Ameren MISSOURI

December 20, 2019

Mr. Michael Abbott
Chief, Operating Permits Section
Missouri Department of Natural Resources
Water Pollution Control Branch
Permit Section
PO Box 176
Jefferson City, Mo 65102-1076

Dear Mr. Abbott,

RE: Callaway Energy Center NPDES Permit Reapplication #MO-0098001

In accordance with State and Federal regulations, enclosed is the renewal application for Union Electric Company, d/b/a Ameren Missouri Callaway Energy Center. Please note that we are awaiting the final lab results for Outfall 001, and we expect to send those results to your office by Feb 1, 2020.

This application includes a set of Attachments. The attachments provide additional details regarding information required in the application forms and contain specific requests regarding permit conditions. We appreciate your consideration of these requests.

Please contact me should you have any questions or need additional information.

Sincerely,

Craig Giesmann
Senior Manager Environmental Services
Ameren Missouri

Enclosure

CC: C. Giesmann
S. Whitworth
J. Small
T. Neterer
M. Kohlbusch

Callaway NPDES Permit Reapplication Contents

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
FORM A – APPLICATION FOR NONDOMESTIC PERMIT UNDER MISSOURI CLEAN WATER LAW

FOR AGENCY USE ONLY	
CHECK NUMBER	
DATE RECEIVED	FEE SUBMITTED
JET PAY CONFIRMATION NUMBER	

PLEASE READ ALL THE ACCOMPANYING INSTRUCTIONS BEFORE COMPLETING THIS FORM.
SUBMITTAL OF AN INCOMPLETE APPLICATION MAY RESULT IN THE APPLICATION BEING RETURNED.

IF YOUR FACILITY IS ELIGIBLE FOR A NO EXPOSURE EXEMPTION:
Fill out the No Exposure Certification Form (Mo 780-2828): https://dnr.mo.gov/forms/780-2828-f.pdf

1. REASON FOR APPLICATION:

☑ a. This facility is now in operation under Missouri State Operating Permit (permit) MO – 0098001, is submitting an application for renewal, and there is no proposed increase in design wastewater flow. Annual fees will be paid when invoiced and there is no additional permit fee required for renewal.

☐ b. This facility is now in operation under permit MO – __________, is submitting an application for renewal, and there is a proposed increase in design wastewater flow. Antidegradation Review may be required. Annual fees will be paid when invoiced and there is no additional permit fee required for renewal.

☐ c. This is a facility submitting an application for a new permit (for a new facility). Antidegradation Review may be required. New permit fee is required.

☐ d. This facility is now in operation under Missouri State Operating Permit (permit) MO – __________ and is requesting a modification to the permit. Antidegradation Review may be required. Modification fee is required.

2. FACILITY

NAME		TELEPHONE NUMBER WITH AREA CODE	
Ameren Missouri Callaway Energy Center		314-554-2955	
ADDRESS (PHYSICAL)	CITY	STATE	ZIP CODE
8315 County Rd 459	Steedman	MO	65251

3. OWNER

NAME		TELEPHONE NUMBER WITH AREA CODE	
Union Electric Company d/b/a Ameren Missouri		314-554-2955	
EMAIL ADDRESS			
cgiesmann@ameren.com			
ADDRESS (MAILING)	CITY	STATE	ZIP CODE
1901 Chouteau Ave MC 602	St. Louis	MO	63166-6149

4. CONTINUING AUTHORITY

NAME		TELEPHONE NUMBER WITH AREA CODE	
SAME AS OWNER			
EMAIL ADDRESS			
ADDRESS (MAILING)	CITY	STATE	ZIP CODE

5. OPERATOR CERTIFICATION

NAME	CERTIFICATE NUMBER	TELEPHONE NUMBER WITH AREA CODE	
SAME AS OWNER			
ADDRESS (MAILING)	CITY	STATE	ZIP CODE

6. FACILITY CONTACT

NAME	TITLE	TELEPHONE NUMBER WITH AREA CODE
Timothy D. Neterer	Chemistry Manager	314-210-3835
E-MAIL ADDRESS		
tneterer@ameren.com		

7. DOWNSTREAM LANDOWNER(S) Attach additional sheets as necessary.

NAME			
Michael J & Joby L Brower			
ADDRESS	CITY	STATE	ZIP CODE
10200 State Route 94	Portland	Mo	65067

8. ADDITIONAL FACILITY INFORMATION

8.1 Legal Description of Outfalls. (Attach additional sheets if necessary.) **(SEE ATTACHED SHEET)**

For Universal Transverse Mercator (UTM), use Zone 15 North referenced to North American Datum 1983 (NAD83)

001 ____¼ ____¼ Sec ____ T ____ R ____ ____ County
UTM Coordinates Easting (X): __________ Northing (Y): __________

002 ____¼ ____¼ Sec ____ T ____ R ____ ____ County
UTM Coordinates Easting (X): __________ Northing (Y): __________

003 ____¼ ____¼ Sec ____ T ____ R ____ ____ County
UTM Coordinates Easting (X): __________ Northing (Y): __________

004 ____¼ ____¼ Sec ____ T ____ R ____ ____ County
UTM Coordinates Easting (X): __________ Northing (Y): __________

8.2 Primary Standard Industrial Classification (SIC) and Facility North American Industrial Classification System (NAICS) Codes.

Primary SIC 4911 and NAICS 221113 SIC ____ and NAICS ____
SIC ____ and NAICS ____ SIC ____ and NAICS ____

9. ADDITIONAL FORMS AND MAPS NECESSARY TO COMPLETE THIS APPLICATION

A. Is this permit for a manufacturing, commercial, mining, solid/hazardous waste, or silviculture facility? YES ☑ NO ☐
If yes, complete Form C.

B. Is the facility considered a "Primary Industry" under EPA guidelines (40 CFR Part 122, Appendix A): YES ☑ NO ☐
If yes, complete Forms C and D.

C. Is wastewater land applied? YES ☐ NO ☑
If yes, complete Form I.

D. Are sludge, biosolids, ash, or residuals generated, treated, stored, or land applied? YES ☐ NO ☑
If yes, complete Form R.

E. Have you received or applied for any permit or construction approval under the CWA or any other environmental regulatory authority? YES ☐ NO ☑
If yes, please include a list of all permits or approvals for this facility.

F. Do you use cooling water in your operations at this facility? YES ☑ NO ☐
If yes, please indicate the source of the water: Missouri River

G. Attach a map showing all outfalls and the receiving stream at 1" = 2,000' scale.

10. ELECTRONIC DISCHARGE MONITORING REPORT (eDMR) SUBMISSION SYSTEM

Per 40 CFR Part 127 National Pollutant Discharge Elimination System (NPDES) Electronic Reporting Rule, reporting of effluent limits and monitoring shall be submitted by the permittee via an electronic system to ensure timely, complete, accurate, and nationally consistent set of data. **One of the following must be checked in order for this application to be considered complete.** Please visit http://dnr.mo.gov/env/wpp/edmr.htm to access the Facility Participation Package.

☐ - You have completed and submitted with this permit application the required documentation to participate in the eDMR system.

☑ - You have previously submitted the required documentation to participate in the eDMR system and/or you are currently using the eDMR system.

☐ - You have submitted a written request for a waiver from electronic reporting. See instructions for further information regarding waivers.

11. FEES

Permit fees may be paid by attaching a check, or online by credit card or eCheck through the JetPay system. Use the URL provided to access JetPay and make an online payment: https://magic.collectorsolutions.com/magic-ui/payments/mo-natural-resources/

12. CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME AND OFFICIAL TITLE (TYPE OR PRINT)	TELEPHONE NUMBER WITH AREA CODE
Fadi Diya, Senior Vice Pres. & Chief Nuclear Operator	573-823-6531
SIGNATURE: Fadi Diya by Meghan Kohlhauser	DATE SIGNED: 12-20-19

MO 780-1479 (02-19)

8.1 Legal Description of Outfalls

001	NE 1/4	NE 1/4	Sec 14	T 46N	R 8W	Callaway County
002	NW 1/4	NW 1/4	Sec 13	T 46N	R 8W	Callaway County
003	SW 1/4	SW 1/4	Sec 13	T 46N	R 8W	Callaway County
007	SW 1/4	SW 1/4	Sec 13	T 46N	R 8W	Callaway County
009	NW 1/4	NW 1/4	Sec 5	T 46N	R 8W	Callaway County
010	SW 1/4	SW 1/4	Sec 12	T 46N	R 8W	Callaway County
011	NW 1/4	SE 1/4	Sec 12	T 46N	R 8W	Callaway County
012	NE 1/4	NE 1/4	Sec 11	T 46N	R 8W	Callaway County
014	NE 1/4	NE 1/4	Sec 14	T 46N	R 8W	Callaway County
015	SE 1/4	SE 1/4	Sec 11	T 46N	R 8W	Callaway County
016	NW 1/4	NW 1/4	Sec 13	T 46N	R 8W	Callaway County
017	SE 1/4	NE 1/4	Sec 14	T 46N	R 8W	Callaway County

Note: The location of Outfalls 002 and 016 is described at the connection to the plant discharge line. The location of Outfall 001 is described from the Discharge Monitor Tanks.

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM, WATER POLLUTION CONTROL BRANCH

FORM C – APPLICATION FOR DISCHARGE PERMIT – MANUFACTURING, COMMERCIAL, MINING, SILVICULTURE OPERATIONS, AND STORMWATER

GENERAL INFORMATION (PLEASE SEE INSTRUCTIONS)

1.0 NAME OF FACILITY

Ameren Missouri Callaway Energy Center

1.1 THIS FACILITY IS OPERATING UNDER MISSOURI STATE OPERATING PERMIT (MSOP) NUMBER:

MO-0098001

1.2 IS THIS A NEW FACILITY? PROVIDE CONSTRUCTION PERMIT (CP) NUMBER IF APPLICABLE

1.3 Describe the nature of the business, in detail. Identify the goods and services provided by the business. Include descriptions of all raw, intermediate, final products, byproducts, or waste products used in the production or manufacturing process, stored outdoors, loaded or transferred and any other pertinent information for potential sources of wastewater or stormwater discharges.

Steam Electric Power Plant (Nuclear)

FLOWS, TYPE, AND FREQUENCY

2.0 Attach a line drawing showing the water flow through the facility. Indicate sources of intake water, operations contributing wastewater to the effluent, and treatment units labeled to correspond to the more detailed descriptions in item B. Construct a water balance on the line drawing by showing average and maximum flows between intakes, operations, treatment units, evaporation, public sewers, and outfalls. If a water balance cannot by determined (e.g., for certain mining activities), provide a pictorial description of the nature and amount of any sources of water and any collection or treatment measures.

2.1 For each outfall (1) below, provide: (2) a description of all operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, stormwater runoff, and any other process or non-process wastewater, (3) the average flow and maximum flow (put max in parentheses) contributed by each operation and the sum of those operations, (4) the treatment received by the wastewater, and (5) the treatment type code. Continue on additional sheets if necessary.

1. OUTFALL NO.	2. OPERATION(S) CONTRIBUTING FLOW; INCLUDE ALL PROCESSES AND SUB PROCESSES AT EACH OUTFALL	3. AVERAGE FLOW AND (MAXIMUM FLOW). INCLUDE UNITS	4. TREATMENT DESCRIPTION	5. TREATMENT CODES FROM TABLE A
001	Radwaste Treatment System*	0.020 (0.190) MGD	Discharge	2J,1Q,2K,4A
	1) Boron Recycle	0.001		
	2) Equipment Drains	0.0002		
	3)Primary Floor Drains	0.0013		
	4)Laundry/Hot Shower	0.0002		
	5)Polisher Regen Waste	0.008		
	6)Secondary Floor Drains	0.0093		
	7)Steam Generator Blowdown	0 **		
002	Cooling Tower Blowdown	3.7 (14.40) MGD	Discharge	2F, 4A
003	Water Treatment Plant Waste**	0.36 (1.6) MGD	Sedimentation	1U, 4C

Attach additional pages if necessary.

2.1 FLOWS, TYPE and FREQUENCY CONTINUED

2.1 For each outfall (1) below, provide: (2) a description of all operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, stormwater runoff, and any other process or non-process wastewater,

1. OUTFALL NO	2. OPERATION(S) CONTRIBUTING FLOW; INCLUDE ALL PROCESSES AND SUB PROCESSES AT EACH	3. AVERAGE FLOW AND (MAXIMUM FLOW), INCLUDE	4. TREATMENT DESCRIPTION	5 TREATMENT CODES FROM TABLE A
003	1)Clarifier Blowdown	0.33	Flocculation	1G
	2) Carbon Filter Backwash	0.004	Filtration	1Q
	3) Oily Waste	0.023	Separation	XX
	4) Makeup Demin Plant Waste	0.0072	Neutralization	2K
007	Sanitary Waste **	0.018 (0.050) MGD	Sedimentation	3G
009	Intake Electric Heaters	0 (0.000) MGD	Neutralization	2K, 4A
010	Storm Water Runoff	0.11(4.6) MGD	Sedimentation	1U, 4A
011	Storm Water Runoff	0.36 (19.7) MGD	Sedimentation	1U, 4A
012	Storm Water Runoff	0.11(6.6) MGD	Sedimentation	1U, 4A
014	Storm Water Runoff	0.087 (4.8) MGD	Sedimentation	1U, 4A
015	Storm Water Runoff	0.050 (2.8) MGD	Sedimentation	1U, 4A
016	Cooling Tower Bypass *	2.88 (14.40) MGD	Discharge	4A
017	Ultimate Heat Sink Pond	0 (0)	No Discharge	NA

* Flow is intermittent. "Average daily" flow is reported. See Section 2.20 for average for days when discharging

** No discharge in past 30 years

2.2 INTERMITTENT DISCHARGES

Except for stormwater runoff, leaks, or spills, are any of the discharges described in items 2.0 or 2.1 intermittent or seasonal?

☑ Yes *(complete the following table)* ☐ No *(go to section 2.3)*

1. OUTFALL NUMBER	2. OPERATION(S) CONTRIBUTING FLOW	3. FREQUENCY		4. FLOW				C. DURATION *(in days)*
				A. FLOW RATE *(in mgd)*		B. TOTAL VOLUME *(specify with units)*		
		A. DAYS PER WEEK *(specify average)*	B. MONTHS PER YEAR *(specify average)*	1. MAXIMUM DAILY	2. LONG TERM AVERAGE	1. LONG TERM DAILY	2. MAXIMUM AVERAGE	
001	Radwaste Treatment	1.2	12	0.099	0.076			61 D/yr
016	Cooling Tower Bypass	3.5	12	3.2	1.3			180 D/yr
	See Attachment C, Description of							
	Intermittent Flows							

2.3 PRODUCTION

A. Does an effluent limitation guideline (ELG) promulgated by EPA under section 304 of the Clean Water Act apply to your facility? Indicate the part and subparts applicable.

☑ Yes 40 CFR 122 Subpart(s) ______ ☐ No *(go to section 2.5)*

B. Are the limitations in the effluent guideline(s) expressed in terms of production (or other measure of operation)? Describe in C below.

☐ Yes *(complete C.)* ☑ No *(go to section 2.5)*

C. If you answered "yes" to B, list the quantity representing an actual measurement of your maximum level of production, expressed in the terms and units used in the applicable effluent guideline and indicate the affected outfalls.

A. OUTFALL(S)	B. QUANTITY PER DAY	C. UNITS OF MEASURE	D. OPERATION, PRODUCT, MATERIAL, ETC. *(specify)*

2.4 IMPROVEMENTS

A. Are you required by any federal, state, or local authority to meet any implementation schedule for the construction, upgrading, or operation of wastewater treatment equipment or practices or any other environmental programs which may affect the discharges described in this application? This includes, but is not limited to, permit conditions, administrative or enforcement orders, enforcement compliance schedule letters, stipulations, court orders, and grant or loan conditions.

☐ Yes *(complete the following table)* ☑ No *(go to 2.6)*

1. IDENTIFICATION OF CONDITION, AGREEMENT, ETC.	2. AFFECTED OUTFALLS	3. BRIEF DESCRIPTION OF PROJECT	4. FINAL COMPLIANCE DATE	
			A. REQUIRED	B. PROJECTED

B. Optional: provide below or attach additional sheets describing water pollution control programs or other environmental projects which may affect discharges. Indicate whether each program is underway or planned, and indicate actual or planned schedules for construction. This may include proposed bmp projects for stormwater.

2.5 SLUDGE MANAGEMENT

Describe the removal of any industrial or domestic biosolids or sludges generated at your facility. Include names and contact information for any haulers used. Note the frequency, volume, and methods (incineration, landfilling, composting, etc) used. See Form A for additional forms which may need to be completed.

DATA COLLECTION AND REPORTING REQUIREMENTS FOR APPLICANTS

3.0 EFFLUENT (AND INTAKE) CHARACTERISTICS (SEE INSTRUCTIONS)

A. & B. See instructions before continuing – complete one Table 1 for **each outfall** (and intake) – annotate the outfall (intake) number or designation in the space provided. The facility is not required to complete intake data unless required by the department or rule.

C. Use the space below to list any pollutants listed in the instructions section 3.0 C. Table B which you know or have reason to believe is discharged or may be discharged from any outfall not listed in parts 3.0 A or B on Table 1. For every pollutant listed, briefly describe the reasons you believe it to be present and report any analytical data in your possession.

1. POLLUTANT	2. SOURCE	3. OUTFALL(S)	4. ANALYTICAL RESULTS (INCLUDE UNITS)
Asbestos	Cooling Tower Fill material	002	Trace amounts
Strontium, Zirconium	Fission & Activation products	001	mg/day

3.1 Whole Effluent Toxicity Testing

A. To your knowledge, have any Whole Effluent Toxicity (WET) tests been performed on the facility discharges (or on receiving waters in relation to your discharge) within the last three years?

☑ Yes (go to 3.1 B) ☐ No (go to 3.2)

3.1 B

Disclose wet testing conditions, including test duration (chronic or acute), the organisms tested, and the testing results. Provide any results of toxicity identification evaluations (TIE) or toxicity reduction evaluations (TRE) if applicable. Please indicate the conclusions of the test(s) including any pollutants identified as causing toxicity and steps the facility is taking to remedy the toxicity.

Annual Whole Effluent Toxicity (WET) tests are conducted in accordance with permit conditions. The last test was conducted in September 2019 and a report was issued October 2019. All WET tests in the past 3 years have passed with no additional issues.

3.2 CONTRACT ANALYSIS INFORMATION

Were any of the analyses reported herein, above, or on Table 1 performed by a contract laboratory or consulting firm?

☑ Yes (list the name, address, telephone number, and pollutants analyzed by each laboratory or firm.) ☐ No *(go to 4.0)*

A. LAB NAME	B. ADDRESS	C. TELEPHONE *(area code and number)*	D. POLLUTANTS ANALYZED *(list or group)*
PDC Laboratories, Inc.	3278 North Hwy 67 Florissant, Mo 63033	314-596-7337	See Attachment E, NPDES Sampling & Analysis
Test America Laboratoies, Inc.	13715 Rider Trail North Earth City, Mo 63045	314-298-8566	See Attachment E, NPDES Sampling & Analysis

4.0 STORMWATER

4.1

Do you have industrial stormwater discharges from the site? If so, attach a site map outlining drainage areas served by each outfall. Indicate the following attributes within each drainage area: pavement or other impervious surfaces; buildings; outdoor storage areas; material loading and unloading areas; outdoor industrial activities; structural stormwater control measures; hazardous waste treatment, storage, and disposal units; and wells or springs in the area.

OUTFALL NUMBER	TOTAL AREA DRAINED (PROVIDE UNITS)	TYPES OF SURFACES (VEGETATED, STONE, PAVED, ETC)	BEST MANAGEMENT PRACTICES EMPLOYED; INCLUDE STRUCTURAL BMPS AND TREATMENT DESIGN FLOW FOR BMPS DESCRIBE HOW FLOW IS MEASURED
010	108 acres	Vegetated, Paved	See Attachment A, Description of Outfalls
011	425 acres	Vegetated, Paved	See Attachment A, Description of Outfalls
012	87 acres	Vegetated, Paved	See Attachment A, Description of Outfalls
014	100 acres	Vegetated, Paved	See Attachment A, Description of Outfalls
015	60 acres	Vegetated, Paved	See Attachment A, Description of Outfalls

4.2 STORMWATER FLOWS

Provide the date of sampling with the flows, and how the flows were estimated.

See Attachment E, NPDES Sampling & Analysis for full description

SIGNATORY REQUIREMENTS

5.0 CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME AND OFFICIAL TITLE (TYPE OR PRINT)	TELEPHONE NUMBER WITH AREA CODE
Fadi Diya, Senior Vice President & Chief Nuclear Officer	573-823-6531
SIGNATURE (SEE INSTRUCTIONS)	**DATE SIGNED**
Fadi Diya by Meghan Kohlhausen	12-20-19

SEE INSTRUCTIONS; PLEASE PRINT CSEE INST
You may report some or all of this informa You may parate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS THIS OUTFALL IS: Cooling Tower Blowdown OUTFALL NO 002

3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.

1. POLLUTANT	2. VALUES							3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	<6.0	<184.1					1	mg/L	lbs/day
B. Chemical Oxygen Demand (COD)	34	1043.5					1	mg/L	lbs/day
C. Total Organic Carbon (TOC)	10	306.9					1	mg/L	lbs/day
D. Total Suspended Solids (TSS)	13	399	84.7	2600	42.2	1295	52	mg/L	lbs/day
E. Ammonia as N	<0.3	<9.21					1	mg/L	lbs/day
F. Flow	VALUE 4.1		VALUE 7.7		VALUE 3.68		365	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE 80.74		VALUE 95.40		VALUE 75.18		52	°F	
H. Temperature *(summer)*	VALUE		VALUE 97.92		VALUE 84.32		53	°F	
I. pH	MINIMUM 6.81		MAXIMUM 8.98		AVERAGE		365	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)	x		MINIMUM 160	4911	MINIMUM		MINIMUM		1	mg/L	lbs/day
B. Bromide (24959-67-9)	x		<0.50	<15.35					1	mg/L	lbs/day
C. Chloride (16887-00-6)	x		43	1320					1	mg/L	lbs/day
D. Chlorine, Total Residual	x		<0.05	<1.53	0.18	5.52	0.032	0.98	365	mg/L	lbs/day
E. Color		x									
F. Conductivity		x									
F. Cyanide, Amenable to Chlorination		x	<0.0025	<0.0767					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	X		41						1	MPN/100mL	
H. Fluoride (16984-48-8)	X		<0.50	<15.35					1	mg/L	lbs/day
I. Nitrate plus Nitrate *(as N)*	X		2.6	79.80					1	mg/L	lbs/day
J. Kjeldahl, Total (as N)	X		<1.0	<30.7					1	mg/L	lbs/day
K. Nitrogen, Total Organic *(as N)*	X		<1.3	<39.9					1	mg/L	lbs/day
L. Oil and Grease	X		<5.0	<153.46	<5.0	<153.46	<5.0	<153.46	6	mg/L	lbs/day
M. Phenols, Total	X		<0.050	1.53					1	mg/L	lbs/day
N. Phosphorus *(as P)*, Total (7723-14-0)	X		0.45	13.81					1	mg/L	lbs/day
O. Sulfate *(as SO^4)* (14808-79-8)	X		450	13811					1	mg/L	lbs/day
P. Sulfide *(as S)*		X	<2.0	<61.38					1	mg/L	lbs/day
Q. Sulfite (as SO^3) (14265-45-3)		X	<2.0	<61.38					1	mg/L	lbs/day
R. Surfactants	X		0.20	6.14					1	mg/L	lbs/day
S. Trihalomethanes, Total		X	<5.0	<153.46					1	mg/L	lbs/day
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	X		0.33	10.13					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)	X		0.00094	0.0289					1	mg/L	lbs/day
3M. Arsenic, Total Recoverable (7440-38-2)		X	0.0071	0.218					1	mg/L	lbs/day
4M. Barium, Total Recoverable (7440-39-3)	X		0.20	6.14					1	mg/L	lbs/day
5M. Beryllium, Total Recoverable (7440-41-7)		X	<0.0002	<0.0061					1	mg/L	lbs/day
6M. Boron, Total Recoverable (7440-42-8)	X		0.13	3.99					1	mg/L	lbs/day
7M. Cadmium, Total Recoverable (7440-43-9)		X	<0.0002	<0.0061					1	mg/L	lbs/day
8M. Chromium III Total Recoverable (16065-83-1)		X	<5.8	<178					1	ug/L	lbs/day
9M. Chromium VI, Dissolved (18540-29-9)		X	<0.0005	<0.0153					1	mg/L	lbs/day
10M. Cobalt, Total Recoverable (7440-48-4)		X	<0.0004	<0.0123					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)	x		0.012	0.368					1	mg/L	lbs/day
12M. Iron, Total Recoverable (7439-89-6)	x		0.45	13.81					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)	x		0.00035	0.011					1	mg/L	lbs/day
14M. Magnesium, Total Recoverable (7439-95-4)	x		35	1074					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)	x		0.027	0.829					1	mg/L	lbs/day
16M. Mercury, Total Recoverable (7439-97-6)		x	<0.0002	<0.0061					1	mg/L	lbs/day
17M. Methylmercury (22967926)		X	<0.06	<1.84					1	mg/L	lbs/day
18M. Molybdenum, Total Recoverable (7439-98-7)	x		0.0059	0.181					1	mg/L	lbs/day
19M. Nickel, Total Recoverable (7440-02-0)	x		0.0074	0.227					1	mg/L	lbs/day
20M. Selenium, Total Recoverable (7782-49-2)	x		0.0031	0.095					1	mg/L	lbs/day
21M. Silver, Total Recoverable (7440-22-4)		x	<0.001	<0.031					1	mg/L	lbs/day
22M. Thallium, Total Recoverable (7440-28-0)		x	<0.0002	<0.0061					1	mg/L	lbs/day
23M. Tin, Total Recoverable (7440-31-5)		x	<0.06	<1.841					1	mg/L	lbs/day
24M. Titanium, Total Recoverable (7440-32-6)	x		0.0064	0.196					1	mg/L	lbs/day
25M. Zinc, Total Recoverable (7440-66-6)	x		0.0047	0.144						mg/L	lbs/day
Subpart 3 – Radioactivity											
1R. Alpha Total		x	<0.782						1	pCi/L	
2R. Beta Total		x	<0.609						1	pCi/L	
3R. Radium Total		x									
4R. Radium 226 plus 228 Total		x	<0.782						1	pCi/L	

SEE INSTRUCTIONS; PLEASE PRINT CSEE INST
You may report some or all of this informa You may parate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS THIS OUTFALL IS: Water Treatment Plant OUTFALL NO. 003

3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.

1. POLLUTANT	2. VALUES							3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	7.1	1.56					1	mg/L	lbs/day
B. Chemical Oxygen Demand (COD)	31	6.83					1	mg/L	lbs/day
C. Total Organic Carbon (TOC)	8.2	1.8					1	mg/L	lbs/day
D. Total Suspended Solids (TSS)	9.6	2.11					1	mg/L	lbs/day
E. Ammonia as N	<0.30	<0.07					1	mg/L	lbs/day
F. Flow	VALUE 0.364		VALUE		VALUE		1	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE 9.9		VALUE		VALUE		1	°F	
H. Temperature *(summer)*	VALUE		VALUE		VALUE			°F	
I. pH	MINIMUM 8.32		MAXIMUM 8.88		AVERAGE		2	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)	x		MINIMUM 150	33.03	MINIMUM		MINIMUM		1	mg/L	lbs/day
B. Bromide (24959-67-9)	x		<0.50	<0.11					1	mg/L	lbs/day
C. Chloride (16887-00-6)	x		25	5.5					1	mg/L	lbs/day
D. Chlorine, Total Residual	x		<0.05	<0.011					1	mg/L	lbs/day
E. Color		x									
F. Conductivity		x									
F. Cyanide, Amenable to Chlorination		x	<0.0025	<0.0006					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*		x	<10						1	MPN/100mL	
H. Fluoride (16984-48-8)	x		<0.50	<0.11					1	mg/L	lbs/day
I. Nitrate plus Nitrate *(as N)*	x		0.26	0.057					1	mg/L	lbs/day
J. Kjeldahl, Total (as N)	x		<1.0	<0.22					1	mg/L	lbs/day
K. Nitrogen, Total Organic *(as N)*	x		<1.3	<0.29					1	mg/L	lbs/day
L. Oil and Grease	x		<5.3	1.17					1	mg/L	lbs/day
M. Phenols, Total		x	<0.050	<0.011					1	mg/L	lbs/day
N. Phosphorus *(as P)*, Total (7723-14-0)	x		0.13	0.03					1	mg/L	lbs/day
O. Sulfate *(as SO^4)* (14808-79-8)	x		28	6.16					1	mg/L	lbs/day
P. Sulfide *(as S)*		x	<2.0	<0.44					1	mg/L	lbs/day
Q. Sulfite (as SO^3) (14265-45-3)		x	<2.0	<0.44					1	mg/L	lbs/day
R. Surfactants	x		0.18	0.04					1	mg/L	lbs/day
S. Trihalomethanes, Total		x	<5	<1.1					1	ug/L	lbs/day
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	x		0.42	0.09					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)		x	<0.0006	<0.00013					1	mg/L	lbs/day
3M. Arsenic, Total Recoverable (7440-38-2)		x	0.008	0.002					1	mg/L	lbs/day
4M. Barium, Total Recoverable (7440-39-3)	x		0.032	0.007					1	mg/L	lbs/day
5M. Beryllium, Total Recoverable (7440-41-7)	x		<0.0002	<0.00004					1	mg/L	lbs/day
6M. Boron, Total Recoverable (7440-42-8)	x		0.050	0.011					1	mg/L	lbs/day
7M. Cadmium, Total Recoverable (7440-43-9)		x	<0.0002	<0.00004					1	mg/L	lbs/day
8M. Chromium III Total Recoverable (16065-83-1)		x	<0.0058	<0.0013					1	mg/L	lbs/day
9M. Chromium VI, Dissolved (18540-29-9)		x	0.0057	0.0013					1	mg/L	lbs/day
10M. Cobalt, Total Recoverable (7440-48-4)		x	<0.0004	<0.00009					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)		x	<0.0006	<0.0001					1	mg/L	lbs/day
12M. Iron, Total Recoverable (7439-89-6)	x		0.41	0.09					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)	x		0.00028	0.00006					1	mg/L	lbs/day
14M. Magnesium, Total Recoverable (7439-95-4)	x		12	2.64					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)	x		0.053	0.012					1	mg/L	lbs/day
16M. Mercury, Total Recoverable (7439-97-6)		x	<0.0002	<0.00004					1	mg/L	lbs/day
17M. Methylmercury (22967926)		x	0.16	3.5e-8					1	ng/L	lbs/day
18M. Molybdenum, Total Recoverable (7439-98-7)	x		0.0006	0.0001					1	mg/L	lbs/day
19M. Nickel, Total Recoverable (7440-02-0)		x	<0.001	<0.0002					1	mg/L	lbs/day
20M. Selenium, Total Recoverable (7782-49-2)		x	<0.0002	<0.00004					1	mg/L	lbs/day
21M. Silver, Total Recoverable (7440-22-4)		x	<0.001	<0.0002					1	mg/L	lbs/day
22M. Thallium, Total Recoverable (7440-28-0)		x	<0.0002	<0.00004					1	mg/L	lbs/day
23M. Tin, Total Recoverable (7440-31-5)		x	<0.06	<0.013					1	mg/L	lbs/day
24M. Titanium, Total Recoverable (7440-32-6)	x		<0.005	<0.001					1	mg/L	lbs/day
25M. Zinc, Total Recoverable (7440-66-6)	x		0.0039	0.0009					1	mg/L	lbs/day
Subpart 3 – Radioactivity											
1R. Alpha Total		x	<0.696						1	pCi/L	
2R. Beta Total		x	<0.696						1	pCi/L	
3R. Radium Total											
4R. Radium 226 plus 228 Total		x	<0.696						1	pCi/L	

SEE INSTRUCTIONS; PLEASE PRINT OR TYPE.
You may report some or all of this information on separate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS		THIS OUTFALL IS: Sanitary Waste Lagoon							OUTFALL NO. 007
3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.									
1. POLLUTANT	2. VALUES							3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	15	2.25					1	mg/L	lbs/day
B. Chemical Oxygen Demand (COD)	140	21.02					1	mg/L	lbs/day
C. Total Organic Carbon (TOC)	21	3.15					1	mg/L	lbs/day
D. Total Suspended Solids (TSS)	74	11.1					1	mg/L	lbs/day
E. Ammonia as N	<0.3	<0.045					1	mg/L	lbs/day
F. Flow	VALUE 0.018		VALUE		VALUE		1	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE 24.7		VALUE		VALUE		1	°F	
H. Temperature *(summer)*	VALUE		VALUE		VALUE			°F	
I. pH	MINIMUM 8.33		MAXIMUM 8.76		AVERAGE		2	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)	x		MINIMUM 88	13.21	MINIMUM		MINIMUM		1	mg/L	lbs/day
B. Bromide (24959-67-9)		x	<0.5	<0.075					1	mg/L	lbs/day
C. Chloride (16887-00-6)	x		200	30.02					1	mg/L	lbs/day
D. Chlorine, Total Residual		x	<0.05	<0.008					1	mg/L	lbs/day
E. Color		x									
F Conductivity		x									
F Cyanide, Amenable to Chlorination		x	<0.0025	<0.0004					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	x		310						1	MPN/100mL	
H. Fluoride (16984-48-8)		x	<0.50	<0.075					1	mg/L	lbs/day
I. Nitrate plus Nitrate *(as N)*	x		1.5	0.225					1	mg/L	lbs/day
J. Kjeldehl, Total (as N)	x		<1.0	<0.15					1	mg/L	lbs/day
K. Nitrogen, Total Organic *(as N)*	x		<1.3	<0.195					1	mg/L	lbs/day
L. Oil and Grease	x		<5.0	<0.75					1	mg/L	lbs/day
M. Phenols, Total		x	<0.05	<0.0075					1	mg/L	lbs/day
N. Phosphorus *(as P)*, Total (7723-14-0)	x		1.7	0.255					1	mg/L	lbs/day
O. Sulfate *(as SO^4)* (14808-79-8)	x		39	5.85					1	mg/L	lbs/day
P. Sulfide *(as S)*		x	<2.0	<0.30					1	mg/L	lbs/day
Q. Sulfite (as SO^3) (14265-45-3)		x	<2.0	<0.30					1	mg/L	lbs/day
R. Surfactants		x	<0.10	<0.015					1	mg/L	lbs/day
S. Trihalomethanes, Total		x	<5.0	<0.75					1	ug/L	lbs/day
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	x		0.0062	0.0009					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)		x	<0.0006	<0.00009					1	mg/L	lbs/day
3M. Arsenic, Total Recoverable (7440-38-2)		x	0.0007	0.0001					1	mg/L	lbs/day
4M. Barium, Total Recoverable (7440-39-3)	x		0.029	0.004					1	mg/L	lbs/day
5M. Beryllium, Total Recoverable (7440-41-7)		x	<0.0002	<0.0003					1	mg/L	lbs/day
6M. Boron, Total Recoverable (7440-42-8)	x		0.15	0.023					1	mg/L	lbs/day
7M. Cadmium, Total Recoverable (7440-43-9)		x	<0.0002	<0.0003					1	mg/L	lbs/day
8M. Chromium III Total Recoverable (16065-83-1)		x	<5.8	<0.87					1	ug/L	lbs/day
9M. Chromium VI, Dissolved (18540-29-9)		x	0.0066	0.001					1	mg/L	lbs/day
10M. Cobalt, Total Recoverable (7440-48-4)		x	<0.0004	<0.00006					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)		x	<0.0006	<0.00009					1	mg/L	lbs/day
12M. Iron, Total Recoverable (7439-89-6)	x		0.012	0.0018					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)		x	<0.0002	<0.0003					1	mg/L	lbs/day
14M. Magnesium, Total Recoverable (7439-95-4)	x		18	2.7					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)	x		0.11	0.017					1	mg/L	lbs/day
16M. Mercury, Total Recoverable (7439-97-6)		x	<0.0002	<0.0003					1	mg/L	lbs/day
17M. Methylmercury (22967926)		x	0.322	0.048					1	mg/L	lbs/day
18M. Molybdenum, Total Recoverable (7439-98-7)	x		0.00044	0.00007					1	mg/L	lbs/day
19M. Nickel, Total Recoverable (7440-02-0)	x		<0.001	<0.0002					1	mg/L	lbs/day
20M. Selenium, Total Recoverable (7782-49-2)		x	<0.0002	<0.0003					1	mg/L	lbs/day
21M. Silver, Total Recoverable (7440-22-4)		x	<0.001	<0.0002					1	mg/L	lbs/day
22M. Thallium, Total Recoverable (7440-28-0)		x	<0.0002	<0.0003					1	mg/L	lbs/day
23M. Tin, Total Recoverable (7440-31-5)		x	<0.06	<0.009					1	mg/L	lbs/day
24M. Titanium, Total Recoverable (7440-32-8)	x		<0.005	<0.0008					1	mg/L	lbs/day
25M. Zinc, Total Recoverable (7440-66-6)	x		0.0038	0.0006					1	mg/L	lbs/day
Subpart 3 – Radioactivity											
1R. Alpha Total		x	<0.606						1	pCi/L	
2R. Beta Total		x	<0.981						1	pCi/L	
3R. Radium Total		x									
4R. Radium 226 plus 228 Total		x	<0.981						1	pCi/L	

SEE INSTRUCTIONS; PLEASE PRINT OR TYPE.
You may report some or all of this information on separate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS THIS OUTFALL IS: Storm Water Runoff OUTFALL NO. 010

3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.

1. POLLUTANT	2. VALUES							3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	7.0	6.68					1	mg/l	lbs/day
B. Chemical Oxygen Demand (COD)	120	114					1	mg/l	lbs/day
C. Total Organic Carbon (TOC)	6.6	6.3					1	mg/l	lbs/day
D. Total Suspended Solids (TSS)	6.4	6.1					1	mg/l	lbs/day
E. Ammonia as N	<0.30	<0.29					1	mg/l	lbs/day
F. Flow	VALUE 0.1144		VALUE		VALUE		1	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE		VALUE		VALUE			°F	
H. Temperature *(summer)*	VALUE 83.1		VALUE		VALUE		1	°F	
I. pH	MINIMUM 7.81		MAXIMUM		AVERAGE		1	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)		X	MINIMUM		MINIMUM		MINIMUM				
B. Bromide (24959-67-9)		X									
C. Chloride (16887-00-6)		X									
D. Chlorine, Total Residual		X									
E. Color		X									
F. Conductivity		X									
F. Cyanide, Amenable to Chlorination		X									

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	X		<10	<9.5					1	MPN100ml	lbs/day
H. Fluoride (16984-48-8)		X									
I. Nitrate plus Nitrate *(as N)*	X		<1.0	<0.95					1	mg/L	lbs/day
J. Kjeldahl, Total (as N)	X		<1.0	<0.95					1	mg/L	lbs/d
K. Nitrogen, Total Organic *(as N)*	X		<1.3	<1.25					1	mg/L	lbs/d
L. Oil and Grease	X		<5.0	<4.8					1	mg/L	lbs/d
M. Phenols, Total		X									
N. Phosphorus *(as P)*, Total (7723-14-0)	X		0.13	0.12					1	mg/L	lbs/d
O. Sulfate *(as SO^4)* (14808-79-8)	X		8.6	8.2					1	mg/L	lbs/d
P. Sulfide *(as S)*		X									
Q. Sulfite (as SO^3) (14265-45-3)		X									
R. Surfactants		X									
S. Trihalomethanes, Total		X									
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	X		0.10	0.095					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)		X									
3M. Arsenic, Total Recoverable (7440-38-2)		X									
4M. Barium, Total Recoverable (7440-39-3)		X									
5M. Beryllium, Total Recoverable (7440-41-7)		X									
6M. Boron, Total Recoverable (7440-42-8)		X									
7M. Cadmium, Total Recoverable (7440-43-9)		X									
8M. Chromium III Total Recoverable (16065-83-1)		X									
9M. Chromium VI, Dissolved (18540-29-9)		X									
10M. Cobalt, Total Recoverable (7440-48-4)		X									

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)		X									
12M. Iron, Total Recoverable (7439-89-6)	X		0.18	0.17					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)		X									
14M. Magnesium, Total Recoverable (7439-95-4)	X		7.8	7.44					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)		X									
16M. Mercury, Total Recoverable (7439-97-6)		X									
17M. Methylmercury (22967926)		X									
18M. Molybdenum, Total Recoverable (7439-98-7)		X									
19M. Nickel, Total Recoverable (7440-02-0)		X									
20M. Selenium, Total Recoverable (7782-49-2)		X									
21M. Silver, Total Recoverable (7440-22-4)		X									
22M. Thallium, Total Recoverable (7440-28-0)		X									
23M. Tin, Total Recoverable (7440-31-5)		X									
24M. Titanium, Total Recoverable (7440-32-6)		X									
25M. Zinc, Total Recoverable (7440-66-6)											
Subpart 3 – Radioactivity											
1R. Alpha Total		X									
2R. Beta Total		X									
3R. Radium Total		X									
4R. Radium 226 plus 228 Total		X									

SEE INSTRUCTIONS; PLEASE PRINT OR TYPE.
You may report some or all of this information on separate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS THIS OUTFALL IS: Storm Water Runoff — OUTFALL NO. 011

3:0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.

1. POLLUTANT	2. VALUES							3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	79	236					1	mg/L	lbs/d
B. Chemical Oxygen Demand (COD)	120	358					1	mg/L	lbs/d
C. Total Organic Carbon (TOC)	7.1	21.2					1	mg/L	lbs/d
D. Total Suspended Solids (TSS)	13	38.8					1	mg/L	lbs/d
E. Ammonia as N	<0.30	<0.89					1	mg/L	lbs/d
F. Flow	VALUE 0.3577		VALUE		VALUE		1	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE		VALUE		VALUE			°F	
H. Temperature *(summer)*	VALUE 83.12		VALUE		VALUE		1	°F	
I. pH	MINIMUM 8.33		MAXIMUM		AVERAGE		1	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)		X	MINIMUM		MINIMUM		MINIMUM				
B. Bromide (24959-67-9)		X									
C. Chloride (16887-00-6)		X									
D. Chlorine, Total Residual		X									
E. Color		X									
F Conductivity		X									
F. Cyanide, Amenable to Chlorination		X									

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	x		20	59.7						MPN/100m	lbs/d
H. Fluoride (16984-48-8)		x									
I. Nitrate plus Nitrate *(as N)*	x		<1.0	<2.98						mg/L	lbs/d
J. Kjeldahl, Total (as N)	x		<1.0	<2.98						mg/L	lbs/d
K. Nitrogen, Total Organic *(as N)*	x		<1.3	<3.88						mg/L	lbs/d
L. Oil and Grease	x		<5.1	<15.21						mg/L	lbs/d
M. Phenols, Total		x									
N. Phosphorus *(as P)*, Total (7723-14-0)	x		0.091	0.27						mg/L	lbs/d
O. Sulfate *(as SO^4)* (14808-79-8)	x		5.6	16.7						mg/L	lbs/d
P. Sulfide *(as S)*		x									
Q. Sulfite (as SO^3) (14265-45-3)		x									
R. Surfactants		x									
S. Trihalomethanes, Total		x									
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	x		0.24	0.72						mg/L	lbs/d
2M. Antimony, Total Recoverable (7440-36-9)		x									
3M. Arsenic, Total Recoverable (7440-38-2)		x									
4M. Barium, Total Recoverable (7440-39-3)		x									
5M. Beryllium, Total Recoverable (7440-41-7)		x									
6M. Boron, Total Recoverable (7440-42-8)		x									
7M. Cadmium, Total Recoverable (7440-43-9)		x									
8M. Chromium III Total Recoverable (16065-83-1)		x									
9M. Chromium VI, Dissolved (18540-29-9)		x									
10M. Cobalt, Total Recoverable (7440-48-4)		x									

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)		X									
12M. Iron, Total Recoverable (7439-89-6)	X		0.32	0.95						mg/L	lbs/d
13M. Lead, Total Recoverable (7439-92-1)		X									
14M. Magnesium, Total Recoverable (7439-95-4)	X		4.6	13.72						mg/L	lbs/d
15M. Manganese, Total Recoverable (7439-96-5)		X									
16M. Mercury, Total Recoverable (7439-97-6)		X									
17M. Methylmercury (22967926)		X									
18M. Molybdenum, Total Recoverable (7439-98-7)		X									
19M. Nickel, Total Recoverable (7440-02-0)		X									
20M. Selenium, Total Recoverable (7782-49-2)		X									
21M. Silver, Total Recoverable (7440-22-4)		X									
22M. Thallium, Total Recoverable (7440-28-0)		X									
23M. Tin, Total Recoverable (7440-31-5)		X									
24M. Titanium, Total Recoverable (7440-32-6)		X									
25M. Zinc, Total Recoverable (7440-66-6)		X									
Subpart 3 – Radioactivity											
1R. Alpha Total		X									
2R. Beta Total		X									
3R. Radium Total		X									
4R. Radium 226 plus 228 Total		X									

SEE INSTRUCTIONS; PLEASE PRINT OR TYPE.
You may report some or all of this information on separate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS THIS OUTFALL IS: Storm Water Runoff OUTFALL NO. 012

3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.

1. POLLUTANT	2. VALUES							3. UNITS (specify if blank)	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	34	30.14					1	mg/L	lbs/day
B. Chemical Oxygen Demand (COD)	130	115					1	mg/L	lbs/day
C. Total Organic Carbon (TOC)	4.1	3.63					1	mg/L	lbs/day
D. Total Suspended Solids (TSS)	48	42.55					1	mg/L	lbs/day
E. Ammonia as N	<0.30	<0.27					1	mg/L	lbs/day
F. Flow	VALUE 0.1063		VALUE		VALUE		1	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE		VALUE		VALUE			°F	
H. Temperature *(summer)*	VALUE 83.1		VALUE		VALUE		1	°F	
I. pH	MINIMUM 8.14		MAXIMUM		AVERAGE		1	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)		X	MINIMUM		MINIMUM		MINIMUM				
B. Bromide (24959-67-9)		X									
C. Chloride (16887-00-6)		X									
D. Chlorine, Total Residual		X									
E. Color		X									
F. Conductivity		X									
F. Cyanide, Amenable to Chlorination		X									

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	X		<10	8.87					1	MPN/100m	lbs/day
H. Fluoride (16984-48-8)		X									
I. Nitrate plus Nitrate *(as N)*	X		<1.0	<0.89					1	mg/L	lbs/day
J. Kjeldahl, Total (as N)	X		<1.0	<0.89					1	mg/L	lbs/day
K. Nitrogen, Total Organic *(as N)*	X		<1.3	<1.15					1	mg/L	lbs/day
L. Oil and Grease	X		11	9.75					1	mg/L	lbs/day
M. Phenols, Total		X									
N. Phosphorus *(as P)*, Total (7723-14-0)	X		0.10	0.089					1	mg/L	lbs/day
O. Sulfate *(as SO^4)* (14808-79-8)	X		35	31.03					1	mg/L	lbs/day
P. Sulfide *(as S)*		X									
Q. Sulfite (as SO^3) (14265-45-3)		X									
R. Surfactants		X									
S. Trihalomethanes, Total		X									
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	X		0.32	0.28					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)		X									
3M. Arsenic, Total Recoverable (7440-38-2)		X									
4M. Barium, Total Recoverable (7440-39-3)		X									
5M. Beryllium, Total Recoverable (7440-41-7)		X									
6M. Boron, Total Recoverable (7440-42-8)		X									
7M. Cadmium, Total Recoverable (7440-43-9)		X									
8M. Chromium III Total Recoverable (16065-83-1)		X									
9M. Chromium VI, Dissolved (18540-29-9)		X									
10M. Cobalt, Total Recoverable (7440-48-4)		X									

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)		X									
12M. Iron, Total Recoverable (7439-89-6)	X		0.47	0.42					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)		X									
14M. Magnesium, Total Recoverable (7439-95-4)	X		9.9	8.78					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)		X									
16M. Mercury, Total Recoverable (7439-97-6)		X									
17M. Methylmercury (22967926)		X									
18M. Molybdenum, Total Recoverable (7439-98-7)		X									
19M. Nickel, Total Recoverable (7440-02-0)		X									
20M. Selenium, Total Recoverable (7782-49-2)		X									
21M. Silver, Total Recoverable (7440-22-4)		X									
22M. Thallium, Total Recoverable (7440-28-0)		X									
23M. Tin, Total Recoverable (7440-31-5)		X									
24M. Titanium, Total Recoverable (7440-32-6)		X									
25M. Zinc, Total Recoverable (7440-66-6)		X									
Subpart 3 – Radioactivity											
1R. Alpha Total		X									
2R. Beta Total		X									
3R. Radium Total		X									
4R. Radium 226 plus 228 Total		X									

SEE INSTRUCTIONS; PLEASE PRINT CSEE INST

You may report some or all of this informa You may barate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS THIS OUTFALL IS: Storm Water Runoff OUTFALL NO. 014

3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.

1. POLLUTANT	2. VALUES							3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	<12	<8.70					1	mg/L	lbs/day
B. Chemical Oxygen Demand (COD)	11	7.97					1	mg/L	lbs/day
C. Total Organic Carbon (TOC)	14	10.16					1	mg/L	lbs/day
D. Total Suspended Solids (TSS)	37	26.82					1	mg/L	lbs/day
E. Ammonia as N	<0.30	<0.22					1	mg/L	lbs/day
F. Flow	VALUE 0.0869		VALUE		VALUE		1	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE		VALUE		VALUE			°F	
H. Temperature *(summer)*	VALUE 83.1		VALUE		VALUE		1	°F	
I. pH	MINIMUM 7.55		MAXIMUM		AVERAGE		1	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)		X	MINIMUM		MINIMUM		MINIMUM				
B. Bromide (24959-67-9)		X									
C. Chloride (16887-00-6)		X									
D. Chlorine, Total Residual		X									
E. Color		X									
F. Conductivity		X									
F. Cyanide, Amenable to Chlorination		X									

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	X		10	7.24					1	MPN/100m	lbs/day
H. Fluoride (16984-48-8)		X									
I. Nitrate plus Nitrate *(as N)*	X		1.02	0.74					1	mg/L	lbs/day
J. Kjeldahl, Total (as N)	X		1.7	1.23					1	mg/L	lbs/day
K. Nitrogen, Total Organic *(as N)*	X		1.7	1.23					1	mg/L	lbs/day
L. Oil and Grease	X		<5.1	<3.69					1	mg/L	lbs/day
M. Phenols, Total		X									
N. Phosphorus *(as P)*, Total (7723-14-0)	X		0.14	0.10					1	mg/L	lbs/day
O. Sulfate *(as SO^4)* (14808-79-8)	X		6.0	4.35					1	mg/L	lbs/day
P. Sulfide *(as S)*		X									
Q. Sulfite (as SO^3) (14265-45-3)		X									
R. Surfactants		X									
S. Trihalomethanes, Total		X									
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	X		0.15	0.11					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)		X									
3M. Arsenic, Total Recoverable (7440-38-2)		X									
4M. Barium, Total Recoverable (7440-39-3)		X									
5M. Beryllium, Total Recoverable (7440-41-7)		X									
6M. Boron, Total Recoverable (7440-42-8)		X									
7M. Cadmium, Total Recoverable (7440-43-9)		X									
8M. Chromium III Total Recoverable (16065-83-1)		X									
9M. Chromium VI, Dissolved (18540-29-9)		X									
10M. Cobalt, Total Recoverable (7440-48-4)		X									

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)		X									
12M. Iron, Total Recoverable (7439-89-6)	X		1.7	1.23					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)		X									
14M. Magnesium, Total Recoverable (7439-95-4)	X		9.2	6.67					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)		X									
16M. Mercury, Total Recoverable (7439-97-6)		X									
17M. Methylmercury (22967926)		X									
18M. Molybdenum, Total Recoverable (7439-98-7)		X									
19M. Nickel, Total Recoverable (7440-02-0)		X									
20M. Selenium, Total Recoverable (7782-49-2)		X									
21M. Silver, Total Recoverable (7440-22-4)		X									
22M. Thallium, Total Recoverable (7440-28-0)		X									
23M. Tin, Total Recoverable (7440-31-5)		X									
24M. Titanium, Total Recoverable (7440-32-6)		X									
25M. Zinc, Total Recoverable (7440-66-6)		X									
Subpart 3 – Radioactivity											
1R. Alpha Total		X									
2R. Beta Total		X									
3R. Radium Total		X									
4R. Radium 226 plus 228 Total		X									

SEE INSTRUCTIONS; PLEASE PRINT OR TYPE.
You may report some or all of this information on separate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS		THIS OUTFALL IS: Storm Water Runoff						OUTFALL NO. 015
3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.								
1. POLLUTANT	2. VALUES						3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	<6.0	<2.53					1	mg/L	lbs/day
B. Chemical Oxygen Demand (COD)	43	18.11					1	mg/L	lbs/day
C. Total Organic Carbon (TOC)	7.7	2.73					1	mg/L	lbs/day
D. Total Suspended Solids (TSS)	6.0	2.53					1	mg/L	lbs/day
E. Ammonia as N	<0.30	<0.13					1	mg/L	lbs/day
F. Flow	VALUE 0.0505		VALUE		VALUE		1	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE		VALUE		VALUE			°F	
H. Temperature *(summer)*	VALUE 83.1		VALUE		VALUE		1	°F	
I. pH	MINIMUM 8.34		MAXIMUM		AVERAGE		1	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)		X	MINIMUM		MINIMUM		MINIMUM				
B. Bromide (24959-67-9)		X									
C. Chloride (16887-00-6)		X									
D. Chlorine, Total Residual		X									
E. Color		X									
F. Conductivity		X									
F. Cyanide, Amenable to Chlorination		X									

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	x		<10	<4.21					1	MPN/100m	lbs/day
H. Fluoride (16984-48-8)		x									
I. Nitrate plus Nitrate *(as N)*	x		<1.0	<0.421					1	mg/L	lbs/day
J. Kjeldahl, Total (as N)	x		<1.0	<0.421					1	mg/L	lbs/day
K. Nitrogen, Total Organic *(as N)*	x		7.7	3.24					1	mg/L	lbs/day
L. Oil and Grease	x		<5.1	<2.15					1	mg/L	lbs/day
M. Phenols, Total		x									
N. Phosphorus *(as P)*, Total (7723-14-0)	x		0.072	0.03					1	mg/L	lbs/day
O. Sulfate *(as SO^4)* (14808-79-8)	x		<0.50	<0.21					1	mg/L	lbs/day
P. Sulfide *(as S)*		x									
Q. Sulfite (as SO^3) (14265-45-3)		x									
R. Surfactants		x									
S. Trihalomethanes, Total		x									
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	x		0.052	0.022					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)		x									
3M. Arsenic, Total Recoverable (7440-38-2)		x									
4M. Barium, Total Recoverable (7440-39-3)		x									
5M. Beryllium, Total Recoverable (7440-41-7)		x									
6M. Boron, Total Recoverable (7440-42-8)		x									
7M. Cadmium, Total Recoverable (7440-43-9)		x									
8M. Chromium III Total Recoverable (16065-83-1)		x									
9M. Chromium VI, Dissolved (18540-29-9)		x									
10M. Cobalt, Total Recoverable (7440-48-4)		x									

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)		X									
12M. Iron, Total Recoverable (7439-89-6)	X		0.15	0.063					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)		X									
14M. Magnesium, Total Recoverable (7439-95-4)	X		5.3	2.23					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)		X									
16M. Mercury, Total Recoverable (7439-97-6)		X									
17M. Methylmercury (22967926)		X									
18M. Molybdenum, Total Recoverable (7439-98-7)		X									
19M. Nickel, Total Recoverable (7440-02-0)		X									
20M. Selenium, Total Recoverable (7782-49-2)		X									
21M. Silver, Total Recoverable (7440-22-4)		X									
22M. Thallium, Total Recoverable (7440-28-0)		X									
23M. Tin, Total Recoverable (7440-31-5)		X									
24M. Titanium, Total Recoverable (7440-32-6)		X									
25M. Zinc, Total Recoverable (7440-66-6)		X									
Subpart 3 – Radioactivity											
1R. Alpha Total		X									
2R. Beta Total		X									
3R. Radium Total		X									
4R. Radium 226 plus 228 Total		X									

SEE INSTRUCTIONS; PLEASE PRINT OR TYPE.
You may report some or all of this information on separate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS THIS OUTFALL IS: Cooling Tower Bypass OUTFALL NO. 016

3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.

1. POLLUTANT	2. VALUES							3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	<6.0	<144					1	mg/L	lbs/day
B. Chemical Oxygen Demand (COD)	20	480.4					1	mg/L	lbs/day
C. Total Organic Carbon (TOC)	5.2	125					1	mg/L	lbs/day
D Total Suspended Solids (TSS)	6.4	154			7.64	183.5	1	mg/L	lbs/day
E. Ammonia as N	<0.3	<7.2					1	mg/L	lbs/day
F. Flow	VALUE 2.88		VALUE		VALUE 1.67		4,10	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE 24.1		VALUE		VALUE		4	°F	
H. Temperature *(summer)*	VALUE		VALUE		VALUE			°F	
I. pH	MINIMUM 7.80		MAXIMUM 8.36		AVERAGE		4	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)	x		MINIMUM 230	5524	MINIMUM		MINIMUM		1	mg/L	lbs/day
B. Bromide (24959-67-9)	x		<0.50	<12					1	mg/L	lbs/day
C. Chloride (16887-00-6)	x		25	600					1	mg/L	lbs/day
D. Chlorine, Total Residual	x		<0.05	<1.2			<0.05	<1.2	4,4	mg/L	lbs/day
E. Color		x									
F. Conductivity		x									
F. Cyanide, Amenable to Chlorination		x	<0.0025	<0.06					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	x		20						1	MPN/100mL	
H. Fluoride (16984-48-8)	x		<0.50	<12					1	mg/L	lbs/day
I. Nitrate plus Nitrate *(as N)*	x		1.2	28.83					1	mg/L	lbs/day
J. Kjeldahl, Total (as N)		x	<1.0	<24.02					1	mg/L	lbs/day
K. Nitrogen, Total Organic *(as N)*	x		<1.3	<31.22					1	mg/L	lbs/day
L. Oil and Grease	x		<5.1	<122			<5.0	<1.2	4,4	mg/L	lbs/day
M. Phenols, Total		x	<0.05	<1.2					4	mg/L	lbs/day
N. Phosphorus *(as P)*, Total (7723-14-0)	x		0.12	2.88					1	mg/L	lbs/day
O. Sulfate *(as SO^4)* (14808-79-8)	x		120	2882					1	mg/L	lbs/day
P. Sulfide *(as S)*		x	<2.0	<48.04					1	mg/L	lbs/day
Q. Sulfite (as SO^3) (14265-45-3)		x	<2.0	<48.04					1	mg/L	lbs/day
R. Surfactants		x	<0.1	<2.40					1	mg/L	lbs/day
S. Trihalomethanes, Total		x	<5.0	<120					1	ug/L	lbs/day
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	x		0.11	2.64					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)		x	<0.0006	<0.014					1	mg/L	lbs/day
3M. Arsenic, Total Recoverable (7440-38-2)	x		0.0026	0.062					1	mg/L	lbs/day
4M. Barium, Total Recoverable (7440-39-3)	x		0.087	2.09					1	mg/L	lbs/day
5M. Beryllium, Total Recoverable (7440-41-7)		x	<0.0002	<0.0048					1	mg/L	lbs/day
6M. Boron, Total Recoverable (7440-42-8)	x		0.056	1.35					1	mg/L	lbs/day
7M. Cadmium, Total Recoverable (7440-43-9)		x	<0.0002	<0.0048					1	mg/L	lbs/day
8M. Chromium III Total Recoverable (16065-83-1)		x	<5.8	<139					1	ug/L	lbs/day
9M. Chromium VI, Dissolved (18540-29-9)		x	0.0055	0.132					1	mg/L	lbs/day
10M. Cobalt, Total Recoverable (7440-48-4)		x	<0.0004	<0.01					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)	x		0.0021	0.05					1	mg/L	lbs/day
12M. Iron, Total Recoverable (7439-89-6)	x		0.17	4.08					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)	x		<0.0002	<0.0048					1	mg/L	lbs/day
14M. Magnesium, Total Recoverable (7439-95-4)	x		15	360.3					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)	x		0.0079	0.19					1	mg/L	lbs/day
16M. Mercury, Total Recoverable (7439-97-6)		x	<0.0002	<0.0048					1	mg/L	lbs/day
17M. Methylmercury (22967926)		x	<0.06	<1.44					1	mg/L	lbs/day
18M. Molybdenum, Total Recoverable (7439-98-7)	x		0.0026	0.062					1	mg/L	lbs/day
19M. Nickel, Total Recoverable (7440-02-0)	x		0.0026	0.062					1	mg/L	lbs/day
20M. Selenium, Total Recoverable (7782-49-2)	x		0.0012	0.029					1	mg/L	lbs/day
21M. Silver, Total Recoverable (7440-22-4)	x		<0.001	<0.024					1	mg/L	lbs/day
22M. Thallium, Total Recoverable (7440-28-0)		x	<0.0002	<0.0048					1	mg/L	lbs/day
23M. Tin, Total Recoverable (7440-31-5)		x	<0.06	<1.44					1	mg/L	lbs/day
24M. Titanium, Total Recoverable (7440-32-6)		x	<0.005	<0.12					1	mg/L	lbs/day
25M. Zinc, Total Recoverable (7440-66-6)	x		0.0037	0.089					1	mg/L	lbs/day
Subpart 3 – Radioactivity											
1R. Alpha Total		x	<0.786						1	pCi/L	
2R. Beta Total		x	<0.654						1	pCi/L	
3R. Radium Total		x									
4R. Radium 226 plus 228 Total		x	<0.786						1	pCi/L	

SEE INSTRUCTIONS; PLEASE PRINT OR TYPE.
You may report some or all of this information on separate sheet *(use similar format)* instead of completing these pages.

FORM C TABLE 1 FOR 3.0 - ITEMS A AND B

EFFLUENT (AND INTAKE) CHARACTERISTICS	THIS OUTFALL IS: Intake	OUTFALL NO

3.0 PART A – You must provide the results of at least one analysis for every pollutant in Part A. Complete one table for each outfall or proposed outfall. See instructions.

1. POLLUTANT	2. VALUES							3. UNITS *(specify if blank)*	
	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS
	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS			
A. Biochemical Oxygen Demand, 5-day (BOD_5)	<6.0	<1010					1	mg/L	lbs/day
B. Chemical Oxygen Demand (COD)	100	16,838					1	mg/L	lbs/day
C. Total Organic Carbon (TOC)	5.4	909					1	mg/L	lbs/day
D. Total Suspended Solids (TSS)	277	46,643					1	mg/L	lbs/day
E. Ammonia as N	<0.30	<50.5					1	mg/L	lbs/day
F. Flow	VALUE 20.19		VALUE		VALUE		1	MILLIONS OF GALLONS PER DAY (MGD)	
G. Temperature *(winter)*	VALUE 75.29		VALUE		VALUE		4	°F	
H. Temperature *(summer)*	VALUE		VALUE		VALUE			°F	
I. pH	MINIMUM 7.68		MAXIMUM 7.75		AVERAGE		4	STANDARD UNITS (SU)	

3.0 PART B – Mark "X" in column 2A for each pollutant you know or have reason to believe is present. Mark "X" in column 2B for each pollutant you believe to be absent. If you mark Column 2A for any pollutant, you must provide the results for at least one analysis for the pollutant. Complete one table for each outfall (intake). Provide results for additional parameters not listed here in Part 3.0 C.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUES		C. LONG TERM AVERAGE VALUES		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants											
A. Alkalinity ($CaCO_3$)	x		MINIMUM 130	21,890	MINIMUM		MINIMUM		1	mg/L	lbs/day
B. Bromide (24959-67-9)		x	<0.50	<84.19					1	mg/L	lbs/day
C. Chloride (16887-00-6)	x		26	4378					1	mg/L	lbs/day
D. Chlorine, Total Residual		x									
E. Color		x									
F. Conductivity		x									
F. Cyanide, Amenable to Chlorination		x	<0.0025	<0.42					4	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 1 – Conventional and Non-Conventional Pollutants (Continued)											
G. *E. coli*	x		261						1	MPN/100mL	lbs/day
H. Fluoride (16984-48-8)	x		<0.50	<84.2					1	mg/L	lbs/day
I. Nitrate plus Nitrate *(as N)*	x		2.4	404					1	mg/L	lbs/day
J. Kjeldahl, Total (as N)		x	<1.0	<168					1	mg/L	lbs/day
K. Nitrogen, Total Organic *(as N)*	x		<1.3	<219					1	mg/L	lbs/day
L. Oil and Grease	x		<5.1	<859					4	mg/L	lbs/day
M. Phenols, Total		x	<0.05	<8.4					4	mg/L	lbs/day
N. Phosphorus *(as P)*, Total (7723-14-0)	x		0.42	70.72					1	mg/L	lbs/day
O. Sulfate *(as SO^4)* (14808-79-8)	x		110	18,522					1	mg/L	lbs/day
P. Sulfide *(as S)*		x	<2.0	<337					1	mg/L	lbs/day
Q. Sulfite (as SO^3) (14265-45-3)		x	<2.0	<337					1	mg/L	lbs/day
R. Surfactants		x	<0.10	<17					1	mg/L	lbs/day
S. Trihalomethanes, Total		x	<0.005	<0.842					1	mg/L	lbs/day
Subpart 2 – Metals											
1M. Aluminum, Total Recoverable (7429-90-5)	x		7.6	1280					1	mg/L	lbs/day
2M. Antimony, Total Recoverable (7440-36-9)		x	<0.0006	<0.10					1	mg/L	lbs/day
3M. Arsenic, Total Recoverable (7440-38-2)		x	0.0056	0.94					1	mg/L	lbs/day
4M. Barium, Total Recoverable (7440-39-3)	x		0.19	32					1	mg/L	lbs/day
5M. Beryllium, Total Recoverable (7440-41-7)		x	0.00048	0.08					1	mg/L	lbs/day
6M. Boron, Total Recoverable (7440-42-8)	x		0.056	9.43					1	mg/L	lbs/day
7M. Cadmium, Total Recoverable (7440-43-9)		x	0.00029	0.05					1	mg/L	lbs/day
8M. Chromium III Total Recoverable (16065-83-1)		x	<0.0058						1	ug/L	
9M. Chromium VI, Dissolved (18540-29-9)		x	0.0053	0.89					1	mg/L	lbs/day
10M. Cobalt, Total Recoverable (7440-48-4)		x	0.0057	0.96					1	mg/L	lbs/day

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"		3. VALUES							4. UNITS	
	A. BELIEVED PRESENT	B. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE		C. LONG TERM AVERAGE VALUE		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS
			CONCENTRATION	MASS	CONCENTRATION	MASS	CONCENTRATION	MASS			
Subpart 2 – Metals (Continued)											
11M. Copper, Total Recoverable (7440-50-8)	x		0.014	2.36					1	mg/L	lbs/day
12M. Iron, Total Recoverable (7439-89-6)	x		14	2,357					1	mg/L	lbs/day
13M. Lead, Total Recoverable (7439-92-1)		x	0.0081	1.36					1	mg/L	lbs/day
14M. Magnesium, Total Recoverable (7439-95-4)	x		17	2,863					1	mg/L	lbs/day
15M. Manganese, Total Recoverable (7439-96-5)	x		0.48	81					1	mg/L	lbs/day
16M. Mercury, Total Recoverable (7439-97-6)		x	<0.0002	<0.034					1	mg/L	lbs/day
17M. Methylmercury (22967926)		x	0.150						1	ng/L	
18M. Molybdenum, Total Recoverable (7439-98-7)		x	0.0024	0.41					1	mg/L	lbs/day
19M. Nickel, Total Recoverable (7440-02-0)	x		0.015	2.53					1	mg/L	lbs/day
20M. Selenium, Total Recoverable (7782-49-2)		x	0.0016	0.27					1	mg/L	lbs/day
21M. Silver, Total Recoverable (7440-22-4)		x	<0.001	<0.17					1	mg/L	lbs/day
22M. Thallium, Total Recoverable (7440-28-0)		x	0.0003	0.05					1	mg/L	lbs/day
23M. Tin, Total Recoverable (7440-31-5)		x	<0.06	<10.1					1	mg/L	lbs/day
24M. Titanium, Total Recoverable (7440-32-6)	x		0.071	12					1	mg/L	lbs/day
25M. Zinc, Total Recoverable (7440-66-6)	x		0.038	6.4					1	mg/L	lbs/day
Subpart 3 – Radioactivity											
1R. Alpha Total	x		1.30						1	pCi/L	
2R. Beta Total	x		0.06						1	pCi/L	
3R. Radium Total		x									
4R. Radium 226 plus 228 Total	x		1.36						1	pCi/L	

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM, WATER POLLUTION BRANCH

FORM D – APPLICATION FOR DISCHARGE PERMIT – PRIMARY INDUSTRIES

FOR AGENCY USE ONLY	
CHECK NO.	
DATE RECEIVED	FEE SUBMITTED

NOTE: DO NOT ATTEMPT TO COMPLETE THIS FORM BEFORE READING THE ACCOMPANYING INSTRUCTIONS

1.00 NAME OF FACILITY
Ameren Missouri Callaway Energy Center

1.10 THIS FACILITY IS NOW IN OPERATION UNDER MISSOURI OPERATING PERMIT NUMBER
MO - 0098001

This form is to be filled out in addition to forms A and C "Application for Discharge Permit" for the Industries listed below:

INDUSTRY CATEGORY

Adhesives and sealants	Ore mining
Aluminum forming	Organic chemicals manufacturing
Auto and other laundries	Paint and ink formulation
Battery manufacturing	Pesticides
Coal mining	Petroleum refining
Coil coating	Pharmaceutical preparations
Copper forming	Photographic equipment and supplies
Electric and electronic compounds	Plastic and synthetic materials manufacturing
Electroplating	Plastic processing
Explosives manufacturing	Porcelain enameling
Foundries	Printing and publishing
Gum and wood chemicals	Pulp and paperboard mills
Inorganic chemicals manufacturing	Rubber processing
Iron and steel manufacturing	Soap and detergent manufacturing
Leather tanning and finishing	Steam electric power plants
Landfill	Textile mills
Mechanical products manufacturing	Timber products processing
Nonferrous metals manufacturing	

2.00 POTENTIAL DISCHARGES NOT COVERED BY ANALYSIS

A. IS ANY POLLUTANT LISTED IN ITEM 1.30 A SUBSTANCE OR A COMPONENT OF A SUBSTANCE WHICH YOU DO OR EXPECT THAT YOU WILL OVER THE NEXT FIVE YEARS USE OR MANUFACTURE AS AN INTERMEDIATE OR FINAL PRODUCT OR BYPRODUCT?

