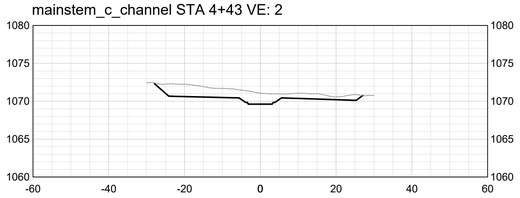
DESIGN SURFACE
EXISTING GROUND

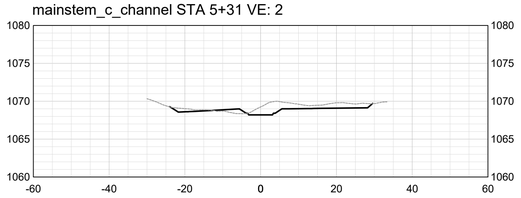


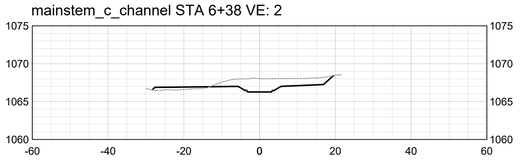


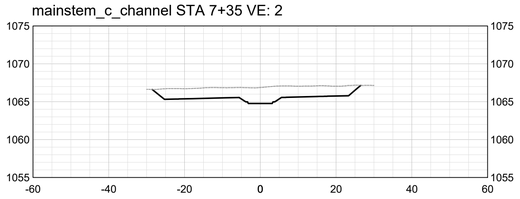


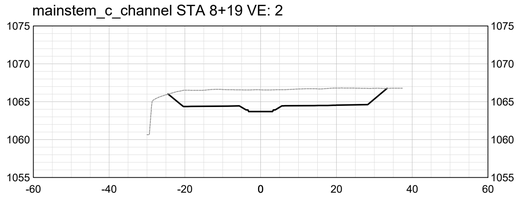


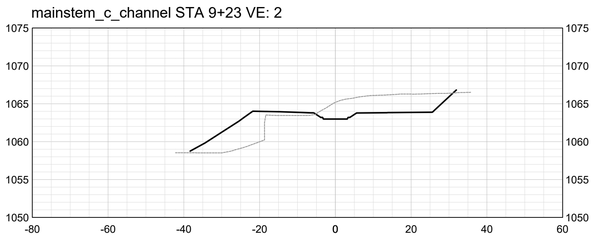


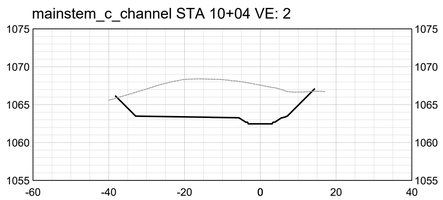


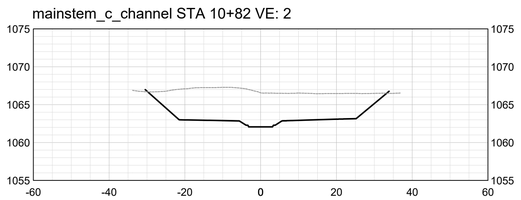


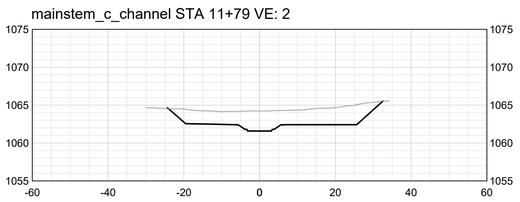


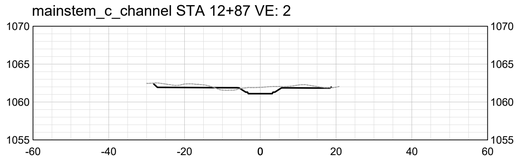


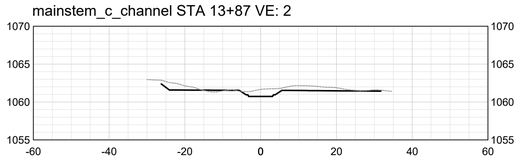












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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
MAINSTEM - C SECTION
SECTIONS - (1)
STA 0+16 TO 13+87

BEAVER RIVER CONSULTING

South St. Louis
SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

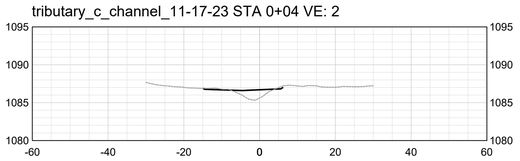
DATE: 12/01/2023
SCALE (34"X22"): 1" = 20'
SCALE (17"X11"): 1" = 40'

