ANALYSIS OF

THE MISSOURI RIVER
(LAKE SHARPE)

FROM OAHE DAM TO BIG BEND DAM

OCTOBER 2019

South Dakota
Department of Environment and Natural Resources
Division of Environmental Services
Pierre, SD

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Executive Summary

Name of Waterbody: Missouri River (Lake Sharpe).

Location: Stanley, Hughes, Lyman, Hyde, and Buffalo Counties.

Boundary of Waterbody under Assessment:
The Missouri River (Lake Sharpe) from Oahe Dam to Big Bend Dam.

Current Assigned Beneficial Use
The Missouri River, from Big Bend Dam to the North Dakota border, is assigned the beneficial use classification of (1) Domestic water supply waters; (2) Coldwater permanent fish life propagation waters: (7) Immersion recreation waters; (8) Limited contact recreation waters; (9) Fish and wildlife propagation, recreation, and stock watering waters; (10) Irrigation waters; and (11) Industry and commerce waters.

Recommendation:
The South Dakota Department of Environment and Natural Resources (DENR) recommends that the aquatic life beneficial use designation (2) Coldwater permanent fish life propagation waters be removed and replaced with (4) Warmwater permanent fish life propagation waters, from Oahe Dam to Big Bend Dam.

The (1) Domestic water supply waters; (7) Immersion recreation waters; (8) Limited contact recreation waters; (9) Fish and wildlife propagation, recreation, and stock watering waters; (10) Irrigation waters; and (11) Commerce and industry waters beneficial use designations will remain unchanged.

(4) Warmwater permanent fish life propagation waters is the appropriate and existing use for Lake Sharpe. This is due to the existing condition of the reservoir and the abundance and natural reproduction of warmwater fish species. Lake Sharpe supports a robust warmwater permanent fishery, providing excellent walleye, smallmouth bass, catfish, and white bass fishing opportunities.

Additionally, the operation and design of both Oahe Dam and Big Bend Dam result in a well-mixed polymictic water column in Lake Sharpe that does not provide any thermal refuge to coldwater species in Lake Sharpe during summer months. The temperature criterion associated with the (4) Warmwater use is 80^{o} F and can be met even during the hot summer months.

DENR finds that the currently assigned (2) Coldwater permanent fish life propagation waters beneficial use designation is inappropriate. The temperature criterion for the 2) Coldwater use is 65^{o} F. However, due to the operation and design of both Oahe Dam and Big Bend Dam, coldwater habitat for coldwater species does not form and the temperature criterion of 65^{o} F cannot be met during the hot summer months on Lake Sharpe. DENR recommends the removal of the (2) Coldwater permanent fish life propagation waters beneficial use designation. Consistent with 40 CFR Part 131.10 (g),

water quality conditions caused by the operation and design of Oahe and Big Bend Dams prevent the attainment of the coldwater permanent fish life use.
40 CFR Part 131.10 (g)

- (4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use.

Introduction/General Description

The Missouri River enters South Dakota in the north central region of the state. It flows in a south to southeasterly direction until it reaches the southeast corner of the state and exits into Nebraska. Within South Dakota, the Missouri River is impounded and contains four reservoirs named Lake Oahe, Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake. In ARSD Surface Water Quality Standards 74:51:01:43, the Missouri River impoundments are classified as flowing streams and not as reservoirs. However, for the purpose of this report, Lake Oahe will refer to the segment of the Missouri River from the North Dakota border to Oahe Dam, and Lake Sharpe will refer to the segment of the Missouri River from below Oahe Dam to Big Bend Dam.

In 1974, DENR changed the beneficial use of Lake Sharpe from a warmwater permanent fish life propagation waters to a coldwater permanent fish life propagation use. This use change was recommended by the South Dakota Department of Game, Fish, and Parks (GF&P) because coldwater species were being stocked in Lake Sharpe. However, there is no documentation of any studies conducted to determine if coldwater habitat existed in Lake Sharpe to support the coldwater fish, or if the water temperature criterion could be met. At that time, DENR was not monitoring water quality on Lake Sharpe. The beneficial use change appears to have happened based on the expectation to create a coldwater fishery and not on any facts or data that the waterbody could conform to the newly designated coldwater fishery use.

The United States Army Corps of Engineers manages the Oahe Dam and Big Bend Dam and conducts water quality monitoring on the Missouri River, including Lake Sharpe and Lake Oahe. Corps monitoring includes water chemistry data, discharge data, profile temperature and dissolved oxygen data, and much more. GF&P manages the fisheries within the Missouri River and annually conducts fish surveys, creel surveys, stocks fish, and provides fisheries management goals and objectives. The South Dakota Department of Environment and Natural Resources (DENR) collects water chemistry data at the powerhouse of each dam on the Missouri River. Additionally, in 2005 and 2006, DENR conducted assessments of the reservoirs and collected water chemistry, physical water quality profile measurements, zooplankton, phytoplankton, and sediment data. Information provided by the Corps, GF&P and DENR was used as the basis to recommend an aquatic life beneficial use designation change. Attachments 1 and 2 are site maps. Attachment 3 is a photograph of Big Bend Dam. Attachment 4 is a photograph of an angler on the Missouri River near West Bend (above Big Bend Dam).