☐ YES *(LIST ALL SUCH POLLUTANTS BELOW)* ☒ NO *(GO TO B)*

B ARE YOUR OPERATIONS SUCH THAT YOUR RAW MATERIALS, PROCESSES OR PRODUCTS CAN REASONABLE BE EXPECTED TO VARY SO THAT YOUR DISCHARGES OF POLLUTANTS MAY DURING THE NEXT FIVE YEARS EXCEED TWO TIMES THE MAXIMUM VALUES REPORTED IN ITEM 1.30?

☐ YES *(COMPLETE C BELOW)* ☒ NO *(GO TO SECTION 3.00)*

C IF YOU ANSWERED "YES" TO ITEM B, EXPLAIN BELOW AND DESCRIBE IN DETAIL THE SOURCES AND EXPECTED LEVELS OF SUCH POLLUTANTS THAT YOU ANTICIPATE WILL BE DISCHARGED FROM EACH OUTFALL OVER THE NEXT FIVE YEARS, TO THE BEST OF YOUR ABILIITY AT THIS TIME. CONTINUE ON ADDITIONAL SHEETS IF YOU NEED MORE SPACE.

3.00 CONTRACT ANALYSIS INFORMATION

WERE ANY OF THE ANALYSES REPORTED IN 1.30 PERFORMED BY A CONTRACT LABORATORY OR CONSULTING FIRM?

☒ YES *(LIST THE NAME, ADDRESS, AND TELEPHONE NUMBER OF, AND ANALYZED BY, EACH SUCH LABORATORY OR FIRM BELOW)*

☐ NO *(GO TO SECTION 4.00)*

A. NAME	B. ADDRESS	C. TELEPHONE *(area code and number)*	D. POLLUTANTS ANALYZED *(list)*
PDC Laboratories, Inc.	3278 North Highway 67	(314) 595-7337	See Attachment E, NPDES
	Florissant, Mo 63033		Sampling & Analysis
Test America	13715 Rider Trail North	(314) 298-8566	See Attachment E, NPDES
	Earth City, Mo 63033		Sampling & Analysis
Pace Analytical	4730 Oneota St,	(218) 727-6380	See Attachment E, NPDES
	Duluth, MN 55807		Sampling & Analysis

4.00 CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME AND OFFICIAL TITLE (TYPE OR PRINT)	PHONE NUMBER (AREA CODE AND NUMBER)
Fadi Diya, Senior Vice President & Chief Nuclear Officer - Callaway Energy Center	(573) 823-6531
SIGNATURE	DATE SIGNED
Fadi Diya by Reghan Kehlbusch	12-20-19

APPLICATION FOR DISCHARGE PERMIT
FORM D – PRIMARY INDUSTRIES

TABLE II	
NPDES # (*IF ASSIGNED*)	OUTFALL NUMBER
MO-0098001	002

1.30 If you are a primary industry and this outfall contains process wastewater, refer to Table A in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-A for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. Mark "X" in column 2-B for each pollutant you know or have reason to believe is present. Mark "X" in column 2-C for each pollutant you believe to be absent. If you mark either columns 2-A or 2-B for any pollutant, you must provide the results of at least one analysis for that pollutant. Note that there are seven pages to this part, please review each carefully. Complete one table (*all seven pages*) for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (*optional*)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (*if available*)		C. LONG TERM AVRG. VALUE (*if available*)		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, AND TOTAL PHENOLS															
1M. Antimony, Total (7440-36-9)			✓	0.00094	0.0289					1	mg/L	lbs/d			
2M. Arsenic, Total (7440-38-2)		✓		0.0071	0.218					1	mg/L	lbs/d			
3M. Beryllium, Total (7440-41-7)			✓	<0.0002	<0.006					1	mg/L	lbs/d			
4M. Cadmium, Total (7440-43-9)			✓	<0.0002	<0.006					1	mg/L	lbs/d			
5M. Chromium III (16065-83-1)			✓	<0.0058	<0.178					1	mg/L	lbs/d			
6M. Chromium VI (18540-29-9)			✓	<0.005	<0.015					1	mg/L	lbs/d			
7M. Copper, Total (7440-50-8)		✓		0.012	0.368					1	mg/L	lbs/d			
8M. Lead, Total (7439-92-1)		✓		0.00035	0.011					1	mg/L	lbs/d			
9M. Magnesium Total (7439-95-4)		✓		35	1074					1	mg/L	lbs/d			
10M. Mercury, Total (7439-97-6)			✓	<0.0002	<0.006					1	mg/L	lbs/d			
11M. Molybdenum Total (7439-98-7)		✓		0.0059	0.181					1	mg/L	lbs/d			
12M. Nickel, Total (7440-02-0)		✓		0.0074	0.227					1	mg/L	lbs/d			
13M. Selenium, Total (7782-49-2)		✓		0.0031	0.095					1	mg/L	lbs/d			
14M. Silver, Total (7440-22-4)			✓	<0.001	<0.031					1	mg/L	lbs/d			
15M. Thallium, Total (7440-28-0)			✓	<0.0002	<0.006					1	mg/L	lbs/d			
16M. Tin Total (7440-31-5)			✓	<0.06	<1.841					1	mg/L	lbs/d			
17M. Titanium Total (7440-32-6)		✓		0.0064	0.196					1	mg/L	lbs/d			
18M. Zinc, Total (7440-66-6)		✓		0.0047	0.144					1	mg/L	lbs/d			

CONTINUED FROM PAGE 3

19M. Cyanide, Amenable to Chlorination			☑	<0.0025	<0.08					1	mg/L	lbs/d			
20M. Phenols, Total			☑	<0.05	<1.53					1	mg/L	lbs/d			
DIOXIN															
2,3,7,8 – Tetra – chlorodibenzo-P-Dioxin (1764-01-6)			☑	**DESCRIBE RESULTS**											

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (*optional*)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (*if available*)		C. LONG TERM AVRG. VALUE (*if available*)		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – VOLATILE COMPOUNDS															
1V. Acrolein (107-02-8)			☑	<50	<1.53					1	ug/L	lbs/d			
2V. Acrylonitrile (107-13-1)			☑	<50	<1.53					1	ug/L	lbs/d			
3V. Benzene (71-43-2)			☑	<5.0	<0.15					1	ug/L	lbs/d			
4V. Bis (*Chloromethyl*) Ether (542-88-1)			☑	<10000	<307					1	ug/L	lbs/d			
5V. Bromoform (75-25-2)			☑	<5.0	<0.15					1	ug/L	lbs/d			
6V. Carbon Tetrachloride (56-23-5)			☑	<5.0	<0.15					1	ug/L	lbs/d			
7V. Chlorobenzene (108-90-7)			☑	<5.0	<0.15					1	ug/L	lbs/d			
8V. Chlorodibromomethane (124-48-1)			☑	<5.0	<0.15					1	ug/L	lbs/d			
9V. Chloroethane (75-00-3)			☑	<5.0	<0.15					1	ug/L	lbs/d			
10V. 2-Chloroethylvinyl Ether (110-75-8)			☑	<5 0	<0.15					1	ug/L	lbs/d			
11V. Chloroform (67-66-3)			☑	<5.0	<0.15					1	ug/L	lbs/d			
12V. Dichlorobromomethane (75-27-4)			☑	<5.0	<0.15					1	ug/L	lbs/d			
13V. Dichloro-difluoromethane (75-71-8)			☑	<5.0	<0.15					1	ug/L	lbs/d			
14V. 1,1 – Dichloroethane (75-34-3)			☑	<5.0	<0.15					1	ug/L	lbs/d			
15V. 1,2 – Dichloroethane (107-06-2)			☑	<5.0	<0.15					1	ug/L	lbs/d			
16V. 1,1 – Dichloroethylene (75-35-4)			☑	<5.0	<0.15					1	ug/L	lbs/d			
17V. 1,3 – Dichloropropane (78-87-5)			☑	<5.0	<0.15					1	ug/L	lbs/d			
18V. 1,2 –Dichloropropylene (542-75-6)			☑	<5.0	<0.15					1	ug/L	lbs/d			
19V. Ethylbenzene (100-41-4)			☑	<5.0	<0.15					1	ug/L	lbs/d			
20V. Methyl Bromide (74-83-9)			☑	<5.0	<0.15					1	ug/L	lbs/d			
21V. Methyl Chloride (74-87-3)			☑	<5.0	<0.15					1	ug/L	lbs/d			

 CONTINUE ON PAGE 4

CONTINUED FROM THE FRONT

NPDES # (*IF ASSIGNED*)	OUTFALL NUMBER
MO-0098001	002

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (*optional*)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (*if available*)		C. LONG TERM AVRG. VALUE (*if available*)		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC.MS FRACTION – VOLATILE COMPOUNDS (*continued*)															
22V. Methylene Chloride (75-09-2)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
23V. 1,1,2,2 – Tetra-chloroethane (79-34-5)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
24V. Tetrachloroethylene (127-18-4)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
25V. Toluene (108-88-3)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
26V. 1,2 – Trans Dichloroethylene (156-60-5)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
27V. 1,1,1 – Tri – chloroethane (71-55-6)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
28V. 1,1,2 – Tri-chloroethane (79-00-5)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
29V. Trichloro – ethylene (79-01-6)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
30V. Trichloro – fluoromethane (75-69-4)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
31V. Vinyl Chloride (75-01-4)	☐	☐	☑	<5.0	<0.15					1	ug/L	lbs/d			
GC/MS FRACTION – ACID COMPOUNDS															
1A. 2 – Chlorophenol (95-57-8)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
2A. 2,4 – Dichloro – phenol (120-83-2)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
3A. 2,4 – Dimethyl – phenol (105-67-9)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
4A. 4,6 – Dinitro - O-Cresol (534-52-1)	☐	☐	☑	<20	<0.61					1	ug/L	lbs/d			
5A. 2,4 – Dinitro – phenol (51-28-5)	☐	☐	☑	<50	<1.53					1	ug/L	lbs/d			
6A. 2-Nitrophenol (88-75-5)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
7A. 4-Nitrophenol (100-02-7)	☐	☐	☑	<50	<1.53					1	ug/L	lbs/d			
8A. P – Chloro – M Cresol (59-50-7)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
9A. Pentachloro – phenol (87-86-5)	☐	☐	☑	<50	<1.53					1	ug/L	lbs/d			
10A. Phenol (108-952)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
11A. 2,4,6 – Trichloro-phenol (88-06-2)	☐	☐	☑	<50	<1.53					1	ug/L	lbs/d			
12A. 2 - methyl – 4,6 dinitrophenol (534-52-1)	☐	☐	☑	<50	<1.53					1	ug/L	lbs/d			

CONTINUE ON PAGE 5

CONTINUED FROM THE FRONT

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE *(optional)*		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE *(if available)*		C. LONG TERM AVRG. VALUE *(if available)*		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS															
1B. Acenaphthene (83-32-9)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
2B. Acenaphtylene (208-96-8)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
3B. Anthracene (120-12-7)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
4B. Benzidine (92-87-5)	☐	☐	☑	<80	<2.5					1	ug/L	lbs/d			
5B. Benzo (a) Anthracene (56-55-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
6B. Benzo (a) Pyrene (50-32-8)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
7B. 3,4 – Benzofluoranthene (205-99-2)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
8B. Benzo (ghi) Perylene (191-24-2)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
9B. Benzo (k) Fluoranthene (207-08-9)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
10B. Bis (2-Chloroethoxy) Methane (111-91-1)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
11B. Bis (2-Chloroethyl) Ether (111-44-4)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
12B. Bis (2-Chloroisopropyl) Ether (39638-32-9)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
13B. Bis (2-Ethylhexyl) Phthalate (117-81-7)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
14B. 4-Bromophenyl Phenyl Ether (101-55-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
15B. Butyl Benzyl Phthalate (85-68-7)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
16B. 2-Chloronaphthalene (91-56-7)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
17B. 4-Chlorophenyl Phenyl Ether (7005-72-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
18B. Chrysene (218-01-9)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
19B. Dibenzo (a,h) Anthracene (53-70-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
20B. 1,2 – Dichlorobenzene (95-50-1)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
21B. 1,3 – Dichlorobenzene (541-73-1)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			

 CONTINUE ON PAGE 6

CONTINUED FROM PAGE 5

NPDES # (IF ASSIGNED)	OUTFALL NUMBER
MO-0098001	002

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (optional)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (if available)		C. LONG TERM AVRG. VALUE (if available)		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS *(continued)*															
22B. 1, 4-Dichlorobenzene (106-46-7)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
23B. 3, 3'-Dichlorobenzidine (91-94-1)	☐	☐	☑	<20	<0.61					1	ug/L	lbs/d			
24B. Diethyl Phthalate (84-66-2)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
25B. Dimethyl Phthalate (131-11-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
26B. Di-N-butyl Phthalate (84-74-2)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
27B. 2,4-Dinitrotoluene (121-14-2)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
28B. 2,6-Dinitrotoluene (606-20-2)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
29B. Di-N-Octyphthalate (117-84-0)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
30B. 1,2-Diphenylhydrazine (as *Azobenzene*) (122-66-7)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
31B. Fluoranthene (206-44-0)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
32B. Fluorene (86-73-7)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
33B. Hexachlorobenzene (87-68-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
34B. Hexachlorobutadiene (87-68-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
35B. Hexachloro-cyclopentadiene (77-47-4)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
36B. Hexachloroethane (67-72-1)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
37B. Indeno (1,2,3-c-d) Pyrene (193-39-5)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
38B. Isophorone (78-59-1)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
39B. Naphthalene (91-20-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
40B. Nitrobenzene (98-95-3)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			
41B. N-Nitro-sodimethylamine (62-75-9)	☐	☐	☑	<10	<0.31					1	ug/L	lbs/d			

 CONTINUE ON PAGE 7

CONTINUED FROM THE FRONT

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X" A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	3. EFFLUENT A. MAXIMUM DAILY VALUE (1) CONCENTRATION	(2) MASS	B. MAXIMUM 30 DAY VALUE (*if available*) (1) CONCENTRATION	(2) MASS	C. LONG TERM AVRG. VALUE (*if available*) (1) CONCENTRATION	(2) MASS	D. NO. OF ANALYSES	4. UNITS A. CONCENTRATION	B. MASS	5. INTAKE (*optional*) A. LONG TERM AVRG. VALUE (1) CONCENTRATION	(2) MASS	B. NO OF ANALYSES
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS (*continued*)															
42B. N-Nitroso N-Propylamine (621-64-7)			✓	<10	<0.31					1	ug/L	lbs/d			
43B. N-Nitro-sodiphenylamine (86-30-6)			✓	<10	<0.31					1	ug/L	lbs/d			
44B. Phenanthrene (85-01-8)			✓	<10	<0.31					1	ug/L	lbs/d			
45B. Pyrene (129-00-0)			✓	<10	<0.31					1	ug/L	lbs/d			
46B. 1,2,4-Tri chlorobenzene (120-82-1)			✓	<10	<0.31					1	ug/L	lbs/d			
GC/MS FRACTION - PESTICIDES															
1P. Aldrin (309-00-2)			✓												
2P. α-BHC (319-84-6)			✓												
3P. β-BHC (319-84-6)			✓												
4P. γ-BHC (58-89-9)			✓												
5P. δ-BHC (319-86-8)			✓												
6P. Chlordane (57-74-9)			✓												
7P. 4,4'-DDT (50-29-3)			✓												
8P. 4,4'-DDE (72-55-9)			✓												
9P. 4,4'-DDD (72-54-8)			✓												
10P. Dieldrin (60-57-1)			✓												
11P. α-Endosulfan (115-29-7)			✓												
12P. β-Endosulfan (115-29-7)			✓												
13P. Endosulfan Sulfate (1031-07-8)			✓												
14P. Endrin (72-20-8)			✓												
15P. Endrin Aldehyde (7421-93-4)			✓												
16P. Heptachlor (76-44-8)			✓												

 CONTINUED ON PAGE 8

CONTINUED FROM PAGE 7

NPDES # (IF ASSIGNED): MO-0098001

OUTFALL NUMBER: 002

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (optional)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (if available)		C. LONG TERM AVRG. VALUE (if available)		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – PESTICISES *(continued)*															
17P. Heptachlor Epoxide (1024-57-3)	☐	☐	☑												
18P. PCB-1242 (53469-21-9)	☐	☐	☑												
19P. PBC-1254 (11097-69-1)	☐	☐	☑												
20P. PCB-1221 (11104-28-2)	☐	☐	☑												
21P. PCB-1232 (11141-16-5)	☐	☐	☑												
22P. PCB-1248 (12672-29-6)	☐	☐	☑												
23P. PCB-1260 (11096-82-5)	☐	☐	☑												
24P. PCB-1016 (12674-11-2)	☐	☐	☑												
25P. Toxaphene (8001-35-2)	☐	☐	☑												
J. RADIOACTIVITY															
(1) Alpha Total	☐	☐	☑												
(2) Beta Total	☐	☑	☐							1	pCi/L				
(3) Radium Total	☐	☐	☑												
(4) Radium 226 Total	☐	☐	☑												

APPLICATION FOR DISCHARGE PERMIT
FORM D – PRIMARY INDUSTRIES

TABLE II	
NPDES # *(IF ASSIGNED)*	OUTFALL NUMBER
MO-0098001	003

1.30 If you are a primary industry and this outfall contains process wastewater, refer to Table A in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-A for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. Mark "X" in column 2-B for each pollutant you know or have reason to believe is present. Mark "X" in column 2-C for each pollutant you believe to be absent. If you mark either columns 2-A or 2-B for any pollutant, you must provide the results of at least one analysis for that pollutant. Note that there are seven pages to this part, please review each carefully. Complete one table (*all seven pages*) for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE *(optional)*		
	A. TEST-ING REQUIRED	B. BELIEVE D PRESENT	C. BELIEVE D ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE *(if available)*		C. LONG TERM AVRG. VALUE *(if available)*		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, AND TOTAL PHENOLS															
1M. Antimony, Total (7440-36-9)	✓		✓	<0.0006	<0.1					1	mg/L	lbs/d	<0.0006	<0.1	1
2M. Arsenic, Total (7440-38-2)	✓		✓	0.008	0.002					1	mg/L	lbs/d	0.0056	0.94	1
3M. Beryllium, Total (7440-41-7)	✓	✓		<0.0002	<0.001					1	mg/L	lbs/d	0.00048	0.08	1
4M. Cadmium, Total (7440-43-9)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/d	0.0003	0.05	1
5M. Chromium III (16065-83-1)	✓		✓	<0.0058	<0.001					1	mg/L	lbs/d	<0.0058	<0.01	1
6M. Chromium VI (18540-29-9)	✓		✓	0.0057	0.0013					1	mg/L	lbs/d	0.0053	0.89	1
7M. Copper, Total (7440-50-8)	✓		✓	<0.0006	<0.001					1	mg/L	lbs/d	0.014	2.36	1
8M. Lead, Total (7439-92-1)	✓	✓		0.00028	<0.001					1	mg/L	lbs/d	0.0081	1.36	1
9M. Magnesium Total (7439-95-4)	✓	✓		12	2.64					1	mg/L	lbs/d	17	2863	1
10M. Mercury, Total (7439-97-6)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/d	<0.0002	<0.01	1
11M. Molybdenum Total (7439-98-7)	✓	✓		0.0006	<0.001					1	mg/L	lbs/d	0.0024	0.404	1
12M. Nickel, Total (7440-02-0)	✓		✓	<0.001	<0.001					1	mg/L	lbs/d	0.015	2.53	1
13M. Selenium, Total (7782-49-2)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/d	0.0016	2.69	1
14M. Silver, Total (7440-22-4)	✓		✓	<0.001	<0.001					1	mg/L	lbs/d	<0.001	<0.01	1
15M. Thallium, Total (7440-28-0)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/d	0.0003	0.05	1
16M. Tin Total (7440-31-5)	✓		✓	<0.06	<0.001					1	mg/L	lbs/d	<0.06	<0.01	1
17M. Titanium Total (7440-32-6)	✓	✓		<0.005	<0.001					1	mg/L	lbs/d	0.071	11.96	1
18M. Zinc, Total (7440-66-6)	✓	✓		0.0039	<0.001					1	mg/L	lbs/d	0.038	6.40	1

CONTINUED FROM PAGE 3

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (*optional*)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE (1) CONCENTRATION	A. MAXIMUM DAILY VALUE (2) MASS	B. MAXIMUM 30 DAY VALUE (*if available*) (1) CONCENTRATION	B. MAXIMUM 30 DAY VALUE (*if available*) (2) MASS	C. LONG TERM AVRG. VALUE (*if available*) (1) CONCENTRATION	C. LONG TERM AVRG. VALUE (*if available*) (2) MASS	D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE (1) CONCENTRATION	A. LONG TERM AVRG. VALUE (2) MASS	B. NO OF ANALYSES
19M. Cyanide, Amenable to Chlorination	☑	☐	☑	<0.0025	<0.001					4	mg/L	lbs/d	<0.0025	<0.01	4
20M. Phenols, Total	☑	☐	☑	<0.05	<0.01					4	mg/L	lbs/d	<0.05	<0.01	4
DIOXIN															
2,3,7,8 – Tetra – chlorodibenzo-P-Dioxin (1764-01-6)	☐	☐	☑	**DESCRIBE RESULTS** Testing Not Required											
GC/MS FRACTION – VOLATILE COMPOUNDS															
1V. Acrolein (107-02-8)	☑	☐	☑	<50	<0.011					1	ug/L	lbs/d	<50	<8.5	1
2V. Acrylonitrile (107-13-1)	☑	☐	☑	<50	<0.011					1	ug/L	lbs/d	<50	<8.5	1
3V. Benzene (71-43-2)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
4V. Bis (*Chloromethyl*) Ether (542-88-1)	☑	☐	☑	<10000	<2.20					1	ug/L	lbs/d	<10000	<2K	1
5V. Bromoform (75-25-2)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
6V. Carbon Tetrachloride (56-23-5)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
7V. Chlorobenzene (108-90-7)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
8V. Chlorodibromomethane (124-48-1)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
9V. Chloroethane (75-00-3)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
10V. 2-Chloroethylvinyl Ether (110-75-8)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
11V. Chloroform (67-66-3)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
12V. Dichlorobromomethane (75-27-4)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
13V. Dichloro-difluoromethane (75-71-8)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
14V. 1,1 – Dichloroethane (75-34-3)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
15V. 1,2 – Dichloroethane (107-06-2)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
16V. 1,1 – Dichloroethylene (75-35-4)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
17V. 1,3 – Dichloropropane (78-87-5)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
18V. 1,2 –Dichloropropylene (542-75-6)	☑	☐	☑	<15	<0.004					1	ug/L	lbs/d	<5.0	<0.9	1
19V. Ethylbenzene (100-41-4)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
20V. Methyl Bromide (74-83-9)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
21V. Methyl Chloride (74-87-3)	☑	☐	☑	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1

 CONTINUE ON PAGE 4

CONTINUED FROM THE FRONT

NPDES # (IF ASSIGNED)	OUTFALL NUMBER
MO-0098001	003

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X" A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	3. EFFLUENT A. MAXIMUM DAILY VALUE (1) CONCENTRATION	(2) MASS	B. MAXIMUM 30 DAY VALUE (if available) (1) CONCENTRATION	(2) MASS	C. LONG TERM AVRG. VALUE (if available) (1) CONCENTRATION	(2) MASS	D. NO. OF ANALYSES	4. UNITS A. CONCENTRATION	B. MASS	5. INTAKE (optional) A. LONG TERM AVRG. VALUE (1) CONCENTRATION	(2) MASS	B. NO OF ANALYSES
GC.MS FRACTION – VOLATILE COMPOUNDS *(continued)*															
22V. Methylene Chloride (75-09-2)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
23V. 1,1,2,2 – Tetra-chloroethane (79-34-5)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
24V. Tetrachloroethylene (127-18-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
25V. Toluene (108-88-3)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
26V. 1,2 – Trans Dichloroethylene (156-60-5)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
27V. 1,1,1 – Tri – chloroethane (71-55-6)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
28V. 1,1,2 – Tri-chloroethane (79-00-5)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
29V. Trichloro – ethylene (79-01-6)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
30V. Trichloro – fluoromethane (75-69-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
31V. Vinyl Chloride (75-01-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
GC/MS FRACTION – ACID COMPOUNDS															
1A. 2 – Chlorophenol (95-57-8)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
2A. 2,4 – Dichloro – phenol (120-83-2)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
3A. 2,4 – Dimethyl – phenol (105-67-9)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
4A. 4,6 – Dinitro - O-Cresol (534-52-1)	✓		✓	<20	<0.003					1	ug/L	lbs/d	<50	<8.5	1
5A. 2,4 – Dinitro – phenol (51-28-5)	✓		✓	<50	<0.011					1	ug/L	lbs/d	<50	<8.5	1
6A. 2-Nitrophenol (88-75-5)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
7A. 4-Nitrophenol (100-02-7)	✓		✓	<50	<0.011					1	ug/L	lbs/d	<50	<8.5	1
8A. P – Chloro – M Cresol (59-50-7)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
9A. Pentachloro – phenol (87-86-5)	✓		✓	<50	<0.011					1	ug/L	lbs/d	<50	<8.5	1
10A. Phenol (108-952)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
11A. 2,4,6 – Trichloro-phenol (88-06-2)	✓		✓	<50	<0.011					1	ug/L	lbs/d	<50	<8.5	1
12A. 2 - methyl – 4,6 dinitrophenol (534-52-1)	✓		✓	<50	<0.011					1	ug/L	lbs/d	<50	<8.5	1

CONTINUE ON PAGE 5

CONTINUED FROM THE FRONT

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (optional)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (if available)		C. LONG TERM AVRG. VALUE (if available)		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS															
1B. Acenaphthene (83-32-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
2B. Acenaphtylene (208-96-8)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
3B. Anthracene (120-12-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
4B. Benzidine (92-87-5)	☑	☐	☑	<80	<0.02					1	ug/L	lbs/d	<80	<13.5	1
5B. Benzo (a) Anthracene (56-55-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
6B. Benzo (a) Pyrene (50-32-8)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
7B. 3,4 – Benzofluoranthene (205-99-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
8B. Benzo (ghi) Perylene (191-24-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
9B. Benzo (k) Fluoranthene (207-08-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
10B. Bis (2-Chloroethoxy) Methane (111-91-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
11B. Bis (2-Chloroethyl) Ether (111-44-4)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
12B. Bis (2-Chloroisopropyl) Ether (39638-32-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
13B. Bis (2-Ethylhexyl) Phthalate (117-81-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
14B. 4-Bromophenyl Phenyl Ether (101-55-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
15B. Butyl Benzyl Phthalate (85-68-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
16B. 2-Chloronaphthalene (91-58-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
17B. 4-Chlorophenyl Phenyl Ether (7005-72-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
18B. Chrysene (218-01-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
19B. Dibenzo (a,h) Anthracene (53-70-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
20B. 1,2 – Dichlorobenzene (95-50-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
21B. 1,3 – Dichlorobenzene (541-73-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<5.0	<0.9	1

 CONTINUE ON PAGE 6

CONTINUED FROM PAGE 5

NPDES # (IF ASSIGNED)	OUTFALL NUMBER
MO-0098001	003

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (optional)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (if available)		C. LONG TERM AVRG. VALUE (if available)		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS *(continued)*															
22B. 1, 4-Dichlorobenzene (106-46-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<5.0	<0.9	1
23B. 3, 3'-Dichlorobenzidine (91-94-1)	☑	☐	☑	<20	<0.003					1	ug/L	lbs/d	<20	<3.4	1
24B. Diethyl Phthalate (84-66-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
25B. Dimethyl Phthalate (131-11-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
26B. Di-N-butyl Phthalate (84-74-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
27B. 2,4-Dinitrotoluene (121-14-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
28B. 2,6-Dinitrotoluene (606-20-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
29B. Di-N-Octyphthalate (117-84-0)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
30B. 1,2-Diphenylhydrazine (*as Azobenzene*) (122-66-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
31B. Fluoranthene (206-44-0)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
32B. Fluorene (86-73-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
33B. Hexachlorobenzene (87-68-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
34B. Hexachlorobutadiene (87-68-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
35B. Hexachloro-cyclopentadiene (77-47-4)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
36B. Hexachloroethane (67-72-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
37B. Indeno (1,2,3-c-d) Pyrene (193-39-5)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
38B. Isophorone (78-59-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
39B. Naphthalene (91-20-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
40B. Nitrobenzene (98-95-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
41B. N-Nitro-sodimethylamine (62-75-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1

CONTINUE ON PAGE 7

CONTINUED FROM THE FRONT

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE *(optional)*		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE *(if available)*		C. LONG TERM AVRG. VALUE *(if available)*		D. NO. OF ANALYSES	a. CONCENTRATION	b. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS *(continued)*															
42B. N-Nitroso N-Propylamine (621-64-7)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
43B. N-Nitro-sodiphenylamine (86-30-6)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
44B. Phenanthrene (85-01-8)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
45B. Pyrene (129-00-0)	✓		✓	<10	<0.003					1	ug/L	lbs/d	<10	<1.7	1
46B. 1,2,4-Tri chlorobenzene (120-82-1)	✓		✓	<5.0	<0.002					1	ug/L	lbs/d	<5.0	<0.9	1
GC/MS FRACTION - PESTICIDES															
1P. Aldrin (309-00-2)			✓												
2P. α-BHC (319-84-6)			✓												
3P. β-BHC (319-84-6)			✓												
4P. γ-BHC (58-89-9)			✓												
5P. δ-BHC (319-86-8)			✓												
6P. Chlordane (57-74-9)			✓												
7P. 4,4'-DDT (50-29-3)			✓												
8P. 4,4'-DDE (72-55-9)			✓												
9P. 4,4'-DDD (72-54-8)			✓												
10P. Dieldrin (60-57-1)			✓												
11P. α-Endosulfan (115-29-7)			✓												
12P. β-Endosulfan (115-29-7)			✓												
13P. Endosulfan Sulfate (1031-07-8)			✓												
14P. Endrin (72-20-8)			✓												
15P. Endrin Aldehyde (7421-93-4)			✓												
16P. Heptachlor (76-44-8)			✓												

CONTINUED ON PAGE 8

CONTINUED FROM PAGE 7

NPDES # (IF ASSIGNED)	OUTFALL NUMBER
MO-0098001	003

1. POLLUTANT AND CAS NUMBER (If available)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (optional)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE (1) CONCENTRATION	A. MAXIMUM DAILY VALUE (2) MASS	B. MAXIMUM 30 DAY VALUE (if available) (1) CONCENTRATION	B. MAXIMUM 30 DAY VALUE (if available) (2) MASS	C. LONG TERM AVRG. VALUE (if available) (1) CONCENTRATION	C. LONG TERM AVRG. VALUE (if available) (2) MASS	D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE (1) CONCENTRATION	A. LONG TERM AVRG. VALUE (2) MASS	B. NO OF ANALYSES
GC/MS FRACTION – PESTICISES (continued)															
17P. Heptachlor Epoxide (1024-57-3)			✓												
18P. PCB-1242 (53469-21-9)			✓												
19P. PBC-1254 (11097-69-1)			✓												
20P. PCB-1221 (11104-28-2)			✓												
21P. PCB-1232 (11141-16-5)			✓												
22P. PCB-1248 (12672-29-6)			✓												
23P. PCB-1260 (11096-82-5)			✓												
24P. PCB-1016 (12674-11-2)			✓												
25P. Toxaphene (8001-35-2)			✓												
J. RADIOACTIVITY															
(1) Alpha Total			✓	<0.696						1	pCi/L		1.30		1
(2) Beta Total			✓	<0.696						1	pCi/L		0.059		1
(3) Radium Total			✓												
(4) Radium 226 Total			✓	<0.696						1	pCi/L		1.36		1

APPLICATION FOR DISCHARGE PERMIT
FORM D – PRIMARY INDUSTRIES

TABLE II	
NPDES # *(IF ASSIGNED)*	OUTFALL NUMBER
MO-0098001	007

1.30 If you are a primary industry and this outfall contains process wastewater, refer to Table A in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-A for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. Mark "X" in column 2-B for each pollutant you know or have reason to believe is present. Mark "X" in column 2-C for each pollutant you believe to be absent. If you mark either columns 2-A or 2-B for any pollutant, you must provide the results of at least one analysis for that pollutant. Note that there are seven pages to this part, please review each carefully. Complete one table (*all seven pages*) for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE *(optional)*		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE *(if available)*		C. LONG TERM AVRG. VALUE *(if available)*		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, AND TOTAL PHENOLS															
1M. Antimony, Total (7440-36-9)	✓		✓	<0.0006	<0.001					1	mg/L	lbs/day			
2M. Arsenic, Total (7440-38-2)	✓		✓	0.0007	<0.001					1	mg/L	lbs/day			
3M. Beryllium, Total (7440-41-7)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/day			
4M. Cadmium, Total (7440-43-9)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/day			
5M. Chromium III (16065-83-1)	✓		✓	<5.8	<0.87					1	ug/L	lbs/day			
6M. Chromium VI (18540-29-9)	✓		✓	0.007	0.001					1	mg/L	lbs/day			
7M. Copper, Total (7440-50-8)	✓		✓	<0.0006	<0.001					1	mg/L	lbs/day			
8M. Lead, Total (7439-92-1)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/day			
9M. Magnesium Total (7439-95-4)	✓	✓		18	2.7					1	mg/L	lbs/day			
10M. Mercury, Total (7439-97-6)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/day			
11M. Molybdenum Total (7439-98-7)	✓	✓		0.00044	<0.001					1	mg/L	lbs/day			
12M. Nickel, Total (7440-02-0)	✓	✓		<0.001	<0.001					1	mg/L	lbs/day			
13M. Selenium, Total (7782-49-2)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/day			
14M. Silver, Total (7440-22-4)	✓		✓	<0.0001	<0.001					1	mg/L	lbs/day			
15M. Thallium, Total (7440-28-0)	✓		✓	<0.0002	<0.001					1	mg/L	lbs/day			
16M. Tin Total (7440-31-5)	✓		✓	<0.06	<0.009					1	mg/L	lbs/day			
17M. Titanium Total (7440-32-6)	✓		✓	<0.005	<0.001					1	mg/L	lbs/day			
18M. Zinc, Total (7440-66-6)	✓	✓		0.0038	<0.001					1	mg/L	lbs/day			

CONTINUED FROM PAGE 3

19M. Cyanide, Amenable to Chlorination	☑	☐	☑	<0.0025	<0.001					1	mg/L	lbs/day			
20M. Phenols, Total	☑	☐	☑	<0.05	<0.008					1	mg/L	lbs/day			
DIOXIN															
2,3,7,8 – Tetra – chlorodibenzo-P-Dioxin (1764-01-6)	☐	☐	☑	**DESCRIBE RESULTS**											
1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE *(optional)*		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE *(if available)*		C. LONG TERM AVRG. VALUE *(if available)*		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – VOLATILE COMPOUNDS															
1V. Acrolein (107-02-8)	☑	☐	☑	<50	<0.008					1	ug/L	lbs/day			
2V. Acrylonitrile (107-13-1)	☑	☐	☑	<50	<0.008					1	ug/L	lbs/day			
3V. Benzene (71-43-2)	☑	☐	☑	<5.0	<0.008					1	ug/L	lbs/day			
4V. Bis (*Chloromethyl*) Ether (542-88-1)	☑	☐	☑	<10000	<1502					1	ug/L	lbs/day			
5V. Bromoform (75-25-2)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
6V. Carbon Tetrachloride (56-23-5)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
7V. Chlorobenzene (108-90-7)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
8V. Chlorodibromomethane (124-48-1)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
9V. Chloroethane (75-00-3)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
10V. 2-Chloroethylvinyl Ether (110-75-8)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
11V. Chloroform (67-66-3)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
12V. Dichlorobromomethane (75-27-4)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
13V. Dichloro-difluoromethane (75-71-8)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
14V. 1,1 – Dichloroethane (75-34-3)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
15V. 1,2 – Dichloroethane (107-06-2)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
16V. 1,1 – Dichloroethylene (75-35-4)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
17V. 1,3 – Dichloropropane (78-87-5)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
18V. 1,2 –Dichloropropylene (542-75-6)	☑	☐	☑	<15	<0.003					1	ug/L	lbs/day			
19V. Ethylbenzene (100-41-4)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
20V. Methyl Bromide (74-83-9)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			
21V. Methyl Chloride (74-87-3)	☑	☐	☑	<5.0	<0.001					1	ug/L	lbs/day			

 CONTINUE ON PAGE 4

CONTINUED FROM THE FRONT

NPDES # (*IF ASSIGNED*)	OUTFALL NUMBER
MO-0098001	007

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (*optional*)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (*if available*)		C. LONG TERM AVRG. VALUE (*if available*)		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC.MS FRACTION – VOLATILE COMPOUNDS (*continued*)															
22V. Methylene Chloride (75-09-2)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
23V. 1,1,2,2 – Tetra-chloroethane (79-34-5)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
24V. Tetrachloroethylene (127-18-4)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
25V. Toluene (108-88-3)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
26V. 1,2 – Trans Dichloroethylene (156-60-5)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
27V. 1,1,1 – Tri – chloroethane (71-55-6)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
28V. 1,1,2 – Tri-chloroethane (79-00-5)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
29V. Trichloro – ethylene (79-01-6)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
30V. Trichloro – fluoromethane (75-69-4)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
31V. Vinyl Chloride (75-01-4)	X		X	<5.0	<0.001					1	ug/L	lbs/day			
GC/MS FRACTION – ACID COMPOUNDS															
1A. 2 – Chlorophenol (95-57-8)	X		X	<10	<0.002					1	ug/L	lbs/day			
2A. 2,4 – Dichloro – phenol (120-83-2)	X		X	<10	<0.002					1	ug/L	lbs/day			
3A. 2,4 – Dimethyl – phenol (105-67-9)	X		X	<10	<0.002					1	ug/L	lbs/day			
4A. 4,6 – Dinitro - O-Cresol (534-52-1)	X		X	<20	<0.003					1	ug/L	lbs/day			
5A. 2,4 – Dinitro – phenol (51-28-5)	X		X	<50	<0.008					1	ug/L	lbs/day			
6A. 2-Nitrophenol (88-75-5)	X		X	<10	<0.002					1	ug/L	lbs/day			
7A. 4-Nitrophenol (100-02-7)	X		X	<50	<0.008					1	ug/L	lbs/day			
8A. P – Chloro – M Cresol (59-50-7)	X		X	<10	<0.002					1	ug/L	lbs/day			
9A. Pentachloro – phenol (87-86-5)	X		X	<50	<0.008					1	ug/L	lbs/day			
10A. Phenol (108-952)	X		X	<10	<0.002					1	ug/L	lbs/day			
11A. 2,4,6 – Trichloro-phenol (88-06-2)	X		X	<50	<0.008					1	ug/L	lbs/day			
12A. 2 - methyl – 4,6 dinitrophenol (534-52-1)	X		X	<50	<0.008					1	ug/L	lbs/day			

CONTINUE ON PAGE 5

CONTINUED FROM THE FRONT

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X" A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	3. EFFLUENT A. MAXIMUM DAILY VALUE (1) CONCENTRATION	(2) MASS	B. MAXIMUM 30 DAY VALUE (*if available*) (1) CONCENTRATION	(2) MASS	C. LONG TERM AVRG. VALUE (*if available*) (1) CONCENTRATION	(2) MASS	D. NO. OF ANALYSES	4. UNITS A. CONCEN-TRATION	B. MASS	5. INTAKE (*optional*) A. LONG TERM AVRG. VALUE (1) CONCENTRATION	(2) MASS	B. NO OF ANALYSES
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS															
1B. Acenaphthene (83-32-9)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
2B. Acenaphtylene (208-96-8)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
3B. Anthracene (120-12-7)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
4B. Benzidine (92-87-5)	☑	☐	☑	<80	<0.013					1	ug/L	lbs/day			
5B. Benzo (a) Anthracene (56-55-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
6B. Benzo (a) Pyrene (50-32-8)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
7B. 3,4 – Benzofluoranthene (205-99-2)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
8B. Benzo (ghi) Perylene (191-24-2)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
9B. Benzo (k) Fluoranthene (207-08-9)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
10B. Bis (2-Chloroethoxy) Methane (111-91-1)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
11B. Bis (2-Chloroethyl) Ether (111-44-4)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
12B. Bis (2-Chloroisopropyl) Ether (39638-32-9)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
13B. Bis (2-Ethylhexyl) Phthalate (117-81-7)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
14B. 4-Bromophenyl Phenyl Ether (101-55-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
15B. Butyl Benzyl Phthalate (85-68-7)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
16B. 2-Chloronaphthalene (91-58-7)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
17B. 4-Chlorophenyl Phenyl Ether (7005-72-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
18B. Chrysene (218-01-9)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
19B. Dibenzo (a,h) Anthracene (53-70-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
20B. 1,2 – Dichlorobenzene (95-50-1)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
21B. 1,3 – Dichlorobenzene (541-73-1)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			

CONTINUE ON PAGE 6

CONTINUED FROM PAGE 5

NPDES # (IF ASSIGNED)	OUTFALL NUMBER
MO-0098001	007

1. POLLUTANT AND CAS NUMBER *(if available)*	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE *(optional)*		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE *(if available)*		C. LONG TERM AVRG. VALUE *(if available)*		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS *(continued)*															
22B. 1, 4-Dichlorobenzene (106-46-7)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
23B. 3, 3'-Dichlorobenzidine (91-94-1)	☑	☐	☑	<20	<0.004					1	ug/L	lbs/day			
24B. Diethyl Phthalate (84-66-2)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
25B. Dimethyl Phthalate (131-11-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
26B. Di-N-butyl Phthalate (84-74-2)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
27B. 2,4-Dinitrotoluene (121-14-2)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
28B. 2,6-Dinitrotoluene (606-20-2)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
29B. Di-N-Octyphthalate (117-84-0)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
30B. 1,2-Diphenylhydrazine *(as Azobenzene)* (122-66-7)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
31B. Fluoranthene (206-44-0)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
32B. Fluorene (86-73-7)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
33B. Hexachlorobenzene (87-68-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
34B. Hexachlorobutadiene (87-68-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
35B. Hexachloro-cyclopentadiene (77-47-4)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
36B. Hexachloroethane (67-72-1)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
37B. Indeno (1,2,3-c-d) Pyrene (193-39-5)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
38B. Isophorone (78-59-1)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
39B. Naphthalene (91-20-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
40B. Nitrobenzene (98-95-3)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			
41B. N-Nitro-sodimethylamine (62-75-9)	☑	☐	☑	<10	<0.002					1	ug/L	lbs/day			

 CONTINUE ON PAGE 7

CONTINUED FROM THE FRONT

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X" A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	3. EFFLUENT A. MAXIMUM DAILY VALUE (1) CONCENTRATION	(2) MASS	B. MAXIMUM 30 DAY VALUE (if available) (1) CONCENTRATION	(2) MASS	C. LONG TERM AVRG. VALUE (if available) (1) CONCENTRATION	(2) MASS	D. NO. OF ANALYSES	4. UNITS A. CONCENTRATION	B. MASS	5. INTAKE (optional) A. LONG TERM AVRG. VALUE (1) CONCENTRATION	(2) MASS	B. NO OF ANALYSES
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS *(continued)*															
42B. N-Nitroso N-Propylamine (621-64-7)	✓		✓	<10	<0.002					1	ug/L	lbs/day			
43B. N-Nitro-sodiphenylamine (86-30-6)	✓		✓	<10	<0.002					1	ug/LL	lbs/day			
44B. Phenanthrene (85-01-8)	✓		✓	<10	<0.002					1	ug/L	lbs/day			
45B. Pyrene (129-00-0)	✓		✓	<10	<0.002					1	ug/L	lbs/day			
46B. 1,2,4-Tri chlorobenzene (120-82-1)	✓		✓	<5.0	<0.001					1	ug/L	lbs/day			
GC/MS FRACTION - PESTICIDES															
1P. Aldrin (309-00-2)			✓												
2P. α-BHC (319-84-6)			✓												
3P. β-BHC (319-84-6)			✓												
4P. γ-BHC (58-89-9)			✓												
5P. δ-BHC (319-86-8)			✓												
6P. Chlordane (57-74-9)			✓												
7P. 4,4'-DDT (50-29-3)			✓												
8P. 4,4'-DDE (72-55-9)			✓												
9P. 4,4'-DDD (72-54-8)			✓												
10P. Dieldrin (60-57-1)			✓												
11P. α-Endosulfan (115-29-7)			✓												
12P. β-Endosulfan (115-29-7)			✓												
13P. Endosulfan Sulfate (1031-07-8)			✓												
14P. Endrin (72-20-8)			✓												
15P. Endrin Aldehyde (7421-93-4)			✓												
16P. Heptachlor (76-44-8)			✓												

CONTINUED ON PAGE 8

CONTINUED FROM PAGE 7

NPDES # (IF ASSIGNED)	OUTFALL NUMBER
MO-0098001	007

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (optional)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (if available)		C. LONG TERM AVRG. VALUE (if available)		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – PESTICISES *(continued)*															
17P. Heptachlor Epoxide (1024-57-3)	☐	☐	☑												
18P. PCB-1242 (53469-21-9)	☐	☐	☑												
19P. PBC-1254 (11097-69-1)	☐	☐	☑												
20P. PCB-1221 (11104-28-2)	☐	☐	☑												
21P. PCB-1232 (11141-16-5)	☐	☐	☑												
22P. PCB-1248 (12672-29-6)	☐	☐	☑												
23P. PCB-1260 (11096-82-5)	☐	☐	☑												
24P. PCB-1016 (12674-11-2)	☐	☐	☑												
25P. Toxaphene (8001-35-2)	☐	☐	☑												
J. RADIOACTIVITY															
(1) Alpha Total	☐	☐	☑	<0.606						1	pCi/L				
(2) Beta Total	☐	☐	☑	<0.981						1	pCi/L				
(3) Radium Total	☐	☐	☑												
(4) Radium 226 Total	☐	☐	☑	<0.981						1	pCi/L				

APPLICATION FOR DISCHARGE PERMIT
FORM D – PRIMARY INDUSTRIES

TABLE II	
NPDES # (*IF ASSIGNED*)	OUTFALL NUMBER
MO-0098001	016

1.30 If you are a primary industry and this outfall contains process wastewater, refer to Table A in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-A for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. Mark "X" in column 2-B for each pollutant you know or have reason to believe is present. Mark "X" in column 2-C for each pollutant you believe to be absent. If you mark either columns 2-A or 2-B for any pollutant, you must provide the results of at least one analysis for that pollutant. Note that there are seven pages to this part, please review each carefully. Complete one table (*all seven pages*) for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (*optional*)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (*if available*)		C. LONG TERM AVRG. VALUE (*if available*)		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, AND TOTAL PHENOLS															
1M. Antimony, Total (7440-36-9)	✓		✓	<0.0006	<0.014					1	mg/L	lbs/day			
2M. Arsenic, Total (7440-38-2)	✓	✓		0.0026	0.062					1	mg/L	lbs/day			
3M. Beryllium, Total (7440-41-7)	✓		✓	<0.0002	<0.0048					1	mg/L	lbs/day			
4M. Cadmium, Total (7440-43-9)	✓		✓	<0.0002	<0.0048					1	mg/L	lbs/day			
5M. Chromium III (16065-83-1)	✓		✓	<5.8	<139					1	mg/L	lbs/day			
6M. Chromium VI (18540-29-9)	✓	✓		0.0055	0.132					1	mg/L	lbs/day			
7M. Copper, Total (7440-50-8)	✓	✓		0.0021	0.05					1	mg/L	lbs/day			
8M. Lead, Total (7439-92-1)	✓		✓	<0.0002	<0.0048					1	mg/L	lbs/day			
9M. Magnesium Total (7439-95-4)	✓	✓		15	360.3					1	mg/L	lbs/day			
10M. Mercury, Total (7439-97-6)	✓		✓	<0.0002	<0.0048					1	mg/L	lbs/day			
11M. Molybdenum Total (7439-98-7)	✓	✓		0.0026	0.062					1	mg/L	lbs/day			
12M. Nickel, Total (7440-02-0)	✓	✓		0.0026	0.062					1	mg/L	lbs/day			
13M. Selenium, Total (7782-49-2)	✓	✓		0.0012	0.029					1	mg/L	lbs/day			
14M. Silver, Total (7440-22-4)	✓		✓	<0.001	<0.024					1	mg/L	lbs/day			
15M. Thallium, Total (7440-28-0)	✓		✓	<0.0002	<0.0048					1	mg/L	lbs/day			
16M. Tin Total (7440-31-5)	✓		✓	<0.06	<1.44					1	mg/L	lbs/day			
17M. Titanium Total (7440-32-6)	✓		✓	<0.005	<0.12					1	mg/L	lbs/day			
18M. Zinc, Total (7440-66-6)	✓	✓		0.0037	0.089					1	mg/L	lbs/day			

CONTINUED FROM PAGE 3

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (optional)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE (1) CONCENTRATION	A. MAXIMUM DAILY VALUE (2) MASS	B. MAXIMUM 30 DAY VALUE (if available) (1) CONCENTRATION	B. MAXIMUM 30 DAY VALUE (if available) (2) MASS	C. LONG TERM AVRG. VALUE (if available) (1) CONCENTRATION	C. LONG TERM AVRG. VALUE (if available) (2) MASS	D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE (1) CONCENTRATION	A. LONG TERM AVRG. VALUE (2) MASS	B. NO OF ANALYSES
19M. Cyanide, Amenable to Chlorination			✓	<0.0025	<0.06					1	mg/L	lbs/day			
20M. Phenols, Total			✓	<0.05	<1.2					1	mg/L	lbs/day			
DIOXIN															
2,3,7,8 – Tetra – chlorodibenzo-P-Dioxin (1764-01-6)			✓	**DESCRIBE RESULTS**											
GC/MS FRACTION – VOLATILE COMPOUNDS															
1V. Acrolein (107-02-8)	✓		✓	<50	<0.011					1	ug/L	lbs/day			
2V. Acrylonitrile (107-13-1)	✓		✓	<50	<0.011					1	ug/L	lbs/day			
3V. Benzene (71-43-2)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
4V. Bis (*Chloromethyl*) Ether (542-88-1)	✓		✓	<10000	<2.20					1	ug/L	lbs/day			
5V. Bromoform (75-25-2)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
6V. Carbon Tetrachloride (56-23-5)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
7V. Chlorobenzene (108-90-7)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
8V Chlorodibromomethane (124-48-1)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
9V. Chloroethane (75-00-3)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
10V. 2-Chloroethylvinyl Ether (110-75-8)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
11V. Chloroform (67-66-3)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
12V. Dichlorobromomethane (75-27-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
13V. Dichloro-difluoromethane (75-71-8)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
14V. 1,1 – Dichloroethane (75-34-3)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
15V. 1,2 – Dichloroethane (107-06-2)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
16V. 1,1 – Dichloroethylene (75-35-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
17V. 1,3 – Dichloropropane (78-87-5)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
18V. 1,2 –Dichloropropylene (542-75-6)	✓		✓	<15	<0.004					1	ug/L	lbs/day			
19V. Ethylbenzene (100-41-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
20V. Methyl Bromide (74-83-9)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
21V. Methyl Chloride (74-87-3)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			

CONTINUE ON PAGE 4

CONTINUED FROM THE FRONT

NPDES # (*IF ASSIGNED*)	OUTFALL NUMBER
MO-0098001	016

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (*optional*)		
	A. TESTING RE-QUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (*if available*)		C. LONG TERM AVRG. VALUE (*if available*)		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC.MS FRACTION – VOLATILE COMPOUNDS (*continued*)															
22V. Methylene Chloride (75-09-2)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
23V. 1,1,2,2 – Tetra-chloroethane (79-34-5)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
24V. Tetrachloroethylene (127-18-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
25V. Toluene (108-88-3)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
26V. 1,2 – Trans Dichloroethylene (156-60-5)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
27V. 1,1,1 – Tri – chloroethane (71-55-6)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
28V. 1,1,2 – Tri-chloroethane (79-00-5)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
29V. Trichloro – ethylene (79-01-6)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
30V. Trichloro – fluoromethane (75-69-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
31V. Vinyl Chloride (75-01-4)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
GC/MS FRACTION – ACID COMPOUNDS															
1A. 2 – Chlorophenol (95-57-8)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
2A. 2,4 – Dichloro – phenol (120-83-2)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
3A. 2,4 – Dimethyl – phenol (105-67-9)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
4A. 4,6 – Dinitro - O-Cresol (534-52-1)	✓		✓	<20	<0.003					1	ug/L	lbs/day			
5A. 2,4 – Dinitro – phenol (51-28-5)	✓		✓	<50	<0.011					1	ug/L	lbs/day			
6A. 2-Nitrophenol (88-75-5)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
7A. 4-Nitrophenol (100-02-7)	✓		✓	<50	<0.011					1	ug/L	lbs/day			
8A. P – Chloro – M Cresol (59-50-7)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
9A. Pentachloro – phenol (87-86-5)	✓		✓	<50	<0.011					1	ug/L	lbs/day			
10A. Phenol (108-952)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
11A. 2,4,6 – Trichloro-phenol (88-06-2)	✓		✓	<50	<0.011					1	ug/L	lbs/day			
12A. 2 - methyl – 4,6 dinitrophenol (534-52-1)	✓		✓	<50	<0.011					1	ug/L	lbs/day			

CONTINUE ON PAGE 5

CONTINUED FROM THE FRONT

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X" A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	3. EFFLUENT A. MAXIMUM DAILY VALUE (1) CONCENTRATION	(2) MASS	B. MAXIMUM 30 DAY VALUE (if available) (1) CONCENTRATION	(2) MASS	C. LONG TERM AVRG. VALUE (if available) (1) CONCENTRATION	(2) MASS	D. NO. OF ANALYSES	4. UNITS A. CONCEN-TRATION	B. MASS	5. INTAKE (optional) A. LONG TERM AVRG. VALUE (1) CONCENTRATION	(2) MASS	B. NO OF ANALYSES
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS															
1B. Acenaphthene (83-32-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
2B. Acenaphtylene (208-96-8)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
3B. Anthracene (120-12-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
4B. Benzidine (92-87-5)	☑	☐	☑	<80	<0.02					1	ug/L	lbs/day			
5B Benzo (a) Anthracene (56-55-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
6B. Benzo (a) Pyrene (50-32-8)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
7B. 3,4 – Benzofluoranthene (205-99-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
8B. Benzo (ghi) Perylene (191-24-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
9B. Benzo (k) Fluoranthene (207-08-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
10B. Bis (2-Chloroethoxy) Methane (111-91-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
11B. Bis (2-Chloroethyl) Ether (111-44-4)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
12B. Bis (2-Chloroisopropyl) Ether (39638-32-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
13B. Bis (2-Ethylhexyl) Phthalate (117-81-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
14B. 4-Bromophenyl Phenyl Ether (101-55-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
15B. Butyl Benzyl Phthalate (85-68-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
16B. 2-Chloronaphthalene (91-58-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
17B. 4-Chlorophenyl Phenyl Ether (7005-72-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
18B. Chrysene (218-01-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
19B. Dibenzo (a,h) Anthracene (53-70-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
20B. 1,2 – Dichlorobenzene (95-50-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
21B. 1,3 – Dichlorobenzene (541-73-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			

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CONTINUED FROM PAGE 5

NPDES # (IF ASSIGNED)	OUTFALL NUMBER
MO-0098001	016

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X" A. TESTING REQUIRED	2. B. BELIEVED PRESENT	2. C. BELIEVED ABSENT	3. EFFLUENT A. MAXIMUM DAILY VALUE (1) CONCENTRATION	A. (2) MASS	B. MAXIMUM 30 DAY VALUE (if available) (1) CONCENTRATION	B. (2) MASS	C. LONG TERM AVRG. VALUE (if available) (1) CONCENTRATION	C. (2) MASS	D. NO. OF ANALYSES	4. UNITS A. CONCEN-TRATION	4. B. MASS	5. INTAKE (optional) A. LONG TERM AVRG. VALUE (1) CONCENTRATION	5. A. (2) MASS	5. B. NO OF ANALYSES
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS *(continued)*															
22B. 1, 4-Dichlorobenzene (106-46-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
23B. 3, 3'-Dichlorobenzidine (91-94-1)	☑	☐	☑	<20	<0.003					1	ug/L	lbs/day			
24B. Diethyl Phthalate (84-66-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
25B. Dimethyl Phthalate (131-11-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
26B. Di-N-butyl Phthalate (84-74-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
27B. 2,4-Dinitrotoluene (121-14-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
28B. 2,6-Dinitrotoluene (606-20-2)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
29B. Di-N-Octylphthalate (117-84-0)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
30B. 1,2-Diphenylhydrazine (as *Azobenzene*) (122-66-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
31B. Fluoranthene (206-44-0)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
32B. Fluorene (86-73-7)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
33B. Hexachlorobenzene (87-68-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
34B. Hexachlorobutadiene (87-68-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
35B. Hexachloro-cyclopentadiene (77-47-4)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
36B. Hexachloroethane (67-72-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
37B. Indeno (1,2,3-c-d) Pyrene (193-39-5)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
38B. Isophorone (78-59-1)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
39B. Naphthalene (91-20-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
40B. Nitrobenzene (98-95-3)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			
41B. N-Nitro-sodimethylamine (62-75-9)	☑	☐	☑	<10	<0.003					1	ug/L	lbs/day			

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CONTINUED FROM THE FRONT

1. POLLUTANT AND CAS NUMBER (*if available*)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (*optional*)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (*if available*)		C. LONG TERM AVRG. VALUE (*if available*)		D. NO. OF ANALYSES	A. CONCENTRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – BASE/NEUTRAL COMPOUNDS (*continued*)															
42B. N-Nitroso N-Propylamine (621-64-7)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
43B. N-Nitro-sodiphenylamine (86-30-6)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
44B. Phenanthrene (85-01-8)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
45B. Pyrene (129-00-0)	✓		✓	<10	<0.003					1	ug/L	lbs/day			
46B. 1,2,4-Tri chlorobenzene (120-82-1)	✓		✓	<5.0	<0.002					1	ug/L	lbs/day			
GC/MS FRACTION - PESTICIDES															
1P. Aldrin (309-00-2)			✓												
2P. α-BHC (319-84-6)			✓												
3P. β-BHC (319-84-6)			✓												
4P. γ-BHC (58-89-9)			✓												
5P. δ-BHC (319-86-8)			✓												
6P. Chlordane (57-74-9)			✓												
7P. 4,4'-DDT (50-29-3)			✓												
8P. 4,4'-DDE (72-55-9)			✓												
9P. 4,4'-DDD (72-54-8)			✓												
10P. Dieldrin (60-57-1)			✓												
11P. α-Endosulfan (115-29-7)			✓												
12P. β-Endosulfan (115-29-7)			✓												
13P. Endosulfan Sulfate (1031-07-8)			✓												
14P. Endrin (72-20-8)			✓												
15P. Endrin Aldehyde (7421-93-4)			✓												
16P. Heptachlor (76-44-8)			✓												

CONTINUED ON PAGE 8

CONTINUED FROM PAGE 7

NPDES # (IF ASSIGNED)	OUTFALL NUMBER
MO-0098001	016

1. POLLUTANT AND CAS NUMBER (if available)	2. MARK "X"			3. EFFLUENT							4. UNITS		5. INTAKE (optional)		
	A. TESTING REQUIRED	B. BELIEVED PRESENT	C. BELIEVED ABSENT	A. MAXIMUM DAILY VALUE		B. MAXIMUM 30 DAY VALUE (if available)		C. LONG TERM AVRG. VALUE (if available)		D. NO. OF ANALYSES	A. CONCEN-TRATION	B. MASS	A. LONG TERM AVRG. VALUE		B. NO OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION – PESTICISES *(continued)*															
17P. Heptachlor Epoxide (1024-57-3)	☐	☐	☑												
18P. PCB-1242 (53469-21-9)	☐	☐	☑												
19P. PBC-1254 (11097-69-1)	☐	☐	☑												
20P. PCB-1221 (11104-28-2)	☐	☐	☑												
21P. PCB-1232 (11141-16-5)	☐	☐	☑												
22P. PCB-1248 (12672-29-6)	☐	☐	☑												
23P. PCB-1260 (11096-82-5)	☐	☐	☑												
24P. PCB-1016 (12674-11-2)	☐	☐	☑												
25P. Toxaphene (8001-35-2)	☐	☐	☑												
J. RADIOACTIVITY															
(1) Alpha Total	☐	☐	☑	<0.786							pCi/L				
(2) Beta Total	☐	☐	☑	<0.654							pCi/L				
(3) Radium Total	☐	☐	☐												
(4) Radium 226 Total	☐	☐	☑	<0.786							pCi/L				

Attachment A
Description of Outfalls

001 – Radwaste Treatment System

This system serves to collect, process, store, recycle, and dispose of liquid radioactive waste generated at Callaway Energy Center. Five general sub-systems can be defined as described below:

The **Boron Recycle System** receives reactor coolant for the purpose of processing this waste stream for discharge. Boric acid is used as a neutron absorber in the primary system.

The boron concentration can vary substantially in Outfall 001 based on plant operation. Also the ion exchange resin utilized in the radwaste treatment system can become rapidly saturated with boron allowing boron to pass through the treatment demineralizers. Therefore, processing of liquid radwaste by demineralization could result in up to 1000 mg/l of boron being discharged in Outfall 001. This has been noted in past NPDES Permit Reapplications for Callaway Energy Center. Although boron concentration in this Outfall may reach up to 1000 mg/L in the Discharge Monitor Tank (sample point prior to discharge), this waste stream is routed to the plant discharge line where it mixes with a minimal flow of 3,000 gpm as required by the plants Nuclear Regulatory Commission operating license. However, with administrative controls the dilution flow is maintained greater than 5,000 gpm allowing the final effluent at the point of discharge into the Missouri River to contain less than 50 mg/l of boron.

The **Liquid Radwaste System** collects and processes floor and equipment drains from the containment, auxiliary building, fuel building, and radwaste buildings during normal operation. However, during outages, non-radioactive drainage from equipment in these buildings may be treated by the Oily Waste System as described in Attachment C.

The **Laundry and Hot Shower** system collects waste generated from washing radioactively contaminated protective gear and clothing and personnel decontamination shower wastewater. These wastes are then transferred to the liquid radwaste system for treatment.

The **Secondary Liquid Waste** system is used to process condensate demineralizer regeneration wastes and potentially radioactive liquid waste collected from the turbine building. The condensate demineralizer regeneration waste is divided into two waste streams; High TDS waste from the acid and caustic rinses used when chemically regenerating spent resin, and low TDS waste which results from the initial back-flushing of the unregenerated resin and the final rinsing of the regenerated resin to remove acid and caustic.

