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SEP 09 2026

MR DAVID MULLINS
PLANT MANAGER
OCCIDENTAL CHEMICAL CORPORATION
1010 NORTH WILSON DAM ROAD
MUSCLE SHOALS ALABAMA 35661

RE: DRAFT PERMIT
NPDES PERMIT NUMBER AL0000213

Dear Mr. Mullins:

Transmitted herein is a draft of the referenced permit.

We would appreciate your comments on the permit within **30 days** of the date of this letter. Please direct any comments of a technical or administrative nature to the undersigned.

By copy of this letter and the draft permit, we are also requesting comments within the same time frame from EPA.

Our records indicate that you have utilized the Department's web-based electronic environmental (E2) reporting system for submittal of discharge monitoring reports (DMRs). The Department transitioned from the E2 Reporting System to the Alabama Environmental Permitting and Compliance System (AEPACS) for the submittal of DMRs on November 15, 2021. AEPACS is an electronic system that allows facilities to apply for and maintain permits as well as submit other required applications, registrations, and certifications. In addition, the system allows facilities to submit required compliance reports or other information to the Department. The Department has used the E2 User account information to set up a similar User Profile in AEPACS based on the following criteria:

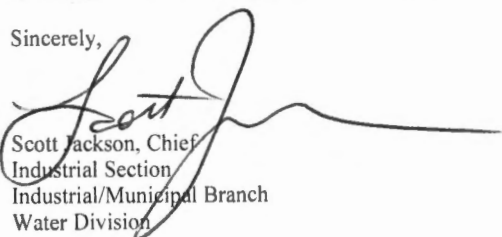
1. The user has logged in to E2 since October 1, 2019; and
2. The E2 user account is set up using a unique email address.

E2 users that met the above criteria will only need to establish an ADEM Web Portal account (<https://prd.adem.alabama.gov/awp>) under the same email address as their E2 account to have the same permissions in AEPACS as they did in E2. They will also automatically be linked to the same facilities they were in E2.

The Alabama Department of Environmental Management encourages you to voluntarily consider pollution prevention practices and alternatives at your facility. Pollution Prevention may assist you in complying with effluent limitations, and possibly reduce or eliminate monitoring requirements.

If you have questions regarding this permit or monitoring requirements, please contact Theo Pinson by e-mail at tpinson@adem.alabama.gov or by phone at (334) 274-4202.

Sincerely,


Scott Jackson, Chief
Industrial Section
Industrial/Municipal Branch
Water Division

Enclosure: Draft Permit

pc via website: Montgomery Field Office
EPA Region IV
U.S. Fish & Wildlife Service
AL Historical Commission
Advisory Council on Historic Preservation
Department of Conservation and Natural Resources



Birmingham Office
110 Vulcan Road
Birmingham, AL 35209-4702
(205) 942-6168
(205) 941-1603 (FAX)

Decatur Office
2715 Sandlin Road, S.W.
Decatur, AL 35603-1333
(256) 353-1713
(256) 340-9359 (FAX)

Coastal Office
1615 South Broad Street
Mobile, AL 36605
(251) 450-3400
(251) 479-2593 (FAX)

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

PERMITTEE: OCCIDENTAL CHEMICAL CORPORATION

FACILITY LOCATION: OCCIDENTAL CHEMICAL CORPORATION
1010 NORTH WILSON DAM ROAD
MUSCLE SHOALS, ALABAMA 35661
COLBERT COUNTY

PERMIT NUMBER: AL0000213

RECEIVING WATERS: 001 - POND CREEK
003 - UNNAMED TRIBUTARY TO POND CREEK
006 - POND CREEK

In accordance with and subject to the provisions of the Federal Water Pollution Control Act, as amended, 33 U.S.C. §§1251-1388 (the "FWPCA"); the Alabama Water Pollution Control Act, as amended, Code of Alabama 1975, §§ 22-22-1 to 22-22-14 (the "AWPCA"), the Alabama Environmental Management Act, as amended, Code of Alabama 1975, §§22-22A-1 to 22-22A-17, and rules and regulations adopted thereunder, and subject further to the terms and conditions set forth in this permit, the Permittee is hereby authorized to discharge into the above-named receiving waters.

ISSUANCE DATE:

EFFECTIVE DATE:

EXPIRATION DATE:

DRAFT

Alabama Department of Environmental Management
Water Division Chief

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PART I: DISCHARGE LIMITATIONS, CONDITIONS, AND REQUIREMENTS**A. DISCHARGE LIMITATIONS AND MONITORING REQUIREMENTS**

DSN0011: Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff 3/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency ²	Sample Type ¹	Seasonal
Temperature, Water Deg. Fahrenheit (00011) 4/ 5/ Effluent Gross Value	*****	*****	*****	*****	*****	90.0 Daily Average	deg F	Continuous	Recorder	All Months
Oxygen, Dissolved (DO) (00300) 6/ Effluent Gross Value	*****	*****	*****	3.0 Minimum Daily	*****	*****	mg/l	Monthly	Grab	All Months
pH (00400) 7/ Effluent Gross Value	*****	*****	*****	(Report) Minimum Daily	*****	(Report) Maximum Daily	S.U.	Continuous	Recorder	All Months
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	All Months
Nitrogen, Ammonia Total (As N) (00610) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	All Months
Nitrogen, Kjeldahl Total (As N) (00625) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	Apr, May, Jun, Jul, Aug, Sep
Nitrite Plus Nitrate Total I Det. (As N) (00630) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	Apr, May, Jun, Jul, Aug, Sep
Phosphorus, Total (As P) (00665) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	Apr, May, Jun, Jul, Aug, Sep

**THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE
OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.**

- 1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.
- 2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.
- 3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.
- 4/ Temperature shall be monitored as a time-weighted average over the course of a 24-hour calendar day.
- 5/ "Continuous" as it applies to temperature shall mean a minimum of one measurement taken at least every 20 minutes.
- 6/ DO Monitoring and compliance shall occur at the base of the flume on the west side of Highway 133.
- 7/ Where the pH of wastewater is measured continuously, the total time during which the pH values are outside the required range of 6.0 to 8.5 standard units shall not exceed 7 hours and 26 minutes in any calendar month and no individual excursion from the required range of pH values shall exceed 60 minutes in duration.

DSN0011 (Continued): Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff 3/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency ²	Sample Type ¹	Seasonal
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	(Report) Monthly Average	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Continuous	Totalizer	All Months
Chlorine, Total Residual (50060) 8/ Effluent Gross Value	*****	*****	*****	*****	*****	0.022 Maximum Daily	mg/l	Monthly	Grab	All Months
Mercury Total Recoverable (71901) 9/ Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	ug/l	Monthly	Grab	All Months
BOD, Carbonaceous 05 Day, 20C (80082) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	All Months
pH Range Excursions, > 60 Minutes (82581) 7/ Effluent Gross Value	*****	0.0 Maximum Monthly	occur/month	*****	*****	*****	*****	Monthly	Calculated	All Months
pH Range Excursions, Monthly Total Accumulation (82582) 7/ Effluent Gross Value	*****	446.0 Maximum Monthly	min	*****	*****	*****	*****	Monthly	Calculated	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

- 1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.
- 2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.
- 3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.
- 4/ Temperature shall be monitored as a time-weighted average over the course of a 24-hour calendar day.
- 5/ "Continuous" as it applies to temperature shall mean a minimum of one measurement taken at least every 20 minutes.
- 6/ DO Monitoring and compliance shall occur at the base of the flume on the west side of Highway 133.
- 7/ Where the pH of wastewater is measured continuously, the total time during which the pH values are outside the required range of 6.0 to 8.5 standard units shall not exceed 7 hours and 26 minutes in any calendar month and no individual excursion from the required range of pH values shall exceed 60 minutes in duration.
- 8/ A measurement of Total Residual Chlorine below 0.05 mg/L shall be considered in compliance with the permit limitations above and should be reported as NODI=B or *B on the discharge monitoring report.
- 9/ EPA Methods 1631E/1669, or alternative methods specifically approved by the Department, shall be used for the analysis of this parameter. For the purpose of demonstration of compliance with this parameter, "Total" and "Total Recoverable" shall be considered equivalent. See Part IV.F for Mercury Minimization Plan (MMP) Requirements.

DSN001S: Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff 3/ 4/ 5/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency ²	Sample Type ¹	Seasonal
pH (00400) Effluent Gross Value	*****	*****	*****	(Report) Minimum Daily	*****	(Report) Maximum Daily	S.U.	Semi-Annually	Grab	All Months
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Semi-Annually	Grab	All Months
Oil & Grease (00556) Effluent Gross Value	*****	*****	*****	*****	*****	15.0 Maximum Daily	mg/l	Semi-Annually	Grab	All Months
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	*****	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Semi-Annually	Instantaneous	All Months
Chemical Oxygen Demand (COD) (81017) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Semi-Annually	Grab	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

- 1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.
- 2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.
- 3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.
- 4/ See Part IV.B for Stormwater Measurement and Sampling Requirements.
- 5/ Sample shall be collected during a qualifying storm event.

DSN001T: Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff 3/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency ²	Sample Type ¹	Seasonal
Toxicity, Ceriodaphnia Acute (61425) 4/ Effluent Gross Value	*****	0 Single Sample	pass=0;fail=1	*****	*****	*****	*****	Annually	Composite	All Months
Toxicity, Pimephales Acute (61427) 5/ Effluent Gross Value	*****	0 Single Sample	pass=0;fail=1	*****	*****	*****	*****	Annually	Composite	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

- 1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.
- 2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.
- 3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.
- 4/ See Part IV.D for Ceriodaphnia Acute Toxicity Biomonitoring Requirements.
- 5/ See Part IV.E for Pimephales Acute Toxicity Biomonitoring Requirements.

DSN001Y: Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff 3/ 4/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency ²	Sample Type ¹	Seasonal
Arsenic, Total Recoverable (00978) 5/ Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	ug/l	Annually	Grab	All Months
Cyanide, Free Available (51173) 6/ Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	ug/l	Annually	Grab	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

- 1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.
- 2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.
- 3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.
- 4/ Sample shall **NOT** be collected during a precipitation event.
- 5/ For the purpose of demonstration of compliance with this parameter, "Total" and "Total Recoverable" shall be considered equivalent.
- 6/ For the purpose of demonstration of compliance with this parameter, "Cyanide, Free Available" and "Cyanide, Free" shall be considered equivalent. The test methods listed in 40 CFR 136.3 Table 1B for "24.A Cyanide, Free" or equivalent EPA approved methods shall be used for analysis.

DSN003S: Stormwater runoff associated with the production of potassium carbonate and potassium bicarbonate including the rail yard and tank car storage areas 3/ 4/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency ²	Sample Type ¹	Seasonal
pH (00400) Effluent Gross Value	*****	*****	*****	(Report) Minimum Daily	*****	(Report) Maximum Daily	S.U.	Semi-Annually	Grab	All Months
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Semi-Annually	Grab	All Months
Oil & Grease (00556) Effluent Gross Value	*****	*****	*****	*****	*****	15.0 Maximum Daily	mg/l	Semi-Annually	Grab	All Months
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	*****	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Semi-Annually	Estimate	All Months
Chemical Oxygen Demand (COD) (81017) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Semi-Annually	Grab	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

- 1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.
- 2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.
- 3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.
- 4/ See Part IV.B for Stormwater Measurement and Sampling Requirements.

DSN006: Rinse waters from the employee car wash and stormwater runoff associated with the employee car wash, maintenance building, employee parking areas, and the plant entrance road 1/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

1/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.

B. DISCHARGE MONITORING AND RECORD KEEPING REQUIREMENTS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge and shall be in accordance with the provisions of this permit.

2. Test Procedures

For the purpose of reporting and compliance, permittees shall use one of the following procedures:

- a. For parameters with an EPA established Minimum Level (ML), report the measured value if the analytical result is at or above the ML and report "0" for values below the ML. Test procedures for the analysis of pollutants shall conform to 40 CFR Part 136 and guidelines published pursuant to Section 304(h) of the FWPCA, 33 U.S.C. Section 1314(h). If more than one method for analysis of a substance is approved for use, a method having a minimum level lower than the permit limit shall be used. If the minimum level of all methods is higher than the permit limit, the method having the lowest minimum level shall be used and a report of less than the minimum level shall be reported as zero and will constitute compliance; however, should EPA approve a method with a lower minimum level during the term of this permit the permittee shall use the newly approved method.
- b. For pollutants parameters without an established ML, an interim ML may be utilized. The interim ML shall be calculated as 3.18 times the Method Detection Level (MDL) calculated pursuant to 40 CFR Part 136, Appendix B.

Permittees may develop an effluent matrix-specific ML, where an effluent matrix prevents attainment of the established ML. However, a matrix specific ML shall be based upon proper laboratory method and technique. Matrix-specific MLs must be approved by the Department, and may be developed by the permittee during permit issuance, reissuance, modification, or during compliance schedule.

In either case the measured value should be reported if the analytical result is at or above the ML and "0" reported for values below the ML.

- c. For parameters without an EPA established ML, interim ML, or matrix-specific ML, a report of less than the detection limit shall constitute compliance if the detection limit of all analytical methods is higher than the permit limit using the most sensitive EPA approved method. For the purpose of calculating a monthly average, "0" shall be used for values reported less than the detection limit.

The Minimum Level utilized for procedures A and B above shall be reported on the permittee's DMR. When an EPA approved test procedure for analysis of a pollutant does not exist, the Director shall approve the procedure to be used.

3. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

- a. The facility name and location, point source number, date, time and exact place of sampling;
- b. The name(s) of person(s) who obtained the samples or measurements;
- c. The dates and times the analyses were performed;
- d. The name(s) of the person(s) who performed the analyses;
- e. The analytical techniques or methods used, including source of method and method number; and
- f. The results of all required analyses.

4. Records Retention and Production

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the above reports or the application for this permit, for a period of at least three years from the date of the sample measurement, report or application. This period may be extended by request of the Director at any time. If litigation or other enforcement action, under the AWPCA and/or the FWPCA, is ongoing which involves any of the above records, the records shall be kept until the litigation is resolved. Upon the written request of the Director or his designee, the

permittee shall provide the Director with a copy of any record required to be retained by this paragraph. Copies of these records shall not be submitted unless requested.

All records required to be kept for a period of three years shall be kept at the permitted facility or an alternate location approved by the Department in writing and shall be available for inspection.

5. Monitoring Equipment and Instrumentation

All equipment and instrumentation used to determine compliance with the requirements of this permit shall be installed, maintained, and calibrated in accordance with the manufacturer's instructions or, in the absence of manufacturer's instructions, in accordance with accepted practices. The permittee shall develop and maintain quality assurance procedures to ensure proper operation and maintenance of all equipment and instrumentation. The quality assurance procedures shall include the proper use, maintenance, and installation, when appropriate, of monitoring equipment at the plant site.

C. DISCHARGE REPORTING REQUIREMENTS

1. Reporting of Monitoring Requirements

- a. The permittee shall conduct the required monitoring in accordance with the following schedule:

MONITORING REQUIRED MORE FREQUENTLY THAN MONTHLY AND MONTHLY shall be conducted during the first full month following the effective date of coverage under this permit and every month thereafter.

QUARTERLY MONITORING shall be conducted at least once during each calendar quarter. Calendar quarters are the periods of January through March, April through June, July through September, and October through December. The permittee shall conduct the quarterly monitoring during the first complete calendar quarter following the effective date of this permit and is then required to monitor once during each quarter thereafter. Quarterly monitoring may be done anytime during the quarter, unless restricted elsewhere in this permit, but it should be submitted with the last DMR due for the quarter, i.e., (March, June, September and December DMR's).