Consistent with 40 CFR Part 131.10 (g), water quality conditions caused by the operation and design of Oahe Dam and Big Bend Dam prevent the attainment of the coldwater permanent fish life use. The aquatic life beneficial use designation change recommendation is based on the physical characteristics of the reservoirs, Corps management objectives, and operation and design of Oahe Dam and Big Bend Dam. The relative shallowness, short retention time, and bottom withdrawal at Big Bend Dam inhibit the formation of a strong and long-lasting thermocline in Lake Sharpe and prevent attainment of coldwater temperature criterion for this segment of the Missouri River. During the months of July and August, Lake Sharpe is thoroughly mixed and does not provide any thermal refuge to coldwater species along the length of the reservoir other than immediately below Oahe Dam.

Additionally, the beneficial use of (4) Warmwater permanent fish life propagation waters includes stocked coldwater fish species. ARSD 74:51:01:01 (50) "Warmwater permanent fish life propagation," a beneficial use assigned to surface waters of the state which support aquatic life and are suitable for the permanent propagation or maintenance, or both, of warmwater fish. Stocked coldwater fish may also be present.

Corps Assessment Result Summary

The United States Army Corps of Engineers built, maintains, and operates dams along the Missouri River, including Oahe Dam and Big Bend Dam. The Corps operates the Missouri River reservoirs under "The Missouri River Mainstem Reservoir System Master Water Control Manual" and is available at: https://www.nwd.usace.army.mil/Media/News-Releases/Article/1697921/2018-edition-of-missouri-river-master-manual-now-available/. This plan is also available in Attachment 11.

The Corps collects water quality and physical data at specific locations within Lake Oahe and Lake Sharpe. The Corps' 2016 Report "Water Quality Conditions in the Missouri River and Mainstem System," summarizes monitoring results and was used as a determining factor in the fishery beneficial use change recommendation. The information provided in the section below is from the 2016 report. A copy of this report is available at:

https://www.nwo.usace.army.mil/Portals/23/2016_MainstemWQCondReport.pdf?ver=2017-06-28-123806-027. This report is also available in Attachment 12.

Lake Oahe

Lake Oahe was created in 1958 under the Missouri River Basin Project/Pick-Sloan Plan Missouri Basin Program of the 1944 Flood Control Act. When full, Lake Oahe measures 231 miles and covers 374,000 acres.

The reservoir and dam are congressionally authorized for the purposes of flood control, recreation, fish and wildlife, hydroelectric power production, water supply, water quality, navigation, and irrigation. Lake Oahe has distinct pool elevation zones that are regulated by the Corps including: exclusive flood control (elevation 1620 – 1617), annual

flood control and multiple use (1617 – 1607.5), carryover multiple use zone (1607.5 – 1540), and permanent pool (1540 – 1415). Water releases are controlled by the Corps and are based on power generation needs, downstream navigation, pool elevation, and other factors.

The intakes to Oahe Dam are located at 1524 foot mean sea level (ft-msl) which is 114 feet above the bottom of the lake. Water is drawn from Lake Oahe through the intakes, flows through the powerhouse, and is discharged to the Missouri River. Below Oahe Dam, the Missouri River is managed by the Corps as a free-flowing river for approximately five miles (river mile 1067) then becomes the headwaters of Lake Sharpe.

Lake Sharpe

Lake Sharpe was formed in 1963 when the Corps dammed the Missouri River with Big Bend Dam. Lake Sharpe extends from Big Bend Dam to river mile 1067, approximately 5 miles below Oahe Dam. When the reservoir is full, Lake Sharpe extends over 80 miles in length and covers approximately 61,000 acres. The reservoir and dam are congressionally authorized for the purposes of flood control, recreation, fish and wildlife, hydroelectric power production, water supply, water quality, navigation, and irrigation. Big Bend Dam is primarily used for power generation and is not operated to provide seasonal flood protection as are upstream Missouri River reservoirs. The Annual Flood Control and Multiple Use Zone in Lake Sharpe is used to meet daily and weekly power operation demands. There is minimal fluctuation in water levels on Lake Sharpe, and the reservoir acts as a flow-through system. The Corps normally maintains Lake Sharpe pool elevation between 1419 and 1421.5 feet-msl. Water retention time in Lake Sharpe is short and varies from 31 to 35 days based on pool elevation. The water intakes on Big Bend Dam are located near the bottom of Lake Shape. Water is drawn from the bottom of the lake, flows through the powerhouse, and is discharged to Lake Francis Case. Due to the flow-through operation and bottom withdrawal design of Big Bend Dam, the water column in Lake Sharpe remains well-mixed and does not stratify.

Despite cool water releases from Oahe Dam (dependent on time of year, pool elevation, and flow rate), during the months of July and August, solar radiation quickly heats the water in Lake Sharpe. The coldwater temperature criterion of 65^{o} F is exceeded, therefore providing no coldwater habitat. Attachment 5 provides an illustration of profile and longitudinal water temperature in Lake Sharpe collected by the Corps. Cool water is released from Oahe Dam, the water is quickly heated by solar radiation, and the profile data shows no thermal stratification anywhere in Lake Sharpe.

Even during the hot summer months of July and August, the temperature criterion of 80^{o} F for the proposed 4) Warmwater permanent beneficial use is seldom exceeded, and warmwater species flourish.

Time of Year

Lake Sharpe displays seasonal cooling and warming; however, a permanent thermocline does not develop during summer months. On occasion, a temperature gradient will form in the lower lacustrine portion of the reservoir, but the temperature

gradient is minimal and short lived. When a thermocline does develop, the water temperature is not cool enough to support coldwater fish.