Steam Generator Blowdown is normally recycled to the main condenser for reuse in the secondary cycle. Provisions also exist to discharge the treated blowdown via Outfall 001 although this has not been done in the last thirty years.

It should be noted that the radwaste treatment system is specifically designed for flexibility to achieve Nuclear Regulatory Commission (NRC) limitations. Actual treatment for any given batch of wastewater is dictated by the following criteria:

- The level of radiological contamination and the corresponding NRC mandated discharge criteria
- The NPDES permit discharge limitations
- The most effective waste treatment scheme that will give the smallest volume of solid radwaste.
- Overall waste stream management – processing and holdup rates, volumes of other waste streams requiring treatment or storage, etc.
- The need, feasibility, and economics of the recycle versus discharge options.

The following wastewater treatment systems are used as required to treat this waste stream for recycle or discharge in compliance with NRC requirements and are also available as auxiliary or backup treatment systems to treat this discharge for compliance with NPDES permit limitations: Evaporation and/or Mixing and/or Filtration and/or Carbon Absorption and/or Ion Exchange and/or Neutralization and/or Reuse/Recycle or treated Effluent. All processing in the Radwaste Treatment System is done on a batch basis except team generator blowdown. After monitoring for radioactive content, release rates are controlled administratively to ensure that radioactive discharge criteria are met.

ALPS – Advanced Liquid Processing System is a permanently installed vendor provided skid used for treatment of liquid radioactive waste. This skid consists of six vessels and a filter housing. These components may contain various resin mixtures, charcoal adsorption media and/or filter media to provide optimum treatment for the specific wastewater being processed (show on the Flow Diagram and Water Balance).

002 – Cooling Tower Blowdown

A cooling tower is utilized to dissipate excess heat to the atmosphere from the Circulating and Service Water Systems. Outfall 002 is designed as the cooling tower blowdown discharge. Blowdown from the cooling tower is necessary to maintain dissolved solids concentration in the recirculating water within acceptable operating limits.

003 – Water Treatment Plant Wastes

The water treatment plant (WTP) supplies clarified river water for cooling tower makeup and other plant cooling water systems. The suspended material that is removed from

the river water is drawn from the bottom of the clarifiers as sludge. This sludge is routed through a sedimentation lagoon for solids removal. A single sedimentation lagoon is utilized; sedimentation lagoon #5 was constructed in the fall of 2016. Demineralizer system waste streams and oil separator discharges are also routed to sedimentation lagoon #5. Sedimentation lagoon #5 receives water from the demineralizer waste sump with this flow cascading to lagoon #6. The demineralizer system waste stream (previously a separate discharge point, Outfall 004, which was eliminated during previous permitting) consists of wastes generated from resin regeneration, sand and carbon filter backwash, miscellaneous wastes from floor drainage, and wet well overflows. Note finally, that this lagoon also receives effluent from the Oily Waste Processing System (which also receives effluent from an oil recovery well used to remediate a historic on-site release).

The supernatant from the sedimentation lagoon is designated as Outfall 003. Outfall 003 has been recycled for more than 20 years by routing it back to the head of the water treatment plant via a supernatant pump station.

007 – Sanitary Treatment Lagoons

Outfall 007 is defined as the sanitary wastewater treatment system discharge. Primary treatment is provided in a conventional three-cell stabilization pond. Effluent from the final cell is routed (in series) to two wetland basins. Both are "artificial" (constructed) wetlands created by conversion of filled WTP (sludge) sedimentation lagoons.

The supernatant from the third stabilization pond is designated as Outfall 007. The effluent then flows through two wetlands. The connection from discharge of the final wetland to the supernatant pump station was made in conjunction with the construction of an additional WTP sedimentation lagoon (as described in a previous NPDES Permit reapplication and in the construction permit application). Outfall 007 is recycled by routing it back to the head of the water treatment plant via the WTP supernatant pump station.

Outfall 009 – Intake Heater Blowdown

The river intake structure contains two recirculating electric heaters, which are used to prevent ice formation on the intake bar screen during the winter months. Outfall 009 consists of discharges from the infrequent blowdown or drainage of these boilers. We have not discharged from this outfall in the past thirty years. The boilers are currently kept in a dry lay-up condition.

Outfall 010 – Storm Water Runoff Settling Pond

The drainage area for the Outfall 010 Settling Pond encompasses a total of 108 acres. Only 20% of the drainage area consists of impervious plant site area. These areas include the cooling water chemical control building, the quality control building, the

former Unit #2 area and an area plant west of the radwaste building. The remaining drainage area consists of grassy areas within the plant boundary and areas leased to the Missouri Department of Conservation (MDC). The pond has a retention time greater than 24 hours. Two 48–inch square overflow boxes are located at the north side of the settling pond. Flow enters the overflow boxes and goes under the earthen pond dam to the actual discharge/sampling location. Metal louvers have been installed on the top opening of the concrete overflow box to prevent large debris from entering the storm water discharge. Outfall 010 discharges to Logan Creek.

Outfall 011 – Storm Water Runoff Settling Pond

The drainage area for the Outfall 011 Settling Pond encompasses a total of 425 acres. Only 2% of the drainage area consists of the impervious area on the plant site. These areas include the water treatment plant, radwaste building, operation support facility, demineralizer potable water building and the circulating and service water pump houses. The remaining drainage area consists of grassy areas, excavation surplus storage, and areas leased to the MDC. The pond has a retention time of less than 24 hours. Two 48-inch square overflow boxes are located on the north side of the settling pond. Flow enters these overflow boxes and goes under the earthen pond damn to the actual discharge/sampling location. Metal louvers have been installed on the top opening of the concrete overflow box to prevent large debris from entering the storm water discharge. Outfall 011 discharges to Logan Creek.

Outfall 012 – Storm Water Runoff Settling Pond

The drainage area for the Outfall 012 Settling Pond encompasses a total of 87 acres. Approximately 25% of the total drainage area consists of impervious area on the plant site. This outfall collects storm water runoff from the most of the plant area including the parking lots, office buildings, part of the switchyard, the turbine building, the outage maintenance facility and the Stores I building. The remaining areas consist of grassy areas. The pond has a retention time of less than 24 hours. A concrete spillway has been constructed at the south side of the settling pond where the actual sampling point is located. Outfall 012 discharges to Mud Creek.

Outfall 014 – Storm Water Runoff Settling Pond

The drainage area for the Outfall 014 Settling Pond encompasses a total of 100 acres. Only 4% of the drainage area consists of impervious areas on the plant site. These areas include, half of the construction parking lot, the Stores II building and the maintenance shop annex. The remaining drainage area consists of grassy areas and the land leased to the MDC. The pond has a retention time of less than 24 hours. A concrete spillway has been constructed on the north side of the pond where the actual sampling point is located. Outfall 014 discharges to Auxvasse Creek.

Outfall 015 – Storm Water Runoff Settling Pond

The drainage area for the Outfall 015 Settling Pond encompasses a total of 60 acres. Only one percent of the drainage area consists of impervious areas, which are paved roadways. The remaining area consists of grassy areas and land leased to the MDC. The pond has a retention time greater than 24 hours. A concrete spillway has been constructed on the north side of the pond where the actual sampling point is located. Outfall 015 discharges to Auxvasse Creek.

NOTE: The MDC uses a minor portion of the leased land for farming and the remaining land is left in its native state for wildlife habitat.

Outfall 016 – Cooling Tower Bypass

This outfall consists of clarified river water and wastewater that has been recycled through the water treatment plant. It is used to moderate flow through the water treatment plant and to provide carrier water in the discharge line if needed when discharging from Outfall 001.

Outfall 017 – Ultimate Heat Sink

The Ultimate Heat Sink is a cooling pond that can provide cooling water to various plant systems during abnormal plant conditions. Outfall 017 is the overflow from the Ultimate Heat Sink, to storm water runoff pond settling pond Outfall 011. It is a no discharge outfall.

Attachment B
Return of River Water

The Callaway Energy Center has five points at which river water is returned back to the river, none are designated as outfalls.

1. Intake Structure Stilling Basin – The stilling basin at the intake structure predominately receives water from the excess flow of the intake pumps via the free discharge valve and returns this flow to the river. Other minor contributions include the intake sump discharge and a well used to supply lube water. As this flow is not contaminated with process waste, we believe it constitutes a return of river water.

2. Intake Line Drainage – The plant has a 48-inch diameter line that carries Missouri River water from the intake structure to the plant, which is approximately five miles away. Infrequently, it is necessary to drain this line. Usually, this only occurs about two or three times per year. The line is drained by opening the free discharge valve and/or the discharge valves for the intake pumps. This allows the water in the line to flow back to the river through the free discharge valve and the de-energized intake pumps. The drainage rate is about the same as the intake rate when the pumps are operating, so it should not pick up any additional solids that may have settled out in the line. Therefore, we believe this intake line drain back flow constitutes a return of river water.

3. Raw Water Bypass – This line diverts untreated water from the head of the water treatment plant to the plant discharge line. It is used to release excess water that is pumped from the river. The flow through this line can vary from 0 to 10,000 gallons per minute based on operating requirements. Since the line diverts and returns untreated river water, we believe it constitutes a return of river water.

4. Downstream River Sampler – Approximately 1.5 miles downstream of the intake structure is an automatic river water sampler. The sampler pumps from 1 to 2.5 GPM continuously from the river, composites a small sample and returns the remaining flow to the river. No pollutants are added to this flow so it is our position that this discharge flow is a return of river water.

5. Intake River Sampler – An automatic river water sampler is located at the intake structure to provide upstream sample data. This sampler pumps from 1 to 2.5 GPM continuously from the river, composites a small sample, and returns the remaining flow to the river. No pollutants are added to this flow so it is our position that this discharge flow is a return of river water.

ATTACHMENT C
Description of Intermittent Flows

Five of the six conventional outfalls defined in this application can be considered to include intermittent discharges since they process and/or release wastewater intermittently. Each is described below.

ROUTINE RELEASES:

001 – Radwaste Treatment – All of the subsystems described in Attachment A, except Steam Generator Blowdown (SGB), process or release discrete batches of wastewater. The frequency and magnitude of each is variable. The flows from the subsystems accumulate in the Discharge Monitor Tanks (DMTs). The discharge flow rate from the DMTs is relatively constant for each batch. The current system typically produces discharges flows of approximately 250 gpm, but may discharge at 450 gpm with a 2 pump operation. Only one DMT can be discharged each day during normal operation with the maximum daily discharge of less than 100,000 gallons. Only very infrequently during refueling outages is it necessary to discharge two DMTs during one day with a maximum discharge of 190,000 gallons. Approximately five tanks are discharged per month under normal plant operation. During re-fueling outages approximately eight tanks are discharged per month.

During recovery from major plant outages and other unusual transient conditions, it may be necessary to discharge Steam Generator Blowdown (SGB). The discharge flow rate varies up to 360 gpm resulting in a maximum daily discharge flow of up to 518,400 gallons. Past operation has shown that such discharges occur infrequently. SGB has not been discharged for more than 25 years. Since this discharge occurs so infrequently, the SGB flow was not included in the maximum flows shown in Form C, Item 2.2. Previous testing of SGB indicates that this waste stream is of equal or higher quality than other much more routine components of Radwaste Treatment, Outfall 001 effluent.

003 – Water Treatment Plant Wastes – For the past 15 years, this outfall has been recycled back to the head of the water treatment plant for reuse so the discharge flow is zero.

007 – Sanitary Wastewater – For more than 10 years, this outfall has been recycled back to the head of the water treatment plant so the discharge flow is zero.

009 – Intake Heater Blowdown – Discharges from this outfall would only be anticipated in the event of extremely cold weather and are thus seasonal and intermittent. If these heaters were placed in service, it is estimated that blowdown would occur approximately once per week (and amount to less than 100 gallons). At the end of an operating season they would be drained, releasing approximately 6,000 gallons of wastewater. There has been no discharge from this outfall for more than 30 years.

016- Cooling Tower Bypass – Discharges of cooling tower bypass vary considerably. At times discharges may occur only a few times during an entire month. During some months discharges occur almost daily for approximately 3 hours per day and infrequently the bypass is operated continuously. Cooling tower bypass is used to control cooling tower makeup, assist in maintaining circulating and service water chemistry, and at times provide additional flow to the discharge line during releases from Outfall 001.

DISCHARGES DURING PLANT OUTAGES:

It is necessary to drain many systems during plant outages for inspections and maintenance. In order to ensure that this water is of the same quality as water that is discharged during operation, some additional/alternate monitoring is performed.

When the cooling tower basin, and/or associated lines (between the basin and the power block) are drained, a single grab sample will be obtained and analyzed to verify compliance with Outfall 002 permit limits prior to discharge. This alternate monitoring will be performed since continuous monitoring will not be possible at all times during the draining of these systems.

Various non-radioactive systems in the Auxiliary Building have been drained in the past to floor drains in the Auxiliary Building to allow for inspection and maintenance. The floor drains from the Auxiliary Building are routed to the Radwaste System for processing and treatment. Since it is not necessary to process these non-radioactive liquid wastes through the Radwaste System, at times we divert these non-radioactive drains to the Oily Waste Processing System for treatment prior to being recycled. Recycling of this water also results in trace amounts of chemical in Outfalls 002, 003, and 016.

ATTACHMENT D
Chemical Usage

The various chemical compounds that may occur in the discharges from Callaway Energy Center during normal operation fall into three usage categories:

Bulk Usage

This group of compounds describes chemicals that are added directly to specific water systems for treatment at a regular rate or interval. Table 1 lists these chemicals along with their predominant function and potential discharge points.

Laboratory Reagents

This category consists of a group of compounds stored and used in the five on-site plant laboratories. The predominant characteristic of this group is the relatively low usage, which would result in negligible levels in the effluent. Laboratory reagents may be discharged through the radwaste treatment Outfall 001, and sanitary wastewater in Outfall 007. At the request of the Department, Ameren Missouri will provide an inventory of these chemical compounds.

Other Chemical Compounds

This grouping includes other chemical compounds that may be discharged and are not included in the previous lists. General housekeeping and maintenance chemicals, and erosion/corrosion products or byproducts from the Plant's infrastructure or fuel materials are not individually assessed. However, the Form C and D analytical data should reflect any contributions from routine use of these compounds. Note that 12% sodium hypochlorite identified in Table 1 is also used to clean the intake well periodically. At times, we use 20% hydrochloric acid to clean scale in the well. Less than 1000 gallons of 12% sodium hypochlorite and 20% hydrochloric acid are used annually for intake well cleaning.

Chemical Treatment Program for Callaway Cooling Water Systems:

Product Added	WTP Stilling Basin or Clarifiers	Service Water (Pump Bay)	Circulating Water System	Other
Coagulant	Continuous ~55 gallons/day varies with river solids			May apply further upstream of WTP
Sodium hypochlorite		~15-30 min/day ~65 gal/day	~30-60 min/day + shock treatments ~135 gal/day	
Sodium bromide		added with bleach ~ 15 gal/day	added with bleach ~30 gal/day	
Molluskicide				1-2 times per year at the river intake as needed
Coagulant aid	6 months a year ~ 20-30 gal/day			
Monochloramine, chlorine dioxide, or bromine activated chloramine	Continuous feed at a target of 0.5-1.0 ppm at the clearwell as TRO			
Copolymer		Continuously ~50 gal/day		
Hydroxyethylidine, diphonic acid		Continuously ~ 23 gal/day		
Sodium tolyltriazole		Continuously ~5 gal/day		
Biopenetrant		1-2 adds/week ~400 gal/month	Shock treatments 3/year	
Sulfuric acid		Continuously ~1550 gal/day		
Sodium bisulfite or ferrous chloride for dechlorination				Continuous to CT Blowdown 0.4-2.5 gal/hour

BULK CHEMICAL USAGE - CALLAWAY	
1.	Ammonium hydroxide - (Reboiler/Aux. boiler) - used for pH control in recirculating water systems; Outfall 001.
2.	Boric acid - used as a neutron absorber to provide reactivity control and corrosion inhibitor in the primary loop; Outfall 001
3.	Dispersants - (organic sulfonated copolymers) used to reduce solids deposition in process tanks and plant water systems; Outfalls 001, 002, and 003.
4.	Ethylene Glycol - used as freeze protection in recirculating water systems: Outfalls 001, 003, and 007.
5.	Hydrazine - used for dissolved oxygen control in recirculating water systems; Outfalls 001 and 003.
6.	Hydrogen Peroxide - used as a chemical shock and biocide treatment in water systems; Outfall 001 and 003.
7.	Lithium hydroxide - used for pH control in the primary loop; Outfall 001
8.	Nitrite/borate products (solutions) - used as corrosion inhibitors in recirculating water systems; Outfalls 001 and 003.
9.	Coagulants - proprietary organic polymers used as coagulants in the water treatment plant; Outfalls 002, 003, & 016
10.	Sodium hydroxide - used for regenerating demineralizer resins and for pH control in various plant and wastewater systems; Outfalls 001, 003, and 009.
11.	Sodium hypochlorite - used as a biocide in the circulating, service, water treatment, ultimate heat sink, clarifiers, and potable water systems; Also used to generate monochloramine: Outfalls 001, 002, 003, and 016.
12.	Sodium molybdate - used as a corrosion inhibitor in closed water systems; Outfalls 001 and 003.
13.	Sodium tolytriazole or Benzotriazole - used as a copper corrosion inhibitor; Outfalls 001, 002, and 003
14.	Sulfuric acid - used for regenerating demineralizer resins and for pH control in various water and wastewater systems; Outfalls 001, 002, 003, and 009.
15.	Monoethanolamine (ETA) - used as a pH control in closed water systems; Outfalls 001 and 003.
16.	Sodium bromide - used in conjunction with sodium hypochlorite as a biocide in water systems; Outfalls 001, 002, and 003.
17.	Methoxypropylamine (MPA)- used as a pH control agent in closed water systems; Outfalls 001 and 003.
18.	(1-Hydroxyethylidene) diphosphonic acid (HEDP) - used to inhibit calcium carbonate scale formation in water systems and the ultimate heat sink; Outfalls 001, 002, and 003.
19.	Dimethylamide (DMAD) - used as a biopenetrant to improve the efficiency of biocides in controlling bacteria that exist under deposits in piping systems; Outfalls 001, 002, and 003.
20.	Phosphoric Acid or Pyrophosphate - used as a corrosion inhibitor for mild steel in recirculating water systems; Outfalls 001, 002, and 003.
22.	Proprietary Methylene Bis based biocide - used in plant water systems; Outfalls 001, 002, and 003
23.	Proprietary Quatenary ammonium compound - used as a biostat in plant water systems; Outfalls 002, 003 and 016.
24.	Poly Acrylic Acid- may be used as a dispersant in the secondary system: Outfall 001, 003, and 017 during emergencies.
25.	Ferric Sulfate- used for hydrogen sulfide consumption in the ground water sump: Outfall 003.
26.	Trisodium Phosphate- containment sumps for accident conditions: Outfall 001.
27.	Molluscicide - used intermittently (twice/year) at the water treatment plant and intake: Outfalls 002, 003, and 016.
28.	Triazine - a biocide used at water treatment, circulating and service water systems: Outfalls 002, 003, and 016
29.	a-Ketoglutaric Acid (AKGA) - to neutralize hydrazine in secondary liquid waste water prior to discharge: Outfall 001.
30.	Oxamine 6150 – An Ammonium Sulfate based solution used to generate Monochloramine. Outfalls 002, 016.

31.	Sodium Bisulfite – Used to dechlorinate Cooling Tower Bypass when continuously feeding monochloramine to the Water Treatment Plant effluent. Feed rate is typically 15 gallons per day. Outfalls 002, 016
32	Flexpro CL5689 – Added to Circ and Service Water systems for mild steel corrosion control. Approximately 200 gallons added during 1 hour treatment. 2-3 Treatment per week.

ATTACHMENT E
NPDES Sampling and Analysis

The chemical analysis of the various waste streams reported in this application came from two principal sources: 1) a special sampling and analytical project conducted in August and October 2019 and 2) discharge monitoring data as required by our existing NPDES permit.

Plant personnel conducted the entire reapplication sampling effort. Power generation at the plant averaged in excess of 99% of capacity during the sampling period for all process outfalls.

Samples were collected from storm water outfalls during August 15th 2019 after a qualified storm event while the plant was at normal operations. Note that some special sampling techniques for storm water were used as communicated to the staff in a letter dated March 21, 2019 (correspondence attached). As effluent from some outfalls is released intermittently and in batches, it was necessary to modify the default sampling requirements listed in application instructions for selected outfalls. Each sample location is discussed below to clarify these details and to allow the data to be interpreted correctly.

For the sampling project, analyses were performed by Callaway Energy Center, and 3 different commercial laboratories: PDC Laboratories (Florissant, MO), Test America Laboratories (Earth City, MO) and Pace Analytical (Duluth, MN). All analyses were conducted in accordance with Standard Methods and/or EPA methodology. Specific test methods or additional details on other aspects of the sampling or analysis program are available upon request.

Outfall 001

As previously defined, routine discharges from this outfall are from one of five sources: the Boron Recycle System, the Liquid Radwaste System, the Laundry and Hot Shower system, the Secondary Liquid Waste system, and the Steam Generator Blowdown system (no discharge in the past thirty years). While processed separately, these waste streams are normally commingled and retained in various tanks prior to discharge (excluding Steam Generator Blowdown). Thus, discrete samples of each subsystem were not obtained. Further, Steam Generator Blowdown was recycled without discharge during our sampling project schedule as it has been for the past thirty years.

**As stated in the cover letter at the beginning of this reapplication packet, complete Outfall 001 data was not sampled and analyzed by the December 31st due date of the application. All forms and subsequent data will be submitted as soon as this information is completed. Ameren suspects submittal of Outfall 001 data to your office by February 1, 2020.*

Outfall 002

Cooling Tower Blowdown was sampled over a 24-hour period on October 2-3, 2019. A re-sample event for Outfall 002 alpha/beta occurred on October 31, 2019. The discharge was maintained at a constant flow rate. Flow proportional composite and multiple grab samples were taken as appropriate. Other than the exception below, all of the data shown under the 'Maximum Daily Value' columns in Forms C and D is from this sampling event. The flow monitored during this sample event is also shown here and was used to calculate the mass discharges under this heading.

Data under the 'Maximum 30 Day Values' is based on data from Nov 2018 through Oct 2019. 'Long Term Average' values are based on DMR data for the three-year period, October 2016 through October 2019. Mass discharges under these headings were calculated using the appropriate long-term average flow rates.

Outfall 003

Water treatment plant wastes are routed to Sedimentation pond #5 for solids removal before the supernatant is recycled back to the head of the water treatment plant. A small waste volume from makeup demineralizer plant regenerations (the previous NPDES Outfall 004) is routed to the Water Treatment Plant sludge pump station and is also treated by the sedimentation lagoons. A 24-hour flow composite and multiple grab samples were taken from the effluent of sedimentation pond #5 during the period of October 2nd – 3rd, 2019 and a resample taken on October 31st, 2019 for alpha/beta, while it was being recycled back to the head of the water treatment plant. Although there was no discharge from this outfall at the time, the water quality at the sample point for Outfall 003 would be the same as the quality of the wastewater if the Outfall had been discharging. All of the data shown under the 'Maximum Daily Value' columns in Forms C and D is from the sampling event. Note that mass discharge values were calculated based on the estimated average discharge flow rate, even though the effluent was being recycled at the time.

No data was reported under the 'Maximum 30 Day' and 'Long Term Average' columns for this outfall since it is normally recycled and thus there is no recent historical monitoring data from DMR's. Ameren would like to maintain this Outfall permitted to preserve authorization to discharge from the water treatment plant, should the need arise.

Outfall 007

As described in Attachment A, effluent from the sanitary waste stabilization lagoons is routed through two artificially constructed wetlands. For this reapplication project, a single grab sample was collected on October 2nd, 2019 from the effluent weir at the point of discharge from the third treatment lagoon as required by our NPDES permit, although this effluent stream was being recycled at the time of sample collection. Further polishing is completed by pumping this effluent to the first wetland. Flow

continues by gravity through the second wetland which is routed to the supernatant pump station for recycle to the head of the water treatment plant. As the detention time within in the lagoons and the first wetland, both exceed 24 hours, a single grab sample was collected. Data from this sampling event is shown under the 'Maximum Daily Value' column in Form C.

Although there was no discharge from this outfall at the time the samples were taken, the water quality at the sample point for Outfall 007 would be the same as the quality of the wastewater if the outfall had been discharging. Other than the exception mentioned below, all of the data shown under the 'Maximum Daily Value' columns in Forms C and D is from these sampling events. Note that mass discharge values were calculated based on the estimated average discharge flow rate, even though the effluent was being recycled at the time.

No data was reported under the 'Maximum 30 Day' and 'Long Term Average' columns for Outfall 007 since it is normally recycled and thus there is no recent historical monitoring data from DMR's. Ameren would like to maintain this outfall permitted.

Outfall 009

The intake electric boilers are currently in a dry lay-up condition as they have been for many years, and so it was not possible to obtain a sample from them. The last discharge from this system occurred in early 1985, so recent past discharge data are not available. We want to keep this outfall permitted in order to preserve the authorization to discharge from the electric boilers, should extreme weather or other conditions warrant their use.

Outfalls 010 – 015

As described previously, storm water runoff from all plant areas is diverted to settling ponds, prior to discharge waters of the state via the outfalls specified in the existing permit. These outfalls are described in Attachment A and are shown on the attached site maps. All five outfalls were sampled for the permit reapplication, as described below.

The DNR approved our request for a simplified sampling protocol during this round of permitting (see attached letter dated March 21, 2019). Per our agreement with DNR staff, we analyzed SWR effluent for the following parameters:

• pH	E. Coli	Total Kjeldahl Nitrogen
• Temperature	TSS	Total Organic Carbon
• Ammonia	Nitrate	Phosphorus
• Biological Oxygen Demand	Nitrite	Aluminum
• Chemical Oxygen Demand	Sulfate	Iron
• Organic Nitrogen	Oil & Grease	Magnesium

Grab samples were taken from the storm water runoff ponds on August 15, 2019. The day the ponds were sampled was after a rainfall event that resulted in pond discharges. The flow rates for all outfalls are based on calculated runoff (using appropriate runoff coefficients) from the actual rainfall measurements. A second grab sample was obtained from storm water runoff pond #15 of the effluent pH which was high on the first set of samples taken.

All of the data shown under the 'Maximum Daily Value' columns in Form C are from these sampling events for each outfall. The flow, calculated for the rainfall event triggering each of these discharges, is also shown here and used to calculate the mass discharges under this heading.

No data was provided for the 'Maximum 30 Day' and 'Long Term Average' values as routine monitoring is not required by the current permit.

Outfall 016

The cooling tower bypass was sampled over a 24 hour period on October 2-3, 2019. A re-sample event for Outfall 016 alpha/beta occurred on October 31st, 2019. Flow proportional composite and multiple grab samples were taken as appropriate. All of the data shown under the 'Maximum Daily Value' columns in Forms C and D is from the sampling event. Average flows obtained during sampling were used to calculate the mass discharges under this heading.

Data under the 'Maximum 30 Day' and 'Long Term Average' values are based on DMR data for the three year period, October 2016 through October 2019. Mass discharges under these headings were calculated using the appropriate long-term average flow rates.

Outfall 017

This is by definition a no discharge outfall; therefore it was not sampled.

Missouri River

A modified composite sample (consisting of 4 aliquots, each collected approximately 6 hours apart) was taken of Missouri River water being pumped to the head of the water treatment plant for a 24 hour period on October 2-3, 2019. It is believed that this modified composite sample is representative of the river over a normal 24 hour period. Data available on the Missouri River indicates substantial variability over longer periods of time. This data is provided under the 'Intake' columns in Forms C and D, for Outfall 003.

All Outfalls sampled for *E coli* were grabbed on October 17, 2019.

General Notes

Important note on mass discharge calculation: As described previously, mass discharges listed under the 'Maximum Daily Value' heading, represent values calculated from the analytical data and the measured flows during the special re-application, sampling event. Consequently, the values shown do not necessarily represent an actual maximum mass discharge value.

PDC Laboratories, Inc. completed all of the parameters for storm water Outfalls 010, 011, 012, 014 and 015. PDC also analyzed for all the parameters for Outfalls 001, 002, 003, 007, 016 and the river intake except for the parameters listed below:

Test America analyzed for Alpha and Beta Radioactivity for Outfalls 001, 002, 003, 007, 016 and the River Intake

Pace Analytical analyzed for methylmercury for Outfalls 001, 002, 003, 007, 016 and the River Intake

The Callaway Energy Center chemistry staff analyzed each outfall for the remaining parameters:

- Temperature
- Flow
- pH
- Total Residual Chlorine
- Total Hardness

Attachment F
Section 311 and CERCLA Exemptions

The chemicals listed below are used in water treatment processes and may be discharged in amounts exceeding their 'reportable quantities' under 40 CFR 117 and 302 (1989).

Chemical	Anticipated Usage (Avg lbs/day)	Reportable Quantity (lbs/day)	Typical Quantity On-Site	Outfalls
Sodium Hydroxide	620	1,000	300,000	001, 003 & 009
Sodium Hypochlorite	2,100	100	100,000	001, 002, 003 & 016
Sulfuric Acid	26,000	1,000	450,000	001, 002, 003, and 009
Hydrazine	80	1	26,000	001 and 003

* Recycling of Outfall 003, Water Treatment Plant Supernatant, (as described in Attachment A) may also result in trace amounts of these chemicals in Outfalls 002 and 016.

Ameren Missouri requests an exclusion under the NPDES exemptions from Section 311 and Superfund reporting for these four compounds and all others that are, as reported in this application, present in continuous or anticipated intermittent discharges (See Attachment D). These and other discharges for which exclusion are requested are exempt from Section 311 liability by 40 CFR 117.12(a)(1) if they are in compliance with the permit and 117.12(a)(2) 03 (3) if they are not. Discharges that are excluded from 311 reporting are also excluded from Superfund reporting. Any discharges other than those resulting from on-site spills would either result from circumstances identified in this application and be subject to neutralization treatment (see 117.12(c)) or would be continuous or anticipated intermittent discharge originating within the operating or treatment systems at the plant (see 117.12(d)). These discharges are, therefore, excluded from Section 311 and Superfund reporting requirements.

Attachment G
General Comments on Standards Setting

In anticipation of conditions that may be set in this permit renewal, Ameren Missouri requests the consideration of the following comments:

1. **Mass Limits** – The Steam Electric Guidelines (at 40 CFR Part 423.13(g)) specifically allow the permitting authority to express the quantity of pollutants allowed to be discharged as a concentration limitation instead of a mass-based limitation. Fixed numerical mass discharge limitations necessarily impose implicit flow restrictions at the allowable concentration levels. The flow restrictions are too inflexible to cope with the flow variability conditions and the electrical reliability imperatives placed on steam electric power plants. Unlike some industries in which waste stream flow variability is the result of a single factor, like production Callaway Energy Center has no such single parameter indicative of flow. Further, as a utility whose production is dictated by public consumption, the plant must be capable of attaining and maintaining full power production for as long as necessary. Since we feel that the concentration-based limits are sufficient and more appropriate for regulation of power plant discharges, we request that you do no impose any mass limitations when reissuing this permit.

2. **Net Credits** – In a situation whereby a limitation might be set on the discharge of a priority pollutant, Ameren Missouri feels it should reflect an adjustment credit for pollutants in the intake water, because discharges are returned to the Missouri River. As complete removal of compounds in this category would not be achieved by the water treatment systems at the Callaway Energy Center, we hereby request an appropriate net limitation be applied as necessary. We anticipate no adverse water quality effect from net limitations.

3. **WET Test Scheduling** – In accordance with permit conditions (Section D, Other Requirements, Item 6), Callaway Energy Center conducts an annual acute Whole Effluent Toxicity (WET) test on composite samples taken from Outfalls 002 and 016. When attempting to collect these special composite samples, it simplifies the sampling procedure considerably by maintaining the Cooling Tower Blowdown (Outfall 002) and Cooling Tower Bypass (Outfall 016) at a constant flow rate over the 24 hour sampling period. This eliminates the need to adjust sample aliquots proportionally with flow. The annual WET test is completed in either the spring or fall immediately following a molluskicide treatment (and algaecide treatment if performed), and concurrently with the weekly circulating and service water system chemical addition. Callaway Energy Center has conducted an acute WET Test every year for the past 5 years on Outfall 002 and 016. All WET tests conducted during these past 5 years at Callaway have passed with no issues identified.

Attachment H
Section 316(b) Demonstration Status

The Callaway 316(b) demonstration consists of two parts, an impingement study and an entrainment study. Part one, the impingement study, was originally started during the spring of 1984 and was successfully completed in the fall of 1984. Part two, the entrainment study, was originally completed and submitted in June 1986. DNR correspondence dated April 15, 1987 approved the 316(b) study and agreed with the conclusions of the study,that the impacts from the use of the intake structure at Callaway Energy Center are minimal.

For the past 5 years in accordance with 40 CFR 122.21(r), and the NPDES permit Special Conditions #20(c), Ameren submits annual status reports by February 28th each year, detailing the progress of the previous year's completion on the 40 CFR 122.21(r) studies.

In accordance with Special Conditions #20(e) of the current Callaway Energy Center NPDES permit, included within this NPDES Reapplication packet is an updated 316(b) study.

Attachment I

Activities, Materials and Management Practices with the Potential to Impact Storm Water Quality

As described in Attachment E, reduced monitoring of storm water outfalls was authorized by DNR for this application (acknowledging the adequacy of prior characterization of these discharges). The data was entered into Missouri Forms C, eliminating the need to complete EPA form 2F; nonetheless, we believe this Attachment and the referenced drawings provide all the required data.

Routine/Permanent Significant Materials Storage

The following significant materials have been identified at the Callaway Energy Center as being in contact with storm water currently or in the last three years. They are shown on drawing NPDES-001, NPDES Storm Water Information Outfalls 010-015 and described below. Note that compass direction references are relative to 'Plant North', a standardized reference designation, which is depicted on the drawing. Where possible, each item description listed below includes a number in brackets '{}' which corresponds to the drawing legend listing.

1. Amine Storage Tank – A 6,000 gallon tank located plant NE of the turbine building was installed to house ammonia hydroxide. A lined trough is located below the tank capable of holding 110% of the tank contents. This tank is currently empty and has not been used for more than 30 years. {827}

2. Caustic Storage Tank – A 10,000 gallon storage tank containing sodium hydrazine is located plant NE of the turbine building. A lined trough is below the tank capable of holding 110% of the tank contents. Caustic is unloaded from tank truckers using air pressure. {829}

3. Demineralizer Caustic Storage – A 16,000 gallon storage tank containing sodium hydroxide is located plant N of the demineralizer building. A concrete dike surrounds the tank capable of holding 110% of the tank contents. Caustic is unloaded from tank trucks using air pressure. {853}

4. Sulfuric Acid Storage Tank – A 10,000 gallon storage tank containing sulfuric acid is located plant NE of the turbine building. A lined trough is below the tank capable of holding 110% of the tank contents. Acid is unloaded from tank trucks using air pressure. {828}

5. Circulating/Service Water Sulfuric Acid Tank – A 14,000 gallon storage tank containing sulfuric acid is located near the circulating and service water pump house and cooling tower basin. Containment consists of a concrete dike capable of holding 110% of the tank contents. Acid is unloaded from tank trucks using air pressure {844A}

6. Demineralizer Sulfuric Acid Storage Tank – A 10,000 gallon storage tank containing sulfuric acid is located plant N of the demineralizer building. A concrete dike surrounds the tank capable of holding 110% of the tank contents. Acid is unloaded from tank trucks using air pressure. {854}

7. Gasoline Storage Tanks – One above ground gasoline storage tank located plant W of the Stores I building has a capacity of 2,000 gallons. A second above ground gasoline storage tank with a capacity of 500 gallons is located plant W of the Stores II building. A prefabricated metal containment exists around each of the tanks of sufficient size to contain approximately 110% of the tank capacity. Gasoline is unloaded from tank truck using onboard truck pumps. {814}

8. Security Diesel Storage Tank – A 3,000 gallon underground tank containing diesel fuel is located by the Main Access Facility. Diesel fuel oil is unloaded from tank trucks using onboard truck pumps. {814}

9. Alternate Power Emergency System (AEPS) Diesel Generators – Four APES diesel generators are located on Highway CC south of the existing COOP substation. The AEPS diesel generators were installed during 2010. Mounted under each diesel generator skid is a 3500 gallon self-contained diesel fuel oil storage tank with a secondary containment.

10. Emergency Diesel Fuel Tanks- There are two 100,000 gallon underground diesel fuel oil storage tanks located plant S of the Emergency Diesel building. Diesel fuel oil is unloaded from tank trucks using onboard truck pumps. Diesel fuel is used to power the emergency diesel generators during testing and as needed to supply plant power. {838}

11. Vehicle Diesel Fuel Storage Tanks – Two above ground vehicle diesel storage tanks re located plant W of the Stores I building. There is a 300 gallon tank used to store #1 diesel and 700 gallon tank used to store #2 diesel fuel oil. Two additional above ground vehicle diesel storage tanks are located plant W of the Stores II building for storage of #2 diesel fuel oil. Each of these two tanks has a capacity of 500 gallons. A prefabricated metal containment exists around each tank of sufficient size to contain approximately 110% of tank capacity. Diesel fuel oil is unloaded from tank trucks using onboard truck pumps. A gas station type dispenser is used to fill diesel powered vehicles from these tanks. {886}

12. Auxiliary Fuel Oil Storage Tank – The auxiliary fuel oil storage tank is a 300,000 gallon carbon steel tank located plant W of the demineralizer building. An earthen berm capable of containing 110% of the tank contents surrounds the tank. An underground transfer line from the auxiliary fuel oil transfer system fills the tank.

This tank is used to supply diesel fuel oil to the auxiliary boiler and the fire protection diesel pumps. {869}

13. Circulating Water Chemical Control System Salt Storage – Two salt storage tanks (full of rock salt) are located plant north of the circulating water chemical control system building. The storage tanks and equipment have been retired in place.

14. Transformer Oil – Thirteen large power transformers are located on site. They are the main transformers (4 at 12,000 gallons), the Unit Auxiliary transformer (8,000 gallons), the Start Up Transformer (9,700 gallons), the Station Service transformers (2 at 2,770 gallons), the Alternate Energy Power Source transformer (2,170 gallons), the Engineered Safety Features transformers (2 at 2,270 gallons) and the Safeguard transformers (9,700 and 11,500 gallons). In addition, most buildings on site have associated service transformers located outside (~20-30 transformers) which each contain approximately 400 gallons of oil. Most outside oil filled electrical transformers are situated on top of a concrete lined pit which is filled with gravel. The exception to this is the Training Annex transformer and the eight 300 series site power loop transformers which do not have any containment. Any spills from these transformers would have to be contained in the drainage ditches adjacent to the transformers.

15. Demineralized Water Tank – A 150,000 gallon stainless steel demineralized water tank is located plant southeast of the turbine building. No containment exists around this tank. The tank is filled from the demineralized water storage tank through underground piping. It is used to supply water to the steam generators when the plant is shut down and during transients. During transients the tank can also be supplied by firewater. {831}

16. Condensate Water Tank – A 466,000 gallon stainless steel condensate water tank is located plant southeast of the turbine building. No containment exists around this tank. The tank is filled from the demineralized water storage tank through underground piping. It is used to supply water to the steam generators when the plant is shut down and during transients. During transients the tank can also be supplied by firewater. {831}

17. Refueling Water Tank – A 419,000 gallon stainless steel refueling water tank is located plant southwest of the containment building. No containment exists around this tank. The tank is filled from the reactor makeup system through underground piping. It is used to supply water to the refueling pool during outages and to the reactor system during transients. The tank contains radioactive demoralized water with 2,350 to 2,500 mg/L of Boron. {839}

18. Reactor Makeup Water Tank – A 153,000 gallon stainless steel reactor makeup water tank is located plant southwest of the containment building. No containment exists around this tank. The tank is filled from the demoralized water tank trough underground piping. It is used to supply demoralized water to the reactor system and associated support systems. {840}

19. Demineralized Water Clear Well – The demineralized water clear well consists of a 50,000 gallon carbon steel tank located plant northwest of the demineralizer building. No containment exists around this tank. Deep well water is pumped underground to the demineralized water clear well, which is then transferred underground to supply water to the makeup demineralizers. {855}

20. Fire Water Storage Tanks – Two 300,000 gallon carbon steel firewater tanks are located plant southeast of the demineralizer building. No containment exists around these tanks. These tanks are filled from the demineralizer clear well through underground piping. They are used to supply firewater to the plant for testing and fire response. {859}

21. Neutralization Tank – The neutralization tank is a 150,000 gallon open carbon steel tank with an inner protective coating. No containment exists around this tank. It receives regeneration wastewater from the makeup demineralizer system through underground transfer lines. The water is pH adjusted with sulfuric acid or caustic and then sent to the WTP sedimentation lagoons. {862}

22. Discharge Monitor Tanks – Two above ground 100,000 gallon stainless steel discharge monitor tanks are located plant south of the radwaste building. The tanks are used to store plant radioactive wastewater prior to the discharge. A single concrete diked area capable of holding 110% of the contents of one tank provides spill containment. {879}

23. Water Treatment Plant Sodium Hypochlorite Storage Tank – A 6,000 gallon plastic tank previously used for sodium hypochlorite is located plant south of the water treatment plant. The tank is empty with no plans of use in the future. No containment exists around this tank. {O}

24. Gaseous Chemical Storage –

    a) Carbon Dioxide (CO_2): The CO_2 storage tank is located in the plant gas yard, which is plant south of the radwaste building. The primary use of CO_2 is to degas the main generator of hydrogen during outages. The tank has a capacity of 6 tons of liquid CO_2, a maximum pressure of 350 psig at 125° F. It is constructed per section 8 of the ASME pressure vessel code. {832}

b) Hydrogen (H_2): There are 12 tubes for storage of H_2 with a total capacity of 83,232 cubic feet at 2,300 psig located in the plant gas yard. Hydrogen is primarily used as a cover gas for the main turbine generator and to maintain oxygen control in the reactor coolant system. The tubes are constructed per ASME UPV code 8, Code Case 125 of a material that meets ASME SA372 Class 4. {833}

c) Oxygen (O_2): An oxygen storage tube trailer provides the main source of oxygen and 8 oxygen cylinders for backup. The cylinders each contain 330 standard cubic feet of O_2 at 2,640 psig. They are constructed to meet DOT specification 3AA2400. The primary use of O_2 at the plant is in radwaste systems, in the evolution of hydrogen recombination. {841}

d) Nitrogen (N2): Callaway has both high and low pressure N2 with storage tanks located in the plant gas yard. There are two low pressure N2 storage tanks with a liquid capacity of 1569 gallons and 3000 gallons each. They are constructed with an inner vessel of 5083 aluminum and an outer carbon steel vessel. The primary use of low-pressure nitrogen for the plant is to purge and blanket systems to exclude oxygen. High pressure nitrogen is stored in 3 tubes with a total capacity of 24,280 cubic feet at 2,300 psig. They are designed and constructed to meet ASME code for pressure vessels. The primary use of high pressure nitrogen is to provide a backup gas supply to rapidly close plant valves during transients. {892}

25. Reclaimed Oil Storage Tank – The reclaim oil tank has a capacity of 10,000 gallons. It is an above ground tank located within an earthen dike of sufficient size to contain 110% of the tank contents. The tank is filled through underground lines from the oily wastewater separator. Used oil is removed from the tank to tanker trucks by vacuum created within the trucks. {861}

26. Oily Waste Treatment Area – This area is located southeast of the demineralizer building. The area consists of a building containing the oily wastewater separator and associated piping, the reclaimed oil storage tank, the equalization basin, and a 29,000 gallon carbon steel underground process surge tank that supplies plant oily wastewater to the separator. All Oily waste system water and oil transfers in this area are underground. Separated water is transferred to WTP sedimentation lagoon #6. {870}

27. Auxiliary Oil Transfer (Loading) Area – The auxiliary oil transfer loading area is located plant south of the auxiliary fuel oil storage tank. The area consists of a building containing pumps and piping to transfer diesel fuel oil to the auxiliary fuel oil storage tank. Diesel fuel oil is unloaded from tank trucks by pumps on the trucks or using the installed plant equipment pumps. Transfer line to the auxiliary fuel oil storage tanks are underground. {864}

28. Loading Area at Stores II – The loading area at the Stores II building consists of a standard shipping/receiving dock. All chemicals and other products are unloaded from trucks in their own shipping containers. There are not facilities for unloading of any bulk chemicals, fuel oil, or gasoline through pipelines to plant bulk storage tanks. {801}

29. Misc. Materials Storage Areas – Three areas around the Stores II building exist for miscellaneous laydown areas for items such as metal, gravel piles, fill material and old concrete. One is a concrete pad and the other two are on grass/gravel covered areas. Another materials storage area exists near the outage maintenance facility. Materials stored are metal components such as pumps, and valves, structural materials made of items such as metal, wood or concrete, pipe made of materials such as carbon steel, PVC and galvanized metal, empty portable tanks and empty metal dumpsters. {801}

30. Excavation Surplus Storage – Two storage areas are located plant south of the water treatment plant sludge lagoons containing excess dirt, concrete and asphalt from plant activities.

31. Hardened Condensate Storage Tank – The 500,000 gallon tank filled with deionized water is located plant east of the Turbine Building in a large graveled area. The tank was placed in service in June 2016, as part of the FLEX strategy that would supply ample cooling water for the Steam Generators, should a beyond design basis event occur at Callaway Energy Center

32. Oxamine Tank – The 2,500 gallon double walled tank is located plant north west of the water treatment building. This tank was placed in service in 2018 as part of a biocide addition project. This tank works in conjunction with the below mentioned Sodium Hypochlorite Tank.{872}

33. Sodium Hypochlorite Tank- This 6,650 gallon double walled tank is located plant north west of the water treatment building. This tank was placed in service in 2018 as part of a biocide addition project. This tank works in conjunction with the above mentioned Oxamine Tank. {872}

<u>Temporary Significant Materials Storage – During the Last 3 years</u>

The following significant materials were present on-site temporarily within the last three years.

Refuel 22 and 23
The majority of additional materials stored on-site were for large equipment replacements including the main generator rewind and various work on the Reactor Coolant System. Additional trailers to house additional staff and equipment such as scaffolding, cranes and other materials to support the refueling outages were also on-site. No other 'significant materials' were stored on site during Refuel 22 and 23.

Hazardous Wastes
Callaway Energy Center is normally a small quantity generator of hazardous waste generating between 200 and 2200 lbs. of hazardous waste per month. At times the quantity of hazardous waste exceeds the quantity due to infrequent activities such as equipment cleanings etc. The waste is stored in a prefabricated Hazardous Waste Storage Building (HWSB) with containment sumps, designed specifically for storage of hazardous waste. Waste is stored in the HWSB for up to 180 days prior to disposal via an offsite vendor. Typical wastes generated are Chromium, Lead, Mercury, Silver and solvents. The plant also currently maintains an outside satellite accumulation area where waste paint and solvents are accumulated. These wastes are accumulated from work performed in the plant in two separate 55 gallon drums held in a prefabricated closed spill container capable of holding 110 percent of the volume in both drums.

Management Practices

A Spill Prevention, Control and Countermeasure (SPCC) plan and implementing procedure is in place at the Callaway Energy Center. The plan provides plant personnel with the necessary information regarding the types, locations and quantities of no-radioactive oil present at Callaway Energy Center and offers guidance on the containment and reporting of oil spills.

A Chemical Emergency Response Plan (CERP) and implementing procedure is also in place at the plant. This plan provides guidance and information for responding to hazardous chemical and/or oil spills.

Both plans describe various materials management practices employed to minimize contact by these materials with storm water runoff.

Outdoor Vehicle Maintenance and Cleaning Areas

No outdoor vehicle maintenance and cleaning areas exist on the plant site.

Fertilizers, Pesticides, Herbicides and Soil Conditioners

Herbicides are spray applied to various areas in and around the plant site as shown in drawing NPDES-001 Storm Water Information Outfalls 010-015. Herbicides are

also applied to small areas near the intake building, the shooting range, the met tower and the alternate emergency diesel generator yard.

The herbicides used for weed control are Esplande 200 SC, Method 240 SL, and Roundup PRO. Pesticides are not used at Callaway Energy Center. In addition, no restricted use products are utilized at the facility.

Note that fertilizers, herbicides and soil conditioners which are used by the Missouri Department of Conservation on lands leased to them (yet within the plant storm water drainage areas) are not included in this summary.

<u>Authorization for Non-Stormwater Components</u>

In previous applications, we described numerous releases to storm water conveyances from sources not associated with precipitation. We also discussed our justification for these releases with representatives from DNR's Jefferson City Regional Office, in meetings (and during a plant inspection) preceding re-issuance of the permit. All were approved. As a result, testing was not conducted to evaluate the presence of non-stormwater discharges (as they exist and have been previously characterized and evaluated). Thus, this application does not contain the typically applicable "non-storm water source certification" (per EPA Form 2F, Item V).

We hereby request continued allowance for releases from these sources (described below), consistent with DNR's earlier interpretation. The sources include:

1. Potable water – infrequent flushing and/or drainage of potable water lines for repairs or maintenance to the system

2. Firewater – quarterly flushing from 40 connections required for testing and maintenance of the firewater system. Note that we treat the firewater system with a bio stat, a bio penetrant and a scale inhibitor. This treatment program is designed to control microbiologically influenced corrosion to ensure integrity as required by the American Nuclear Insurers and the Nuclear Regulatory Commission. Quarterly flushes will discharge less than 50,000 gallons total. Based on the expected concentrations and aquatic toxicity data, we do not believe there are any significant effects on the storm water runoff settling ponds from these releases. Once per three years, the entire system including the tanks, must be flushed which releases 700-800,000 gallons. Treatment chemicals are not added for a time prior to these flushes in order to ensure that residuals are very low (due to consumption within the system).

3. Manhole Pump-Outs – numerous manholes (providing access to instrumentation, piping, cables, etc.) at the plant are periodically pumped out to remove accumulated storm water. In order to address questions regarding possible contamination due to galvanized metal corrosion, a testing program was conducted and the analytical results shared with DNR. The testing

indicated that zinc concentrations were reduced significantly by maintaining water levels below galvanized supports (i.e. routine pump outs). During 2012 we notified DNR that automatic pumping capability would be installed in several electric manholes. Note that water is not pumped to the storm water conveyance if an oil sheen exists or if the pH is not between 6 and 9 (which would be indicative of a spill or leak).

4. Eye Wash/Safety Shower Discharges – Releases are made from routine testing and/or emergency use of these outdoor facilities.

5. Demineralizer Water/Essential Service Water – during outages and other equipment maintenance activities it is sometime necessary to provide temporary hoses to supply water to equipment. When these hoses are dissembled, residual water is released locally.

6. Air Conditioning Condensate – condensate from various building intake air cooling units is routed to building roof drains and/or to local surfaces which in turn contribute to various storm water outfalls.

The following tables provides non-storm water plant related sources potentially discharged from conventional storm water drainage:

Outfall	Non-Stormwater Sources
010	• Fire water test (100gal/qtr) • Manhole discharges (10,000 gal/mo) • Eye wash/showers • ESW (<500 gall/event)
011	• Fire water test (24,000 gal/qtr) • Fire water tank drain (80,000gal/3 yrs) • Manhole discharges (15,000gal/mo) • Eye wash/shower • Air conditioning condensate • ESW (<500gal/event)
012	• Fire water test (11,000gal/qtr) • Manhole discharges (70,000gal/mo) • Air conditioning condensate • ESW (<500gal/event)
014	• Fire water test (17,000 gal/qtr) • Air conditioning condensate
015	NONE

Plant Modifications
In response to the Fukushima Daiichi Nuclear disaster, the US Nuclear Regulatory Commission made several recommendations applicable to Callaway that occurred throughout 2015 and 2016. The initial phase of this project was to build a FLEX Hardened Storage Building that housed sufficient portable, onsite equipment and consumables for long term safe shutdown, should a nuclear disaster happen at Callaway Energy Center. Phase 2 of the project was to build a 500,000 gallon HCST (Hardened Condensate Storage Tank) that would supply ample cooling water for the Steam Generators, should a beyond design basis event occur at Callaway Energy Center. Both of these projects were completed in 2016.

Independent Spent Fuel Storage Installation (ISFISI) Facility – Callaway constructed a dry cask spent fuel storage facility on-site and the project was completed by end of 2015.

Additional Sedimentation Lagoons – Callaway constructed two additional sedimentation lagoons, #5 and #6, adjacent to the existing water treatment sedimentation lagoons. These lagoons contain mainly Missouri River solids, and went into service in mid-2016. All effluents from the existing lagoons are currently recycled to the head of the water treatment plant as they have been for the past 20 years.

Significant Leaks and Spills

No significant spills (meeting the criteria set forth in the regulations) have occurred at Callaway Energy Center in the last 5 years.

Attachment J
Requests for Modification of Current Permit Conditions

Addition of Oxamine/Monochloramine Sample Point with Cooling Tower Bypass in Service

In 2017, Callaway Energy Center implemented a change in the addition of biocides to the Cooling Water System, for greater microbiological control. The new treatment scheme allows continual addition of biocides, which are subsequently dechlorinated prior to discharge. The NPDES permit modification issued in 2017 restricted discharges from Cooling Tower Bypass (Outfall 016) while adding the new continuous biocide due to the inability to sample Outfall 016 downstream of the dechlorination point. After the current permit was issued Callaway installed a new sample point downstream of the dechlorination point. The sampling location allows CEC to collect a representative sample of either Outfall 016 or Outfall 002 from a common sample valve (VDB1140) Callaway Energy Center requests a change in the re-issued NPDES permit to state that plant personnel may operate Cooling Tower Bypass with the continuous biocide system in service and verify permit compliance by sampling Outfall 016 from either VDB1140 or Manhole 86-2 when Outfall 002 is isolated. After discussions and consent from Missouri DNR, a 1 hour pilot project was effectively carried out on November 13th, 2019 to show TRC requirement compliance per the current NPDES permit. The pilot project consisted of sampling at VDB1140 with cooling tower bypass open and cooling tower blowdown isolated. From the data shown below, Ameren personnel believes sample point VDB1140, with cooling tower by pass open and Cooling Tower Blowdown isolated is a viable sample location for Outfall 016.

Source Waterbody Physical Data
Callaway Energy Center

Submitted in Compliance with
Section 316(b) Rule
40 CFR 122.21(r)(2)

Submitted by:
Ameren Missouri
Saint Louis, Missouri

Developed by:
Wood Environment & Infrastructure Solutions, Inc.
St. Louis, Missouri

December 2019

wood.

Table of Contents

Page

List of Figures

List of Tables

List of Abbreviations and Acronyms

AMSL	above mean sea level
AOI	area of influence
BTA	best technology available
CEC	Callaway Energy Center
cfs	cubic feet per second
CWIS	cooling water intake structure
DIF	design intake flow
DO	dissolved oxygen
ft	foot/feet
FNU	formazin nephelometric unit
fps	feet per second
gpm	gallons per minute
IM&E	impingement and entrainment
LWL	low water level
µS/cm	microsiemens per centimeter
MDNR	Missouri Department of Natural Resources
mg/L	milligram per liter
MGD	million gallons per day
mi	mile(s)
MWIS	makeup water intake structure
NGVD	National Geodetic Vertical Datum (of 1929)
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NWL	normal water level
RM	river mile
sq mi	square mile(s)
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USNRC	U.S. Nuclear Regulatory Agency

1.0 Introduction

In accordance with Section 316(b) of the Clean Water Act, the U.S. Environmental Protection Agency (USEPA) has promulgated rules under 40 CFR Part 125, Subpart J (the Rule) that require the determination of best technology available (BTA) to reduce mortality associated with the impingement and entrainment (IM&E) of aquatic biota. Section 40 CFR §122.21(r)(2) requires the owner or operator of a facility with a cooling water intake structure (CWIS) to submit source water physical data with an application for a National Pollutant Discharge Elimination System (NPDES) permit. Source water physical data are required regardless of the compliance alternative selected to demonstrate BTA.

The required data are used by the Director (i.e., permitting authority) to characterize the facility and evaluate the type of waterbody potentially affected by the CWIS. This includes local species potentially impinged and entrained by the facility's CWIS. Additionally, the information provided is relevant in supporting the reasonableness of the proposed design, construction technologies, operational measures, and restoration actions of the facility for meeting the requirements of the Rule.

Under 40 CFR §122.21(r)(2), specific information that must be submitted for the facility includes:

> *(i) A narrative description and scaled drawings showing the physical configuration of all source water bodies used by your facility, including areal dimensions, depths, salinity and temperature regimes, and other documentation that supports your determination of the water body type where each cooling water intake structure is located;*
>
> *(ii) Identification and characterization of the source waterbody's hydrological and geomorphological features, as well as the methods you used to conduct any physical studies to determine your intake's area of influence within the waterbody and the results of such studies; and*
>
> *(iii) Locational maps.*

The following sections present the information required pursuant to 40 CFR §122.21(r)(2) for the Callaway Energy Center (CEC). It should be noted that CEC refers to its CWIS as a makeup water intake structure (MWIS). This report will use the term MWIS, but it is understood that the two phrases have the same meaning.

1.1 Overview of the Callaway Energy Center

CEC is a baseload, single-unit nuclear generating facility located approximately 10 miles southeast of Fulton, Missouri in Callaway County approximately five miles north of the Missouri River (Figure 1-1). CEC draws makeup water for its closed-cycle cooling water system at its shoreline MWIS at river mile (RM) 115.4 (Figure 1-2). CEC consists of a pressurized water reactor, four steam

generators, one steam turbine generator, and a closed-cycle heat dissipation system. The heat dissipation system consists of a 555 foot (ft) high hyperbolic natural draft cooling tower; the MWIS; a main condenser; and a cooling tower basin and blowdown discharge pipeline. The system recirculates 530,000 gallons per minute (gpm) of water through the natural draft tower to remove waste heat during normal operations.

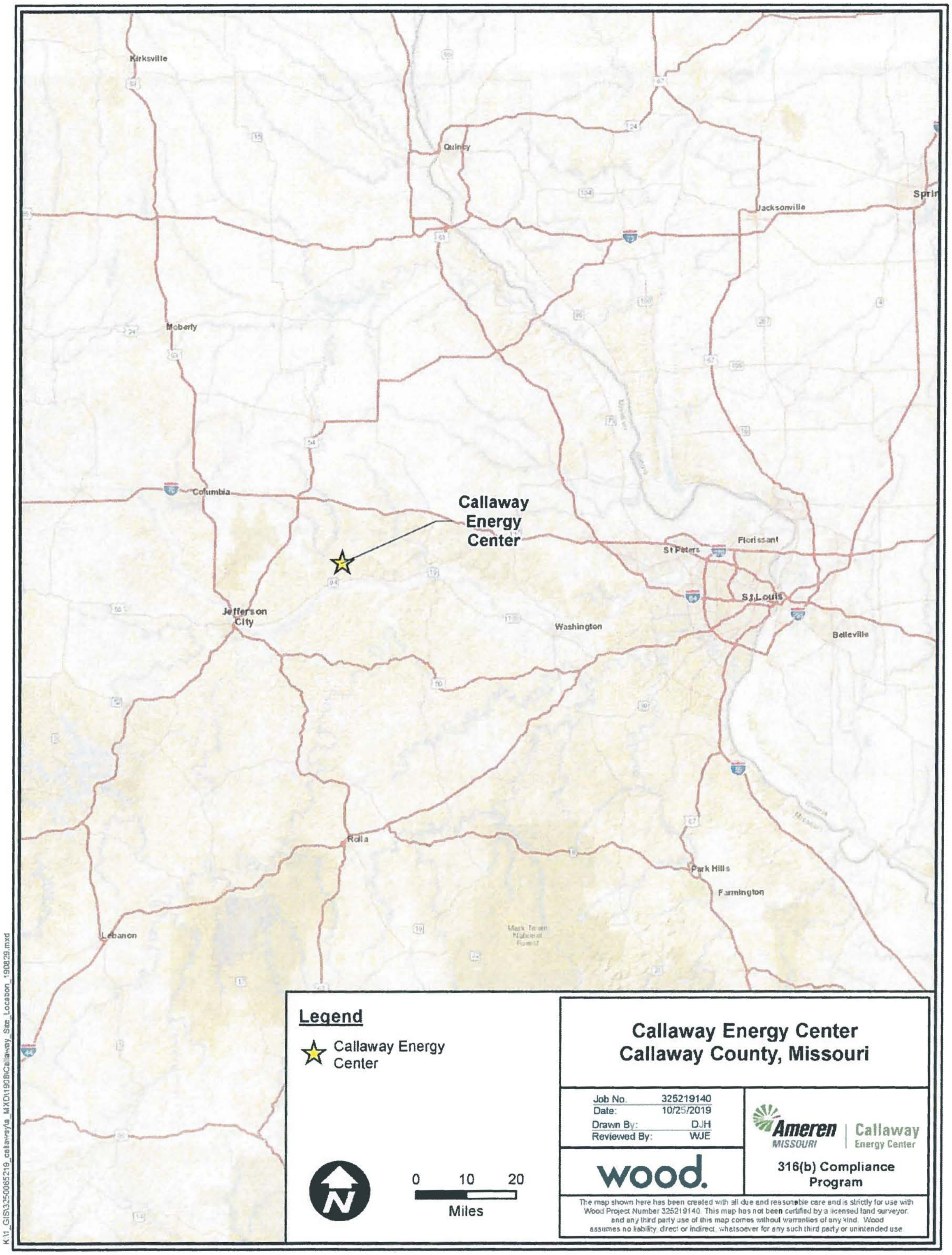


Figure 1-1. Location of the Callaway Energy Center

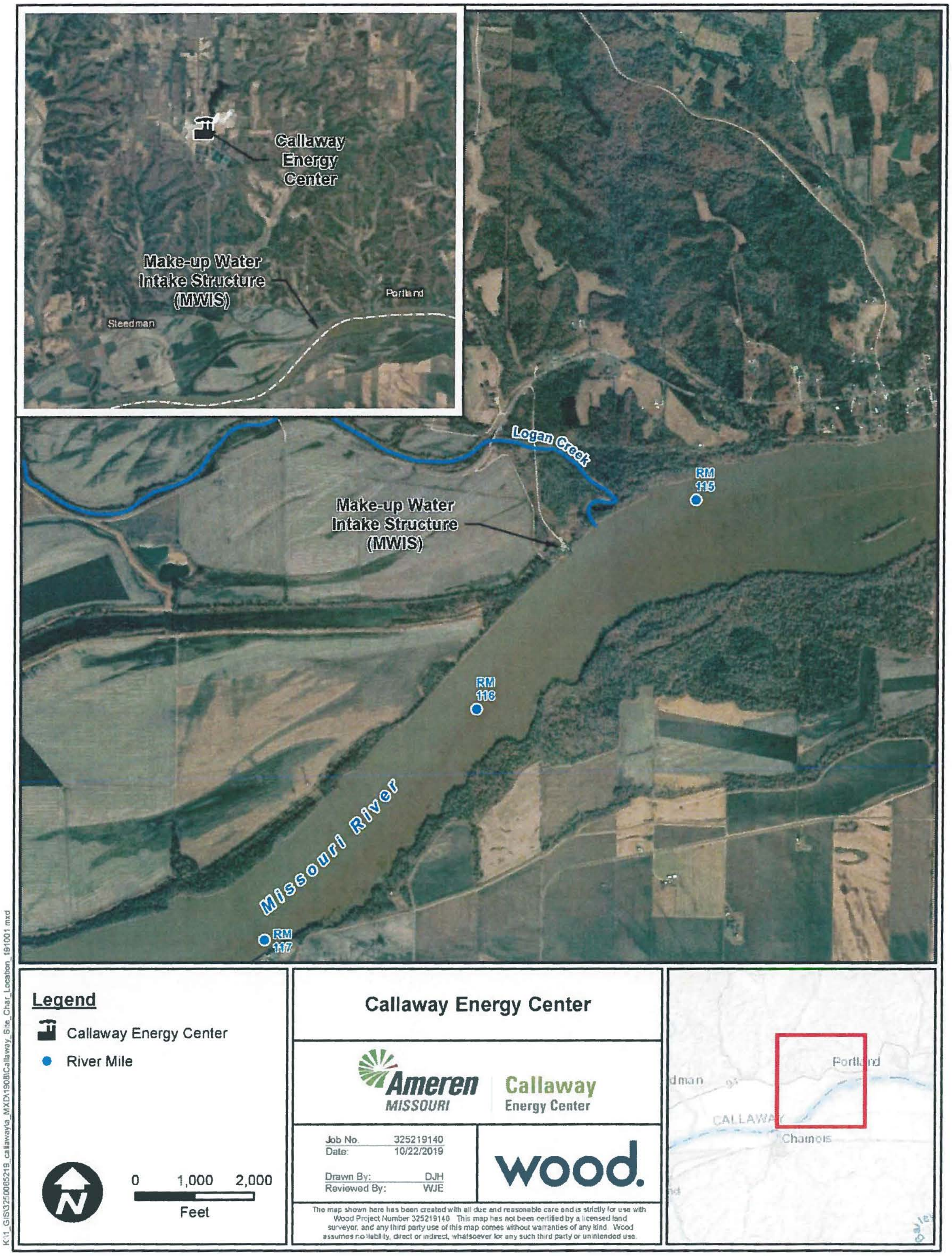


Figure 1-2. Location of the Callaway Energy Center Makeup Water Intake Structure

2.0 Physical Configuration of The Source Waterbody

2.1 Habitat and Morphology Features

Physical characteristics of the source waterbody provide the Director with supporting information to define the quality and quantity of aquatic habitat in the vicinity of the MWIS. Physical features include: water depth, shoreline and channel morphology, the availability and type of potential spawning and nursery habitat, and water quality characteristics. Table 2-1 presents a summary of the physical characteristics of the source waterbody including its configuration in the vicinity (i.e., 1-mile [mi] radius) of the MWIS.

The coordinates for CEC's Missouri River MWIS are:

Latitude	Longitude
38°42'12"	91°44'18"

The Missouri River Basin drains an area of 529,350 square miles (sq mi) and is the largest river basin in the United States (USACE 2012). The river originates with the confluence of the Gallatin, Madison, and Jefferson rivers near Three Forks, Montana and flows for 2,341 miles south and east to its confluence with the Mississippi River at St. Louis, Missouri. The river passes through seven states including Montana, North and South Dakota, Iowa, Nebraska, Kansas, and Missouri. Geology of the basin is varied from Northern Rocky Mountains at the headwaters, through the glaciated Great Plains and Central Lowlands, and finally through the unglaciated, limestone-dolomite Ozark Plateaus at CEC (Galat et al. 2005a, 2005b). Most of the basin flows through the semi-arid Great Plains and is largely a dryland river. The lower Missouri River and its floodplain from Glasgow, Missouri to St. Louis are largely confined by nearly vertical limestone and dolomite bluffs of the Ozarks.