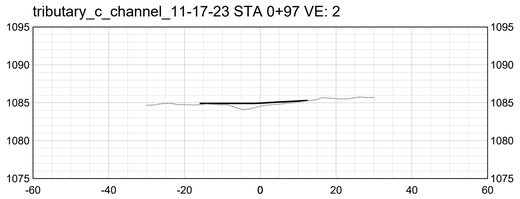
0 20 40
SCALE IN FEET

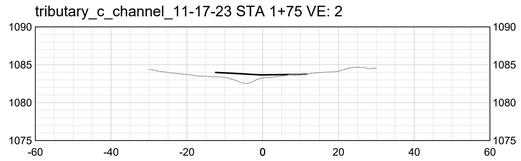
SHEET NUMBER
28 OF 36

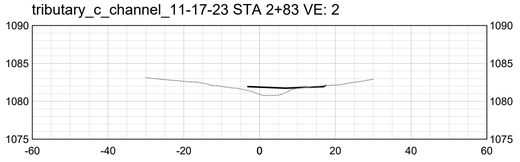
SECTION LEGEND

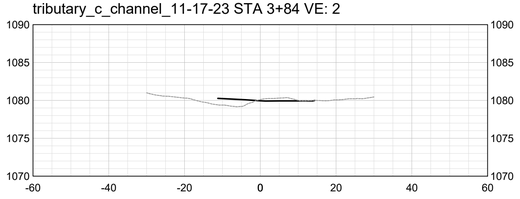
DESIGN SURFACE
EXISTING GROUND

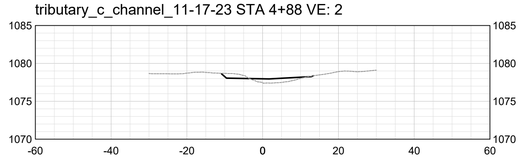


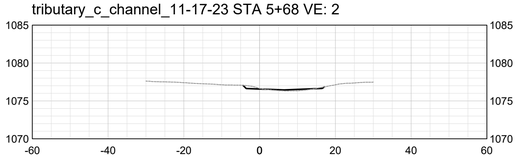


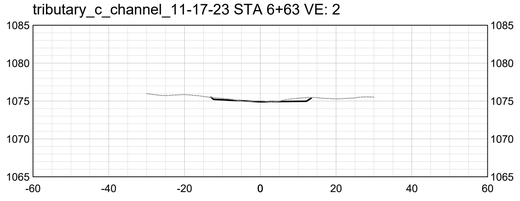


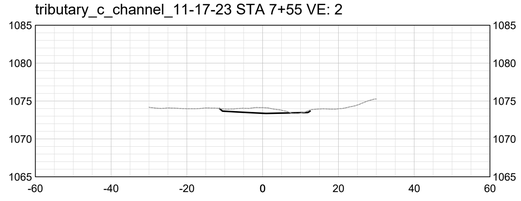


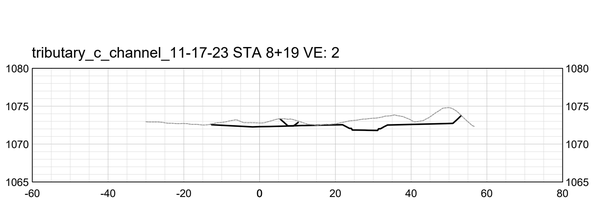












APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX	
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION
TRIBUTARY
SECTIONS - (1)
STA 0+04 TO 8+19

BEAVER RIVER CONSULTING

South St. Louis
SOIL & WATER CONSERVATION DISTRICT

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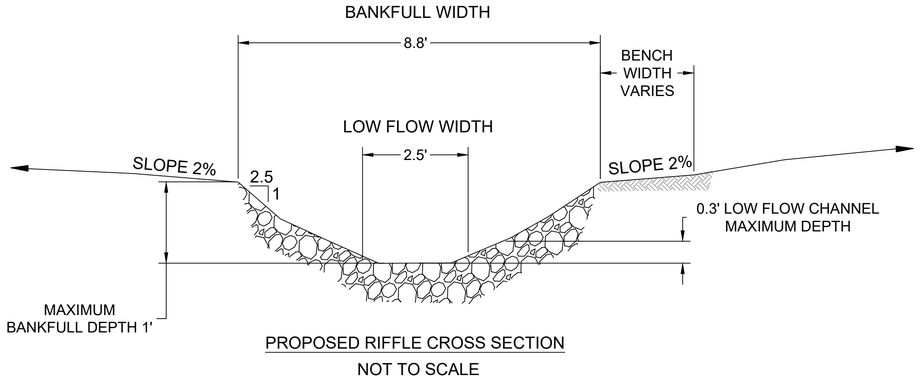
SCALE (17"X11"): 1" = 40'

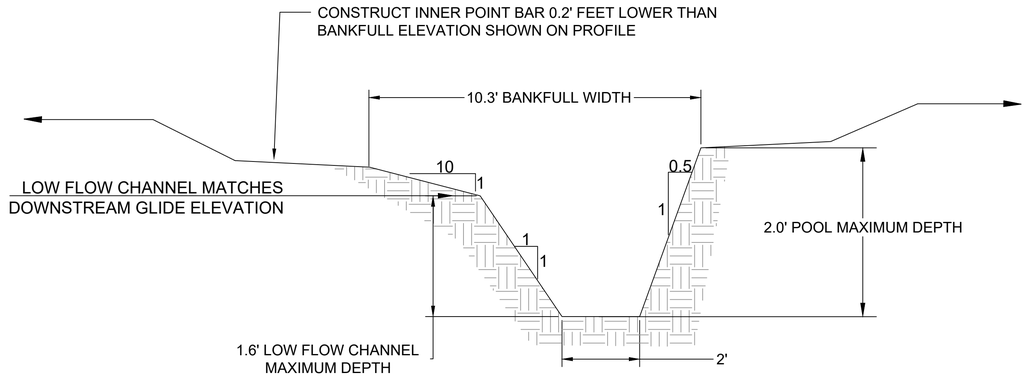
0 20 40
SCALE IN FEET

SHEET NUMBER
29 OF 36

MAINSTEM B-CHANNEL DIMENSIONS



PROPOSED RIFFLE CROSS SECTION
NOT TO SCALE



PROPOSED POOL CROSS SECTION
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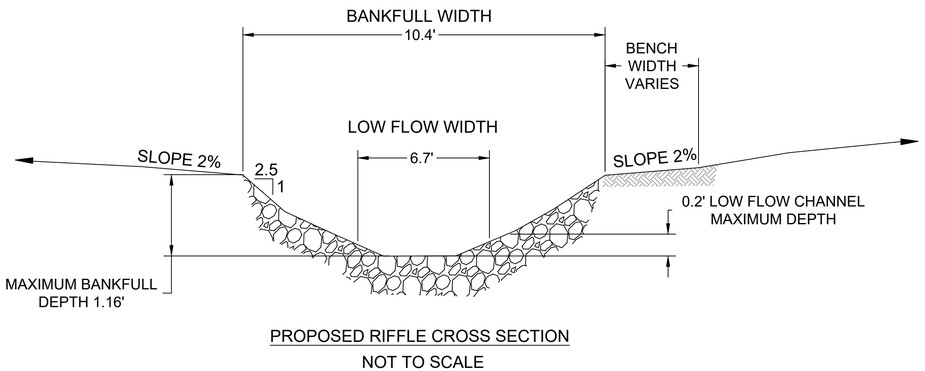
MAINSTEM C-CHANNEL DIMENSIONS



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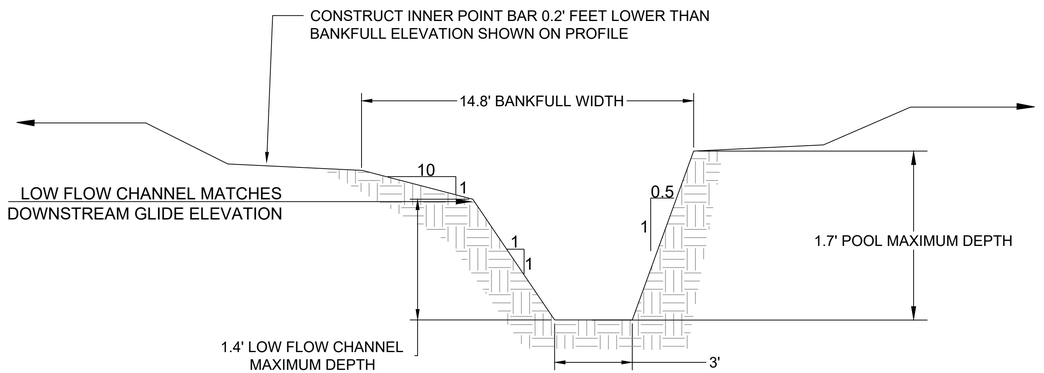