The upper half of the reservoir displays riverine characteristics; it is shallow, well mixed, and readily influenced by ambient air temperatures. The water current is swift and directly related to the volume of water discharged from Oahe Dam. The lower half of the reservoir displays lacustrine characteristics. Near Big Bend Dam, Lake Sharpe is deep, measuring approximately 75 feet. The reservoir is polymictic, frequently mixing throughout the summer months.

Station BBDLK0987A is a near-dam site located on Lake Sharpe that the Corps has continuously monitored since 1980. In the Corps' 2016 Report, the Corps examined water temperature data during the summer months of May through September from 2012 through 2016. Attachment 6 is a summary of Corps data. The results indicate that the (2) Coldwater permanent fish life propagation waters temperature criteria of 65^{o} F was exceeded 71% of the time.

Data downloaded from STORET for station BBDLK0987 indicated an exceedance rate of 64% from 1999 through 2016 for the current temperature criterion. Additionally, when data collected only during the months of July and August was assessed, 97% of samples did not meet the coldwater temperature criterion. However, when compared to the temperature criterion for the proposed warmwater permanent fish life use, less than 1% of measurements exceed the criterion for the period of record and 1% for samples collected during July and August.

Station BBDLK1020DW is a monitoring site located near the Iron Nation Area. Water temperature data collected during the months of May through September from 2012 through 2016 indicate water temperature exceeded the criterion in 66% of the samples. Data downloaded from STORET for this station indicated an exceedance rate of 65% from 2008 through 2016. Additionally, when data collected only during the months of July and August was assessed, 94% of samples did not meet the coldwater temperature criterion. However, when compared to the temperature criterion for the proposed warmwater permanent fish life use, less than 1% of measurements exceed the criterion for the period of record and 2% exceeded the criterion for those samples collected during July and August. This data is available in Attachment 8.

The Corp provided DENR with provisional legacy data for outflow temperatures from Big Bend Dam. The bulk of data from Station BBDRL1 was collected from January 1968 to November 1976. This data represents water quality conditions at Big Bend Dam before and during the time of the 1974 beneficial use change to a coldwater fishery. All data considered, 288 out of 1,193 (24.1%) temperature measurements exceeded the coldwater criterion. When reviewing data collected during the months of July and August, 191 out of 192 (99.5%) temperature measurements exceeded the coldwater criterion. The outflow data shows that water temperature was exceeding the coldwater criterion for most of the time during July and August. Because Big Bend dam has a bottom withdrawal, this temperature data suggests thermal stratification was not occurring. Therefore, coldwater habitat was not available for coldwater species when the

beneficial use change was made in Lake Sharpe. This data set suggests that the beneficial use change in 1974 to a coldwater fishery was inappropriate and did not represent attainable or existing waterbody conditions. This data is available in Attachment 16.

Lake Sharpe Pool Elevation and Big Bend Discharge Rate
Pool elevation and discharge rate from Big Bend Dam is highly dependent upon the discharge rate from Oahe Dam. Weekly flows from Oahe Dam are released at Big Bend Dam and result in minimal pool fluctuation in Lake Sharpe. The Corps operates the dam to meet peak power demands, therefore hourly flows may fluctuate from 0 to 110,000 cubic feet per second (cfs).

Attachment 5 is a contour plot of Lake Sharpe measured on July 27, 2016. This contour plot depicts cool water releases from Oahe Dam near the coldwater criterion. The water quickly becomes well-mixed in the shallow riverine system and heats resulting in longitudinal warming during the summer months. This plot illustrates that despite cool water releases from Oahe Dam, the reservoir remains well-mixed and a thermal gradient is not established. The contour plot also illustrates that during summer months, Lake Sharpe does not provide any coldwater refuge to coldwater species for the entire reach other than immediately below Oahe Dam.

In the 2016 report, the Corps suggests, “Consideration should be given to reclassify Lake Sharpe from a coldwater fishery to a warmwater fishery based on a use attainability assessment of “natural conditions.” Lake Sharpe does not regularly form a hypolimnion, and summer water temperatures discharged from Oahe Dam, especially during lower pool levels, don’t meet temperature criteria for a coldwater fishery use.”

DENR Assessment Result Summary

Station 460672 is a monitoring station at Big Bend Dam. DENR collects quarterly water samples from within the powerhouse. Water collected at this site represents water at the base of Big Bend Dam. DENR began collecting water samples at this location in September 1975 and sampled through 1981. Sampling resumed in 1999 and is currently being sampled under DENR’s Water Quality Monitoring Network.

Water temperature data collected in June, July, and August 1976, during the first summer of sampling after the 1974 beneficial use change to a coldwater fishery, all exceeded the temperature criterion. This indicates that the 1974 beneficial use change was inappropriate and was not based on existing or attainable uses of the reservoir.

For the period of record, which includes year-round quarterly monitoring, 21% of the water temperature measurements exceed the temperature criterion. One hundred percent of the quarterly samples collected during the months of July or August exceed the current coldwater temperature criterion. When compared to the warmwater temperature criterion for the proposed beneficial use, less than 1% of temperature measurements exceeded the standard. This data is available in Attachment 9.

