POOL 12 OVERWINTERING HREP
STAGE 1, SUNFISH LAKE
INSPECTION OF COMPLETED WORKS
2021

I. PROJECT

Pool 12 Overwintering – Stage 1 – 5-year inspection

II. AUTHORITY

Upper Mississippi River Restoration (UMRR)

III. LOCATION

Pool 12, Mississippi River Miles (RM) 563.5-565.0, Jo Davies County, IL

IV. PREVIOUS REPORTS

1) *Pool 12 Overwintering, Value Engineering Study, USACE Rock Island, January 2005*
2) *Pool 12 Overwintering, Definite Project Report, USACE Rock Island, March 2013*
3) *Pool 12 Overwintering, Interim O&M Manual, March 2017*

V. DATE OF FIELD VISIT: September 15, 2021

VI. WEATHER: Mild, Sunny, High 70's °F

VII. ATTENDEES

Table 1. Site Visit Attendees

Name	Office	Title	Number
Rachel Fellman	USACE – Rock Island	Environmental\Civil Engineer	[redacted]
Julie Millhollin	USACE – Rock Island	Project Manager	[redacted]
John Ragle	USACE – Rock Island	Civil Engineer Intern	[redacted]
Benjamin Vandermyde	USACE – Rock Island	Lead Forester	[redacted]
Ed Britton	U.S. Fish & Wildlife Service	District Manager	[redacted]
Kirk Hansen	Iowa Department of Natural Resources	Mississippi River Habitat Coordinator	[redacted]
Sharonne Baylor	U.S. Fish & Wildlife Service	Environmental Engineer	[redacted]
Nate Williams	U.S. Fish & Wildlife Service	Wildlife Refuge Specialist	[redacted]
Rebekah Anderson	Illinois Department of Natural Resources	Fisheries Biologist	[redacted]
Ryan Hupfeld	Iowa Department of Natural Resources	Fisheries Biologist	[redacted]

VIII. PROJECT GOALS AND OBJECTIVES

The project's goals are to restore and protect off-channel aquatic habitat and to restore floodplain forest habitat. As stated in the Pool 12 OW DPR, Table 2 depicts the objectives that have been identified to meet those goals.

Table 2: Goals and Objectives

Goal	Objectives	Project Features
Restore and Protect Off-Channel Aquatic Habitat	Increase the amount of deep water habitat in the backwater lakes complex of Pool 12 as measured by acres to provide pool-wide overwintering habitat for fish. Target depth is 6 to 8 feet. Increase depth diversity in the backwater lakes complex of Pool 12 as measured by acres to provide year-round habitat for fish. Increase sustainability of aquatic habitat in the backwater lakes complex of Pool 12 as measured by acres by decreasing the sedimentation in the complex.	Excavate channels in backwater areas Construct deflection berms, higher-level terraces, and/or islands from dredged material
Restore Floodplain Forest Habitat	Increase areal coverage in acres of forest stands with hard mast-producing trees as a dominant or component species in floodplain forest areas surrounding the backwater lakes of Pool 12.	Establish native mast-producing trees on high elevation areas. Construct areas with elevations above the 2-year flood recurrence

IX. SIGNIFICANT EVENTS SINCE LAST INSPECTION

Stage II construction substantially complete in April 2021 and Stage III construction substantially complete in November 2019.

Table 3: Recent Flood Events

Year	Crest (stage)	Flood Category
2017	16.82	Action Stage
2018	17.50	Flood Stage
2019	20.87	Major Flood Stage
2020	17.51	Flood Stage

"Mississippi River at Lock and Dam 12 (Bellevue IA) gage"; RM: 556; Datum: MSL1912

X. OBSERVATIONS

Perimeter Berms: Good vegetation was present and growing on all of the berms during the site visit. (Photographs 2, 5, and 7) There did not appear to be any excessive erosion of the side slopes or settlement of the crown. A large animal hole was observed in the "doughnut" area at the north end of project.

Mast Tree Plantings: In 2019, 566 containerized trees (#3 RPM) were planted at Sunfish Lake as part of the Stage II construction contract. Container stock plantings are installed at a rate of

50 trees per acre with the following species: Kentucky Coffee Tree, American Sycamore, Pin Oak, Northern Pecan, Swamp White Oak and Bur Oak. A subsequent survey found that there were 358 healthy, 173 stressed, 33 significant decline, and 2 dead. The direct seeded hard mast have surviving seedlings, however, the portion of success is unknown as the seedlings are still shorter than annual herbaceous growth. There was a supplemental planting in 2020 under the BPA contract which consisted of 1322 containerized trees; tree planting density varied based on surviving trees that were planted previously (Photograph 7). Species planted included Hackberry, River Birch, Black Walnut, Shellbark Hickory, Eastern Cottonwood Peachleaf Willow, Black Willow, Silver Maple and Sandbar Willow. Many of the initial trees were noted to be thriving however several, approximately 30 percent, have suffered from drought conditions and are water deprived.

The first plantings were noted to be encased in corrugated plastic drain tile with a slit cut down the center. The forester on the project made note to never use the corrugated plastic drain tile method again as it permanently damages the tree which leads to decay main stem of the tree that will cause mortality over time. (Photographs 9 and 10) The forester recommends Plantra trunk saver solid wall tree guards for several reasons. (Photograph 5) They are twin-walled and porous meaning in high water they will float and can move vertically on the tree so no debris and sediment accumulation occurs at the base of the tree. The type of material the tree guards are created with allows air movement reducing unwanted mold growth on the tree. Plantra tree guards are split full length allowing for easy install and removal; as the tree grows, the tree guard expands without damage to the tree.

Rock Closure Structure: At the west end of Sunfish Lake, a rock closure structure (Photographs 11, 12, and 13) was constructed to aid in winter freeze kill off. This structure increased water velocity and will oxygenate water during the cold months. While on site, a member of the IL DNR made a verbal note that it is performing spectacularly and will hopefully provide enough velocity and oxygen to assist living conditions in the winter.

Channels: During the site visit, the boats used were equipped with depth finders. It was noted by ILDNR that the average depth of the channels appeared to be between 7 and 8 feet. Elevation was 592.1feet (MSL 1912) at this time. Target depth is 6 to 8 feet.

XI. ONGOING MONITORING AND/OR REPORTS

Water Quality: Post construction monitoring for winter water quality parameters at Sunfish have been collected for several years with the most recent data being from the 2019-2020, 2020-2021, and 2021-2022 winter seasons. Both continuous monitoring data and grab sample data have been collected at two selected monitoring sites within Sunfish Lake for the duration of the winter monitoring season. Parameters recorded include in-situ measurements taken at multiple depths within the water column for temperature, specific conductance, pH, dissolved oxygen, and turbidity. Additionally, field measurements were taken at the arrival of each sampling event which included secchi disk depth, total depth, velocity, wave height, ice thickness, snow thickness, air temperature, cloud cover, and wind speed and direction. Sondes were deployed at each site on the first sampling event of the season and were retrieved on the final sampling event of the season. Sondes were programmed to take continuous monitoring readings for dissolved oxygen, temperature, specific conductance, pH, and turbidity every two hours.

The most recent monitoring reveals no immediate concerns in terms of dissolved oxygen (DO). When looking at the years of data collected after construction was complete in 2016, DO levels appear to range between 10-15 mg/L for the majority of the winter seasons with greater

consistency as time progressed. It is to be noted, however, that there are some drops in DO below 5 mg/L observed within some post-construction monitoring years for the winter season. Specifically, for the 2019-2020 season, it was observed that DO levels dropped below the threshold within the winter monitoring season for a notable period. During these observed drops in DO, other associated parameters saw similar drops or increases in values lending the reasoning to be more likely from harsh winter conditions and ice and snow accumulations. With this being said, the exact reasoning behind this would need more data to be determined. Additionally, site W-M564.7R observed an extended drop in DO as well, but this is likely due to equipment malfunctions or field interferences due to inconsistency between grab samples and continuous data. In terms of temperatures and velocities, values are found to be typically higher at site W-M563.6V in comparison to site W-M564.7R due to closer proximity to main flow of the river. Additionally, it is to be noted that dissolved oxygen levels, water temperatures, and velocities observed each monitoring season are going to vary greatly depending on seasonal differences in snow fall, ice formation, and air temperatures. Refer to Attachment C for more specific water quality monitoring results.

Channel Soil Borings: On August 11, 2021, two borings were driven into sediments within the Sunfish Lake constructed overwintering habitat. These borings, SFN12 and SFS12, were collected to help estimate the type and thickness of materials that have deposited within the overwintering habitat since construction. SFN12 is located at Station 27+00B and SFS12 is located at Station 9+00. A map showing the boring locations is included in Attachment A.

Boring SFN12 was hand driven to 3.5 feet below the bed surface. The upper foot of sediment consisted of brown/gray, flocculent silt and clay with very fine sand. From the 1 to 2.5-foot interval sediment consisted of brown, massive, organic silty clay, and in the 2.5-to-3.5-foot interval a brown/gray firm, massive clay was present. No bedding structures were observed. Based on water depth elevations and pool elevations that day, the bed elevation at the boring location was estimated to be at 585 feet.

Boring SFS12 was hand driven to 3.3 feet below the bed surface. The upper foot of sediment consisted of brown, flocculent silt and clay with very fine sand. From the 1 to 2-foot interval sediment consisted of brown, massive, clay that firmed with depth. In the 2 to 3.3 feet interval a brown/gray firm, massive clay was present. No bedding structures were observed. Based on water depth elevations and pool elevations that day, the bed elevation at the boring was estimated to be at 586 feet. Hydrometer grain size analysis was conducted on the materials comprising the top 1-foot interval of boring SFS12. The hydrometer analysis indicated a grain size distribution of 15% clay, 53% silt, and 32% very fine sand.

No determination can be made on the extent of contribution by the Spring 2019 Flood Event to the sediments observed since construction, but it is possible that some portion of the sediment load was from that event. Both borings appear to have been driven through post construction sediments into native materials, with SFN12 penetrating deeper into the native clay.

Based on the depth of flocculent sediment, the borings indicate that approximately 1 foot of sediment accumulation may have occurred in the channel cut area, however this is point data and a hydrographic survey of the entire channel would provide a better indication of post-construction channel depths.

Berm Soil Samples: Five soil samples were collected from the planted berms as part of a larger UMRR study conducted in 2021. This study was conducted to ascertain the microbial community, micro/macro nutrients and overall capacity of the berm soils to sustain plant growth.

Samples were collected on August 11, 2021, and sent to Ward Laboratories, Inc. for the Haney Soil Health Test and Phospholipid Fatty Acid (PLFA) Soil Microbial Community Analysis. A table detailing the parameters of the tests and subsequent results is included in Attachment D.

Samples were taken in two general areas of the Sunfish placement berm as shown on the map in Attachment D. Samples Sunfish Tree 1 (SFT1), Sunfish Tree 2 (SFT2) and Sunfish Tree 3 (SFT3) were collected within 200 feet of each other near the northern portion of the berm. Samples Sunfish Tree 4 (SFT4) and Sunfish Tree 5 (SFT5) were collected within 200 feet of each other in the southern portion of the berm. Miscommunication on sample placement occurred between field personnel, so samples were not distributed as desired, but for the purposes of interpretation, the two separate groupings of samples were compared against recommended standards and each other. A control sample, Stone Control (SC), was collected the same day in a forested area where no placement or construction activities had occurred.