Upstream dam construction and mainstem channelization of the Missouri River has fragmented the river into four ecological units: a free-flowing reach upstream of the reservoirs, the reservoirs, remnant floodplains between the reservoirs, and a channelized reach below the most downstream reservoir (NRC 2002). Prior to alteration, the hydrology of the river formed a braided, meandering channel with a wide floodplain. High sediment loads were the norm due to seasonal rains and the highly erodible soils of the basin. However, conditions on the Missouri River have changed dramatically over the past century as a result of navigation and flood control. Modifications began in the late 1800s with removal of snags to permit navigation, followed by channel enhancements in the early 1900s, and flow regulation via dams in the 1930s (NRC 2002). In the 1950s and 60s, five U.S. Army Corps of Engineers (USACE) dams were built on the mainstem of the upper Missouri River. The lower Missouri River remains unimpounded but has been channelized and has lost connectivity to the floodplain due to levees, bank revetments, and river bar dikes and wing dams (NRC 2011).

Flow in the Missouri River is regulated, as authorized by the Flood Control Act of 1944, according to the Missouri River Main Stem Reservoir System Regulation Manual (USACE 2006). The typical

annual flow cycle in the regulated Missouri River involves peak reservoir storage in July, followed by a gradual decline until late winter. There are two natural peak river flows: one in late February to April, created by snowmelt and rainfall in the plains, and a second one in May to July, created by snowmelt and rainfall in the mountains. Targeted flow releases are increased for the navigation period, which normally begins by April 1 near St. Louis and extends until early December. Frequency and severity of floods and droughts have increased over the past few decades. Record floods were recorded in the lower Missouri River in 1993, 2011, and 2019. The increasing trend in flood stage has been attributed to the constriction of the channel by wing dams and levees.

The CEC MWIS is located on an outside bend on the left descending bank within the channelized reach of the lower Missouri River at RM 115.4 (Figure 1-2). The MWIS and the rock revetment slightly protrude from the upstream river bank and the downstream river bank. The main channel of the Missouri River flows directly in front of the MWIS. On the upstream side, there are pipe-pile clusters used to protect the structure from barges. Substrates in the lower Missouri River are mostly sand with small areas of silt and mud (Reuter et al. 2008).

Within a 1-mi radius of the CEC MWIS, the river channel gradually bends, but habitat remains relatively uniform. Under normal river stage, channel width is approximately 1,630 ft. The main channel bends toward the north shore directly in front of the MWIS. Multiple wing dykes along the far shore upstream of the MWIS provide structure and direct flow into the navigation channel. Channel depths are between 18 and 30 ft at normal flows (ASA 2017). The far shore is a shallower, depositional area that has exposed sandbars at low flows. Logan Creek flows into the Missouri River 650 ft directly downstream of the MWIS. A variable riparian zone from 50 to 300 ft wide exists upstream and downstream of the MWIS. A larger, more consistent riparian zone greater than 500 ft wide is established along the far shore. Land use in the area is 40% forest and wetlands, followed by 35% crop land, 18% open water, 6% developed, and 2% herbaceous shrub (USGS 2011).

Table 2-1. Source Waterbody Physical Characteristics Within a 1-mile Radius of the Makeup Water Intake Structure

General Source Waterbody Characteristics	
Source Waterbody Name:	Missouri River
Non-tidal Rivers	
Range of river discharge during the study:	• 34,400 to 492,000 cubic feet per second (cfs) • Mean 112,257 cfs • Median 88,500 cfs
Range of river stage:	• 484 to 517 feet (ft) National Geodetic Vertical Datum (of 1929) (NGVD) • Mean of 494 ft NGVD • Median of 493 ft NGVD
Tidal Rivers/Estuaries	
Tidal variation:	N/A
Salinity ranges:	N/A
Lakes	
Range of the lake stage	N/A
Other	
Other notable changes or activities in the source waterbody that are relevant to impingement & entrainment (IM&E) studies	Missouri River is a navigable river used for commercial transport by barge.
Habitat Characteristics	
Channel Morphology	Channel narrows at "Portland Bend" from river mile (RM) 116 to RM 114.
Aquatic Habitat Features	• Main channel habitat dominates. • Shoreline habitats limited at the makeup water intake structure (MWIS) due to levees and sheet-pile walls. • Multiple wing dykes upstream along the far bank. • Shallower depositional habitat along the far bank and downstream; becomes sandbar habitat at low flows. • Logan Creek confluence 650 ft downstream of MWIS.
Water Depth	Main channel depths range from 18 to 30 ft under normal river stage.
Substrate Type	Dominated by sand.
Shoreline Features	• Immediate vicinity of MWIS is protected by a pipe-pile cluster and sheet-pile wall. • Riparian buffers upstream and downstream.
Width of riparian zone	• 300 ft wide upstream and 50 ft wide immediately downstream of MWIS. • >500 ft wide on opposite shoreline.

2.2 Water Quality Characteristics

Water quality characteristics of the source waterbody are represented by trends in discharge, stage, temperature, pH, dissolved oxygen (DO), conductivity, turbidity, and suspended sediment. These parameters are important indicators of habitat quality and ecosystem function and are used by the Director to estimate the potential impact of the MWIS on the source waterbody. Additionally, temperature and DO are used to interpret trends in IM&E at the MWIS. For example, seasonally depressed temperatures result in greater impingement rates due to increased stress (White et al. 1986; King et al. 2010). Similarly, low DO within the source waterbody may also result in greater impingement rates due to reduced vigor or death of resident fish (King et al. 2010).

Historical data for streamflow and water quality were compiled from the U.S. Geological Survey (USGS) stream gage on the Missouri River at Hermann, Missouri (USGS 06934500). This gage is the nearest to the CEC MWIS and is 17.2 RM downstream. Missouri River discharge and stage data from 2014 through 2019 (5 years) are shown in Figures 2-1 and 2-2. Mean monthly variations in water quality parameters from 2014 to 2019 (5 years for most parameters) are shown in Figures 2-3 through 2-8.

General causes of water quality degradation include sediment, nutrient, and pesticide runoff from agriculture; sediment and metal loadings from mines; urban storm water discharges; wastewater and industrial plant discharges; septic system leaching; and entrapment of sediments and pollutants behind dams. The Missouri River from its mouth at St. Louis to the Gasconade River has designated use support for warmwater fishery, drinking water, recreation, agriculture, industrial, and livestock and wildlife watering (USACE 2006). Portions of the Missouri River are on the Missouri 303(d) List of Impaired Streams due to *Escherichia coli* contamination; however, the section of river around CEC's MWIS is not listed (MDNR 2018).

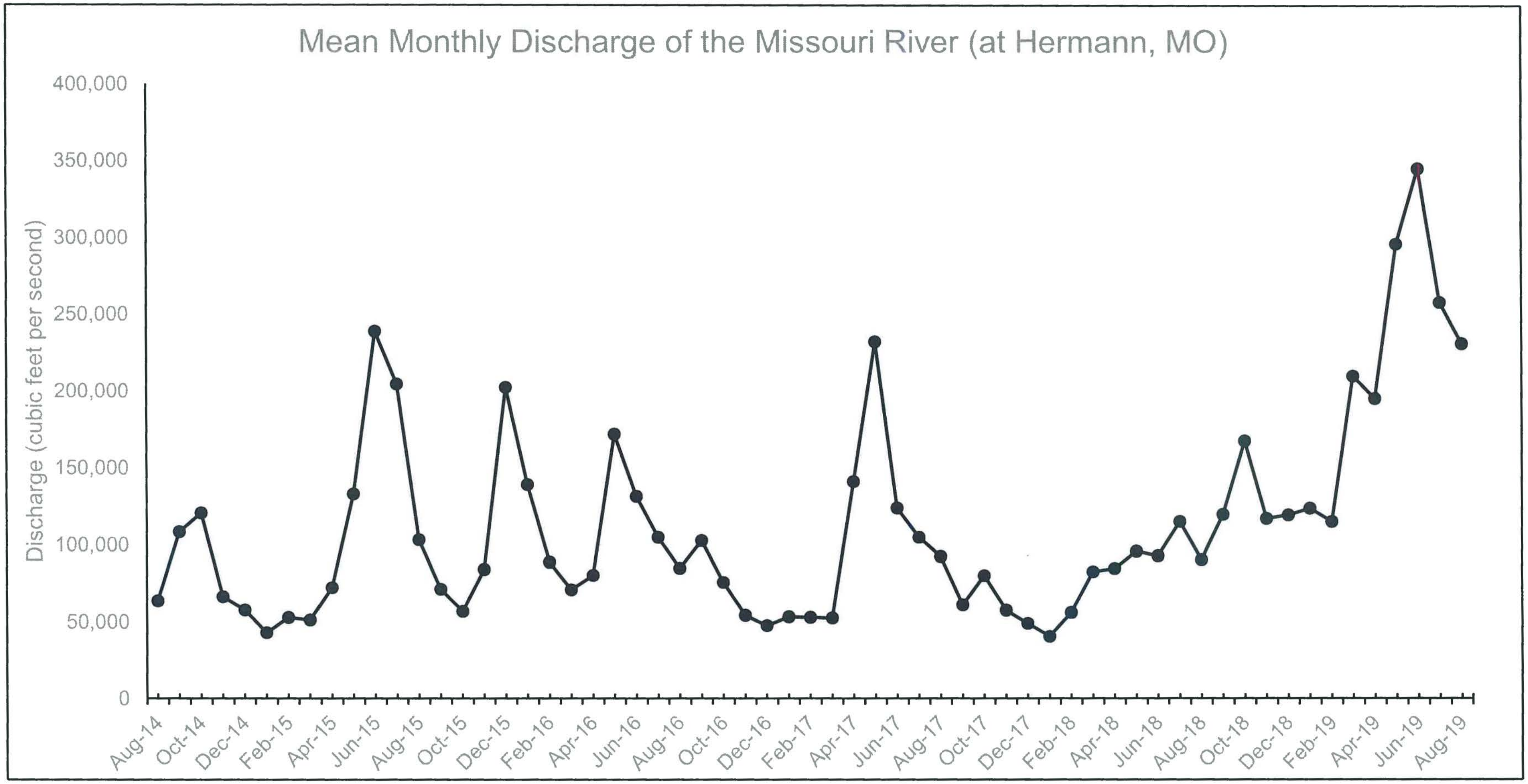


Figure 2-1. Mean Monthly Discharge (cfs) of the Missouri River at Hermann, MO (USGS 06934500) from August 2014 through August 2019

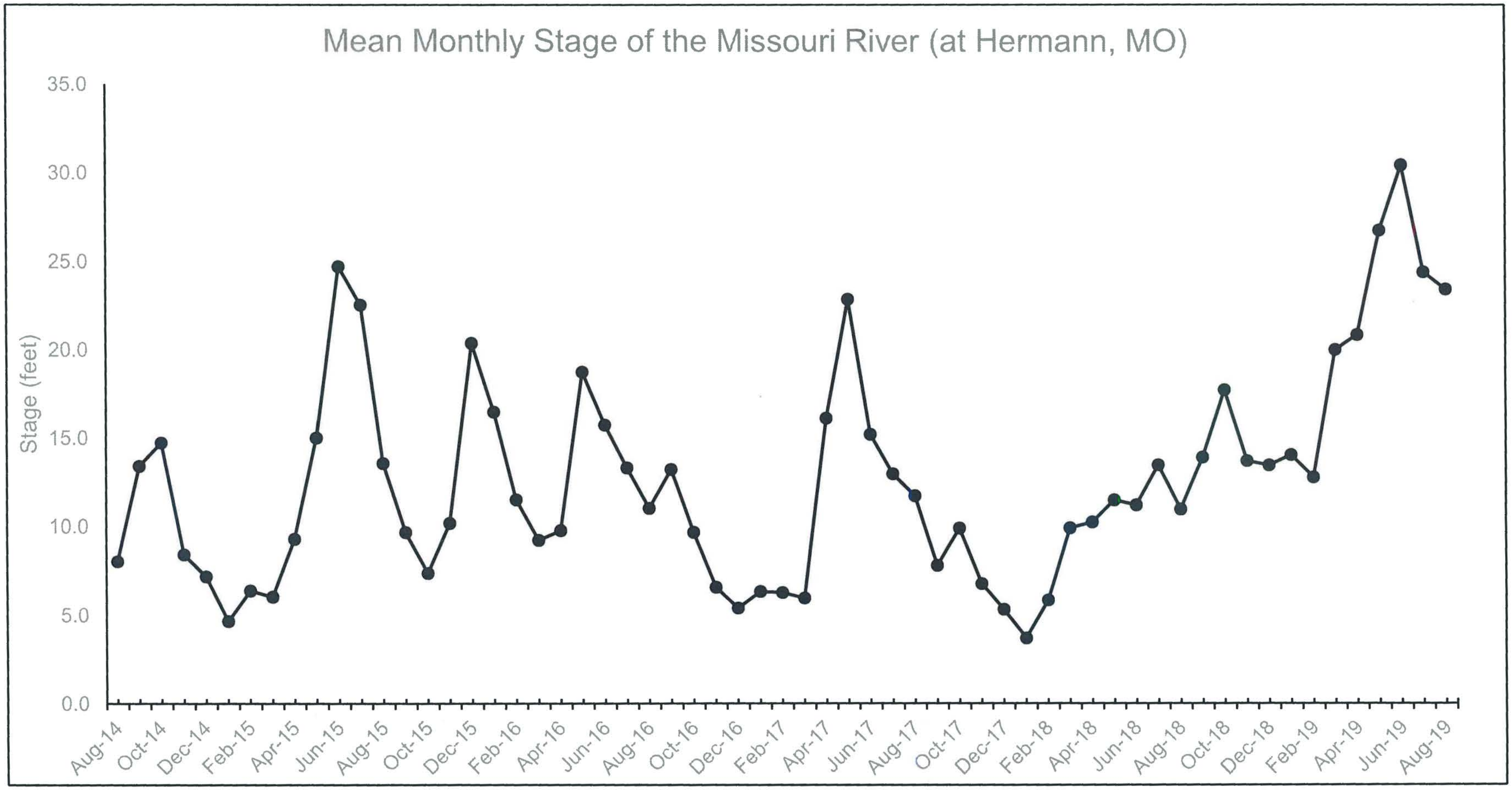


Figure 2-2. Mean Monthly Stage (feet) of the Missouri River at Hermann, MO (USGS 06934500) from August 2014 through August 2019

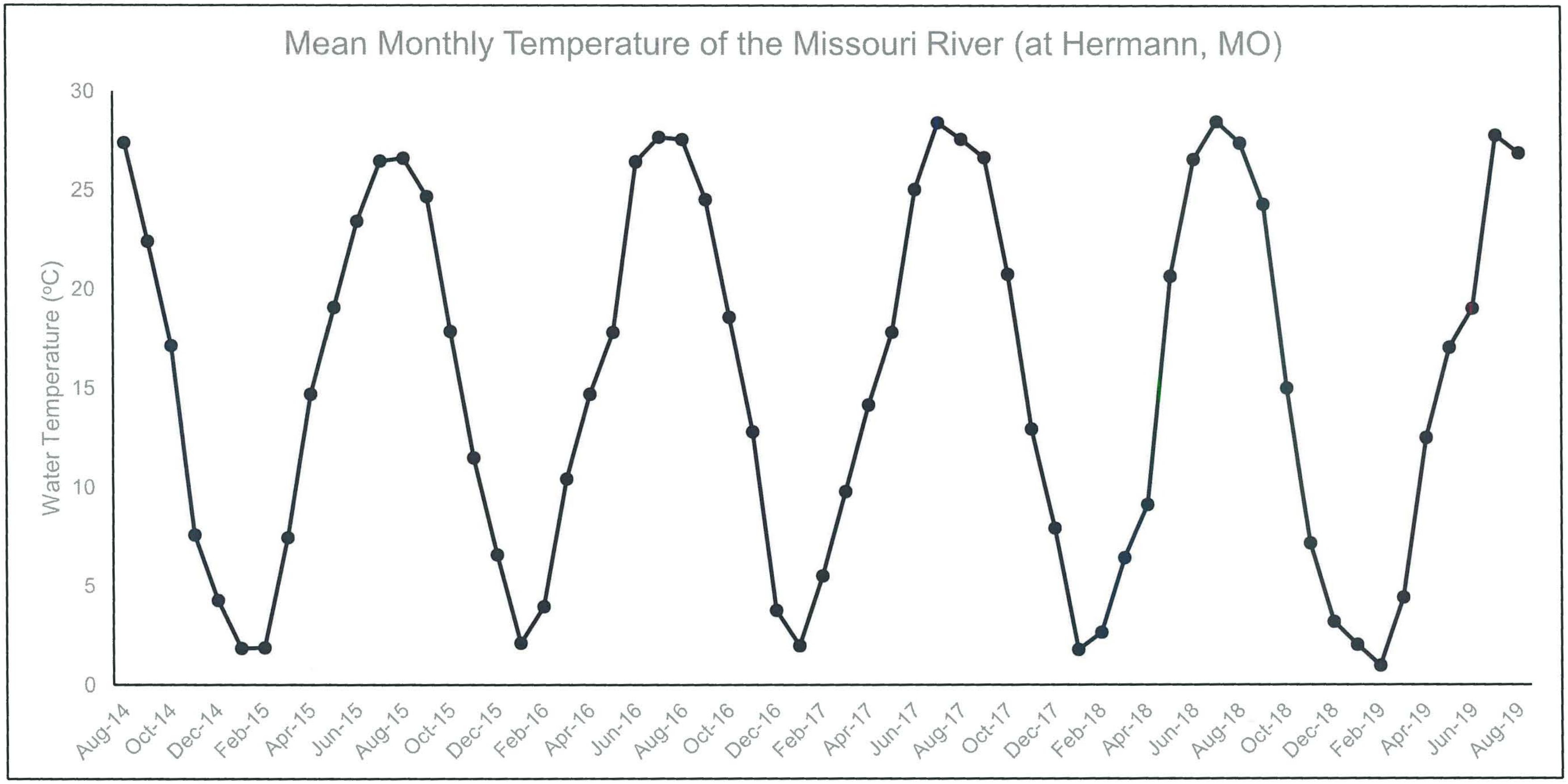


Figure 2-3. Mean Monthly Water Temperature (ºC) of the Missouri River at Hermann, MO (USGS 06934500) from August 2014 through August 2019

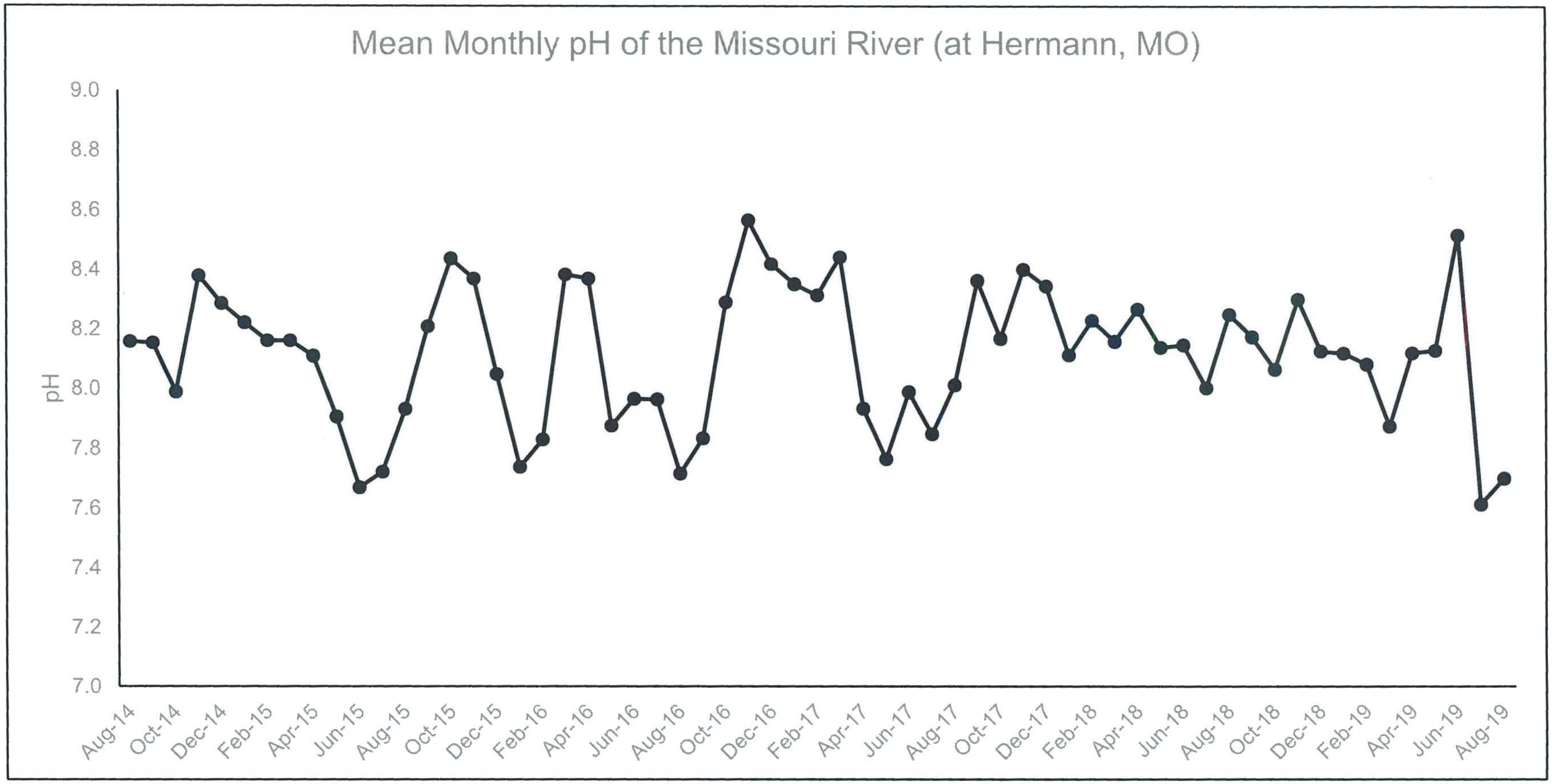


Figure 2-4. Mean Monthly pH of the Missouri River at Hermann, MO (USGS 06934500) from August 2014 through August 2019

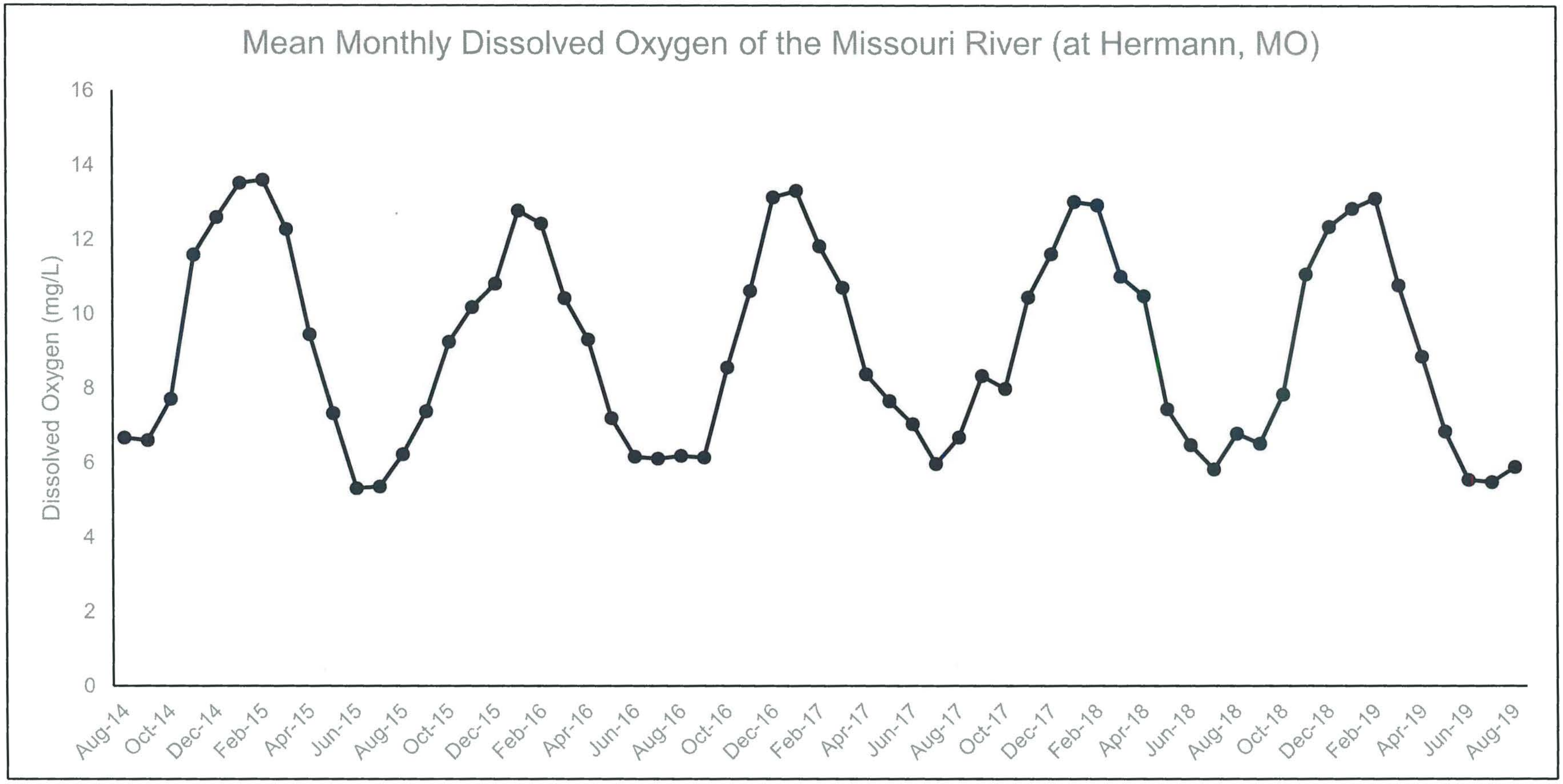


Figure 2-5. Mean Monthly Dissolved Oxygen (mg/L) of the Missouri River at Hermann, MO (USGS 06934500) from August 2014 through August 2019

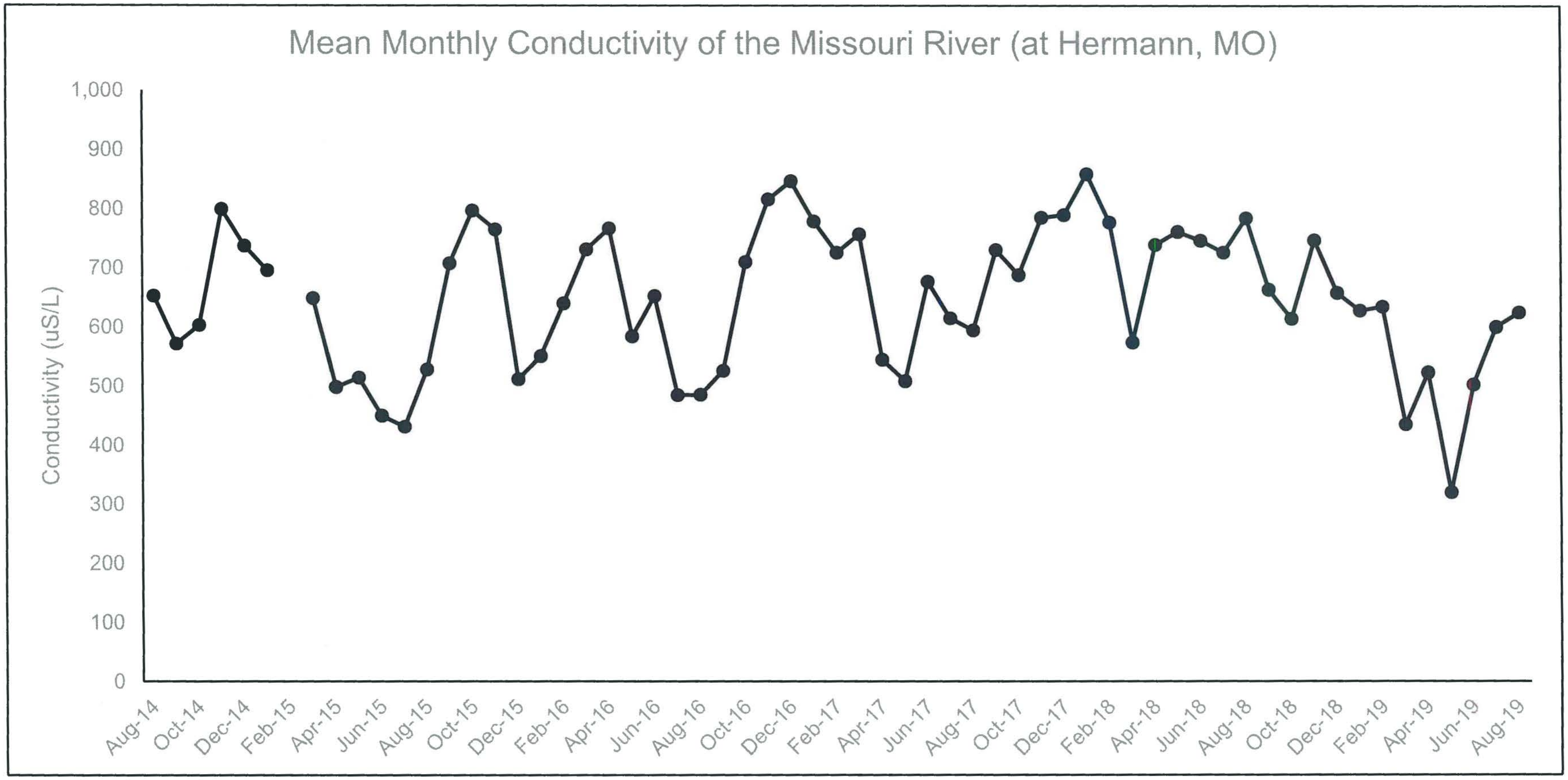


Figure 2-6. Mean Monthly Conductivity (µS/cm) of the Missouri River at Hermann, MO (USGS 06934500) from August 2014 through August 2019

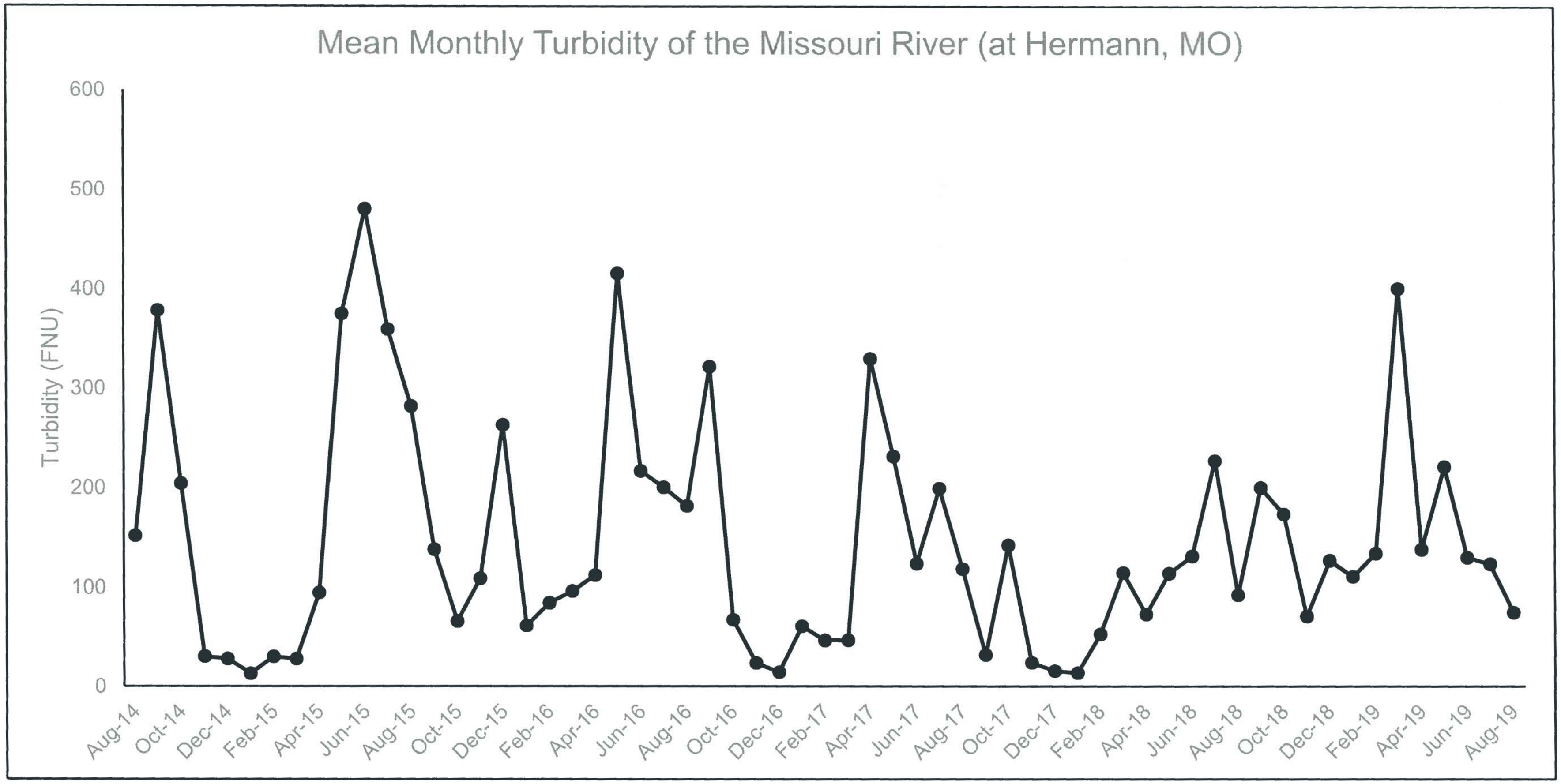


Figure 2-7. Mean Monthly Turbidity (FNU) of the Missouri River at Hermann, MO (USGS 06934500) from August 2014 through August 2019

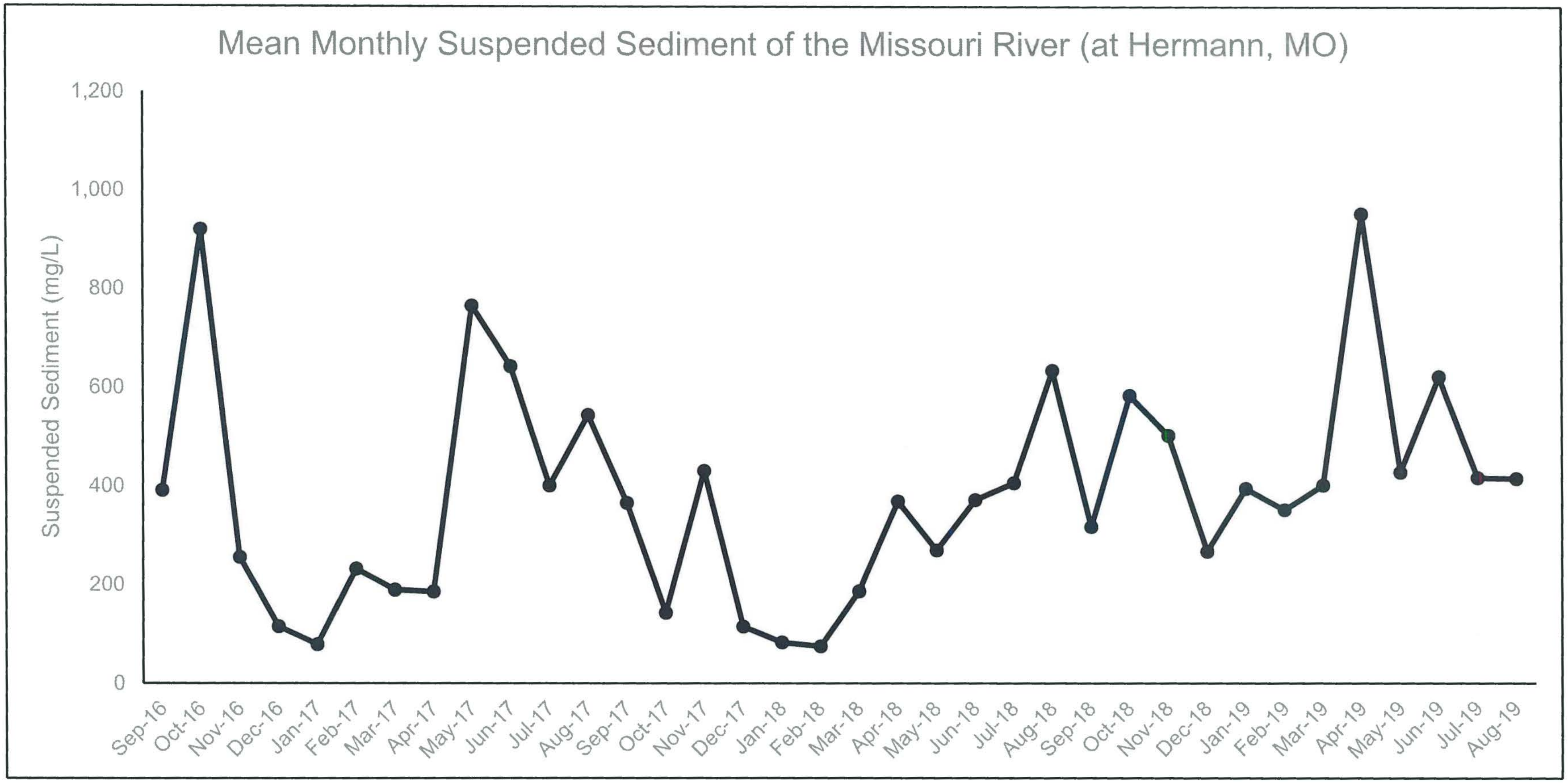


Figure 2-8. Mean Monthly Suspended Sediment (mg/L) of the Missouri River at Hermann, MO (USGS 06934500) from September 2016 through August 2019

3.0 Hydrological and Geomorphological Features

3.1 Source Waterbody Flow Characteristics

Flow characterization of the Missouri River was conducted with available discharge and stage data from the nearest stream gage to the MWIS (17.2 RM downstream) at Hermann, Missouri (USGS 06934500; 481.5 ft National Geodetic Vertical Datum (of 1929) (NGVD). Data for daily discharge were available from August 2014 through August 2019 (i.e., 5 years).

Figures 2-1 and 2-2 present the mean monthly discharge and mean monthly stage of the Missouri River at Hermann, respectively. In general, flows throughout the year can be characterized by a spring to early summer pulse, flow reduction through late summer, and low-flows in fall. Mean discharge in this section of the Missouri River during this study was 112,257 cubic feet per second (cfs) (median of 88,500 cfs) and ranged from 34,400 to 492,000 cfs. Mean stage was 12.6 ft (median of 11.1 ft) and ranged from 2.4 to 35.5 ft (483.9 to 517.0 ft NGVD). Flood stage for this section of the Missouri River is 21 ft (502.5 ft NGVD). During this five-year period, the river was above flood stage for 232 days (12.7 percent)—most recently in August of this year. Since 2014, the average river flow at the gage nearest the CEC MWIS was 60,414 million gallons per day (MGD).

The Missouri River MWIS at CEC is used to supply makeup water to the plant's closed cycle cooling system. Two intake pumps usually meet plant load requirements. CEC does not keep records of flow records for each pump. Normally, the flow is from 12,000 to 18,000 gpm (17.3 to 25.9 MGD) depending on the time of year.

3.2 Source Water Geomorphology

3.2.1 General Geomorphologic Conditions

According to 40 CFR §122.21(r)(2), geomorphologic features must also be presented as part of the physical characterization of the source waterbody. USACE Navigation charts were used to present the geomorphology (i.e., channel location and anthropogenic features) of the Missouri River at the MWIS (Figures 3-1 and 3-2).

Recent data were unavailable from USACE bathymetric surveys, so supplemental bathymetry data were estimated using in-river fisheries sampling collected in 2016 (ASA 2017). Sampling was conducted at the MWIS under various flow conditions. Water depths near the MWIS were 18 to 35 ft within the main channel, which is the dominant habitat at the intake. In summary, aquatic habitats in the vicinity of the MWIS are primarily deep with shallow areas in the littoral zone (i.e., habitats important for spawning and foraging) concentrated at the far bank at the inside bend of the river. Habitat in the main channel is uniform due to upstream wing dykes and periodic dredging to maintain a navigation channel (Figure 3-1).

wood.

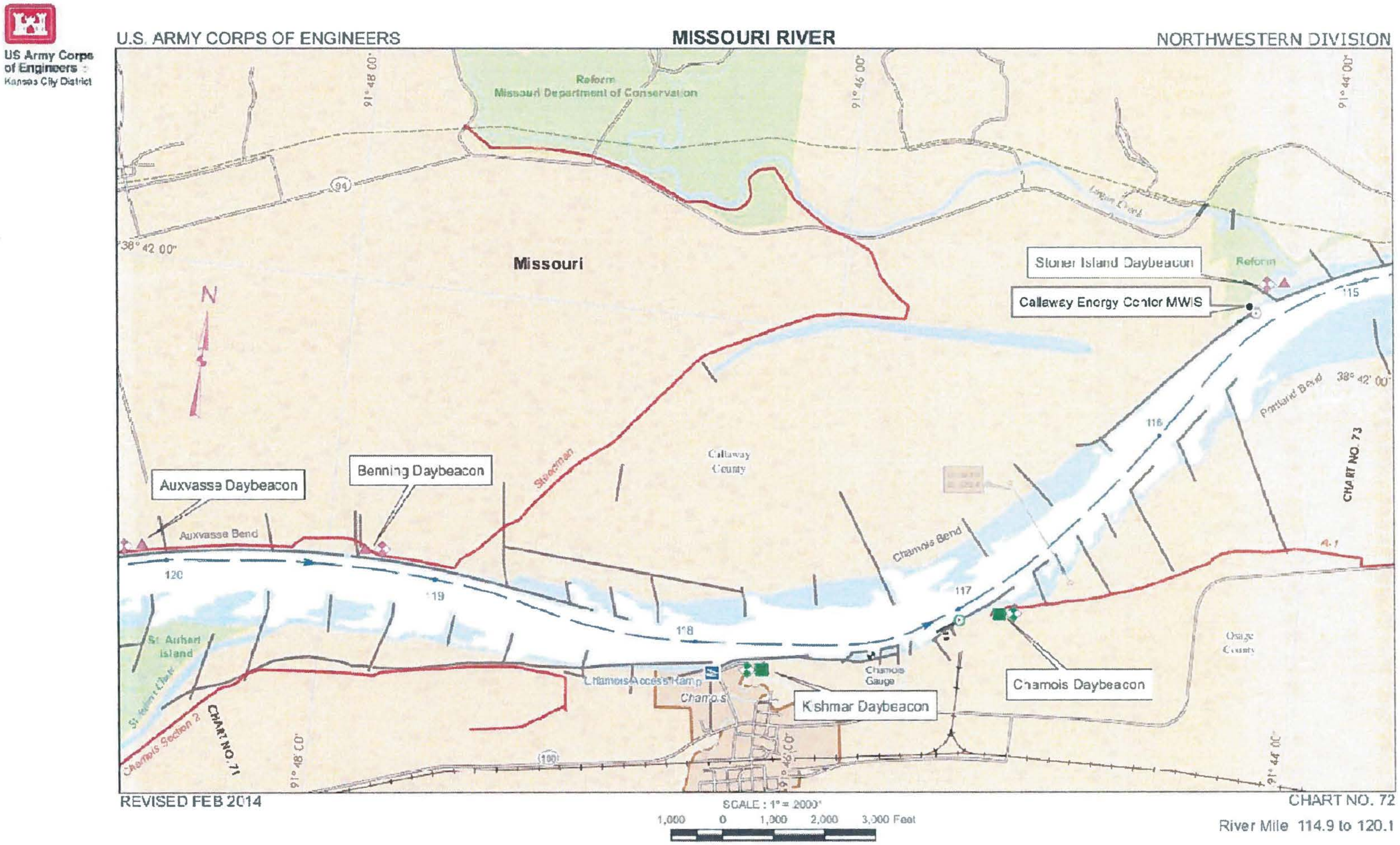


Figure 3-1. Missouri River Navigation Chart Upstream of Ameren's Callaway Energy Center MWIS

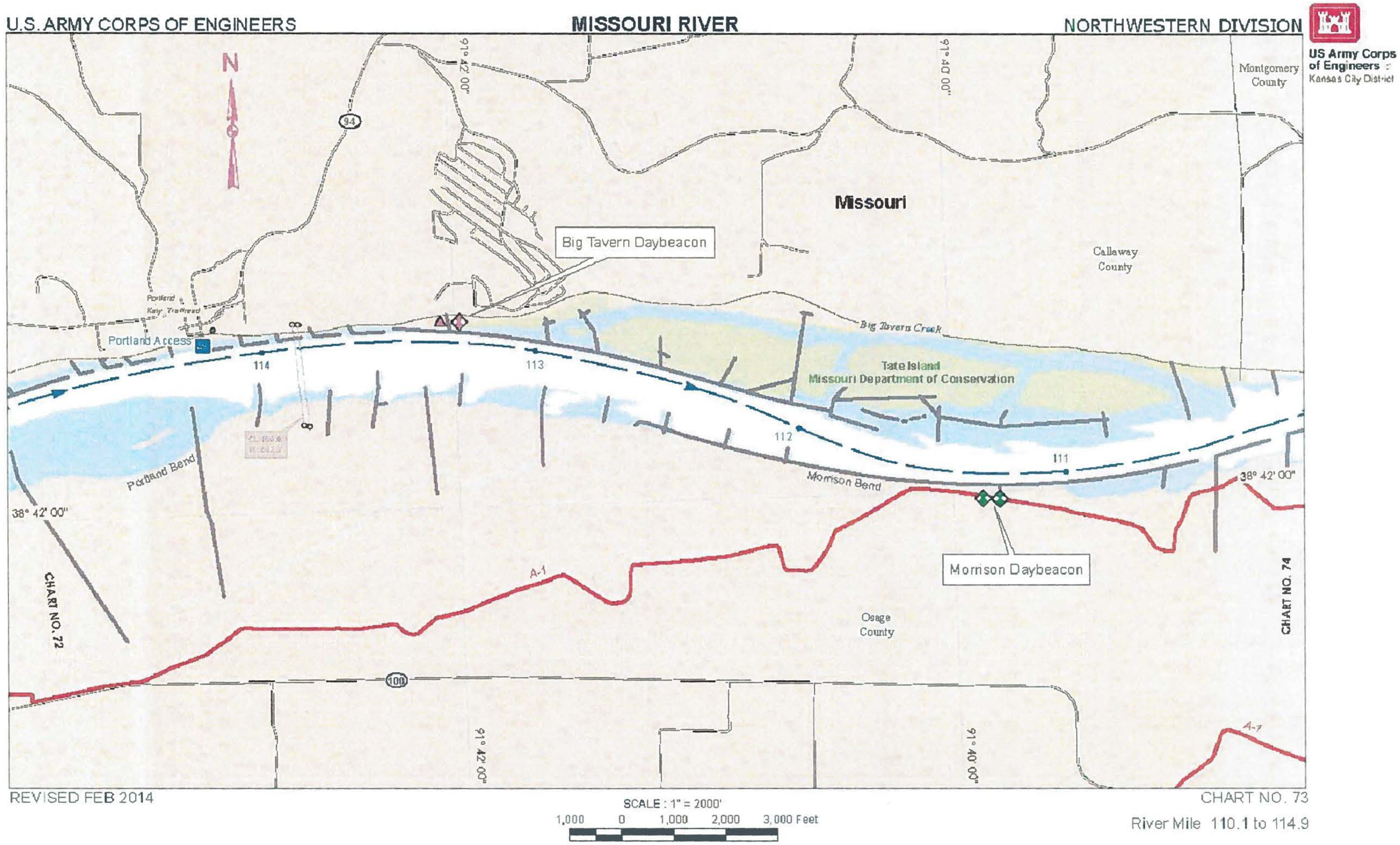


Figure 3-2. Missouri River Navigation Chart Downstream of Ameren's Callaway Energy Center MWIS

3.2.2 Area of Influence

As required by 40 CFR §122.21(r)(2), Ameren is obligated to document and characterize the area of influence (AOI) of CEC's Missouri River MWIS. The definition of AOI is site-specific and can be determined by factors such as vulnerability of aquatic organisms based on species life history, swimming speed, intake velocity, pumping rate, intake structure configuration, river stage and other local factors.

For CEC, the AOI of the Missouri River MWIS may be evaluated using the design flow velocities at multiple locations through the structure. These locations include: approach velocity at the trash rack, through velocity at the trash rack, approach velocity at the curtain wall opening, approach velocity at the traveling screen, and through velocity at the traveling screen.

3.2.2.1 Background

The CEC MWIS is a shoreline surface intake consisting of three identical pump bays with trash racks, each with a separate intake bay opening[1]. Within each bay there is a vertical three-stage centrifugal pump design-rated at 14,000 gpm. The trash racks have vertical ½-inch steel bars at 3 inches on center for an approximate percent open area of 83 percent. Stoplogs can be inserted behind the trash racks to prevent sand from migrating into the bay or can be removed to maximize intake flow. Stoplogs are typically in place during spring, summer, and fall, and are usually removed during winter when river elevations and flows are lower. The main closure gates downstream of the sand logs are 10-ft tall and 8-ft wide. Each pump bay has a standard vertical traveling screen, except each screen panel is constructed of 1/8-inch (rather than 3/8-inch) square mesh screen wire.

3.2.2.2 AOI Calculations

In order to address the requirement to determine the AOI, Ameren elected to calculate water velocities based on the design pumping capacity of the MWIS. Specifically, this approach uses existing intake design flow data, surface areas of the intakes, and source water hydrology (e.g., river stage) for calculations. The analysis consists of a numeric flow analysis to determine the velocity of water near the MWIS with the one pump operating fully. Assumptions include:

1. The velocity threshold for AOI associated with impingement is 0.5 feet per second (fps). This is the velocity threshold used by USEPA in the Rule under Compliance Option 2—0.5 fps through-screen design velocity. It is the assumed velocity that, if not exceeded, would allow a fish to escape the influence of the MWIS.
2. The approach and flow-through velocities of the MWIS were calculated using the maximum design flow.
3. A normal water level (NWL) of 502.0 ft NGVD.
4. Approach velocities were calculated at two locations:

---

[1] Separate intake bays theoretically have equal intake velocities (i.e., impingement risk).

   a. just upstream of the trash rack; and
   b. just upstream of the traveling screen.

5. Flow-through velocities were calculated at three locations:
   a. through the trash rack (assumed open area of 83 percent);
   b. at the curtain wall opening; and
   c. through the traveling screen (assumed open area of 73 percent).

6. Through-Screen Velocity is calculated according to the following equation:

$$\text{Through-Screen Velocity} = Q/(BW*WS*CPOA)$$

   Where
   Q is flow rate in cfs
   BW is the screen width in feet
   WS is the screen depth from bottom of screen to the water surface elevation
   CPOA is the "calculated percent open area" of the screen

7. Calculated Percent Open Areas were:
   a. 83.3 percent for the trash rack; and
   b. 21.4 percent for travelling-water screen.

3.2.2.3 Results

Table 3-1 summarizes the input parameters, design conditions, and results of the calculations used to assess the impingement AOI (i.e., velocities > 0.5 fps). At normal water levels, only through-screen velocity at the curtain wall and travelling-water screen (i.e., 0.52 and 1.52 fps, respectively) are above the impingement velocity threshold. All other calculated velocity values are less than the 0.5 fps threshold. Therefore, under normal water levels there is no effective AOI associated with the MWIS. For those fish that enter the intake structure, fish passage gates in the side walls of each pump bay allow fish to escape at the downstream side of the intake. Each fish passage gate is normally open when the bay's intake pump is operating.

Table 3-1. Callaway's Missouri River MWIS Approach and Through-Velocity Calculations

Velocities are based on flow area at a normal water level (NWL) of 502.0 ft NGVD.			Each Pump (separate intake bays)
			14,000 gpm
			20 MGD
			31.2 cfs
Location	**Water Level**	**Flow Area (ft^2)**	**Velocity (fps)**
Trash Rack (approach)	NWL	101	0.31
Trash Rack (through bars)		84	0.37
Curtain Wall Opening (through)		60	0.52
Traveling Screen (approach)		96	0.32
Traveling Screen (through screen)		21	1.52
Structure dimensions and elevations:			
Trash Rack:	Top elevation: 541.0 ft; Bottom elevation: 486.0 ft; Effective height: 55.0 ft; Width: 6.4 ft; Net clean open area: 83.3%		
Curtain Wall Opening:	Top elevation: 496.0 ft; Bottom elevation: 486.0 ft; Actual height: 10 ft; Width: 6.0 ft; Open gate / stop logs		
Traveling Screen:	Top elevation: 541.0 ft; Bottom elevation: 486.0 ft; Effective height: 16.0 ft; Width: 6.0 ft; Net clean open area: 21.4%		

4.0 References

ASA Analysis and Communication, Inc. 2017. Potential Impact of Impingement and Entrainment on Pallid Sturgeon at the Callaway Energy Center. Appendix C. Prepared for Ameren. March 2017.

Galat, D.L., C.R. Berry Jr., E.J. Peters, and R.G White. 2005a. Missouri River. pp. 427-480 in Rivers of North America. (A.C. Benke and C.E. Cushing, eds). Elsevier, Oxford.

Galat, D.L., C.R. Berry, W.M. Gardner, J.C. Hendrickson, G.E. Mestl, G.J. Power, C.Stone, and M.R. Winston. 2005b. Spatiotemporal patterns and changes in Missouri River fishes. Pages 249-291 in Historical changes in fish assemblages of large American rivers (J.N. Rinne, R.M. Hughes, and R. Calamusso, eds.). American Fisheries Society Symposium 45, Bethesda, Maryland.

Missouri Department of Natural Resources (MDNR). 2018. Section 303(d) Listed Waters. Accessed August 2019. https://dnr.mo.gov/env/wpp/waterquality/303d/docs/2018-303d-list-epa-approved-08-30-2019-attachments.pdf

King, R.G., G. Seegert, and J. Vondruska. 2010. Factors Influencing Impingement at 15 Ohio River Power Plants. North American Journal of Fisheries Management 30:1149-1175.

National Research Council (NRC). 2002. The Missouri River ecosystem: exploring the prospects for recovery. Water Science and Technology Board. National Academy Press, Washington, D.C. 149 pp.

National Research Council (NRC). 2011. Missouri River Planning: Recognizing and Incorporating Sediment Management. National Research Council, Division of Earth and Life Science. The National Academies Press. Washington, D.C. 152 pp.

Reuter, J.M., R.B. Jacobson, C.M. Elliott, H.E. Johnson III, and A.J. DeLonay. 2008. Hydraulic and substrate maps of reaches used by sturgeon (genus *Scaphirhynchus*) in the Lower Missouri River, 2005–07: U.S. Geological Survey Data Series 386, 442 p.

Union Electric Company (UEC). 1986. Callaway Plant evaluation of cooling water intake impacts on the Missouri River. Section 316b PL 92-500, NPDES Permit No. MO-0098001. Environmental Services Department. July 1986.

U.S. Army Corps of Engineers (USACE). 2006. Missouri River Mainstem Reservoir System Master Water Control Manual, Missouri River Basin. Reservoir Control Center. Northwestern Division. Omaha, Nebraska. Revised March 2004.

U.S. Army Corps of Engineers (USACE). 2012. Missouri River Mainstem System Final 2012-2013 Annual Operating Plan. Missouri River Basin Water Management Division. December 2102.

U.S. Geological Survey (USGS). 2011. National Land Cover Dataset. Retrieved from http://viewer.nationalmap.gov/viewer/ (accessed September 2019).

U. S. Nuclear Regulatory Commission (USNRC). 2014. Generic Environmental Impact Statement for License Renewal of Nuclear Plants. Supplement 51. Regarding Callaway Plant, Unit 1. NUREG 1457.

White, A, F. Moore, N. Aldridge, and D. Loucks. 1986. The effects of natural winter stresses on eastern gizzard shad, *Dorosoma cepedianum*, in Lake Erie. Report submitted to the Cleveland Electric Illuminating Company and the Ohio Edison Company. Environmental Resource Associates, Inc., University Heights, Ohio.

Cooling Water Intake Structure Data
Callaway Energy Center

Submitted in Compliance with
Section 316(b) Rule
40 CFR 122.21(r)(3)

Submitted by:
Ameren Missouri
Saint Louis, Missouri

Developed by:
Wood Environment & Infrastructure Solutions, Inc.
St. Louis, MO

December 2019

Table of Contents

List of Figures

List of Appendices

List of Abbreviations and Acronyms

AMSL	above mean sea level
BTA	best technology available
CWIS	cooling water intake structure
DIF	design intake flow
fps	feet per second
ft	foot/feet
gpm	gallons per minute
MGD	million gallons per day
msl	mean sea level
MWe	megawatt electric
MWIS	makeup water intake structure
NPDES	National Pollutant Discharge Elimination System
psig	pounds per square inch gauge
RM	river mile
TWS	traveling water screen
USEPA	U.S. Environmental Protection Agency

1.0 Introduction

In accordance with Section 316(b) of the Clean Water Act, the U.S. Environmental Protection Agency (USEPA) has promulgated rules under 40 CFR Part 125, Subpart J (the Rule) that require the determination of best technology available (BTA) to reduce mortality associated with the impingement and entrainment of aquatic biota. Section 40 CFR §122.21(r)(3) requires the owner or operator of a facility with a cooling water intake structure (CWIS) to submit cooling water intake structure data with an application for a National Pollutant Discharge Elimination System (NPDES) permit. The CWIS data is required regardless of the compliance alternative selected to demonstrate BTA.

The CWIS data is needed to characterize the CWIS of the facility and provide supporting information for the determination of the appropriate performance standard that should be applied to the facility. This report presents information regarding the design and operation of the Callaway Energy Center (CEC). Additionally, the information provided is relevant in supporting the reasonableness of the proposed design, construction technologies, operational measures, and restoration actions of the facility for meeting the requirements of the Rule.

In accordance with 40 CFR §122.21(r)(3), specific information that must be submitted for the facility includes the following:

> *(i) A narrative description of the configuration of each of your cooling water intake structures and where it is located in the water body and in the water column;*
>
> *(ii) Latitude and longitude in degrees, minutes, and seconds for each of your cooling water intake structures;*
>
> *(iii) A narrative description of the operation of each of your cooling water intake structures, including design intake flows, daily hours of operation, number of days of the year in operation and seasonal changes, if applicable;*
>
> *(iv) A flow distribution and water balance diagram that includes all sources of water to the facility, recirculating flows, and discharges; and*
>
> *(v) Engineering drawings of the cooling water intake structure.*

The following sections present the information required pursuant to 40 CFR §122.21(r)(3) for CEC. It should be noted that CEC refers to its CWIS as a makeup water intake structure (MWIS). This report will use the term MWIS, but it is understood that the two phrases have the same meaning.

2.0 Cooling Water Intake Structure Data

2.1 Narrative Description of the Configuration of Each of the CWIS

CEC, which began operations in December 1984, is located five miles north of the MWIS and approximately 10 miles southeast of Fulton, Missouri in Callaway County. CEC has a single generating unit that consists of a pressurized water reactor, four steam generators, and one steam turbine generator. CEC is operated as a baseload facility and normally operates near its generating capacity of 1,228 megawatts electric (MWe) (net). CEC's average capacity factor from 2015 to 2019 was 89 percent. The value escalates to 98 percent when eliminating days when the plant is shut down.

CEC is designed with a closed-cycle cooling system that obtains makeup water from the Missouri River. The cooling system includes a 555-foot-high hyperbolic natural draft cooling tower. Makeup river water is pumped to the plant's water treatment facility before being fed into the cooling tower basin. CEC has one MWIS that is located on the left descending shoreline of the Missouri River at river mile (RM) 115.4 (Figure 2-1). The Missouri River is a navigable waterway and is frequently used by barge and recreational boat traffic.

General schematic diagrams of the MWIS are presented in Figures 2-2 through 2-4. The MWIS is an enclosed cast-in-place concrete well structure constructed near the bank of the river. The invert elevation of the MWIS is 486.0 feet (ft) above mean sea level (AMSL). The operating floor of the MWIS is 541.5 ft AMSL. Normal water level is reported as 16 ft above the invert elevation at 502.0 ft AMSL. Minimum design water level is reported as 495.0 ft AMSL. Maximum design water level is reported as 539.0 ft AMSL.

The MWIS is divided into three identical intake bays that each consist of a trash rack at the river face of the intake. The trash racks have vertical ½-inch steel bars at 3 inches on center for an approximate percent open area of 88 percent. Behind the trash racks are sand logs that can be installed to prevent sand from migrating into the bay or can be removed to maximize intake flow. The sand logs are typically in place during spring, summer, and fall, and they are usually removed during winter when river elevations and flows are lower. The main closure gates downstream of the sand logs are 10 ft tall and 8 ft wide. Behind the main closure gates are low velocity fish gates in the sides of the walls of each intake bay. These fish gates allow fish to escape the intake structure.

Downstream of the fish gates, each intake bay has a standard 6-ft-wide through-flow traveling water screen (TWS) with 1/8-inch-square stainless steel mesh. There is a screen wash system that removes debris and organisms trapped on the mesh and sprays the debris into a trough to be returned to the river. The screens are typically rotated on an 8-hour timer with a run duration of 30 minutes. During periods with high debris load in the river the screens may operate more frequently. For instance, the screens have pressure differential sensors on each side, and if a pressure difference is detected the screens will automatically rotate. Similarly, during periods of inclement weather, the plant staff may anticipate a high debris load and turn the screens on to run continuously for several days. The screen spray wash system must operate at greater than 100

pounds per square inch gauge (psig) to ensure the TWSs are cleaned as they rotate. If pressure falls below 100 psig, the screens will stop rotating to prevent carry over of debris into the pumping system. The approach velocity of the TWS is 0.32 feet per second (fps) at the maximum pump flow of 14,000 gallons per minute (gpm) and a normal water level of 16 ft in the intake bay.

The spray wash water system is fed from the intake pump header. The spray water is strained to remove small debris before being used as TWS spray wash water and desilting spray water. There are desilting spray heads located near the invert of the MWIS at the main gates, the fish gates, the TWS, and the pump suction tube. These spray heads keep silt from accumulating near the elements. The spray heads typically operate on a 12-hour timer. The desilting spray pressure is approximately 175 psig. The spray wash system also includes inline water heaters that provide warm spray water during cold seasons; however, according to plant staff, these heaters are rarely used.

It should be noted that the CEC is currently replacing the intake pumps and TWSs. There is a plan to replace one pump and one TWS in 2019, one pump and one TWS in 2020, and one pump and one TWS in 2021. The replacement units are of the same type and capacity as the existing pumps and TWSs.

Upstream from the MWIS are multi-pile steel dolphins that protect the MWIS from large debris and ice flow. CEC performs dredging operations near the front of the MWIS as needed to maintain reasonable flow into the MWIS.