In 2005 and 2006, DENR conducted a probability-based assessment of Lake Sharpe as part of the Missouri River Project that included collecting water chemistry data, physical data, zooplankton and phytoplankton, and sediment. In reviewing data from this project, DENR staff determined that water temperature in Lake Sharpe did not meet existing water quality standards during summer months.

DENR collected 627 water temperature measurements at varying depths in Lake Sharpe as part of the Missouri River Project. Forty-nine percent of those measurements did not meet the current coldwater temperature criterion. During the months of July and August 2005 and 2006, approximately forty locations along the entire length of the reservoir were analyzed. 100% of those measurements collected during the months of July and August did not meet the current coldwater temperature criterion. However, when compared to the temperature criterion for the proposed warmwater beneficial use, less than 1% of those measurements would not meet the criterion for the proposed use. This data is available in Attachment 10.

Based on profile data collected in deep water regions of the reservoir, there was no thermal stratification and no cool water habitat for coldwater species. The greatest temperature gradient occurred at Station 307-2 with a bottom temperature of 70° F, a surface temperature of over 81° F, and 25% – 75% of the water column temperature falling within a range of 75 to 77° F. Stations 314-1, 314-2, and 314-3 were similar with a bottom temperature reading near 75° F, a surface temperature at 78° F, and 25% – 75% of the water column temperature falling within a range of 75 to 78° F. All of those measurements exceed the current temperature criterion for the coldwater beneficial use. Attachment 6 is a summer temperature profile graph of deep-water areas in Lake Sharpe.

The physical conditions of the reservoir inhibit Lake Sharpe from providing cool water refuge and habitat for coldwater species during summer months. Lake Sharpe does not typically thermally stratify and exhibits minimal temperature gradients from the surface to the bottom. The 2) Coldwater permanent fish life beneficial use cannot be obtained and is not an appropriate use for Lake Sharpe. The 4) Warmwater permanent fish life beneficial use is an attainable use and provides protection to species that are expected to occur in Lake Sharpe.

Despite the age of the Missouri River Project data, the results are consistent with longer-term DENR and USACE data and conclusions.

Attachment 7 is a chart that contains temperature monitoring summaries for data collected on Lake Sharpe.

GF&P Management Strategy and Fishery Survey Result Summary

The South Dakota Department of Game, Fish, and Parks manages the fishery in Lake Sharpe under the directive of the Fisheries and Aquatic Resources Adaptive Management System 2019-2023, Missouri River Fisheries Management Area. Lake Sharpe is managed with the following reservoir-wide goal: “The state of South Dakota

manages Lake Sharpe's aquatic resources for the continued use and enjoyment of South Dakota Residents and its visitors." This plan is available at https://gfp.sd.gov/userdocs/docs/MRFMA_2019-2023_Plan_Commission_Adopted.pdf and in Attachment 14.

GF&P conducts annual fishery surveys on Lake Sharpe. These surveys are designed to provide biological information regarding species composition, relative abundance, age, growth, condition, recruitment, and survival and mortality rates. Highly abundant common species in Lake Sharpe include: channel catfish, walleye, yellow perch, smallmouth bass, common carp, freshwater drum, gizzard shad, spottail shiner, shorthead redhorse, and flathead catfish. These warmwater fish species thrive and reproduce naturally in Lake Sharpe. Currently, walleye are the most commonly harvested fish species, followed by smallmouth bass, white bass, and channel catfish.

While rainbow trout and other coldwater species may be present in Lake Sharpe, their abundance is extremely low and is evident in annual fish surveys. Gill net surveys conducted from 2015 through 2019 on Lake Sharpe yielded twenty six species and 4,785 fish. Three species totaling eleven fish were coldwater species, including one rainbow smelt, one chinook salmon, and nine lake herring. These fish likely originated in Lake Oahe and were entrained through the Oahe powerhouse into Lake Sharpe. This data is available in Attachment 15.

Rainbow trout do not reproduce naturally in Lake Sharpe and their existence is due to past stocking activities in the area below Oahe Dam. Over the last five decades, GF&P has stocked hundreds of thousands of coldwater fish in Lake Sharpe, yet reservoir conditions prohibit the formation of a coldwater fishery and the fish have failed to thrive.

GF&P routinely stocked trout in Lake Sharpe beginning in 1965 up until 2019. About 3,000 to 10,000 catchable-size rainbow trout were released each spring in Oahe Marina and Down's Marina in the 2000s through 2019. Below Oahe Dam was considered a "put and take" fishery for trout because the fish were exclusively stocked for anglers to catch. Long-term survival and/or reproduction were not expected. Due to hatchery and other management changes, GF&P has discontinued stocking trout in Lake Sharpe for the foreseeable future.

To date, there is no documentation of natural reproduction of salmon or trout in Lake Sharpe (R. Hanten, personal communication). Overall, the abundance of carryover and/or stocked coldwater species is insignificant in Lake Sharpe. Because GF&P no longer stocks coldwater species in Lake Sharpe, and natural reproduction does not occur, the continued presence of any coldwater species fish will diminish over time as fish are harvested or die.

GF&P lake survey results, creel surveys, and fish stocking information are available at: https://apps.sd.gov/GF56FisheriesReports/ and are also available in Attachment 13.

Conclusion and Recommendation

DENR recommends that the aquatic life beneficial use designation (2) Coldwater permanent fish life propagation waters be removed and replaced with (4) Warmwater permanent fish life propagation waters, from Oahe Dam to Big Bend Dam.