In total, 38 different soil parameters were analyzed. However, not all these parameters have a recommended value or standard to compare results to, and in some cases these recommendations are based on agricultural situations. The following lists how each sample site compared to the recommendations for each parameter.

Sample results that are considered low, poor, below average or not optimal:
Soil Respiration CO_2-C: SFT1, SFT2, SFT3 - low
Organic Nitrogen: SFT1, SFT2, SFT3, SFT4, SFT5, SC - low
Inorganic Phosphorus: SFT1, SFT2, SFT3 - low
Potassium: SFT1, SFT2, SFT3, SFT4, SC – very low, low
Zinc: SC - low
Copper: SFT1, SFT2 - low
Sulfate: SFT1, SFT2, SFT3 - low
Organic C/Organic N Ratio: SFT2, SFT4 – marginal
Microbially Active Carbon: SFT1, SFT2, SFT3 - low
Haney Soil Health: SFT1, SFT2, SFT3 - poor
PFLA: SFT1, SFT2, SFT3, SFT4, SFT5 - poor
Functional Group Diversity Index: SFT4 - poor
Total arbuscular mycorrhizae spores: SFT3, SFT4, SFT5 – below average
Fungi/Bacteria Ratio: SFT4 - poor
Predator/Prey Ratio: SFT1, SFT2, SFT3, SFT4, SFT5, SC - poor
Gram+/Gram- Ratio: SFT1, SFT2, SFT5 – gram negative dominated

Sample results that are considered average, optimal or desired:
pH: SFT1, SFT2, SFT3, SFT4, SFT5, SC - acceptable
% Organic Matter: SFT1, SFT2, SFT3, SFT4, SFT5, SC (latter three samples higher %) - acceptable
Soluble Salts: SFT1, SFT2, SFT3, SFT4, SFT5, SC - acceptable
Total Phosphorus: SFT1, SFT2, SFT3 - moderate
Potassium: SFT5 - moderate
Zinc: SFT1, SFT2, SFT3 - moderate
Copper: SFT3 - moderate
Sulfate: SC - moderate
Organic C/Organic N Ratio: SFT1, SFT3, SFT5, SC - good
Organic N/Inorganic N Ratio: SFT1, SFT2, SFT3, SFT4, SFT5, SC - acceptable
Haney Soil Health: SFT4, SFT5, SC - moderate
PFLA: SC – slightly below average

Functional Group Diversity Index: SFT1, SFT2, SFT3, SFT5 - average
Total arbuscular mycorrhizae spores: SFT1, SFT2, SC - acceptable
Fungi/Bacteria Ratio: SFT3, SC - average
Gram+/Gram- Ratio: SFT3, SFT4, SC - balanced

Sample results that are considered high or above average:
Soil Respiration CO_2-C: SFT5, SC - high
Total Phosphorus: SFT4 - high
Inorganic Phosphorus: SFT4 - high
Zinc: SFT4 - high
Functional Group Diversity Index: SC - good
Fungi/Bacteria Ratio: SFT1, SFT2, SFT5 – above average, excellent

Sample results that are considered very high:
Soil Respiration CO_2-C: SFT4 – very high
Total Phosphorus: SFT5, SC – very high
Inorganic Phosphorus: SFT5, SC – very high
Zinc: SFT5 – very high
Iron: SFT1, SFT2, SFT3, SFT4, SFT5, SC -very high
Manganese: SFT1, SFT2, SFT3, SFT4, SFT5, SC (latter three samples higher) – very high
Copper: SFT4, SFT5, SC – very high
Sulfate: SFT4, SFT5 – very high
Microbially Active Carbon: SFT4, SFT5, SC – very high, not desirable

In general, SFT1, SFT2 and SFT3 had more parameters not meeting the recommended standards than they had parameters that exceeded those standards. For SFT4 and SFT5, roughly half of the parameters exceeded the recommended standards. Each parameter has different meaning to the overall soils ability to sustain plant growth, for some too much is not desirable, for others too little is not desirable. Certain parameters are discussed more in depth below.

Soil Respiration: This parameter is the potential for microbial activity. The higher the value the better as it means more microbes are present. SFT1, SFT2, and SFT3 are considered low, while SFT4, SFT5 and SC are high or very high. The control sample was significantly lower than SFT4 and SFT5.

Microbially Active Carbon: The measure of how much the water extractable organic carbon is acted upon by the microbial community. A value of <25% is considered poor, and a value of >80% is an
indicator that carbon may become a limiting factor. The 50 to 75% range is considered desirable for productive systems. SFT1, SFT2, and SFT3 are considered low, while SFT4, SFT5 and SC are high or very high. None of the samples were in the desirable range.

Water Extractable Organic Nitrogen: This measures the pool of organic nitrogen available for the microbial community. Guidance suggests most soils have values between 10 and 30 ppm. All samples were below the average range. SFT1, SFT2 and SFT3 values were similar to the control sample value.

Organic C to Organic N Ratio: A ratio of greater than 20:1 is considered poor, 16:20 is marginal, 8:15 good, 10:12 ideal, and less than 8:1 is poor. The samples were mixed, with SC, STF1, STF3 and SFT5 considered in the good range, and STF2 and STF4 in the marginal

range. The control sample had the lowest ratio value at 9.1, while the remainder of the samples ranges from 12.9 to 19.8.

Organic N to Inorganic N Ratio: A higher ratio is considered desirable, with less than 1 indicating a possible fertilizer dependent system, 2-3 acceptable and greater than 5 considered ideal. All samples were considered acceptable. The control sample had the lowest ratio value at 1.4, while the remainder of the samples ranges from 1.7 to 2.9. A lower ratio value means that more of the N present in the soil exists as nitrate and ammonium, leading to possible nitrogen immobilization (aka tie-up).

Arbuscular mycorrhizail fungi spores: Mycorrhizae is the symbiotic relationship between a bacteria or fungi and a plant species. Arbuscular mycorrhizae (AM) are the most common of all mycorrhizae and are found in up to 90% of the world's plant species. AM receives photosynthesis products from the plant, while AM retrieves nutrients from the surrounding soil and passes them onto the plan root system. No official standard or recommended quantity is published, but most AM inoculant products have counts above 50 spores/gram, and the laboratory manager considered a count greater than 30 to be desirable. SFT1, SFT2 and SC had spore counts above the desired value.

Phosphorus: As a primary macronutrient, phosphorus can be a limiting factor for plant growth. SFT1, SFT2 and SFT3 were classified as low or moderate in varying forms of phosphorus. SFT4, SFT5 and SC were classified as high or very high. It should be noted that at least in crop production a value over 25 parts per million has not been shown to increase yields. SFT4, SFT5 and SC exceeded this value.

Potassium: Samples SFT1, SFT2 and SFT3 are classified as very low for this macronutrient. SFT4 was classified as low, while SFT5 is classified as medium. The control sample SC was classified as low. Literature suggests that, at least for row crops, a value over 90 parts per millions is not beneficial. No samples exceeded this value.

Haney Soil Health Score: The Score is a summary/combination of the aforementioned parameters as well as other parameters. The range can be from 0 to 50, with most Scores below 30. The higher values are desirable, and a Score of less than 7 is considered poor. Samples SFT1, SFT2 and SFT3 had Scores less than 7.

Phospholipid fatty acids (PLFAs) are found in the membranes of all active organisms. Certain fatty acids are used to indicate the bacteria, fungi, or other types of microbes. The PLFA test provides a real-time snapshot of the soil microbial community. SFT1, SFT2, SFT3 and SFT4 were classified as very poor, and STF5 was considered poor. The control sample was classified as slightly below average.

Overwintering Dredge Cut Bathymetry: As-built depth measurements were collected following construction activities at Sunfish Lake, as well as Stone, Kehough and Tippy Lake. Following the Spring 2019 Flood event, post construction depth measurements were taken at the same cross section station intervals to determine the impact of the flood on recent construction. However, this post flood survey was only conducted at Stone, Tippy and Kehough overwintering dredge cuts. Some information can be inferred about the area that may apply to the Sunfish Lake overwintering dredge cut.

At Stone Lake, Channel A experienced on average 0.8 feet of sedimentation, Channel B on average 0.3 feet and Channel C 0.75 feet. At Kehough Lake, the Lower channel experienced

0.6 feet of sedimentation on average, and the Upper channel 0.7 feet. At both lakes, some cross sections showed as much as 2 feet of sediment accumulation over as-built conditions, while in other areas sedimentation did not appear to occur. The data at Tippy Lake was not usable at the time of writing this report.

The cross-section depth data for Stone and Kehough Lakes generally correlate with the findings of the two Sunfish borings, where areas of one to two feet of sediment accumulation likely occurred, while areas of net zero accumulation also are likely present.