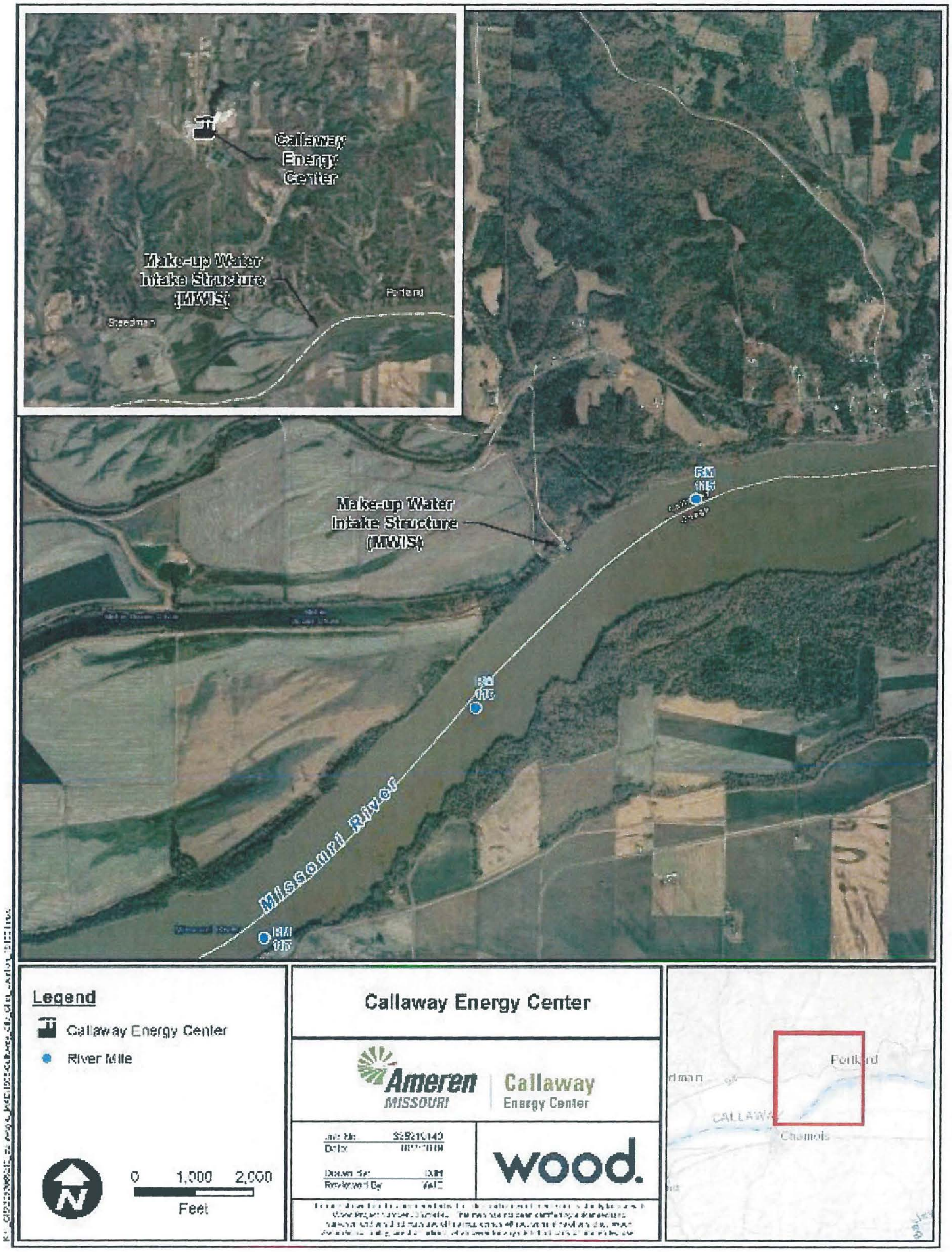


Figure 2-1. Location of the Callaway Energy Center

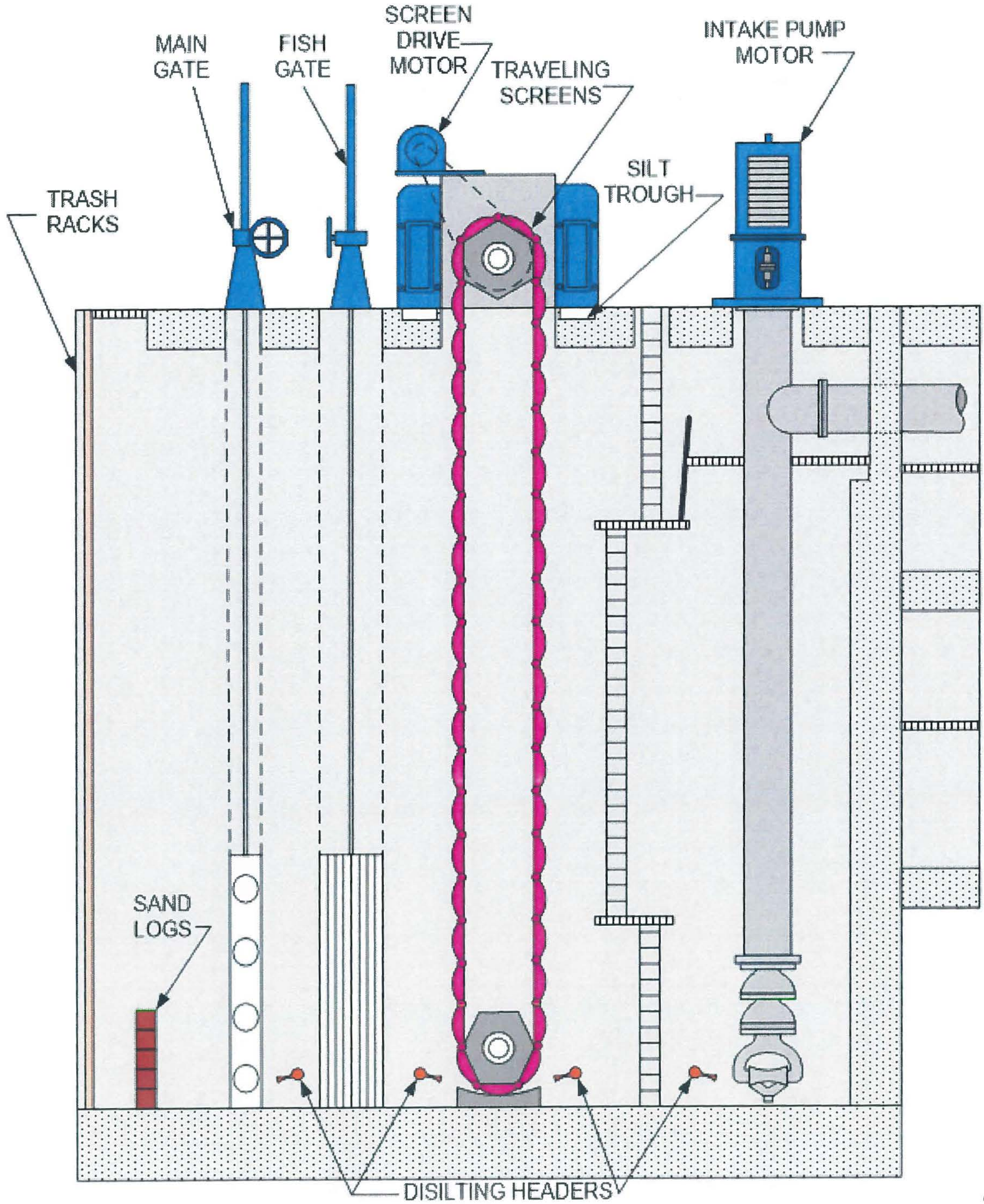


Figure 2-2. Callaway Energy Center MWIS Typical Elevation

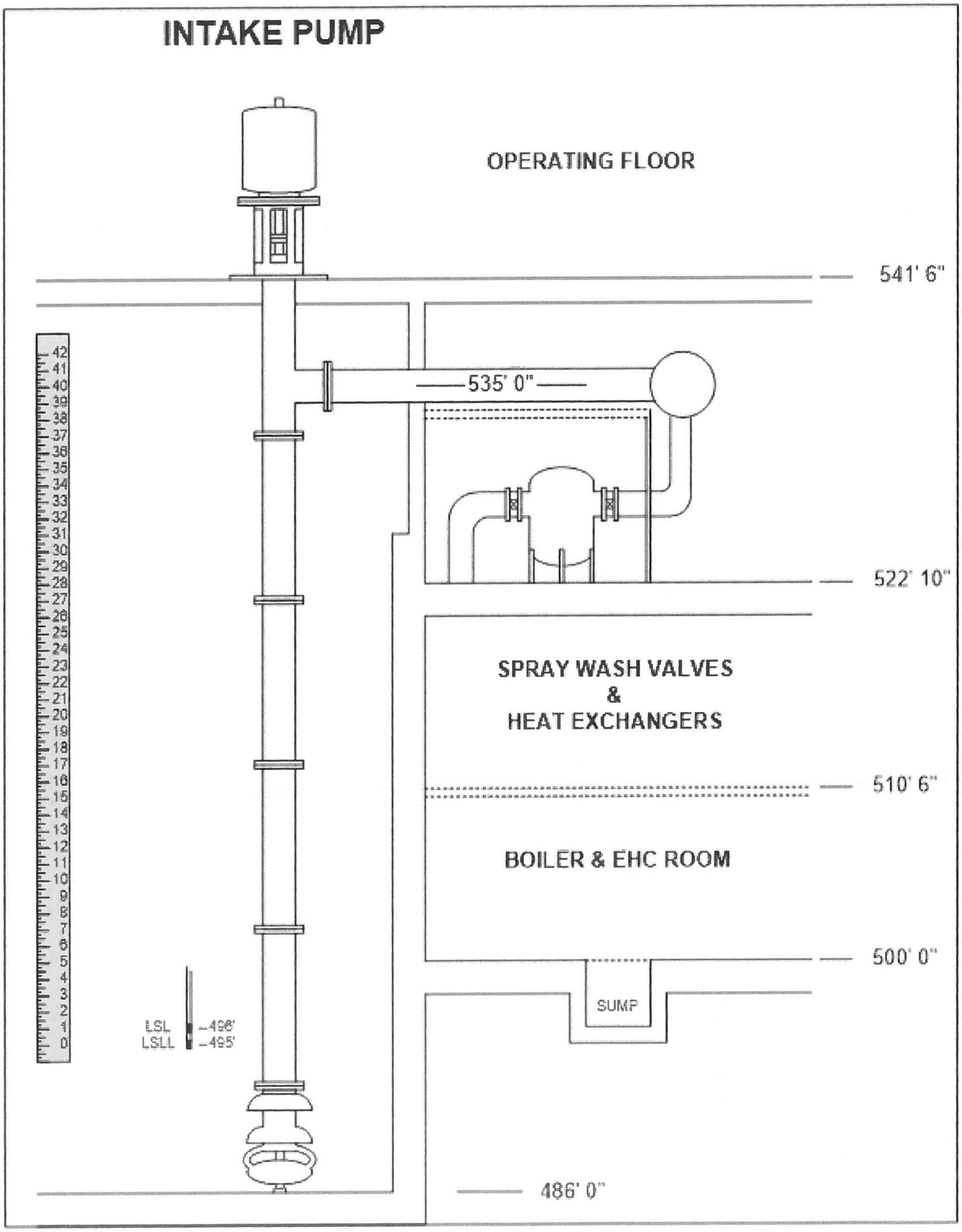
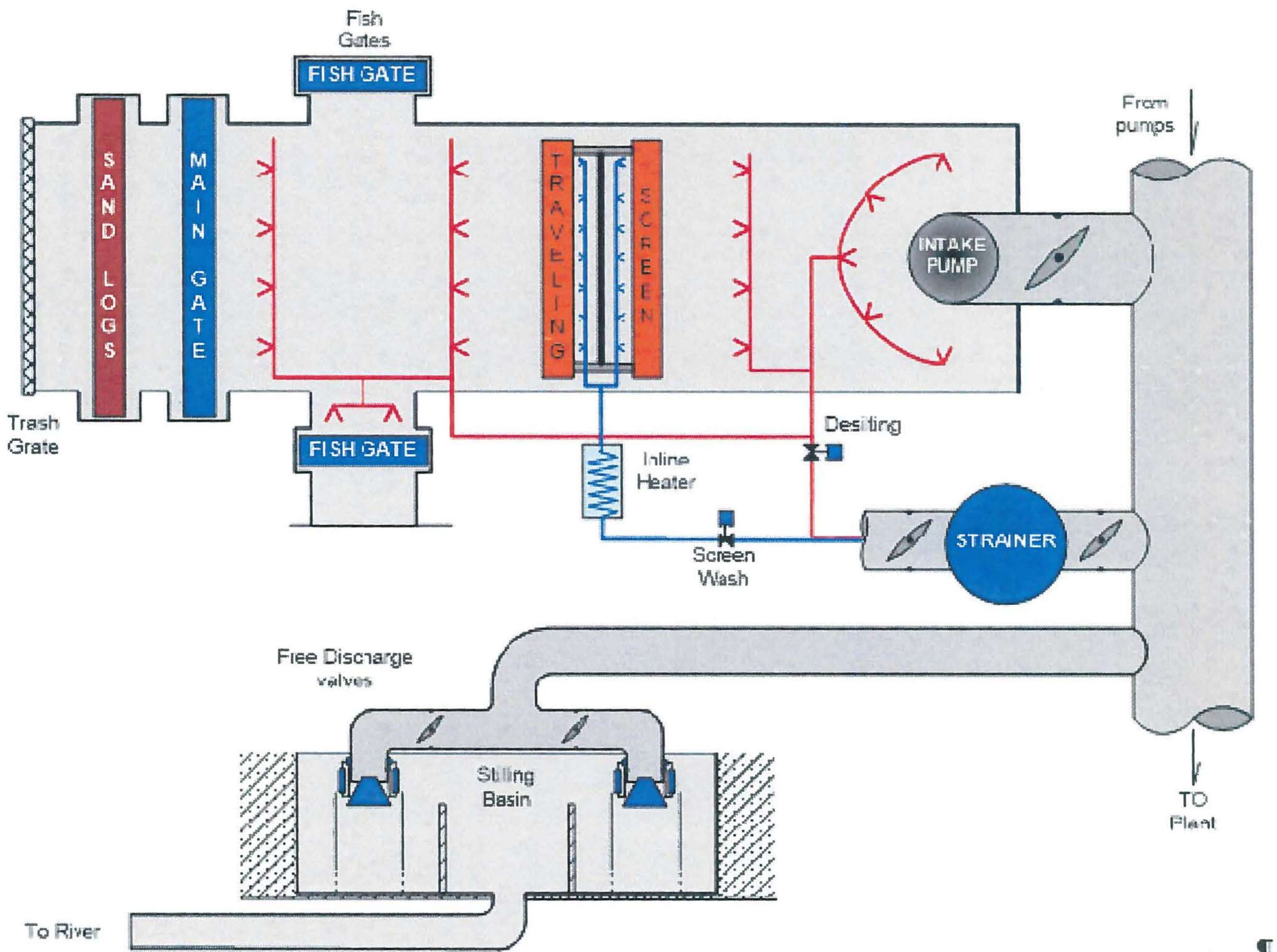


Figure 2-3. Callaway Energy Center MWIS Pump Arrangement



Note: One intake bay is shown; three intake bays are present.

Figure 2-4. Callaway Energy Center MWIS Partial Plan

2.2 Latitude and Longitude of the CWIS

CEC operates with the use of a single MWIS. The latitude and longitude of this structure is as follows:

Latitude	Longitude
38°42'12"	91°44'19"

2.3 Narrative Description of the Operation of the CWIS

CEC is a baseload facility and typically operates 24 hours a day, 365 days a year, except during plant outages for refueling. Refueling outages take place every 18 months in the spring or fall, and the plant is typically shut down for 30-50 days during the outage depending on the maintenance needs. CEC's MWIS utilizes three intake pumps to supply makeup water to the plant's water treatment plant via a 5.5-mile pipeline. The three pumps (A, B, and C) each withdraw river water from an intake bay. The intake bays are each equipped with a single vertical three-stage centrifugal pump with a maximum rating of 14,000 gpm. The pipeline system includes two discharge valves to control transient surge pressure of water being pumped into the system. The valves regulate pressure and divert excess water to a discharge box downstream of the MWIS and then back to the river. Generally, CEC operates two of the three pumps continously to supply makeup water to the plant. The third pump is held as a backup. Operatin of individual pumps is frequently rotated to prevent overuse of an individual. During favorable conditions and during plant outages, CEC can supply makeup water with a single intake pump. Due to a change in plant management software, CEC does not have daily intake flow volumes for the past five years. The plant has supplied daily intake volumes for a portion of 2016 through August of 2019. Figure 2-5 provides a summary of the last four years of makeup water flow data. The total plant design intake flow (DIF) is 24.5 million gallons per day (MGD) at a river elevation of approximately 502 ft AMSL. The average intake flow (AIF) rate over the past four years has been 18.1 MGD.

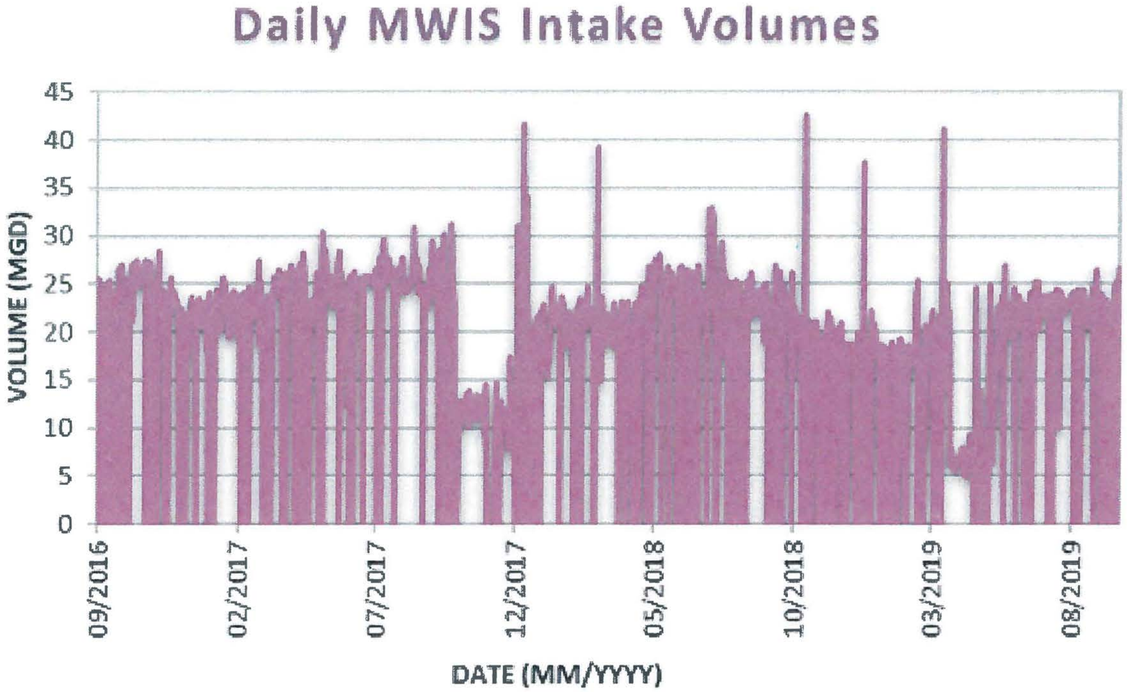


Figure 2-5. Total MWIS Intake Volume

2.4 Flow Distribution and Water Balance Diagram

The water balance diagram for CEC is part of the normal NPDES permit application package. As required by the Rule, this information is presented in Figure 2-6 and Appendix B.

wood.

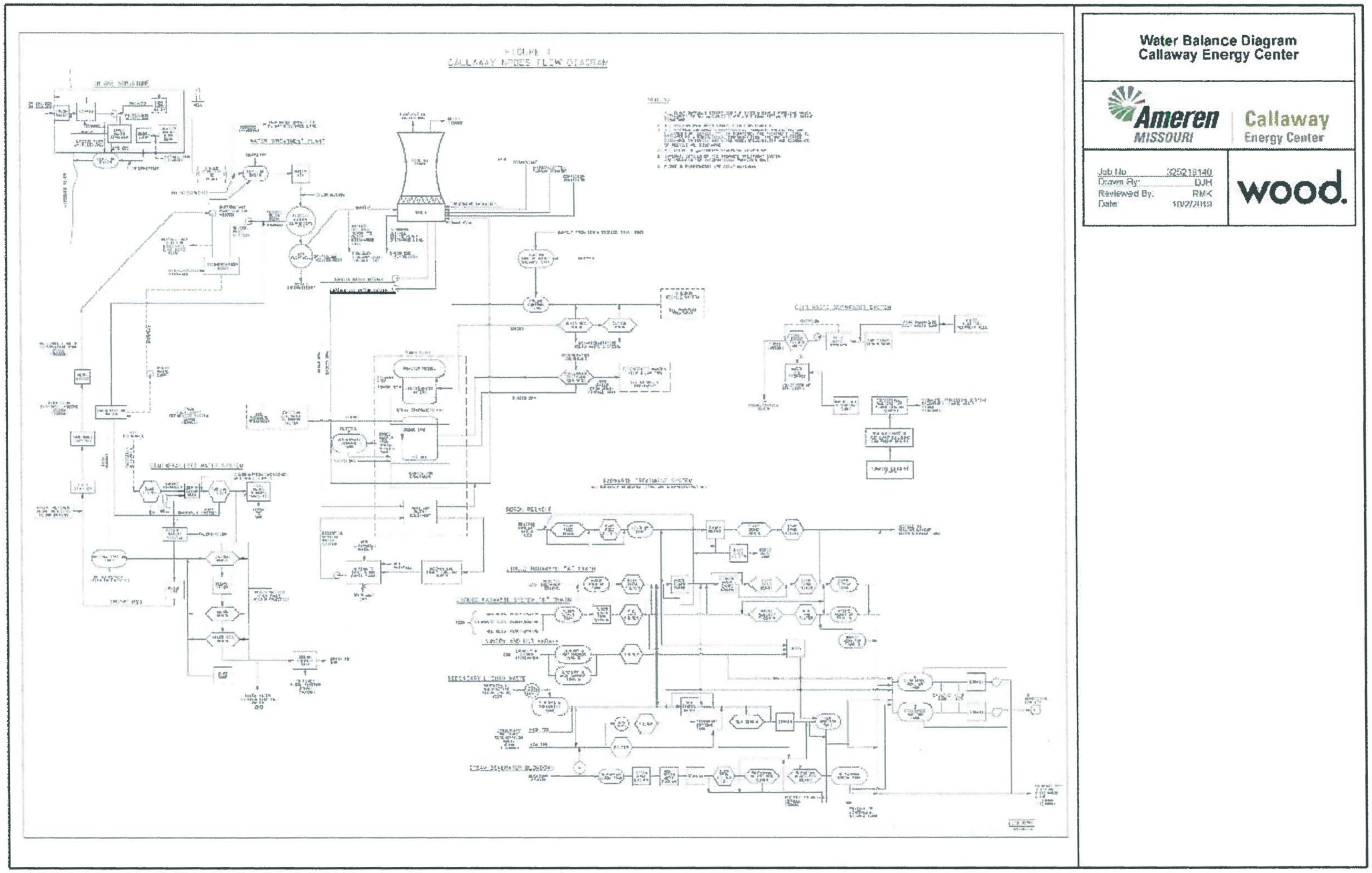


Figure 2-6. Callaway Energy Center Water Balance Diagram

2.5 Engineering Drawings of the CWIS

Engineering drawings of the MWIS at CEC have been included in this report as Appendix B. The list of drawings included are as follows:

Drawing Number	Drawing Title
8600-X-88244	AS-BUILT PUMP ROOM INTAKE STRUCTURE
8600-X-88246	AS-BUILT SECTION PUMP LONGITUDINAL INTAKE STRUCTURE
8600-X-88651	EQUIPMENT MECHANICAL LOCATION INTAKE STRUCTURE

Appendix A

Representative Site Photographs

Photo 1: Callaway Energy Center MWIS PUMPS

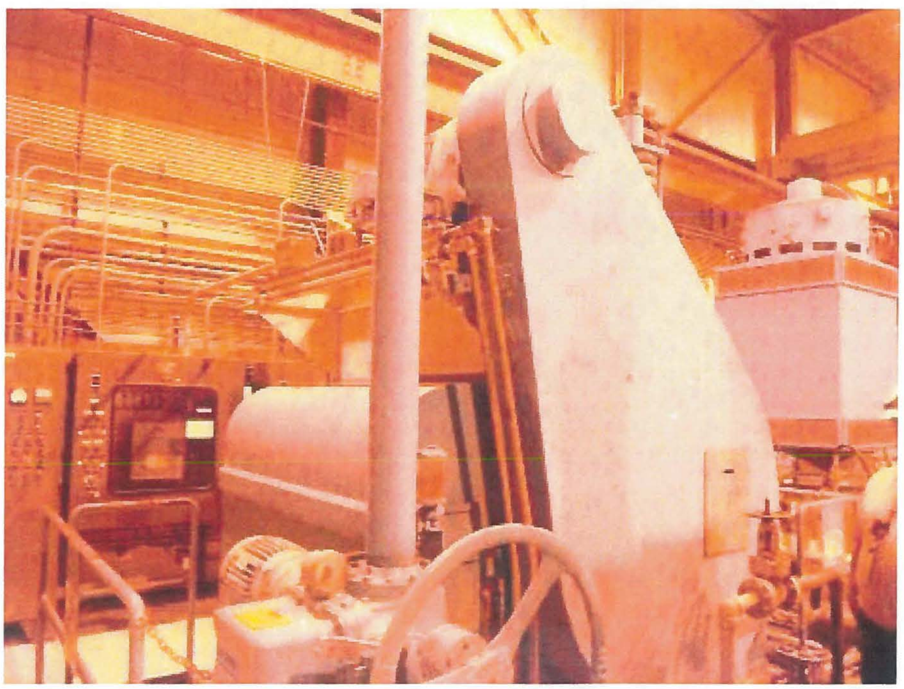


Photo 2: MWIS Traveling Water Screen

Photo 3: River side of MWIS

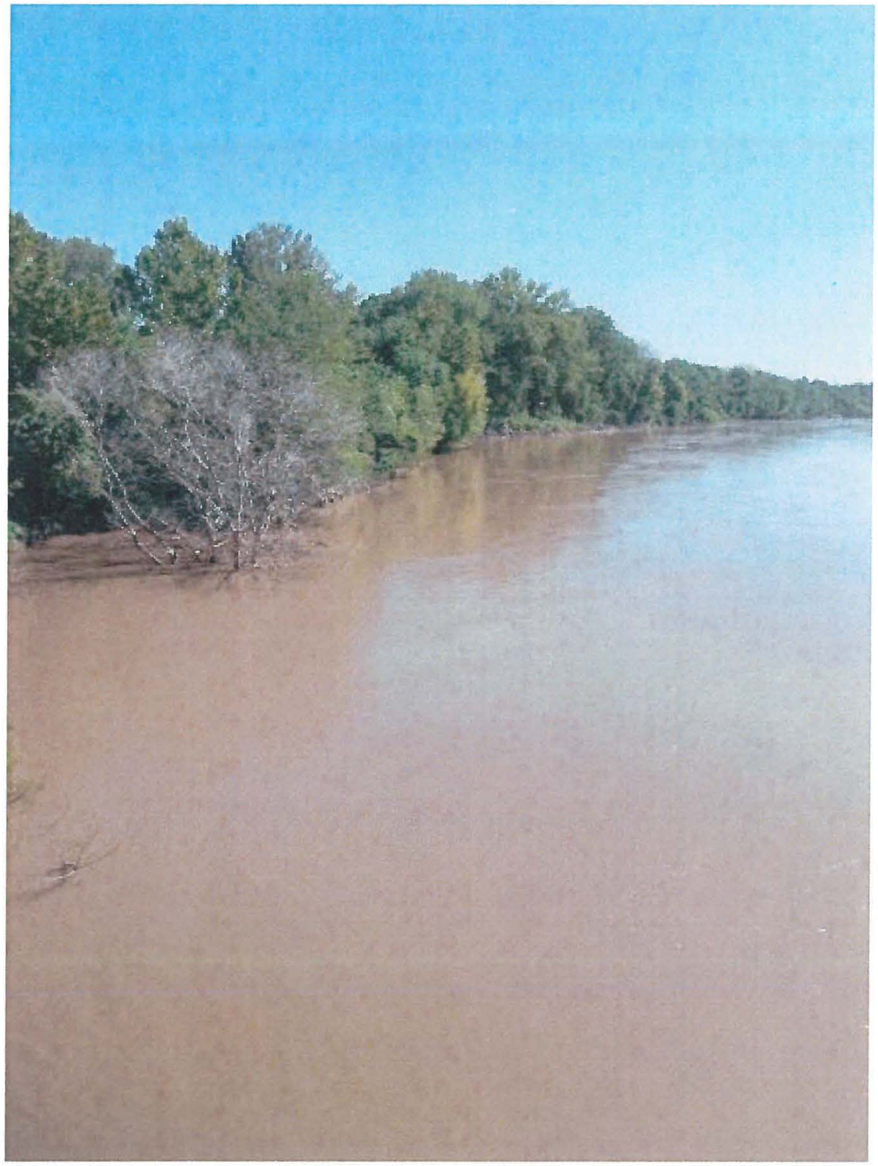
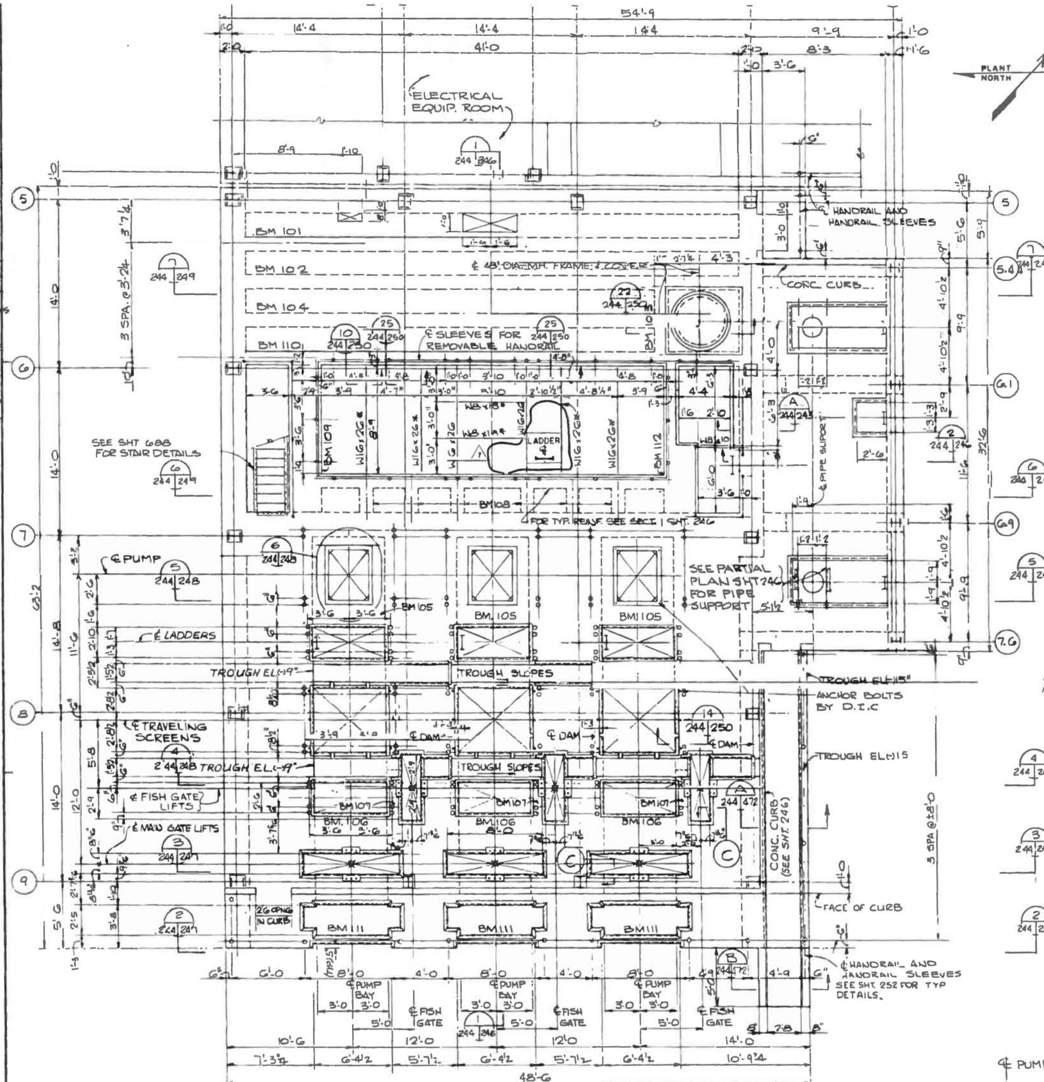


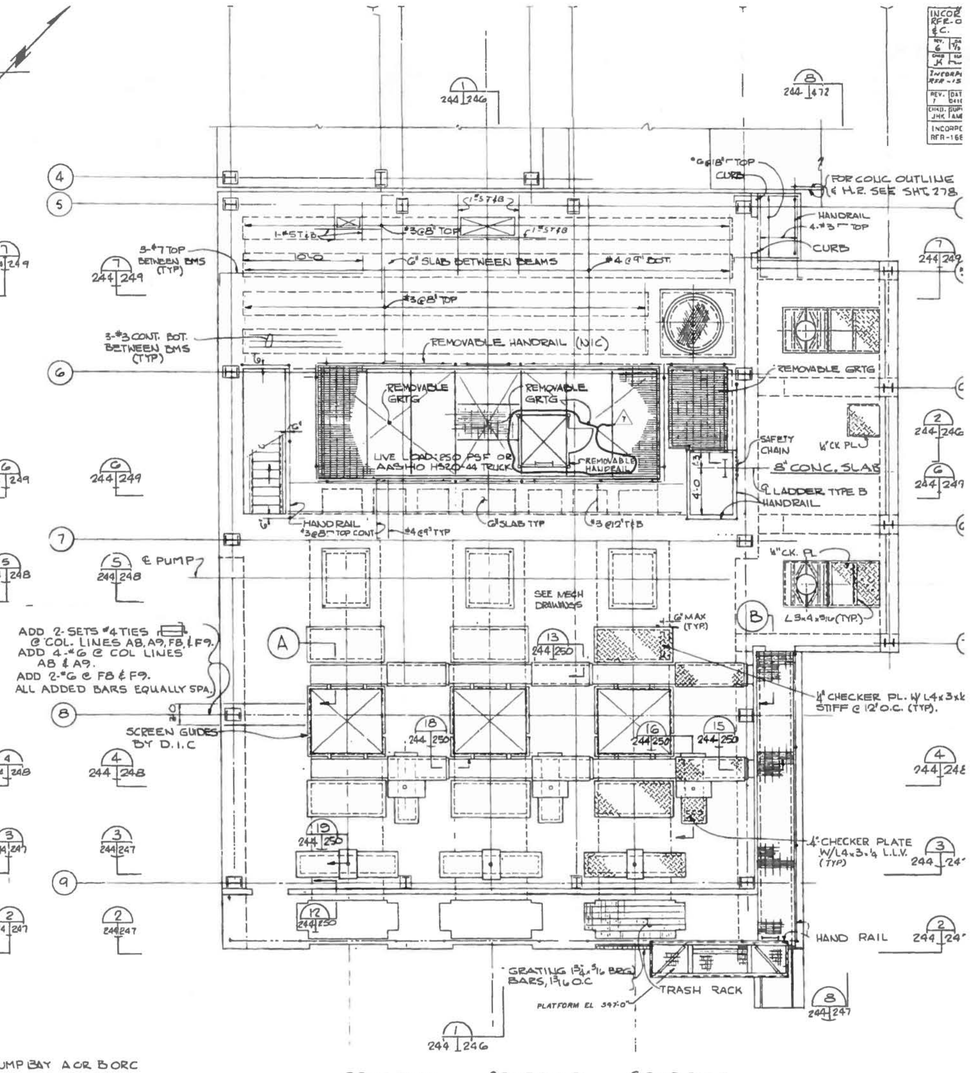
Photo 4: Looking downstream from MWIS at shoreline

Appendix B

Engineering Drawings

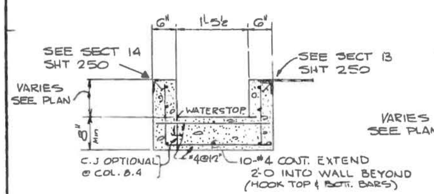


EMBEDDED ITEMS
PLAN AT OPERATING LEVEL (EL. 541'-6)
¼" = 1'-0

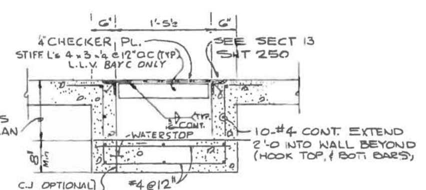


COVER PLATES AND REINFORCEMENT
PLAN AT OPERATING LEVEL (EL. 541'-6)
¼" = 1'-0

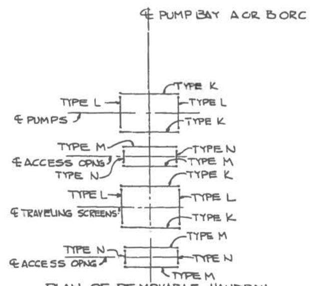
NOTES
1. FOR GENERAL NOTES SEE SHT. 241
2. SEE SHEET 251 FOR BEAM ELEVATION
3. ELEVATIONS MARKED 'Z' ARE FROM REFERENCED ELEVATION 541'-6
4. DESIGN L.L. = 250 P.S.F. OR ACTUAL EQUIPMENT LOAD.
5. WHERE SIZE, LOCATION AND OR NUMBE OF ANCHOR BOLTS FOR EQUIP. ANCHORA ARE NOT SHOWN, ALL DETAILS WILL BE FURNISHED BY D.I.C.
6. FOR LOCATION OF EMBEDDED PIPING SE MECHANICAL PLAN DRAWINGS 358 THRU 651
7. FOR LOCATION OF EMBEDDED CONDUI SEE ELECTRICAL PLAN DRAWINGS 34 THRU 345
8. SIZE AND LOCATION OF CONCRETE PAD FOR EQUIPMENT IS FURNISHED BY D.I



SECTION (A)
1" = 1'-0



SECTION (B)
(N.T.S)



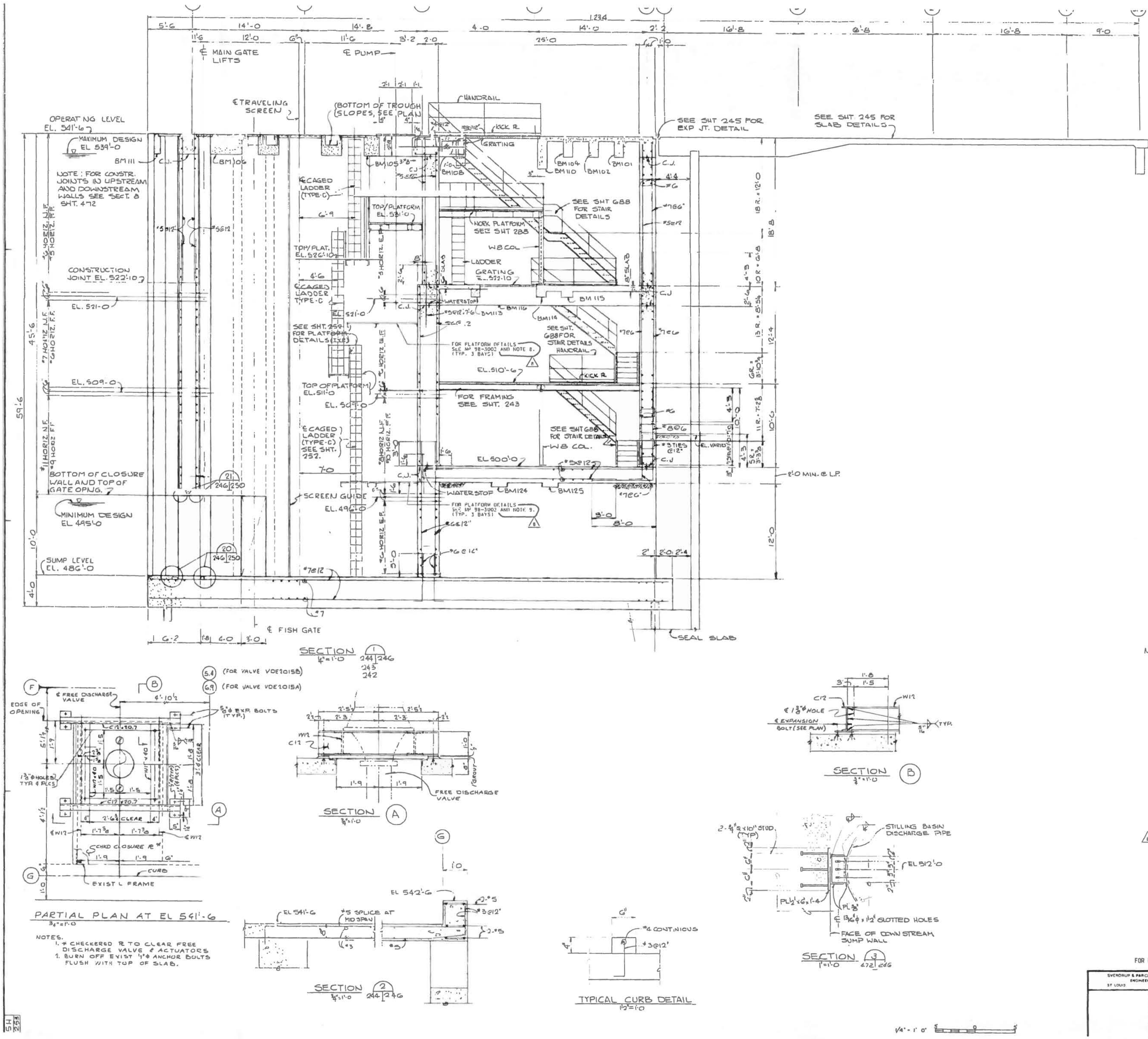
PLAN OF REMOVABLE HANDRAIL
N.T.S

THE REMOVABLE HANDRAILS TO BE SUPPLIED UNDER THIS CONTRACT ARE AS FOLLOWS
4 TYPE K
4 TYPE L
4 TYPE M
4 TYPE N } ONE SET ONLY

SECTION (C)
1" = 1'-0

For Dwg Index See Cover Sheet 8600-X-88367

SVERDRUP & PARCEL AND ASSOCIATES INC ENGINEERS-ARCHITECTS ST LOUIS MISSOURI	AS-BUILT
	BUILDING - CONCRETE PLAN-OPERATING LEVEL EL 541'- PUMP ROOM INTAKE STRUCTURE
	CALLAWAY PLANT UNIT 1



NOTES:
1. FOR GENERAL NOTES SEE SHEET:
2. SEE SHEET 251 FOR BEAM ELEVATION
3. FOR PIPE PENTRATION AND SEAL DETAILS SEE MECHANICAL SPECIFICATI
4. FOR LOCATION OF EMBEDDED PIP SEE MECHANICAL PLAN DRAWING
5. FOR LOCATION OF EMBEDDED CONDUIT SEE ELECTRICAL PLA DRAWINGS SHEET 341 THRU 345
6. DEWATERING SUMPS NOT SHOWN FOR CLARITY. FOR LOCATION OF SUMPS, SEE DRAWING 8600-X-88242.
7. SINGLE MAN SAFETY ATTACHMENT "D-RIN LUGS MAY BE ATTACHED TO CONCRETE WALLS, WHERE REQUIRED PER THE DETAI SHOWN IN RFR-19187A.
8. PLATFORM ELEVATION:
"A" PUMP BAY = 520'-1"
"B" PUMP BAY = 511'-0"
"C" PUMP BAY = 520'-4"
9. PLATFORM ELEVATION:
"A" PUMP BAY = 501'-11"
"B" PUMP BAY = 493'-4"
"C" PUMP BAY = 502'-0"

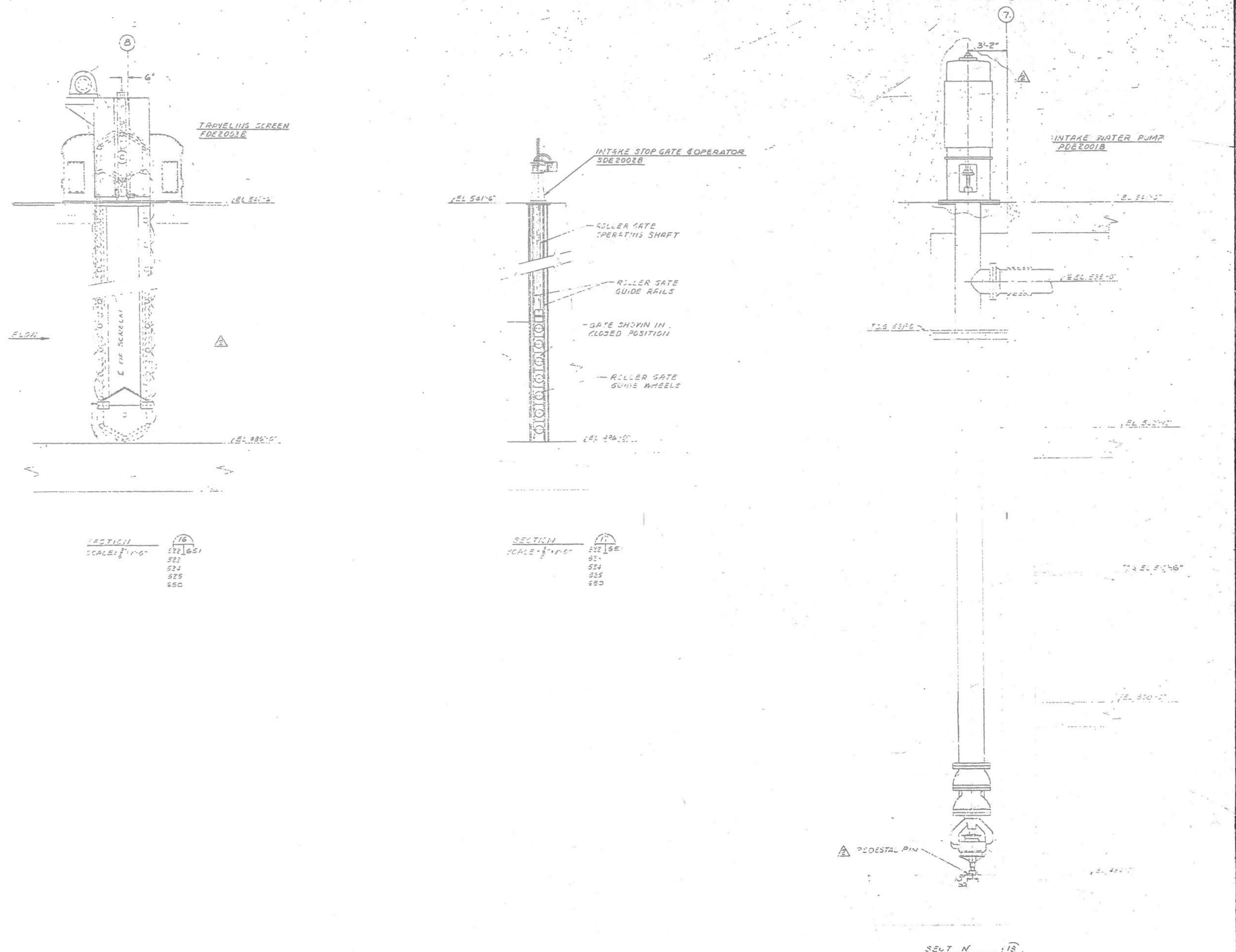
FOR DRAWING INDEX SEE DRAWING NO. 8600-X-88367

SVERDRUP & PARCEL AND ASSOCIATES, Inc
ENGINEERS-ARCHITECTS
ST LOUIS MISSOURI

AS-BUILT

BUILDING - CONCRETE
SECTION - PUMP LONGITUDINAL
INTAKE STRUCTURE

LOCATION	CALLAWAY LOCATION	CALLAWAY PLANT
1017	903	UNIT 1



8600-X-88651

8600-X-0886510207020001017 121978

EQUIP MECH LOC SECT INTK STRUCT C

(SEE DWG NO. 8600-X-88522 FOR NOTES)

ISSUED FOR CONSTRUCTION

DALKOKUP & PARCEL AND ASSOCIATES INC.

EQUIPMENT MECHANICAL LOCATION SECTIONS INTAKE STRUCTURE

CALLAWAY PLANT UNIT TSI 32

UNION ELECTRIC COMPANY ST. LOUIS, MO

8600-X-88651

4695

Source Water Baseline Biological Characterization Data Callaway Energy Center

Submitted in Compliance with Section 316(b) Rule 40 CFR 122.21(r)(4)

Submitted by:
Ameren Missouri
Saint Louis, Missouri

Ameren MISSOURI

Developed by:
Wood Environment & Infrastructure Solutions, Inc.
St. Louis, Missouri

December 2019

wood.

Table of Contents

List of Figures

List of Tables

Abbreviations and Acronyms

BFS	Benthic Fish Study
BTA	Best Technology Available
CEC	Callaway Energy Center
cfs	cubic feet per second
cm	centimeters
CPUE	catch per unit effort
CWIS	cooling water intake structure
DIF	design intake flow
Director	EPA Regional Administrator or IEPA State Director
°C	degrees Celsius
°F	degrees Fahrenheit
ESA	Endangered Species Act
EtOH	Ethanol
ft	feet
fps	feet per second
gpm	gallons per minute

g	grams
IM&E	impingement and entrainment
kg	kilograms
lbs	pounds
m	meters
m^3	cubic meters
µm	micrometer
MGD	million gallons per day
mm	millimeter
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MRRP	Missouri River Recovery Program
mtDNA	mitochondrial DNA
MWIS	makeup water intake system
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
PSPAP	Pallid Sturgeon Population Assessment Program
PCR	polymerase chain reaction
QAPP	quality assurance project plan
RM	river mile
SNP	single nucleotide polymorphism
SOP	standard operating procedures
T&E	threatened and endangered
T(S/A)	threatened due to similarity of appearance
TL	total length
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
YOY	young-of-year

1.0 Introduction

1.1 Background

In accordance with Section 316(b) of the Clean Water Act, the U.S. Environmental Protection Agency (USEPA) has promulgated rules under 40 CFR Part 125, Subpart J (the Rule) that require the determination of best technology available (BTA) to reduce mortality associated with the impingement and entrainment (IM&E) of aquatic biota. Section 40 CFR §122.21(r)(4) requires the owner or operator of a facility with a cooling water intake structure (CWIS) to submit source water baseline biological characterization data with an application for a National Pollutant Discharge Elimination System (NPDES) permit. Source water baseline biological characterization data are required for all facilities with a Design Intake Flow (DIF) greater than 2 million gallons per day (MGD), regardless of the compliance alternative selected to demonstrate BTA.

The required source water baseline biological characterization data are used by the Director to characterize the biological community in the vicinity of the CWIS and to characterize the operation of the CWIS. This information includes species and life stages (including threatened and endangered [T&E] species) most susceptible to IM&E by the facility's CWIS. Additionally, information is provided regarding the primary period of reproduction, larval recruitment, and abundance for relevant taxa.

In accordance with 40 CFR §122.21(r)(4), specific information that must be submitted for the facility includes:

> *(i) A list of the data in paragraphs (r)(4)(ii) through (vi) of this section that are not available and efforts made to identify sources of the data;*
>
> *(ii) A list of species (or relevant taxa) for all life stages and their relative abundance in the vicinity of the cooling water intake structure;*
>
> *(iii) Identification of the species and life stages that would be most susceptible to impingement and entrainment. Species evaluated should include the forage base as well as those most important in terms of significance to commercial and recreational fisheries;*
>
> *(iv) Identification and evaluation of the primary period of reproduction, larval recruitment, and period of peak abundance for relevant taxa;*
>
> *(v) Data representative of the seasonal and daily activities (e.g., feeding and water column migration) of biological organisms in the vicinity of the cooling water intake structure;*
>
> *(vi) Identification of all threatened, endangered, and other protected species that might be susceptible to impingement and entrainment at your cooling water intake structures;*

(vii) Documentation of any public participation or consultation with Federal or State agencies undertaken in development of the plan; and

(viii) If you supplement the information requested in paragraph (r)(4)(i) of this section with data collected using field studies, supporting documentation for the Source Water Baseline Biological Characterization must include a description of all methods and quality assurance procedures for sampling, and data analysis including a description of the study area; taxonomic identification of sampled and evaluated biological assemblages (including all life stages of fish and shellfish); and sampling and data analysis methods. The sampling and/or data analysis methods you use must be appropriate for a quantitative survey and based on consideration of methods used in other biological studies performed within the same source water body. The study area should include, at a minimum, the area of influence of the cooling water intake structure.

(x) For the owner or operator of an existing facility, identification of protective measures and stabilization activities that have been implemented, and a description of how these measures and activities affected the baseline water condition in the vicinity of the intake.

(xi) For the owner or operator of an existing facility, a list of fragile species, as defined at 40 CFR 125.92(m), at the facility. The applicant need only identify those species not already identified as fragile at 40 CFR 125.92(m). New units at an existing facility are not required to resubmit this information if the cooling water withdrawals for the operation of the new unit are from an existing intake.

(xii) For the owner or operator of an existing facility that has obtained incidental take exemption or authorization for its cooling water intake structure(s) from the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, any information submitted in order to obtain that exemption or authorization may be used to satisfy the permit application information requirement of paragraph 40 CFR 125.95(f) if included in the application.

(ix) In the case of the owner or operator of an existing facility or new unit at an existing facility, the Source Water Baseline Biological Characterization Data is the information in paragraphs (r)(4)(i) through (xii) of this section.

(x) For the owner or operator of an existing facility, identification of protective measures and stabilization activities that have been implemented, and a description of how these measures and activities affected the baseline water condition in the vicinity of the intake.

(xi) For the owner or operator of an existing facility, a list of fragile species, as defined at 40 CFR 125.92(m), at the facility. The applicant need only identify those species not already identified as fragile at 40 CFR 125.92(m). New units at an existing facility are not required to resubmit this information if the cooling water withdrawals for the operation of the new unit are from an existing intake.

(xii) For the owner or operator of an existing facility that has obtained incidental take exemption or authorization for its cooling water intake structure(s) from the U.S. Fish and

Wildlife Service or the National Marine Fisheries Service, any information submitted in order to obtain that exemption or authorization may be used to satisfy the permit application information requirement of paragraph 40 CFR 125.95(f) if included in the application.

The following sections present the information required pursuant to 40 CFR §122.21(r)(4) for the Callaway Energy Center (CEC). It should be noted that CEC refers to its CWIS as a makeup water intake structure (MWIS). This report will use the term MWIS, but it is understood that the two phrases have the same meaning.

1.2 Overview of the Callaway Energy Center

CEC is a baseload, single-unit nuclear generating facility located approximately 10 miles southeast of Fulton, Missouri in Callaway County, approximately five miles north of the Missouri River. CEC draws makeup water from the river at its shoreline MWIS for its closed-cycle cooling water system (Figure 1-1). Makeup water is withdrawn from the north shore of the Missouri River at river mile (RM) 115.4 (Latitude: 38˚42'N and Longitude: 91˚44'W). CEC consists of a pressurized water reactor, four steam generators, one steam turbine generator, and a closed-cycle heat dissipation system. The heat dissipation system consists of a 555 foot (ft) high hyperbolic, natural draft cooling tower; the MWIS; a main condenser; and a cooling tower basin and blowdown discharge pipeline. The system recirculates 530,000 gallons per minute (gpm) of water through the natural draft tower to remove waste heat during normal operations. The average blowdown water volume discharged to the Missouri River is 8 cubic feet per second (cfs) (3,900 gpm), and the maximum rate is 20 cfs (10,000 gpm).

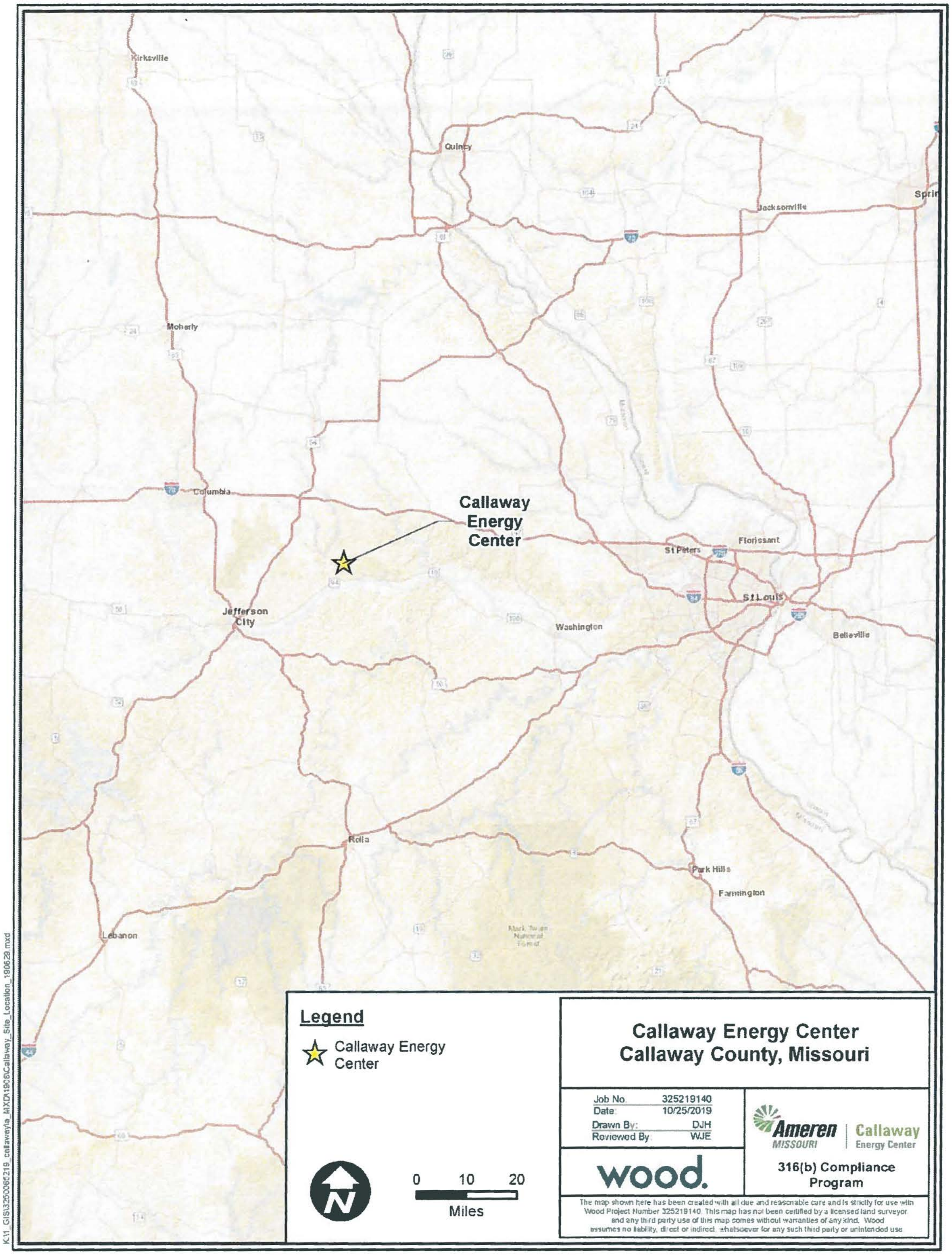


Figure 1-1. Location of the Callaway Energy Center

2.0 Data Availability and Needs (40 CFR 122.21(r)(4)(i))

Sufficient data and information exist from previous studies to allow for the characterization of fisheries populations from the Missouri River within the vicinity of CEC's MWIS. Surveys of the Missouri River fish community near CEC's MWIS include pre-construction and pre- and post-operational surveys associated with various CEC permitting processes. In addition, independent researchers have periodically conducted larger scale fisheries surveys of the lower Missouri River that include the reach where the CEC intake is located. Two multi-year survey programs, the Benthic Fish Study (BFS) from 1996-1998 (Berry and Young 2001; Berry et al. 2004) and the ongoing Pallid Sturgeon Population Assessment Program (PSPAP) (Herman et al. 2014; Herman and Wrasse 2015, 2016) routinely sample fish communities within the lower Missouri River to assess the abundance, distribution, habitat usage, and population structure of target fish species, such as the endangered pallid sturgeon (*Scaphirhynchus albus*), as well as the overall fish community present in the river. These studies and others (Galat et al. 2005; Schloesser et al. 2011; Wildhaber et al. 2014) provide data of the changes in the fish community over the past 20 years and present data representative of current populations. The sampling methodologies in these previous studies utilized multiple "gear"[1] types over varied spatiotemporal intervals. The use of multiple gear types in a range of habitats and over varying seasons and years provides for the collection of a wide range of aquatic biota that are representative of that occurring not only in the Missouri River, but also in the vicinity of the CEC MWIS.

These studies provide a taxonomic list of species to characterize the fishery population in the Missouri River near the CEC MWIS. All of these data sources generally show a similar species composition, with the exception of the greater abundance of non-native, invasive species like Asian carp (*Hypophthalmichthys* spp.) in more recent studies. Additionally, these data sources provide information relative to age and growth, fish condition, fish distribution and habitat, physical characteristics of the river (e.g., water quality, depth, etc.), and fish behavior.

Both historic and recent IM&E sampling has been conducted at CEC's MWIS to determine the fish species and life stages most susceptible to IM&E (UEC 1986; Amec Foster Wheeler 2017; ASA 2017). In addition, previous studies of the ichthyoplankton community are available from the lower Missouri River that can be used to assess the susceptibility of species to entrainment (Schrank et al. 2001; Reeves 2006; Reeves and Galat 2010). These publications and others provide valuable information on the current composition of adult and larval fishes present in the Missouri River and will be used along with IM&E surveys conducted at CEC to assess the likelihood that specific species could be impinged or entrained at CEC.

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[1] "gear" is a term used to reflect the methodology for sampling of aquatic biological communities. For sampling of fish communities, typical gear may include electrofishing, otter trawls, gill netting, fyke nets, or seining.

3.0 Characterization of Aquatic Biota in the Vicinity of Callaway Energy Center (40 CFR 122.21(r)(4)(ii))

3.1 Taxonomic List and Relative Abundance of Aquatic Biota

Historical Studies. The fish community of the lower Missouri River in the vicinity of CEC's MWIS was studied during baseline studies conducted in 1973-1975 (UEC 1974, 1976), pre-operational studies from 1980-1982 (CDM 1981, 1982), and post-operational studies during 1983-1986 (UEC 1986). Pre-operational fish surveys conducted from June 1980 to May 1982 included ichthyoplankton sampling in front of the intake and monthly electrofishing, gill net, wingless trap nets, and minnow seine surveys at stations sampled during baseline studies.

Post-operational entrainment sampling during 1984 and impingement sampling during 1985-1986 at CEC are discussed in more detail in Sections 4.1 and 4.2. In addition to IM&E sampling, field studies using boat electrofishing and seining (when possible) were conducted once per month from February 1985 through January 1986, concurrently with impingement sampling. Five sites were sampled along the north and south shorelines either upstream of the MWIS, at the MWIS, or downstream of the MWIS (UEC 1986). Data collected from captured juvenile and adult fish were the same as from impinged fish. Collected fish of sufficient size were externally tagged before being released to study their movements within the river and to collect data on growth and condition of recaptured fish. Additional post-operational biological monitoring was conducted in July and October 2007 and January and March/April 2008 to support the proposed Unit 2 license application, which was withdrawn. During each sampling period, six locations in the Missouri River were sampled using electrofishing, gill nets, hoop nets, and seining.

The most recent fisheries surveys at CEC were conducted from 2007-2008, and a total of 4,128 fish representing 45 distinct species were collected during this effort (Table 3-1). Samples were numerically dominated by gizzard shad (*Dorosoma cepedianum*; 39.5 percent of total), red shiner (*Cyprinella lutrensis;* 22.5 percent), and emerald shiner (*Notropis atherinoides*; 20.1 percent), which together represented 82.0 percent of the total catch. Other common large-river species sampled included channel catfish (*Ictalurus punctatus*), shoal chub[2] (*Macrhybopsis hyostoma*), freshwater drum (*Aplodinotus grunniens*), shovelnose sturgeon (*Scaphirhynchus platorynchus*), goldeye (*Hiodon alosoides*), and bullhead minnow (*Pimephales vigilax*). Nearly all species that were encountered in historical collections from this reach of the Missouri River were collected during the 2007 – 2008 survey (UEC 1974, 1976; CDM 1981, 1982). Exceptions included highfin carpsucker (*Carpiodes velifer*) and white crappie (*Pomoxis annularis*). Species richness and catch-per-unit-effort (CPUE) rates were greatest in electrofishing and seining samples, substantially lower in gill net samples, and extremely low in hoop net samples (Table 3-2). However, gill netting resulted in the collection of two species, lake sturgeon (*Acipenser*

[2] The shoal chub was elevated to full species status from the speckled chub species-complex through morphological studies by Eisenhour (1999, 2004) and genetic studies by Underwood et al. (2003). Henceforth, all specimens formerly identified as speckled chub are now identified as shoal chub.

fulvescens) and paddlefish (*Polyodon spathula*), that were not collected by any other method. Similarly, black crappie (*Pomoxis nigromaculatus*) was only collected while hoop netting.

Table 3-1. Taxonomic Composition and Abundance in Fish Surveys of the Missouri River in Vicinity of Callaway Energy Center's MWIS, 2007 – 2008

Common Name	Scientific Name	Total Number Collected	Percent of Total
Gizzard shad	*Dorosoma cepedianum*	1,630	39.49
Red shiner	*Cyprinella lutrensis*	927	22.46
Emerald shiner	*Notropis atherinoides*	828	20.06
Channel catfish	*Ictaluras punctatus*	110	2.66
Shoal chub	*Macrhybopsis hyostoma*	89	2.16
Freshwater drum	*Aplodinotus grunniens*	63	1.53
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	55	1.33
Goldeye	*Hiodon alosoides*	55	1.33
Bullhead minnow	*Pimephales vigilax*	51	1.24
River carpsucker	*Carpiodes carpio*	39	0.94
Channel shiner	*Notropis wickliffi*	31	0.75
Temperate basses	*Morone* spp.	28	0.68
Sand shiner	*Notropis stramineus*	24	0.58
Blue catfish	*Ictaluras furcatus*	24	0.58
Common carp	*Cyprinus carpio*	18	0.44
Sunfishes	*Lepomis* spp.	18	0.44
Smallmouth buffalo	*Ictiobus bubalus*	15	0.36
Flathead catfish	*Pylodictis olivaris*	15	0.36
Longnose gar	*Lepisosteus osseus*	13	0.31
Plains minnow	*Hybognathus placitus*	10	0.24
Silver carp	*Hypopthalmichthys molitrix*	10	0.24
Carpsucker or Buffalo	*Carpiodes/Ictiobus*	8	0.19
Shortnose gar	*Lepisosteus platostomus*	7	0.17
Silver chub	*Macrhybopsis storeriana*	6	0.15
Blue sucker	*Cycleptus elongatus*	6	0.15
Bluegill	*Lepomis macrochirus*	6	0.15
River shiner	*Notropis blennius*	4	0.10
Western mosquitofish	*Gambusia affinis*	4	0.10
Brook silverside	*Labidesthes sicculus*	4	0.10
Carpsuckers	*Carpiodes* spp.	3	0.07
Shorthead redhorse	*Moxostoma macrolepidotum*	3	0.07
Chestnut lamprey	*Ichthyomyzon castaneus*	2	0.05
Skipjack herring	*Alosa chrysochloris*	2	0.05
Grass carp	*Ctenopharyngodon idella*	2	0.05
River redhorse	*Moxostoma carinatum*	2	0.05
Golden redhorse	*Moxostoma erythrurum*	2	0.05
Slenderhead darter	*Percina phoxocephala*	2	0.05
Lake sturgeon	*Acipenser fulvescens*	1	0.02
Paddlefish	*Polyodon spathula*	1	0.02
Spotted gar	*Lepisosteus oculatus*	1	0.02
Mooneye	*Hiodon tergisus*	1	0.02
Sturgeon chub	*Macrhybopsis gelida*	1	0.02
Bluntnose minnow	*Pimephales notatus*	1	0.02
White bass	*Morone chrysops*	1	0.02
Spotted bass	*Micropterus punctulatus*	1	0.02

Common Name	Scientific Name	Total Number Collected	Percent of Total
Largemouth bass	*Micropterus salmoides*	1	0.02
Black crappie	*Pomoxis nigromaculatus*	1	0.02
Missouri saddled darter	*Etheostoma tetrazonum*	1	0.02
Sauger	*Sander canadensis*	1	0.02
Total		**4,128**	**100.00**
Species Richness*		**45**	

* Unidentified species within a genus did not count toward the species richness total unless they were the only representatives identified within that genus

Table 3-1. Taxonomic Composition and Catch-Per-Effort by Method in Fish Surveys of the Missouri River in the Vicinity of Callaway Energy Center's MWIS, 2007 – 2008

Common Name	Electrofishing (# fish/hour)	Gill Netting (# fish/24 hr)	Hoop Netting (# fish/24 hr)	Seining (# fish/haul)
Gizzard shad	64	0.43		34.28
Red shiner	0.5			25.67
Emerald shiner	1.83			22.69
Freshwater drum	8	0.3	0.03	0.14
River carpsucker	5	0.2		0.08
Channel catfish	2.33	0.4	0.2	2.28
Goldeye	3	0.3		0.81
Blue catfish	2.33	0.33		
Shoal chub				2.47
Common carp	2.33	0.13		
Temperate basses	2	0.03		0.42
Smallmouth buffalo	2	0.1	0.07	
Shovelnose sturgeon	0.17	1.8		
Flathead catfish	1.67		0.17	
Silver carp	1.67			
Bullhead minnow				1.42
Channel shiner	0.5			0.78
Sunfishes	0.5			0.42
Shortnose gar	0.5	0.3	0.03	0.03
Longnose gar	0.5	0.27	0.07	
Blue sucker	0.5	0.23		
Sand shiner				0.67
Bluegill	0.5			0.08
Shorthead redhorse	0.33	0.13		
Skipjack herring	0.17	0.27		
Chestnut lamprey	0.33			
River redhorse	0.33			
Golden redhorse	0.33			
Plains minnow				0.28
Slenderhead darter	0.17			0.06
Carpsucker or Buffalo				0.22
Grass carp	0.17		0.03	
Spotted gar	0.17			
Mooneye	0.17			
Silver chub				0.17

Common Name	Electrofishing (# fish/hour)	Gill Netting (# fish/24 hr)	Hoop Netting (# fish/24 hr)	Seining (# fish/haul)
Largemouth bass	0.17			
River shiner				0.11
Mosquitofish				0.11
Brook silverside				0.11
Carpsuckers				0.08
Lake sturgeon		0.03		
Paddlefish		0.03		
Sturgeon chub				0.03
Bluntnose minnow				0.03
White bass		0.03		
Spotted bass				0.03
Black crappie			0.03	
Missouri saddled darter				0.03
Total	**102.17**	**5.33**	**0.63**	**93.47**
Species Richness*	**29**	**17**	**6**	**24**

* Unidentified species within a genus did not count toward the species richness total unless they were the only representatives identified within that genus

Benthic Fishes Study. The BFS was a research project conducted on the Missouri River from Montana to Missouri by a consortium of Cooperative Research Units (ID, MT, KD, KS, IA, MO), the Columbia Environmental Research Center (U.S. Geological Survey [USGS]), and the Montana Department of Fish, Wildlife, and Parks. The main goal of the three-year (1996 – 1998) project was to evaluate the status of benthic or bottom dwelling fishes and riverine habitat to assist the U.S. Army Corps of Engineers (USACE) and other federal and state agencies in managing the Missouri River system (Berry and Young 2001; Berry et al. 2004). Five sampling gears (gill net, bag seine, bottom trawl, drifting trammel net, and electrofishing) were used during annual surveys conducted between July and October 1996, 1997, and 1998 in 15 river segments that extended from the river's headwaters in Montana at RM 1,999 to the confluence with the Mississippi River near St. Louis, Missouri. Twenty-six benthic species were targeted for evaluation based on their wide distribution in the river and primary habitat use of benthic habitat. These species included threatened and endangered species (9 species) and species important to commercial (3 species) and recreational fishing (6 species), and as prey (8 species). Non-target species collected during surveys were also recorded. Fish were sampled in six macrohabitats: secondary channel connected, secondary channel non-connected, tributary mouth, mainstem outside bend, mainstem inside bend, and mainstem cannel crossover. A stratified random sampling design was employed each year to select five sites of each macrohabitat for sampling within each segment.