DENR considers the (4) Warmwater permanent fish life propagation waters to be the appropriate and the use actually attained in Lake Sharpe before, on, and after November 28, 1975. This is due to the abundance and natural reproduction of warmwater fish species and lack of abundance and natural reproduction of coldwater species. Lake Sharpe supports a warmwater permanent fishery, providing excellent walleye, smallmouth bass, catfish, and white bass fishing opportunities. Additionally, the 4) Warmwater permanent fish life use includes the presence of stocked coldwater fish and provides for their protection.

DENR recommends the removal of the (2) Coldwater permanent fish life propagation waters beneficial use designation based on 40 CFR Part 131.10 (g):

- (4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use.

The Corps operates and manages Oahe Dam and Big Bend Dam in accordance with the Master Manual. The construction and operation of these dams was authorized by Congress under the Flood Control Act of 1944. It is not permissible or feasible for the Corp to operate either dam in such a way that would allow attainment of the coldwater beneficial use. The current coldwater classification is incorrect and needs to be updated to reflect existing and attainable uses.

Lake Sharpe does not provide coldwater habitat for coldwater fish species due to the physical conditions of Lake Sharpe and Corps management objectives and operation of Big Bend Dam and Oahe Dam. The 2) Coldwater use has never been an existing or attainable use on Lake Sharpe. The beneficial use was changed from a warmwater fishery to a coldwater fishery in 1974 on the basis that coldwater fish were being stocked and the goal to create a coldwater fishery. This use change was made without data or documentation to support the beneficial use change. Consequently, Big Bend outflow data provided by the Corp before and during the time of the use change indicate that the coldwater temperature criterion was exceeded most of time during the months of July and August. Based on the flow-through design and bottom withdrawal of Big Bend Dam, thermal stratification does not occur now, and clearly did not occur in 1974 when the beneficial use change was made.

The (1) Domestic water supply waters; (7) Immersion recreation waters; (8) Limited contact recreation waters; (9) Fish and wildlife propagation, recreation, and stock watering waters; (10) Irrigation waters; and (11) Commerce and industry waters beneficial use designations will remain unchanged.

References

South Dakota Department of Environment and Natural Resources. 1999. Recommended Procedures for Reviewing Beneficial Use Designations, With Special Emphasis on Fishery and Recreational Uses.

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United States Army Corps of Engineers. 2016 Report, Water Quality Conditions in the Missouri River Mainstem System. May 2017.