SEMIANNUAL MONITORING shall be conducted at least once during the period of January through June and at least once during the period of July through December. The permittee shall conduct the semiannual monitoring during the first complete calendar semiannual period following the effective date of this permit and is then required to monitor once during each semiannual period thereafter. Semiannual monitoring may be done anytime during the semiannual period, unless restricted elsewhere in this permit, but it should be submitted with the last DMR for the month of the semiannual period, i.e. (June and December DMR's).

ANNUAL MONITORING shall be conducted at least once during the period of January through December. The permittee shall conduct the annual monitoring during the first complete calendar annual period following the effective date of this permit and is then required to monitor once during each annual period thereafter. Annual monitoring may be done anytime during the year, unless restricted elsewhere in this permit, but it should be submitted with the December DMR.

- b. The permittee shall submit discharge monitoring reports (DMRs) on the forms provided by the Department and in accordance with the following schedule:

REPORTS OF MORE FREQUENTLY THAN MONTHLY AND MONTHLY TESTING shall be submitted on a **monthly** basis. The first report is due on the **28th day of (MONTH, YEAR)**. The reports shall be submitted so that they are received by the Department no later than the 28th day of the month following the reporting period.

REPORTS OF QUARTERLY TESTING shall be submitted on a **quarterly** basis. The first report is due on the **28th day of [Month, Year]**. The reports shall be submitted so that they are received by the Department no later than the 28th day of the month following the reporting period.

REPORTS OF SEMIANNUAL TESTING shall be submitted on a semiannual basis. The reports are due on the 28th day of JANUARY and the 28th day of JULY. The reports shall be submitted so that they are received by the Department no later than the 28th day of the month following the reporting period.

REPORTS OF ANNUAL TESTING shall be submitted on an annual basis. The first report is due on the 28th day of JANUARY. The reports shall be submitted so that they are received by the Department no later than the 28th day of the month following the reporting period.

- c. Except as allowed by Provision I.C.1.c.(1) or (2), the permittee shall submit all Discharge Monitoring Reports (DMRs) required by Provision I.C.1.b electronically.

- (1) If the permittee is unable to complete the electronic submittal of DMR data due to technical problems originating with the Department's electronic system (this could include entry/submittal issues with an entire set of DMRs or individual parameters), the permittee is not relieved of their obligation to submit DMR data to the Department by the date specified in Provision I.C.1.b, unless otherwise directed by the Department.

If the Department's electronic system is down on the 28th day of the month in which the DMR is due or is down for an extended period of time, as determined by the Department, when a DMR is required to be submitted, the permittee may submit the data in an alternate manner and format acceptable to the Department. Preapproved alternate acceptable methods include faxing, e-mailing, mailing, or hand-delivery of data such that they are received by the required reporting date. Within 5 calendar days of the Department's electronic system resuming operation, the permittee shall enter the data into the Department's electronic system, unless an alternate timeframe is approved by the Department. A comment should be included on the electronic DMR submittal verifying the original submittal date (date of the fax, copy of the dated e-mail, or hand-delivery stamped date), if applicable.

- (2) The permittee may submit a request to the Department for a temporary electronic reporting waiver for DMR submittals. The waiver request should include the permit number; permittee name; facility/site name; facility address; name, address, and contact information for the responsible official or duly authorized representative; a detailed statement regarding the basis for requesting such a waiver; and the duration for which the waiver is requested. Approved electronic reporting waivers are not transferrable.

Permittees with an approved electronic reporting waiver for DMRs may submit hard copy DMRs for the period that the approved electronic reporting waiver request is effective. The permittee shall submit the Department-approved DMR forms to the address listed in Provision I.C.1.e.

- (3) If a permittee is allowed to submit a hard copy DMR, the DMR must be legible and bear an original signature. Photo and electronic copies of the signature are not acceptable and shall not satisfy the reporting requirements of this permit.
 - (4) If the permittee, using approved analytical methods as specified in Provision I.B.2, monitors any discharge from a point source for a limited substance identified in Provision I.A. of this permit more frequently than required by this permit, the results of such monitoring shall be included in the calculation and reporting of values on the DMR and the increased frequency shall be indicated on the DMR.
 - (5) In the event no discharge from a point source identified in Provision I.A. of this permit and described more fully in the permittee's application occurs during a monitoring period, the permittee shall report "No Discharge" for such period on the appropriate DMR.
- d. All reports and forms required to be submitted by this permit, the AWPCA and the Department's Rules, shall be electronically signed (or, if allowed by the Department, traditionally signed) by a "responsible official" of the permittee as defined in ADEM Administrative Code Rule 335-6-6-.09 or a "duly authorized representative" of such official as defined in ADEM Administrative Code Rule 335-6-6-.09 and shall bear the following 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 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."

- e. Discharge Monitoring Reports required by this permit, the AWPCA, and the Department's Rules that are being submitted in hard copy shall be addressed to:

Alabama Department of Environmental Management
Water Division
Office of Water Services
Post Office Box 301463
Montgomery, Alabama 36130-1463

Certified and Registered Mail containing Discharge Monitoring Reports shall be addressed to:

Alabama Department of Environmental Management
Water Division
Office of Water Services
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

- f. All other correspondence and reports required to be submitted by this permit, the AWPCA, and the Department's Rules shall be addressed to:

Alabama Department of Environmental Management
Water Division
Post Office Box 301463
Montgomery, Alabama 36130-1463

Certified and Registered Mail shall be addressed to:

Alabama Department of Environmental Management
Water Division
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

- g. If this permit is a re-issuance, then the permittee shall continue to submit DMRs in accordance with the requirements of their previous permit until such time as DMRs are due as discussed in Part I.C.1.b above.

2. Noncompliance Notification

a. 24-Hour Noncompliance Reporting

The permittee shall report to the Director, within 24-hours of becoming aware of the noncompliance, any noncompliance which may endanger health or the environment. This shall include but is not limited to the following circumstances:

- (1) does not comply with any daily minimum or maximum discharge limitation for an effluent characteristic specified in Provision I. A. of this permit which is denoted by an "(X)";
- (2) threatens human health or welfare, fish or aquatic life, or water quality standards;
- (3) does not comply with an applicable toxic pollutant effluent standard or prohibition established under Section 307(a) of the FWPCA, 33 U.S.C. Section 1317(a);
- (4) contains a quantity of a hazardous substance which has been determined may be harmful to public health or welfare under Section 311(b)(4) of the FWPCA, 33 U.S.C. Section 1321(b)(4);
- (5) exceeds any discharge limitation for an effluent characteristic as a result of an unanticipated bypass or upset; and
- (6) is an unpermitted direct or indirect discharge of a pollutant to a water of the state (unpermitted discharges properly reported to the Department under any other requirement are not required to be reported under this provision).

The permittee shall orally report the occurrence and circumstances of such discharge to the Director within 24-hours after the permittee becomes aware of the occurrence of such discharge. In addition to the oral report, the permittee shall submit to the Director or Designee a written report as provided in Part I.C.2.c no later than five (5) days after becoming aware of the occurrence of such discharge.

- b. If for any reason, the permittee's discharge does not comply with any limitation of this permit, the permittee shall submit to the Director or Designee a written report as provided in Part I.C.2.c below, such report shall be submitted with the next Discharge Monitoring Report required to be submitted by Part I.C.1 of this permit after becoming aware of the occurrence of such noncompliance.
- c. Any written report required to be submitted to the Director or Designee by Part I.C.2 a. or b. shall be submitted using a Noncompliance Notification Form (ADEM Form 421) available on the Department's website (<http://adem.alabama.gov/DeptForms/Form421.pdf>) and include the following information:
- (1) A description of the discharge and cause of noncompliance;

- (2) The period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and
- (3) A description of the steps taken and/or being taken to reduce or eliminate the noncomplying discharge and to prevent its recurrence.

D. OTHER REPORTING AND NOTIFICATION REQUIREMENTS

1. Anticipated Noncompliance

The permittee shall give the Director written advance notice of any planned changes or other circumstances regarding a facility which may result in noncompliance with permit requirements.

2. Termination of Discharge

The permittee shall notify the Director, in writing, when all discharges from any point source(s) identified in Provision I. A. of this permit have permanently ceased. This notification shall serve as sufficient cause for instituting procedures for modification or termination of the permit.

3. Updating Information

- a. The permittee shall inform the Director of any change in the permittee's mailing address, telephone number or in the permittee's designation of a facility contact or office having the authority and responsibility to prevent and abate violations of the AWPCA, the Department's Rules, and the terms and conditions of this permit, in writing, no later than ten (10) days after such change. Upon request of the Director or his designee, the permittee shall furnish the Director with an update of any information provided in the permit application.
- b. If the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information with a written explanation for the mistake and/or omission.

4. Duty to Provide Information

The permittee shall furnish to the Director, within a reasonable time, any information which the Director or his designee may request to determine whether cause exists for modifying, revoking and re-issuing, suspending, or terminating this permit, in whole or in part, or to determine compliance with this permit.

5. Cooling Water and Boiler Water Additives

- a. The permittee shall notify the Director in writing not later than thirty (30) days prior to instituting the use of any biocide corrosion inhibitor or chemical additive in a cooling or boiler system, not identified in the application for this permit, from which discharge is allowed by this permit. Notification is not required for additives that do not contain a heavy metal(s) as an active ingredient and that pass through a wastewater treatment system prior to discharge nor is notification required for additives that should not reasonably be expected to cause the cooling water or boiler water to exhibit toxicity as determined by analysis of manufacturer's data or testing by the permittee. Such notification shall include:
 - (1) name and general composition of biocide or chemical;
 - (2) 96-hour median tolerance limit data for organisms representative of the biota of the waterway into which the discharge will ultimately reach;
 - (3) quantities to be used;
 - (4) frequencies of use;
 - (5) proposed discharge concentrations; and
 - (6) EPA registration number, if applicable.
- b. The use of a biocide or additive containing tributyl tin, tributyl tin oxide, zinc, chromium or related compounds in cooling or boiler system(s), from which a discharge regulated by this permit occurs, is prohibited except as exempted below. The use of a biocide or additive containing zinc, chromium or related compounds may be used in special circumstances if (1) the permit contains limits for these substances, or (2) the applicant demonstrates during the application process that the use of zinc, chromium or related compounds as a biocide or additive will not pose a reasonable potential to violate the applicable State water quality standards for these substances. The use of any additive, not identified in this permit or in the

application for this permit or not exempted from notification under this permit is prohibited, prior to a determination by the Department that permit modification to control discharge of the additive is not required or prior to issuance of a permit modification controlling discharge of the additive.

6. Permit Issued Based on Estimated Characteristics

- a. If this permit was issued based on estimates of the characteristics of a process discharge reported on an EPA NPDES Application Form 2D (EPA Form 3510-2D), the permittee shall complete and submit an EPA NPDES Application Form 2C (EPA Form 3510-2C) no later than two years after the date that discharge begins. Sampling required for completion of the Form 2C shall occur when a discharge(s) from the process(s) causing the new or increased discharge is occurring. If this permit was issued based on estimates concerning the composition of a stormwater discharge(s), the permittee shall perform the sampling required by EPA NPDES Application Form 2F (EPA Form 3510-2F) no later than one year after the industrial activity generating the stormwater discharge has been fully initiated.
- b. This permit shall be reopened if required to address any new information resulting from the completion and submittal of the Form 2C and or 2F.

E. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the discharge limitations specified in Provision I. A. in accordance with the following schedule:

COMPLIANCE SHALL BE ATTAINED ON THE EFFECTIVE DATE OF THIS PERMIT

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

PART II: OTHER REQUIREMENTS, RESPONSIBILITIES, AND DUTIES**A. OPERATIONAL AND MANAGEMENT REQUIREMENTS****1. Facilities Operation and Maintenance**

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities only when necessary to achieve compliance with the conditions of the permit.

2. Best Management Practices

- a. Dilution water shall not be added to achieve compliance with discharge limitations except when the Director or his designee has granted prior written authorization for dilution to meet water quality requirements.
- b. The permittee shall prepare, implement, and maintain a Spill Prevention, Control and Countermeasures (SPCC) Plan in accordance with 40 C.F.R. Section 112 if required thereby.
- c. The permittee shall prepare, submit for approval and implement a Best Management Practices (BMP) Plan for containment of any or all process liquids or solids, in a manner such that these materials do not present a significant potential for discharge, if so required by the Director or his designee. When submitted and approved, the BMP Plan shall become a part of this permit and all requirements of the BMP Plan shall become requirements of this permit.

3. Spill Prevention, Control, and Management

The permittee shall provide spill prevention, control, and/or management sufficient to prevent any spills of pollutants from entering a water of the state or a publicly or privately owned treatment works. Any containment system used to implement this requirement shall be constructed of materials compatible with the substance(s) contained and which shall prevent the contamination of groundwater and such containment system shall be capable of retaining a volume equal to 110 percent of the capacity of the largest tank for which containment is provided.

B. OTHER RESPONSIBILITIES**1. Duty to Mitigate Adverse Impacts**

The permittee shall promptly take all reasonable steps to mitigate and minimize or prevent any adverse impact on human health or the environment resulting from noncompliance with any discharge limitation specified in Provision I. A. of this permit, including such accelerated or additional monitoring of the discharge and/or the receiving waterbody as necessary to determine the nature and impact of the noncomplying discharge.

2. Right of Entry and Inspection

The permittee shall allow the Director, or an authorized representative, upon the presentation of proper credentials and other documents as may be required by law to:

- a. enter upon the permittee's premises where a regulated facility or activity or point source is located or conducted, or where records must be kept under the conditions of the permit;
- b. have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit;
- c. inspect any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under the permit; and
- d. sample or monitor, for the purposes of assuring permit compliance or as otherwise authorized by the AWPCA, any substances or parameters at any location.

C. BYPASS AND UPSET**1. Bypass**

- a. Any bypass is prohibited except as provided in b. and c. below:
- b. A bypass is not prohibited if:

- (1) It does not cause any discharge limitation specified in Provision I. A. of this permit to be exceeded;
 - (2) It enters the same receiving stream as the permitted outfall; and
 - (3) It is necessary for essential maintenance of a treatment or control facility or system to assure efficient operation of such facility or system.
- c. A bypass is not prohibited and need not meet the discharge limitations specified in Provision I. A. of this permit if:
- (1) It is unavoidable to prevent loss of life, personal injury, or severe property damage;
 - (2) There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime (this condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance); and
 - (3) The permittee submits a written request for authorization to bypass to the Director at least ten (10) days prior to the anticipated bypass (if possible), the permittee is granted such authorization, and the permittee complies with any conditions imposed by the Director to minimize any adverse impact on human health or the environment resulting from the bypass.
- d. The permittee has the burden of establishing that each of the conditions of Provision II.C.1.b. or c. have been met to qualify for an exception to the general prohibition against bypassing contained in a. and an exemption, where applicable, from the discharge limitations specified in Provision I. A. of this permit.

2. Upset

- a. A discharge which results from an upset need not meet the discharge limitations specified in Provision I. A. of this permit if:
- (1) No later than 24-hours after becoming aware of the occurrence of the upset, the permittee orally reports the occurrence and circumstances of the upset to the Director or his designee; and
 - (2) No later than five (5) days after becoming aware of the occurrence of the upset, the permittee furnishes the Director with evidence, including properly signed, contemporaneous operating logs, or other relevant evidence, demonstrating that (i) an upset occurred; (ii) the permittee can identify the specific cause(s) of the upset; (iii) the permittee's facility was being properly operated at the time of the upset; and (iv) the permittee promptly took all reasonable steps to minimize any adverse impact on human health or the environment resulting from the upset.
- b. The permittee has the burden of establishing that each of the conditions of Provision II. C.2.a. of this permit have been met to qualify for an exemption from the discharge limitations specified in Provision I.A. of this permit.