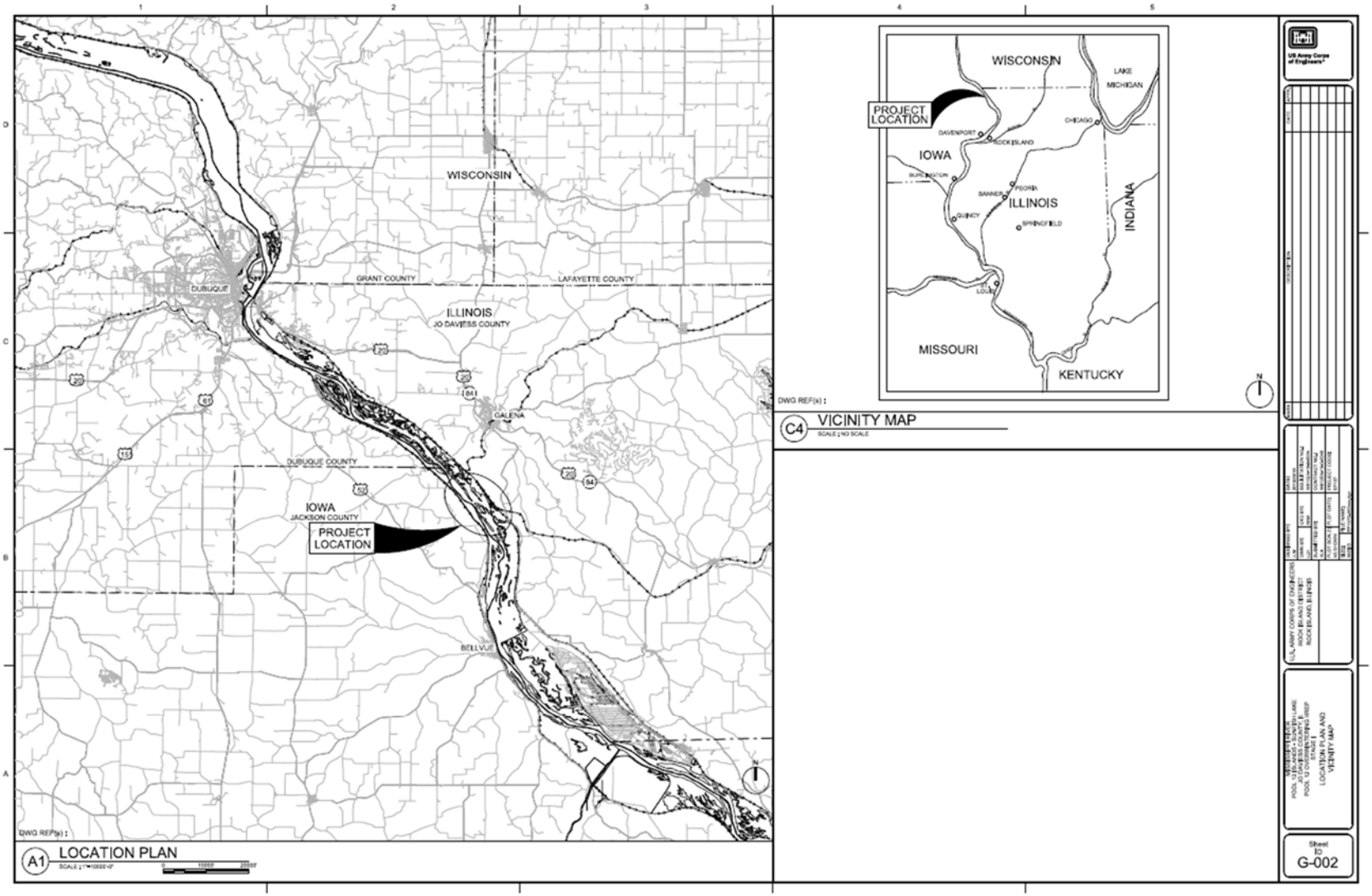
XII. RECOMMENDATIONS

- Repair large animal hole in “doughnut” area on the north end of project.
- Place no wake sign throughout the slough to reduce erosion.

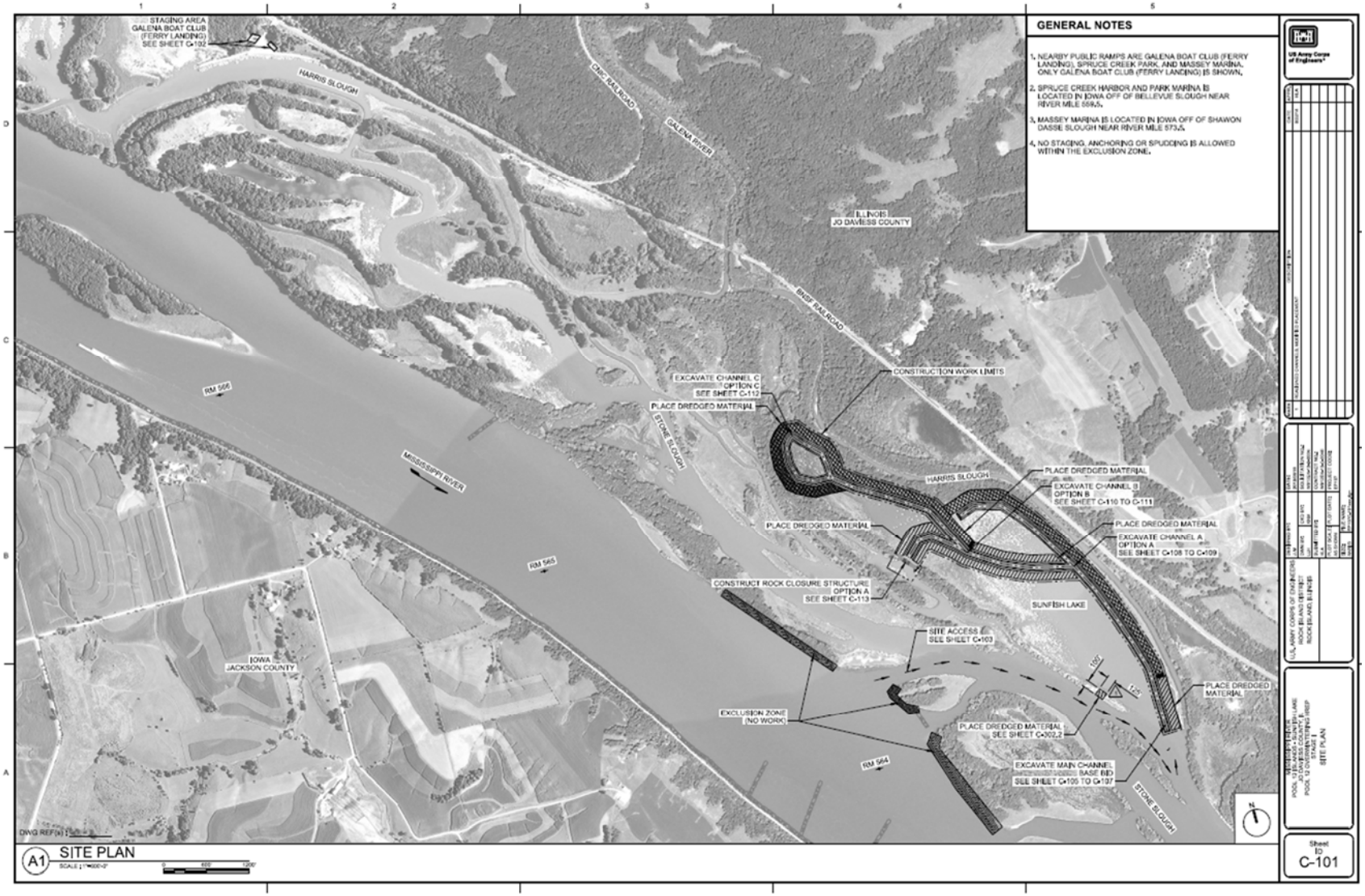
XIII. LESSONS LEARNED

Utilize Plantra trunk saver solid wall tree guards in all situations that tree protection is merited. Corrugated drain tile is not a sufficient alternative and detrimental to tree growth. Do not direct seed button bush with dense herbaceous seed, the competition of the herbaceous vegetation will out compete the button bush and prevent establishment. If having a slough that is winding or can keep curving is an option, try to go this route. It might help with bank erosion due to vessel wave wash because the boats move slower.

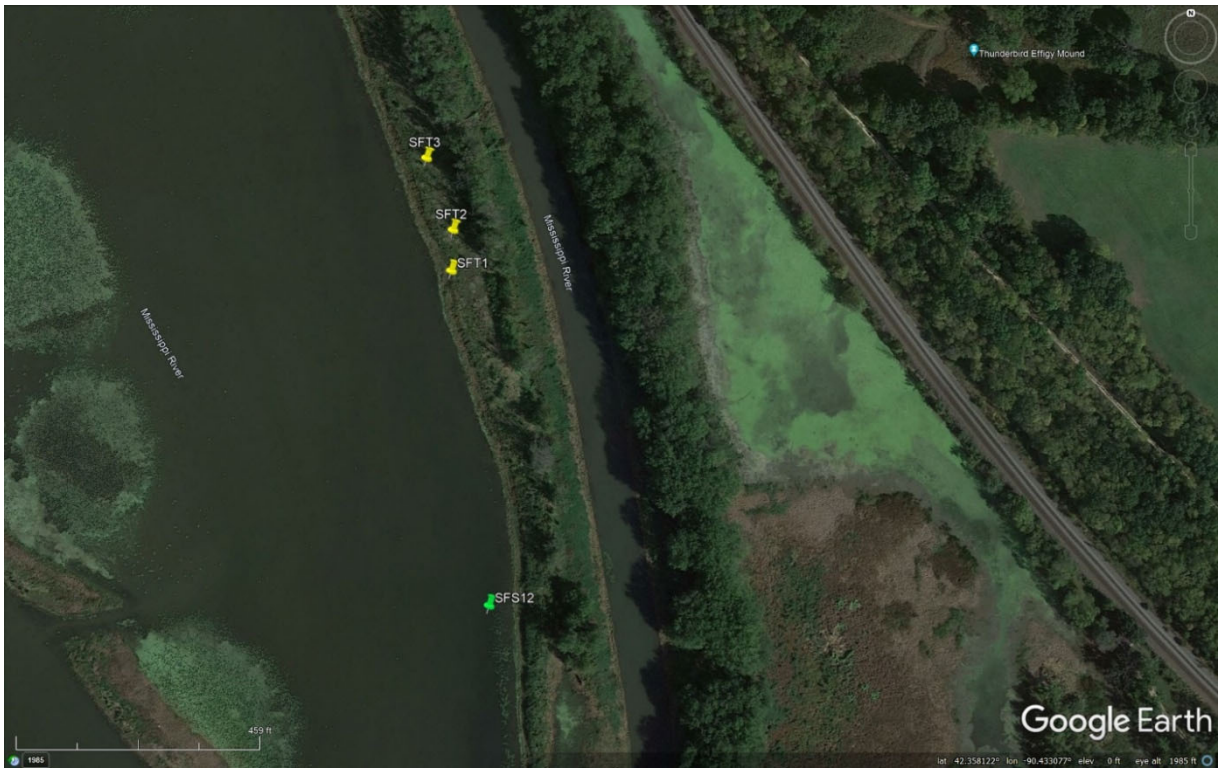
ATTACHMENT A
SITE VICINITY MAP, SITE PLAN, CHANNEL BORING AND BERM SAMPLE LOCATIONS



Site Vicinity Map


GENERAL NOTES
1. NEARBY PUBLIC RAMPS ARE GALENA BOAT CLUB (FERRY LANDING), SPRUCE CREEK PARK, AND MASSEY MARINA. ONLY GALENA BOAT CLUB (FERRY LANDING) IS SHOWN.
2. SPRUCE CREEK HARBOR AND PARK MARINA IS LOCATED IN IOWA OFF OF BELLEVUE SLOUGH NEAR RIVER MILE 559.5.
3. MASSEY MARINA IS LOCATED IN IOWA OFF OF SHAWON DASSE SLOUGH NEAR RIVER MILE 573.5.
4. NO STAGING, ANCHORING OR SPUDDING IS ALLOWED WITHIN THE EXCLUSION ZONE.
STAGING AREA GALENA BOAT CLUB (FERRY LANDING) SEE SHEET C-102
HARRIS SLOUGH
CNIC RAILROAD
GALENA RIVER
ILLINOIS JO DAVIESS COUNTY
BNSF RAILROAD
CONSTRUCTION WORK LIMITS
EXCAVATE CHANNEL C OPTION C SEE SHEET C-112
PLACE DREDGED MATERIAL
STONE SLOUGH
RM 566
MISSISSIPPI RIVER
HARRIS SLOUGH
PLACE DREDGED MATERIAL
EXCAVATE CHANNEL B OPTION B SEE SHEET C-110 TO C-111
PLACE DREDGED MATERIAL
PLACE DREDGED MATERIAL
EXCAVATE CHANNEL A OPTION A SEE SHEET C-108 TO C-109
RM 565
CONSTRUCT ROCK CLOSURE STRUCTURE OPTION A SEE SHEET C-113
SUNFISH LAKE
SITE ACCESS SEE SHEET C-103
IOWA JACKSON COUNTY
PLACE DREDGED MATERIAL
EXCLUSION ZONE (NO WORK)
PLACE DREDGED MATERIAL SEE SHEET C-302.2
RM 564
EXCAVATE MAIN CHANNEL BASE BID SEE SHEET C-105 TO C-107
STONE SLOUGH
DWG REF(s):
A1 SITE PLAN
US Army Corps of Engineers
U.S. ARMY CORPS OF ENGINEERS ROCK ISLAND DISTRICT ROCK ISLAND, ILLINOIS
POOL 12 ISLANDS - SUNFISH LAKE JO DAVIESS COUNTY, IL POOL 12 OVERWINTERING WEIR STAGE I
SITE PLAN
Sheet ID C-101