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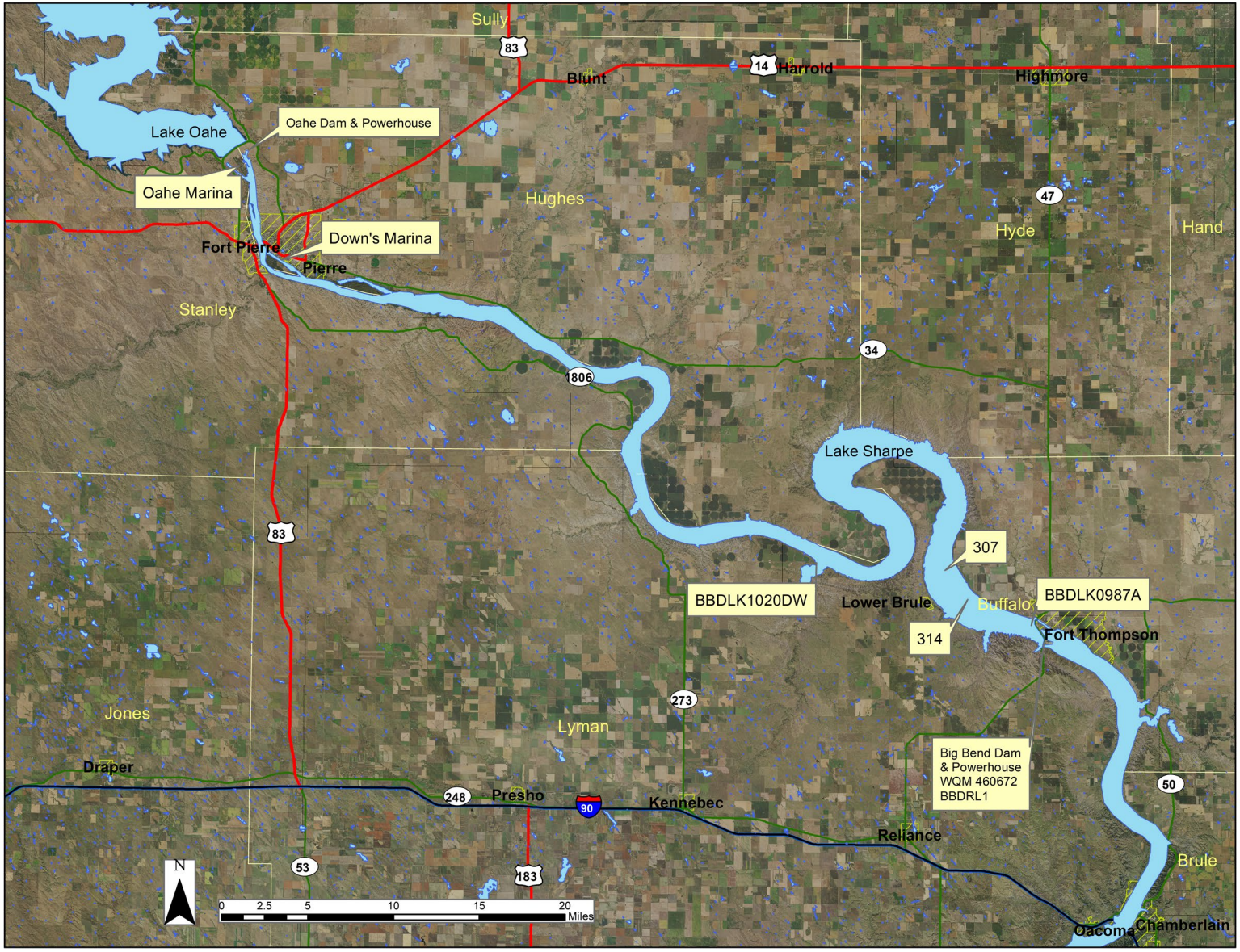
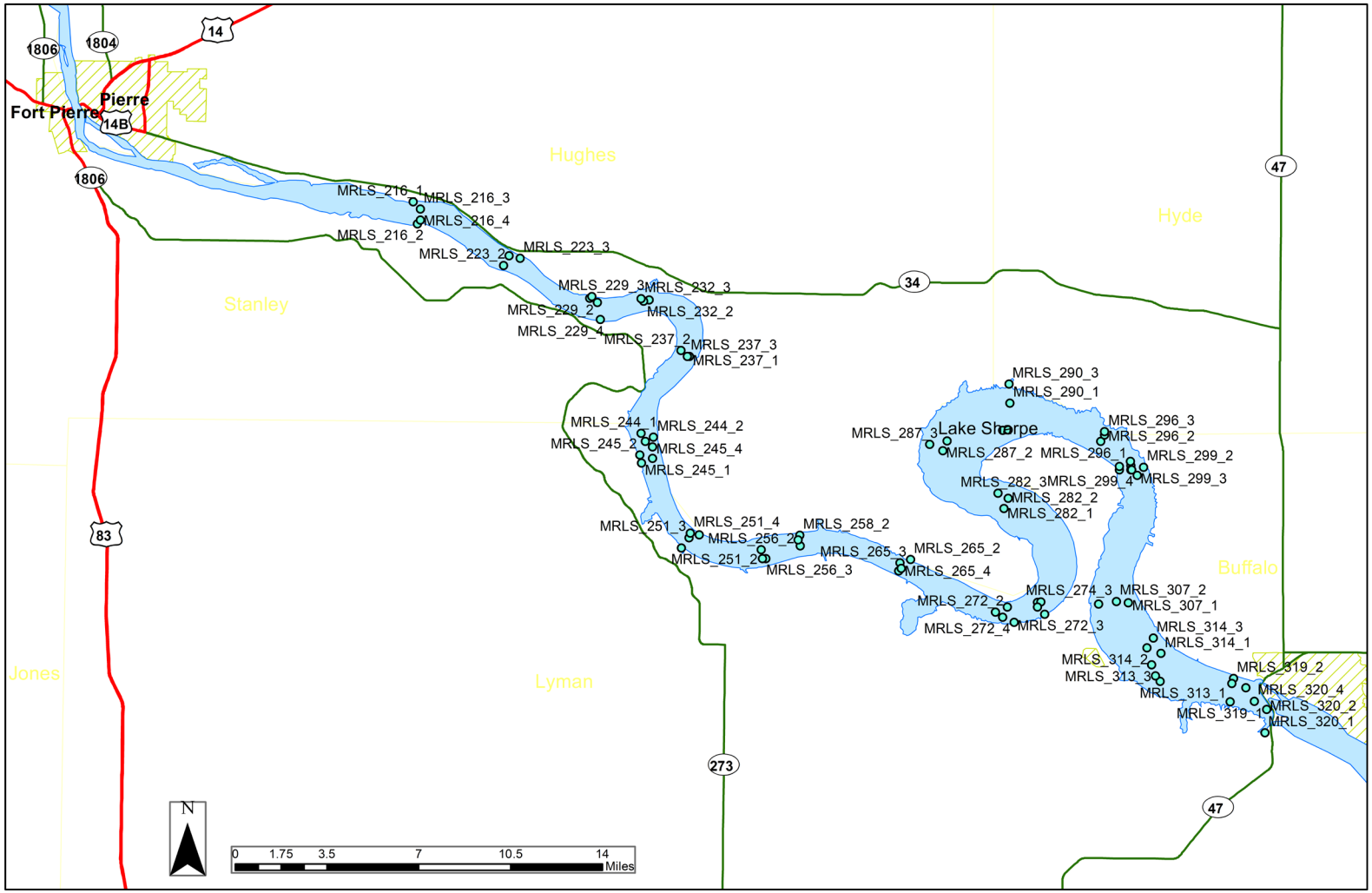
United States Environmental Protection Agency. 1983. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020. Cincinnati, Ohio.

ATTACHMENT 1



Site Map

ATTACHMENT 2



DENR Missouri River Project Site Locations

ATTACHMENT 3

Big Bend Dam near Fort Thompson.

ATTACHMENT 4

Angler with a largemouth bass on the Missouri River (Lake Sharpe) near West Bend.