D. DUTY TO COMPLY WITH PERMIT, RULES, AND STATUTES

1. Duty to Comply

- a. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the AWPCA and the FWPCA and is grounds for enforcement action, for permit termination, revocation and reissuance, suspension, modification; or denial of a permit renewal application.
- b. The necessity to halt or reduce production or other activities in order to maintain compliance with the conditions of the permit shall not be a defense for a permittee in an enforcement action.
- c. The discharge of a pollutant from a source not specifically identified in the permit application for this permit and not specifically included in the description of an outfall in this permit is not authorized and shall constitute noncompliance with this permit.
- d. The permittee shall take all reasonable steps, including cessation of production or other activities, to minimize or prevent any violation of this permit or to minimize or prevent any adverse impact of any permit violation.
- e. Nothing in this permit shall be construed to preclude and negate the permittee's responsibility or liability to apply for, obtain, or comply with other ADEM, Federal, State, or Local Government permits, certifications, licenses, or other approvals.

2. Removed Substances

Solids, sludges, filter backwash, or any other pollutant or other waste removed in the course of treatment or control of wastewaters shall be disposed of in a manner that complies with all applicable Department Rules.

3. Loss or Failure of Treatment Facilities

Upon the loss or failure of any treatment facilities, including but not limited to the loss or failure of the primary source of power of the treatment facility, the permittee shall, where necessary to maintain compliance with the discharge limitations specified in Provision I. A. of this permit, or any other terms or conditions of this permit, cease, reduce, or otherwise control production and/or all discharges until treatment is restored. If control of discharge during loss or failure of the primary source of power is to be accomplished by means of alternate power sources, standby generators, or retention of inadequately treated effluent, the permittee must furnish to the Director within six months a certification that such control mechanisms have been installed.

4. Compliance with Statutes and Rules

- a. This permit has been issued under ADEM Administrative Code, Chapter 335-6-6. All provisions of this chapter, that are applicable to this permit, are hereby made a part of this permit. A copy of this chapter may be obtained for a small charge from the Office of General Counsel, Alabama Department of Environmental Management, 1400 Coliseum Blvd., Montgomery, AL 36130.
- b. This permit does not authorize the noncompliance with or violation of any Laws of the State of Alabama or the United States of America or any regulations or rules implementing such laws. FWPCA, 33 U.S.C. Section 1319, and Code of Alabama 1975, Section 22-22-14.

E. PERMIT TRANSFER, MODIFICATION, SUSPENSION, REVOCATION, AND REISSUANCE**1. Duty to Reapply or Notify of Intent to Cease Discharge**

- a. If the permittee intends to continue to discharge beyond the expiration date of this permit, the permittee shall file a complete permit application for reissuance of this permit at least 180 days prior to its expiration. If the permittee does not intend to continue discharge beyond the expiration of this permit, the permittee shall submit written notification of this intent which shall be signed by an individual meeting the signatory requirements for a permit application as set forth in ADEM Administrative Code Rule 335-6-6-.09.
- b. Failure of the permittee to apply for reissuance at least 180 days prior to permit expiration will void the automatic continuation of the expiring permit provided by ADEM Administrative Code Rule 335-6-6-.06 and should the permit not be reissued for any reason any discharge after expiration of this permit will be an unpermitted discharge.

2. Change in Discharge

- a. The permittee shall apply for a permit modification at least 180 days in advance of any facility expansion, production increase, process change, or other action that could result in the discharge of additional pollutants or increase the quantity of a discharged pollutant such that existing permit limitations would be exceeded or that could result in an additional discharge point. This requirement applies to pollutants that are or that are not subject to discharge limitations in this permit. No new or increased discharge may begin until the Director has authorized it by issuance of a permit modification or a reissued permit.
- b. The permittee shall notify the Director as soon as it is known or there is reason to believe:
 - (1) That any activity has occurred or will occur which would result in the discharge on a routine or frequent basis, of any toxic pollutant which is not limited in this permit, if that discharge will exceed the highest of the following notification levels:
 - (i) one hundred micrograms per liter;
 - (ii) two hundred micrograms per liter for acrolein and acrylonitrile; five hundred micrograms per liter for 2,4-dinitrophenol and for 2-methyl-4,6-dini-trophenol; and one milligram per liter for antimony;
 - (iii) five times the maximum concentration value reported for that pollutant in the permit application; or
 - (2) That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:

- (i) five hundred micrograms per liter;
- (ii) one milligram per liter for antimony;
- (iii) ten times the maximum concentration value reported for that pollutant in the permit application.

3. Transfer of Permit

This permit may not be transferred or the name of the permittee changed without notice to the Director and subsequent modification or revocation and reissuance of the permit to identify the new permittee and to incorporate any other changes as may be required under the FWPCA or AWPCA. In the case of a change in name, ownership or control of the permittee's premises only, a request for permit modification in a format acceptable to the Director is required at least 30 days prior to the change. In the case of a change in name, ownership or control of the permittee's premises accompanied by a change or proposed change in effluent characteristics, a complete permit application is required to be submitted to the Director at least 180 days prior to the change. Whenever the Director is notified of a change in name, ownership or control, he may decide not to modify the existing permit and require the submission of a new permit application.

4. Permit Modification and Revocation

- a. This permit may be modified or revoked and reissued, in whole or in part, during its term for cause, including but not limited to, the following:
 - (1) If cause for termination under Provision II. E. 5. of this permit exists, the Director may choose to revoke and reissue this permit instead of terminating the permit;
 - (2) If a request to transfer this permit has been received, the Director may decide to revoke and reissue or to modify the permit; or
 - (3) If modification or revocation and reissuance is requested by the permittee and cause exists, the Director may grant the request.
- b. This permit may be modified during its term for cause, including but not limited to, the following:
 - (1) If cause for termination under Provision II. E. 5. of this permit exists, the Director may choose to modify this permit instead of terminating this permit;
 - (2) There are material and substantial alterations or additions to the facility or activity generating wastewater which occurred after permit issuance which justify the application of permit conditions that are different or absent in the existing permit;
 - (3) The Director has received new information that was not available at the time of permit issuance and that would have justified the application of different permit conditions at the time of issuance;
 - (4) A new or revised requirement(s) of any applicable standard or limitation is promulgated under Sections 301(b)(2)(C), (D), (E), and (F), and 307(a)(2) of the FWPCA;
 - (5) Errors in calculation of discharge limitations or typographical or clerical errors were made;
 - (6) To the extent allowed by ADEM Administrative Code, Rule 335-6-6-.17, when the standards or regulations on which the permit was based have been changed by promulgation of amended standards or regulations or by judicial decision after the permit was issued;
 - (7) To the extent allowed by ADEM Administrative Code, Rule 335-6-6-.17, permits may be modified to change compliance schedules;
 - (8) To agree with a granted variance under 301(c), 301(g), 301(h), 301(k), or 316(a) of the FWPCA or for fundamentally different factors;
 - (9) To incorporate an applicable 307(a) FWPCA toxic effluent standard or prohibition;
 - (10) When required by the reopener conditions in this permit;
 - (11) When required under 40 CFR 403.8(e) (compliance schedule for development of pretreatment program);

- (12) Upon failure of the state to notify, as required by Section 402(b)(3) of the FWPCA, another state whose waters may be affected by a discharge permitted by this permit;
- (13) When required to correct technical mistakes, such as errors in calculation, or mistaken interpretations of law made in determining permit conditions; or
- (14) When requested by the permittee and the Director determines that the modification has cause and will not result in a violation of federal or state law, regulations or rules.

5. Permit Termination

This permit may be terminated during its term for cause, including but not limited to, the following:

- a. Violation of any term or condition of this permit;
- b. The permittee's misrepresentation or failure to disclose fully all relevant facts in the permit application or during the permit issuance process or the permittee's misrepresentation of any relevant facts at any time;
- c. Materially false or inaccurate statements or information in the permit application or the permit;
- d. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge;
- e. The permittee's discharge threatens human life or welfare or the maintenance of water quality standards;
- f. Permanent closure of the facility generating the wastewater permitted to be discharged by this permit or permanent cessation of wastewater discharge;
- g. New or revised requirements of any applicable standard or limitation that is promulgated under Sections 301(b)(2)(C), (D), (E), and (F), and 307(a)(2) of the FWPCA that the Director determines cannot be complied with by the permittee; or
- h. Any other cause allowed by the ADEM Administrative Code, Chapter 335-6-6.

6. Permit Suspension

This permit may be suspended during its term for noncompliance until the permittee has taken action(s) necessary to achieve compliance.

7. Request for Permit Action Does Not Stay Any Permit Requirement

The filing of a request by the permittee for modification, suspension or revocation of this permit, in whole or in part, does not stay any permit term or condition.

F. COMPLIANCE WITH TOXIC POLLUTANT STANDARD OR PROHIBITION

If any applicable effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the FWPCA, 33 U.S.C. Section 1317(a), for a toxic pollutant discharged by the permittee and such standard or prohibition is more stringent than any discharge limitation on the pollutant specified in Provision I. A. of this permit, or controls a pollutant not limited in Provision I. A. of this permit, this permit shall be modified to conform to the toxic pollutant effluent standard or prohibition and the permittee shall be notified of such modification. If this permit has not been modified to conform to the toxic pollutant effluent standard or prohibition before the effective date of such standard or prohibition, the permittee shall attain compliance with the requirements of the standard or prohibition within the time period required by the standard or prohibition and shall continue to comply with the standard or prohibition until this permit is modified or reissued.

G. DISCHARGE OF WASTEWATER GENERATED BY OTHERS

The discharge of wastewater, generated by any process, facility, or by any other means not under the operational control of the permittee or not identified in the application for this permit or not identified specifically in the description of an outfall in this permit is not authorized by this permit.

PART III: OTHER PERMIT CONDITIONS

A. CIVIL AND CRIMINAL LIABILITY

1. Tampering

Any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained or performed under the permit shall, upon conviction, be subject to penalties as provided by the AWPCA.

2. False Statements

Any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be subject to penalties as provided by the AWPCA.

3. Permit Enforcement

- a. Any NPDES permit issued or reissued by the Department is a permit for the purpose of the AWPCA and the FWPCA and as such any terms, conditions, or limitations of the permit are enforceable under state and federal law.
- b. Any person required to have a NPDES permit pursuant to ADEM Administrative Code Chapter 335-6-6 and who discharges pollutants without said permit, who violates the conditions of said permit, who discharges pollutants in a manner not authorized by the permit, or who violates applicable orders of the Department or any applicable rule or standard of the Department, is subject to any one or combination of the following enforcement actions under applicable state statutes.
 - (1) An administrative order requiring abatement, compliance, mitigation, cessation, clean-up, and/or penalties;
 - (2) An action for damages;
 - (3) An action for injunctive relief; or
 - (4) An action for penalties.
- c. If the permittee is not in compliance with the conditions of an expiring or expired permit the Director may choose to do any or all of the following provided the permittee has made a timely and complete application for reissuance of the permit:
 - (1) initiate enforcement action based upon the permit which has been continued;
 - (2) issue a notice of intent to deny the permit reissuance. If the permit is denied, the owner or operator would then be required to cease the activities authorized by the continued permit or be subject to enforcement action for operating without a permit;
 - (3) reissue the new permit with appropriate conditions; or
 - (4) take other actions authorized by these rules and AWPCA.

4. Relief from Liability

Except as provided in Provision II.C.1 (Bypass) and Provision II.C.2 (Upset), nothing in this permit shall be construed to relieve the permittee of civil or criminal liability under the AWPCA or FWPCA for noncompliance with any term or condition of this permit.

B. OIL AND HAZARDOUS SUBSTANCE LIABILITY

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities or penalties to which the permittee is or may be subject under Section 311 of the FWPCA, 33 U.S.C. Section 1321.

C. PROPERTY AND OTHER RIGHTS

This permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to persons or property or invasion of other private rights, trespass, or any infringement of federal, state, or local laws or regulations, nor does it authorize or approve the construction of any physical structures or facilities or the undertaking of any work in any waters of the state or of the United States.

D. AVAILABILITY OF REPORTS

Except for data determined to be confidential under Code of Alabama 1975, Section 22-22-9(c), all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. Effluent data shall not be considered confidential.

E. EXPIRATION OF PERMITS FOR NEW OR INCREASED DISCHARGES

1. If this permit was issued for a new discharger or new source, this permit shall expire eighteen months after the issuance date if construction of the facility has not begun during the eighteen-month period.
2. If this permit was issued or modified to allow the discharge of increased quantities of pollutants to accommodate the modification of an existing facility and if construction of this modification has not begun during the eighteen month period after issuance of this permit or permit modification, this permit shall be modified to reduce the quantities of pollutants allowed to be discharged to those levels that would have been allowed if the modification of the facility had not been planned.
3. Construction has begun when the owner or operator has:
 - a. begun, or caused to begin as part of a continuous on-site construction program:
 - (1) any placement, assembly, or installation of facilities or equipment; or
 - (2) significant site preparation work including clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment; or
 - b. entered into a binding contractual obligation for the purpose of placement, assembly, or installation of facilities or equipment which are intended to be used in its operation within a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility, engineering, and design studies do not constitute a contractual obligation under the paragraph. The entering into a lease with the State of Alabama for exploration and production of hydrocarbons shall also be considered beginning construction.

F. COMPLIANCE WITH WATER QUALITY STANDARDS

1. On the basis of the permittee's application, plans, or other available information, the Department has determined that compliance with the terms and conditions of this permit should assure compliance with the applicable water quality standards.
2. Compliance with permit terms and conditions notwithstanding, if the permittee's discharge(s) from point sources identified in Provision I. A. of this permit cause or contribute to a condition in contravention of state water quality standards, the Department may require abatement action to be taken by the permittee in emergency situations or modify the permit pursuant to the Department's Rules, or both.
3. If the Department determines, on the basis of a notice provided pursuant to this permit or any investigation, inspection or sampling, that a modification of this permit is necessary to assure maintenance of water quality standards or compliance with other provisions of the AWPCA or FWPCA, the Department may require such modification and, in cases of emergency, the Director may prohibit the discharge until the permit has been modified.

G. GROUNDWATER

Unless specifically authorized under this permit, this permit does not authorize the discharge of pollutants to groundwater. Should a threat of groundwater contamination occur, the Director may require groundwater monitoring to properly assess the degree of the problem and the Director may require that the Permittee undertake measures to abate any such discharge and/or contamination.

H. DEFINITIONS

1. Average monthly discharge limitation - means the highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month (zero discharge days shall not be included in the number of "daily discharges" measured and a less than detectable test result shall be treated as a concentration of zero if the most sensitive EPA approved method was used).
2. Average weekly discharge limitation - means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week (zero discharge days shall not be included in the number of "daily discharges" measured and a less than detectable test result shall be treated as a concentration of zero if the most sensitive EPA approved method was used).