Site Plan



Berm Samples SFT1, SFT2, SFT3, Channel Boring SFS12
Image Courtesy Google Earth™

Berm Samples SFT4, SFT5, Channel Boring SFN12
Image Courtesy Google Earth™

ATTACHMENT B
SITE VISIT PHOTOGRAPHS

Photograph 1: Arriving at Mouth of Sunfish Lake

Photograph 2: Recent Tree Plantings

Photograph 3: Looking Over Sunfish Lake

Photograph 4: Vegetation on One of the Berms

Photograph 5: Plantra Trunk Saver Solid Wall Tree Guard on a Planted Tree

Photograph 6: Berm Vegetation

Photograph 7: Berm Tree Planting

Photograph 8: Sunfish Lake Dredged Area

Photograph 9: Damaged Bark On Tree Due to Corrugated Tree Wraps Previously Used

Photograph 10: Damaged Bark on Tree Due to Corrugated Tree Wrap Previously Used

Photograph 11: Rock Structure

Photograph 12: Rock Structure

Photograph 13: Rock Structure

Photograph 14: North End of Sunfish Lake

ATTACHMENT C
WATER QUALITY RESULTS

Sunfish Lake Winter 2019-2020

The Winter 2019-2020 sampling season at sites W-M567.4R and W-M563.6V consisted of three grab samples that were spread out at the beginning (Dec 9, 2019), middle (Jan 30, 2020), and end (March 4, 2020) of the winter season. At each sampling event, grab samples were taken for total alkalinity and turbidity analysis (EC-HQ lab) and in-situ measurements were taken at multiple depths within the water column for temperature, specific conductance, pH, dissolved oxygen (DO), and turbidity. In addition to this, field measurements were taken at the arrival of each event which included secchi disk depth, total depth, velocity, wave height, ice thickness, snow thickness, air temperature, cloud cover, and wind speed and direction. Sondes were deployed at each site on the first sampling event of the season and were retrieved on the final sampling event of the season. Sondes were programmed to take continuous monitoring readings for DO, temperature, specific conductance, pH, and turbidity every two hours.

Event One: December 09, 2019

W-M563.6V

Sampling occurred at 11:14. The air temperature was recorded to be 6.1 degrees Celsius with a 4.0-mph wind from the northwest and 100% cloud cover. No ice cover or snow cover were recorded at the time of sampling. Total depth was measured at 2.790 meters and in-situ measurements were taken at the surface and at 1.4 meters. Recorded velocity at the sampling site was **1.060 cm/sec**. Readings at multiple depths showed no distinct indication of stratification.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	2.5	513	13.98	8.3	5.34
1.4	2.5	514	13.99	8.25	6.09

W-M564.7R

Sampling occurred at 11:32. The air temperature was recorded to be 6.1 degrees Celsius with a 4.0-mph wind from the west and 100% cloud cover. No ice cover or snow cover were recorded at the time of sampling. Total depth was measured at 2.430 meters and in-situ measurements were taken at the surface and at 0.9 meters. Recorded velocity at the sampling site was **2.850 cm/sec**. Readings at multiple depths showed no distinct indication of stratification.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	2.8	515	13.84	8.31	5.51
0.9	2.8	515	13.86	8.29	

Event Two: January 30, 2020

W-M563.6V

Sampling occurred at 13:44. The air temperature was recorded to be -1.1 degrees Celsius with a 6.0-mph wind from the south and 100% cloud cover. Less than 0.25 inches of snow cover and 6.5 inches of ice cover were present at the time of sampling. Total depth was measured at 3.150 meters and in-situ measurements were taken at the surface, 1.7 meters, and 2.9 meters. Recorded velocity at the sampling site was **7.440 cm/sec**. Readings at multiple depths showed no distinct indication of stratification.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	0.1	469	13.52	7.73	2.74
1.7	0.1	468	13.46	7.65	2.75
2.9	0.1	469	13.43	7.63	2.66

W-M564.7R

Sampling occurred at 13:58. The air temperature was recorded to be -1.1 degrees Celsius with a 3.0-mph wind from the south and 100% cloud cover. 0.5 inches of snow cover and 9.5 inches of ice cover were present at the time of sampling. Total depth was measured at 3.040 meters and in-situ measurements were taken at the surface, at 1.5 meters, and at 2.7 meters. Recorded velocity at the sampling site was **0.370 cm/sec**. Readings showed a slight increase in water temperature with increase in depth and higher DO and turbidity at the middle of the water column.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	0.1	477	14.24	7.92	9.87
1.5	0.2	484	15.9	7.91	12.15
2.7	0.9	493	14.65	7.91	2.63

Event Three: March 04, 2020

W-M563.6V

Sampling occurred at 16:16. The air temperature was recorded to be 7.8 degrees Celsius with a 2.5-mph wind from the west and 10% cloud cover. No ice cover or snow cover were recorded at the time of sampling. Total depth was measured at 2.675 meters and in-situ measurements were taken at the surface, 1.2 meters, and 2.4 meters. Recorded velocity at the sampling site was **2.530 cm/sec**. Readings show a slight decrease in water temperature and DO and pH with depth, and a slight increase in turbidity.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	3.1	437	15.38	8	11.94
1.2	2.6	483	15.26	7.86	13.82
2.4	2.6	494	14.87	7.78	16.31

W-M564.7R

Sampling occurred at 16:38. The air temperature was recorded to be 7.8 degrees Celsius with a 2.8-mph wind from the west and 10% cloud cover. 11 inches of ice and 0 inches snow cover were recorded at the time of sampling. Total depth was measured at 2.360 meters and in-situ measurements were taken at the surface, 0.9 meters, and at 2.1 meters. Recorded velocity at the sampling site was **1.150 cm/sec**. Readings at multiple depths showed some variation in readings with changes in depth.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	3.1	416	22.5	8.42	2.42
0.9	3.6	443	23.64	8.46	3.01
2.1	3	516	19.39	8.25	9.3

Sunfish Lake Winter 2020-2021

The Winter 2019-2020 sampling season at sites W-M567.4R and W-M563.6V consisted of three grab samples that were spread out at the beginning (Dec 9, 2020), middle (Feb 22, 2021), and end (March 24, 2021) of the winter season. At each sampling event, grab samples were taken for total alkalinity and turbidity analysis (EC-HQ lab) and in-situ measurements were taken at multiple depths within the water column for temperature, specific conductance, pH, DO, and turbidity. In addition to this, field measurements were taken at the arrival of each event which included secchi disk depth, total depth, velocity, wave height, ice thickness, snow thickness, air temperature, cloud cover, and wind speed and direction. Sondes were deployed at each site on the first sampling event of the season and were retrieved on the final sampling event of the season. Sondes were programmed to take continuous monitoring readings for DO, temperature, specific conductance, pH, and turbidity every two hours. It is to be noted that there was a malfunction with the sonde deployed at W-M563.6V during the Winter 2020-2021 season. The DO probe did not perform causing data to be lost on the overall internal logging. Samples were thus only recorded from December 9 to December 28 and some hours on December 31 and January 13.

Event One: December 09, 2020

W-M563.6V

Sampling occurred at 11:06. The air temperature was recorded to be 5.0 degrees Celsius with a no wind and 0% cloud cover. No ice or snow cover were recorded at the time of sampling. Total depth was measured at 2.460 meters and in-situ measurements were taken at the surface, 0.9 meters, and at 2.1 meters. Recorded velocity at the sampling site was **0.983 cm/sec**. Readings at multiple depths showed slight increase in temperature and turbidity with depth.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	1.9	443.1	14.58	8.29	3.94
0.9	2.9	450.9	14.65	8.18	4.3
2.1	2.9	457.3	14.29	8.13	8.87

W-M564.7R

Sampling occurred at 11:21. The air temperature was recorded to be 5.0 degrees Celsius with a 0.9-mph wind from the northwest and 0% cloud cover. No ice or snow cover were recorded at the time of sampling. Total depth was measured at 2.170 meters and in-situ measurements were taken at the surface, 0.6 meters, and at 1.8 meters. Recorded velocity at the sampling site was **2.175 cm/sec**. Readings at multiple depths showed some variation in readings with changes in depth.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	3.9	430.7	12.21	7.89	3.88
0.6	3.9	430.9	12.16	7.88	4.05
1.8	4.1	448.3	10.24	7.66	4.44

Event Two: February 22, 2021

W-M563.6V

Sampling occurred at 08:56. The air temperature was recorded to be -2.8 degrees Celsius with a 9.0-mph wind from the southwest and 100% cloud cover. 36 centimeters of ice and 24

centimeters of snow cover were recorded at the time of sampling. Total depth was measured at 2.370 meters and in-situ measurements were taken at the surface, 0.8 meters, and at 2.0 meters. Recorded velocity at the sampling site was **0.140 cm/sec**. Readings at multiple depths showed some variation in readings with changes in depth.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	0	516	13.65	7.46	1.2
0.8	0	514	13.7	7.45	1.04
2.0	0.8	555	9.84	7.28	3.31

W-M564.7R

Sampling occurred at 09:19. The air temperature was recorded to be 5.5 degrees Celsius with a 5.5-mph wind and 100% cloud cover. 33 centimeters of ice and 16 centimeters snow cover were recorded at the time of sampling. Total depth was measured at 2.200 meters and in-situ measurements were taken at the surface, 0.7 meters, and at 1.9 meters. Recorded velocity at the sampling site was **0.730 cm/sec**. Readings at multiple depths showed little variation in readings with changes in depth.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	1	502	3.65	7.25	4.49
0.7	1.3	502	3.05	7.21	5.11
1.9	1.5	510	2.55	7.2	5.45

Event Three: March 24, 2021

W-M563.6V

Sampling occurred at 10:17. The air temperature was recorded to be 10.0 degrees Celsius with a 10.6-mph wind from the south and 100% cloud cover. No ice or snow cover were recorded at the time of sampling. Total depth was measured at 2.805 meters and in-situ measurements were taken at the surface, 1.3 meters, and at 2.5 meters. Recorded velocity at the sampling site was **5.720 cm/sec**. Readings at multiple depths showed no distinct indication of stratification.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	8.2	401.5	12.53	8.39	7.07
1.3	8.1	401.6	12.56	8.33	7.24
2.5	8.1	401.8	12.5	8.2	7.32

W-M564.7R

Sampling occurred at 10:56. The air temperature was recorded to be 10.0 degrees Celsius with a 10.6-mph wind from the southwest and 100% cloud cover. No ice or snow cover were recorded at the time of sampling. Total depth was measured at 2.375 meters and in-situ measurements were taken at the surface, 1.2 meters, and at 2.0 meters. Recorded velocity at the sampling site was **7.350 cm/sec**. Readings at multiple depths showed some variation in readings with changes in depth.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	9.3	395.8	12.83	8.7	9.58
1.2	9.2	395.7	12.86	8.67	9.99
2.0	9.2	395.8	12.82	8.63	10.61

Sunfish Lake Winter 2021-2022

The Winter 2021-2022 sampling season at sites W-M567.4R and W-M563.6V consisted of three grab samples that were spread out at the beginning (Dec 2, 2021), middle (Feb 2, 2022), and end (April 5, 2022) of the winter season. At each sampling event, grab samples were taken for total alkalinity and turbidity analysis (EC-HQ lab) and in-situ measurements were taken at multiple depths within the water column for temperature, specific conductance, pH, DO, and turbidity. In addition to this, field measurements were taken at the arrival of each event which included secchi disk depth, total depth, velocity, wave height, ice thickness, snow thickness, air temperature, cloud cover, and wind speed and direction. Sondes were deployed at each site on the first sampling event of the season and were retrieved on the final sampling event of the season. Sondes were programmed to take continuous monitoring readings for DO, temperature, specific conductance, pH, and turbidity every hour.