ATTACHMENT 5

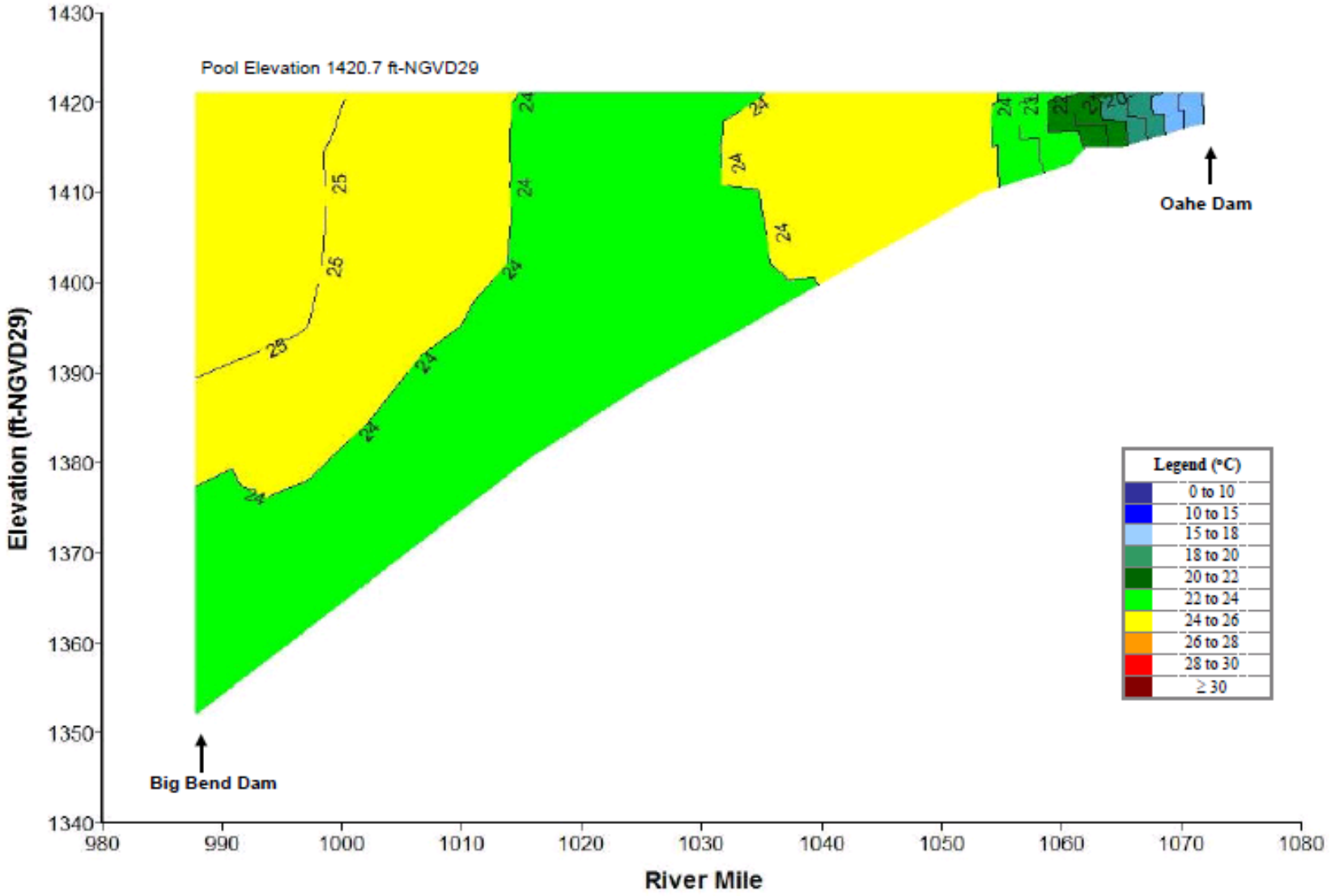
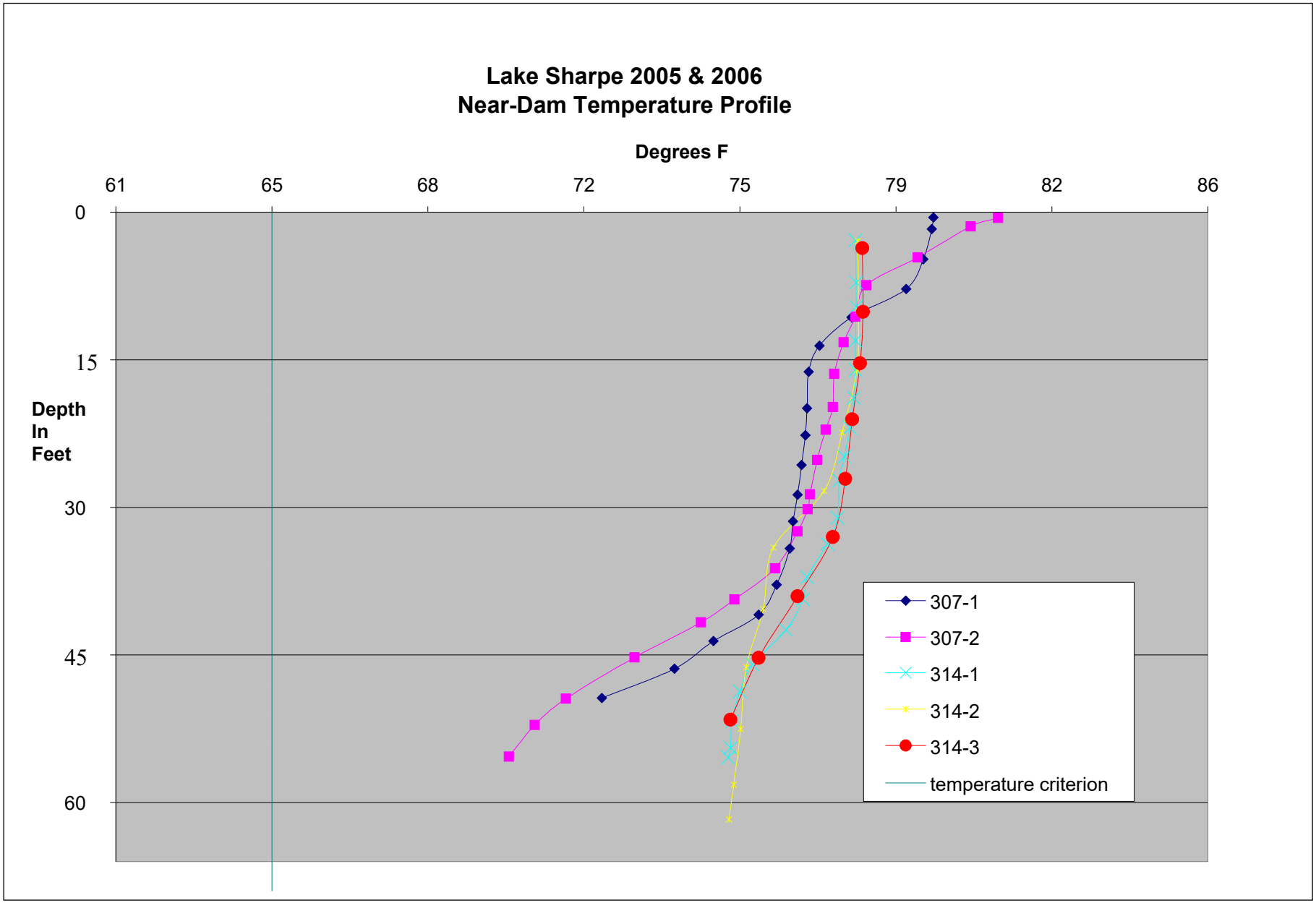