3. Arithmetic Mean – means the summation of the individual values of any set of values divided by the number of individual values.
4. AWPCA - means the Alabama Water Pollution Control Act.
5. BOD – means the five-day measure of the pollutant parameter biochemical oxygen demand.
6. Bypass - means the intentional diversion of waste streams from any portion of a treatment facility.
7. CBOD – means the five-day measure of the pollutant parameter carbonaceous biochemical oxygen demand.
8. Daily discharge - means the discharge of a pollutant measured during any consecutive 24-hour period in accordance with the sample type and analytical methodology specified by the discharge permit.
9. Daily maximum - means the highest value of any individual sample result obtained during a day.
10. Daily minimum - means the lowest value of any individual sample result obtained during a day.
11. Day - means any consecutive 24-hour period.
12. Department - means the Alabama Department of Environmental Management.
13. Director - means the Director of the Department.
14. Discharge - means "[t]he addition, introduction, leaking, spilling or emitting of any sewage, industrial waste, pollutant or other wastes into waters of the state". Code of Alabama 1975, Section 22-22-1(b)(8).
15. Discharge Monitoring Report (DMR) - means the form approved by the Director to accomplish reporting requirements of an NPDES permit.
16. DO – means dissolved oxygen.
17. 8HC – means 8-hour composite sample, including any of the following:
 - a. The mixing of at least 5 equal volume samples collected at constant time intervals of not more than 2 hours over a period of not less than 8 hours between the hours of 6:00 a.m. and 6:00 p.m. If the sampling period exceeds 8 hours, sampling may be conducted beyond the 6:00 a.m. to 6:00 p.m. period.
 - b. A sample continuously collected at a constant rate over period of not less than 8 hours between the hours of 6:00 a.m. and 6:00 p.m. If the sampling period exceeds 8 hours, sampling may be conducted beyond the 6:00 a.m. to 6:00 p.m. period.
18. EPA - means the United States Environmental Protection Agency.
19. FC – means the pollutant parameter fecal coliform.
20. Flow – means the total volume of discharge in a 24-hour period.
21. FWPCA - means the Federal Water Pollution Control Act.
22. Geometric Mean – means the Nth root of the product of the individual values of any set of values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered one (1).
23. Grab Sample – means a single influent or effluent portion which is not a composite sample. The sample(s) shall be collected at the period(s) most representative of the discharge.
24. Indirect Discharger – means a nondomestic discharger who discharges pollutants to a publicly owned treatment works or a privately owned treatment facility operated by another person.
25. Industrial User – means those industries identified in the Standard Industrial Classification manual, Bureau of the Budget 1967, as amended and supplemented, under the category "Division D – Manufacturing" and such other classes of significant waste producers as, by regulation, the Director deems appropriate.
26. MGD – means million gallons per day.

27. Monthly Average – means, other than for fecal coliform bacteria, the arithmetic mean of the entire composite or grab samples taken for the daily discharges collected in one month period. The monthly average for fecal coliform bacteria is the geometric mean of daily discharge samples collected in a one month period. The monthly average for flow is the arithmetic mean of all flow measurements taken in a one month period.
28. New Discharger – means a person, owning or operating any building, structure, facility or installation:
 - a. from which there is or may be a discharge of pollutants;
 - b. that did not commence the discharge of pollutants prior to August 13, 1979, and which is not a new source; and
 - c. which has never received a final effective NPDES permit for dischargers at that site.
29. NH3-N – means the pollutant parameter ammonia, measured as nitrogen.
30. Permit application - means forms and additional information that is required by ADEM Administrative Code Rule 335-6-6-.08 and applicable permit fees.
31. Point source - means "any discernible, confined and discrete conveyance, including but not limited to any pipe, channel, ditch, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, . . . from which pollutants are or may be discharged." Section 502(14) of the FWPCA, 33 U.S.C. Section 1362(14).
32. Pollutant - includes for purposes of this permit, but is not limited to, those pollutants specified in Code of Alabama 1975, Section 22-22-1(b)(3) and those effluent characteristics specified in Provision I. A. of this permit.
33. Privately Owned Treatment Works – means any devices or system which is used to treat wastes from any facility whose operator is not the operator of the treatment works, and which is not a "POTW".
34. Publicly Owned Treatment Works – means a wastewater collection and treatment facility owned by the State, municipality, regional entity composed of two or more municipalities, or another entity created by the State or local authority for the purpose of collecting and treating municipal wastewater.
35. Receiving Stream – means the "waters" receiving a "discharge" from a "point source".
36. Severe property damage - means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
37. Significant Source – means a source which discharges 0.025 MGD or more to a POTW or greater than five percent of the treatment work's capacity, or a source which is a primary industry as defined by the U.S. EPA or which discharges a priority or toxic pollutant.
38. Solvent – means any virgin, used or spent organic solvent(s) identified in the F-Listed wastes (F001 through F005) specified in 40 CFR 261.31 that is used for the purpose of solubilizing other materials.
39. TKN – means the pollutant parameter Total Kjeldahl Nitrogen.
40. TON – means the pollutant parameter Total Organic Nitrogen.
41. TRC – means Total Residual Chlorine.
42. TSS – means the pollutant parameter Total Suspended Solids.
43. 24HC – means 24-hour composite sample, including any of the following:
 - a. the mixing of at least 12 equal volume samples collected at constant time intervals of not more than 2 hours over a period of 24 hours;
 - b. a sample collected over a consecutive 24-hour period using an automatic sampler composite to one sample. As a minimum, samples shall be collected hourly and each shall be no more than one twenty-fourth (1/24) of the total sample volume collected; or
 - c. a sample collected over a consecutive 24-hour period using an automatic composite sampler composited proportional to flow.

44. Upset - means an exceptional incident in which there is an unintentional and temporary noncompliance with technology-based permit discharge limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.
45. Waters - means "[a]ll waters of any river, stream, watercourse, pond, lake, coastal, ground or surface water, wholly or partially within the state, natural or artificial. This does not include waters which are entirely confined and retained completely upon the property of a single individual, partnership or corporation unless such waters are used in interstate commerce." Code of Alabama 1975, Section 22-22-1(b)(2). Waters "include all navigable waters" as defined in Section 502(7) of the FWPCA, 22 U.S.C. Section 1362(7), which are within the State of Alabama.
46. Week - means the period beginning at twelve midnight Saturday and ending at twelve midnight the following Saturday.
47. Weekly (7-day and calendar week) Average - is the arithmetic mean of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. The calendar week is defined as beginning on Sunday and ending on Saturday. Weekly averages shall be calculated for all calendar weeks with Saturdays in the month. If a calendar week overlaps two months (i.e., the Sunday is in one month and the Saturday in the following month), the weekly average calculated for the calendar week shall be included in the data for the month that contains the Saturday.

I. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

PART IV: ADDITIONAL REQUIREMENTS, CONDITIONS, AND LIMITATIONS**A. BEST MANAGEMENT PRACTICES (BMP) PLAN REQUIREMENTS****1. BMP Plan**

The permittee shall develop and implement a Best Management Practices (BMP) Plan which prevents, or minimizes the potential for, the release of pollutants from ancillary activities, including material storage areas; plant site runoff; in-plant transfer, process and material handling areas; loading and unloading operations, and sludge and waste disposal areas, to the waters of the State through plant site runoff; spillage or leaks; sludge or waste disposal; or drainage from raw material storage.

2. Plan Content

The permittee shall prepare and implement a best management practices (BMP) plan, which shall:

- a. Establish specific objectives for the control of pollutants:
 - (1) Each facility component or system shall be examined for its potential for causing a release of significant amounts of pollutants to waters of the State due to equipment failure, improper operation, natural phenomena such as rain or snowfall, etc.
 - (2) Where experience indicates a reasonable potential for equipment failure (e.g., a tank overflow or leakage), natural condition (e.g. precipitation), or circumstances to result in significant amounts of pollutants reaching surface waters, the plan should include a prediction of the direction, rate of flow, and total quantity of pollutants which could be discharged from the facility as a result of each condition or circumstance.
- b. Establish specific best management practices to meet the objectives identified under paragraph a. of this section, addressing each component or system capable of causing a release of significant amounts of pollutants to the waters of the State, and identifying specific preventative or remedial measures to be implemented;
- c. Establish a program to identify and repair leaking equipment items and damaged containment structures, which may contribute to contaminated stormwater runoff. This program must include regular visual inspections of equipment, containment structures and of the facility in general to ensure that the BMP is continually implemented and effective;
- d. Prevent the spillage or loss of fluids, oil, grease, gasoline, etc. from vehicle and equipment maintenance activities and thereby prevent the contamination of stormwater from these substances;
- e. Prevent or minimize stormwater contact with material stored on site;
- f. Designate by position or name the person or persons responsible for the day to day implementation of the BMP;
- g. Provide for routine inspections, on days during which the facility is manned, of any structures that function to prevent stormwater pollution or to remove pollutants from stormwater and of the facility in general. Routine inspections should be done at a frequency to ensure that the BMP is continually implemented and effective and in no case less frequent than once per year;
- h. Provide for the use and disposal of any material used to absorb spilled fluids that could contaminate stormwater;
- i. Develop a solvent management plan, if solvents are used on site. The solvent management plan shall include as a minimum lists of the solvents on site; the disposal method of solvents used instead of dumping, such as reclamation, contract hauling; and the procedures for assuring that solvents do not routinely spill or leak into the stormwater;
- j. Provide for the disposal of all used oils, hydraulic fluids, firefighting foams, solvent degreasing material, etc. in accordance with good management practices and any applicable state or federal regulations;
- k. Include a diagram of the facility showing the locations where stormwater exits the facility, the locations of any structure or other mechanisms intended to prevent pollution of stormwater or to remove pollutants from stormwater, the locations of any collection and handling systems;
- l. Provide control sufficient to prevent or control pollution of stormwater by soil particles to the degree required to maintain compliance with the water quality standard for turbidity applicable to the waterbody(s) receiving discharge(s) under this permit;
- m. Provide spill prevention, control, and/or management sufficient to prevent or minimize contaminated stormwater runoff. Any containment system used to implement this requirement shall be constructed of materials compatible with the

substance(s) contained and shall prevent the contamination of groundwater. The containment system shall also be capable of retaining a volume equal to 110 percent of the capacity of the largest tank for which containment is provided;

- n. Provide and maintain curbing, diking or other means of isolating process areas to the extent necessary to allow segregation and collection for treatment of contaminated stormwater from process areas;
- o. Be reviewed by plant engineering staff and the plant manager; and
- p. Bear the signature of the plant manager.

3. Compliance Schedule

The permittee shall have reviewed (and revised if necessary) and fully implemented the BMP plan as soon as practicable but no later than six months after the effective date of this permit.

4. Department Review

- a. When requested by the Director or his designee, the permittee shall make the BMP available for Department review.
- b. The Director or his designee may notify the permittee at any time that the BMP is deficient and require correction of the deficiency.
- c. The permittee shall correct any BMP deficiency identified by the Director or his designee within 30 days of receipt of notification and shall certify to the Department that the correction has been made and implemented.

5. Administrative Procedures

- a. A copy of the BMP shall be maintained at the facility and shall be available for inspection by representatives of the Department.
- b. A log of the routine inspection required above shall be maintained at the facility and shall be available for inspection by representatives of the Department. The log shall contain records of all inspections performed for the last three years and each entry shall be signed by the person performing the inspection.
- c. The permittee shall provide training for any personnel required to implement the BMP and shall retain documentation of such training at the facility. This documentation shall be available for inspection by representatives of the Department. Training shall be performed prior to the date that implementation of the BMP is required.
- d. BMP Plan Modification. The permittee shall amend the BMP plan whenever there is a change in the facility or change in operation of the facility which materially increases the potential for the ancillary activities to result in a discharge of significant amounts of pollutants.
- e. BMP Plan Review. The permittee shall complete a review and evaluation of the BMP plan at least once every three years from the date of preparation of the BMP plan. Documentation of the BMP Plan review and evaluation shall be signed and dated by the Plant Manager.

B. STORMWATER FLOW MEASUREMENT AND SAMPLING REQUIREMENTS

1. Stormwater Flow Measurement

- a. All stormwater samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches.
- b. The total volume of stormwater discharged for the event must be monitored, including the date and duration (in hours) and rainfall (in inches) for storm event(s) sampled. The duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event must be a minimum of 72 hours. This information must be recorded as part of the sampling procedure and records retained according to Part I.B. of this permit.
- c. The volume may be measured using flow measuring devices, or estimated based on a modification of the Rational Method using total depth of rainfall, the size of the drainage area serving a stormwater outfall, and an estimate of the runoff coefficient of the drainage area. This information must be recorded as part of the sampling procedure and records retained according to Part I.B. of this permit.

2. Stormwater Sampling

- a. A grab sample, if required by this permit, shall be taken during the first thirty minutes of the discharge (or as soon thereafter as practicable); and a flow-weighted composite sample, if required by this permit, shall be taken for the entire event or for the first three hours of the event.
- b. All test procedures will be in accordance with part I.B. of this permit.

C. COOLING WATER INTAKE STRUCTURE (CWIS) REQUIREMENTS

1. The cooling water intake structure used by the permittee has been evaluated using available information. At this time, the Department has determined that the cooling water intake structure does represent the best technology available (BTA) to minimize adverse environmental impact(s) in accordance with Section 316(b) of the federal Clean Water Act (33 U.S.C. section 1326).
2. The permittee is required to operate and maintain the CWIS in a manner that minimizes impingement and entrainment levels. Documentation detailing the steps that have and are being taken to minimize the impingement and entrainment levels shall be maintained on site and made available upon request.
3. Nothing in this Permit authorizes take for the purposes of a facility compliance with the Endangered Species Act.
4. The permittee shall submit the information for the CWIS as required by 40 CFR 122.21 (r) at least 180 days prior to expiration of the permit unless a request has been approved by the Department in writing. The facility must submit the request for reduced cooling water intake structure and waterbody application information to the Department at least two years and six months prior to the expiration of the permit. The permittee's request must identify each element that it determines has not been substantially changed since the previous permit application and the basis for the determination.
5. The Permittee must keep records of all submissions that are part of the permit application pertaining to the CWIS until the subsequent permit is issued to the Permittee.
6. The Permittee's permit application must contain readily available information, at the time of permit application development, in identifying all federally-listed threatened and endangered species and/or designated critical habitat that are or may be present in the action area.
7. The Permittee must conduct weekly visual inspections or employ remote monitoring devices during the period the cooling water intake structure is in operation. This condition is only applicable if control technologies are being employed to comply with BTA for impingement mortality.
8. The Permittee is required to submit an Annual Certification to the Department no later than January 28th of each year. The Annual Certification shall detail if any changes have been made to impact the operation of the CWIS structure.

D. EFFLUENT TOXICITY LIMITATIONS AND BIOMONITORING REQUIREMENTS - CERIODAPHNIA

1. The permittee shall perform **48-hour** acute toxicity screening tests on the wastewater discharges required to be tested for **ceriodaphnia** acute toxicity by Part I of this permit.
 - a. Test Requirements:
 - (1) The samples shall be diluted, using an appropriate control water, to the Instream Waste Concentration (IWC) which is 75% effluent. The IWC is the actual concentration of effluent, after mixing, in the receiving stream during a 1-day, 10-year flow period.
 - (2) Any test where survival in the effluent concentration is less than 90% and statistically lower than the control indicates acute toxicity and constitutes noncompliance with this permit.
 - b. General Test Requirements:
 - (1) A 24-hour composite sample shall be obtained for use in above biomonitoring tests. The holding time for each sample shall not exceed 36 hours. The control water shall be a water prepared in the laboratory in accordance with the EPA procedure described in EPA 821-R-02-012 or most current edition or another control water selected by the permittee and approved by the Department.

- (2) Effluent toxicity tests in which the control survival is less than 90% or in which the other requirements of the EPA Test Procedure are not met shall be unacceptable and the permittee shall rerun the tests as soon as practical within the monitoring period.
- (3) In the event of an invalid test, upon subsequent completion of a valid test, the results of all tests, valid and invalid, are reported with an explanation of the tests performed and results.

c. Reporting Requirements:

- (1) The permittee shall notify the Department in writing within 48 hours after toxicity has been demonstrated by the scheduled test(s).
- (2) Biomonitoring test results obtained during each monitoring period shall be summarized and reported using the appropriate Discharge Monitoring Report (DMR) form approved by the Department. In accordance with Section 2. of this part, an effluent toxicity report containing the information in Section 2. shall be included with the DMR. Two copies of the test results must be submitted to the Department no later than 28 days after the month in which the tests were performed.

d. Additional Testing Requirements:

- (1) If acute toxicity is indicated (noncompliance with permit limit), the permittee shall perform four additional valid acute toxicity tests in accordance with these procedures to determine the extent and duration of the toxic condition. The toxicity tests shall be performed once per week and shall be performed during the first four calendar weeks following the date on which the permittee became aware of the permit noncompliance and the results of these tests shall be submitted no later than 28 days following the month in which the tests were performed.
- (2) After evaluation of the results of the follow-up tests, the Department will determine if additional action is appropriate and may require additional testing and/or toxicity reduction measures. The permittee may be required to perform a Toxicity Identification Evaluation (TIE) and/or a Toxicity Reduction Evaluation (TRE). The TIE/TRE shall be performed in accordance with the most recent protocols/guidance outlined by EPA (e.g., EPA/600/2-88/062, EPA/600/R-92/080, EPA/600/R-92/081, EPA/833/B-99/022 and/or EPA/600/6-91/005F, etc.).

e. Test Methods:

The tests shall be performed in accordance with the latest edition of the "EPA Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms" and shall be performed using the fathead minnow (*Pimephales promelas*) and the cladoceran (*Ceriodaphnia dubia*).