Event One: December 02, 2021

W-M563.6V

Sampling occurred at 13:51. The air temperature was recorded to be 11.1 degrees Celsius with a 2.2-mph wind from the northwest and 10% cloud cover. No ice cover or snow cover were recorded at the time of sampling. Total depth was measured at 1.760 meters and in-situ measurements were taken at the surface. Recorded velocity at the sampling site was **2.697 cm/sec**.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	4.4	444.6	14.68	8.35	4.50

W-M564.7R

Sampling occurred at 14:13. The air temperature was recorded to be 11.1 degrees Celsius with a 6.2-mph wind from the west and 10% cloud cover. No ice cover or snow cover were recorded at the time of sampling. Total depth was measured at 2.145 meters and in-situ measurements were taken at the surface and at 0.7 meters. Recorded velocity at the sampling site was **0.473 cm/sec**. Readings at multiple depths showed no distinct indication of stratification.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	4.6	431.4	14.69	8.54	5.93
0.7	4.5	431.4	14.87	8.52	5.72

Event Two: February 08, 2022

W-M563.6V

Sampling occurred at 14:21. The air temperature was recorded to be 5.0 degrees Celsius with a 0.8-mph wind from the southwest and 90% cloud cover. Approximately 5.0 centimeters of snow cover and 39.0 centimeters of ice cover were present at the time of sampling. Total depth was measured at 2.280 meters and in-situ measurements were taken at the surface, 0.8 meters, and

2.0 meters. Recorded velocity at the sampling site was **0.555 cm/sec**. Readings at multiple depths showed a slight decrease in specific conductance and pH with depth as well as a slight decrease and then increase in temperature, DO, and turbidity.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	1.3	552	14.57	7.58	2.93
0.8	0.2	548	15.08	7.30	1.80
2.0	0.9	479	13.65	7.24	4.77

W-M564.7R
Sampling occurred at 14:42. The air temperature was recorded to be 5.0 degrees Celsius with a no presence of wind and 75% cloud cover. 4.0 centimeters of snow cover and 28 centimeters of ice cover were present at the time of sampling. Total depth was measured at 2.160 meters and in-situ measurements were taken at the surface, at 0.7 meters, and at 1.9 meters. Recorded velocity at the sampling site was **0.057 cm/sec**. Readings at multiple depths showed a slight increase in accordance with increasing depth for most parameters.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	0.2	586	7.02	7.38	30.80
0.7	1.2	565	6.49	7.27	3.17
1.9	1.3	564	6.24	7.23	3.33

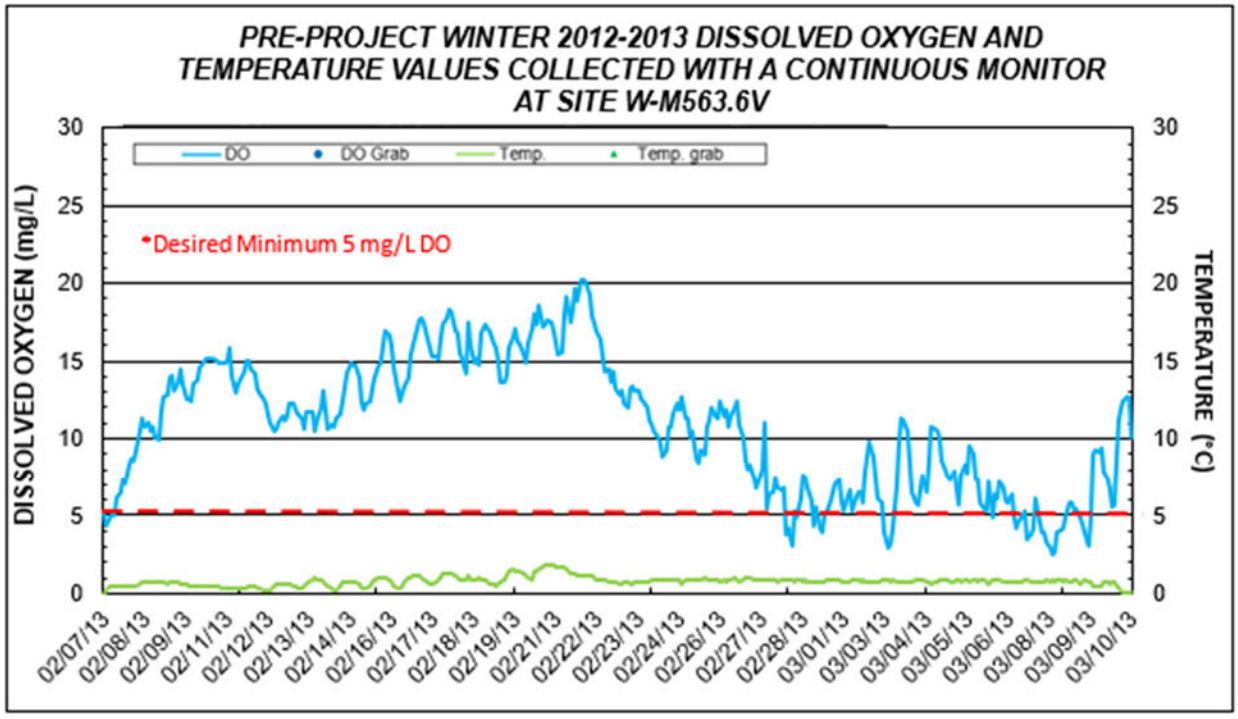
Event Three: April 05, 2022
W-M563.6V
Sampling occurred at 14:39. The air temperature was recorded to be 11.1 degrees Celsius with a 3.4-mph wind from the south and 100% cloud cover. No ice cover or snow cover were recorded at the time of sampling. Total depth was measured at 2.660 meters and in-situ measurements were taken at the surface, 1.1 meters, and 2.3 meters. Recorded velocity at the sampling site was **2.898 cm/sec**. Readings at multiple depths showed no distinct indication of stratification.

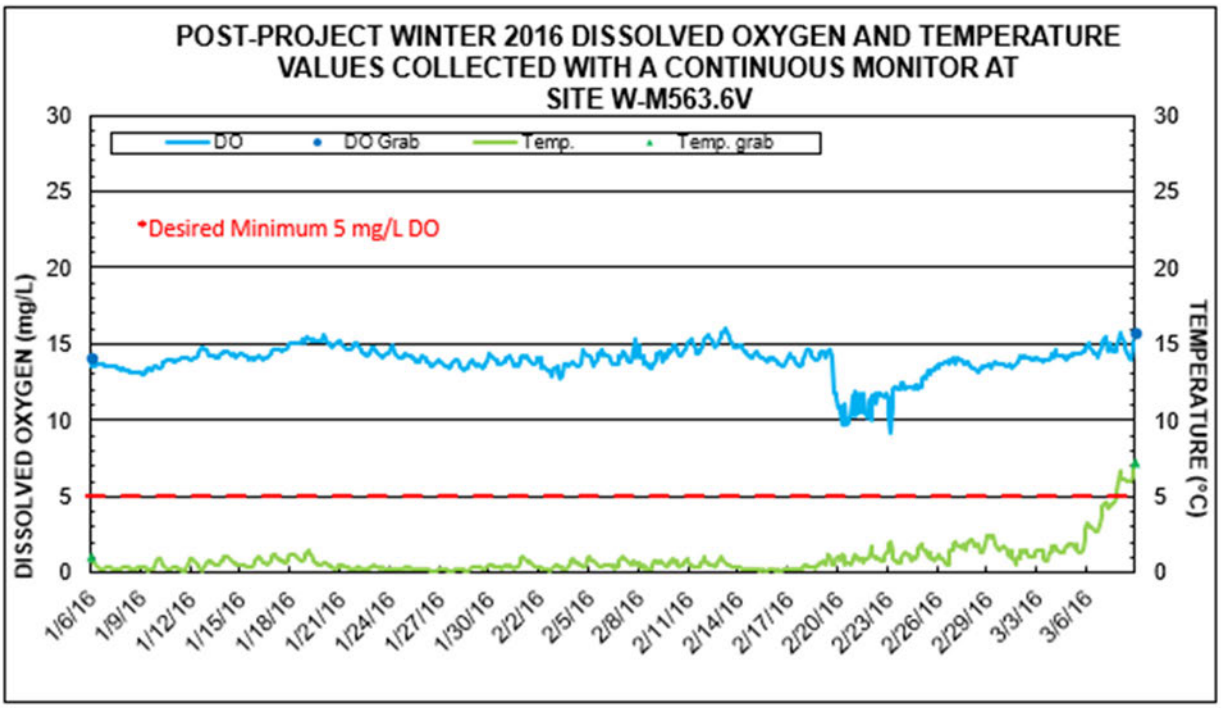
Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	6.2	361.9	14.13	8.27	7.33
1.1	6.1	362.2	14.08	8.23	7.26
2.3	6.1	362.2	14.05	8.21	7.26