PROPOSED POOL CROSS SECTION
NOT TO SCALE

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX	
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

MAINSTEM DIMENSIONS

BEAVER RIVER CONSULTING

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

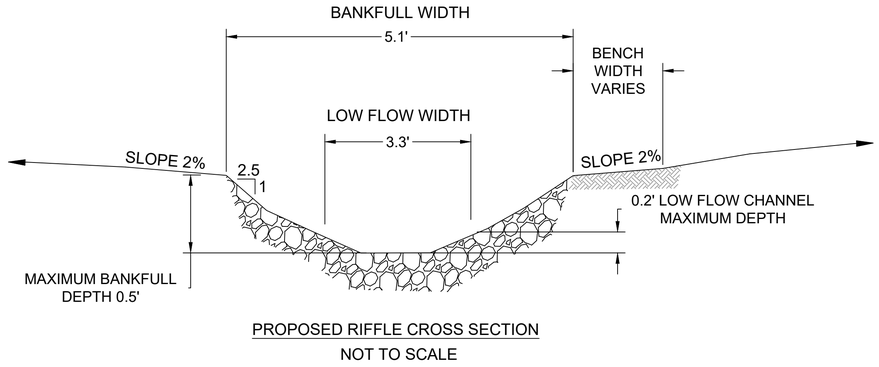
DATE: LIC. NO 42827

DATE: 12/01/2023

NTS

SHEET NUMBER
30 OF 36

TRIBUTARY B-CHANNEL DIMENSIONS



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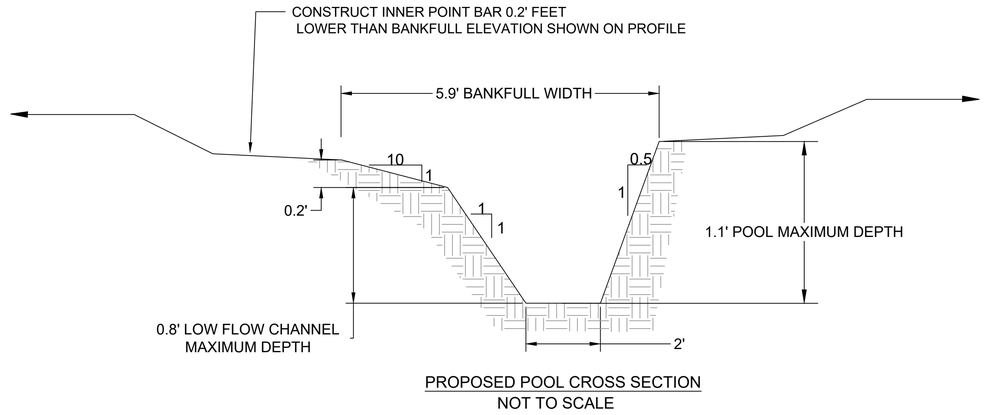
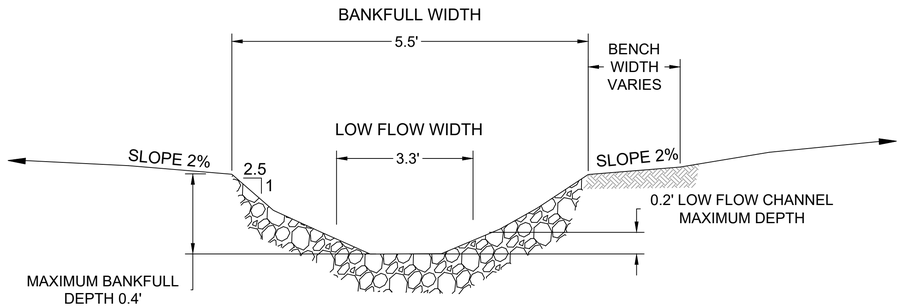


PROPOSED POOL CROSS SECTION
NOT TO SCALE

TRIBUTARY C-CHANNEL DIMENSIONS



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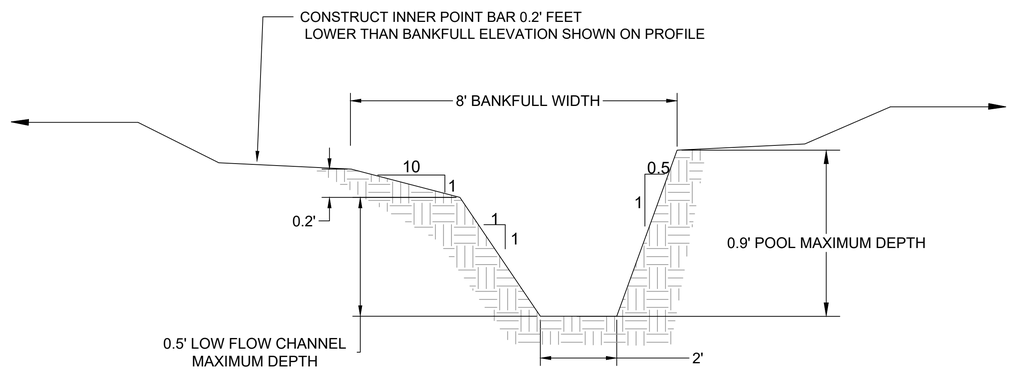

PROPOSED POOL CROSS SECTION
NOT TO SCALE

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

TRIBUTARY DIMENSIONS

BEAVER RIVER CONSULTING

South St. Louis SOIL & WATER CONSERVATION DISTRICT

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PRINTED NAME: KEITH ANDERSON

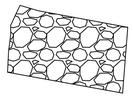
SIGNATURE:

DATE: LIC. NO 42827

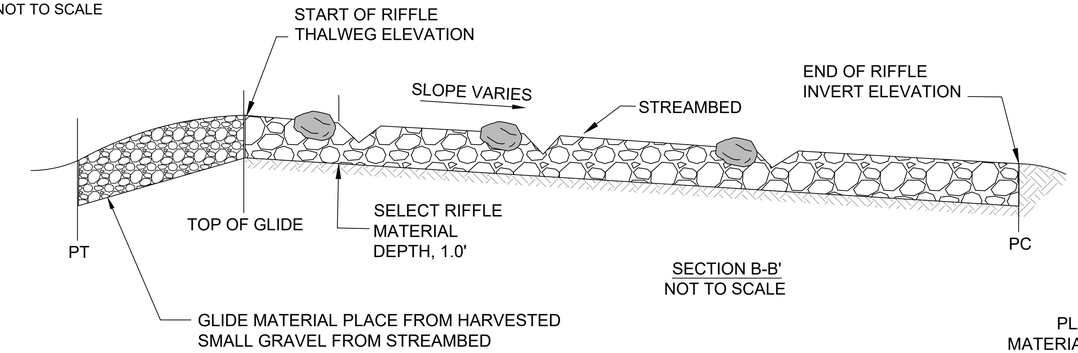
DATE: 12/01/2023

NTS

SHEET NUMBER
31 OF 36



PLAN-SYMBOL
NOT TO SCALE



SECTION B-B'
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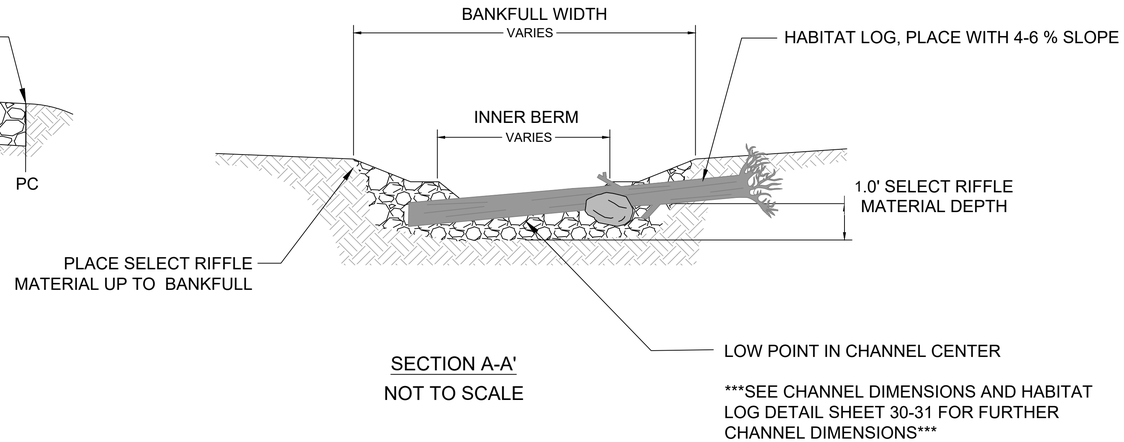
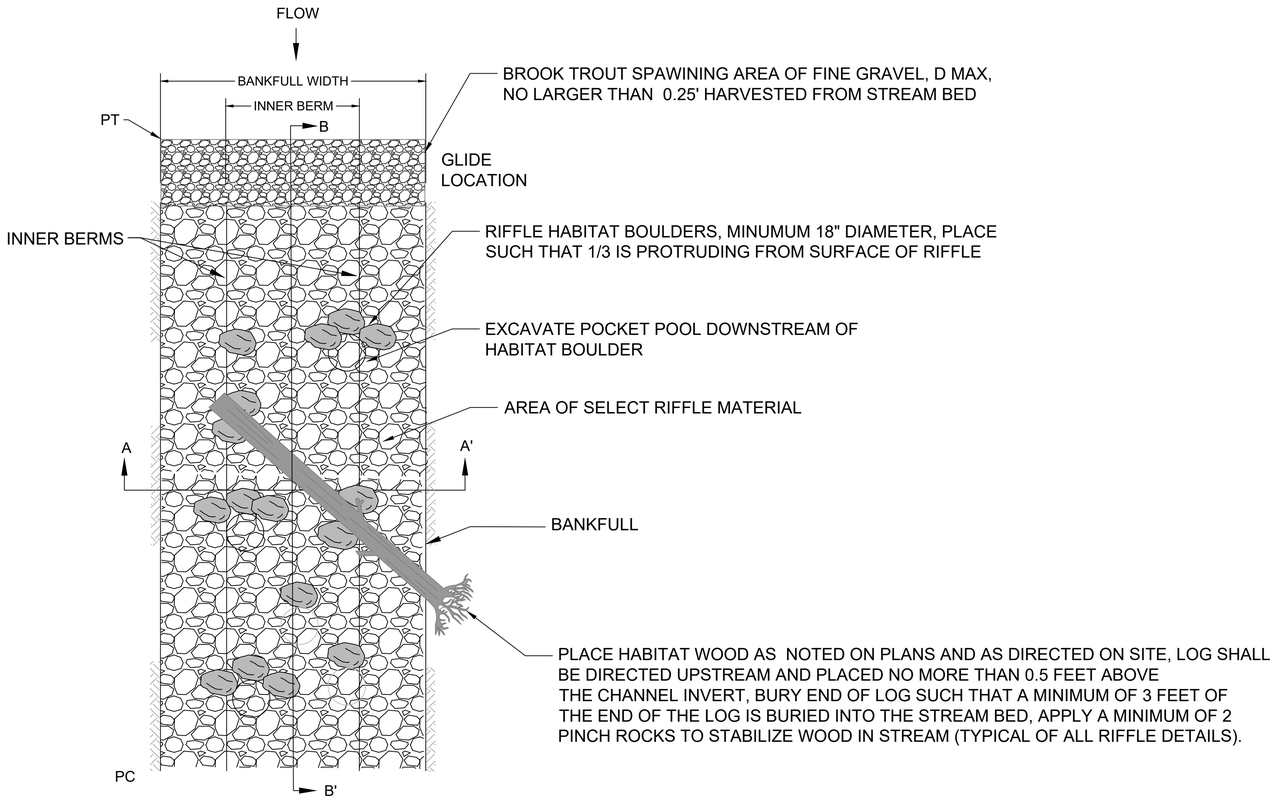


SECTION A-A'
NOT TO SCALE

SEE CHANNEL DIMENSIONS AND HABITAT LOG DETAIL SHEET 30-31 FOR FURTHER CHANNEL DIMENSIONS



GRAVEL RIFFLE PLAN VIEW
NOT TO SCALE

NOTES:

1. THE GRAVEL AND COBBLE SUBSTRATE USED FOR THIS FEATURE SHOULD BE PREFERENTIALLY HARVESTED FROM THE ARMOR LAYER OF THE EXISTING CHANNEL. AND AMENDED OR SORTED AS NOTED BY THE REGION OF THE RIFFLE/GLIDE.
2. SORTING AND SIEVING OF THE HARVESTED RIFFLE SUBSTRATE IS INCIDENTAL TO THE CONSTRUCTION OF THIS STRUCTURE
3. SELECT RIFFLE MATERIAL SHALL HAVE A GRADATION OF 25 % BY VOLUME OF CLASS II RIP RAP, 25 PERCENT BY VOLUME CLASS I RIP RAP, AND 50 PERCENT BY VOLUME HARVESTED IN PLACE STREAM BED MATERIAL WITH A D50 OF 35 MM.
4. SELECT RIFFLE MATERIAL WILL BE PLACED AT A MINIMUM THICKNESS OF 1.0'.
5. THE SELECT RIFFLE MATERIAL WILL BE PLACED SUCH THAT, IN CROSS-SECTION, ITS LOWEST ELEVATION OCCURS IN THE CENTER OF THE CHANNEL AS PER THE DETAIL.
6. HABITAT BOULDERS SHALL BE PLACED IN THE RIFFLE SUCH THAT NOT MORE THAN 1/3- 1/2 THE DIAMETER OF THE BOULDER PROTRUDES ABOVE THE STREAM BED. AS SHOWN SOME OF THE BOULDERS SHALL BE PLACED IN GROUPINGS OF 3 IN ORDER TO CREATE DOWNSTREAM SCOUR, THE BOULDERS SHALL BE 18-30" IN DIAMETER.
7. SET INVERTS AT ELEVATIONS SHOWN ON SHEET 30-31.
8. FINE GRAVEL MATERIAL NO LARGER THAN 0.25' SHALL BE PLACED IN A THIN LAYER FROM ON THE GLIDE FROM THE PT, 9' DOWNSTREAM.
9. SELECT RIFFLE MATERIAL SHALL BE COMPACTED USING TRACK EQUIPMENT SUCH THAT FUTURE SETTLEMENT OF THE MATERIAL IS KEPT TO A MINIMUM.
10. RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX

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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