2. Effluent toxicity testing reports

The following information shall be submitted with each discharge monitoring report unless otherwise directed by the Department. The Department may at any time suspend or reinstate this requirement or may increase or decrease the frequency of submittals.

a. Introduction

- (1) Facility Name, location and county
- (2) Permit number
- (3) Toxicity testing requirements of permit
- (4) Name of receiving water body
- (5) Contract laboratory information (if tests are performed under contract)
 - (i) Name of firm
 - (ii) Telephone number
 - (iii) Address
- (6) Objective of test

b. Plant Operations

- (1) Discharge operating schedule (if other than continuous)
 - (2) Volume of discharge during sample collection to include Mean daily discharge on sample collection date (MGD, CFS, GPM)
 - (3) Design flow of treatment facility at time of sampling
- c. Source of Effluent and Dilution Water
- (1) Effluent samples
 - (i) Sampling point
 - (ii) Sample collection dates and times (to include composite sample start and finish times)
 - (iii) Sample collection method
 - (iv) Physical and chemical data of undiluted effluent samples (water temperature, pH, alkalinity, hardness, specific conductance, total residual chlorine (if applicable), etc.)
 - (v) Sample temperature when received at the laboratory
 - (vi) Lapsed time from sample collection to delivery
 - (vii) Lapsed time from sample collection to test initiation
 - (2) Dilution Water Samples
 - (i) Source
 - (ii) Collection date(s) and time(s) (where applicable)
 - (iii) Pretreatment
 - (iv) Physical and chemical characteristics (pH, hardness, water temperature, alkalinity, specific conductance, etc.)
- d. Test Conditions
- (1) Toxicity test method utilized
 - (2) End point(s) of test
 - (3) Deviations from referenced method, if any, and reason(s)
 - (4) Date and time test started
 - (5) Date and time test terminated
 - (6) Type and volume of test chambers
 - (7) Volume of solution per chamber
 - (8) Number of organisms per test chamber
 - (9) Number of replicate test chambers per treatment
 - (10) Test temperature, pH and dissolved oxygen as recommended by the method (to include ranges)
 - (11) Feeding frequency, and amount and type of food
 - (12) Light intensity (mean)
- e. Test Organisms
- (1) Scientific name
 - (2) Life stage and age

- (3) Source
- (4) Disease treatment (if applicable)
- f. Quality Assurance
 - (1) Reference toxicant utilized and source
 - (2) Date and time of most recent acute reference toxicant test(s), raw data, and current cusum chart(s)
 - (3) Dilution water utilized in reference toxicant test
 - (4) Results of reference toxicant test(s) (LC50, etc.), report concentration-response relationship and evaluate test sensitivity. The most recent reference toxicant test shall be conducted within 30-days of the routine.
 - (5) Physical and chemical methods utilized
- g. Results
 - (1) Provide raw toxicity data in tabular form, including daily records of affected organisms in each concentration (including controls) and replicate
 - (2) Provide table of endpoints: LC50, NOAEC, Pass/Fail (as required in the applicable NPDES permit)
 - (3) Indicate statistical methods used to calculate endpoints
 - (4) Provide all physical and chemical data required by method
 - (5) Results of test(s) (LC50, NOAEC, Pass/Fail, etc.), report concentration-response relationship (definitive test only), report percent minimum significant difference (PMSD)
- h. Conclusions and Recommendations
 - (1) Relationship between test endpoints and permit limits
 - (2) Action to be taken

Adapted from "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms", Fifth Edition, October 2002 (EPA 821-R-02-012), Section 12, Report Preparation

E. EFFLUENT TOXICITY LIMITATIONS AND BIOMONITORING REQUIREMENTS - PIMEPHALES

- 1. The permittee shall perform **24-hour** acute toxicity screening tests on the wastewater discharges required to be tested for **pimephales** acute toxicity by Part I of this permit.
 - a. Test Requirements:
 - (1) The tests shall be performed using undiluted effluent.
 - (2) Any test where survival in the effluent concentration is less than 90% and statistically lower than the control indicates acute toxicity and constitutes noncompliance with this permit.
 - b. General Test Requirements:
 - (1) A 24-hour composite sample shall be obtained for use in above biomonitoring tests. The holding time for each sample shall not exceed 36 hours. The control water shall be a water prepared in the laboratory in accordance with the EPA procedure described in EPA 821-R-02-012 or most current edition or another control water selected by the permittee and approved by the Department.
 - (2) Effluent toxicity tests in which the control survival is less than 90% or in which the other requirements of the EPA Test Procedure are not met shall be unacceptable and the permittee shall rerun the tests as soon as practical within the monitoring period.
 - (3) In the event of an invalid test, upon subsequent completion of a valid test, the results of all tests, valid and invalid, are reported with an explanation of the tests performed and results.

c. Reporting Requirements:

- (1) The permittee shall notify the Department in writing within 48 hours after toxicity has been demonstrated by the scheduled test(s).
- (2) Biomonitoring test results obtained during each monitoring period shall be summarized and reported using the appropriate Discharge Monitoring Report (DMR) form approved by the Department. In accordance with Section 2. of this part, an effluent toxicity report containing the information in Section 2. shall be included with the DMR. Two copies of the test results must be submitted to the Department no later than 28 days after the month in which the tests were performed.

d. Additional Testing Requirements:

- (1) If acute toxicity is indicated (noncompliance with permit limit), the permittee shall perform four additional valid acute toxicity tests in accordance with these procedures to determine the extent and duration of the toxic condition. The toxicity tests shall be performed once per week and shall be performed during the first four calendar weeks following the date on which the permittee became aware of the permit noncompliance and the results of these tests shall be submitted no later than 28 days following the month in which the tests were performed.
- (2) After evaluation of the results of the follow-up tests, the Department will determine if additional action is appropriate and may require additional testing and/or toxicity reduction measures. The permittee may be required to perform a Toxicity Identification Evaluation (TIE) and/or a Toxicity Reduction Evaluation (TRE). The TIE/TRE shall be performed in accordance with the most recent protocols/guidance outlined by EPA (e.g., EPA/600/2-88/062, EPA/600/R-92/080, EPA/600/R-92/081, EPA/833/B-99/022 and/or EPA/600/6-91/005F, etc.).

e. Test Methods:

The tests shall be performed in accordance with the latest edition of the "EPA Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms" and shall be performed using the fathead minnow (*Pimephales promelas*) and the cladoceran (*Ceriodaphnia dubia*).

2. Effluent toxicity testing reports

The following information shall be submitted with each discharge monitoring report unless otherwise directed by the Department. The Department may at any time suspend or reinstate this requirement or may increase or decrease the frequency of submittals.

a. Introduction

- (1) Facility Name, location and county
- (2) Permit number
- (3) Toxicity testing requirements of permit
- (4) Name of receiving water body
- (5) Contract laboratory information (if tests are performed under contract)
 - (i) Name of firm
 - (ii) Telephone number
 - (iii) Address
- (6) Objective of test

b. Plant Operations

- (1) Discharge operating schedule (if other than continuous)
- (2) Volume of discharge during sample collection to include Mean daily discharge on sample collection date (MGD, CFS, GPM)
- (3) Design flow of treatment facility at time of sampling

c. Source of Effluent and Dilution Water

(1) Effluent samples

- (i) Sampling point
- (ii) Sample collection dates and times (to include composite sample start and finish times)
- (iii) Sample collection method
- (iv) Physical and chemical data of undiluted effluent samples (water temperature, pH, alkalinity, hardness, specific conductance, total residual chlorine (if applicable), etc.)
- (v) Sample temperature when received at the laboratory
- (vi) Lapsed time from sample collection to delivery
- (vii) Lapsed time from sample collection to test initiation

(2) Dilution Water Samples

- (i) Source
- (ii) Collection date(s) and time(s) (where applicable)
- (iii) Pretreatment
- (iv) Physical and chemical characteristics (pH, hardness, water temperature, alkalinity, specific conductance, etc.)

d. Test Conditions

- (1) Toxicity test method utilized
- (2) End point(s) of test
- (3) Deviations from referenced method, if any, and reason(s)
- (4) Date and time test started
- (5) Date and time test terminated
- (6) Type and volume of test chambers
- (7) Volume of solution per chamber
- (8) Number of organisms per test chamber
- (9) Number of replicate test chambers per treatment
- (10) Test temperature, pH and dissolved oxygen as recommended by the method (to include ranges)
- (11) Feeding frequency, and amount and type of food
- (12) Light intensity (mean)

e. Test Organisms

- (1) Scientific name
- (2) Life stage and age
- (3) Source
- (4) Disease treatment (if applicable)

f. Quality Assurance

- (1) Reference toxicant utilized and source

- (2) Date and time of most recent acute reference toxicant test(s), raw data, and current cusum chart(s)
- (3) Dilution water utilized in reference toxicant test
- (4) Results of reference toxicant test(s) (LC50, etc.), report concentration-response relationship and evaluate test sensitivity. The most recent reference toxicant test shall be conducted within 30-days of the routine.
- (5) Physical and chemical methods utilized

g. Results

- (1) Provide raw toxicity data in tabular form, including daily records of affected organisms in each concentration (including controls) and replicate
- (2) Provide table of endpoints: LC50, NOAEC, Pass/Fail (as required in the applicable NPDES permit)
- (3) Indicate statistical methods used to calculate endpoints
- (4) Provide all physical and chemical data required by method
- (5) Results of test(s) (LC50, NOAEC, Pass/Fail, etc.), report concentration-response relationship (definitive test only), report percent minimum significant difference (PMSD)

h. Conclusions and Recommendations

- (1) Relationship between test endpoints and permit limits
- (2) Action to be taken

Adapted from "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms", Fifth Edition, October 2002 (EPA 821-R-02-012), Section 12, Report Preparation

F. MERCURY MINIMIZATION PLAN (MMP) REQUIREMENTS

The Permittee shall implement and maintain a Mercury Minimization Plan (MMP) focused on reducing mercury levels in the discharge. The MMP should at a minimum consider source evaluation and identification, treatment and/or control measures, and internal monitoring programs. The Permittee shall complete a review and evaluation of the MMP at least annually. Documentation of the plan review and evaluation shall be signed and dated by the Plant Manager. A copy of the plan shall be maintained at the facility and shall be available for inspection by representatives of the Department. Additionally, the Permittee shall submit an annual progress report summarizing the activities and findings of the MMP by January 28th of each year. The progress reports at a minimum shall include:

- i. A list of all potential and confirmed mercury sources;
- ii. A summary of internal and effluent monitoring results and data trends;
- iii. A summary of actions taken to reduce or eliminate mercury discharges;
- iv. A summary of the mercury source treatment and/or control measures implemented and/or planned; and
- v. Proposed revisions to the MMP based on findings from the previous year.

ADEM PERMIT RATIONALE

PREPARED DATE: August 30, 2026

PREPARED BY: Theo Pinson

Permittee Name: Occidental Chemical Corporation

Facility Name: Occidental Chemical Corporation

Permit Number: AL0000213

PERMIT IS REISSUANCE DUE TO EXPIRATION

DISCHARGE SERIAL NUMBERS (DSN) & DESCRIPTIONS:

- 001 Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff
- 003 Stormwater runoff associated with the production of potassium carbonate and potassium bicarbonate including the rail yard and tank car storage areas
- 006 Rinse waters from the employee car wash and stormwater runoff associated with the employee car wash, maintenance building, employee parking areas, and the plant entrance road

INDUSTRIAL CATEGORY: NON-CATEGORICAL

MAJOR: No

STREAM INFORMATION:

Outfall:	DSN001, DSN006	DSN003
Receiving Stream:	Pond Creek	Unnamed Tributary to Pond Creek
Classification:	Agricultural & Industrial (A&I)	Fish and Wildlife (F&W)
River Basin:	Tennessee	Tennessee
7Q10:	0 cfs	0 cfs
7Q2:	0 cfs	0 cfs
1Q10:	0 cfs	0 cfs
Annual Average Flow:	47.2 cfs	-
303(d) List:	Yes	No
Impairment:	Organic Enrichment (CBOD, NBOD) and Metals (Arsenic, Cyanide, Mercury)	No
TMDL:	No	No

DISCUSSION:

The facility manufactures potassium carbonate and potassium bicarbonate. Former operations at the facility included the operation of a chlor-alkali which was retired circa 2008. The former chlor-alkali plant area has been decommissioned and capped through oversight of the Land Division.

On January 2, 2026, a transaction was completed for Berkshire Hathaway Inc. to acquire all Occidental Petroleum Corporation's equity interest in Occidental Chemical Corporation and its subsidiaries. The facility indicated that there has been no change of name, ownership, or operational control as a result of the transaction. The facility indicated that the only change requested based on the transaction is an update of the facility address formerly listed as 1000 North Wilson Dam Road to 1010 North Wilson Dam Road.

ADEM Administrative Rule 335-6-10-.12 requires applicants to new or expanded discharges to Tier II waters demonstrate that the proposed discharge is necessary for important economic or social development in the area in which the waters are located. The application submitted by the facility is neither for a new or expanded discharge nor for a discharge to a Tier II waterbody; therefore, the anti-degradation requirements are not applicable.

EPA has not promulgated specific guidelines for the discharges covered under the proposed permit. Proposed permit limits are based on Best Professional Judgment. The proposed frequencies are based on a review of site specific conditions and an evaluation of similar facilities.