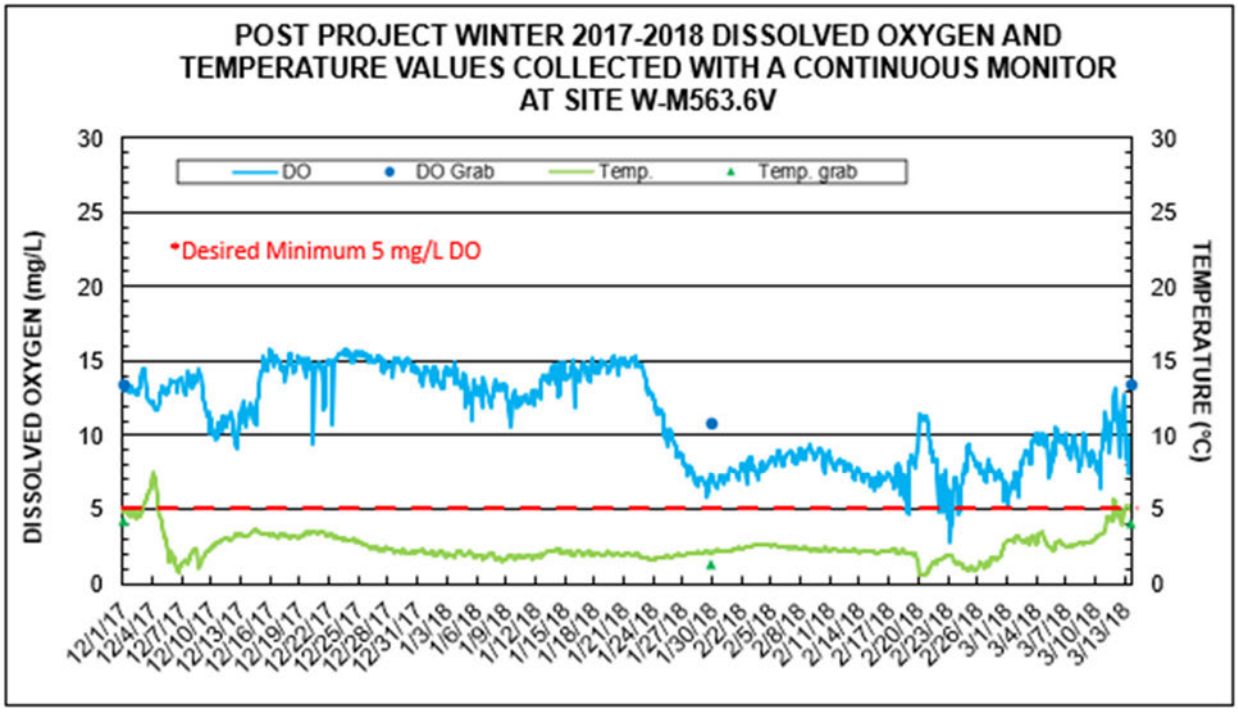
W-M564.7R
Sampling occurred at 15:01. The air temperature was recorded to be 11.1 degrees Celsius with a 3.8-mph wind from the west and 100% cloud cover. No ice cover or snow cover were recorded at the time of sampling. Total depth was measured at 2.916 meters and in-situ measurements were taken at the surface, 1.2 meters, and at 2.1 meters. Recorded velocity at the sampling site was **2.916 cm/sec**. Readings at multiple depths showed no distinct indication of stratification.

Sample Depth (m)	Water Temp (degree C)	Specific Conductance (umho/cm)	Dissolved Oxygen mg/l)	pH (None)	Turbidity (FNU)
0	7.4	354.1	18.33	9.02	8.72
1.2	7.3	354.2	18.32	9.03	8.87
2.1	7.2	354.5	18.15	9.03	8.32

Pre and Post Project Graphical Comparison Site W-M536.6V






POST PROJECT WINTER 2017-2018 DISSOLVED OXYGEN AND TEMPERATURE VALUES COLLECTED WITH A CONTINUOUS MONITOR AT SITE W-M563.6V
DO
DO Grab
Temp.
Temp. grab
*Desired Minimum 5 mg/L DO
DISSOLVED OXYGEN (mg/L)
TEMPERATURE (°C)
0
5
10
15
20
25
30
12/1/17
12/4/17
12/7/17
12/10/17
12/13/17
12/16/17
12/19/17
12/22/17
12/25/17
12/28/17
12/31/17
1/3/18
1/6/18
1/9/18
1/12/18
1/15/18
1/18/18
1/21/18
1/24/18
1/27/18
1/30/18
2/2/18
2/5/18
2/8/18
2/11/18
2/14/18
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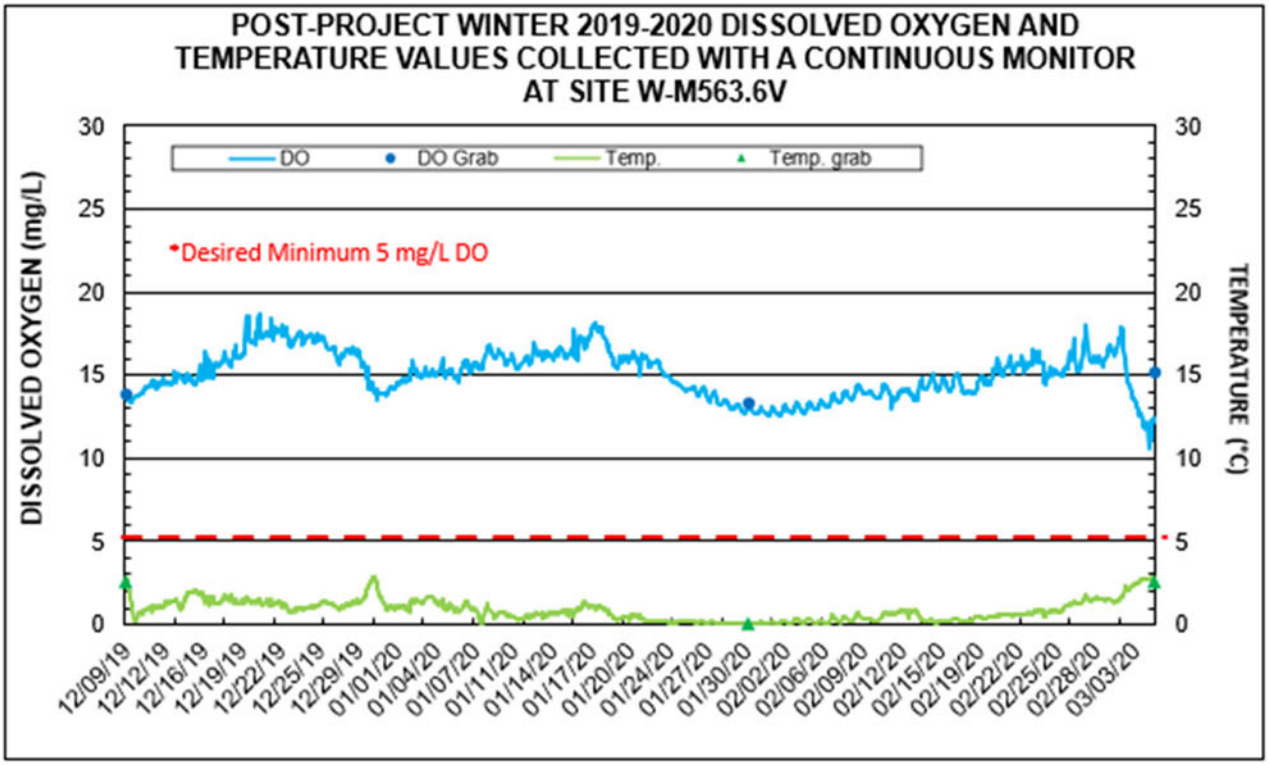
3/13/18