Plate 8-7. Longitudinal water temperature (°C) contour plot of Lake Sharpe based on depth-profile water temperatures measured at sites BBDLK0987A, BBDLK1020DW, BBDLK1055DW and OAHPP1 on July 27, 2016.

Courtesy of Corps' 2016 Report.

ATTACHMENT 6



ATTACHMENT 7

Lake Sharpe Temperature Monitoring

Agency	Monitoring Description	Station	Timeframe	#Observations	%Exceedance Current Coldwater Criterion	%Exceedance Proposed Warmwater Criterion
USACE	Continuous	BBDLK0987A	May-Sept 2012-2016	523	71	<1
USACE	Continuous	BBDLK0987A	May-Sept 1999-2016	1821	64	<1
USACE	Continuous	BBDLK0987A	July-Aug 1999-2016	735	97	1
USACE	Continuous	BBDLK1020DW	May-Sept 2012-2016	290	66	<1
USACE	Continuous	BBDLK1020DW	May-Sept 2008-2016	447	65	<1
USACE	Continuous	BBDLK1020DW	July-Aug 2008-2016	193	94	2
USACE	Monthly (legacy)	BBDLR1	Jan 1968 - Nov 1976	1193	24.1	0
USACE	Monthly (legacy)	BBDLR1	July-Aug 1968-1975	192	99.5	0
DENR	Monthly grab (includes winter)	460672	Sept 1975-May 2019	121	21	<1
DENR	Probabilistic	307 & 314	July/August 2005-2006	87	100	5
DENR	Probabilistic	All Lake Sharpe Missouri River Project sites	May/August 2005-2006	627	49	<1

ATTACHMENT 8

USACE DATA

ATTACHMENT 9

DENR WQM DATA

ATTACHMENT 10

DENR Missouri River Project Monitoring Data

ATTACHMENT 11

USACE MASTER WATER CONTROL MANUAL

ATTACHMENT 12

USACE 2016 MISSOURI RIVER REPORT

ATTACHMENT 13

GFP FISH STOCKING, CREEL SURVEY, FISHERY SURVEY

ATTACHMENT 14

FISHERIES AND AQUATIC RESOURCES ADAPTIVE MANAGEMENT SYSTEM 2019-2023, MISSOURI RIVER FISHERIES MANAGEMENT AREA

ATTACHMENT 15

GF&P GILL NET SURVEY SUMMARY DATA 2015-2019

2015-2019 GFP Gill Net Survey Lake Sharpe

Species Name	Number Collected
Bigmouth Buffalo	12
Black Bullhead	3
Black Crappie	5
Channel Catfish	1205
Chinook Salmon	1
Common Carp	257
Flathead Catfish	11
Freshwater Drum	176
Gizzard Shad	245
Goldeye	113
Lake Herring	9
Northern Pike	7
Rainbow Smelt	1
River Carpsucker	43
Sauger	100
Shorthead Redhorse	67
Shortnose Gar	7
Shovelnose Sturgeon	95
Smallmouth Bass	254
Smallmouth Buffalo	12
Spottail Shiner	47
Walleye	1631
White Bass	92
White Crappie	18
White Sucker	4
Yellow Perch	370

ATTACHMENT 16

STATION BBDRL1 DATA