DSN0011: Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency	Sample Type	Seasonal	Basis
Temperature, Water Deg. Fahrenheit (00011) Effluent Gross Value	*****	*****	*****	*****	*****	90.0 Daily Average	deg F	Continuous	Recorder	All Months	WQBEL
Oxygen, Dissolved (DO) (00300) Effluent Gross Value	*****	*****	*****	3.0 Minimum Daily	*****	*****	mg/l	Monthly	Grab	All Months	WQBEL
pH (00400) Effluent Gross Value	*****	*****	*****	(Report) Minimum Daily	*****	(Report) Maximum Daily	S.U.	Continuous	Recorder	All Months	WQBEL/ BPJ
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	All Months	BPJ
Nitrogen, Ammonia Total (As N) (00610) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	All Months	BPJ
Nitrogen, Kjeldahl Total (As N) (00625) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	Apr, May, Jun, Jul, Aug, Sep	BPJ
Nitrite Plus Nitrate Total 1 Det. (As N) (00630) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	Apr, May, Jun, Jul, Aug, Sep	BPJ
Phosphorus, Total (As P) (00665) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	Apr, May, Jun, Jul, Aug, Sep	BPJ
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	(Report) Monthly Average	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Continuous	Totalizer	All Months	BPJ
Chlorine, Total Residual (50060) Effluent Gross Value	*****	*****	*****	*****	*****	0.022 Maximum Daily	mg/l	Monthly	Grab	All Months	WQBEL
Mercury Total Recoverable (71901) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	ug/l	Monthly	Grab	All Months	BPJ
BOD, Carbonaceous 05 Day, 20C (80082) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Monthly	Grab	All Months	BPJ
pH Range Excursions, > 60 Minutes (82581) Effluent Gross Value	*****	0.0 Maximum Monthly	occur/month	*****	*****	*****	*****	Monthly	Calculated	All Months	EGL
pH Range Excursions, Monthly Total Accum (82582) Effluent Gross Value	*****	446.0 Maximum Monthly	min	*****	*****	*****	*****	Monthly	Calculated	All Months	EGL

DSN001Y: Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency	Sample Type	Seasonal	Basis
Arsenic, Total Recoverable (00978) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	ug/l	Annually	Grab	All Months	303(d)
Cyanide, Free Available (51173) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	ug/l	Annually	Grab	All Months	303(d)

DSN001S: Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency	Sample Type	Seasonal	Basis
pH (00400) Effluent Gross Value	*****	*****	*****	(Report) Minimum Daily	*****	(Report) Maximum Daily	S.U.	Semi-Annually	Grab	All Months	BPJ
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Semi-Annually	Grab	All Months	BPJ
Oil & Grease (00556) Effluent Gross Value	*****	*****	*****	*****	*****	15.0 Maximum Daily	mg/l	Semi-Annually	Grab	All Months	BPJ
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	*****	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Semi-Annually	Instantaneous	All Months	BPJ
Chemical Oxygen Demand (COD) (81017) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Semi-Annually	Grab	All Months	BPJ

DSN001T: Process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency	Sample Type	Seasonal	Basis
Toxicity, Ceriodaphnia Acute (61425) Effluent Gross Value	*****	0 Single Sample	pass=0;fail=1	*****	*****	*****	*****	Annually	Composite	All Months	BPJ
Toxicity, Pimephales Acute (61427) Effluent Gross Value	*****	0 Single Sample	pass=0;fail=1	*****	*****	*****	*****	Annually	Composite	All Months	BPJ

DSN003S: Stormwater runoff associated with the production of potassium carbonate and potassium bicarbonate including the rail yard and tank car storage areas

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency	Sample Type	Seasonal	Basis
pH (00400) Effluent Gross Value	*****	*****	*****	(Report) Minimum Daily	*****	(Report) Maximum Daily	S.U.	Semi-Annually	Grab	All Months	BPJ
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Semi-Annually	Grab	All Months	BPJ
Oil & Grease (00556) Effluent Gross Value	*****	*****	*****	*****	*****	15.0 Maximum Daily	mg/l	Semi-Annually	Grab	All Months	BPJ
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	*****	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Semi-Annually	Estimate	All Months	BPJ
Chemical Oxygen Demand (COD) (81017) Effluent Gross Value	*****	*****	*****	*****	*****	(Report) Maximum Daily	mg/l	Semi-Annually	Grab	All Months	BPJ

***Basis for Permit Limitation**

- BPJ – Best Professional Judgment
- WQBEL – Water Quality Based Effluent Limits
- EGL – Federal Effluent Guideline Limitations
- 303(d) – 303(d) List of Impaired Waters
- TMDL – Total Maximum Daily Load Requirements

Discussion

The parameters of concern for this facility are based on the parameters of concern listed in the permit application and from the current permit. These parameters are consistent with similar facilities in the state and have been proven to be reflective of the operations at this facility.

Outfall DSN001

Monitoring Points 0011, 001S, 001T, 001Y

Outfall 001 serves as the discharge location for process wastewaters generated at the facility and stormwater runoff from a large portion of the facility. The discharge includes process wastewaters associated with the production of potassium carbonate and potassium bicarbonate, miscellaneous wash down wastewaters, cooling waters, boiler blowdown, stormwater from tank containment areas, and stormwater runoff. The Permittee indicated that a magnesium oxide and potassium bicarbonate blending process is expected commence in 2026; however, this process is not expected to directly contribute to process wastewater discharges.

Water Quality Based Effluent Limits (WQBEL)

The Outfall DSN001 discharge is located approximately 1.27 miles away from the Tennessee River (Pickwick Lake) which has a higher use classification of Public Water Supply (PWS), Swimming (S), and Fish and Wildlife (F&W). The Department's Water Quality Branch has previously estimated the travel time from the Outfall DSN001 discharge to the Tennessee River to be approximately two and a half hours.

The Permittee completed a water quality model to demonstrate that the water quality-based limitations developed to be protective of the Agricultural & Industrial (A&I) use classification are also expected to be protective of the downstream PWS/S/F&W classified waters. Additionally, the model predicted an instream waste concentration in the Tennessee River for Ceriodaphnia toxicity biomonitoring. The proposed permit conditions and limitations have been developed to be protective of both use classifications. A long-term average flowrate of 1.315 MGD from the Muscle Shoals WWTP, AL0024180, has been used in the calculation of water quality-based limitations. This long-term average was calculated based on the monthly average DMR data submitted for the monitoring periods of May 2023 – April 2026.

pH

ADEM Administrative Code, Division 6 Regulations, specifically 335-6-10-.09(7)(c)2 – Specific Water Quality for A&I classified streams states: "Sewage, industrial waste or other wastes shall not cause the pH to deviate more than one unit from then normal or natural pH, nor be less than 6.0, nor greater than 8.5 standard units." Based on the provisions at 40 CFR 401.17 for continuous pH monitoring, the total excursion time above or below the minimum and maximum limits for the month shall not exceed 7 hours 26 minutes in any calendar month. No individual excursion shall exceed 60 minutes in duration.

Temperature

ADEM Administrative Code, Division 6 Regulations, specifically 335-6-10-.09(7)(c)3 – Specific Water Quality for A&I classified streams states: "the maximum temperature rise above natural temperatures due to the addition of artificial heat shall not exceed 5 °F in streams, lakes, and reservoirs." Additionally, the maximum water temperature shall not exceed 90 °F. Temperature is proposed to be monitored as a time-weighted average over the course of a 24-hour calendar day. Monitoring is proposed as continuous where at least one measurement is to be recorded at least every 20 minutes.

Acute Toxicity Biomonitoring

The receiving stream has a use classification of A&I; however, the discharge is considered within a 24-hour travel time to a higher use classification of PWS, S, F&W. To be protective of both use classifications, 24-hour acute toxicity biomonitoring is proposed for Pimephales using 100% effluent with no dilution based on applicable criteria in Pond Creek. 48-hour acute toxicity biomonitoring is proposed for Ceriodaphnia using 75% effluent based on the water quality model performed by the Permittee which indicates that an IWC of 75% is representative of the discharge concentration from Pond Creek at the boundary of the zone of initial dilution in the Tennessee River (Pickwick Lake). The Department believes the proposed IWC of 75% for Ceriodaphnia biomonitoring is appropriate and is consistent with CWA Section 402(o)(2)(B)(i) regarding new technical information provided by the updated mixing zone and outfall modeling which supports that the proposed IWC is expected to be protective of water quality.

Dissolved Oxygen

ADEM Administrative Code, Division 6 Regulations, specifically 335-6-10-.09(7)(c)4 – Specific Water Quality for A&I classified streams states: that sewage, industrial wastes, or other wastes shall not cause the dissolved oxygen to be less than 3.0 mg/l.

Total Residual Chlorine (TRC)

The proposed total residual chlorine (TRC) maximum daily limitation is based on the Department's aquatic life criteria specified in ADEM Administrative Code 335-6-10-.07, Table 1 – Toxic Pollutant Criteria.

The Stream Dilution Ratio has been calculated using the long-term average flow of 7.8 MGD from the facility, the long-term average flow of 1.315 MGD from the Muscle Shoal WWTP, and a receiving stream 7Q10 of zero. The SDR was then used with the chlorine criteria to calculate the available allocation.

$$\text{Stream Dilution Ratio (SDR)} = \frac{\text{Facility Flow}}{7Q10 + \text{WWTP} + \text{Facility Flow}}$$

$$\text{Stream Dilution Ratio (SDR)} = \frac{7.8 \text{ MGD}}{0 + 1.315 \text{ MGD} + 7.8 \text{ MGD}} = 0.8557$$

$$\text{TRC Maximum Daily} = \text{TRC criteria/SDR}$$

$$\text{TRC Maximum Daily} = (0.019)/(0.8557) = 0.0222 \text{ mg/l}$$

A monthly average limitation has not been proposed based on the A&I classification of the receiving stream. The current TRC limitation of 0.022 mg/l has been proposed to be continued. In accordance with a letter dated August 11, 1998 from EPA Headquarters and a 1991 memorandum from EPA Region 4's Environmental Services Division (ESD), due to testing and method detection limitations, a Total Residual Chlorine measurement below 0.05 mg/L shall be considered below detection for compliance purposes.

Numeric Reasonable Potential Analysis (RPA), Mercury Minimization Plan (MMP) Requirements

The Department completed a numeric reasonable potential analysis (RPA) of the discharge based on laboratory data provided in the Permittee's application, historical discharge monitoring report data, and available instream water quality data. The long-term average flow from the Muscle Shoals WWTP was included in the RPA calculations. The RPA indicates whether pollutants in the treated effluent have the potential to contribute to excursions of Alabama's in-stream water quality standards. Based on the analytical data available to the Department, a reasonable potential exists to cause an in-stream water quality exceedance for mercury. As a result, the Department has proposed the following narrative limitations in Part IV.F of the Permit:

The Permittee shall implement and maintain a Mercury Minimization Plan (MMP) focused on reducing mercury levels in the discharge. The MMP should at a minimum consider source evaluation and identification, treatment and/or control measures, and internal monitoring programs. The Permittee shall complete a review and evaluation of the MMP at least annually. Documentation of the plan review and evaluation shall be signed and dated by the Plant Manager. A copy of the plan shall be maintained at the facility and shall be available for inspection by representatives of the Department. Additionally, the Permittee shall submit an annual progress report summarizing the activities and findings of the MMP by January 28th of each year. The progress reports at a minimum shall include:

- i. A list of all potential and confirmed mercury sources;
- ii. A summary of internal and effluent monitoring results and data trends;
- iii. A summary of actions taken to reduce or eliminate mercury discharges;
- iv. A summary of the mercury source treatment and/or control measures implemented and/or planned; and
- v. Proposed revisions to the MMP based on findings from the previous year.

Best Professional Judgment (BPJ)

Oil & Grease

The daily maximum limit for Oil and Grease should prevent the occurrence of a visible sheen in the stream and has been shown to be achievable through the use of proper BMPs.

Ammonia

Monitoring for ammonia has been proposed to assess the relationship between DO and ammonia in the discharge.

Nutrients

Monitoring for phosphorus, kjeldahl nitrogen, and nitrite plus nitrate has been proposed on a seasonal basis to evaluate the nutrient discharges from the facility.

Indicator Parameters

Monitoring has been proposed for indicator parameters to evaluate the effectiveness of the facility BMP plan and to assess the impact of the discharge on the receiving stream.

303(d) List of Impaired Waters

Pond Creek is listed on the 303(d) List of Impaired Waters for Organic Enrichment (CBOD, NBOD) and Metals (Arsenic, Cyanide, Mercury). Narrative conditions for mercury have been proposed through the MMP requirements. Arsenic and cyanide are not expected to be parameters of concern based on DMR data collected during the previous permit cycle; therefore, monitoring with no specific limitations for arsenic and cyanide has been proposed at Outfall 001, Monitoring Point DSN001Y, to confirm that the discharge is not contributing to the impairment. The DSN001Y samples are to be collected on an annual basis at the same location as Outfall DSN001 and samples shall not be collected during a precipitation event. NBOD is not expected to be a parameter of concern. Monitoring for CBOD has been proposed based on the impairment.

Stormwater Outfalls 001, 003, 006

Monitoring Points 001S, 003S

The samples collected for compliance with the requirements of monitoring points DSN001S and DSN003S are to be captured during a qualifying storm event as described in Part IV of the proposed permit. Based on a review of discharge monitoring report data, the Department has reduced the frequency for stormwater monitoring from quarterly to semiannually as requested by the Permittee.

Best Management Practices (BMP) Plan

Best Management Practices (BMPs) are believed to be the most effective way to control the contamination of stormwater from areas of industrial activities. This facility is required to maintain a BMP plan. The requirements of the BMP plan call for minimization of stormwater contact with waste materials, products and by-products, and for prevention of spills or loss of fluids from equipment maintenance activities. The effectiveness of the BMPs will be measured through the monitoring of the pollutants of concern.

The Department has updated the BMP language located in Part IV.A.2.g of the Permit. The Permit Condition now states "Provide for routine inspections, or days during which the facility is manned, of any structures that function to prevent stormwater pollution or to remove pollutants from stormwater and of the facility in general. Routine inspections should be done at a frequency to ensure that the BMP is continually implemented and effective and in no case less frequent than once per year." This clarification was added to be consistent with 40 CFR Part 122.43(c).

Oil & Grease

The daily maximum limit for Oil and Grease should prevent the occurrence of a visible sheen in the stream and has been shown to be achievable through the use of proper BMPs.

Indicator Parameters

Monitoring has been proposed for indicator parameters to evaluate the effectiveness of the facility BMP plan and to assess the impact of the discharges on the receiving stream.

Receiving Stream - Outfall 003

The Permittee indicated in the permit application that the appropriate receiving stream for Outfall 003 should be listed as an Unnamed Tributary to Pond Creek. The 003 discharge flows to the northeast and enters an unnamed tributary near the former cooling water ponds. The tributary flows to the north around the perimeter of the former cooling ponds and enters Pond Creek adjacent to the facility discharge conveyance into Pond Creek.

Employee Car Wash - Outfall DSN006

Discharges through Outfall 006 include rinse waters from the employee car wash and stormwater runoff associated with the employee car wash, maintenance building, employee parking areas, and the plant entrance road. The car wash utilizes river water with no chemicals or detergents added. Specific monitoring requirements have not been proposed at Outfall DSN006 since significant pollutants are not expected to be introduced through the car wash and stormwater runoff is not from process areas.

Cooling Water Intake Structure (CWIS) Requirements

Section 316(b) of the Clean Water Act requires that facilities minimize adverse environmental impacts resulting from the operation of cooling water intake structures (CWIS) by using the "Best Technology Available" (BTA). All of those facilities including those not specifically addressed by rules, must be evaluated for 316(b) compliance. For those facilities not addressed in Phase I, II, or III rules, a BTA determination must be made using "Best Professional Judgment" (BPJ) under the authority of 40 CFR §§ 125 Subpart J and 401.14. Facilities that meet these criteria must submit the application information described in 40 CFR 122.21(r)(2) through (r)(8) in order for the Department to make a BTA determination on the CWIS. The Department has determined that the CWIS utilized by the Permittee is subject to the 316(b) Phase II requirements.

Previously, the Permittee utilized two separate CWIS; the Fleet Hollow CWIS located on Lake Wilson of the Tennessee River and the PDW CWIS located on Pickwick Lake of the Tennessee River. The previous permit made a BTA determination on both CWIS. The Permittee has indicated that the facility has transitioned to utilizing only the PDW intake as of late 2025/early 2026 and the Fleet Hollow intake has been disconnected. As a result, the Department has evaluated only the PDW CWIS as part of this permit reissuance.

The Permittee indicated that electrical and mechanical upgrades have been completed for the PDW CWIS which has reduced the maximum design intake of the CWIS from the information provided in the previous permit application. The 3 pumps and motors have been replaced with new pumps, each having a 11.5 MGD capacity, and single-speed drives. The intake screens have been replaced with a fixed ½" mesh fixed screen with a 65% open area. The fuses supplying power to the CWIS are sized to only provide enough power for one motor and pump to operate at any given time. The two additional pumps are held in reserve to be present for continuity of operations in the event of equipment failure or required maintenance. Based on this configuration, the Permittee has indicated that the maximum design intake capacity is 11.5 MGD and the maximum through screen velocity is 0.20 ft/sec. The Permittee has selected the compliance option for BTA standards for impingement mortality listed at 40 CFR 125.94(c)(2) which requires a through-screen design velocity of less than 0.5 ft/sec. The maximum design intake is less than 1% of the 7Q10 flow of the Tennessee River (Pickwick Lake). No entrainment mortality studies have been conducted for the PDW CWIS.