POST-PROJECT WINTER 2019-2020 DISSOLVED OXYGEN AND TEMPERATURE VALUES COLLECTED WITH A CONTINUOUS MONITOR AT SITE W-M563.6V
DO
DO Grab
Temp.
Temp. grab
*Desired Minimum 5 mg/L DO
DISSOLVED OXYGEN (mg/L)
TEMPERATURE (°C)
0
5
10
15
20
25
30
12/09/19
12/12/19
12/16/19
12/19/19
12/22/19
12/25/19
12/29/19
01/01/20
01/04/20
01/07/20
01/11/20
01/14/20
01/17/20
01/20/20
01/24/20
01/27/20
01/30/20
02/02/20
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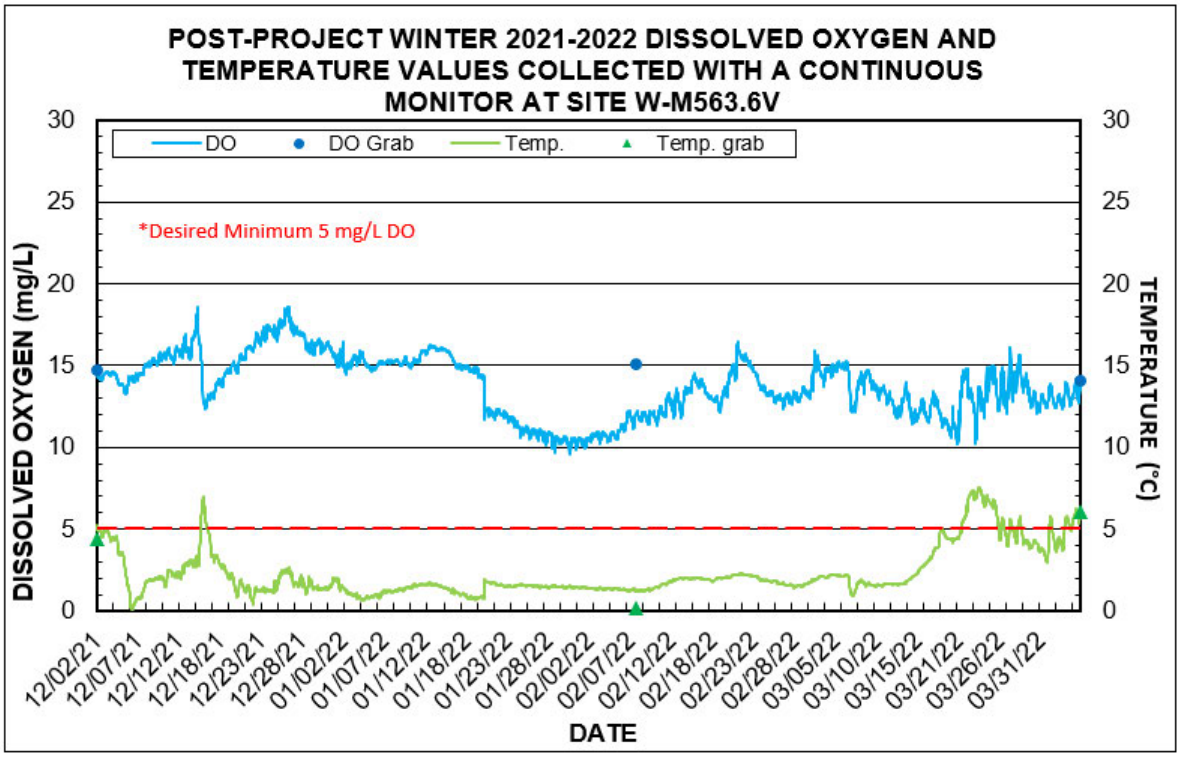
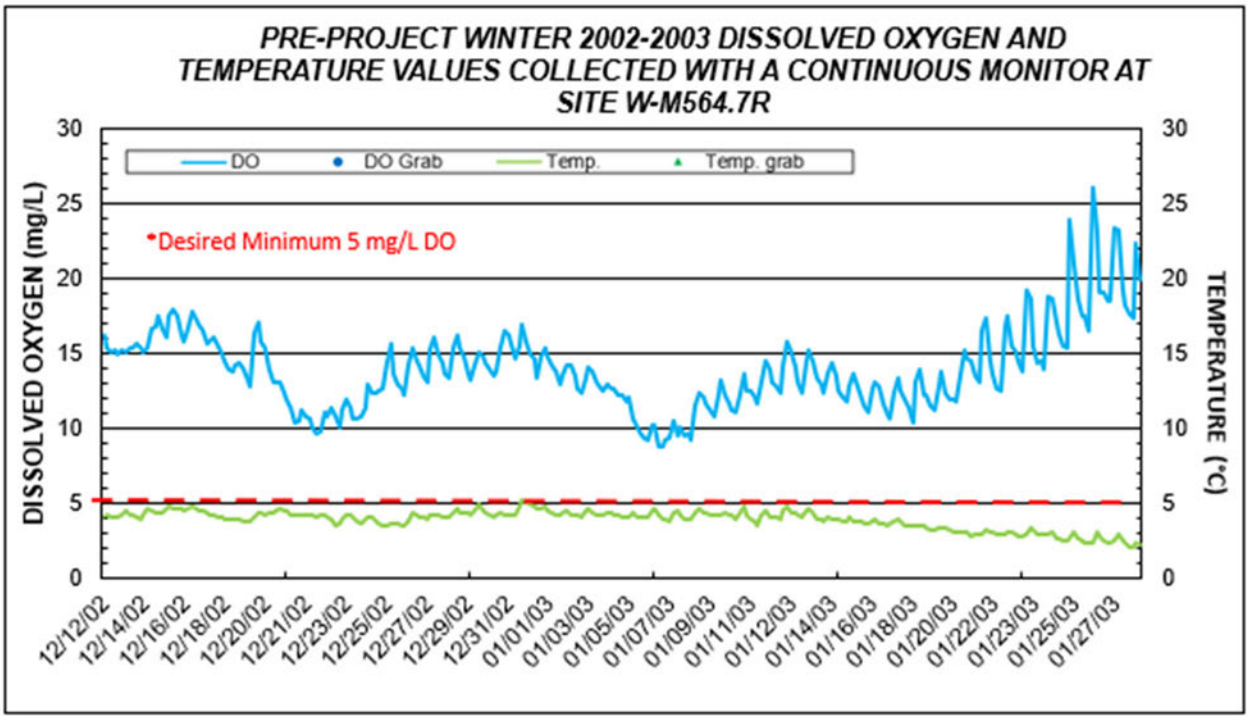
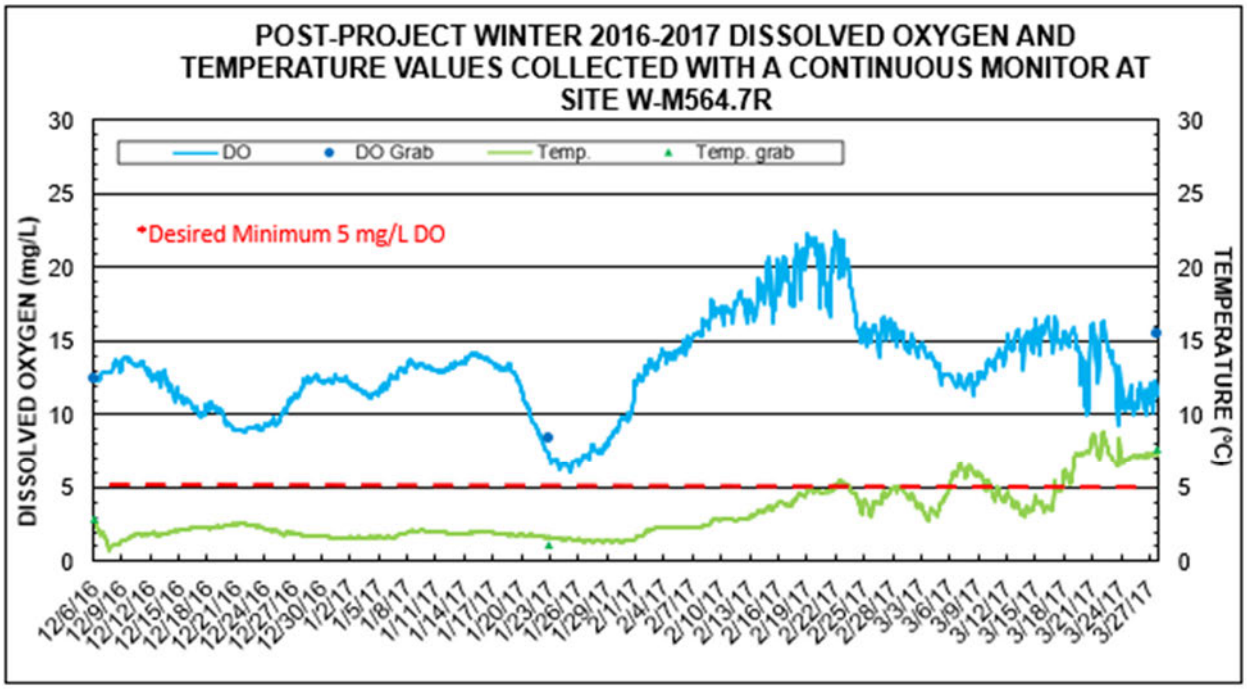
03/03/20



Pre and Post Project Graphical Comparison Site W-M564.7R




POST-PROJECT WINTER 2016-2017 DISSOLVED OXYGEN AND TEMPERATURE VALUES COLLECTED WITH A CONTINUOUS MONITOR AT SITE W-M564.7R
DO
DO Grab
Temp.
Temp. grab
*Desired Minimum 5 mg/L DO
DISSOLVED OXYGEN (mg/L)
TEMPERATURE (°C)
0
5
10
15
20
25
30
12/6/16
12/9/16
12/12/16
12/15/16
12/18/16
12/21/16
12/24/16
12/27/16
12/30/16
1/2/17
1/5/17
1/8/17
1/11/17
1/14/17
1/17/17
1/20/17
1/23/17
1/26/17
1/29/17
2/1/17
2/4/17
2/7/17
2/10/17
2/13/17
2/16/17
2/19/17
2/22/17
2/25/17
2/28/17
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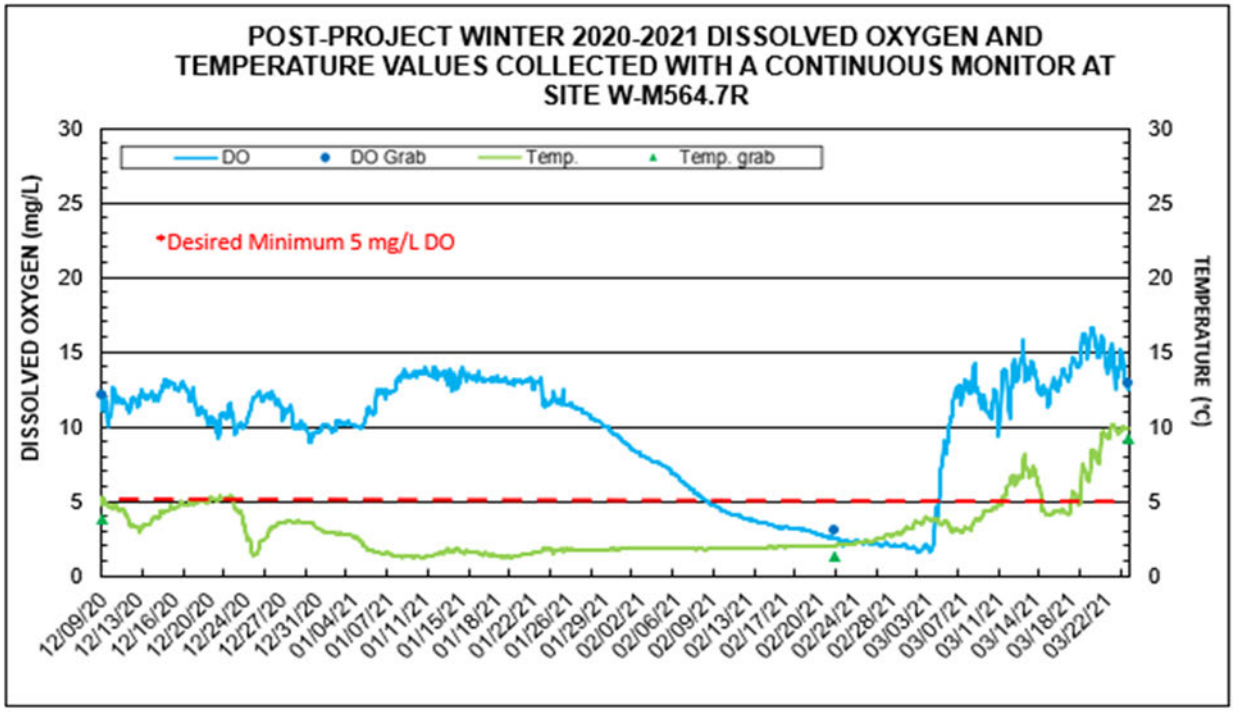
3/27/17


POST-PROJECT WINTER 2020-2021 DISSOLVED OXYGEN AND TEMPERATURE VALUES COLLECTED WITH A CONTINUOUS MONITOR AT SITE W-M564.7R
DO
DO Grab
Temp.
Temp. grab
*Desired Minimum 5 mg/L DO
DISSOLVED OXYGEN (mg/L)
TEMPERATURE (°C)
0
5
10
15
20
25
30
12/09/20
12/13/20
12/16/20
12/20/20
12/24/20
12/27/20
12/31/20
01/04/21
01/07/21
01/11/21
01/15/21
01/18/21
01/22/21
01/26/21
01/29/21
02/02/21
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02/09/21
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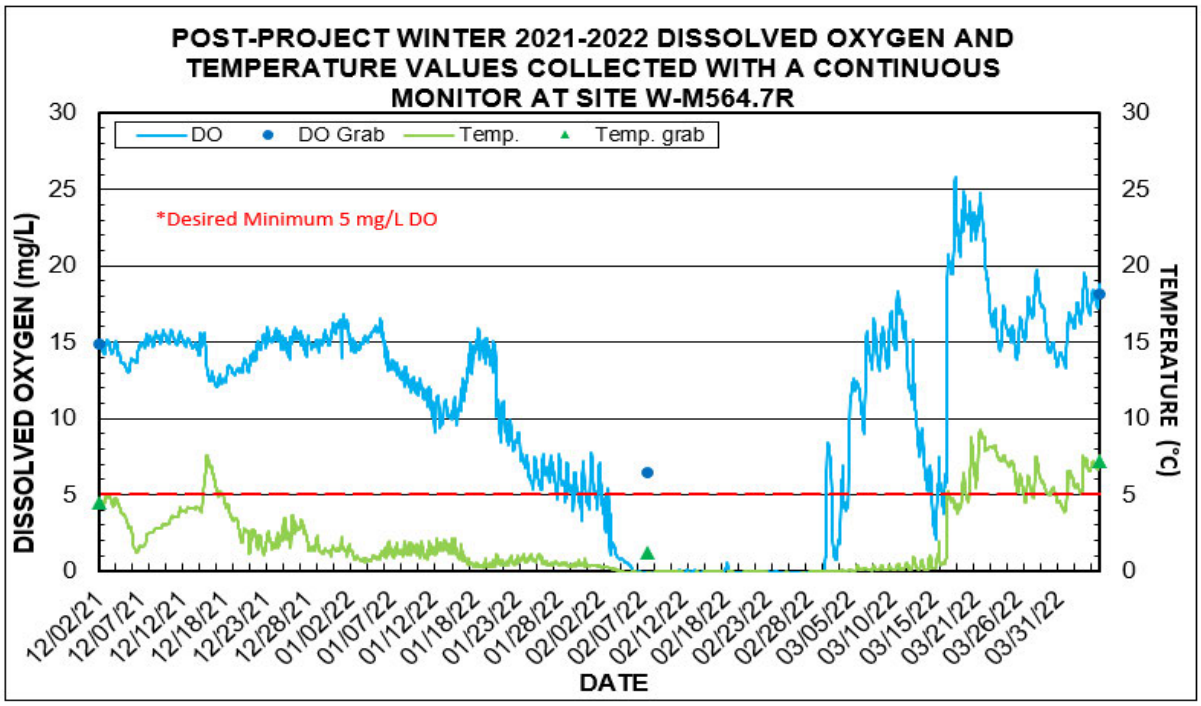

*Potential equipment malfunction 2/7/2022-2/28/2022 due to grab samples not matching sonde data

Water Quality Conclusion

Winter water quality monitoring at Sunfish Lake within Pool 12 at sites W-M564.7R and W-M563.6V indicated dissolved oxygen levels above 5 mg/L for 100% of the duration of winter monitoring for the 2019-2020 season. The average temperature for site W-M546.7R was 1.54 degrees Celsius and the average temperature for site W-M563.6V was 0.84 degrees Celsius. The average velocity for site W-M546.7R was 1.457 cm/sec and the average velocity for site W-M563.6V was 3.677 cm/sec.