Overall, a total of 77,196 specimens were collected from all river segments with the most common species being emerald shiner (25 percent of total), flathead chub (*Platygobio gracilis*; 13 percent), river carpsucker (*Carpiodes carpio*; 9 percent), channel catfish (9 percent), and white sucker (*Catostomus commersonii*; 6 percent). Five species did not inhabit the entire mainstem because their distribution was limited to the upper basin (burbot [*Lota lota*], white

sucker) or the lower basin (flathead catfish [*Pylodictis olivaris*], blue catfish [*Ictalurus furcatus*], sand shiner [*Notropis stramineus*]).

Catches from segments 25 (RM 220 – RM 130) and 27 (RM 50 – RM 0) in the channelized zone of the Missouri River may best describe the fish community at CEC because these segments are in closest proximity and are located upstream and downstream of the facility, respectively. Over the three-year sampling period a total of 26,136 specimens were collected from segments 25 and 27, representing 68 unique species (Table 3-3). More fish were collected in 1997 (n = 14,045; 63 species) than 1998 (n = 8,833; 51 species) and 1996 (n = 3,258; 38 species). The reduced catch in 1996 occurred in all river segments and was caused by modifications in sampling procedures that increased seining, electrofishing, and gill netting effort during 1997 and 1998. The top three most abundant species in segments 25 and 27 over the three-year sampling period were gizzard shad (34.2 percent of total), emerald shiner (15.5 percent), and silvery minnows (*Hybognathus* spp.; 11.5 percent). River carpsucker was the second most abundant species in 1997, but it was less abundant in 1996 and 1998, representing 9.4 percent of the total overall catch (Table 3-3). These taxa along with red shiner, channel catfish, and freshwater drum were the most numerous fishes collected, representing approximately 84.7 percent of the combined catch over the three survey years.

Table 3-2. Total Number and Percent of Fish Collected from Segments 25 and 27 of the Missouri River During the 1996 – 1998 Benthic Fishes Study

Common Name	Missouri River (Segments 25 and 27)				
	1996	1997	1998	Total Number Collected	Percent of Total
Gizzard shad	1,529	4,531	2,874	8,934	34.2
Emerald shiner	301	1,851	1,912	4,064	15.5
Silvery minnows	164	2,080	764	3,008	11.5
River carpsucker	46	2,201	219	2,466	9.4
Red shiner	81	672	955	1,708	6.5
Channel catfish	254	506	518	1,278	4.9
Freshwater drum	256	210	241	707	2.7
Common carp	93	218	138	449	1.7
Flathead catfish	102	82	149	333	1.3
Bluegill	44	205	53	302	1.2
Shoal chub	5	215	32	252	1.0
Shortnose gar	45	131	55	231	0.9
Goldeye	81	83	51	215	0.8
Blue catfish	81	34	95	210	0.8
Western mosquitofish	5	107	96	208	0.8
Sand shiner	19	90	95	204	0.8
Shovelnose sturgeon	13	62	109	184	0.7
Sicklefin chub	15	37	93	145	0.6
River shiner	1	124	10	135	0.5
White bass	6	86	16	108	0.4
Silver chub	28	64	11	103	0.4
Mimic shiner	0	57	33	90	0.3
Longnose gar	16	28	35	79	0.3
Smallmouth buffalo	6	46	20	72	0.3

Common Name	Missouri River (Segments 25 and 27)				
	1996	1997	1998	Total Number Collected	Percent of Total
Unidentified fishes	0	28	39	67	0.3
Unidentified shiners	0	5	51	56	0.2
Spotted bass	0	41	14	55	0.2
Unidentified minnows	1	23	29	53	0.2
Bluntnose minnow	3	19	16	38	0.1
Green sunfish	3	18	13	34	0.1
Largemouth bass	11	19	1	31	0.1
Sauger	6	15	6	27	0.1
White crappie	13	9	2	24	0.1
Orangespotted sunfish	3	11	9	23	0.1
Bigmouth shiner	0	18	3	21	0.1
Plains minnow	0	20	0	20	0.1
Striped bass	15	5	0	20	0.1
Bighead carp	2	3	9	14	0.1
Sturgeon chub	2	9	3	14	0.1
Stonecat	0	0	11	11	<0.1
Unidentified chubs	0	2	9	11	<0.1
Shorthead redhorse	0	7	4	11	<0.1
Brook silverside	0	2	7	9	<0.1
Quillback	0	7	2	9	<0.1
Skipjack herring	0	7	2	9	<0.1
Freckled madtom	0	3	5	8	<0.1
Blue sucker	0	1	6	7	<0.1
Bigmouth buffalo	1	5	1	7	<0.1
Yellow bass	0	4	2	6	<0.1
Black crappie	0	5	1	6	<0.1
Suckermouth minnow	2	4	0	6	<0.1
Paddlefish	0	1	4	5	<0.1
Lake sturgeon	0	4	1	5	<0.1
Bigeye shiner	0	1	3	4	<0.1
Grass carp	0	3	1	4	<0.1
Flathead chub	1	2	1	4	<0.1
Bullhead minnow	0	4	0	4	<0.1
Logperch	0	4	0	4	<0.1
Highfin carpsucker	0	2	1	3	<0.1
Walleye	1	2	0	3	<0.1
Chestnut lamprey	0	2	0	2	<0.1
Common shiner	0	2	0	2	<0.1
Largescale stoneroller	0	2	0	2	<0.1
Fathead minnow	1	1	0	2	<0.1
Bowfin	0	0	1	1	<0.1
Larval fishes	0	0	1	1	<0.1
Northern pike	0	0	1	1	<0.1
Johnny darter	0	1	0	1	<0.1
Rainbow smelt	0	1	0	1	<0.1
Silverband shiner	0	1	0	1	<0.1
Spotted gar	0	1	0	1	<0.1
Striped shiner	0	1	0	1	<0.1
Ghost shiner	1	0	0	1	<0.1
Longear sunfish	1	0	0	1	<0.1

Common Name	Missouri River (Segments 25 and 27)				
	1996	1997	1998	Total Number Collected	Percent of Total
Total	**3,258**	**14,045**	**8,833**	**26,136**	**100.0**
Number of Species	**38**	**63**	**51**	**68**	

Several species were only collected from segments 25 and 27, including chestnut lamprey (*Ichthyomyzon castaneus*), lake sturgeon, bowfin (*Amia calva*), common shiner (*Luxilus cornutus*), largescale stoneroller (*Campostoma oligolepis*), striped shiner (*Luxilus chrysocephalus*), freckled madtom (*Noturus nocturnus*), yellow bass (*Morone mississippiensis*), and longear sunfish (*Lepomis megalotis*). Similarly, there were thirty-eight species collected during the BFS that were not present in segments 25 and 27. Species commonly collected during the BFS that were present at notably low numbers in segments 25 and 27 included one Missouri state-endangered fish, the flathead chub (n = 4 individuals collected), and the sturgeon chub (*Macrhybopsis gelida*; n = 14), fathead minnow (*Pimephales promelas*; n =2), shorthead redhorse (*Moxostoma macrolepidotum*; n = 11), quillback (*Carpiodes cyprinus*; n = 9), bigmouth buffalo (*Ictiobus cyprinellus*; n = 7), stonecat (*Noturus flavus*; n = 11), northern pike (*Esox lucius*; n = 1), white crappie (n = 24), sauger (*Sander canadensis*; n = 27), and walleye (*Sander vitreus*; n = 3). Species more abundant in segments 25 and 27 than in other upstream segments included red shiner, blue catfish, and shoal chub.

Two Missouri state-endangered species were collected in segments 25 and 27: the lake sturgeon (n = 5 individuals collected) and the flathead chub (n = 4 individuals) (MDC 2018). The lake sturgeon was only collected from these segments, whereas the flathead chub was more abundant in upstream reaches of the Missouri River above Garrison Dam (Berry et al. 2004). Additional species of state concern collected in Segments 25 and 27 included three species assigned an S2 "imperiled" ranking, plains minnow (*Hybognathus placitus*; n = 20), ghost shiner (*Notropis buchanani*; n = 1), and highfin carpsucker (n = 3), and one species assigned an S3 "vulnerable" ranking, sturgeon chub. Skipjack herring (*Alosa chrysochloris*; n = 9), which has an SU ranking, unrankable due to lack of information, was also collected. The shovelnose sturgeon, which is considered threatened due to similarity of appearance [T(S/A)] to the federally-endangered pallid sturgeon (*Scaphirhynchus albus*), was also collected during the BFS in segments 25 and 27 (USFWS 2010). T(S/A) species such as the shovelnose sturgeon are not considered biologically threatened and are not subject to Section 7 consultation.

Pallid Sturgeon Population Assessment Project. The PSPAP is an ongoing, collaborative monitoring program of the Missouri River that was initiated in 2003 under the Missouri River Recovery Program (MRRP) led by the USACE and U.S. Fish and Wildlife Service (USFWS), with full implementation beginning in 2006, and includes members representing both federal and state agencies and university researchers. The main objectives of the PSPAP are to evaluate annual and long-term trends of abundance, distribution, habitat usage, and population structure of the federally endangered pallid sturgeon. In addition, the PSPAP seeks to evaluate annual results and long-term trends of population abundance, geographical distribution, and habitat usage of native target and non-target species. Native target species of the PSPAP include the shovelnose sturgeon, plains minnow, western silvery minnow (*Hybognathus argyritis*), sand

shiner, sturgeon chub, sicklefin chub (*Macrhybopsis meeki*), shoal chub, blue sucker (*Cycleptus elongatus*), and sauger. Annual surveys are conducted in the upper basin (segments 1 – 4) above Garrison Dam and the lower basin (segments 5 – 10, and 13 – 14) below Fort Randall Dam (Herman et al. 2014; Herman and Wrasse 2015, 2016). River segment 14, which begins at the confluence of the Osage River (RM 130.2) and ends at the confluence with the Mississippi River (RM 0.0), is where CEC is located. Annual surveys are divided into two seasons, sturgeon season and fish community season. The sturgeon season begins in the fall of the previous calendar year when water temperatures fall below 12.8°C and concludes at the end of June, and the fish community season occurs from July through October. Results from recent annual surveys (2013 - 2015) conducted within river segment 14 using five gear types (gill nets, otter trawls, trammel nets, mini-fyke nets, and trotlines) are summarized below.

Overall, a total of 42,760 specimens were collected over the three-year period from 2013 – 2015, representing 87 unique species and 2 hybrids (Table 3-4). The total catch was higher in 2013 (n = 18,380 individuals; 68 species) compared with 2015 (n = 12,934; 67 species) and 2014 (n = 11,446; 60 species). Sampling effort was relatively consistent across the three survey years for four of the gear types: gill nets (ranging from 134-140 samples), trotlines (113-114 samples), trammel nets (109-112 samples), and mini-fyke nets (110-113 samples). However, high-flow conditions during 2015 prevented the deployment of many of the otter trawls; only 153 otter trawls were deployed in 2015, while 240 and 232 trawls were deployed in 2013 and 2014, respectively (Herman et al. 2014; Herman and Wrasse 2015, 2016). Therefore, the higher total catch observed in 2013 (n = 18,380 individuals) compared to 2014 (n = 11,446) and 2015 (n = 12,934) was not a result of greater effort and was predominately due to the increased collection of six species (red shiner, gizzard shad, channel shiner, emerald shiner, blue catfish, and shoal chub).

The most abundant species collected in all three survey years was shovelnose sturgeon, which represented 24.2 percent of the total catch overall. The high catch of shovelnose sturgeon may reflect gear specificity for river sturgeons, the primary target of the sampling program. Gill nets and trotlines had relatively consistent CPUE for sturgeon species over the course of the monitoring program (Herman and Wrasse 2016). The second most abundant species varied among years, with red shiner being the second most abundant species in 2013 versus shoal chub in 2014 and blue catfish in 2015 (Table 3-4). Over the three survey years, the most abundant species following shovelnose sturgeon, in decreasing order, were blue catfish (10.0 percent), red shiner (8.4 percent), channel catfish (8.1 percent), shoal chub (7.4 percent), and gizzard shad (6.9 percent). Other species that were less abundant over the three-year period included freshwater drum (3.6 percent), channel shiner (*Notropis wickliffi*; 3.4 percent), and sicklefin chub (3.2 percent), each comprising roughly equal abundances.

A total of 53 federally endangered pallid sturgeon were collected in segment 14 over the survey period from 2013 – 2015, with most individuals collected in 2015 (Table 3-4). Twenty-seven state-endangered lake sturgeon were also collected, with the majority being of hatchery origin and collected near the Osage River confluence. Additional species of state concern collected in Segment 14 included two species assigned an S2 "imperiled" ranking, plains minnow (n = 40)

and highfin carpsucker (n = 1), as well as two species assigned an S3 “vulnerable” ranking, sturgeon chub (n = 222) and river darter (*Percina shumardi*; n = 2). Two species with SU rankings, skipjack herring (n = 3) and American eel (*Anguilla rostrate*; n = 1), were also collected.

Table 3-3. Number and Percent of Fish Collected in Segment 14 (RM 130.2 to RM 0.0) of the Missouri River for All Gear Types Combined During 2013 – 2015 Surveys by the Pallid Sturgeon Population Assessment Project

Common Name	2013	2014	2015	Total Number Collected	Percent of Total
Shovelnose sturgeon	3,537	3,582	3,235	10,354	24.2
Blue catfish	1,830	666	1,780	4,276	10.0
Red shiner	2,372	959	248	3,579	8.4
Channel catfish	1,225	1,144	1,084	3,453	8.1
Shoal chub	1,418	1,628	111	3,157	7.4
Gizzard shad	1,992	48	897	2,937	6.9
Freshwater drum	752	142	638	1,532	3.6
Channel shiner	1,201	175	88	1,464	3.4
Sicklefin chub	274	887	213	1,374	3.2
Emerald shiner	867	216	91	1,174	2.7
Unidentified sunfishes (*Lepomis* spp.)	209	2	830	1,041	2.4
Longnose gar	276	173	371	820	1.9
Blue sucker	211	251	247	709	1.7
White crappie	22		503	525	1.2
Goldeye	434	46	26	506	1.2
Bullhead minnow	177	100	206	483	1.1
Orangespotted sunfish	15	84	349	448	1.0
Bluegill	48	37	301	386	0.9
Silver carp	56	272	18	346	0.8
Unidentified fish		5	332	337	0.8
Silver chub	132	55	137	324	0.8
Western mosquitofish	33	62	205	300	0.7
Unidentified Cyprinidae	93	123	19	235	0.5
Shortnose gar	109	57	64	230	0.5
Unidentified Centrarchidae	4	63	162	229	0.5
Sturgeon chub	93	99	30	222	0.5
River carpsucker	115	50	41	206	0.5
Unidentified Catostomidae	192	4	3	199	0.5
Unidentified chub	95	65	21	181	0.4
Smallmouth buffalo	47	50	64	161	0.4
Unidentified buffalo		77	50	127	0.3
Unidentified *Ictalurus*	50	36	22	108	0.3
Bluntnose minnow	36	14	49	99	0.2
Sand shiner	12	35	32	79	0.2
Sauger	28	33	17	78	0.2

Common Name	2013	2014	2015	Total Number Collected	Percent of Total
Flathead catfish	20	16	32	68	0.2
Common carp	20	11	33	64	0.1
White bass	35	2	25	62	0.1
Unidentified sturgeons	21		39	60	0.1
Pallid sturgeon	10	17	26	53	0.1
Young-of-Year (YOY) Fish	26	6	19	51	0.1
Shorthead redhorse	26	13	11	50	0.1
Unidentified silvery minnows	9	5	34	48	0.1
Paddlefish	28	14	3	45	0.1
Plains minnow		9	31	40	0.1
Green sunfish	8		31	39	0.1
Grass carp	11	16	11	38	0.1
River shiner	27	3	7	37	0.1
Unidentified shiner	34			34	0.1
Unidentified carpsuckers	32			32	0.1
Lake sturgeon	14	8	5	27	0.1
Spotted sunfish	8	3	15	26	0.1
Stonecat	6	15	3	24	0.1
Pallid sturgeon × shovelnose sturgeon	8	8	7	23	0.1
Unidentified *Ictalurus* spp.	3		17	20	<0.1
Brook silverside	12	1	6	19	<0.1
Unidentified temperate bass		13	2	15	<0.1
Unidentified *Pimephales* spp.	3	9		12	<0.1
Black buffalo	7	3	2	12	<0.1
Unidentified herring			12	12	<0.1
Fathead minnow	2		10	12	<0.1
Black crappie	1	1	9	11	<0.1
Logperch	2		9	11	<0.1
Quillback	5	2	3	10	<0.1
Largemouth bass	3		7	10	<0.1
Unidentified redhorse	3		6	9	<0.1
Unidentified Asian carp	4	2		6	<0.1
Chestnut lamprey	2	1	3	6	<0.1
Blackspotted topminnow	1	4		5	<0.1
Spotfin shiner	2	3		5	<0.1
Golden redhorse	4	1		5	<0.1
Blackstripe topminnow	1	2	1	4	<0.1
Striped bass × white bass	1	1	2	4	<0.1
Unidentified *Catostomus* spp.			4	4	<0.1
Yellow bullhead	3		1	4	<0.1
Bigeye shiner	4			4	<0.1
Black bullhead		1	2	3	<0.1
Johnny darter	1	1	1	3	<0.1
Black carp			3	3	<0.1

Common Name	2013	2014	2015	Total Number Collected	Percent of Total
Redfin shiner			3	3	<0.1
Golden shiner	2		1	3	<0.1
Skipjack herring	2		1	3	<0.1
Blackside darter		2		2	<0.1
Gravel chub		2		2	<0.1
Western silvery minnow		2		2	<0.1
Goldfish		1	1	2	<0.1
Northern hog sucker	1	1		2	<0.1
River darter	1	1		2	<0.1
River redhorse	1	1		2	<0.1
Spotted gar	1	1		2	<0.1
Central stoneroller			2	2	<0.1
Striped bass	1		1	2	<0.1
Walleye	1		1	2	<0.1
Slenderhead darter	2			2	<0.1
Banded darter		1		1	<0.1
Highfin carpsucker		1		1	<0.1
Unidentified darter		1		1	<0.1
Yellow bass		1		1	<0.1
American eel			1	1	<0.1
Bighead carp			1	1	<0.1
Common shiner			1	1	<0.1
Mimic shiner			1	1	<0.1
Mooneye			1	1	<0.1
Tadpole madtom			1	1	<0.1
Unidentified gar			1	1	<0.1
Warmouth			1	1	<0.1
Bigmouth buffalo	1			1	<0.1
Freckled madtom	1			1	<0.1
Missouri saddled darter	1			1	<0.1
Suckermouth minnow	1			1	<0.1
Unidentified Percidae	1			1	<0.1
White sucker	1			1	<0.1
Totals	**18,380**	**11,446**	**12,934**	**42,760**	**100.0**
Number of species	**68**	**60**	**67**	**87**	
Number of hybrids	**2**	**2**	**2**	**2**	

Note: All fish were caught in Segment 14 during regularly scheduled sampling during the sturgeon and fish community seasons as reported in Appendix F of each annual report. Fish collected during additional sampling events (e.g., broodstock collection efforts) were not included.

Source: Herman et al. 2014; Herman and Wrasse 2015, 2016.

Mussel Sampling. Very few freshwater mussel surveys have been conducted on the Missouri River, particularly within the lower Missouri River where the CEC is located. Much of the river was historically considered devoid of unionid mussels due to heavy sediment loads coupled with the high mobility of the sediment in the river (Hoke 2009). The first reports of mussel

populations were of the eastern pearlshell mussel (*Margaritifera margaritifera*) and fatmucket (*Lampsilis siliquoidea*) from the upper reaches of the Missouri River in Montana (Bland and Cooper 1861; Cooper 1869). Only recently have studies shown that mussels inhabit the river despite high silt loads and the loss of habitats from modifications made to the river (Hoke 1983; Perkins and Backlund 2000; Hoke 2009). The current mussel assemblage is comprised of mostly silt tolerant species; however, species known to be intolerant of silt are also present in low numbers, including scaleshell (*Leptodea leptodon*) and yellow sandshell (*Lampsilis teres*) (Hoke 2009). A summary of unionid mussel surveys completed by Hoke (2009) between 1982 and 2000 of the Lower Missouri River that includes areas in the vicinity of the CEC (Regions I and II) are presented in Table 3-5. These designated regions on the Missouri River include sampling locations from near the confluence of the Lamine River downstream to the river's end at the confluence with the Mississippi River. Most surveys were conducted from 1988 to 1990 during the late fall and winter. Mussel shells were sampled by hand or by using a garden rake at each location until diversity plateaued or no accessible area remained. Sampling locations extended as far as 2 kilometers and were selected opportunistically based upon available access to the river. Habitats identified at sampling locations included sandbars, pools below wing dams, side channels, detached lakes, sloughs, backwaters, revetments, and accessible portions of the main channel.

Table 3-4. Number of Freshwater Mussels (Unionidae) Collected from Region I and II within the Channelized Missouri River and Adjacent Floodplain During Surveys Conducted Between 1982 and 2000

Common Name	Scientific Name	Region		Total Number Collected
		I	II	
Flat floater	*Utterbackiana suborbiculata**	7	3	10
Yellow sandshell	*Lampsilis teres*	1	3	4
White heelsplitter	*Lasmigona complanata*	3	-	3
Fragile papershell	*Leptodea fragilis*	8	9	17
Scaleshell†	*Leptodea leptodon*	1	-	1
Threehorn wartyback	*Obliquaria reflexa*	2	1	3
Hickorynut	*Obovaria olivaria*	-	1	1
Pink heelsplitter	*Potamilus alatus*	4	6	10
Pink papershell	*Potamilus ohiensis*	12	8	20
Giant floater	*Pyganodon grandis*	9	8	17
Mapleleaf	*Quadrula quadrula*	2	2	4
Lilliput	*Toxolasma parvum*	1	2	3
Fawnsfoot	*Truncilla donaciformis*	1	2	3
Paper pondshell	*Utterbackia imbecillis*	3	1	4
Total Number Collected		**54**	**46**	**100**
Total Number of Species		**13**	**12**	**14**
Number of Collection Sites		**15**	**10**	**25**
Number of Species per Site		**3.60**	**4.60**	**4.00**

* Reassigned from *Anodonta*.
† Federally and state-listed as endangered
Source: Hoke 2009.

The greatest species diversity observed among the eight regions surveyed within the channelized lower Missouri River was in regions I and II, with 13 and 12 unionid mussel species collected, respectively (Table 3-5). The river in these regions is wider than in upstream regions and contains a greater diversity of habitats. In addition, these regions were the most accessible and consequently had a greater number of sampling locations (n = 10 – 15 sites). The most common species collected were pink papershell (*Potamilus ohiensis*; n = 20 total individuals), fragile papershell (*Leptodea fragilis*; n = 17), and giant floater (*Pyganodon grandis*; n = 17) (Table 3-5). These species were the most abundant species over all eight regions surveyed as well, accounting for over 60 percent of the total unionids collected in the study (Hoke 2009). Fragile papershell mussels were most numerous in or near moderate current, but they were less abundant in quiet waters. This was the only species collected in the turbulent area beyond the tip of wing dams. In contrast, pink papershell and giant floater mussels were more abundant in quiet waters found in sheltered habitats.

Seven of the fourteen unionid species collected within Regions I and II (*Utterbackiana suborbiculata, Leptodea fragilis, Obliquaria reflexa, Pyganodon grandis, Quadrula quadrula, Truncilla donaciformis,* and *Utterbackia imbecillis*) have been reported to be tolerant to silt (Brim Box and Mossa 1999), suggesting that silt may be an important factor influencing the species composition in some habitats. The most common habitats for unionids in the lower Missouri River, including near CEC, are pools below wing dams that are areas of high silt deposition, possibly accounting for the overall high abundance of silt tolerant species in the lower Missouri River (Hoke 2009).

Species known to be intolerant of silt were also present, albeit in low numbers, including the federally endangered scaleshell (n = 1 individual collected). Several species of conservation concern were also collected during mussel surveys of Regions 1 and II, including one species assigned an S2 “imperiled” ranking, the flat floater (*Utterbackiana suborbiculata*; n = 10 individuals collected), and one species assigned an S3 “vulnerable” ranking, the hickorynut (*Obovaria olivaria*; n = 1).

Freshwater mussels have a unique life cycle, which involves a larval form (i.e., glochidia) that is parasitic on the gills of adult fish before transforming and completing the mussel’s life cycle. Mussel glochidia are not free-swimming and require a fish host for survival; without successful attachment to a host fish, they will die shortly thereafter. Due to the life cycle characteristics of freshwater mussels and their glochidia, it is unlikely for them to be found in entrainment samples, as typically only larval fish and eggs are collected by entrainment. Thus, no impacts to freshwater mussels are expected to occur at CEC.

3.2 Temporal Changes

Galat et al. (2005) reviewed spatial and temporal patterns of Missouri River fishes for the main channel, floodplain, and major reservoirs. A total of 136 species were identified from 25 families with 54 percent (73 species) classified as “big river” species, residing primarily in the main channel. Ninety-three percent (68 species) of these big river species were designated as fluvial

dependent or fluvial specialists (i.e., requiring flowing water for some life-stage activity) (Galat et al. 2005). These results indicate that many of Missouri River fishes are well adapted for life in turbid, swift waters with unstable sand-silt bottoms as is common in the Missouri River. Populations of 17 species were found to be increasing, including those of nine introduced species (e.g., Asian carp and salmonids). Contrary to these results, 23 of the 24 species whose populations are decreasing were native species. Eleven fishes were listed as imperiled (i.e., S1, S2) by two or more states bordering the mainstem Missouri River, including: lake sturgeon, pallid sturgeon, paddlefish, western silvery minnow, plains minnow, sturgeon chub, sicklefin chub, silver chub, flathead chub, quillback, and highfin carpsucker (Galat et al. 2005).

A general trend of increasing species richness was observed going downriver, with the lower Missouri River having the most species overall (n = 110 species; 89 native/18 introduced) (Galat et al. 2005). Species from the Ozark Highlands and Mississippi River comprised a component of the lower Missouri River ichthyofauna, accounting for some of the observed increase in species richness within this region. Changes in the fish community of the lower Missouri River between 1940 and 1983 include the increased abundance of the following pelagic planktivores and sight-feeding carnivores: skipjack herring, gizzard shad, white bass, bluegill, white crappie, river shiner, and red shiner (Pflieger and Grace 1987). Other fishes that decreased in abundance included big river species with specialized habitat or feeding requirements (e.g., pallid sturgeon and flathead chub) or species more common in backwaters (e.g., western silvery minnow, plains minnow, and river carpsucker) (Pflieger and Grace 1987). The population decline of many big river minnow species was generally corroborated by Grady and Milligan (1998) who showed that populations of plains minnow, flathead chub, western silvery minnow, ghost shiner, and bluntnose minnow have continued to decrease from 1945 to 1997, with populations of sturgeon chub remaining rare at all times and locations (Grady and Milligan 1998). The results of the BFS (see Section 3.1) generally support these findings despite the increased catch of some small cyprinids (e.g., shoal chub and sicklefin chub) in the main channel using benthic trawls compared with historical bag seining samples (Berry et al. 2004).

Perhaps one of the most significant temporal changes in the lower Missouri River ichthyofauna has been the introduction and spread of invasive species (e.g., Asian carp) that are now established throughout much of the lower Missouri River below Gavins Point Dam (Galat et al. 2005). In Missouri and other states, Asian carp have been regarded as a nuisance species due to their high potential to cause ecological harm to native fishes and other aquatic organisms (MDC 2007). Asian carp have been so successful in establishing populations due to their wide tolerance of environmental conditions and their life history characteristics, including high fecundity, protracted spawning, rapid growth, and early maturation (Schrank and Guy 2002; Williamson and Garvey 2005; Garvey et al. 2006). Silver and bighead carp often migrate upstream to spawn during periods of high river discharge in late spring and summer (Schrank et al. 2001). Females are highly fecund, releasing 0.5-1.9 million eggs during spawning that are fertilized by nearby males and develop into larvae while drifting in the main river currents (Kamilov and Komrakova 1999; George et al. 2017). Ichthyoplankton studies at RM 176 on the lower Missouri River from May – August 2002 found that Asian carp larvae comprised 60 percent of the total drift during daylight and 85 percent of the drift at night (Reeves 2006;

Reeves and Galat 2010). Temporal variation in larval densities has been shown to be strongly influenced by abiotic cues (e.g., temperature and flood pulses) that are important for initiating spawning (Schrank et al. 2001; DeGrandchamp et al. 2007; Csoboth and Garvey 2008). The relatively recent proliferation of Asian carp in the lower Missouri River has caused a shift in the ichthyoplankton community that may have major effects on the native fish fauna. Asian carp compete with native fishes such as paddlefish, bigmouth buffalo, and gizzard shad, as well as the young-of-year (YOY) of almost all native fish. Recent studies indicate that Asian carp have negatively affected native planktivores such as gizzard shad by reducing zooplankton abundance and composition, thereby having a detrimental effect by altering the base of the aquatic food web (Fritts et al. 2018).

3.3 Spatial Characteristics

Summaries of source waterbody biological composition and characteristics in the preceding sections are based on multi-year data sets that capture the spatial variability inherent in the lower Missouri River system at multiple scales. Data from surveys conducted as part of the BFS and PSPAP are the result of sampling multiple habitats within the lower Missouri River (e.g., main channel, secondary channels, tributary mouths, etc.) and consequently represent the full range of spatial variability between habitat types. Therefore, our summarized data is appropriate for characterizing source waterbody biological composition at CEC's MWIS.

Based on data collected during the BFS from 1996 – 1998, total catches were high for all species in mainstem inside bend and secondary channel-connected macrohabitats, but only six species had high total catches in mainstem channel crossovers (channel catfish, flathead chub, sicklefin chub, shovelnose sturgeon, stonecat, sturgeon chub) (Berry et al. 2004). These results are based on comparisons made only during the summer through early autumn sampling period in 1996 – 1998 because fish may use more than one habitat depending on season and life stage (Berry et al. 2004).

PSPAP monitoring data from 2013 – 2015 surveys indicated shallow water habitats including off-channel habitats (e.g., chutes) may be important for many fishes in providing refuge during high flow events (Herman and Wrasse 2016). For example, otter trawl catch rates were relatively high in off-channel areas during prolonged flood conditions of 2011 compared with low catch rates for most species on main channel sandbars (Herman and Wrasse 2016). Similarly, catch rates were relatively low in the main channel compared with the tributary mouth and side channel habitats found at the confluence of the Osage River in 2015 during high summer flows (Hermann and Wrasse 2016).

In addition, post-operational surveys conducted at CEC in July and October 2007 and January and March/April 2008 provide data on the spatial distribution of fishes in the immediate vicinity of CEC's MWIS and their susceptibility to impingement. During each sampling period, six locations in the Missouri River were sampled using electrofishing, gill nets, hoop nets, and seining. Sampling locations were located upstream, adjacent, and downstream of the MWIS on both the near shore (intake side) and opposite far shoreline (Figure 3-1). Total abundance was

substantially greater, and species richness was slightly higher, in collections from the near shore (intake side) sampling locations (Table 3-6). Total abundance was also higher at the locations adjacent to, and downstream of, the plant intake as compared to the location upstream of the intake. Total richness was greatest in the adjacent zone (n = 34 species), followed closely by the upstream (n = 33) and downstream (n = 30) zones, respectively. Differences in species abundances among locations were primarily due to the differential capture of schooling species, rather than habitat differences among sampling locations.

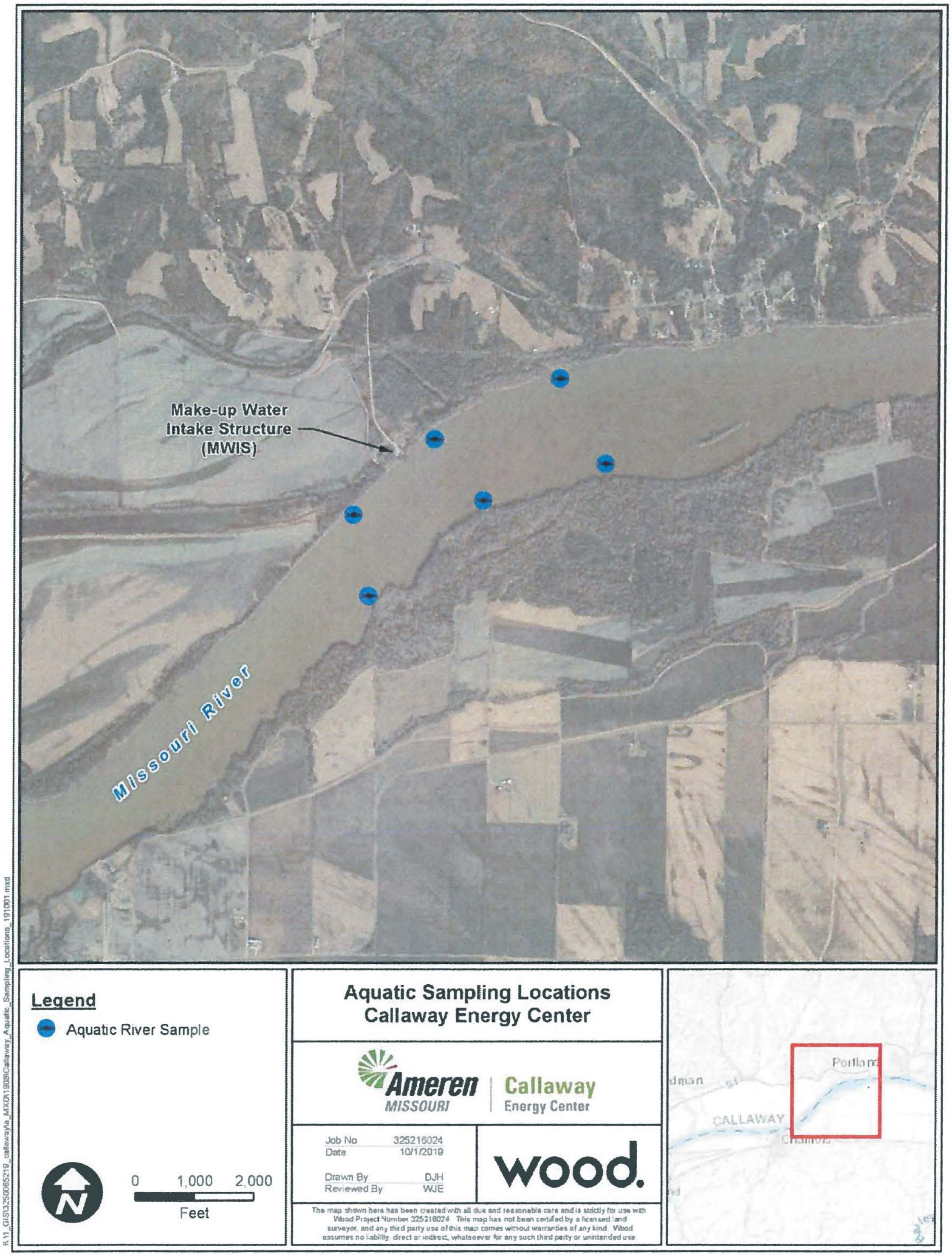

Figure 3-1. Sampling Locations on the Missouri River near Callaway Energy Center's MWIS during 2007 – 2008 Fish Surveys

Table 3-6. Taxonomic Composition and Abundance in Fish Surveys of the Missouri River in Vicinity of Callaway Energy Center's MWIS, 2007 – 2008

Species	Plant Side "Near Shore"	Opposite Side "Far Shore"	Upstream of Intake	Adjacent to Intake	Downstream of Intake	Total Number Collected	Percent of Total
Chestnut lamprey	1	1	2			2	0.05
Lake sturgeon		1	1			1	0.02
Shovelnose sturgeon	9	46	12	39	4	55	1.33
Paddlefish		1	1			1	0.02
Spotted gar		1	1			1	0.02
Longnose gar	7	6	2	9	2	13	0.31
Shortnose gar	4	3	1	4	2	7	0.17
Goldeye	38	17	32	18	5	55	1.33
Mooneye		1			1	1	0.02
Skipjack herring	2			2		2	0.05
Gizzard shad	1,347	283	261	1,159	210	1,630	39.49
Grass carp	1	1		2		2	0.05
Red shiner	838	89	168	89	670	927	22.46
Common carp	10	8	7	7	4	18	0.44
Plains minnow	5	5	3	1	6	10	0.24
Silver carp	5	5	6	2	2	10	0.24
Shoal chub	80	9	52	13	24	89	2.16
Sturgeon chub	1		1			1	0.02
Silver chub	5	1	1	5		6	0.15
Emerald shiner	546	282	325	53	450	828	20.06
River shiner	3	1	1	2	1	4	0.10
Sand shiner	18	6		17	7	24	0.58
Channel shiner	18	13	12	11	8	31	0.75
Bluntnose minnow	1			1		1	0.02
Bullhead minnow	40	11	8	30	13	51	1.24
Carpsuckers	3		3			3	0.07
Carpsucker or Buffalo		8			8	8	0.19

Species	Plant Side "Near Shore"	Opposite Side "Far Shore"	Upstream of Intake	Adjacent to Intake	Downstream of Intake	Total Number Collected	Percent of Total
River carpsucker	14	25	21	9	9	39	0.94
Blue sucker	4	2	2	1	3	6	0.15
Smallmouth buffalo	6	9	8	7		15	0.36
River redhorse	1	1	1	1		2	0.05
Golden redhorse	1	1	1	1		2	0.05
Shorthead redhorse	1	2		2	1	3	0.07
Blue catfish	4	20	20	3	1	24	0.58
Channel catfish	44	66	31	41	38	110	2.66
Flathead catfish	13	2	4	8	3	15	0.36
Mosquitofish	1	3	1		3	4	0.10
Brook silverside	4			3	1	4	0.10
Temperate basses	17	11	9	10	9	28	0.68
White bass		1		1		1	0.02
Sunfishes	4	14	2	2	14	18	0.44
Bluegill	1	5	2	1	3	6	0.15
Spotted bass	1			1		1	0.02
Largemouth bass	1				1	1	0.02
Black crappie	1		1			1	0.02
Missouri saddled darter	1			0	1	1	0.02
Slenderhead darter	2			2		2	0.05
Sauger		1			1	1	0.02
Freshwater drum	20	43	15	42	6	63	1.53
Total	**3,123**	**1,005**	**1,018**	**1,599**	**1,511**	**4,128**	**100.00**
Species Richness[1]	**40**	**36**	**33**	**34**	**30**	**45**	**45**

[1] Unidentified species within a genus did not count toward the species richness total unless they were the only representatives identified within that genus

4.0 Species and Life Stages Most Susceptible to Impingement and Entrainment (40 CFR 122.21(r)(4)(iii))

4.1 Species Most Susceptible to Impingement

Historical Sampling. The first post-operational impingement sampling was conducted at CEC from February 1985 through January 1986 (UEC 1986) and provides some information regarding fish species most susceptible to impingement at CEC's MWIS. Impingement samples were collected from the screen-wash for a 24-hour period on one randomly-selected day per week for a full year. A total of 301 fish representing 13 species and nine families were collected in impingement samples (Table 4-1). Total annual impingement based on CEC operating records was estimated to be only 2,401 fish weighing a total of 131.2 pounds (lbs) (59.5 kilograms [kg]). Gizzard shad and freshwater drum together comprised over 95 percent of the total fish impinged during the study. With the exception of channel catfish (n = 3 individuals) and blue catfish (n = 2 individuals), all other species were represented by a single specimen in impingement collections. Juvenile fish dominated the collections, especially for gizzard shad, which were composed of more than 98 percent Age-1 or younger fish. No pallid sturgeon or other threatened or endangered species or state-listed species of concern were collected.

Table 4-1. Number and Species of Fish Collected in Impingement Samples at Callaway Energy Center, February 1985 – January 1986

Common Name	Scientific Name	Total Number Collected	Percent of Total
Gizzard shad	*Dorosoma cepedianum*	275	91.36
Freshwater drum	*Aplodinotus grunniens*	12	3.99
Channel catfish	*Ictalurus punctatus*	3	1.00
Blue catfish	*Ictalurus furcatus*	2	0.66
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	1	0.33
Shortnose gar	*Lepisosteus platostomus*	1	0.33
Goldeye	*Hiodon alosoides*	1	0.33
River carpsucker	*Carpiodes carpio*	1	0.33
Smallmouth buffalo	*Ictiobus bubalus*	1	0.33
Black bullhead	*Ictalurus melas*	1	0.33
Flathead catfish	*Pylodictis olivaris*	1	0.33
Green sunfish	*Lepomis cyanellus*	1	0.33
Walleye	*Sander vitreus*	1	0.33
	Total	**301**	**100.00**

Amec Foster Wheeler Sampling. The most recent impingement study conducted at CEC assessed the potential impacts from impingement on the nearby fish community including potential impacts on the endangered pallid sturgeon (Amec Foster Wheeler 2017; ASA 2017). This study provides current information on the species most susceptible to impingement given that potentially significant changes in the composition of the fish community may have occurred since the previous impingement study was conducted 30 years ago. The one-year study was conducted from October 2015 to September 2016 with one 24-hour impingement sample collected during each sampling event. The sampling frequency was one time per week for October-December 2015, January-April 2016, and August-September 2016 and 3 times per week (non-consecutive days) for May-July 2016. Prior to the start of sample collection, the traveling screens were rotated to clear existing fish and debris from the screens. During sample collection, the traveling screens were operated on their normal schedule, i.e., typically rotated every 8 hours except during periods of high debris loading when screens were rotated continuously. Specifications for sampling gear and additional information regarding methods are available in study reports (Amec Foster Wheeler 2017; ASA 2017).

A total of 77 daily impingement samples were collected, with one scheduled daily event (April 27, 2016) not conducted due to MWIS pumps not operating[3]. Overall, a total of 537 specimens were collected during the one-year impingement study from October 2015 through September 2016, representing at least 24 distinct taxa (Table 4-2). Some fish could be identified only to genus or family, as they were larvae or were damaged. Impinged fish were collected in every month except April, with peak collections occurring in July. Invasive Asian carp species (silver carp, bighead carp, and grass carp [*Ctenopharyngodon idella*]) comprised only 3.4 percent of the total impinged fish. No federally listed species were collected at CEC during the impingement sampling. Furthermore, no species listed by Missouri as endangered, threatened, or species of concern were collected.

Gizzard shad and common carp (*Cyprinus carpio*) were the two most abundant fish species collected, comprising 50.5 percent (n = 271 individuals) and 12.7 percent (n = 68 individuals) of the total catch, respectively (Table 4-2). Notable secondary species included blue catfish (5.8 percent; n = 31), freshwater drum (4.7 percent; n = 25), sliver chub (*Macrhybopsis storeriana*; 3.2 percent; n = 17), silver/bighead carp (*Hypophthalmichthys* spp.; 3.2 percent; n = 17), unidentified sunfish species (*Lepomis* spp.; 3.0 percent; n = 16), and bluegill (*Lepomis macrochirus*; 3.0 percent; n = 16). These eight taxa combined were responsible for 85.9 percent of all impinged fish collected. These taxa are addressed individually below in more detail.

The total annual estimated impingement for all species combined in 2015 – 2016 was 1,833 fish under the assumption of a MWIS flow rate of 9,000 gpm per operating pump and 2,427 fish assuming 12,000 gpm per operating pump (ASA 2017). Gizzard shad dominated the estimated annual impingement with 47.8 percent of the total. Common carp was second overall with 8.2 percent. Total annual biomass for all species combined was 2.332 kg under the assumption of a MWIS flow rate of 9,000 gpm per operating pump and 3.108 kg assuming 12,000 gpm per operating pump.

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[3] No impinged fish were collected during the preceding three sampling events in April 2016.

Table 4-2. Number of Fish and Biomass Collected in Impingement Samples at Callaway Energy Center, October 2015 – September 2016

Common Name	Scientific Name	Total Number Collected	Percent of Total	Biomass (grams)	Percent of Total Biomass
Gizzard shad	*Dorosoma cepedianum*	271	50.47	97.05	9.44
Common carp	*Cyprinus carpio*	68	12.66	4.90	0.48
Blue catfish	*Ictalurus furcatus*	31	5.77	66.08	6.43
Freshwater drum	*Aplodinotus grunniens*	25	4.66	14.10	1.37
Silver chub	*Macrhybopsis storeriana*	17	3.17	2.30	0.22
Silver/bighead carp	*Hypophthalmichthys* spp.	17	3.17	1.60	0.16
Sunfish (*Lepomis*)	*Lepomis* spp.	16	2.98	9.20	0.89
Bluegill	*Lepomis macrochirus*	16	2.98	6.60	0.64
Eggs	Eggs - unknown spp.	15	2.79	<0.10	
Western mosquitofish	*Gambusia affinis*	14	2.61	2.00	0.19
Catfishes	Ictaluridae spp.	6	1.12	0.50	0.05
White bass	*Morone chrysops*	6	1.12	0.40	0.04
Orangespotted sunfish	*Lepomis humilis*	5	0.93	10.90	1.06
Channel catfish	*Ictalurus punctatus*	4	0.74	3.80	0.37
Flathead catfish	*Pylodictis olivaris*	4	0.74	544.40	52.94
Bullhead catfish	*Amerius* spp.	3	0.56	0.30	0.03
Minnows	Cyprinidae spp.	3	0.56	0.20	0.02
Sunfishes	Centrarchidae spp.	2	0.37	0.20	0.02
White crappie	*Pomoxis annularis*	2	0.37	3.40	0.33
Gars	Lepisosteidae sp.	1	0.19	0.10	0.01
Shortnose gar	*Lepisosteus platostomus*	1	0.19	0.40	0.04
Goldeye	*Hiodon alosoides*	1	0.19	248.50	24.16
Mooneye	*Hiodon tergisus*	1	0.19	<0.10	
Grass carp	*Ctenopharyngodon idella*	1	0.19	0.10	0.01
Shoal chub	*Macrhybopsis hyostoma*	1	0.19	1.00	0.10
Bluntnose minnow	*Pimephales notatus*	1	0.19	0.20	0.02
Minnows group 2	Cyprinidae group 2 sp.	1	0.19	0.10	0.01
Black bullhead	*Amerius melas*	1	0.19	9.80	0.95
Yellow bullhead	*Amerius natalis*	1	0.19	0.10	0.01
Crappies	*Pomoxis* sp.	1	0.19	0.10	0.01
Walleye/sauger	Sander sp.	1	0.19	0.10	0.01
Totals		**537**	**100.00**	**1,028.43**	**100.00**

Gizzard shad, the primary forage species within the Missouri River, accounted for the greatest component of the total catch (50.5 percent) but only 9.4 percent of the total weight (Table 4-2). The majority (76.4 percent) of gizzard shad were impinged in July (n = 207 individuals). The total length (TL) of impinged gizzard shad ranged from 17 to 105 millimeters (mm) TL, with most

individuals collected between 10 – 20 mm and 40 – 50 mm TL, indicating that primarily Age-0, YOY fish were captured during impingement sampling.

Common carp is a non-native fish brought from Asia that was aggressively stocked in Missouri during the 19th century and is now one of the most widespread and abundant fishes in the state (Pflieger 1997). Common carp was the second most frequently impinged fish species in terms of total catch (12.7 percent), but it was only 0.5 percent of the total weight (Table 4-2). Common carp were only collected in two months (May and June) of the impingement survey with 38 individuals weighing 1.7 grams (g) collected in May and 30 individuals weighing 3.2 g collected in June (Tables 4-3 and 4-4). All individuals collected were less than 40 mm TL, indicating that Age-0, YOY fish were captured during the impingement survey.

The blue catfish is a highly sought after game and food fish that can be somewhat migratory and seasonally abundant in the Missouri River (Pflieger 1997). Blue catfish represented 5.8 percent of the total catch and 6.4 percent of the total weight (Table 4-2). Impingement of blue catfish was fairly low throughout the survey, with individuals collected in five of the twelve months: January 2016 (1 individual, 52.2 g), May 2016 (1 individual, <0.1 g), June 2016 (1 individual, 5.0 g), July 2016 (25 individuals, 8.4 g), and August 2016 (3 individuals, 0.5 g) (Tables 4-3 and 4-4). Most individuals measured between 20 – 30 mm and 30 – 40 mm TL, indicating that primarily Age-0, YOY fish were collected during impingement sampling. The largest blue catfish specimen was 204 mm TL and 52 g and was collected in January 2016.

Freshwater drum, an abundant species in the lower Missouri River sought by both sport and commercial fisherman, represented 4.7 percent of the total catch and 1.4 percent of the total weight (Table 4-2). Impingement of freshwater drum varied throughout the survey with individuals only collected in three months: November 2015 (1 individual, 10.8 g), June 2016 (16 individuals, 1.5 g), and July 2016 (8 individuals, 1.8 g) (Tables 4-3 and 4-4). Most individuals collected measured less than 40 mm TL, indicating that primarily Age-0, YOY fish were captured during impingement sampling. The largest freshwater drum specimen recorded was 100 mm TL and was collected in November.

Silver and bighead carp are non-native fish from Asia that were brought to the United States and stocked into fish culture ponds for food and to improve water quality since they are a planktivorous, filter feeders (Pflieger 1997). They are now widely distributed within the lower Missouri River. Silver/bighead carp represented 3.2 percent of the total catch (17 individuals collected) and 0.2 percent of the total weight (1.6 g) (Table 4-2). Silver/bighead carp were only collected in four months with one individual collected in November 2015 and March and May 2016 and fourteen individuals collected in June 2016 (Table 4-3). Most individuals measured between 20 – 30 mm TL, indicating that Age-0, YOY fish were collected during the impingement survey.

The silver chub is a common small bodied benthic fish of the lower Missouri River that typically inhabits quiet pools and backwaters (Pflieger 1997). Silver chub accounted for 3.2 percent of the total catch (17 individuals collected) and only 0.2 percent of the total weight (2.3 g) (Table 4-2). Impingement of silver chub varied throughout the sampling period with no individuals

collected in seven of the twelve months sampled (January, February, April, May, June, August, and September 2016). The largest catch of 12 individuals occurred in November 2015 (Table 4-3). Most individuals impinged measured between 20 – 30 mm and 30 – 40 mm TL, indicating that primarily YOY fish were collected. The largest specimens of silver chub measured between 40 – 50 mm TL.

Bluegill and unidentified sunfish (*Lepomis* spp.) are important forage species within the Missouri River that inhabit shallow, shoreline littoral zones (Pflieger 1997). Bluegill and unidentified sunfish (*Lepomis* spp.) each represented 3.0 percent of the total impingement catch (16 individuals each), with unidentified sunfish comprising slightly more of the biomass (0.9 percent, 9.2 g) than bluegill (0.6 percent, 6.6 g) (Table 4-2). Impingement of bluegill was low throughout the sampling period with the largest catch being five individuals on December 2015 (Table 4-3). Most individuals were Age-0, YOY fish that measured between 20 – 30 mm TL. The largest bluegill collected measured 100 mm TL from March 2016.

Commercial fishing was once a common and important practice along the Missouri River but now is at a very low level. Economic issues are likely the primary driving force for the decline, although pollution and habitat destruction have also played a role in the decline of commercial fishing (Pflieger 1997). Despite the decline of commercial fishing, sport fishing has continued to increase in recent years. Commercial species and/or sportfish captured at CEC during the impingement study included common carp (n = 68), blue catfish (n = 31), freshwater drum (n = 25), white bass (*Morone chrysops*; n = 6), channel catfish (n = 4), flathead catfish (n = 4), white crappie (*Pomoxis annularis*) (n = 2), and walleye/sauger (*Sander* spp.; n = 1) (Table 4-2). Prey/forage species that were frequently captured in the impingement samples included gizzard shad (n = 271), silver chub (n = 17), bluegill (n = 16), western mosquitofish (n = 14), and orangespotted sunfish (*Lepomis humilis*; n = 5) (Table 4-2).

This impingement study revealed that though many species are present in the Missouri River (see Section 3.1), with some at relatively high abundances, not all are equally vulnerable to impingement. A similar species composition was observed compared to previous studies of the fish community in the lower Missouri River, but with different relative abundances, suggesting that not all fish are equally susceptible to impingement.

In addition to fish, there were five shellfish taxa (42 individuals) collected at CEC during the one-year impingement study (Table 4-5). Mississippi grass shrimp (*Palaemonetes kadiakensis*) and crayfish spp. (*Orconectes* spp.) comprised 36 percent (n = 15 individuals) and 24 percent (n = 10 individuals) of the total catch, respectively (Table 4-5). Other shellfish taxa included zebra mussel (*Dreissena* polymorpha; 19 percent), freshwater mussel (*Lampsilis* spp. and Unionidae; 19 percent), and golden crayfish (*Orconectes luteus*; 2 percent).

Low impingement rates recorded during the 1985 – 1986 study and 2015 – 2016 study were the result of reduced water withdrawal rates combined with the design and location of the MWIS. The use of a closed-cycle re-circulating system has reduced intake flows and, thus, lowered associated impingement rates. In addition, through-screen water velocities that are consistently

<0.5 feet per second (fps) under normal operations and river elevation noticeably contributed to lower impingement rates, especially for larger sized individuals.

Table 4-3. Number of Fish Collected in Impingement Samples at Callaway Energy Center by Month, October 2015 – September 2016

Common Name	Scientific Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Total
Gars	Lepisosteidae sp.								1					1
Shortnose gar	*Lepisosteus platostomus*								1					1
Gizzard shad	*Dorosoma cepedianum*			1	11	35	6			11	207			271
Goldeye	*Hiodon alosoides*				1									1
Mooneye	*Hiodon tergisus*									1				1
Minnows	Cyprinidae spp.				1					1	1			3
Silver/bighead carp	*Hypophthalmichthys* spp.		1				1		1	14				17
Grass carp	*Ctenopharyngodon idella*									1				1
Common carp	*Cyprinus carpio*								38	30				68
Shoal chub	*Macrhybopsis hyostoma*								1					1
Silver chub	*Macrhybopsis storeriana*	1	12	2			1				1			17
Bluntnose minnow	*Pimephales notatus*												1	1
Minnows group 2	Cyprinidae group 2 sp.											1		1
Catfishes	Ictaluridae spp.				1					4	1			6
Blue catfish	*Ictalurus furcatus*				1				1	1	25	3		31
Bullhead catfish	*Amerius* spp.										3			3
Black bullhead	*Amerius melas*			1										1
Yellow bullhead	*Amerius natalis*										1			1
Channel catfish	*Ictalurus punctatus*				1		1					2		4
Flathead catfish	*Pylodictis olivaris*			1	1							2		4
Western mosquitofish	*Gambusia affinis*		8	4	1					1				14
White bass	*Morone chrysops*									6				6
Sunfishes	Centrarchidae spp.										2			2
Sunfish	*Lepomis* spp.		7							1	6		2	16
Orangespotted sunfish	*Lepomis humilis*		5											5
Bluegill	*Lepomis macrochirus*		4	5	1	1	1				1	3		16
Crappies	*Pomoxis* sp.									1				1
White crappie	*Pomoxis annularis*				1					1				2
Walleye/sauger	*Sander* sp.								1					1
Freshwater drum	*Aplodinotus grunniens*		1							16	8			25
Eggs	Eggs - unknown spp.								15					15
Total Number by Month		**1**	**38**	**14**	**20**	**36**	**10**	**0**	**59**	**89**	**256**	**11**	**3**	**537**
Percent of Total by Month		**0.19**	**7.08**	**2.61**	**3.72**	**6.70**	**1.86**	**0.00**	**10.99**	**16.57**	**47.67**	**2.05**	**0.56**	**100.000**
Number of Sampling Events		**4**	**4**	**5**	**4**	**4**	**5**	**4**	**13**	**13**	**13**	**5**	**4**	**78**

Table 4-4. Biomass (grams) of Impinged Fish by Month at Callaway Energy Center, October 2015 – September 2016

Common Name	Scientific Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Total
Gars	Lepisosteidae sp.								0.1					0.1
Shortnose gar	*Lepisosteus platostomus*								0.4					0.4
Gizzard shad	*Dorosoma cepedianum*			3.2	31.3	42.9	4.6			2.4	12.6			97.05
Goldeye	*Hiodon alosoides*				248.5									248.5
Mooneye	*Hiodon tergisus*													<0.1
Minnows	Cyprinidae spp.				0.1						0.1			0.2
Silver/bighead carp	*Hypophthalmichthys* spp.								0.2	1.4				1.6
Grass carp	*Ctenopharyngodon idella*									0.1				0.1
Common carp	*Cyprinus carpio*								1.7	3.2				4.9
Shoal chub	*Macrhybopsis hyostoma*								1					1
Silver chub	*Macrhybopsis storeriana*	0.1	1.8	0.2			0.1				0.1			2.3
Bluntnose minnow	*Pimephales notatus*												0.2	0.2
Minnows group 2	Cyprinidae group 2 sp.											0.1		0.1
Catfishes	Ictaluridae spp.				0.3					0.1	0.1			0.5
Blue catfish	*Ictalurus furcatus*				52.2					5	8.38	0.5		66.08
Bullhead catfish	*Amerius* spp.										0.3			0.3
Black bullhead	*Amerius melas*			9.8										9.8
Yellow bullhead	*Amerius natalis*										0.1			0.1
Channel catfish	*Ictalurus punctatus*				1.6		2					0.2		3.8
Flathead catfish	*Pylodictis olivaris*			265	277.5							1.9		544.4
Western mosquitofish	*Gambusia affinis*		1.4	0.4	0.1					0.1				2.0
White bass	*Morone chrysops*									0.4				0.4
Sunfishes	Centrarchidae spp.										0.2			0.2
Sunfish	*Lepomis* spp.		7.1							0.1	0.7		1.3	9.2
Orangespotted	*Lepomis humilis*		10.9											10.9
Bluegill	*Lepomis macrochirus*		0.4	0.7	0.2	0.2	4.5				0.1	0.5		6.6
Crappies	*Pomoxis* sp.									0.1				0.1
White crappie	*Pomoxis annularis*				3.3					0.1				3.4
Walleye/ sauger	*Sander* sp.								0.1					0.1
Freshwater drum	*Aplodinotus grunniens*		10.8							1.5	1.8			14.1
Total by Number		**0.10**	**32.4**	**279.2**	**615.1**	**43.1**	**11.2**	**0.00**	**3.50**	**14.5**	**24.5**	**3.20**	**1.50**	**1,028.43**
Total by Percent		**0.01**	**3.15**	**27.15**	**59.82**	**4.19**	**1.09**	**0.00**	**0.34**	**1.41**	**2.39**	**0.31**	**0.15**	**100.00**
Sampling Events		**4**	**4**	**5**	**4**	**4**	**5**	**4**	**13**	**13**	**13**	**5**	**4**	**78**

Table 4-5. Shellfish Collected in Impingement Samples at Callaway Energy Center, October 2015 – September 2016

Other Biota	Scientific Name	Total Number Collected	Percent of Total
Mississippi grass shrimp	*Palaemonetes kadiakensis*	15	35.7
Crayfish	*Orconectes* spp.	10	23.8
Zebra mussel	*Dreissena polymorpha*	8	19.0
Freshwater mussel	*Lampsilis* spp.	5	11.9
Freshwater mussel	Unionidae	3	7.1
Golden crayfish	*Orconectes luteus*	1	2.4
Total		**42**	**100**

4.2 Species Most Susceptible to Entrainment

Historical and recent entrainment data have been collected at CEC to determine the fish species and life stages most susceptible to entrainment (UEC 1986; AmecFW 2017; ASA 2017). Additionally, independent studies of the ichthyoplankton community from the lower Missouri River provide information on the current composition of larval fishes present in the Missouri River (Schrank et al. 2001; Reeves 2006; Reeves and Galat 2010). Data from these historical and recent studies will be used to characterize the species most susceptible to entrainment at CEC's MWIS.

Historical Sampling. The first post-operational entrainment study at CEC was conducted in 1984 by sampling ichthyoplankton in front of the MWIS from April through September (UEC 1986). This entrainment study provides some information regarding the taxonomic composition, density, and spatial and temporal distribution of fish eggs and larvae most likely to be entrained at CEC's MWIS. Ichthyoplankton was collected by towing paired 0.5-meter-diameter conical plankton nets with 570-micrometer (µm) mesh between RMs 115.4 and 116 within three parallel zones spanning the river in front of CEC's MWIS (UEC 1986). Sampling was conducted weekly from April 1 through September 23, 1984. Three consecutive tows were made in each of the three zones on each sampling day for a total of 468 samples during the 26-week sampling period.

A total of 3,736 specimens were collected representing at least 13 distinct species and 10 families (Table 4-6). Freshwater drum larvae dominated the collections, comprising 54.1 percent of the total catch (Table 4-6). The next most abundant species were gizzard shad (15.4 percent), common carp (8.9 percent), and other cyprinid larvae not identified to species (6.7 percent). No pallid sturgeon or shovelnose sturgeon eggs or larvae were found in the collections.

Table 4-6. Ichthyoplankton Collected in Front of the Callaway Energy Center Intake, May 1 – September 10, 1984

Common Name	Scientific Name	Total Number Collected	Percent of Total
Freshwater drum	*Aplodinotus grunniens*	2,022	54.12
Gizzard shad	*Dorosoma cepedianum*	577	15.44
Common carp	*Cyprinus carpio*	328	8.78
Minnow family	Cyprinidae spp.	250	6.69
Egg - Freshwater drum	*Aplodinotus grunniens*	140	3.75
Sucker family	Catostomidae spp.	118	3.16
Goldeye	*Hiodon alosoides*	105	2.81
Eggs - fish unknown	Fish eggs - unknown spp.	55	1.47
Sunfish	*Lepomis* spp.	28	0.75
Crappie	*Pomoxis* spp.	28	0.75
Unidentified larvae	Unidentified fish larvae	28	0.75
Sunfishes	Centrarchidae spp.	27	0.72
Temperate bass	*Morone* spp.	5	0.13
Bluegill	*Lepomis macrochirus*	5	0.13
White crappie	*Pomoxis annularis*	5	0.13
Buffalo species	*Ictiobus* spp.	4	0.11
Perch family	Percidae spp.	3	0.08
Sauger	*Sander canadense*	2	0.05
Unidentified juvenile	Unidentified fish juvenile	1	0.03
Paddlefish	*Polyodon spathula*	1	0.03
Shortnose gar	*Lepisosteus platostomus*	1	0.03
Goldeye or mooneye	*Hiodon* sp.	1	0.03
Shoal chub	*Macrhybopsis hyostoma*	1	0.03
Spotted bass	*Micropterus punctulatus*	1	0.03
Total		**3,736**	**100.00**

Amec Foster Wheeler Sampling. The most recent entrainment study (AmecFW 2017; ASA 2017) conducted at CEC assessed the abundance, seasonality, species composition, and size structure of all stages of fishes including fish eggs, larvae, and post-larvae entrained through the MWIS. The potential impacts of entrainment on the endangered pallid sturgeon were also assessed. The one-year study was conducted from March 2016 to September 2016 with one 24-hour entrainment sample collected during each sampling event. The sampling frequency was one day per week in March, April, August, and September and three days per week (non-consecutive days) in May, June, and July, with the selection of that day being fixed and coinciding with the same days as impingement sampling. Entrainment samples were collected according to the following time intervals: 0000-0600, 0600-1200, 1200-1800, 1800-2400, such that one sample was obtained every six hours. Entrainment samples were collected at the beginning of each time interval to ensure that samples were evenly separated over the 24-hour sampling period, and that two day and two night samples were taken. Sample volume was determined with an in-line flow meter and was not less than 100 cubic meters (m^3) (i.e. 26,417 gallons).

Entrainment samples were obtained from a 20-foot jon boat positioned in front of the bar racks of the MWIS. The sampling setup consisted of a 4-inch flexible hose attached to a trash pump in front of the bar rack and placed at an appropriate depth within the hydraulic zone of influence of the cooling water pumps. Only one of the three intake bays was sampled for each sampling event. Typically, only two of the three intake bays were withdrawing water at any time. The intake bay to be sampled for each sampling event was chosen randomly from these two bays. However, when the spray wash system was running, the downstream intake pump bay was not safe to sample due to water being dumped where the jon boat would need to be positioned for sampling this bay. Under these circumstances, the other intake bay withdrawing water was selected. Each of the three intake bays were sampled at a fixed depth of 6-7 ft above the river bottom that coincides directly with the depth of water withdrawal, allowing for the 5-ft height of the sand logs and the 10-ft height of the intake bay's main gate. Specifications for sampling gear and additional information regarding methods are available in study reports (AmecFW 2017; ASA 2017).