At this time, the Department has made a determination that the CWIS represents the BTA to minimize adverse environmental impact in accordance with Section 316(b) of the Federal Clean Water Act (33 U.S.C. section 1326).

The following conditions have been proposed in Part IV.C of the Permit:

1. The cooling water intake structure used by the permittee has been evaluated using available information. At this time, the Department has determined that the cooling water intake structure does represent the best technology available (BTA) to minimize adverse environmental impact(s) in accordance with Section 316(b) of the federal Clean Water Act (33 U.S.C. section 1326).
2. The permittee is required to operate and maintain the CWIS in a manner that minimizes impingement and entrainment levels. Documentation detailing the steps that have and are being taken to minimize the impingement and entrainment levels shall be maintained on site and made available upon request.
3. Nothing in this Permit authorizes take for the purposes of a facility compliance with the Endangered Species Act.

4. The permittee shall submit the information for the CWIS as required by 40 CFR 122.21 (r) at least 180 days prior to expiration of the permit unless a request has been approved by the Department in writing. The facility must submit the request for reduced cooling water intake structure and waterbody application information to the Department at least two years and six months prior to the expiration of the permit. The permittee's request must identify each element that it determines has not been substantially changed since the previous permit application and the basis for the determination.
5. The Permittee must keep records of all submissions that are part of the permit application pertaining to the CWIS until the subsequent permit is issued to the Permittee.
6. The Permittee's permit application must contain readily available information, at the time of permit application development, in identifying all federally-listed threatened and endangered species and/or designated critical habitat that are or may be present in the action area.
7. The Permittee must conduct weekly visual inspections or employ remote monitoring devices during the period the cooling water intake structure is in operation. This condition is only applicable if control technologies are being employed to comply with BTA for impingement mortality.
8. The Permittee is required to submit an Annual Certification to the Department no later than January 28th of each year. The Annual Certification shall detail if any changes have been made to impact the operation of the CWIS structure.

Facility Name: **Occidental Chemical Corporation**NPDES No.: **AL0000213**

Q _d *C _d + Q _{d2} *C _{d2} + Q _s *C _s = Q _r *C _r								Enter Max Daily Discharge as reported by Applicant (C _d) Max	Enter Avg Daily Discharge as reported by Applicant (C _d) Ave	Partition Coefficient (Stream / Lake)
ID	Pollutant	Concentration Year	Type	Background from upstream source (C _{d2}) Daily Max	Background from upstream source (C _{d2}) Monthly Ave	Background Instream (C _d) Daily Max	Background Instream (C _d) Monthly Ave			
1	Antimony		Metals	0	0	0	0	0	0	-
2	Arsenic**	YES	Metals	0	0	0	0	0	0	0.574
3	Beryllium		Metals	0	0	0	0	0	0	-
4	Cadmium**		Metals	0	0	0	0	0	0	0.236
5	Chromium / Chromium III**		Metals	0	0	0	0	0	0	0.210
6	Chromium / Chromium VI**		Metals	0	0	0	0	0	0	-
7	Copper**		Metals	0	0	0	0	0	0	0.388
8	Lead**		Metals	0	0	0	0	0	0	0.206
9	Mercury**		Metals	0	0	0	0	0.0725	0.0267	0.302
10	Nickel**		Metals	0	0	0	0	0	0	0.505
11	Selenium		Metals	0	0	0	0	0	0	-
12	Silver		Metals	0	0	0	0	0	0	-
13	Thallium		Metals	0	0	0	0	0	0	-
14	Zinc**		Metals	0	0	0	0	0	0	0.330
15	Cyanide		Metals	0	0	0	0	0	0	-
16	Total Phenolic Compounds		Metals	0	0	0	0	0	0	-
17	Hardness (As CaCO3)		Metals	0	0	0	0	0	0	-
18	Acetone		VOC	0	0	0	0	0	0	-
19	Acrylonitrile*	YES	VOC	0	0	0	0	0	0	-
20	Aldrin	YES	VOC	0	0	0	0	0	0	-
21	Benzene*	YES	VOC	0	0	0	0	0	0	-
22	Bromoform*	YES	VOC	0	0	0	0	0	0	-
23	Carbon Tetrachloride*	YES	VOC	0	0	0	0	0	0	-
24	Chlordane	YES	VOC	0	0	0	0	0	0	-
25	Chlorobenzene	YES	VOC	0	0	0	0	0	0	-
26	Chlorodibromo-Methane*	YES	VOC	0	0	0	0	0	0	-
27	Chloroethane		VOC	0	0	0	0	0	0	-
28	2-Chloro-Ethylvinyl Ether		VOC	0	0	0	0	0	0	-
29	Chloroform*	YES	VOC	0	0	0	0	1.44	1.44	-
30	4,4'-DDE	YES	VOC	0	0	0	0	0	0	-
31	4,4'-DDE	YES	VOC	0	0	0	0	0	0	-
32	4,4'-DDT	YES	VOC	0	0	0	0	0	0	-
33	Dichlorobromo-Methane*	YES	VOC	0	0	0	0	0	0	-
34	1,1-Dichloroethane		VOC	0	0	0	0	0	0	-
35	1,2-Dichloroethane*	YES	VOC	0	0	0	0	0	0	-
36	Trans-1,2-Dichloro-Ethylene		VOC	0	0	0	0	0	0	-
37	1,1-Dichloroethylene*	YES	VOC	0	0	0	0	0	0	-
38	1,2-Dichloroethene		VOC	0	0	0	0	0	0	-
39	1,3-Dichloro-Propylene		VOC	0	0	0	0	0	0	-
40	Dieldrin	YES	VOC	0	0	0	0	0	0	-
41	Ethylbenzene		VOC	0	0	0	0	0	0	-
42	Methyl Bromide		VOC	0	0	0	0	0	0	-
43	Methyl Chloride		VOC	0	0	0	0	0	0	-
44	Methylene Chloride*	YES	VOC	0	0	0	0	0	0	-
45	1,1,1,2,2-Tetrachloro-Ethane*	YES	VOC	0	0	0	0	0	0	-
46	Tetrachloro-Ethylene*	YES	VOC	0	0	0	0	0	0	-
47	Toluene		VOC	0	0	0	0	0	0	-
48	Toxaphene	YES	VOC	0	0	0	0	0	0	-
49	Triethylamine (TEA)	YES	VOC	0	0	0	0	0	0	-
50	1,1,1-Trichloroethane		VOC	0	0	0	0	0	0	-
51	1,1,2-Trichloroethane*	YES	VOC	0	0	0	0	0	0	-
52	Trichloroethylene*	YES	VOC	0	0	0	0	0	0	-
53	Vinyl Chloride*	YES	VOC	0	0	0	0	0	0	-
54	p-Chloro-H-Cresol		Acids	0	0	0	0	0	0	-
55	2-Chlorophenol		Acids	0	0	0	0	0	0	-
56	2,4-Dichlorophenol		Acids	0	0	0	0	0	0	-
57	2,4-Dinitrophenol		Acids	0	0	0	0	0	0	-
58	4,6-Dinitro-O-Cresol		Acids	0	0	0	0	0	0	-
59	2,4-Dinitrophenol		Acids	0	0	0	0	0	0	-
60	4,6-Dinitro-2-methylphenol	YES	Acids	0	0	0	0	0	0	-
61	Dioxin (2,3,7,8-TCDD)	YES	Acids	0	0	0	0	0	0	-
62	2-Nitrophenol		Acids	0	0	0	0	0	0	-
63	4-Nitrophenol		Acids	0	0	0	0	0	0	-
64	Pentachlorophenol*	YES	Acids	0	0	0	0	0	0	-
65	Phenol		Acids	0	0	0	0	0	0	-
66	2,4,6-Trichlorophenol*	YES	Acids	0	0	0	0	0	0	-
67	Acenaphthene		Bases	0	0	0	0	0	0	-
68	Acenaphthylene		Bases	0	0	0	0	0	0	-
69	Anthracene		Bases	0	0	0	0	0	0	-
70	Benidine		Bases	0	0	0	0	0	0	-
71	Benzo(A)Anthracene*	YES	Bases	0	0	0	0	0	0	-
72	Benzo(A)Pyrene*	YES	Bases	0	0	0	0	0	0	-
73	3,4-Benzo-Fluoranthene		Bases	0	0	0	0	0	0	-
74	Benzo(GH)Perylene		Bases	0	0	0	0	0	0	-
75	Benzo(K)Fluoranthene		Bases	0	0	0	0	0	0	-
76	Bis (2-Chloroethoxy) Methane		Bases	0	0	0	0	0	0	-
77	Bis (2-Chloroethoxy) Ether*	YES	Bases	0	0	0	0	0	0	-
78	Bis (2-Chloro-Propyl) Ether		Bases	0	0	0	0	0	0	-
79	Bis (2-Ethylhexyl) Phthalate*	YES	Bases	0	0	0	0	0	0	-
80	4-Bromophenyl Phenyl Ether		Bases	0	0	0	0	0	0	-
81	Butyl Benzyl Phthalate		Bases	0	0	0	0	0	0	-
82	2-Chloronaphthalene		Bases	0	0	0	0	0	0	-
83	4-Chlorophenyl Phenyl Ether		Bases	0	0	0	0	0	0	-
84	Chrysene*	YES	Bases	0	0	0	0	0	0	-
85	Di-N-Butyl Phthalate		Bases	0	0	0	0	0	0	-
86	Di-N-Octyl Phthalate		Bases	0	0	0	0	0	0	-
87	Dibenzo(A,H)Anthracene*	YES	Bases	0	0	0	0	0	0	-
88	1,2-Dichlorobenzene		Bases	0	0	0	0	0	0	-
89	1,3-Dichlorobenzene		Bases	0	0	0	0	0	0	-
90	1,4-Dichlorobenzene		Bases	0	0	0	0	0	0	-
91	3,3-Dichlorobenzidine*	YES	Bases	0	0	0	0	0	0	-
92	Diethyl Phthalate		Bases	0	0	0	0	0	0	-
93	Dimethyl Phthalate		Bases	0	0	0	0	0	0	-
94	2,4-Dinitrotoluene*	YES	Bases	0	0	0	0	0	0	-
95	2,6-Dinitrotoluene		Bases	0	0	0	0	0	0	-
96	1,2-Diphenylhydrazine		Bases	0	0	0	0	0	0	-
97	Endosulfan (alpha)	YES	Bases	0	0	0	0	0	0	-
98	Endosulfan (beta)	YES	Bases	0	0	0	0	0	0	-
99	Endosulfan sulfate	YES	Bases	0	0	0	0	0	0	-
100	Endrin	YES	Bases	0	0	0	0	0	0	-
101	Endrin Aldehyde	YES	Bases	0	0	0	0	0	0	-
102	Fluoranthene		Bases	0	0	0	0	0	0	-
103	Fluorene		Bases	0	0	0	0	0	0	-
104	Heptachlor	YES	Bases	0	0	0	0	0	0	-
105	Heptachlor Epoxide	YES	Bases	0	0	0	0	0	0	-
106	Hexachlorobenzene*	YES	Bases	0	0	0	0	0	0	-
107	Hexachlorobutadiene*	YES	Bases	0	0	0	0	0	0	-
108	Hexachlorocyclohexan (alpha)	YES	Bases	0	0	0	0	0	0	-
109	Hexachlorocyclohexan (beta)	YES	Bases	0	0	0	0	0	0	-
110	Hexachlorocyclohexan (gamma)	YES	Bases	0	0	0	0	0	0	-
111	Hexachlorocyclopentadiene		Bases	0	0	0	0	0	0	-
112	Hexachloroethane		Bases	0	0	0	0	0	0	-
113	Indene(1,2,3-CH)Pyrene*	YES	Bases	0	0	0	0	0	0	-
114	Isophorone		Bases	0	0	0	0	0	0	-
115	Naphthalene		Bases	0	0	0	0	0	0	-
116	Nitrobenzene		Bases	0	0	0	0	0	0	-
117	N-Nitrosodi-N-Propylamine*	YES	Bases	0	0	0	0	0	0	-
118	N-Nitrosodi-N-Methylamine*	YES	Bases	0	0	0	0	0	0	-
119	N-Nitrosodi-N-Phenylamine*	YES	Bases	0	0	0	0	0	0	-
120	PCB-1016	YES	Bases	0	0	0	0	0	0	-
121	PCB-1221	YES	Bases	0	0	0	0	0	0	-
122	PCB-1232	YES	Bases	0	0	0	0	0	0	-
123	PCB-1242	YES	Bases	0	0	0	0	0	0	-
124	PCB-1248	YES	Bases	0	0	0	0	0	0	-
125	PCB-1254	YES	Bases	0	0	0	0	0	0	-
126	PCB-1260	YES	Bases	0	0	0	0	0	0	-
127	Phenanthrene		Bases	0	0	0	0	0	0	-
128	Pyrene		Bases	0	0	0	0	0	0	-
129	1,2,4-Trichlorobenzene		Bases	0	0	0	0	0	0	-

7.8	Enter Q _d = wastewater discharge flow from facility (MGD)
12.068385	Q _d = wastewater discharge flow (cfs) (this value is calculated from the MGD)
1.315	Enter flow from upstream discharge Q _{d2} = background stream flow in MGD above point of discharge
2.03460614	Q _{d2} = background stream flow from upstream source (cfs)
0	Enter TQ10, Q _s = background stream flow in cfs above point of discharge
0	Enter or estimated, TQ10, Q _s = background stream flow in cfs above point of discharge (TQ10 estimated at 75% of TQ10)
47.2	Enter Mean Annual Flow, Q _s = background stream flow in cfs above point of discharge
0	Enter TQ2, Q _s = background stream flow in cfs above point of discharge (For LWF class streams)
Enter or Est	Enter C _d = background in-stream pollutant concentration in µg/l (assuming this is zero '0' unless there is data)
Q _d + Q _{d2} + Q _s	Q _s = resultant in-stream flow, after discharge
Calculated on other	C _s = resultant in-stream pollutant concentration in µg/l in the stream (after complete mixing occurs)
88.5	Enter, Background Hardness above point of discharge (assumed 50 South of Birmingham and 100 North of Birmingham)
7.80 a.u.	Enter, Background pH above point of discharge
YES	Enter, Is discharge to a stream? "YES" Other option would be to a Lake. (This changes the partition coefficients for the metals)