For the 2020-2021 winter monitoring season, site W-M564.7R indicated dissolved oxygen levels above 5 mg/L for 77% of the season, between 3 mg/L and 5 mg/L for 10.3% of the season, and between 1.5 mg/L and 3 mg/L for 12.1% of the season. Site W-M563.6V experienced equipment malfunction and only recorded water quality monitoring data from December 9 to December 28 and some hours on December 31 and January 13. For the recorded data, dissolved oxygen above 5 mg/L for 100 % of this duration. The average temperature for site W-M546.7R was 3.10 degrees Celsius and the average temperature for site W-M563.6V was 2.33 degrees Celsius. The average velocity for site W-M546.7R was 3.418 cm/sec and the average velocity for site W-M563.6V was 2.281 cm/sec.

For the 2021-2022 winter monitoring season, site W-M564.7R 6V indicated dissolved oxygen levels above 5 mg/L for 100% of the duration of winter monitoring for the 2021-2022 season. Site W-M563.6V showed a drop in DO below 5 mg/L from approximately 2/7/2022 to 2/28/2022. Due to grab samples not matching the continuous sonde data, it is likely that there was an equipment malfunction or interference with sensors to record such low values during this time. The average temperature for site W-M546.7R was 1.90 degrees Celsius (lower due to drop in February) and the average temperature for site W-M563.6V was 2.29 degrees Celsius. The

average velocity for site W-M546.7R was 1.149 cm/sec and the average velocity for site W-M563.6V was 2.050 cm/sec.

When looking at the years of data collected after construction was complete in 2016, dissolved oxygen (DO) levels appear to range between 10-15 mg/L for the majority of the winter seasons with greater consistency as time progressed. It is to be noted, however, that there are some drops in DO below 5 mg/L observed within some post-construction monitoring years for the winter season. Commonly with the post-construction data there are drops in DO as other parameters, most commonly temperature, change as well. These drops are likely due to ice and snow accumulation affecting organisms' ability to produce oxygen within the water column, but more data would be necessary for any confirmed conclusions. Drops in continuous data that do not match grab samples are likely experiencing interference while in the field and are not accurate. Temperatures between the two sites are typically higher at site W-M563.6V in comparison to site W-M564.7R due to closer proximity to main flow of the river. Additionally, water temperatures each monitoring season are going to vary greatly depending on seasonal differences in snow fall, ice formation, and air temperatures. Velocities for both sites average below 4 cm/sec each season and are also dependent on ice formation in terms of accumulations and melts. W-M563.6V more commonly experiences slightly higher velocities due to relative proximity to the main channel.

ATTACHMENT D
BERM SAMPLE RESULTS TABLE

Sample ID	Sample Date	Lat	Long	1:1 Soil pH	1:1 Soluble Salts mmho/cm	Organic Matter % LOI	Soil Respiration CO_2-C ppm C	Total N Water Extract ppm N
Sunfish Tree 1	8/11/2021	42.357010°	-90.430030°	8.2	0.19	2.7	24.6	6.1
Sunfish Tree 2	8/11/2021	42.357220°	-90.430010°	8.2	0.19	2.7	21.8	6.4
Sunfish Tree 3	8/11/2021	42.357590°	-90.430200°	8.1	0.17	2.7	20.6	6.1
Sunfish Tree 4	8/11/2021	42.367440°	-90.443390°	6.8	0.19	3.5	231	8.7
Sunfish Tree 5	8/11/2021	42.367550°	-90.443540°	7.5	0.20	3.7	133	10.9
Stone Control	8/11/2021	42.429310°	-90.554960°	7.7	0.17	4.3	221	14.8

Sample ID	Sample Date	Organic N Water Extract ppm N	Total Organic C Water Extract ppm C	Nitrate H3A Extract ppm	Ammonium H3A Extract ppm	Inorganic N H3A Extract ppm	Total (ICAP) P H3A Extract pm	Inorganic (FIA) P H3A Extract ppm
Sunfish Tree 1	8/11/2021	3.2	48	0.8	0.8	1.6	13	10.9
Sunfish Tree 2	8/11/2021	2.7	53	0.6	0.3	0.9	17	14.6
Sunfish Tree 3	8/11/2021	3.2	47	0.5	0.6	1.1	13	10.7
Sunfish Tree 4	8/11/2021	4.8	78	0.8	2.1	2.9	50	40.2
Sunfish Tree 5	8/11/2021	6.5	84	1.2	2.2	3.4	68	56.3
Stone Control	8/11/2021	7.9	72	3.7	2	5.7	59	46.3

Sample ID	Sample Date	Organic P H3A Extract ppm	KH3A Extract ppm	Zn H3A Extract ppm	Fe H3A Extract ppm	Mn H3A Extract ppm	CuH3A Extract ppm	S H3A Extract ppm
Sunfish Tree 1	8/11/2021	1.8	22	6.77	49	4.4	0.09	10.9
Sunfish Tree 2	8/11/2021	2.2	21	3.22	20	2.8	0.03	6.7
Sunfish Tree 3	8/11/2021	1.9	17	4.85	48	2.3	0.06	6.9
Sunfish Tree 4	8/11/2021	9.8	33	29.29	302	5.1	0.69	11.3
Sunfish Tree 5	8/11/2021	12.2	53	43.18	331	10.5	0.69	13.1
Stone Control	8/11/2021	12.3	22	1.86	349	12.3	0.42	6.8

Sample ID	Sample Date	Ca H3A Extract ppm	Mg H3A Extract ppm	Na H3A Extract ppm	AlH3A Extract ppm	Microbially Active Carbon	Organic C: Organic N	Organic N: Inorganic N
Sunfish Tree 1	8/11/2021	2704	335	19	31	51.7	15	2
Sunfish Tree 2	8/11/2021	3041	366	15	22	41.4	19.8	2.8
Sunfish Tree 3	8/11/2021	3018	328	16	24	43.7	14.7	2.9
Sunfish Tree 4	8/11/2021	993	228	19	122	294.9	16.3	1.7
Sunfish Tree 5	8/11/2021	1054	268	17	128	159.2	12.9	1.9
Stone Control	8/11/2021	1215	249	19	80	308.1	9.1	1.4

Sample ID	Sample Date	Organic N Release ppm	Organic N Reserve ppm	Organic P Release ppm	Organic P Reserve ppm	Soil Health	PLFA (ng/g)	Functional Group Diversity
Sunfish Tree 1	8/11/2021	3.2	0	1.8	<0.1	3.73	340.06	1.243
Sunfish Tree 2	8/11/2021	2.7	0	2.2	<0.1	3.5	259.53	1.257
Sunfish Tree 3	8/11/2021	3.2	0	1.9	<0.1	3.32	176.92	1.348
Sunfish Tree 4	8/11/2021	4.8	0	9.8	<0.1	18.55	81.43	1.033
Sunfish Tree 5	8/11/2021	6.5	0	12.2	<0.1	13.4	542.4	1.26
Stone Control	8/11/2021	7.9	0	12.3	<0.1	18.01	1413.02	1.458

Sample ID	Sample Date	Total Bacteria PFLA (ng/g)	Gram + Total Bacteria	Gram + Total Actinomycetes Bacteria (ng/g)	Gram - Total Bacteria (ng/g)	Gram - Total Rhizobia	Total Fungi (ng/g)	Total AM Fungi (ng/g)
Sunfish Tree 1	8/11/2021	33.77	16.12	5.12	17.66	0	39.76	38
Sunfish Tree 2	8/11/2021	38.03	14.27	6.26	23.76	0	39.44	37.14
Sunfish Tree 3	8/11/2021	26.88	16.58	7.08	10.31	0	4.84	4.84
Sunfish Tree 4	8/11/2021	14.84	8.38	5.8	6.47	0	0	0
Sunfish Tree 5	8/11/2021	119.74	36.3	11.32	83.44	0	28.17	10.12
Stone Control	8/11/2021	642.75	392.91	175.26	249.85	0	117.75	57.33

Sample ID	Sample Date	Total Saprophytes Fungi (ng/g)	Protozoa (ng/g)	PLFA Undifferentiated (ng/g)	Fungi: Bacteria Ratio	Predator: Prey Ratio	Gram +: Gram - Ratio	Sat: Ratio
Sunfish Tree 1	8/11/2021	1.77	0	266.52	1.1775	All Prey	0.9128	4.3574
Sunfish Tree 2	8/11/2021	2.3	0	182.05	1.0371	All Prey	0.6004	3.106
Sunfish Tree 3	8/11/2021	0	0	145.19	0.1802	All Prey	1.6084	10.6767
Sunfish Tree 4	8/11/2021	0	0	66.58	ALL BACT	All Prey	1.2956	11.5941
Sunfish Tree 5	8/11/2021	18.05	0	394.49	0.2353	All Prey	0.435	3.5424
Stone Control	8/11/2021	60.42	0	652.52	0.1832	All Prey	1.572	2.363

Sample ID	Sample Date	Mono:Poly Ratio	Pre 16: 1ω7c:cy17:0 Ratio	Pre 18:1ω7c:cy19:0 Ratio
Sunfish Tree 1	8/11/2021	9.4838	None	All PRE 18:1
Sunfish Tree 2	8/11/2021	All Mono	All PRE 16:1	All PRE 18:1
Sunfish Tree 3	8/11/2021	All Mono	None	All PRE 18:1
Sunfish Tree 4	8/11/2021	All Mono	All PRE 16:1	All PRE 18:1
Sunfish Tree 5	8/11/2021	14.3132	All PRE 16:1	All PRE 18:1
Stone Control	8/11/2021	All Mono	All PRE 16:1	37.3778