A total of 10,692 fish eggs and larvae representing at least 23 distinct taxa were found in 2016 entrainment samples collected at CEC (Table 4-7). Fish eggs, including those of freshwater drum, silver/bighead carp (*Hypophthalmichthys* spp.), and grass carp (*Ctenopharyngodon idella*) composed 7.19 percent or 769 specimens of the total ichthyoplankton collected. Gizzard shad represented 0.02 percent of the total ichthyoplankton collected. Only a single goldeye/mooneye (*Hiodon* sp.) specimen was collected. Invasive Asian carp species numerically dominated the samples, with silver and bighead carp together comprising 64.90 percent of the total specimens collected. Non-native grass carp was the second most abundant taxon, representing 11.82 percent of the total eggs and larvae collected. Freshwater drum was the third most abundant taxon, representing 6.86 percent of the total ichthyoplankton observed. Common carp (*Cyprinus carpio*) were far less abundant than silver and bighead carp, but still accounted for 3.45 percent of the total specimens. Specimens identified as belonging to the minnow family, Cyprinidae, but unassigned to a specific group, were the sixth most abundant taxa, representing 1.71 percent of the total eggs and larvae collected. Native minnow species that could be taxonomically assigned to a specific cyprinid group (Table 4-8) based on diagnostic characters (see Fuiman et al. 1983) represented five of the six cyprinid groups and accounted for 1.35 percent of the total larvae observed. Native minnow species that could be identified to species included central stoneroller (*Campostoma anomalum*), silver chub (*Macrhybopsis storeriana*), and emerald shiner. Four genera belonging to the sucker family Catostomidae were represented in entrainment samples: buffalofish (*Ictiobus* spp.), carpsuckers (*Carpiodes* spp.), white suckers (*Catostomus* spp.), and blue suckers (*Cycleptus elongatus*). No catfish species were observed in entrainment samples. The temperate bass family, Moronidae, was represented by only a single specimen. The sunfish family, Centrarchidae, was represented by one genus (*Lepomis* spp.). The perch family, Percidae, was composed of logperch darters (*Percina caprodes*) and darters belonging to the genus *Etheostoma*.

No fish species identified as endangered, threatened, or special concern species were found in 2016 entrainment samples from CEC. The taxonomic list summarizing 2016 entrainment samples is characterized by species that are broadcast spawners with buoyant or semi-buoyant eggs and have larvae that free-drift in the main river channel. Other members of the fish community found in the Missouri River were likely not represented in entrainment samples because they spawn in backwater areas or side channels outside the main channel, have adhesive eggs, have non-drifting larvae, or provide parental care.

The total annual estimated entrainment in 2016 was 8,631,686 eggs and larvae under the assumption of a MWIS flow rate of 9,000 gpm per operating pump and 11,508,915 assuming 12,000 gpm per operating pump (ASA 2017). Bighead carp and silver carp (*Hypophthalmichthys* spp.) dominated entrainment by comprising approximately 57 percent of the total estimated annual entrainment. Together with grass carp and common carp, these four non-native species made up approximately 81 percent of the total estimated annual entrainment. Without these four non-native species, the total annual entrainment estimates would be 1,650,571 under a MWIS flow rate of 9,000 gpm per operating pump and 2,200,763 under 12,000 gpm per operating pump. These estimates assume that all organisms captured in front of the intake would ultimately be entrained, and thus are conservative estimates.

Table 4-7. Ichthyoplankton Collected During Entrainment Sampling at Callaway, March – September, 2016

Common Name	Scientific Name	Total Number Collected	Percent of Total
Silver/bighead carp	*Hypophthalmichthys* spp.	6,680	62.48
Grass carp	*Ctenopharyngodon idella*	1,262	11.80
Freshwater drum	*Aplodinotus grunniens*	520	4.86
Eggs - fish unknown	Fish eggs - unknown spp.	390	3.65
Unidentified larvae	Unidentified fish larvae	374	3.50
Common carp	*Cyprinus carpio*	369	3.45
Eggs - Freshwater drum	*Aplodinotus grunniens*	214	2.00
Minnows	Cyprinidae spp.	183	1.71
Eggs - Silver/bighead carp	*Hypophthalmichthys* spp.	163	1.52
Carpsucker/buffalofish	Ictiobinae spp.	128	1.20
Carpsuckers	*Carpiodes* spp.	115	1.08
Minnows group 2	Cyprinidae group 2 spp.	106	0.99
Bighead carp	*Hypophthalmichthys nobilis*	82	0.77
Minnows group 3	Cyprinidae group 3 spp.	29	0.27
Silver carp	*Hypophthalmichthys molitrix*	14	0.13
Sunfish	*Lepomis* spp.	13	0.12
Buffalofish	*Ictiobus* spp.	8	0.07
Suckers	Catostomidae spp.	6	0.06
Central stoneroller	*Campostoma anomalum*	5	0.05
Darter	*Etheostoma* spp.	4	0.04
White sucker	*Catostomus commersonii*	4	0.04
Blue sucker	*Cycleptus elongatus*	3	0.03
Minnows group 1	Cyprinidae group 1 spp.	3	0.03
Minnows group 4	Cyprinidae group 4 spp.	3	0.03
Minnows group 6	Cyprinidae group 6 spp.	3	0.03
Eggs - Grass carp	*Ctenopharyngodon idella*	2	0.02
Gizzard shad	*Dorosoma cepedianum*	2	0.02
Logperch	*Percina caprodes*	2	0.02
Bluegill	*Lepomis macrochirus*	1	0.01
Emerald shiner	*Notropis atherinoides*	1	0.01
Goldeye/mooneye	*Hiodon* sp.	1	0.01

Common Name	Scientific Name	Total Number Collected	Percent of Total
Silver chub	*Macrhybopsis storeriana*	1	0.01
Temperate bass	*Morone* sp.	1	0.01
	Total	**10,692**	**100.00%**

Table 4-8 Species Group Assignments for Minnow Species Found in the Lower Missouri River

Species Group[1]	Common Name	Scientific Name
Group 1	Goldfish	*Carassius auratus*
	Grass carp	*Ctenopharyngodon idella*
	Common carp	*Cyprinus carpio*
Group 2	Shoal chub	*Machrybopsis hyostoma*
	Silver chub	*Machrybopsis storeriana*
	Sand shiner	*Notropis stramineus*
	Suckermouth minnow	*Phenacobius mirabilis*
	Bluntnose minnow	*Pimephales notatus*
	Bullhead minnow	*Pimephales vigilax*
Group 3	Central stoneroller	*Campostoma anomalum*
	Mississippi silvery minnow	*Hybognathus nuchalis*
	Striped shiner	*Luxilis chrysocephalus*
	Common shiner	*Luxilus cornutus*
	Creek chub	*Semotilus atromaculatus*
Group 4	Golden shiner	*Notemigonus chrysoleucas*
	Emerald shiner	*Notropis atherinoides*
	Rosyface shiner	*Notropis rubellus*
	Silverband shiner	*Notropis shumardi*
	Mimic shiner	*Notropis volucellus*
	Fathead minnow	*Pimephales promelas*
Group 5	Bigmouth shiner	*Notropis dorsalis*
	Spottail shiner	*Notropis hudsonius*
Group 6	River shiner	*Notropis blennius*
	Red shiner	*Cyprinella lutrensis*
	Spotfin shiner	*Cyprinella spiloptera*

[1] Species groups based on character states presented by Fuiman et al. 1983

Fish larvae were first collected in entrainment samples at CEC on 13 April 2016 as water temperatures began steadily rising above 13.5° C or 56.3° F. Ichthyoplankton density was greatest in mid-May through late June, with another peak in larval densities in late August and early September (Figure 4-1). Densities varied considerably during May and June, ranging from 0 to 565 individuals/100 m^3. Mean density peaked on June 29 with 565 individuals/100 m^3 and dropped on the following sampling event to 19 individuals/100 m^3, remaining relatively consistent thereafter until mean densities peaked again on August 29 and September 6 with 196 and 266 individuals/100 m^3, respectively. Larvae continued to be observed through the last sampling event on September 26,

although mean ichthyoplankton densities decreased after the first week in September to less than 4 individuals/100 m^3.

No juvenile or adult fish were found in entrainment collections. Larvae were more prevalent than eggs in entrainment collections, with the majority of larvae measured being yolk-sac larvae or individuals in which the yolk-sac had recently been exhausted. Fish eggs represented 7.19 percent or 769 specimens of the total ichthyoplankton collected. Post yolk-sac larvae accounted for 10.94 percent of the total ichthyoplankton and were found in lower abundance than yolk-sac larvae for most sampling events. Densities of yolk-sac larvae peaked on June 29, corresponding to when total ichthyoplankton densities reached their peak. After June 29, mean densities of yolk-sac larvae declined dramatically and remained relatively low until August 29, when they increased substantially from 12 individuals/100 m^3 on the preceding event to 148 individuals/100 m^3. The densities of yolk-sac larvae continued to rise during the following sampling event on September 6 with 238 individuals/100 m^3 collected.

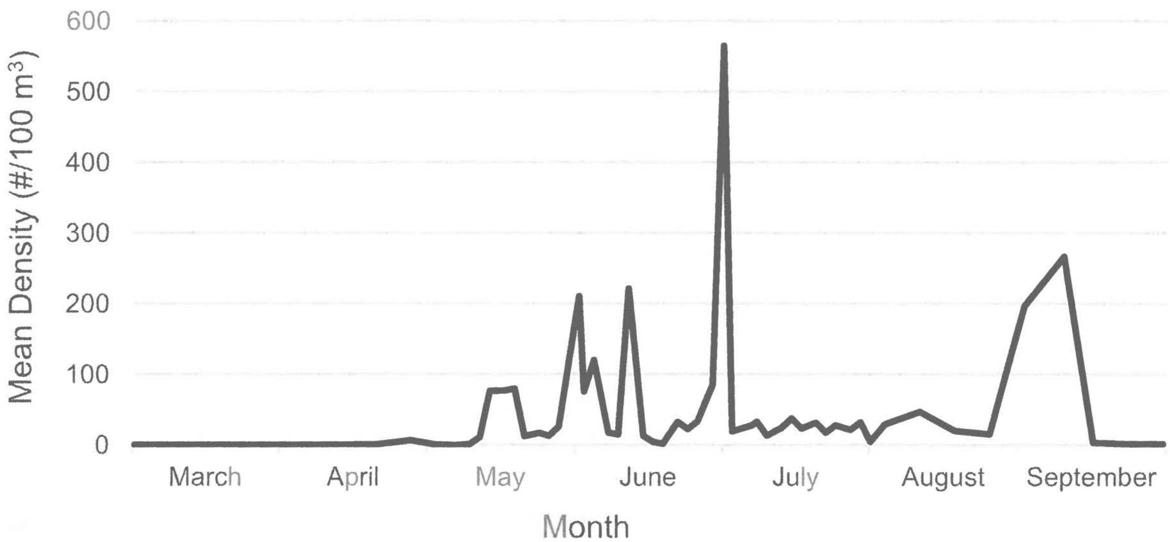


Figure 4-1. Mean Ichthyoplankton Density by Sampling Event During Entrainment Sampling at Callaway Energy Center, March – September 2016

Six taxa comprised 91 percent of the total ichthyoplankton entrained: silver/bighead carp, grass carp, freshwater drum, common carp, unassigned minnow species, and carpsucker/buffalofish. More detailed accounts for each of these taxa is provided below.

Invasive silver and bighead carp larvae and eggs were initially encountered on May 11, as water temperatures reached 19° C or 67° F. Egg densities of silver and bighead carp were highest on May 11 and May 25. Mean densities of silver and bighead carp larvae peaked several times in late May and mid-June, but these species did not reach their greatest densities until June 29, with 472 individuals/100 m^3. Densities dropped on the following event to 7 individuals/100 m^3. Silver and bighead carp larvae were observed in entrainment samples until mid-September, with several substantial peaks in densities (61 to 141 individuals/100 m^3) occurring in late-August and early September. Silver and bighead carp larvae varied in lengths from 5 mm to 12 mm TL. Approximately 96

percent of all silver and bighead carp specimens measured were less than 9 mm TL. The majority of Asian carp larvae at these lengths are considered prolarval (yolk-sac stage), although silver carp larvae can be approximately 8.5 – 9 mm TL when yolk-sac is exhausted (Chapman 2006). No juvenile individuals measuring greater than 30 mm TL were collected.

Non-native grass carp were first observed on May 13, but they did not reach high densities until late June and mid-July. Several spikes in grass carp density occurred sporadically during this period, although densities remained relatively low (< 14 individuals/100 m^3). Mean densities reached their peak on August 29 and September 6 with 119 individuals/100 m^3, while water temperatures remained steady at approximately 25° C or 77° F during this period. Nearly all grass carp measured were 5.0 – 8.9 mm TL and were classified as yolk-sac larvae or recent post yolk-sac larvae. No juvenile individuals measuring greater than 35 mm TL were collected.

Freshwater drum eggs were initially observed on May 23, with larvae first observed in early June. Peak mean densities of freshwater drum eggs and larvae were observed on August 1 with 23 individuals/100 m^3. Drum eggs and larvae were observed until mid-September, although mean densities were less than 1 individual/100 m^3 in September. Yolk-sac larvae were represented in collections by individuals measuring 2.0 – 6.9 mm TL. Post yolk-sac larvae were most prevalent in collections, representing sizes between 4.0 and 6.9 mm TL. No juveniles measuring greater than 21 mm TL were collected.

Non-native common carp larvae were first observed from early-May entrainment samples. Spikes in mean larval densities occurred on June 10 with 15 individuals/100 m^3 and again on June 29 with 65 individuals/100 m^3. Common carp larvae continued to be observed sporadically in collections from late June through early September, although mean densities remained low (< 2 individuals/100 m^3). Common carp were found in lengths ranging from 5.0 – 8.9 mm TL, with the majority of measured individuals classified as yolk-sac larvae.

Unassigned minnow species were the sixth most abundant taxa, representing 1.71 percent of the total eggs and larvae entrained. Minnow species were most abundant during mid-June, early August, and late August, with mean densities peaking on August 8 with 12 individuals/100 m^3 and again on August 29 with 9 individuals/100 m^3. They were observed in samples up until September 12. Larvae identified as unassigned minnow species measured from 3.0 – 7.9 mm TL. Most unassigned minnow species were designated as larvae life stage rather than assigning yolk-sac or post yolk-sac stages, due to damage.

Carpsucker and buffalofish were among the most numerous specimens in early (i.e., late April) samples. They had an early spike in mean density on April 27 with 4 individuals/100 m^3, while larvae continued to be observed in entrainment samples until August 22. Separate smaller spikes in abundance occurred from mid-May through late June. Carpsucker and buffalofish reached their highest mean densities on June 22 (7 individuals/100 m^3), but several additional density spikes occurred from late June through early August. Multiple spikes in densities throughout the sampling period may be indicative of distinct spawning by individual species belonging to the genera *Ictiobus* and *Carpiodes*. Six separate species belonging to these genera are known to occur in the Missouri River (Galat et al. 2005). Current descriptive morphological information is insufficient to taxonomically distinguish among carpsucker species at either the yolk-sac or post yolk-sac larvae stage (Kay et al. 1994). Similarly,

current information is insufficient to identify buffalo larvae to species at yolk-sac and post yolk-sac stages (Kay et al. 1994). Nearly all (97 percent) of carpsucker and buffalofish measured were less than 10 mm TL and considered yolk-sac larvae or recent post yolk-sac larvae. No juvenile individuals were collected.

Other Ichthyoplankton Studies. Data available from other ichthyoplankton studies of the lower Missouri River also provide an assessment of the ichthyoplankton community present and information on early life stages of fish that could be entrained at the CEC MWIS.

Brown and Coon (1994) surveyed the lower Missouri River and lower reaches of four tributaries (Lamine River, Perche Creek, Moreau River, AuxVasse Creek) from mid-March through July in 1987 and 1988. The densities of most taxa were greater from the tributaries than at the corresponding Missouri River sampling locations. Gizzard shad and cyprinds (mostly emerald shiner and red shiner) had the highest densities in both study years, with sunfishes also being relatively abundant (Brown and Coon 1994). Carpsuckers and goldeye had consistently higher densities in the Missouri River than its tributaries. Similarly, freshwater drum and common carp were more abundant in the Missouri River than in some tributaries, reflecting their life history characteristics of pelagic eggs and hatched larvae that drift with main channel currents.

Another study focused on the specific habitat requirements of larval fishes within the lower Missouri River including main channel and shallow water habitats (e.g., sandbar and primary channel border habitats) (Reeves 2006). In this study, the CPUE of carpsuckers and buffalofish and native chub species (*Macrhybopsis* spp.) was significantly higher within sandbar aquatic terrestrial transition zone habitats than within the main channel. Local-environmental factors (current velocity, water depth, substrate type, and temperature) most strongly influenced the abundance of larval fish within the sandbar habitat (Reeves 2006). At the microhabitat scale, the larval fish assemblage and carpsucker/buffalofish selected shallow, warmer, low-current habitats for nursery areas that were ≤10 centimeters (cm) deep with current velocities ≤5 cm/sec (Reeves 2006). Silver/bighead carp, however, exhibited no selection based on water depth or current velocity and did not show any significant difference in CPUE among macrohabitats. Species with the highest densities in main channel macrohabitat compared with channel border habitats included silver/bighead carp, grass carp, and freshwater drum (Reeves 2006). These species along with emerald shiner, carpsucker/buffalo, native cyprinid minnows, gizzard shad, and goldeye were the dominant taxa found in the main channel drift of the lower Missouri River (Reeves 2006) that would likely be impacted by CEC's MWIS.

While these studies generally show a similar species composition in the main channel of the lower Missouri River, one significant difference is the presence and abundance of invasive Asian carp in more recent studies. Based on the results of Reeves (2006), the eggs and larvae of invasive Asian carp species are likely to dominate entrainment at CEC given their high abundance in the main channel drift of the lower Missouri River. Other studies have also suggested extremely high Asian carp larval densities in the water column, approximately 10 to 40 m from the shoreline, on inside river bends of the lower Missouri River (Schrank et al. 2001). Additionally, the eggs of Asian carp species have been found in nearly all reaches of the lower Missouri River upriver from CEC that were sampled from May through July in 2005 and 2006, though substantial spawning by Asian carp in tributaries of the Missouri River was not observed (Deters et al. 2013). Recently, Reeves and Galat (2010) found that Asian carp larvae comprised 60 percent of the total drift during daylight and 85 percent of the drift at night in

samples collected at RM 176 on the lower Missouri River during May through August 2002. Abiotic cues (e.g., temperature and flood pulses) are likely to strongly influence the abundance of Asian carp species by initiating and driving larval recruitment as observed in other river systems (DeGrandchamp et al. 2007; Csoboth and Garvey 2008).

4.3 Commercial and Recreational Fisheries

The lower Missouri River is known to provide good recreational fishing opportunities, particularly for trophy catfish (blue, channel, and flathead). Other recreational fishes sought in the lower Missouri River include freshwater drum, white bass, hybrid striped bass × white bass, shovelnose sturgeon, and other game and panfish.

Commercial fishing has been conducted within the lower Missouri River for decades, though restrictions have been implemented in recent decades. Commercial harvest of paddlefish was closed in 1990 on the Missouri River, harvest of catfish (blue, channel and flathead) was closed on the Missouri River in 1992, and harvest of shovelnose sturgeon was closed in 2010 on the open river portion of the Mississippi River and in the Missouri River (MCSR 2018). As a result of these restrictions, the number of commercial fishers in the Missouri River has declined dramatically since 1990 (Figure 4-2). The total number of fish harvested has also generally decreased in the Missouri, Mississippi, and St. Francis Rivers since 2000, although a spike in fish harvested occurred in the Mississippi River in 2017 (Figure 4-3). Buffalofish dominated the number of pounds harvested in 2017 with 63,227 lbs, comprising 74.8 percent of the total harvest (Table 4-9). Common carp was the second most harvested fish in 2017 with 11.7 percent of the total pounds harvested. Asian carps (silver/bighead carp and grass carp) were a close third, comprising 10.7 percent of the total harvest. Other commercial fishes included carpsuckers, gizzard shad, freshwater drum, gars, and suckers (Table 4-9).

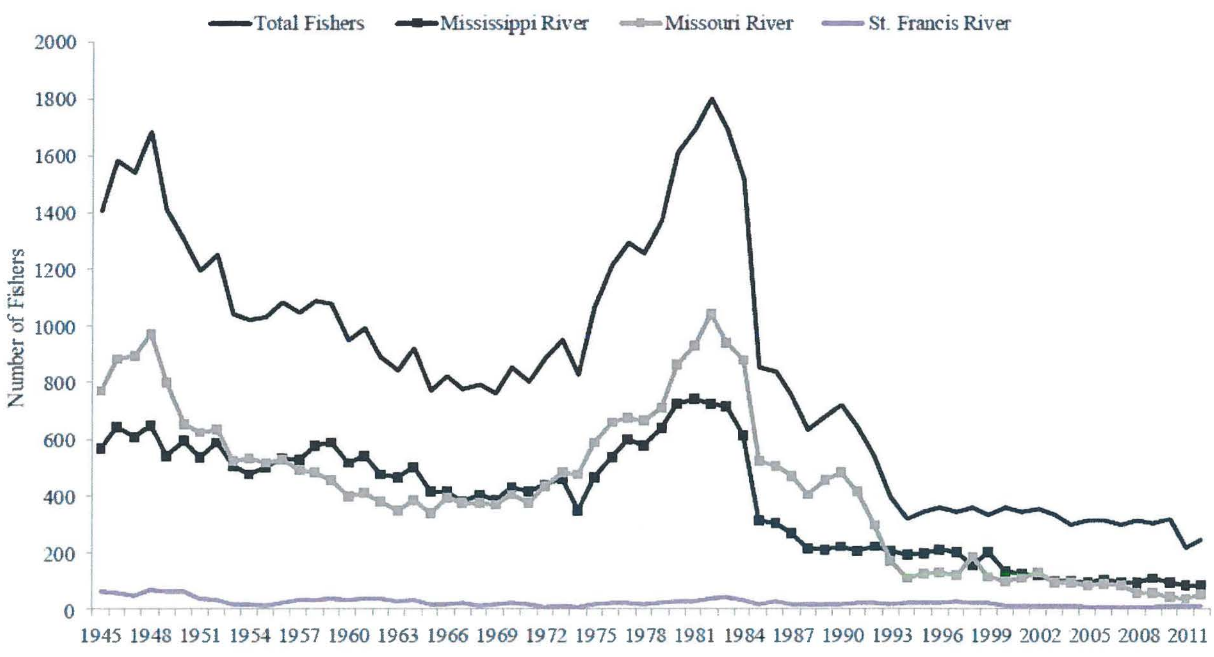
The majority of fish commercially harvested (88 percent) in Missouri in 2017 were from the Mississippi River, with the Missouri and St. Francis Rivers accounting for 10 percent and 2 percent of the total harvest, respectively (McMullen 2018). Within the Missouri River, the harvest was highest (44,031 lbs) from RM 101-150 near Jefferson City and including the stretch of river where CEC's MWIS is located. Commercial harvest within the lower Missouri River was highest from hoop nets and trammel nets in 2017 (Table 4-9).

Table 4-8. Pounds of Fish Commercially Harvested from the Missouri River by Gear Type and for All Gears Combined, During 2017

Species/Species Group	Trammel Net	Gill Net	Hoop Net	Multiple Gears	Total Harvested	Percent of Total
Buffalofish	25,245	827	33,950	3,205	**63,227**	**74.78**
Common carp	4,482	75	4,788	566	**9,911**	**11.72**
Grass carp	1,992	75	1,680	909	**4,656**	**5.51**
Bighead/Silver carp	1,120	75	1,818	1,349	**4,362**	**5.16**
Carpsuckers	173	50	538	442	**1,203**	**1.42**
Gizzard shad	0	634	0	0	**634**	**0.75**
Freshwater Drum	85	30	174	113	**402**	**0.48**
Gars	98	0	0	40	**138**	**0.16**
Suckers	0	0	20	0	**20**	**0.02**
Total	**33,195**	**1,766**	**42,968**	**6,624**	**84,553**	**100.00**

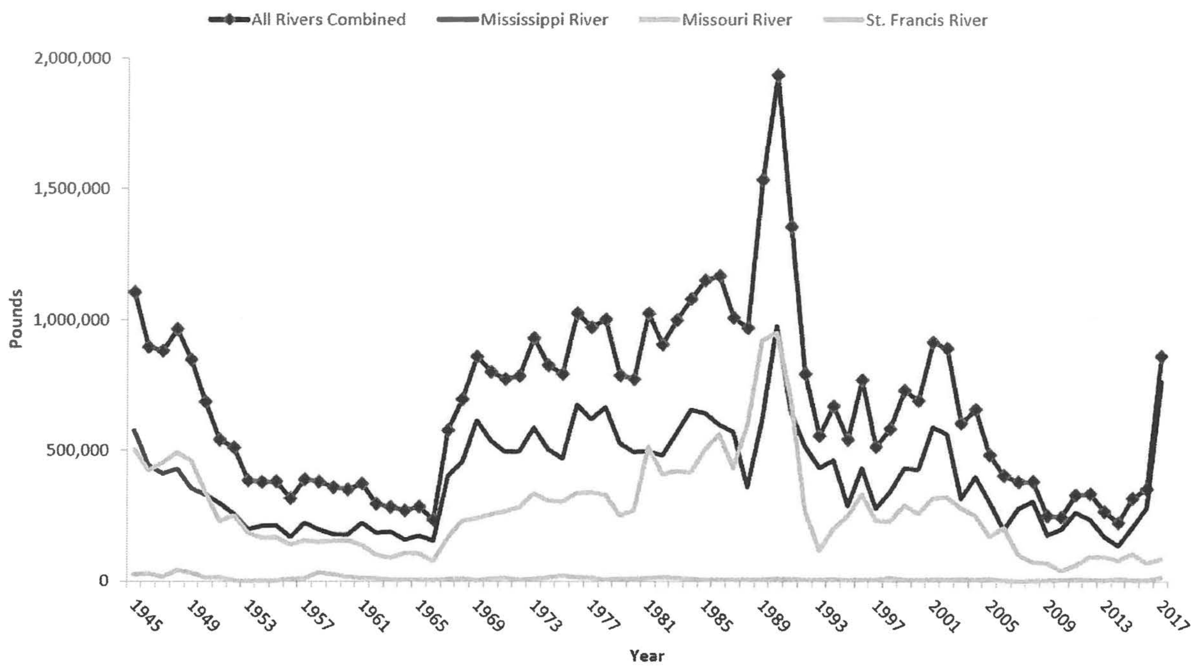
Note: "Multiple Gears" includes harvest not attributable to a single gear type.

Source: McMullen 2018



Source: Tripp et al. 2012

Figure 4-2. Total Commercial Fishers and Number of Fishers from the Missouri, Mississippi, and St. Francis Rivers from 1945 – 2012



Source: McMullen 2018

Figure 4-3. Total Annual Commercial Fish Harvest by River and from All Rivers Combined from 1945 – 2017

5.0 Temporal Variation (40 CFR 122.21(r)(4)(iv, v))

5.1 Primary Period of Reproduction, Larval Recruitment and Period of Peak Abundance (40 CFR 122.21(r)(4)(iv))

The primary period of reproduction, larval recruitment and period of peak abundance may be inferred using the monthly occurrence of fish eggs and larvae within the Missouri River based on previous and current entrainment studies conducted at CEC and from ichthyoplankton surveys of the Missouri River (Table 5-1). Additionally, data on the occurrence and abundance of adult and juvenile fish from fisheries surveys completed near CEC's MWIS (see Section 3.0) coupled with available literature on the life history characteristics of individual fish species can be used to provide information on the timing of occurrence of potential eggs and larvae. Species that are broadcast spawners with buoyant or semi-buoyant eggs and larvae that drift in the water column typically are more vulnerable to entrainment than species that spawn in backwater areas outside the main channel, display parental care (i.e., nest guarding), or have adhesive eggs. For example, prey/forage taxa (i.e., gizzard shad) might be expected to be dominant in entrainment collections due to the relative abundance of adult gizzard shad observed in BFS collections (see Section 3.1), coupled with the fact that gizzard shad are broadcast spawners with semi-buoyant eggs. In fact, previous entrainment sampling at CEC showed that gizzard shad was the dominant taxon entrained in 1984, comprising approximately one-third of the total catch (UEC 1986). However, the relatively recent proliferation of Asian carp species in the Missouri River and its life history traits (e.g., high fecundity, required larval drift) have caused a shift in the ichthyoplankton community. Asian carp eggs and larvae comprised a major component of the current community, as indicated by data from recent 2016 entrainment sampling at CEC (AmecFW 2017; ASA 2017).

While Table 5-1 does not include all species, it shows that entrainment of eggs and larvae could begin in April for early spawning species, such as walleye/sauger and carpsucker/buffalofish, and taper off by the end of August and early September. Peak entrainment rates are expected to occur during the months of May and June, based on previous entrainment studies at CEC and life history information for select species (Table 5-1; AmecFW 2017; ASA 2017). Additionally, eggs may be dominant in entrainment collections due to their greater abundance than larvae and their lack of mobility.

5.2 Seasonal Variation (40 CFR 122.21(r)(4)(v))

Most historical biological data from the lower Missouri River represents monitoring that was performed routinely during a particular time of the year. Typically, sampling is performed during the summer and fall to monitor fish reproduction and recruitment from year to year. Consequently, these data do not address seasonal variability. Post-operational biological monitoring conducted in July and October 2007 and January and March/April 2008 at CEC to support the proposed Unit 2 license application provides some information on seasonal variability in the vicinity of CEC's MWIS. Additionally, two previous impingement studies were performed at CEC for a full year (see Section 4.1; UEC 1986; AmecFW 2017; ASA 2017) that may be used to characterize seasonal variability in the abundance of fish in the source waterbody that are vulnerable to impingement.

Table 5-1. Period of Reproduction for Fish Taxa That May Occur in Entrainment Samples Derived from Fisheries Surveys and Literature Sources

Family	Common Name	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acipenseridae	River sturgeon	egg				■■	■■	■■						
		larvae				■■	■■	■■	■■					
Polyodontidae	Paddlefish	egg				■■	■■	■■						
		larvae				■■	■■	■■						
Lepisosteidae	Longnose gar/ shortnose gar	egg					■■	■■						
		larvae					■■	■■						
Clupeidae	Gizzard shad	egg				■■	■■	■■	■■					
		larvae				■■	■■	■■	■■	■■				
Hiodontidae	Goldeye	egg					■■	■■						
		larvae					■■	■■						
Cyprinidae	Asian carp spp.	egg					■■	■■	■■	■■				
		larvae					■■	■■	■■	■■				
	Common carp	egg				■■	■■	■■	■■					
		larvae				■■	■■	■■	■■	■■				
	Minnow spp.	egg				■■	■■	■■	■■	■■				
		larvae				■■	■■	■■	■■	■■				
Catostomidae	Sucker spp.	egg				■■	■■	■■	■■	■□				
		larvae				■■	■■	■■	■■	■■				
Ictaluridae	Blue catfish	egg					■■	■■						
		larvae					□■	■■	■■	■□				
	Channel catfish	egg					□■	■■						
		larvae						■■	■■					
	Flathead catfish	egg				□■	■■	■■	■■					
		larvae					■■	■■	■■	■□				
Moronidae	White bass	egg				□■	■■	■■						
		larvae				□■	■■	■■						
Centrarchidae	Crappie spp.	egg					■■	■■						
		larvae					■■	■■						
	Largemouth bass	egg					■■	■■						
		larvae					■■	■■	■■					
	Sunfish spp.	egg				■■	■■	■■	■■	■■				
		larvae				■■	■■	■■	■■	■■				
Percidae	Walleye/Sauger	egg			□■	■■								
		larvae				■■	■■							
	Logperch	egg				■■	■■							
		larvae				□■	■■							
Sciaenidae	Freshwater drum	egg				□■	■■	■■	■■	■■				
		larvae				□■	■■	■■	■■	■■				

Sources: AmecFW 2017; ASA 2017; Auer 1982; Braaten et al. 2008; Brummet and Jones 2004; Carlander 1969; Csoboth and Garvey 2008; DeLonay et al. 2012; Deters et al. 2013; Galat et al. 2004; Holland-Bartels and Duval 1988; Holland-Bartels et al. 1990; Holland-Bartles et al. 1993; Holland-Bartles et al. 1995; Hubert 1999; McMahon and Terrell 1982; Pflieger 1997; Phelps et al. 2009; Pitlo et al. 2004; Reeves 2006; Wallus et al. 1990-2008.

Historical Studies. The fish community of the lower Missouri River in the vicinity of CEC's MWIS and small stream segments of three tributaries (Logan Creek, Mud Creek, and tributaries of Auxvasse Creek) were studied during post-operational studies in July and October 2007 and January and March/April 2008 to support the proposed Unit 2 license application, which was withdrawn. During each sampling period, six locations in the Missouri River were sampled using electrofishing, gill nets, hoop nets, and seining, and seven smaller stream segments on Ameren Missouri's property were sampled by seining. The total combined catch from all gear types was highest in the summer 2007 (n = 2,975) followed by the fall 2007 (n = 1,384), winter 2008 (n = 928), and spring 2008 (n = 155) (Table 5-2). Similarly, species richness was highest in the summer and fall seasons, with 49 and 40 species collected, respectively. The lowest species richness was observed in spring 2008, with only 11 species collected. The relative abundance of species varied seasonally. Gizzard shad and red shiner were the dominant species sampled in summer, comprising 62.3 percent of the total catch, compared to the fall survey that was dominated by emerald shiner, western mosquitofish, and red shiner, which comprised 72.9 percent of the total. Similarly, samples from surveys conducted in winter were mostly comprised of gizzard shad and emerald shiners (68.2 percent of the total catch), while spring samples were mostly comprised of redfin shiners (*Lythrurus umbratilis*) and sunfishes (*Lepomis* spp.) (56.8 percent of the total catch).

Seasonal variation in the species composition near CEC is likely the result of natural variability in fish populations, seasonal changes in fish behavior (e.g., due to changes in temperature, food availability, photoperiod, etc.), as well as the result of sporadic collections of shoaling fish (e.g., western mosquitofish). Overall higher catch rates in the late summer and fall, as observed at CEC, are expected due to the collection of YOY Age-0 fishes that hatched earlier in the spring or summer and have attained an appropriate size for collection using standard fisheries gear (e.g., electrofishing and seining). The movements of some species (e.g., sunfish) near-shore in the spring to spawn, movement offshore during the summer, and return to near-shore areas during the fall will also likely influence seasonal catch rates of these species, although these movement patterns are more apparent in lake or lentic ecosystems. During 2007 – 2008 surveys completed near CEC, the collection of sunfish species combined was highest in spring (n = 54 individuals) and summer (n = 45 individuals) months compared with fall (n = 11) and winter (n = 22) (Table 5-2). Additionally, certain species such as silver carp (only 10 individuals collected during the 2007 – 2008 study) may be more abundant than actually observed because of their sensitivity to disturbance and erratic jumping behavior that make them difficult to collect with traditional sampling methods like electrofishing.

Table 5-2. Taxonomic Composition and Abundance in Fish Surveys of the Missouri River and Stream Stations near Callaway Energy Center, by Season, 2007 – 2008

Common Name	Scientific Name	Summer 2007	Fall 2007	Winter 2008	Spring 2008
Chestnut lamprey	*Ichthyomyzon castaneus*		2		
Lake sturgeon	*Acipenser fulvescens*			1	
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	13	6	36	
Paddlefish	*Polyodon spathula*	1			
Spotted gar	*Lepisosteus oculatus*	1			
Longnose gar	*Lepisosteus osseus*	3	10		
Shortnose gar	*Lepisosteus platostomus*	4	3		

Common Name	Scientific Name	Summer 2007	Fall 2007	Winter 2008	Spring 2008
Goldeye	*Hiodon alosoides*	30	7	18	
Mooneye	*Hiodon tergisus*			1	
Skipjack herring	*Alosa chrysochloris*		2		
Gizzard shad	*Dorosoma cepedianum*	1,104	30	496	
Stoneroller	*Campostoma* spp.	94	4		4
Largescale stoneroller	*Campostoma oligolepis*	3			
Central stoneroller	*Campostoma pullum*	2			1
Grass carp	*Ctenopharyngodon idella*		2		
Red shiner	*Cyprinella lutrensis*	749	237	20	4
Common carp	*Cyprinus carpio*	17	13		
Plains minnow	*Hybognathus placitus*	3	1	6	
Silver carp	*Hypopthalmichthys molitrix*	2		8	
Striped shiner	*Luxilus chrysocephalus*	6			
Redfin shiner	*Lythrurus umbratilis*	195	22		44
Shoal chub	*Macrhybopsis hyostoma*			89	
Sturgeon chub	*Macrhybopsis gelida*			1	
Silver chub	*Macrhybopsis storeriana*	5	1		
Emerald shiner	*Notropis atherinoides*	187	504	137	
River shiner	*Notropis blennius*	1	3		
Sand shiner	*Notropis stramineus*	171	3		
Ozark minnow	*Notropis nubilus*	19	1		
Channel shiner	*Notropis wickliffi*	28	2	1	
Bluntnose minnow	*Pimephales notatus*	21	3		19
Bullhead minnow	*Pimephales vigilax*	22	16	13	
Creek chub	*Semotilus atromaculatus*	70			
Carpsucker or Buffalo	*Carpiodes/Ictiobus*	4	8		
Carpsuckers	*Carpiodes* spp.			3	
River carpsucker	*Carpiodes carpio*	15	13	11	
White sucker	*Catostomus commersonii*	9	1		
Blue sucker	*Cycleptus elongatus*	1	4	1	
Smallmouth buffalo	*Ictiobus bubalus*	3	10	2	
River redhorse	*Moxostoma carinatum*			2	
Golden redhorse	*Moxostoma erythrurum*			2	
Shorthead redhorse	*Moxostoma macrolepidotum*	1	1	1	
Yellow bullhead	*Ameiurus natalis*	1			1
Blue catfish	*Ictaluras furcatus*	2	15	7	
Channel catfish	*Ictaluras punctatus*	6	92	12	
Flathead catfish	*Pylodictis olivaris*	1	14		
Blackstripe topminnow	*Fundulus notatus*	13	5		1
Western mosquitofish	*Gambusia affinis*	34	268	4	2
Brook silverside	*Labidesthes sicculus*	3	13		8
Temperate basses	*Morone* spp.	14	9	5	
White bass	*Morone chrysops*	1			
Sunfishes	*Lepomis* spp.	5	5	18	44

Common Name	Scientific Name	Summer 2007	Fall 2007	Winter 2008	Spring 2008
Green sunfish	*Lepomis cyanellus*	13	3		10
Orangespotted sunfish	*Lepomis humilus*	2			
Bluegill	*Lepomis macrochirus*	13	2	3	
Longear sunfish	*Lepomis megalotis*	4			
Spotted bass	*Micropterus punctulatus*	1			
Largemouth bass	*Micropterus salmoides*	6	1	1	
Black crappie	*Pomoxis nigromaculatus*	1			
Fantail darter	*Etheostoma flabellare*		1		
Johnny darter	*Etheostoma nigrum*	3	10		
Orangethroat darter	*Etheostoma spectabile*	62	5		
Missouri saddled darter	*Etheostoma tetrazonum*			1	7
Slenderhead darter	*Percina phoxocephala*	2			
Sauger	*Sander canadensis*	1			10
Freshwater drum	*Aplodinotus grunniens*	3	32	28	
Totals		**2,975**	**1,384**	**928**	**155**
Species richness		**49**	**40**	**27**	**11**

Impingement Studies. In the most recent impingement study (October 2015 – September 2016), the highest impingement rates in terms of numerical abundance occurred in July, with elevated impingement rates occurring from May – June in 2016 (Figure 5-1; Table 4-3). These three months also had the highest intensity of sampling (3 impingement events per week); thus, it would be expected that these months yield the highest impingement rates. Conversely, in terms of biomass, December 2015 and January 2016 had the highest impingement by weight (Figure 5-1; Table 4-4). The peaks in biomass that occurred in December 2015 and January 2016 were the result of one larger impinged flathead catfish in each of these months.

No single species dominated impingement collections from month to month. For the three highest impingement months, May – July 2016, common carp had the highest impingement in May and June, while gizzard shad had the highest impingement in July. Other species including blue catfish, freshwater drum, sunfish species (*Lepomis* spp. combined), silver chub, and silver/bighead carp had relatively low impingement overall, but they had higher impingement rates during certain months. For example, months with elevated impingement numbers, compared to other months, for specific taxa included July 2016 when 25 blue catfish were impinged, June 2016 when 16 freshwater drum were impinged, November 2015 when 16 sunfish species and 12 silver chub species were impinged, and June 2016 when 14 silver/bighead carp were impinged (Table 4-3).

The impingement of shellfish was relatively low throughout the entire sampling period with only 42 individuals collected. Higher impingement months for shellfish occurred in November and December 2015 when 12 and 11 shellfish specimens were collected, respectively. The relatively higher impingement in these months was dominated by Mississippi grass shrimp.

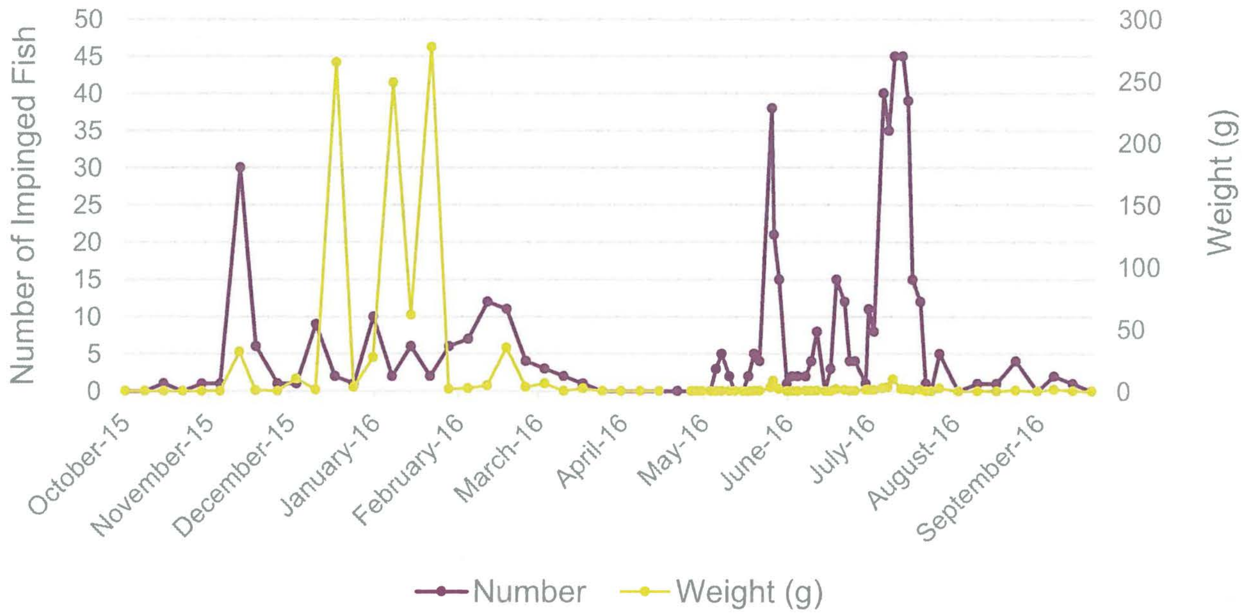


Figure 5-1. Total Number and Weight of Fish Impinged at Callaway Energy Center, October 2015 – September 2016

5.3 Daily Variation in Impingement (40 CFR 122.21(r)(4)(v))

None of the species identified as potentially susceptible to impingement have daily activities, such as diel vertical migrations, that would result in their concentration near CEC's MWIS. Other impingement studies conducted at stations that included diel sampling have showed no distinct daily pattern or trend in impingement (MACTEC 2006). During certain sampling events, a large spike in impingement might occur during a day or night sampling interval, but elevated impingement rates were not consistently observed during this time interval during other sampling events (MACTEC 2006). No clear diel pattern in impingement rates was observed.

6.0 Protected Species (40 CFR 122.21(r)(4)(vi))

6.1 Federally Protected Species

Federally protected aquatic species that may occur near CEC's MWIS were identified by a review of the USFWS online database (USFWS 2019). The federally protected pallid sturgeon occurs within the lower Missouri River though none have been identified during past collections or recent entrainment or impingement studies and intensive ichthyoplankton river surveys conducted in the vicinity of CEC's MWIS. No critical habitats occur in the Missouri River near CEC's MWIS.

Intense current research and management efforts are focused on the recovery of the pallid sturgeon within the Missouri and Mississippi Rivers (Grady et al. 2001; USFWS 2005; USGS 2005; Laustrup et al. 2007; Braaten et al. 2008; Braaten et al. 2010; Braaten et al. 2012; Bryan et al. 2010; Ridenour et al. 2011; Jordan et al. 2016). Within segment 14 (RM 0 – 130.2) of the lower Missouri River, a total of 73 pallid sturgeon were collected by the PSPAP over the survey period from 2013 – 2015, which was designed to estimate the population size, structure, and distribution of the species (Herman et al. 2014; Herman and Wrasse 2015, 2016). Most of these individuals (84.9 percent; n = 62 individuals) were of hatchery origin and most (39.7 percent; n = 29 individuals) were collected from areas in the vicinity of the Osage River (RM 130.2), a major tributary confluence. During the survey period from 2013 – 2015, a total of 13 pallid sturgeon were collected between RM 110 – 120, within the stretch of river where CEC's MWIS (RM 115.4) is located. No pallid sturgeon were caught in the lower Missouri River below RM 221 by either the BFS (Berry et al. 2004) or during recent intense fisheries surveys near Ameren Missouri's Labadie Energy Center. Thus, juvenile and adult pallid sturgeon are present in the lower Missouri River in the vicinity of CEC's MWIS, but in extremely low numbers.

Hatchery-reared larval pallid sturgeon have been stocked into the Missouri River in the past in accordance with a range-wide stocking plan (USFWS 2008). However, its relative abundance in the lower Missouri River has not markedly increased (Wildhaber et al. 2014) despite more than two decades of stocking efforts (USFWS 2014). Three confirmed larval pallid sturgeon were collected in a side channel (Lisbon Chute) at RM 217 (NRC 2014), 102 miles upstream of CEC. Additionally, three naturally-reproduced larval pallid sturgeon were collected by the USGS in May 2014 from the main channel of the lower Missouri River, just above its confluence with the Platte River near Bellevue, Nebraska (https://www.usgs.gov/news/new-evidence-shows-endangered-pallid-sturgeon-spawned-lower-missouri-river). The collection of naturally-produced larval pallid sturgeon and their verification through genetic analyses indicates that suitable conditions and functional spawning habitats for pallid sturgeon are available in the lower Missouri River, though the population is so small that only very limited recruitment has been detected.

Conversely, the shovelnose sturgeon, which is listed T(S/A) to the federally endangered pallid sturgeon, is very numerous in the lower Missouri River. In fact, it was the most abundant species collected by the PSPAP over the survey period from 2013 – 2015, with a total of 10,354 individuals collected within segment 14 (RM 0 – 130.2) of the lower Missouri River, which represented 24.2 percent of the total catch overall. Shovelnose sturgeon were also relatively abundant (n = 184 individuals) in BFS collections made within segments 25 (RM 220 – RM 130) and 27 (RM 50 – RM 0) of the lower Missouri River from 1996-1998 (Berry et al. 2004). T(S/A) species such as the shovelnose

sturgeon are not considered biologically threatened and are not subject to Section 7 consultation. No critical habitats occur in the Missouri River near CEC's MWIS.

One dead specimen of the federally and state-endangered scaleshell was the only federally listed freshwater mussel species collected during river surveys of the lower Missouri River (Hoke 1999; Hoke 2009).

Other non-aquatic federally protected species that may occur near CEC include one endangered flowering plant, running buffalo clover (*Trifolium stoloniferum*), and three mammals, the endangered Indiana bat (*Myotis sodalis*), gray bat (*Myotis grisescens*), and threatened northern long-eared bat (*Myotis septentrionalis*) (USFWS 2019). No terrestrial resources would be disturbed by CEC's MWIS; therefore, no effects to these species are anticipated. No critical habitats have been designated for these terrestrial species.

6.2 State-Protected Species

State-protected aquatic species that may be present near the CEC were identified by a review of the Missouri Species and Communities of Conservation Concern 2018 Checklist. Species identified as state-protected and occurring in the lower Missouri River potentially near CEC's MWIS are listed in Table 6-1.

Table 6-1. State-Protected Aquatic Species Possibly Occurring near Callaway Energy Center

Common Name	Scientific Name	Status*	Notes	Source
Fishes				
Pallid sturgeon	*Acipenser fulvescens*	E	- A total of 73 individuals collected from the lower Missouri River by the PSPAP between 2013-2015	Herman and Wrasse 2016
Lake sturgeon	*Acipenser fulvescens*	E	- Twenty-seven individuals were collected from the lower Missouri River by the PSPAP between 2013-2015	Herman and Wrasse 2016
Flathead chub	*Platygobio gracilis*	E	- Four individuals collected from the lower Missouri River during the BFS between 1996-1998	Berry et al. 2004
Western silvery minnow	*Hybognathus argyritis*	S2	- Two individuals collected in 2014 by the PSPAP	Herman and Wrasse 2016
Plains minnow	*Hybognathus placitus*	S2	- Forty individuals collected between 2014-2015 by the PSPAP	Herman and Wrasse 2016
Ghost shiner	*Notropis buchanani*	S2	- One individual collected during the BFS in 1996	Berry et al. 2004
Highfin carpsucker	*Carpiodes velifer*	S2	- One individual collected in 2014 by the PSPAP - Three individuals collected by the BFS between 1997-1998	Berry et al. 2004; Herman and Wrasse 2016

Common Name	Scientific Name	Status*	Notes	Source
Sturgeon chub	*Macrhybopsis gelida*	S3	- A total of 222 individuals collected by the PSPAP between 2013-2015	Herman and Wrasse 2016
River darter	*Percina shumardi*	S3	- Two individuals collected in 2013-2014 by the PSPAP	Herman and Wrasse 2016
Skipjack herring	*Alosa chrysochloris*	SU	- Three individuals collected in 2013-2015 by the PSPAP	Herman and Wrasse 2016
American eel	*Anguilla rostrata*	SU	- One individual collected in 2015 by the PSPAP	Herman and Wrasse 2016
Mussels				
Scaleshell	*Leptodea leptodon*	E	- One dead specimen found in 1990 from Gasconade County	Hoke 1999
Flat floater	*Utterbackiana suborbiculata*	S2	- Ten individuals collected between 1982 and 2000 within the lower Missouri River - Two live individuals collected in 1999 near Gavins Point Dam	Perkins and Backlund 2000; Hoke 2009
Hickorynut	*Obovaria olivaria*	S3	- One live individual collected downstream Kansas City between 1982 and 2000	Hoke 2009

*S2 indicates "imperiled" status in Missouri due to its rarity or other factor(s) making it very vulnerable to extirpation. Typically, six to 20 occurrences or few individuals remaining (1,000-3,000).
S3 indicates "vulnerable" status in Missouri due to the species being rare and uncommon, or having a restricted range (even if abundant at some locations). Typically, 21-100 occurrences or 3,000-10,000 individuals.
SU indicates "unrankable" due to lack of information or due to substantially conflicting information about status or trends.

7.0 Agency Consultation and Public Participation (40 CFR 122.21(r)(4)(vii))

7.1 Agency Consultation

7.1.1 Consultation with Federal and State Agencies

On December 15, 2011, Ameren Missouri submitted an application for CEC Unit 1 to the U.S. Nuclear Regulatory Commission (NRC) to issue a renewed license for an additional 20-year period. This renewal was granted by the NRC in 2015 for an additional 20 years, through October 18, 2044. In its Generic Environmental Impact Statement (NRC 2014), NRC included Appendix H, entitled *Biological Assessment of the Potential Effects on Federally Listed Pallid Sturgeon from the Proposed License Renewal for the Callaway Plant, Unit 1*. The biological assessment determined that continued operation of CEC "may affect, but not likely to adversely affect the continued existence of the pallid sturgeon" and that any potential adverse effects would accrue primarily through direct mortality due to entrainment or impingement of larvae and juveniles. This determination was reinforced by recent research showing drift of larval pallid sturgeon in the lower Missouri River.

As a result of the license renewal application, the NRC established Endangered Species Act of 1974 (ESA) Section 7 consultation with the USFWS for pallid sturgeon and other native threatened and endangered species. In a September 29, 2014 letter to NRC, the USFWS stated that "At this time, there is insufficient information to conclude that the risk to pallid sturgeon is insignificant or discountable" regarding an appreciable reduction in the survival and recovery of the endangered pallid sturgeon. Consequently, informal meetings were held in the fall of 2014 between USFWS, Ameren, and the Missouri state resource agencies—Missouri Department of Natural Resources (MDNR) and Missouri Department of Conservation (MDC)—to cooperatively devise a study to provide information on the potential risk of continued operation of CEC to the survival and recovery of pallid sturgeon.

A Preliminary Entrainment and Impingement Sampling Plan was outlined by Ameren Missouri, and was reviewed and approved with input from USFWS. Ameren Missouri formally committed in letter ULNRC-06150 (dated October 31, 2014) to conduct a 1-year entrainment and impingement study of the closed-cycle makeup water intake structure, including sampling in the Missouri River in the vicinity of the intake, to assess the potential impact on pallid sturgeon. The study was initiated in 2015 and completed in 2016, with a final report submitted to the NRC with copies provided to USFWS, MDNR, and MDC on March 29, 2017. More details regarding this study are presented in Section 8.0. The results of the 1-year impingement study are presented in Section 4.1 and the results of the entrainment study are presented in Section 4.2.

7.2 Public Participation

No prior outreach or public participation has been undertaken by Ameren Missouri for CEC regarding operation of the MWIS. Furthermore, Ameren Missouri has not received any public comments or inquiries regarding the potential effects of the operations of the CEC MWIS on fish and shellfish of the Missouri River.

8.0 Field Studies Undertaken in Support of Source Water Baseline Biological Characterization (40 CFR 122.21(r)(4)(viii))

Supplemental field sampling was undertaken at CEC in 2015 – 2016 as a result of Section 7 consultation between the NRC and USFWS regarding the potential take of pallid sturgeon and other threatened and endangered species (see Section 7.0). A one-year IM&E study of CEC's MWIS was conducted to assess the potential impact on pallid sturgeon. Additionally, intensive ichthyoplankton sampling in the Missouri River in the vicinity of the MWIS was completed to document the occurrence and spatial distribution of pallid sturgeon larvae drifting in the Missouri River as it flows past CEC's MWIS. All impingement, entrainment, and in-river ichthyoplankton sampling and laboratory processing followed standard operating procedures (SOP) provided separately in the "Standard Operating Procedures for the Ameren Callaway Impingement and Entrainment Program Field Sampling and Analysis". Additionally, a quality assurance project plan (QAPP) with quality assurance measures and procedures is provided separately in the "Quality Assurance Project Plan for the Ameren Callaway Impingement and Entrainment Program."

Collection Methods. A brief description of sampling methods, sampling locations, and results of the in-river ichthyoplankton sampling is provided herein. Additional details about the one-year IM&E study can be found in Sections 4.1 and 4.2. In-river ichthyoplankton samples at CEC were collected directly from the Missouri River upstream of CEC's MWIS, between RM 115.5 – 116 (Figure 8-1). Surface/mid-depth tow samples and bottom tow samples were collected on a weekly basis during daytime and nighttime hours for four consecutive weeks beginning May 3 and ending May 27, when sustained water temperatures reached 16-18°C (61-64°F) or greater. Surface and mid-depth ichthyoplankton sampling consisted of a 3-meter-long, 1-meter-diameter conical ichthyoplankton net with 750-μm[4] mesh pulled behind a jon boat with a rope long enough so that it was outside of the boat's prop wash. Bottom ichthyoplankton sampling was conducted using a 1.1-meter-wide by 1.3-meter-high epibenthic sled fitted with a 3-meter-long, 1-meter-diameter conical ichthyoplankton net with 750-μm mesh. A General Oceanics 2030R flowmeter was suspended in each net mouth to measure flow volume. Both surface/mid-depth and bottom ichthyoplankton samples were collected within three habitat zones during each sampling event:

1. The channel border on intake (north) side of the river,
2. The main channel near or along the river thalweg, and
3. The channel border on the opposite (south) side of the river (Figure 8-1).

[4] This is the standard mesh size used by the USFWS, USGS, and MDC for sampling sturgeon in the Missouri River (see Braaten et al. 2010 and others).

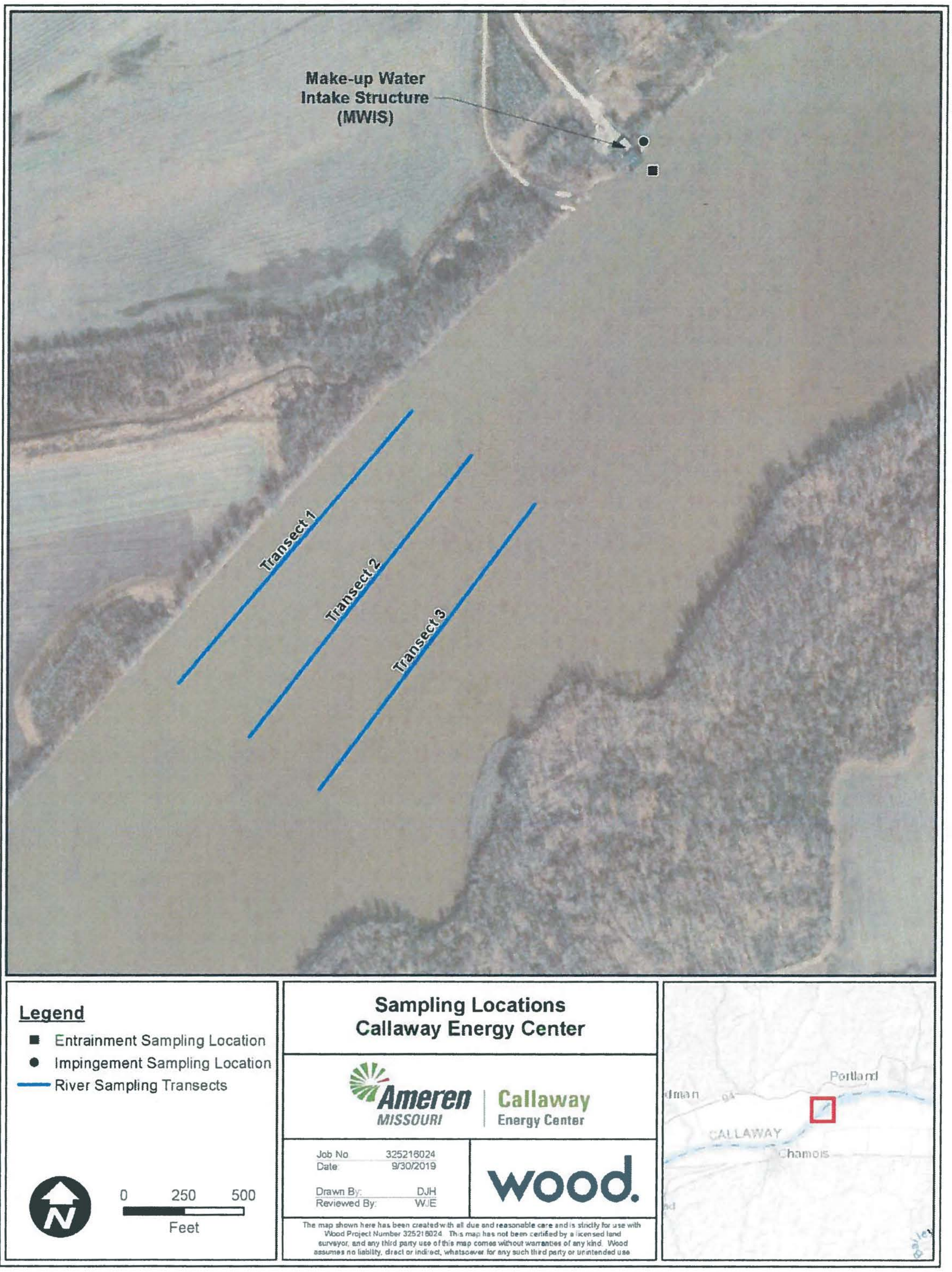


Figure 8-1. Sampling Locations of Supplemental Field Sampling Conducted at Callaway Energy Center from 2015 – 2016

Within each habitat zone, the nets were maintained in as fixed a position as possible for the duration of the sample by adjusting the throttle of the boat motor. Two boats were used to collect river ichthyoplankton samples, one boat for surface/mid-depth ichthyoplankton tows and one boat for bottom ichthyoplankton tows. Each of the two boats sampled each habitat zone for approximately 2 hours during each daytime and nighttime sampling event, such that on a sampling day or night, each zone was sampled over a period of approximately 4 hours (2 hours for surface/mid-depth tows and 2 hours for bottom tows). Ichthyoplankton nets were towed for 2 to 5 minutes, depending on the observed amount of debris/cod end clogging before retrieval and processing, then towed for another 2-5 minutes, with this process being continued until the approximate 2-hour total sampling interval was reached for that particular sampling zone.

Depth for the ichthyoplankton samples was determined at the time of sampling by the water depth for each sampling zone. In order to more effectively sample the water column in the main channel, the ichthyoplankton net was set at mid-depth for the first half of the 2- to 5-minute tow, then raised to the surface for the second half of the sample. Shallower sampling zones were only sampled at the surface. Upon retrieval, the net was pulled in by hand and positioned for external wash-down. Washing of the net was accomplished using source river water on the outside of the net such that it did not compromise the sample. All organisms and detritus were washed into the collection bucket at the cod end of the net.

After the net had been thoroughly washed down, the collection bucket was carefully removed. A tray or pan was positioned under the collection bucket while it was removed and during transfer of the contents of the bucket to labeled sample containers. Collection buckets were carefully rinsed to ensure that all organisms had been properly transferred to the sample container. Any organisms collected in the sorting tray were also transferred to the sample jar. Cleaned and rinsed collection buckets were reinstalled on the cod end of each net in preparation of the next sample. After transfer of the sample to the appropriate, labeled sample container, the sample was preserved in 95 percent Ethanol (EtOH) solution with Rose Bengal stain. Water was fully decanted from the sample and a spray or squeeze bottle with 95 percent EtOH was utilized for sample transfer to the sample jar to maintain the 95 percent EtOH concentration.

River ichthyoplankton samples were processed the same as entrainment samples at the Amec Foster Wheeler Environment & Infrastructure, Inc. St. Louis Laboratory according to SOPs for Laboratory Sample Processing. However, only sturgeon or very similar larvae of the Order Acipenseriformes were identified, counted, and measured. If these specimens were found in the lab samples, they were documented and shipped to a contracted laboratory (i.e., Southern Illinois University) qualified to perform additional processing in conjunction with DNA analysis sufficient to support identification of the specimens to species. Analyses performed at the contracted laboratory consisted of DNA isolation, polymerase chain reaction (PCR) amplification of microsatellite loci, single nucleotide polymorphism (SNP) analysis, and genotyping services.

A more detailed description of the sampling and processing procedures is provided in the SOP and QAPP provided separately.

Results. A total of 277 individual tows were conducted over four consecutive weeks of sampling starting on May 3 and ending May 27, 2016. Due to increased river flows and resulting heavy debris

loading during the sampling period, samples taken in the same zone by the same gear type (midwater/surface net vs. epibenthic sled) during the two-hour sampling interval were composited. From the 277 individual tow samples there were 162 composite samples. Sample volumes of composite samples ranged from 17.76 m^3 to 508.63 m^3 with an average sample volume of 102.88 m^3.

During the four consecutive weeks of sampling, five larvae were collected that were morphologically identified as river sturgeon (*Scaphirhynchus* spp.), and nine larvae were collected that were identified as paddlefish. One small recently hatched specimen was designated as belonging to Acipenseriformes (i.e., either paddlefish or sturgeon) due to inadequate development of ventral snout barbels and other morphological characters that are similar among the two families. In addition to the above larvae, seventeen eggs were collected that were classified as unknown fish species. These seventeen eggs were later classified into five separate groupings based on similarity of appearance (e.g., size, pigmentation, adhesiveness, color, etc.).

The fifteen sturgeon/paddlefish larvae and five eggs (i.e., one from each designated group) were sent to Southern Illinois University – Carbondale for further genetic analysis and identification. Genetic identification of specimens followed methods outlined in Eichelberger et al (2014). Eggs/embryos were not developed enough to allow a sufficient amount of nuclear DNA for analysis of SNPs or microsatellites. As a result, mitochondrial DNA (mtDNA) sequencing was relied on to determine whether an egg was a river sturgeon or other species. Pallid and shovelnose sturgeon cannot be distinguished based on mtDNA alone (personal communication, Dr. Edward Heist, 8/21/2016).

Based on the results of the genetic analysis, two eggs were identified as Goldeye (*Hiodon alosoides*), one egg was identified as a grass carp, and one egg was identified as a river sturgeon (*Scaphirhynchus* sp.). The fifth egg failed to amplify, preventing further identification. None of the other eggs collected were morphologically similar to the one identified as a river sturgeon. This particular egg had a dark black coloration and smooth appearance. The egg's CO1 gene sequence had a 100 percent match with shovelnose sturgeon, pallid sturgeon, and hybrid shovelnose sturgeon × pallid sturgeon CO1 gene sequences found on GenBank. The D-loop gene sequence had a 99 percent match with pallid sturgeon and hybrid shovelnose sturgeon × pallid sturgeon D-loop gene sequences found on GenBank.

To distinguish among pallid and shovelnose sturgeon larvae, three SNP assays were employed to screen Acipenseriform larvae collected. A mtDNA SNP discriminated paddlefish from sturgeon, and specific multilocus genotypes at two nuclear DNA SNPs were used to separate pallid sturgeon from shovelnose sturgeon (Eichelberger et al. 2014). These SNP assays allowed for confident genetic determination of sturgeon species. All of the specimens morphologically identified in the laboratory as paddlefish were also genetically identified as paddlefish based on the mtDNA SNP assay (Table 8-1). The five specimens identified as river sturgeon in the laboratory were genetically identified as shovelnose sturgeon based on the two nuclear DNA SNP assays (Table 8-1). The recently hatched yolk-sac larvae that was morphologically identified as belonging to Acipenseriformes was genetically identified as a shovelnose sturgeon (Table 8-1).