GRAVEL RIFFLE

BEAVER RIVER CONSULTING

South St. Louis
SOIL & WATER CONSERVATION DISTRICT

60% DESIGN
NOT FOR
CONSTRUCTION

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

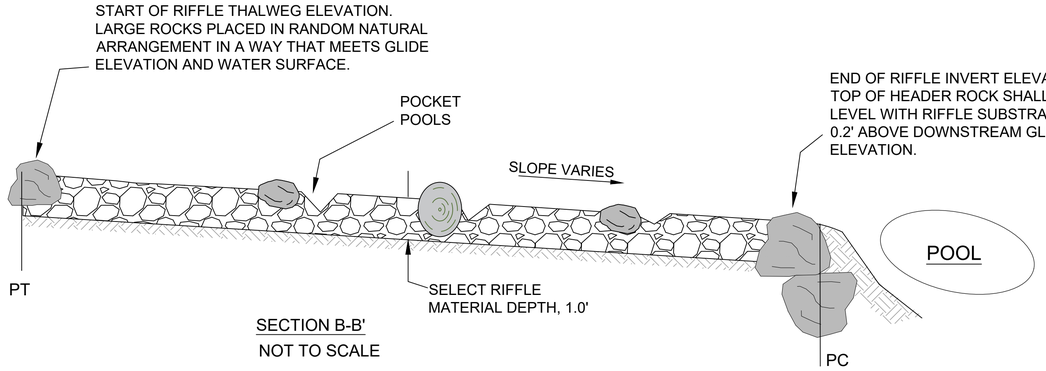
DATE: LIC. NO 42827

DATE: 12/01/2023

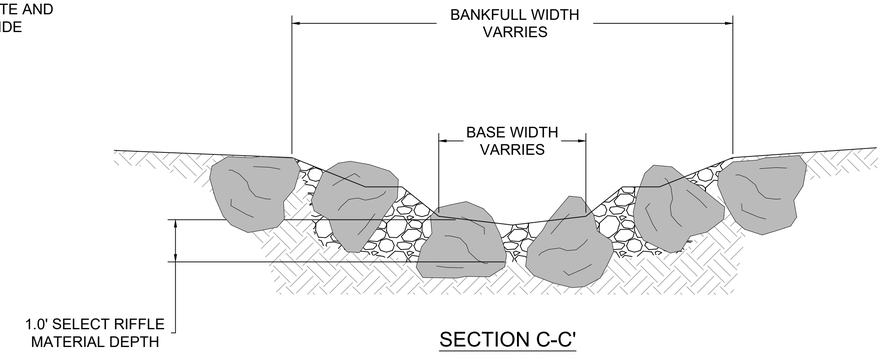
NTS

SHEET NUMBER
32 OF 36

PLAN-SYMBOL
NOT TO SCALE



SECTION B-B'
NOT TO SCALE



SECTION C-C'
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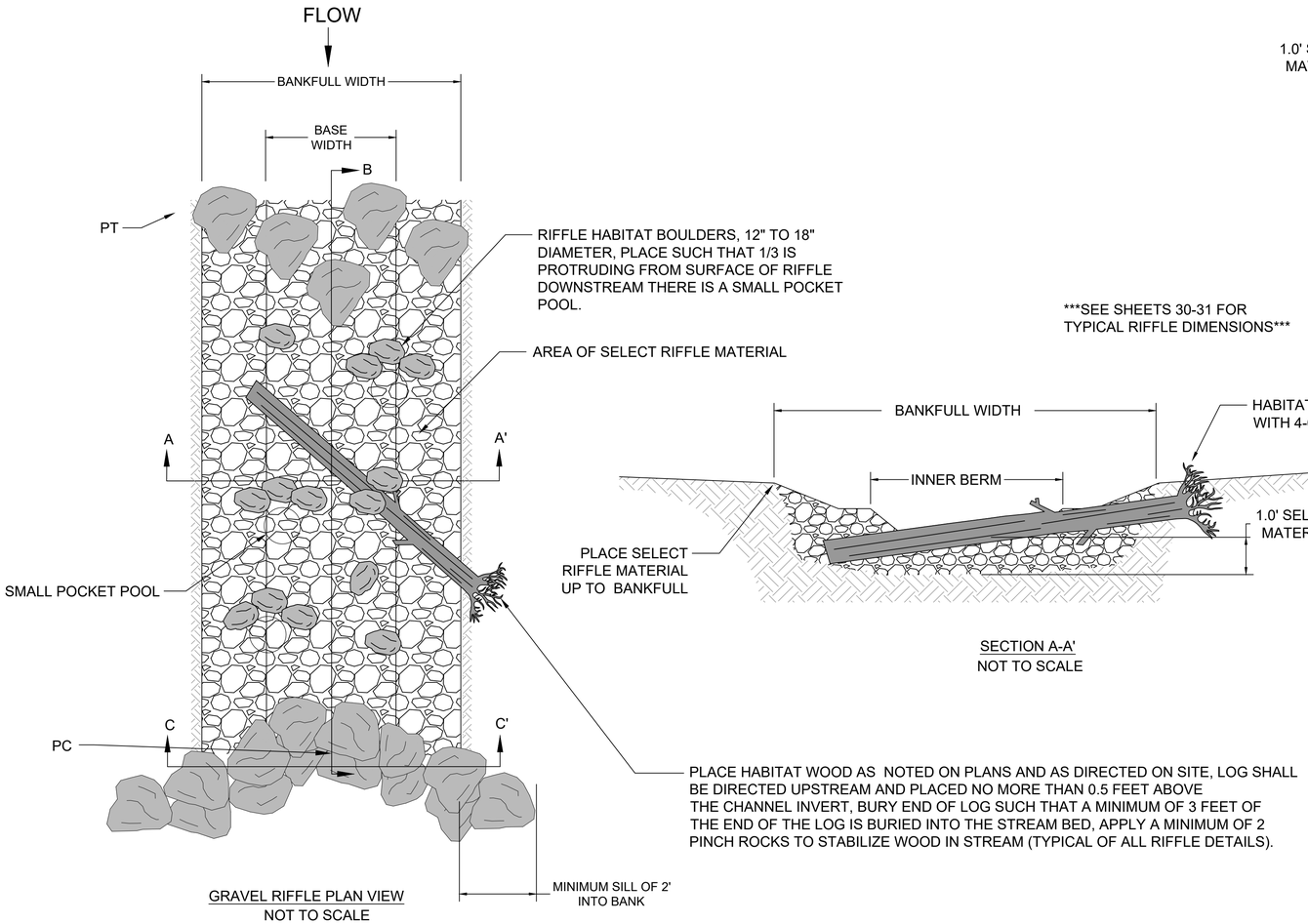

GRAVEL RIFFLE PLAN VIEW
NOT TO SCALE

SEE SHEETS 30-31 FOR TYPICAL RIFFLE DIMENSIONS

SECTION A-A'
NOT TO SCALE

NOTES:

1. THE GRAVEL AND COBBLE SUBSTRATE USED FOR THIS FEATURE SHOULD BE PREFERENTIALLY HARVESTED FROM THE ARMOR LAYER OF THE EXISTING CHANNEL AND AMENDED OR SORTED AS NOTED BY THE REGION OF THE RIFFLE/GLIDE.
2. REFER TO STRUCTURE TABLES FOR ELEVATIONS AND PLACEMENT LOCATIONS.
3. SORTING AND SIEVING OF THE HARVESTED RIFFLE SUBSTRATE IS INCIDENTAL TO THE CONSTRUCTION OF THIS STRUCTURE
4. SELECT RIFFLE MATERIAL SHALL HAVE A GRADATION OF 25 PERCENT BY VOLUME OF CLASS II RIP RAP, 25 PERCENT BY VOLUME CLASS I RIP RAP, AND 50 PERCENT BY VOLUME HARVESTED IN PLACE STREAM BED MATERIAL.
5. SELECT RIFFLE MATERIAL WILL BE PLACED AT A MINIMUM THICKNESS OF 1.0'.
6. THE SELECT RIFFLE MATERIAL WILL BE PLACED SUCH THAT, IN CROSS-SECTION, ITS LOWEST ELEVATION OCCURS IN THE CENTER OF THE CHANNEL AS PER THE DETAIL.
7. BOULDERS LOCATED AT THE PT SHOULD BE PLACED IN A NATURAL FASHION THAT SATISFIES THE GLIDE ELEVATION. THE BOULDERS WILL BE BURIED 2/3 AND SHOULD BE A MINIMUM OF 36'.
8. HABITAT BOULDERS SHALL BE PLACED IN THE RIFFLE SUCH THAT NOT MORE THAN 1/3- 1/2 THE DIAMETER OF THE BOULDER PROTRUDES ABOVE THE STREAM BED. AS SHOWN SOME OF THE BOULDERS SHALL BE PLACED IN GROUPINGS OF 3 IN ORDER TO CREATE DOWNSTREAM SCOUR, THE BOULDERS SHALL BE 18-36" IN DIAMETER.
9. SELECT RIFFLE MATERIAL SHALL BE COMPACTED USING TRACK EQUIPMENT SUCH THAT FUTURE SETTLEMENT OF THE MATERIAL IS KEPT TO A MINIMUM.
10. RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.

APPROVED BY: XX	CHECKED BY: XX	DRAWN BY: XXX	
REV	DESCRIPTION		APPRV
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BUCKINGHAM CREEK
ENGER PARK GOLF COURSE
CITY OF DULUTH
ST. LOUIS COUNTY, MN

60% NOT FOR CONSTRUCTION

BOULDER RIFFLE

BEAVER RIVER CONSULTING

South St. Louis
SOIL & WATER CONSERVATION DISTRICT

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SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023

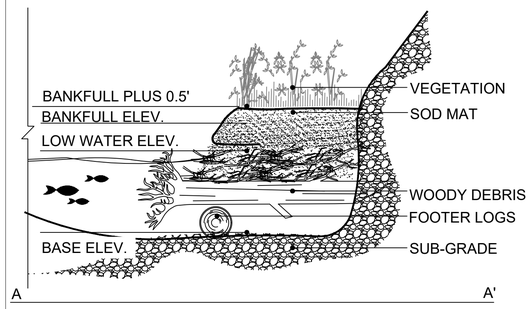
NTS

SHEET NUMBER
33 OF 36

1. INSTALLATION SUMMARY

TOEWOOD BENCH CONSTRUCTION WILL BE DONE IN DRY WEATHER CONDITIONS.
DESIGNER OR CPW REPRESENTATIVE MUST BE PRESENT FOR INSTALLATION OF TOEWOOD BENCH.

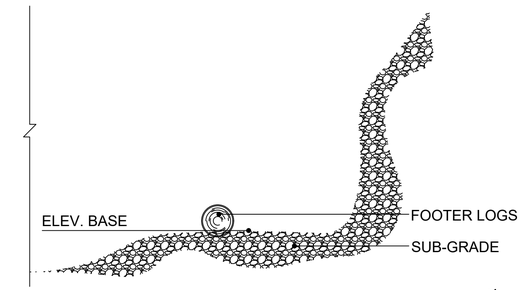
THE DRAWINGS ON THIS PAGE ARE NOT TO SCALE.

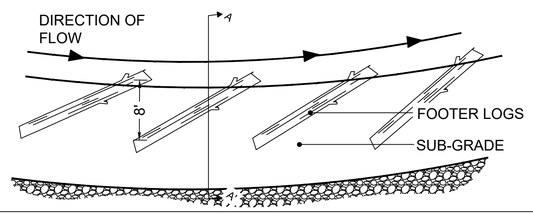


2. SUBGRADE AND FOOTER LOGS

SPECIFICATION:
-10" MIN. DIAMETER
-LIMBS REMOVED
-15' MIN. LENGTH

PLACEMENT:
-EXCAVATE TO BASE ELEVATION.
-PLACE FOOTER LOGS ON BENCH AT 20-45 DEGREE ANGLE.

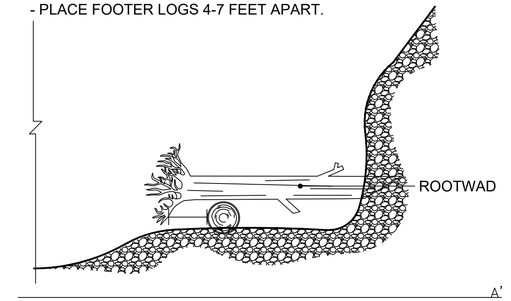


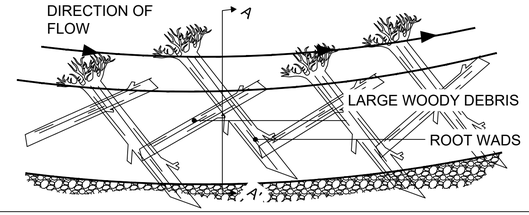


3. ROOTWAD PLACEMENT

ROOTWAD SPECIFICATION:
-12" MIN DIAMETER
-LOG LENGTH OF 10' MINIMUM.
-LIMBS SHALL BE REMOVED.
-ROOT WADS SHALL BE LEFT INTACT.

PLACEMENT:
-PLACE ROOTWADS ON TOP OF FOOTER LOGS AS SHOWN, OVERHANG ROOT WAD LOGS 2-5', VARY AS SHOWN SUCH THAT EVERY OTHER ROOT WAD IS PROTRUDING INTO STREAM 4-6 FEET FROM BANKFULL FEET.
-ANGLE ROOTWADS UPSTREAM AS DIRECTED IN FIELD.
- PLACE FOOTER LOGS 4-7 FEET APART.

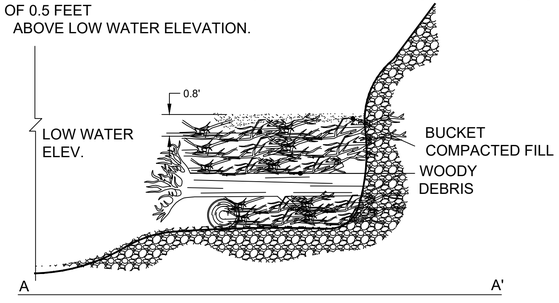


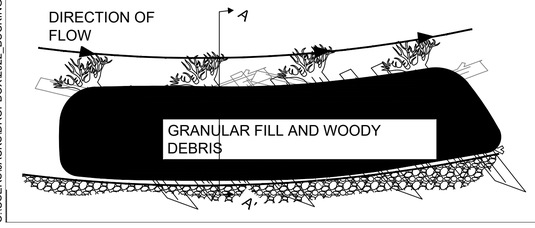


4. WOODY DEBRIS PLACEMENT

WOODY MATERIAL SPECIFICATION:
-WOODY MATERIAL (COMPOSED OF 75 % SMALL LIMBS AND BRANCHES, 25% MEDIUM SIZED MATERIAL (3-6" LIMBS), AND LOGS UP TO 8" IN DIAMETER (TWO PER FIVE FEET).

PLACEMENT:
-FILL BETWEEN FOOTER LOGS AND ROOTWADS WITH WOODY MATERIAL
-PLACE WOODY MATERIAL TO A MAXIMUM OF 0.5' ABOVE LOW WATER ELEVATION.
-LAYER GRANULAR FILL ON TOP OF WOODY DEBRIS.
-COMPACTED FILL SHALL BE PLACED SUCH THAT THE TOP IS A MAXIMUM OF 0.5 FEET
ABOVE LOW WATER ELEVATION.



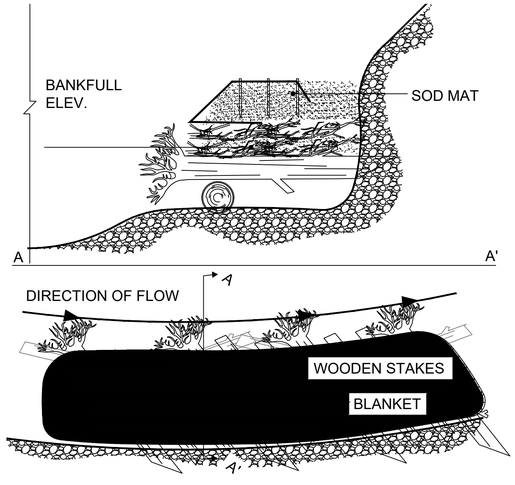


5. SOD LIFT

MATERIAL SPECIFICATION:
900X COIR FABRIC 16 FEET X 150 FEET

PLACEMENT:
-LAY BLANKET ON TOP OF SOIL A MINIMUM OF 2.5 FEET BACK FROM FACE OF WOOD, ON TOP OF BENCH ENSURE THAT COIR BLANKET IS A MAXIMUM OF 3 FEET BACK FROM TOP OF BENCH
-PLACE SOD MATS, USING SKID STEER, ON TOP OF BLANKET, SLOPE AT 2:1 (H:V).

-WRAP SOD MATS WITH COIR AND TIE INTO TRENCH BEHIND SOD MATS WITH A MINIMUM OF 1.5 FEET OF COIR HANGING IN THE TRENCH.
-BACKFILL TRENCH WITH TOPSOIL MATERIAL AND LAY SOD ON TOP.