In total there were six shovelnose sturgeon larvae and one sturgeon egg identified. No pallid sturgeon or hybrid pallid × shovelnose sturgeon larvae were identified. Only one shovelnose sturgeon larvae was collected from the zone along the channel border on the intake (north) side of the river upstream of the

MWIS; however, this larvae was collected in a mid-depth/surface tow. Four shovelnose sturgeon larvae and the sturgeon egg were collected from bottom tows in the main channel near or along the river thalweg. One shovelnose sturgeon larvae was collected in a mid-depth/surface tow from the south (far shore) zone opposite of the MWIS.

Table 8-1. Genetic Identification of Acipenseriform Larvae Collected in the Vicinity of Callaway Energy Center's MWIS from Three Single-Nucleotide Polymorphism Assays

Sample ID*	Date Collected	Number	Life Stage	Lab Identification	mtDNA	RAG 1A	Genetic Identification
CAL-IP-1-S-03-02	5/10/2016	1	larvae	Paddlefish	G		Paddlefish
CAL-IP-1-S-05-01	5/17/2016	1	larvae	Paddlefish	G		Paddlefish
CAL-IP-1-S-05-01	5/17/2016	1	larvae	Paddlefish	G		Paddlefish
CAL-IP-1-S-05-02	5/17/2016	1	larvae	River Sturgeon	A	AA	Shovelnose sturgeon
CAL-IP-3-S-05-02	5/17/2016	1	larvae	River Sturgeon	A	AG	Shovelnose sturgeon
CAL-IP-1-B-06-01	5/20/2016	1	larvae	Paddlefish	G		Paddlefish
CAL-IP-2-B-06-04	5/20/2016	1	larvae	River Sturgeon	A	AA	Shovelnose sturgeon
CAL-IP-2-B-07-01	5/24/2016	1	larvae	Acipenseriformes sp.	A	AA	Shovelnose sturgeon
CAL-IP-2-B-07-02	5/24/2016	1	larvae	River Sturgeon	A	AA	Shovelnose sturgeon
CAL-IP-1-B-08-02	5/26/2016	1	larvae	Paddlefish	G		Paddlefish
CAL-IP-1-S-08-01	5/26/2016	1	larvae	Paddlefish	G		Paddlefish
CAL-IP-3-S-08-01	5/26/2016	1	larvae	Paddlefish	G		Paddlefish
CAL-IP-2-B-08-02	5/27/2016	1	larvae	Paddlefish	G		Paddlefish
CAL-IP-2-B-08-03	5/27/2016	1	larvae	River Sturgeon	A	AA	Shovelnose sturgeon
CAL-IP-2-S-08-04	5/27/2016	1	larvae	Paddlefish	G		Paddlefish

* "CAL" represents the three letter acronym for the Callaway Energy Center. "IP" designates river ichthyoplankton sampling. The following field is a single numeric code representing the sampling zone: "1" for the sampling zone on the channel border on the intake (north) side of the river, "2" for the main channel (thalweg) sampling zone, and "3" for the sampling zone on the channel border on the opposite (south) side of the river. "S" designates surface/mid-depth tows and "B" for bottom tows. The next field represents the sampling event number. The final field designates the tow number such as "01", "02", "03", "04", etc.

9.0 Protective Measures and Stabilization Activities (40 CFR 122.21(r)(4)(x))

Under the Rule, applicants must identify protective measures and stabilization activities that have been implemented and describe how these measures and activities affected the baseline water condition in the vicinity of the intake. CEC's MWIS is located on the floodplain of the Missouri River. The bank of the Missouri River in the vicinity of the CEC MWIS is subject to normal variations of river stage. No signs of erosion or bank failure are evident near the MWIS. As such, Ameren Missouri has not undertaken any special protective measures or stabilization activities at these locations. CEC performs dredging operations around the intake structure as needed. Recently, a diving company removed all the debris from the barge pilings upstream of the intake structure to mitigate flow currents that would cause silt and sand to build up in front of the structure. There is no riprap placed upstream or in front of the intake structure.

10.0 Fragile Species (40 CFR 122.21(r)(4)(xi))

Species within the lower Missouri River in the vicinity of CEC include open water pelagic species (e.g., gizzard shad), species commonly associated with littoral habitats (e.g., spotted bass, white and black crappie, other sunfishes), and species more commonly characterized as benthic dwelling fishes (e.g., channel catfish, flathead catfish, blue catfish) (see Section 3.1; Table 3-1). Fragile species are least likely to survive any form of impingement and are defined as those with an impingement survival rate of less than 30 percent [40 CFR §125.92(m)].

The gizzard shad, a species that occurs near CEC, has been identified by the USEPA in the Rule as a fragile species that is susceptible to IM&E [see 40 CFR §125.92(m)]. White et al. (1986) demonstrated a 99.98 percent mortality rate in YOY gizzard shad when exposed to water temperatures in the mid-30s F, and Wood (formerly MACTEC) had observed high mortality rates in gizzard shad at these temperatures during prior impingement studies, including at CEC (AmecFW 2017; ASA 2017). Other members of the family Clupeidae that occur near CEC, including skipjack herring, are not specifically identified as fragile by USEPA. However, these species are prone to winter die-off when water temperature falls below 42°F and are susceptible to handling-related mortality at other times of the year. As identified by USEPA in the preamble to the Rule (79 FR 48364, Aug. 15, 2014), naturally occurring mortality of these fragile species should not be counted against CEC's performance in reducing impingement mortality.

11.0 Incidental Take Exemptions (40 CFR 122.21(r)(4)(xii)

No prior incidental take exemptions or authorizations have been previously issued by the USFWS or the MDNR for the operation of CEC's MWIS on the Missouri River.

12.0 References

Amec Foster Wheeler Environment & Infrastructure, Inc. (AmecFW) 2017. Ameren Callaway Energy Center Impingement and Entrainment Program Study Report. Prepared for Ameren Missouri, January 2017. 98 pp.

ASA Analysis & Communications, Inc. (ASA) 2017. Potential Impact of Impingement and Entrainment on Pallid Sturgeon at the Callaway Energy Center. Prepared for Ameren Missouri, March 2017. 99 pp.

Auer, N. A. 1982. Identification of Larval Fishes of the Great Lakes Basin with Emphasis on the Lake Michigan Drainage. Special Publication 82-3. Great Lakes Research Division, Ann Arbor, Michigan.

Berry, C.R. Jr. and B.A. Young. 2001. Introduction to the Benthic Fishes Study. Volume 1. Population Structure and Habitat Use of Benthic Fishes Along the Missouri and Lower Yellowstone Rivers. U.S. Geological Survey, Cooperative Fishery Units, South Dakota State University. Brookings, South Dakota.

Berry, C.R. Jr., M.L. Wildhaber, and D.L. Galat. 2004. Fish Distribution and Abundance. Volume 3. Population Structure and Habitat Use of Benthic Fishes Along the Missouri and Yellowstone Rivers. U.S. Geological Survey, Cooperative Research Units, South Dakota University, Brookings, South Dakota.

Bland, T., and J.G. Cooper. 1861. Notice of land and freshwater shells collected by Dr. J.G. Cooper in the Rocky Mountains, etc., in 1860. American Lyecium Natural History, New York, vii, separate, pp. 1-9.

Braaten, P.J., D.B. Fuller, L.D. Holte, R.D. Lott, W. Viste, T.F. Brandt, and R.G. Legare. 2008. Drift dynamics of larval pallid sturgeon and shovelnose sturgeon in a natural side channel of the upper Missouri River. North American Journal of Fisheries Management 28:808-826.

Braaten, P.J., D.B. Fuller, R.D. Lott, M.D. Ruggles, and R.J. Holm. 2010. Spatial distribution of drifting pallid sturgeon larvae in the Missouri River inferred from two net designs and multiple sampling locations. North American Journal of Fisheries Management 30(4):1062-1074.

Braaten, P.J., D.B. Fuller, R.D. Lott, M.P. Ruggles. T.F. Brandt, R.G. Lagaer, and R.J. Holm. 2012. An experimental test and models of drift and dispersal processes of pallid sturgeon (*Scaphirhynchus albus*) free embryos in the Missouri River. Environmental Biology of Fishes 93:377-392.

Brim Box, J. and J.Mossa. 1999. Sediment, land use, and freshwater mussels: prospects and problems. Journal of the North American Benthological Society 18:99-117.

Brown, D.J. and T.G. Coon. 1994. Abundance and assemblage structure of fish larvae in the Lower Missouri River and its tributaries. Transactions of the American Fisheries Society 123:718-732.

Brummet, K. and G. Jones. 2004. Flathead catfish (Pylodictis olivaris). In: Pitlo, J.M. Jr. and J.L. Rasmussen (eds.). UMRRC Fisheries Compendium. 3rd Edition. Upper Mississippi River Conservation Committee. Rock Island, Illinois. January 2004. p. 157-162.

Bryan, J.L., M.L. Wildhaber, D. Gladish, S. Holan, and M. Ellersack. 2010. The power to detect trends in Missouri River fish populations within the pallid sturgeon population assessment program. U.S. Geological Survey Open-File Report 2010-1020, 414 pp.

Camp, Dresser & McKee (CDM). 1981. Water quality and aquatic biological pre-operational monitoring program for the Callaway Nuclear Plant. First annual report, June 1980-May 1981. Prepared for Union Electric Co., St/ Louis, Missouri.

Camp, Dresser & McKee (CDM). 1982. Water quality and aquatic biological pre-operational monitoring program for the Callaway Nuclear Plant. Second annual report, June 1981-May 1982. Prepared for Union Electric Co., St/ Louis, Missouri.

Carlander, K.D. 1969. Handbook of Freshwater Fishery Biology. Volume 1. The Iowa State University Press, Ames, Iowa. 752 pp.

Chapman, D. C. 2006. Early development of four cyprinids native to the Yangtze River, USGS Data Series 239, 51 pp.

Cooper, J.G. 1869. Notes on the fauna of the Upper Missouri. American Naturalist 3:294-299.

Csoboth, L.A. and J.E. Garvey. 2008. Lateral Exchange of Larval Fish between a Restored Backwater and a Large River in the East Central USA. Transactions of the American Fisheries Society 137: 33-44.

DeGrandchamp, K.L., Garvey, J.E. and L.A. Csoboth. 2007. Linking Adult Reproduction and Larval Density of Invasive Carp in a Large River. Transactions of the American Fisheries Society 136: 1327-1334.

DeLonay, A.J., R.B. Jacobson, D.M. Papoulias, M.L. Wildhaber, K.A. Chojnacki, E.K. Pherigo, J.D. Hass, and G.E. Mestl. 2012. Ecological requirements for pallid sturgeon reproduction and recruitment in the Lower Missouri River. Annual Report 2010. U.S. Geological Survey Open-File Report 2012-1009, 51 pp.

Deters, J.E., D.C. Chapman, and B. McElroy. 2013. Location and timing of Asian carp spawning in the lower Missouri River. Environmental Biology of Fish 96:617-629.

Eichelberger, J.S., P. J. Braaten, D. B. Fuller, M. S. Krampe, and E. J. Heist. 2014. Novel single-nucleotide polymorphism markers confirm successful spawning of endangered pallid sturgeon in the upper Missouri river basin. Transactions of the American Fisheries Society 143(6): 1373-1385.

Eisenhour, D.J. 1999. Systematics of *Macrhybopsis tetranema* (Cypriniformes: Cyprinidae). Copeia 1999:969-980.

Eisenhour, D.J. 2004. Systematics, variation, and speciation of the *Macrhybopsis aestivalis* complex west of the Mississippi River. Bulletin of the Alabama Museum of Natural History 23:9-47.

Fuiman, L.A., J.V. Conner, B.F. Lathrop, G.L. Buynak, D.E. Snyder, and J.J. Loos. 1983. State of the Art of Identification for Cyprinid Fish Larvae from Eastern North America. Transactions of the American Fisheries Society 112:319-332.

Fritts, A.K., B.C. Knights, T.D. Lafrancois, J.M. Vallazza, L.A. Bartsch, M.R. Bartsch, W.B. Richardson, S.W. Bailey, R.M. Kreiling, and B.N. Karns. 2018. Evaluating potential effects of bigheaded carps on fatty acid profiles of multiple trophic levels in large rivers of the Midwest, USA. Food Webs 16:2352-2496.

Galat, D.L., G. W. Whitledge, L.D. Patton, and J. Hooker. 2004. Larval fish use of lower Missouri River scour basins in relation to connectivity. Final report to Missouri Department of Conservation, Columbia, Missouri. 75 pp.

Galat, D.L., C.R. Berry, W.M. Gardner, J.C. Hendrickson, G.E. Mestl, G.J. Power, C.Stone, and M.R. Winston. 2005. Spatiotemporal patterns and changes in Missouri River fishes. Pages 249-291 *in* J.N. Rinne, R.M. Hughes, and R. Calamusso (eds.). Historical changes in fish assemblages of large American rivers. American Fisheries Society Symposium 45, Bethesda, Maryland.

Garvey, J. E., DeGrandchamp, K. L., and C. J. Williamson. 2006. Life history attributes of Asian Carps in the upper Mississippi River system. Reports. http://opensiuc.lib.siu.edu/fiaq_reports/3

George, A.E., T. Garcia, and D.C. Chapman. 2017. Comparison of size, terminal fall velocity, and density of bighead carp, silver carp, and grass carp eggs for use in drift modeling. Transactions of the American Fisheries Society 146(5):834-843.

Grady, J.M. and J. Milligan. 1998. Status of selected cyprinid species at historic lower Missouri River sampling sites. U.S. Fish and Wildlife Service, Columbian Fisheries Resources Office, Columbia, Missouri.

Grady, J., J. Milligan, C. Gemming, D. Herzog, G. Mestl, L. Miller, K. Hurley, P. Wills, and R. Sheehan. 2001. Pallid and shovelnose sturgeon in the lower Missouri and Middle Mississippi rivers. Prepared for MICRA. February 2001.

Herman, P., and C. Wrasse. 2015. 2014 Annual Report. Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segment 14. Prepared for the U.S. Army Corps of Engineers, Missouri River Recovery Program. USFWS, Columbia Fish and Wildlife Conservation Office, Columbia, Missouri.

Herman, P., and C. Wrasse. 2016. 2015 Annual Report. Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segment 14. Prepared for the U.S. Army Corps of Engineers, Missouri River Recovery Program. USFWS, Columbia Fish and Wildlife Conservation Office, Columbia, Missouri.

Herman, P., C. Wrasse, and A. McDaniel. 2014. 2013 Annual Report. Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segment 14. Prepared for the USACE, Missouri River Recovery Program. USFWS, Columbia Fish and Wildlife Conservation Office, Columbia, Missouri.

Hoke, E. 1983. Unionid mollusks of the Missouri River on the Nebraska border. American Malacological Bulletin 1:71-74.

Hoke, E. 1999. The scaleshell *Leptodea leptodon* (Rafinesque, 1820) in the Missouri River. Triannual Unionid Report 19:9.

Hoke, E. 2009. The freshwater mussels (Mollusca: Bivalvia Unionidae) of the channelized Missouri River. Journal of the Iowa Academy of Science 116:36-43.

Holland-Bartels, L.E. and M.C. Duval. 1988. Variations in abundance of young-of-the-year channel catfish in a navigation pool of the Upper Mississippi River. Transactions of the American Fisheries Society. 117:202-208.

Holland-Bartels, L. E., S. K. Littlejohn, and M. L. Huston. 1990. A guide to larval fishes of the Upper Mississippi River. U.S. Fish and Wildlife Service, La Crosse, Wisconsin.

Holland-Bartles, L.E., M.R. Dewey, and S.J. Zigler. 1993. Pilot study of spatial patterns of ichthyoplankton among river reaches and habitats of the upper Mississippi River System. Prepared for the U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin. EMTC 93-S010. 47 pp. + Appendixes A-C.

Holland-Bartels, L.E., Dewey, M.R. and S.J. Zigler. 1995. Ichthyoplankton Abundance and Variance in a Large River System Concerns for Long-term Monitoring. Regulated rivers: Research and Management, Vol. 10: 1-13.

Hubert, W.A. 1999. Biology and management of channel catfish. In: Irwin, E.R., W.A. Hubert, C.F. Rabeni, H.L. Schramm, Jr., and T. Coon (eds.). Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Jordan, G.R., E.J. Heist, P.J. Braaten, A.J. DeLonay, P. Hartfield, D.P. Herzog, K.M. Kappenman, and M.A.H. Webb. 2016. Status of knowledge of the Pallid Sturgeon (*Scaphirhynchus albus* Forbes and Richardson, 1905). Journal of Applied Ichthyology 32:191-207.

Kamilov, B.O. and M.Y. Komrakova. 1999. Maturation and fecundity of the silver carp, *Hypophthalmichthys molitrix*, in Uzbekistan. Isr. J. Aquaclture-Bamidgeh 51(1):40-43.

Kay, L.K., R. Wallus, and B.L. Yeager. 1994. Reproductive biology and early life history of fishes in the Ohio River drainage. Volume 2: Catostomidae. Tennessee Valley Authority, Chattanooga, Tennessee, USA.

Laustrup, M.S., R.B. Jacobson, and D.G. Simpkins. 2007. Distribution of potential spawning habitat for sturgeon in the Lower Missouri River. U.S. Geological Survey Open-File Report 2007-1192, 26 pp.

MACTEC Engineering and Consulting, Inc. (MACTEC). 2006. Project Reports 316(b)-Related Services at the Havana Power Station. Prepared for Dynegy Midwest Generation, Inc. September 2006.

McMahon, T.E. and J.W. Terrell. 1982. Habitat suitability index models: channel catfish. U.S. Fish and Wildlife Service. FWS/OBS-82/10.2 29 pp.

McMullen, J. 2018. Missouri Commercial Fish Harvest. 2017. Missouri Department of Conservation. Final Report. 77 pp.

Missouri Code of State Regulations (MCSR). 2018. Rules of Department of Conservation. Division 10-Conservation Commission. Chapter 10-Wildlife Code: Commercial Permits: Seasons, Methods, Limits. 29 January 2018. 9 pp.

Missouri Department of Conservation (MDC). 2007. Aquatic Nuisance Species Management Plan. February 2007. 111 pp.

Missouri Department of Conservation (MDC). 2018. Missouri Species and Communities of Conservation Concern Checklist. January 2018. 56 pp.

Nuclear Regulatory Commission (NRC). 2014. Generic environmental impact statement for license renewal of nuclear plants. Supplement 51 regarding Callaway Plant Unit 1. NUREG 1457. February 2014.

Perkins, K. III, and D.C. Backlund. 2000. Freshwater Mussels of the Missouri National Recreational River below Gavins Point Dam, South Dakota and Nebraska. U.S. Army Corps of Engineers, Omaha District. Paper 76. 23 pp.

Pflieger, W.L. 1997. The Fishes of Missouri. Missouri Department of Conservation, Jefferson City, MO.372 pp.

Pflieger, W.L. and T.B. Grace. 1987. Changes in the fish fauna of the lower Missouri River, 1940-1983. pp. 166-177 *in* Community and Evolutionary Ecology of North American Stream Fishes. (W.J. Matthews and D.C. Heins, eds.). University of Oklahoma Press. Norman, OK.

Phelps, Q.E., S.J. Tripp, J.E. Garvey, D.P. Herzog, D.E. Ostendorf, J.W. Ridings, J.W. Crites, and R.A Hrabic. 2009. Ecology and habitat use of age-0 paddlefish in the un-impounded Middle Mississippi River. American Fisheries Society Symposium 66:423-440.

Pitlo, J., K Brummett, and M. Endris. 2004. Chanel catfish (Ictalurus punctatus). In: Pitlo, J.M. Jr. and J.L. Rasmussen (eds.). UMRRC Fisheries Compendium. 3rd Edition. Upper Mississippi River Conservation Committee. Rock Island, Illinois. January 2004. p. 151-155.

Reeves, K. 2006. Use of main channel and shallow-water habitat by larval fishes in the lower Missouri River. Ph.D. Dissertation, Graduate School of University of Missouri-Columbia. December 2006. 266 pp.

Reeves, K.S., and D.L. Galat. 2010. Do larval fishes exhibit diel drift patterns in a large, turbid river? Journal of Applied Ichthyology 26:571-577.

Ridenour, C.J., W.J. Doyle, and T.D. Hill. 2011. Habitats of age-0 sturgeon in the lower Missouri River. Transactions of the American Fisheries Society 140(5):1351-1358.

Schloesser, J.T., C.P. Paukert, W.J. Doyle, T.D. Hill, K.D. Steffensen, and V.H. Travnichek. 2011. Fish assemblages at engineered and natural channel structures in the lower Missouri River: Implications for modified dike structures. River Research and Applications 28(10):1695-1707.

Schrank, S.J., P.J. Braaten, and C.S. Guy. 2001. Spatiotemporal variation in density of larval bighead carp in the lower Missouri River. Transactions of the American Fisheries Society 130:809-814.

Schrank, S. J., and C. S. Guy. 2002. Age, growth, and gonadal characteristics of adult Bighead Carp, *Hypophthalmichthys nobilis*, in the lower Missouri River. Environmental Biology of Fishes, 64:443-450.

Tripp, S., D. Herzog, S. Reinagel, and J. McMullen. 2012. Missouri Commercial Fish Harvest. 2000-2012. Missouri Department of Conservation. Final Report. 58 pp.

Underwood, D.M, A.A. Echelle, D.J. Eisenhour, M.D. Jones, A.F. Echelle, and W.L. Fisher. 2003. Genetic variation in western member of the *Macrhybopsis aestivalis* complex (Teleostei: Cyprinidae), with emphasis on those of the Red and Arkansas river basins. Copeia 2003:493-501.

Union Electric Company (UEC). 1974. Callaway Plant Units 1 and 2, environmental baseline inventory. Prepared by Dames and Moore, Inc.

Union Electric Company (UEC). 1976. Callaway Plant Units 1 and 2, preconstruction monitoring – tow year summary 1974-1975. Unpublished report. Prepared by Dames and Moore, Inc.

Union Electric Company (UEC). 1986. Callaway Plant evaluation of cooling water intake impacts on the Missouri River. Section 316b PL 92-500, NPDES Permit No. MO-0098001. Environmental Services Department. July 1986.

U.S. Fish and Wildlife Service (USFWS). 2005. 5-Year Review: Summary and Evaluation of Pallid sturgeon (*Scaphirynchus albus*). Endangered Species Bulletins and Technical Reports. Paper 33. 121 pp.

U.S. Fish and Wildlife Service (USFWS). 2008. Pallid sturgeon (Scaphirynchus albus) Range-wide stocking and augmentation plan. Prepared by Pallid Sturgeon Recovery Team. May 2008.

U.S. Fish and Wildlife Service (USFWS). 2010. Federal Register Notice of Proposed Rule. Threatened Status for Shovelnose Sturgeon Under the Similarity of Appearance Provisions of the Endangered Species Act. August 25, 2010.

U.S. Fish and Wildlife Service (USFWS). 2014. Revised Recovery Plan for the Pallid Sturgeon (*Scaphirhynchus albus*). Denver, Colorado. 115 pp.

U.S. Fish and Wildlife Service (USFWS). 2019. IPaC Trust Resource Report. Generated September 2019. https://ecos.fws.gov/ipac/.

U.S. Geological Survey (USGS). 2005. Update on sturgeon research. Columbia Environmental Research Center, Columbia, Missouri. 14 September 2005.

Wallus, R., T. P. Simon, and B. L. Yeager. 1990-2008. Reproductive biology and early life history of fishes in the Ohio River drainage. Volumes 1-7. Tennessee Valley Authority, Chattanooga, Tennessee.

White, A.M., F.D. Moore, N.A. Alldridge, and D.M. Loucks. 1986. The Effects of Natural Winter Stresses on the Mortality of the Eastern Gizzard Shad, in Lake Erie. Environmental Resource Associates, Inc., and John Carroll University. Prepared for Clevland Electric Illuminating Co., and Ohio Edison Co. Report No. 78. 209 pp.

Wildhaber, M. L., W. H. Yang, and A. Arab. 2014. Population Trends, Bend Use Relative to Available Habitat and Within-River-Bend Habitat Use of Eight Indicator Species of Missouri and Lower Kansas River Benthic Fishes: 15 Years After Baseline Assessment. River Research and Applications. 32:36-65.

Williamson, C. J., and J. E. Garvey. 2005. Growth, fecundity, and diets of newly established Silver Carp in the middle Mississippi River. Transactions of the American Fisheries Society, 134:1423-1430.

Cooling Water System Data
Callaway Energy Center

Submitted in Compliance with
Section 316(b) Rule
40 CFR 122.21(r)(5)

Submitted by:
Ameren Missouri
Saint Louis, Missouri

Developed by:
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St. Louis, MO

December 2019

Table of Contents

List of Figures

List of Appendices

List of Abbreviations and Acronyms

AMSL	above mean sea level
BTA	best technology available
CEC	Callaway Energy Center
CWIS	cooling water intake structure
CWS	cooling water system
DIF	design intake flow
fps	feet per second
ft	foot/feet
gpm	gallons per minute
MGD	million gallons per day
MWe	megawatt electric
MWIS	makeup water intake structure
NPDES	National Pollutant Discharge Elimination System
RM	river mile
TWS	traveling water screen
USEPA	U.S. Environmental Protection Agency

1.0 Introduction

In accordance with Section 316(b) of the Clean Water Act, the U.S. Environmental Protection Agency (USEPA) has promulgated rules under 40 CFR Part 125, Subpart J (the Rule) that require the determination of best technology available (BTA) to reduce mortality associated with the impingement and entrainment of aquatic biota. Section 40 CFR §122.21(r)(5) requires the owner or operator of a facility with a cooling water intake structure (CWIS) to submit cooling water system (CWS) data with an application for a National Pollutant Discharge Elimination System (NPDES) permit. This information, which includes data that is descriptive of the CWS, is required for all facilities regardless of the compliance alternative selected under the Rule.

Specifically, the data required by 40 CFR §122.21(r)(5) is needed to characterize the CWS and provide supporting information for the determination of the appropriate performance standard that should be applied to the facility. Additionally, the information provided is relevant in supporting the reasonableness of the proposed design, construction technologies, operational measures, and restoration actions of the facility for meeting the requirements of the Rule.

Specific information that must be submitted for the facility under 40 CFR §122.21(r)(5) includes the following:

> *(i) A narrative description of the operation of the cooling water system and its relationship to cooling water intake structures; the proportion of the design intake flow that is used in the system; the number of days of the year the cooling water system is in operation and seasonal changes in the operation of the system, if applicable; the proportion of design intake flow for contact cooling, non-contact cooling, and process uses; a distribution of water reuse to include cooling water reused as process water, process water reused for cooling, and the use of gray water for cooling; a description of reductions in total water withdrawals including cooling water intake flow reductions already achieved through minimized process water withdrawals; a description of any cooling water that is used in a manufacturing process either before or after it is used for cooling, including other recycled process water flows; the proportion of the source waterbody withdrawn (on a monthly basis);*
>
> *(ii) Design and engineering calculations prepared by a qualified professional and supporting data to support the description required by paragraph (r)(5)(i) of this section; and*
>
> *(iii) Description of existing impingement and entrainment technologies or operational measures and a summary of their performance, including but not limited to reductions in impingement mortality and entrainment due to intake location and reductions in total water withdrawals and usage.*

The following sections present the information required pursuant to 40 CFR §122.21(r)(5) for Callaway Energy Center (CEC). It should be noted that CEC refers to its CWIS as a makeup water

intake structure (MWIS). This report will use the term MWIS, but it is understood that the two phrases have the same meaning.

2.0 Cooling Water System Data

2.1 Cooling Water System Characteristics

2.1.1 Relationship to the Cooling Water Intake Structure

CEC is located five miles north of the MWIS and approximately 10 miles southeast of Fulton, Missouri in Callaway County. CEC has a single generating unit which consists of a pressurized water reactor, four steam generators, and one steam turbine generator. CEC is operated as a baseload facility and normally operates near its generating capacity of 1,228 megawatts electric (MWe) (net). CEC's average capacity factor from 2015 to 2019 was 89 percent. The value escalates to 98 percent when eliminating days when the plant is shut down. CEC began operations in December of 1984.

CEC is designed with a closed cycle cooling system that obtains makeup water from the Missouri River. The Missouri River is a navigable waterway and is frequently used by barge and recreational boat traffic. The CEC cooling system includes a 555-foot-high hyperbolic natural draft cooling tower. Makeup river water is pumped to the plant's water treatment facility before being fed into the cooling tower basin. CEC has one MWIS that is located on the left descending shoreline of the Missouri River at river mile (RM) 115.4 (Figure 2-1).

The MWIS is an enclosed cast-in-place concrete well structure constructed near the bank of the river. The invert elevation of the MWIS is 486.0 feet (ft) above mean sean level (AMSL). The operating floor of the MWIS is 541.5 ft AMSL. Normal water level is reported as 16 ft above the invert elevation at 502.0 ft AMSL. Minimum design water level is reported as 495.0 ft AMSL. Maximum design water level is reported as 539.0 ft AMSL.

The MWIS is divided into three identical intake bays that each consist of a trash rack at the river face of the intake, sand logs, main closure gates, fish gates, a through-flow traveling water screen (TWS) and an intake pump. Upstream of the TWSs are low velocity fish gates in the sides of the walls of the intake bays that allow fish to escape the intake structures. There is a screen wash system that removes debris and organisms trapped on the mesh and sprays the debris into a trough to be returned to the river. The approach velocity of the TWS is 0.32 feet per second (fps) at the maximum pump flow of 14,000 gallons per minute (gpm) and a normal water level of 16 ft in the intake bay. The spray wash water system is fed from the intake pump header. The spray water is strained to remove small debris before being used as TWS spray wash water and desilting spray water. There are desilting spray heads located near the invert of the MWIS at the main gates, the fish gates, the TWS, and the pump suction tube. The spray wash system also includes inline water heaters that provide warm spray water during cold seasons; however, according to plant staff, these heaters are rarely used.

CEC is a baseload facility and typically operates 24 hours a day, 365 days a year, except during plant outages for refueling. The CEC MWIS utilizes three intake pumps to supply makeup water to the plant's water treatment plant via a 5.5-mile pipeline. The three pumps (A, B, and C) each

withdraw river water from an intake bay. Each intake bay is equipped with a single vertical three-stage centrifugal pump with a maximum rating of 14,000 gpm. The pipeline system includes two discharge valves to control transient surge pressure of water being pumped in the pipeline system. The valves regulate pressure and divert excess water to a discharge box downstream of the MWIS and then back to the river. Generally, CEC operates two of the three pumps to supply makeup water to the plant, and the third pump is held as a backup. During favorable conditions and during plant outages, CEC can supply makeup water with a single intake pump.

It should be noted that the CEC is currently replacing the intake pumps and TWSs. There is a plan to replace one pump and one TWS in 2019, one pump and one TWS in 2020, and one pump and one TWS in 2021. The replacement units are of the same type and capacity as the existing pumps and TWSs.

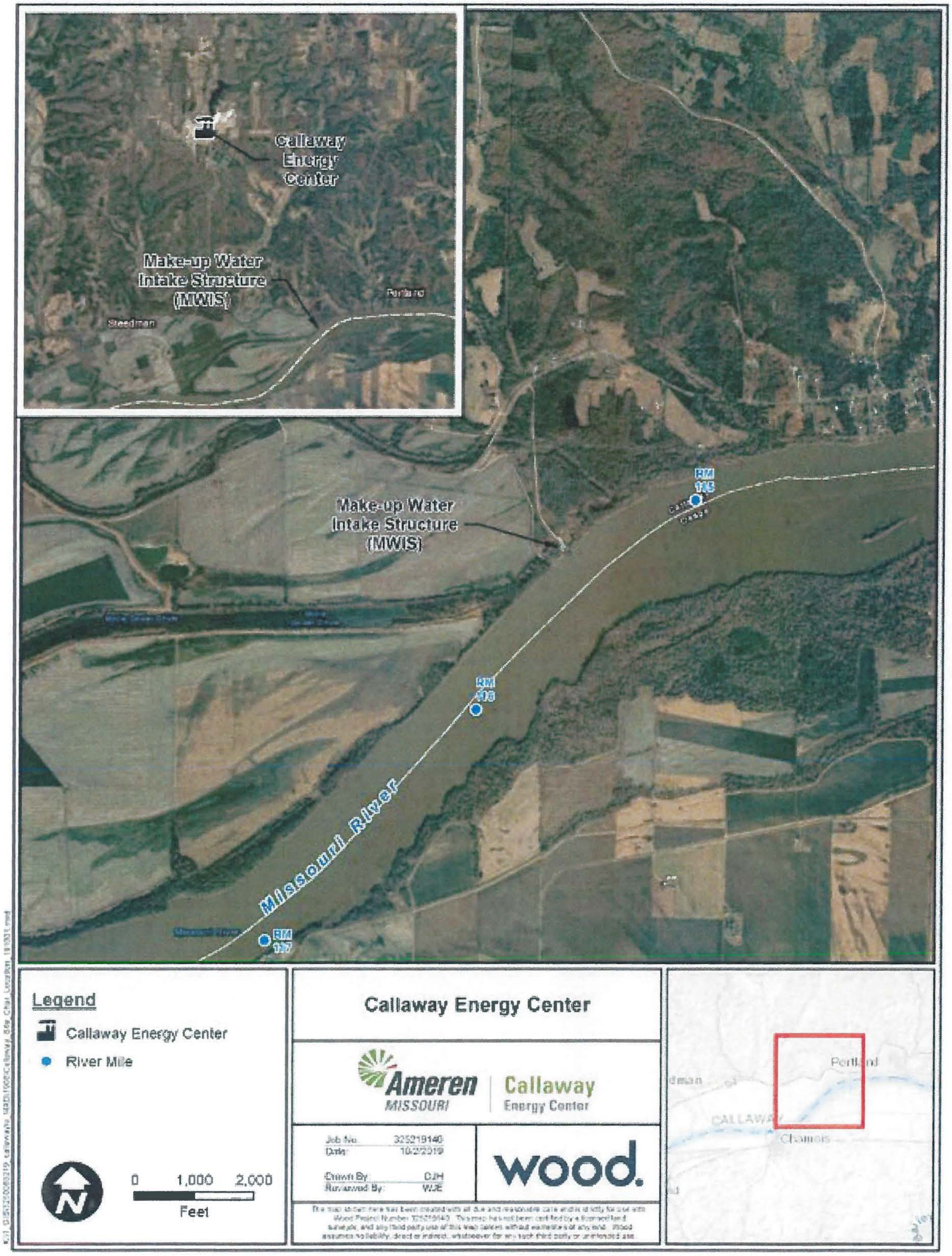


Figure 2-1. Callaway Energy Center Location

2.1.2 Narrative Description of the Proportion of Design Intake Flow That is Used in the System

Most of the intake flow at CEC is piped to the water treatment plant. The water treatement plant conditions the water for use in the circulating water system and the service water system. The only other water use is intake flow that is siphoned from the intake pumps for use as spray wash and desilting spray in the MWIS. This spray wash water is strained before reaching the spray heads. The approximate volume of spray water is 0.36 million gallons per day (MGD). This represents about 1.5 percent of the design intake flow (DIF) of the MWIS.

Once the intake flow is piped to the water treatment plant it is treated in a variety of ways for use in the service water system and the ciculating water system. Approximately 24.5 MGD of treated makeup water is piped by gravity from the treatment plant to the cooling tower basin. Due to the basin's baffling system and the location at which the makeup water enters the basin, it is most accurate to describe the makeup water as being directed into the service water pumping system.

Circulating water and service water are returned to the cooling tower basin by falling through the hyperbolic cooling tower. Water is lost in the system via evaporation and drift. The blowdown system returns about 5.6 MGD back to the Missouri River. The service water system circulates about 55 million gallons of water daily. The cooling water system cycles about 763 million gallons of water daily. Cycles of concentration within the closed cycle cooling system are between 4.2 and 3.8 based on calcium and conductivity levels.

2.1.3 Operation of the Cooling Water System and Seasonal Variation

CEC is a baseload facility and typically operates 24 hours a day, 365 days a year, except during plant outages for refueling. Figure 2-2 provides a summary of the last five years of makeup water intake flow at CEC. The MWIS DIF is 24.5 MGD at the approximate river elevation of 502 ft AMSL. This value varies with the stage of the river and the number of pumps that are running. The plant does not vary generation seasonally nor does it have multiple generating units that cycle on or off. Thus, makeup water demands remain constant, with weather and water quality being the most significant factors affecting the efficiency of the closed cycle cooling system. As designed, and during normal operations, two pumps are typically withdrawing makeup water at CEC. When cooling conditions are favorable, only one pump is required to provide makeup water. During outages, the plant will typically operate one intake pump continuously. The average makeup water intake flow over the past five years has been 18.1 MGD.

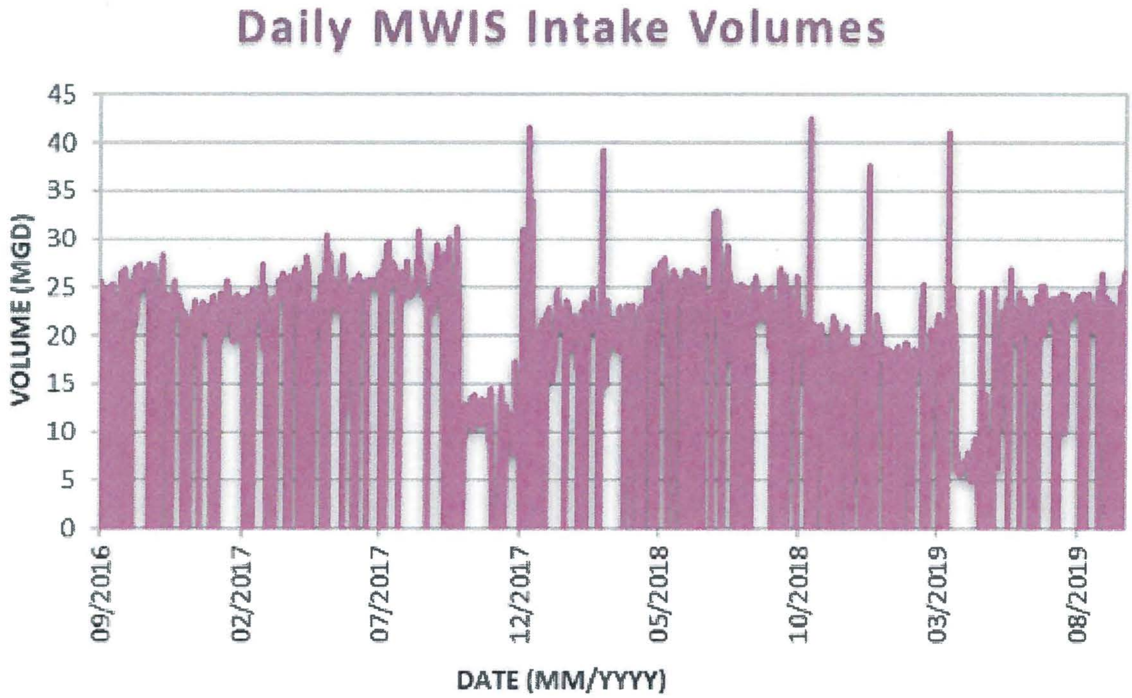


Figure 2-2. Total MWIS Intake Volume

2.1.4 Proportion of the Source Waterbody Withdrawn for Contact Cooling, Non-Contact Cooling and Process Uses

As described in Section 2.1.2, nearly all the water withdrawn from the river is used for non-contact cooling and service water needs at CEC. Within the two systems, service water represents about 6.7 percent of the total circulating water flow, while the remaining 93.3 percent is used for cooling water. However, the makeup water is directed into the cooling tower basin by flowing through the service water pumps first.

2.1.5 Distribution of Water Reuse

The only water reuse at CEC is the withdrawal of water to spray wash the TWSs and to desilt the MWIS before the cooling water is pumped to the treatment plant and to the cooling tower basin. There it is used for service water or cooling water and lost through blowdown back to the Missouri River or through drift or evaporative processes.

2.1.6 A Description of Reductions in Total Water Withdrawals

By operating a closed cycle cooling system, CEC limits source waterbody withdrawals to only makeup water needs. The total circulating water flow for service and cooling water within the plant is

818 MGD. DIF from the river is 24.5 MGD, which represents a makeup water demand of 3.0 percent.

2.1.7 Cooling Water Used in Manufacturing

There are no manufacturing processes at CEC.

2.1.8 The Proportion of the Source Waterbody Withdrawn on a Monthly Basis

The percentage of the source waterbody withdrawn over the past five years, based on actual intake flow, is presented in Figure 2-3. These values are calculated by comparing the monthly average of daily discharge of the Missouri River at the Hermann gage (USGS 06934500) against the actual MWIS monthly average of daily intake flow volume for the corresponding day. The average monthly withdrawal over the past five years was 0.04 percent of the source waterbody. The maximum withdrawal was 0.07 percent, in November and December of 2017. As stated in Section 2.1.3 the plant does not vary generation or intake volume seasonally. When the plant is operating, the withdraw volume is held at a relatively constant rate as shown in Figure 2-2.

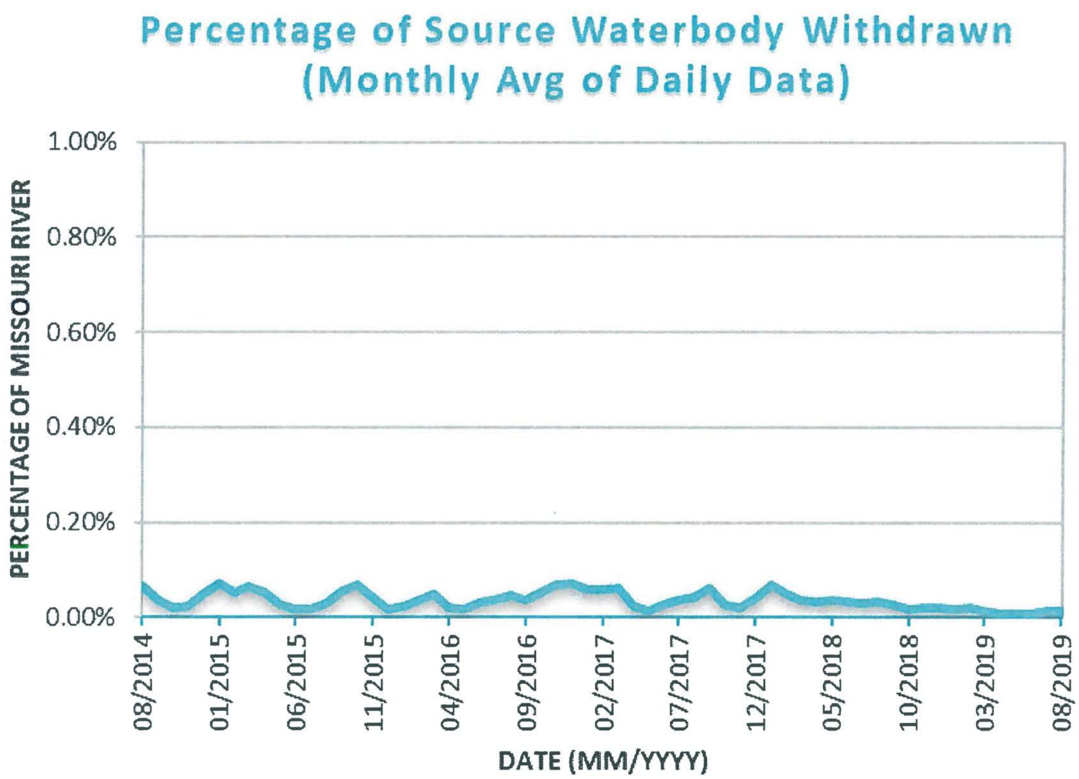


Figure 2-3. Percentage of Source Waterbody Withdrawn

2.2 Design and Engineering Calculations and Supporting Data

Available drawings of the CWS for CEC have been included in Appendix B of this report. The list of drawings included is as follows:

Drawing Number	Drawing Title
Figure 1	Callaway NPDES Flow Diagram

2.3 Description of Existing Impingement and Entrainment Technologies or Operational Measures

CEC operates a closed cycle cooling system. As described in Section 2.1.6, the makeup water flow represents approximately 3.0 percent of the total circulating flow needed. That low makeup water flow results in a corresponding reduction in impingement and entrainment losses at CEC relative to a similar sized base load generating station with once-through cooling.

The MWIS for CEC also includes low velocity fish gates in the side walls of the intake bays upstream of the TWSs that allow fish to escape the structure. The gates separating the bays are typically open when the intake pumps are operating.

Appendix A

Representative Site Photographs

Photo 1: Cooling Water Pumps

Photo 2: Service Water Pumps

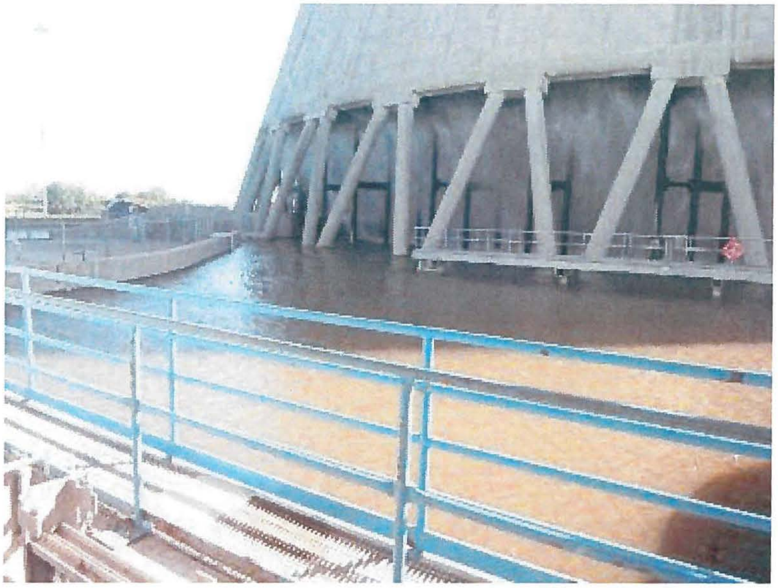


Photo 3: Cooling Tower Basin

Photo 4: Water Treatment Sleeve Valves

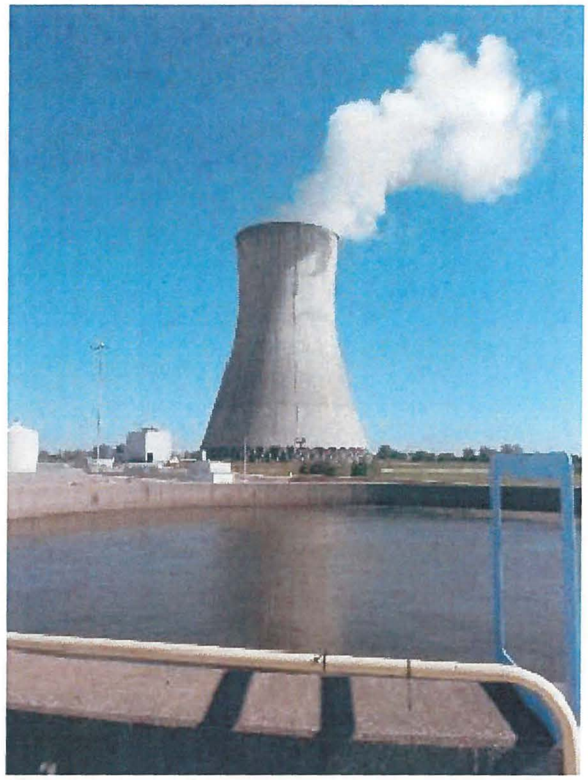
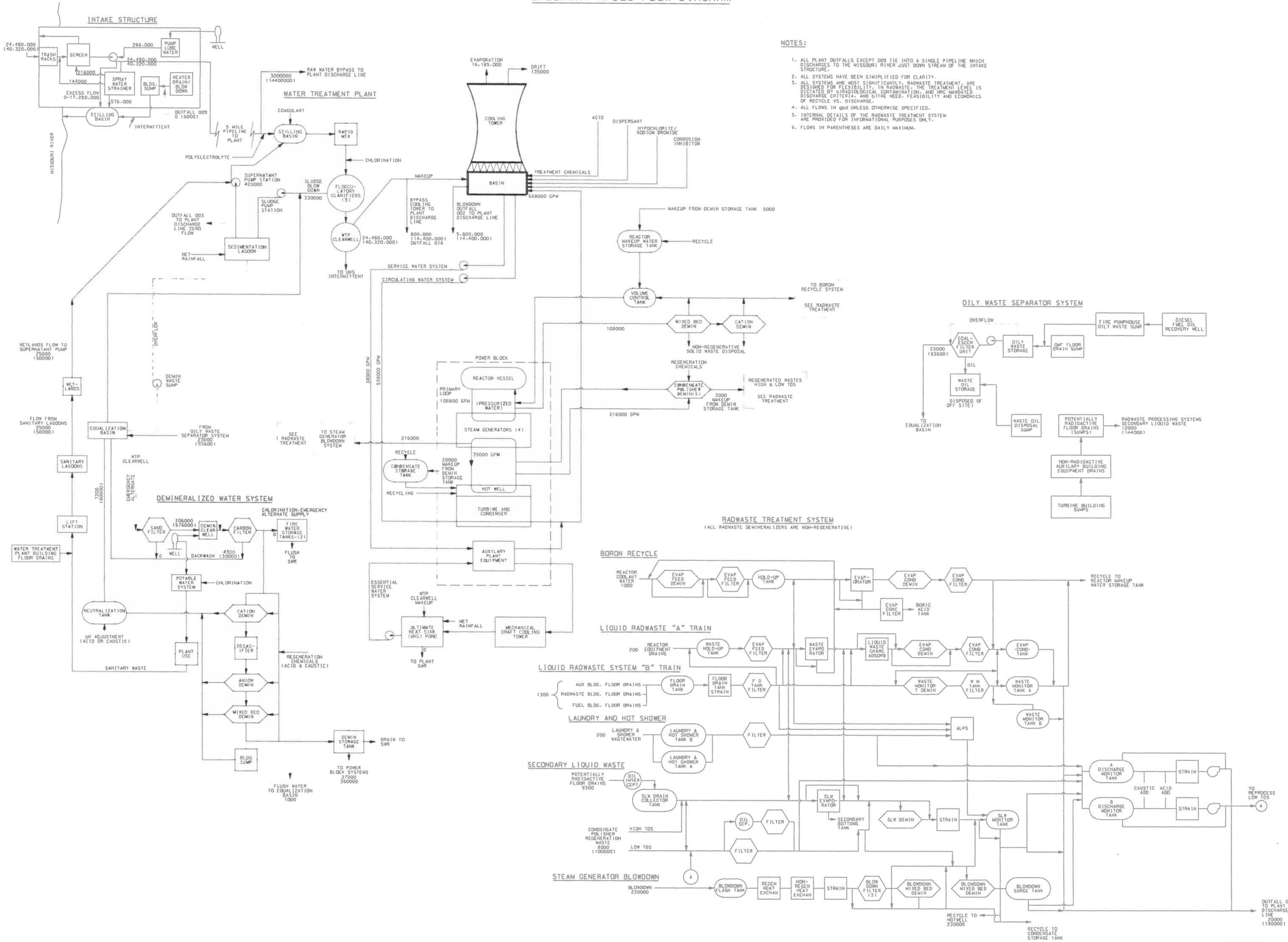


Photo 5: Waste Treatment Plant Clearwell in the foreground and the Natural Draft Cooling Tower in the background

Appendix B

Engineering Drawings

FIGURE 1
CALLAWAY NPDES FLOW DIAGRAM



NOTES:

1. ALL PLANT OUTFALLS EXCEPT 009 TIE INTO A SINGLE PIPELINE WHICH DISCHARGES TO THE MISSOURI RIVER JUST DOWN STREAM OF THE INTAKE STRUCTURE.
2. ALL SYSTEMS HAVE BEEN SIMIPLIFIED FOR CLARITY.
3. ALL SYSTEMS AND MOST SIGNIFICANTLY, RADWASTE TREATMENT, ARE DESIGNED FOR FLEXIBILITY. IN RADWASTE, THE TREATMENT LEVEL IS DICTATED BY o)RADIOLOGICAL CONTAMINATION, AND NRC MANDATED DISCHARGE CRITERIA, AND b)THE NEED, FEASIBILITY AND ECONOMICS OF RECYCLE VS. DISCHARGE.
4. ALL FLOWS IN gpd UNLESS OTHERWISE SPECIFIED.
5. INTERNAL DETAILS OF THE RADWASTE TREATMENT SYSTEM ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY.
6. FLOWS IN PARENTHESES ARE DAILY MAXIMUM.

C4D-0278A
07/02/13

Operational Status Data
Callaway Energy Center

Submitted in Compliance with
Section 316(b) Rule
40 CFR 122.21(r)(8)

Submitted by:

Ameren Missouri

Saint Louis, Missouri

Developed by:

Wood Environment & Infrastructure Solutions, Inc.

St. Louis, MO

December 2019

Table of Contents

List of Figures

List of Tables

List of Abbreviations and Acronyms

BTA	best technology available
CEC	Callaway Energy Center
CWIS	cooling water intake structure
MWHe	megawatt-hours electric
MWe	megawatt electric
MWIS	makeup water intake structure
NPDES	National Pollutant Discharge Elimination System
USNRC	U.S. Nuclear Regulatory Commission
USEPA	U.S. Environmental Protection Agency

1.0 Introduction

In accordance with Section 316(b) of the Clean Water Act, the U.S. Environmental Protection Agency (USEPA) has promulgated rules under 40 CFR Part 125, Subpart J (the Rule) that require the determination of best technology available (BTA) to reduce mortality associated with the impingement and entrainment of aquatic biota. Section 40 CFR §122.21(r)(8) requires the owner or operator of a facility with a cooling water intake structure (CWIS) to submit data that is descriptive of the facility's operational status with an application for a National Pollutant Discharge Elimination System (NPDES) permit. This information is required regardless of the compliance alternative selected under the Rule.

Specifically, the data required by 40 CFR §122.21(r)(8) is needed to characterize the operational status of the facility to provide supporting information for the determination of the appropriate performance standard that should be applied to the facility. Additionally, the information provided is relevant in supporting the reasonableness of the proposed design, construction technologies, operational measures, and restoration actions of the facility for meeting the requirements of the Rule.

In accordance with 40 CFR §122.21(r)(8), specific information that must be submitted for the facility includes the following:

> *(i) For power production or steam generation, descriptions of individual unit operating status including age of each unit, capacity utilization rate (or equivalent) for the previous 5 years, including any extended or unusual outages that significantly affect current data for flow, impingement, entrainment, or other factors, including identification of any operating unit with a capacity utilization rate of less than 8 percent averaged over a 24-month block contiguous period, and any major upgrades completed within the last 15 years, including but not limited to boiler replacement, condenser replacement, turbine replacement, or changes to fuel type;*
>
> *(ii) Descriptions of completed, approved, or scheduled uprates and Nuclear Regulatory Commission relicensing status of each unit at nuclear facilities;*
>
> *(iii) For process units at your facility that use cooling water other than for power production or steam generation, if you intend to use reductions in flow or changes in operations to meet the requirements of 40 CFR 125.94(c), descriptions of individual production processes and product lines, operating status including age of each line, seasonal operation, including any extended or unusual outages that significantly affect current data for flow, impingement, entrainment, or other factors, any major upgrades completed within the last 15 years, and plans or schedules for decommissioning or replacement of process units or production processes and product lines;*
>
> *(iv) For all manufacturing facilities, descriptions of current and future production schedules; and*

(v) Descriptions of plans or schedules for any new units planned within the next 5 years.

[Note: items (iii) and (iv) are not applicable to the Callaway Energy Center]

The following sections present the information required pursuant to 40 CFR §122.21(r)(8) for the Callaway Energy Center (CEC). It should be noted that CEC refers to its CWIS as a makeup water intake structure (MWIS). This report will use the term MWIS, but it is understood that the two phrases have the same meaning.

2.0 Operational Status

2.1 Age of the Units (40 CFR 122.21(8)(4)(i))

CEC, which began operations in December 1984, is located approximately 10 miles southeast of Fulton, Missouri in Callaway County. CEC has a single generating unit which consists of a pressurized water reactor, four steam generators, and one steam turbine generator. CEC is operated as a baseload facility and normally operates near its generating capacity of 1,228 megawatts electric (MWe) (net). CEC has one MWIS that is located on the left descending shoreline of the Missouri River at river mile (RM) 115.4 (Figure 2-1).

2.2 Capacity Utilization for the Previous Five Years (40 CFR 122.21(8)(4)(i))

CEC is a baseload facility and it's average capacity factor (based on net generation versus net capacity) from 2015 to 2019 was 89 percent. Excluding days when the plan was shutdown, the capacity factor was 98 percent. Annual gross and net generation at CEC from 2014 to 2018 is presented in Table 2-1. The five-year net daily generation history for CEC is presented in Figure 2-2. The capacity factors for the past five years are presented in Figure 2-3.

Table 2-1. Callaway Energy Center Generating History

Year	Annual Gross Generation (MWHe)	Annual Net Generation (MWHe)
2014	9,715,347	9,297,338
2015	10,907,502	10,445,078
2016	9,870,348	9,445,580
2017	8,684,710	8,338,454
2018	11,130,178	10,657,752

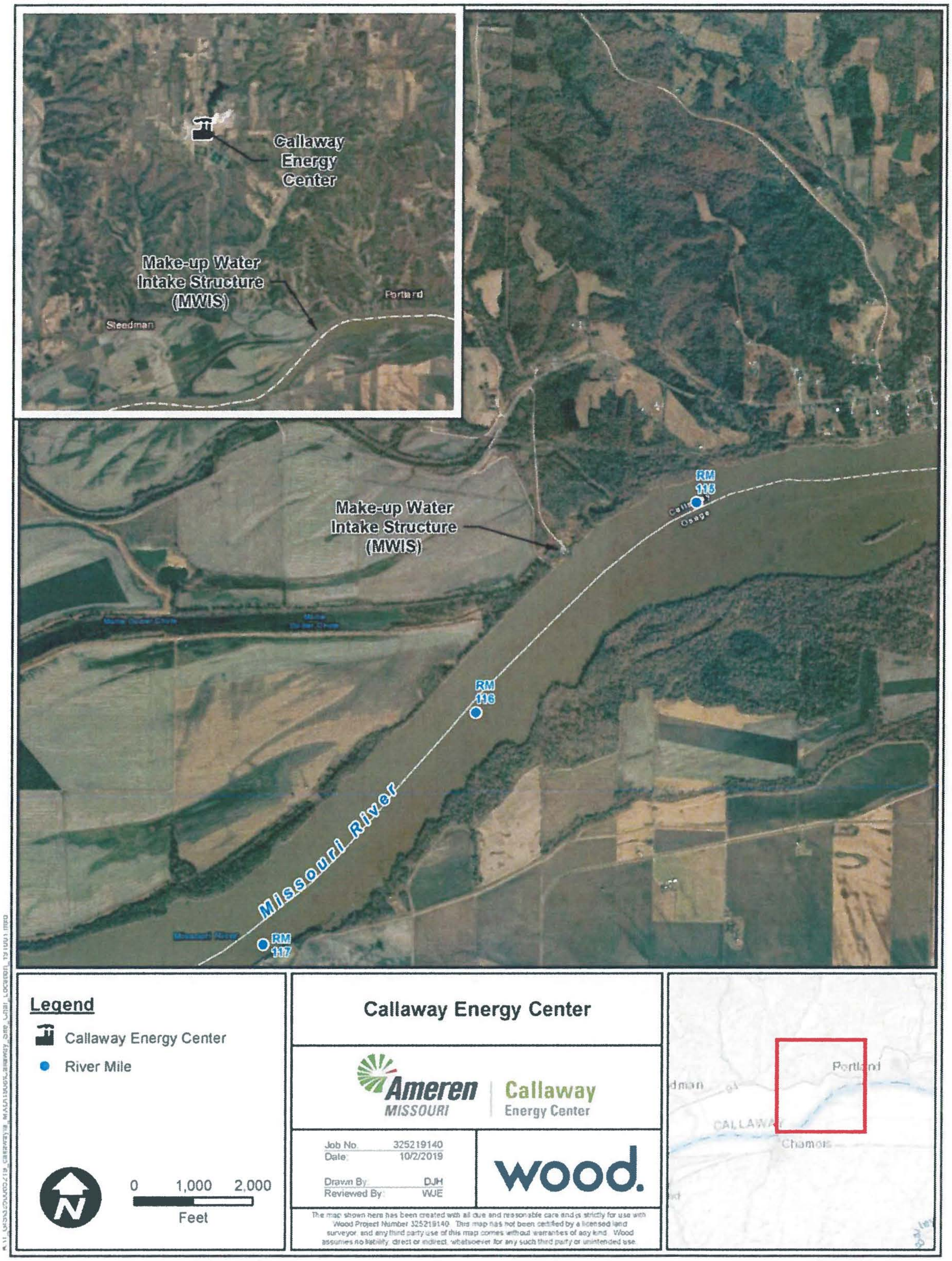


Figure 2-1. Callaway Energy Center Location

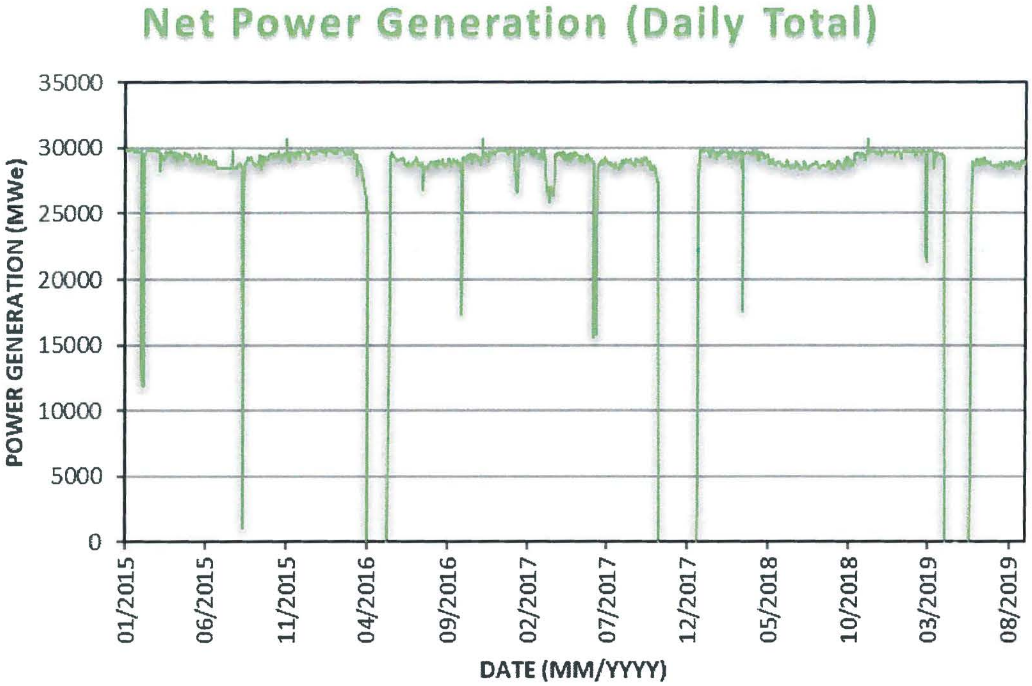


Figure 2-2. Callaway Energy Center 5-Year Power Generation History

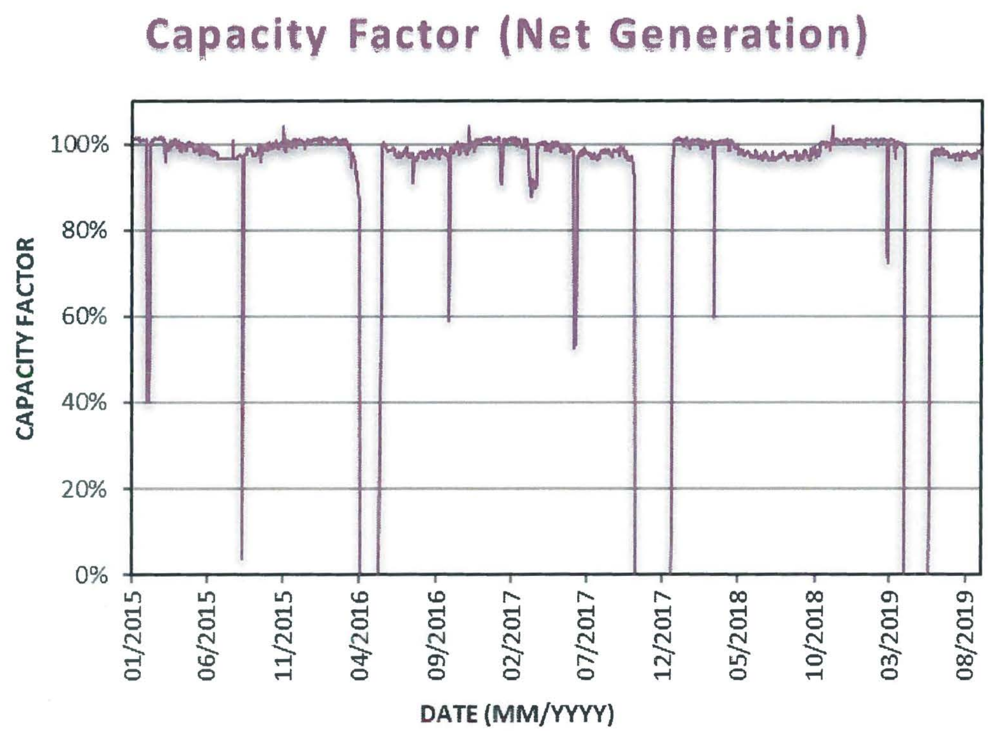


Figure 2-3. Callaway Energy Center 5-Year Capacity Factor History

2.3 Nuclear Regulatory Commission Relicensing Status (40 CFR 122.21(8)(4)(ii))

CEC Unit 1 began commercial operation on December 19, 1984 and its original 40-year operating license (NPF-30) was set to expire in 2024. On December 15, 2011, Ameren Missouri submitted an application for CEC Unit 1 to the U.S. Nuclear Regulatory Commission (USNRC) to issue a renewed license for an additional 20-year period. This renewal was granted by the USNRC in 2015 for an additional 20 years, through October 18, 2044.

2.4 Major Upgrades Completed in the Past 15 Years (40 CFR 122.21(8)(4)(ii))

The CEC has not completed any major projects that would impact water withdrawal in the last 15 years. The CEC has, throughout its operating history, undertaken numerous repairs, maintenance, and efficiency improvement projects at the facility.

2.5 Description of Decommissioning, Unit Replacement or New Units (40 CFR 122.21(8)(4)(v))

CEC began operations in 1984 with a single unit (Unit 1), and there are no known plans to retire this unit. In the past, Ameren had initiated planning steps for a proposed second unit (Unit 2) at CEC. However, planning for Unit 2 has ceased, and there are no current plans for the addition of a second generating unit.