DETAIL – TOEWOOD
NOT TO SCALE

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ST. LOUIS COUNTY, MN

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TOE WOOD

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PRINTED NAME: KEITH ANDERSON

SIGNATURE:

DATE: LIC. NO 42827

DATE: 12/01/2023

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34 OF 36

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VEGETATION OVERVIEW (1)

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VEGETATION OVERVIEW (2)

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ZONE 1 – WET MEADOW / SHRUB CARR

ZONE DESCRIPTION: DISTURBED AREAS OUTSIDE OF THE STREAM CHANNEL BUT WITHIN FAIRWAYS

ZONE NOTES: AS DIRECTED BY THE ENGINEER, TRANSPLANT SEDGE SOD MATS FROM CUT AREAS (SEE PLANTING PLAN OVERVIEW SHEET XX) INSTEAD OF PLANTINGS, SEED, AND BLANKET

SUBCANOPY – POTTED SHRUBS: 64 SQ FT SPACING

SLENDER WILLOW (SALIX PETIOLARIS) – 30%
RED-OSIER DOGWOOD (CORNUS SERICEA) – 20%
PUSSY WILLOW (SALIX DISCOLOR) – 15%
SPECKLED ALDER (ALNUS INCANA) – 15%
BOG BIRCH (BETULA PUMILA) – 10%
MEADOWSWEET (SPIRAEA ALBA) – 5%
BEBB'S WILLOW (SALIX BEBBIANA) – 5%

GROUND LAYER – PLUGS: 16 SQ FT SPACING

BLUEJOINT (CALAMAGROSTIS CANADENSIS) - 30%
LAKE SEDGE (CAREX LACUSTRIS) - 20%
TUSSOCK SEDGE (CAREX STRICTA) - 20%
BEAKED SEDGE (CAREX UTRICULATA) - 5%
RATTLESNAKE MANNA GRASS (GLYCERIA CANADENSIS) - 5%

REMAINING 20% CAN BE A MIX OF AT LEAST FIVE (5) OF THE FOLLOWING SPECIES:

FEN WIREGRASS SEDGE (CAREX LASIOCARPA)
WOOLGRASS (SCIRPUS CYPERINUS)
NORTHERN MARSH FERN (THELYPTERIS PALUSTRIS)
SPOTTED JOE PYE WEED (EUPATORIUM MACULATUM)
SWAMP MILKWEED (ASCLEPIAS INCARNATA)
NORTHERN BLUE FLAG (IRIS VERSICOLOR)
SENSITIVE FERN (ONOCLEA SENSIBILIS)
COMMON MINT (MENTHA ARVENSIS)
RED-STEMMED ASTER (ASTER PUNICEUS)
COMMON BONESET (EUPATORIUM PERFOLIATUM)

SEEDING

SEED WITH MNDOT SEED MIX 34-371 WET MEADOW NORTHEAST @ 35 LBS/ACRE. REFER TO MNDOT SEEDING MANUAL 2014 EDITION FOR SEEDING REQUIREMENTS.

NEAR-BANK COIR AND BACKER BLANKET

BLANKET WITH 6.5' WIDE ROLANKA BIOD-MAT 70, GEOCOIR 700 OR EQUAL BACKED WITH MN DOT CATEGORY 20 EROSION CONTROL BLANKET. BLANKET FROM LOW FLOW TO WIDTH OF THE BLANKET. REFER TO MANUFACTURER SPECIFICATIONS FOR BLANKET INSTALLATION.

FLOODPLAIN EROSION CONTROL BLANKET

ALL AREAS WITHIN ZONE 1 BEYOND THE NEAR-BANK COIR AND BACKER BLANKET TO BE BLANKETED WITH MN DOT CATEGORY 30 EROSION CONTROL BLANKET. REFER TO MANUFACTURER SPECIFICATIONS FOR BLANKET INSTALLATION.

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VEGETATION DETAILS (1)

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ZONE 2 – NORTHERN RICH MESIC HARDWOOD FOREST

ZONE DESCRIPTION: DISTURBED AREAS OUTSIDE OF THE STREAM CHANNEL AND NOT WITHIN FAIRWAYS

ZONE NOTES: SPECIES MARKED WITH AN ASTERISK WILL REQUIRE A 6-FOOT-HIGH, 3-FOOT-DIAMETER WELDED WIRE CAGE ANCHORED BY TWO 6-FOOT- REBAR STAKES AND FASTENED TO THE REBAR STAKES WITH METAL WIRE (NOT ZIP TIES)

CANOPY – #2 POTTED TREES: 64 SQ FT SPACING

*SUGAR MAPLE (ACER SACCHARUM) – 40%
*YELLOW BIRCH (BETULA ALLEGHANIENSIS) – 20%
*BASSWOOD (TILIA AMERICANA) – 10%
*WHITE CEDAR (THUJA OCCIDENTALIS) – 10%
WHITE SPRUCE (PICEA GLAUCA) – 20%

SUBCANOPY – 1 GALLON POTTED SHRUBS: 36 SQ FT SPACING

*IRONWOOD (OSTRYA VIRGINIANA) – 20%
BEAKED HAZELNUT (CORYLUS CORNUTA) – 20%
FLY HONEYSUCKLE (LONICERA CANADENSIS) – 20%
*MOUNTAIN MAPLE (ACER SPICATUM) – 20%
CHOKECHERRY (PRUNUS VIRGINIANA) – 20%

GROUND LAYER – PLUGS: 16 SQ FT SPACING

WILD SARSAPARILLA (ARALIA NUDICAULIS) – 15%
LADY FERN (ATHYRIUM FELIXFEMINA) – 15%
CANADA MAYFLOWER (MAIANTHEMUM CANADENSE) – 15%
PENNSYLVANIA SEDGE (CAREX PENSYLVANICA) – 15%
ZIGZAG GOLDENROD (SOLIDAGO FLEXICAULIS) – 10%
HAIRY SOLOMON'S SEAL (POLYGONATUM PUBESCENS) – 10%
LARGE LEAVED ASTER (EURYBIA MACROPHYLLA) – 10%
MOUNTAIN RICE GRASS (ORYZOPSIS ASPERIFOLIA) – 10%

SEEDING

SEED WITH MNDOT SEED MIX 34-361 RIPARIAN NORTHEAST @ 35 LBS/ACRE. REFER TO MNDOT SEEDING MANUAL 2014 EDITION FOR SEEDING REQUIREMENTS.

NEAR-BANK COIR AND BACKER BLANKET

BLANKET WITH 6.5' WIDE ROLANKA BIOD-MAT 70, GEOCOIR 700 OR EQUAL BACKED WITH MN DOT CATEGORY 20 EROSION CONTROL BLANKET. BLANKET FROM LOW FLOW TO WIDTH OF THE BLANKET. REFER TO MANUFACTURER SPECIFICATIONS FOR BLANKET INSTALLATION.

FLOODPLAIN EROSION CONTROL BLANKET

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