** Using Partition Coefficients

June 10, 2026

Facility Name: Occidental Chemical Corporation														
NPDES No.: AL0000213														
Freshwater AML classification:				Freshwater Acute (µg/l) Q ₁₀ = 7Q10 for AML >24 hrs travel time to higher class				Background from upstream source (C ₀₂) Monthly Avg		Human Health Consumption Fish only (µg/l) Carcinogen Q ₁₀ = Annual Average Non-Carcinogen Q ₁₀ = 7Q10				
ID	Pollutant	RP?	Carcinogen yes	Background from upstream source (C ₀₂) Daily Max	Max Daily Discharge as reported by Applicant (C _{avg})	Water Quality Criteria (C ₁)	Draft Permit Limit (C _{perm})	20% of Draft Permit Limit	RP?	Water Quality Criteria (C ₁)	Draft Permit Limit (C _{perm})	20% of Draft Permit Limit	RP?	
1	Antimony		YES	0	0	562.334	692.198	138.4362031	No	0	0	0	-	
2	Arsenic		YES	0	0	7.577	8.854	1.770877718	No	0	0	0	-	
3	Beryllium			0	0	2454.832	2688.692	573.7383952	No	0	0	0	-	
4	Cadmium			0	0	16.000	16.897	3.738487179	No	0	0	0	-	
5	Chromium/ Chromium III			0	0	30.871	36.075	7.215075888	No	0	0	0	-	
6	Chromium/ Chromium VI			0	0	274.387	320.646	64.12928885	No	0	0	0	-	
7	Copper			0	0	2.400	2.805	0.560923077	No	0	0.0267	0.0424	0.0089	Yes
8	Lead		YES	0	0.0725	836.156	977.123	195.4248275	No	0	0	0	-	
9	Mercury			0	0	20.000	23.372	4.674358674	No	0	0	0	-	
10	Nickel			0	0	2.807	3.047	0.80933031	No	0	0	0	-	
11	Selenium			0	0	320.174	374.152	74.83044642	No	0	0	0	-	
12	Silver			0	0	22.000	28.709	5.141784872	No	0	0	0	-	
13	Thallium			0	0					2.74E-01	3.20E-01	6.39E-02	No	
14	Zinc			0	0					1.49E+04	1.74E+04	3.48E+03	No	
15	Cyanide			0	0					9.33E+03	1.09E+04	2.18E+03	No	
16	Total Phenolic Compounds			0	0								-	
17	Hardness (As CaCO3)			0	0								-	
18	Acrolein			0	0					5.43E+00	6.34E+00	1.27E+00	No	
19	Acrylonitrile		YES	0	0					1.44E-01	7.32E-01	1.46E-01	No	
20	Aldrin		YES	0	0	3.000	3.508	0.701153846	No	0	0	0	-	
21	Benzene		YES	0	0					1.95E+01	7.85E+01	1.57E+01	No	
22	Bromofom		YES	0	0					7.86E+01	4.00E+02	8.00E+01	No	
23	Carbon Tetrachloride		YES	0	0					9.57E-01	4.86E+00	9.73E-01	No	
24	Chlordane		YES	0	0	2.400	2.805	0.560923077	No	0	0	0	-	
25	Chlorobenzene			0	0					4.73E-04	2.40E-03	4.80E-04	No	
26	Chlorodibromo-Methane		YES	0	0					9.08E+02	1.08E+03	2.12E+02	No	
27	Chloroethane			0	0					7.41E+00	3.78E+01	7.53E+00	No	
28	2-Chloro-Ethylvinyl Ether			0	0								-	
29	Chloroform		YES	0	1.44					1.02E+02	5.18E+02	1.04E+02	No	
30	4,4'-DDD		YES	0	0					1.81E-04	9.21E-04	1.84E-04	No	
31	4,4'-DDE		YES	0	0					1.28E-04	6.50E-04	1.30E-04	No	
32	4,4'-DDT		YES	0	0	1.100	1.285	0.257089744	No	0	0	0	-	
33	Dichlorobromo-Methane		YES	0	0					10.04	50.98	10.20	No	
34	1,1-Dichloroethane			0	0					2.14E+01	1.09E+02	2.17E+01	No	
35	1,2-Dichloroethane		YES	0	0					5.91E+03	6.90E+03	1.38E+03	No	
36	Trans-1,2-Dichloro-Ethylene			0	0					4.17E+03	2.12E+04	4.23E+03	No	
37	1,1-Dichloroethylene		YES	0	0					8.49E+00	9.93E+00	1.99E+00	No	
38	1,2-Dichloropropane			0	0					1.23E+01	1.44E+01	2.87E+00	No	
39	1,3-Dichloro-Propylene			0	0					3.12E-05	1.58E-04	3.17E-06	No	
40	Dieldrin		YES	0	0	0.240	0.280	0.056092308	No	0	0	0	-	
41	Ethylbenzene			0	0					1.24E+03	1.45E+03	2.91E+02	No	
42	Methyl Bromide			0	0					8.71E+02	1.02E+03	2.04E+02	No	
43	Methyl Chloride			0	0								-	
44	Methylene Chloride		YES	0	0					3.46E+02	1.78E+03	3.51E+02	No	
45	1,1,2,2-Tetrachloro-Ethane		YES	0	0					2.33E+00	1.19E+01	2.37E+00	No	
46	Tetrachloro-Ethylene		YES	0	0					1.82E+00	9.74E+00	1.95E+00	No	
47	Toluene			0	0					8.72E+03	1.02E+04	2.04E+03	No	
48	Toxaphene		YES	0	0	0.730	0.863	0.170814103	No	0	0	0	-	
49	Tributyltin (TBT)		YES	0	0	0.480	0.538	0.107510256	No	0	0	0	-	
50	1,1,1-Trichloroethane			0	0					1.62E-04	8.23E-04	1.65E-04	No	
51	1,1,2-Trichloroethane		YES	0	0					8.10E+00	4.62E+01	9.24E+00	No	
52	Trichloroethylene		YES	0	0					1.75E+01	8.87E+01	1.77E+01	No	
53	Vinyl Chloride		YES	0	0					1.42E+00	7.24E+00	1.45E+00	No	
54	p-Chloro-m-Cresol			0	0					0	0	0	-	
55	2-Chlorophenol			0	0					8.71E+01	1.02E+02	2.03E+01	No	
56	2,4-Dichlorophenol			0	0					1.72E+02	2.01E+02	4.02E+01	No	
57	2,4-Dimethylphenol			0	0					4.88E+02	5.81E+02	1.16E+02	No	
58	4,6-Dinitro-o-Cresol			0	0					0	0	0	-	
59	2,4-Dinitrophenol			0	0					3.11E+03	3.84E+03	7.27E+02	No	
60	4,6-Dinitro-2-methylphenol		YES	0	0					1.85E+02	8.40E+02	1.68E+02	No	
61	Dioxin (2,3,7,8-TCDD)		YES	0	0					2.87E-08	1.35E-07	2.71E-08	No	
62	2-Nitrophenol			0	0					0	0	0	-	
63	4-Nitrophenol			0	0					0	0	0	-	
64	Pentachlorophenol		YES	0	0	8.723	10.194	2.038766652	No	0	0	0	-	
65	Phenol			0	0					1.77E+00	8.98E+00	1.80E+00	No	
66	2,4,6-Trichlorophenol		YES	0	0					5.00E+05	5.84E+05	1.17E+05	No	
67	Acenaphthene			0	0					1.41E+00	7.18E+00	1.44E+00	No	
68	Acenaphthylene			0	0					8.79E+02	6.78E+02	1.35E+02	No	
69	Anthracene			0	0					2.33E+04	2.73E+04	5.45E+03	No	
70	Benzo(a)Pyrene			0	0					1.16E-04	1.35E-04	2.71E-05	No	
71	Benzo(a)Anthracene		YES	0	0					1.07E-02	5.41E-02	1.08E-02	No	
72	Benzo(b)Fluoranthene			0	0					1.07E-02	5.41E-02	1.08E-02	No	
73	Benzo(k)Fluoranthene			0	0					1.07E-02	1.25E-02	2.48E-03	No	
74	Benzo(g,h,i)Perylene			0	0					0	0	0	-	
75	Benzo(a)Fluoranthene			0	0					1.07E-02	1.25E-02	2.48E-03	No	
76	Bis (2-Chloroethoxy) Methane			0	0					0	0	0	-	
77	Bis (2-Chloroethyl)-Ether		YES	0	0					3.07E-01	1.58E+00	3.12E-01	No	
78	Bis (2-Chloroisopropyl) Ether			0	0					3.78E+04	4.42E+04	8.83E+03	No	
79	Bis (2-Ethylhexyl) Phthalate		YES	0	0					1.28E+00	6.51E+00	1.30E+00	No	
80	4-Bromophenyl Phenyl Ether			0	0					0	0	0	-	
81	Butyl Benzyl Phthalate			0	0					1.13E+03	1.32E+03	2.63E+02	No	
82	2-Chloronaphthalene			0	0					9.24E+02	1.08E+03	2.16E+02	No	
83	4-Chlorophenyl Phenyl Ether			0	0					0	0	0	-	
84	Chrysene		YES	0	0					1.07E-02	5.41E-02	1.08E-02	No	
85	Di-N-Butyl Phthalate			0	0					2.62E+03	3.08E+03	6.13E+02	No	
86	Di-N-Octyl Phthalate			0	0					0	0	0	-	
87	Dibenz(a,h)Anthracene		YES	0	0					1.07E-02	5.41E-02	1.08E-02	No	
88	1,2-Dichlorobenzene			0	0					7.55E+02	8.83E+02	1.77E+02	No	
89	1,3-Dichlorobenzene			0	0					5.52E+02	6.57E+02	1.31E+02	No	
90	1,4-Dichlorobenzene			0	0					1.12E+02	1.31E+02	2.63E+01	No	
91	3,3-Dichlorobenzidine		YES	0	0					1.66E-02	8.44E-02	1.69E-02	No	
92	Diethyl Phthalate			0	0					2.56E+04	2.89E+04	5.88E+03	No	
93	Dimethyl Phthalate			0	0					8.48E+05	7.57E+05	1.51E+05	No	
94	2,4-Dinitrotoluene		YES	0	0					1.98E+00	1.01E+01	2.01E+00	No	
95	2,6-Dinitrotoluene			0	0					0	0	0	-	
96	1,2-Diphenylhydrazine			0	0					1.17E-01	1.37E-01	2.74E-02	No	
97	Endosulfan (alpha)		YES	0	0	0.22	0.257	0.051417949	No	0	0	0	-	
98														

Mixing Zone Analysis Summary

Page 1

REQUEST INFORMATION

request number: 4093

From: (Responsible Engineer) Theo Pinson In Branch/Section Industrial
Date Submitted 10/29/2025 Date Required 11/28/2025 FUND Code 605
Date Permit application received by NPDES program 10/1/2025

Receiving Waterbody Tennessee River (Pickwick Lake)

Previous Stream Name

Facility Name Occidental Chemical Corporation

(Name of Discharger-WQ will use to file)

Previous Discharger Name

River Basin Tennessee

Outfall Latitude 34.789604

(decimal degrees)

*County Colbert

Outfall Longitude -87.643845

(decimal degrees)

Permit Number AL0000213

Permit Type Permit Reissuance

Permit Status Active

Type of Discharger INDUSTRIAL

Do other discharges exist that may impact the model?

☒ Yes ☐ No

If yes, impacting dischargers names.

Muscle Shoals WWTP, TVA Environmental Research Center

Impacting dischargers permit numbers.

AL0024180, AL0003891

Existing Discharge Design Flow 7.8

MGD

Proposed Discharge Design Flow

MGD

Note: The flow rates given should be those requested for modeling.

Seasonal limits requested?

☐ Yes ☒ No

If not seasonal, only the summer sections will be used

Comments included

☒ Yes ☐ No

Information Verified By

JJM

Year File Was Started 2014

Response ID: 478

12 Digit HUC Code 060300050802

Use Classification PWS / F&W

Site Visit Completed? ☒ Yes ☐ No

Date of MZ Response 6/9/2026

Date of Site Visit 2/5/2026

Hydrology

Drainage Area 30751 sq mi

Stream 7Q10 7887.9 cfs

Stream 1Q10 5915.8 cfs

Stream 7Q2 12534 cfs

Annual Average 50937 cfs

Date of MZ Analysis 2/13/2026

Method Used to Calculate

ADEM Estimate w/TVA Flow Data

ADEM Estimate w/TVA Flow Data

ADEM Estimate w/TVA Flow Data

ADEM Estimate w/TVA Flow Data

Model Completed by Jacobs

Pollutant Category

Whole Effluent Toxicity (WET) ☒Thermal ☒Pathogens ☐

Mixing Zone Analysis Summary

Page 2

WET Parameters

Summer

Acute

Ambient Streamflow 5915.8 cfs
 ZID Length 25.54 Meters
 ZID IWC 75 %

Chronic

Ambient Streamflow cfs
 Mixing Zone Length Meters
 Mixing Zone IWC %

Winter

Acute

Ambient Streamflow 5915.8 cfs
 ZID Length 25.54 Meters
 ZID IWC %

Chronic

Ambient Streamflow cfs
 Mixing Zone Length Meters
 Mixing Zone IWC %

Thermal Parameters

Summer

Ambient Streamflow 7887.9 cfs
 Mixing Zone Length 1035 Meters
 Max. Effluent Temp 32.22 °C

Winter

Ambient Streamflow cfs
 Mixing Zone Length Meters
 Max. Effluent Temp °C

Pathogen Parameters

Summer

Ambient Streamflow cfs
 ZID Length Meters
 Max. Effluent Fecal Conc Cols/100 mls
 Max. Effluent E. coli Conc Cols/100 mls
 Monthly Average Effluent E. coli Conc Cols/100 mls
 Max. Effluent Enterococci Conc (for coastal waters) Cols/100 mls

Winter

Ambient Streamflow cfs
 ZID Length Meters
 Max. Effluent Fecal Conc Cols/100 mls
 Max. Effluent E. coli Conc Cols/100 mls
 Monthly Average Effluent E. coli Conc Cols/100 mls
 Max. Effluent Enterococci Conc (for coastal waters) Cols/100 mls

Comments and/or Notations

Mixing Zone review. Modeling completed by Jacobs on behalf of Occidental Chemical Corporation. Occidental Chemical Corporation discharges to Pond Creek, which is a tributary to the Tennessee River (Pickwick Lake). The purposes of the mixing zone evaluation were to confirm that the existing Occidental Chemical Corporation effluent temperature limit of 90°F is protective of the temperature criterion (86°F) for the Tennessee River (Pickwick Lake) and to determine the IWC of the discharge downstream in the Tennessee River (Pickwick Lake).

EDWARD F. POOLOS
DIRECTOR

JEFFERY W. KITCHENS
DEPUTY DIRECTOR



Alabama Department of Environmental Management
adem.alabama.gov

1400 Coliseum Blvd. 36110-2400 ■ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ■ FAX (334) 271-7950

KAY IVEY
GOVERNOR

June 9, 2026

Memorandum:

TO: Theo Pinson
Industrial/Municipal Branch

FROM: James Mooney
Water Quality Branch

RE: Mixing Zone Review – Occidental Chemical Corporation (AL0000213)

The Water Quality Branch has completed the CORMIX model review for the existing Occidental Chemical Corporation discharge. The CORMIX modeling was completed by Jacobs on behalf of Occidental Chemical Corporation. Occidental Chemical Corporation discharges to Pond Creek, which is a tributary to the Tennessee River (Pickwick Lake). The purposes of the mixing zone evaluation were to confirm that Occidental Chemical Corporation's existing effluent temperature limit of 90°F is protective of the applicable temperature criteria for the Tennessee River (Pickwick Lake) and to determine the instream waste concentration (IWC) of the discharge downstream in the Tennessee River (Pickwick Lake).

The applicable mixing zone criterion states that mixing zones "shall not exceed a width of 50 percent of the stream width." The results included in the report submitted to the Department indicate that the predicted temperature at the edge of the mixing zone (3398 ft) is 28.15°C, which is protective of the Tennessee River (Pickwick Lake) temperature criteria of 86°F (30°C).

The applicable distance to the edge of the ZID is based upon the criterion stating that the length of the ZID "shall not exceed...five times the water depth in any horizontal direction from the discharge outlet." The results included in the report submitted to the Department indicate that the IWC for acute toxicity testing purposes for the facility is 75%.

The Water Quality Branch has reviewed the report, model inputs, and model results submitted by Jacobs and agrees that the model inputs and results are appropriate at this time.



Birmingham Office
110 Vulcan Road
Birmingham, AL 35209-4702
(205) 942-6168
(205) 941-1603 (FAX)

Decatur Office
2715 Sandlin Road, S.W.
Decatur, AL 35603-1333
(256) 353-1713
(256) 340-9359 (FAX)

Coastal Office
1615 South Broad Street
Mobile, AL 36605
(251) 450-3400
(251) 479-2593 (FAX)

NPDES Individual Permit Mod/Reissue (Form 187) - Supplementary Information for Industrial Facilities

version 2.11

(Submission #: HQG-0XXY-7Y0S9, version 1)

Digitally signed by:
AEPACS
Date: 2025.10.01 11:03:10 -05:00
Reason: Submission Data
Location: State of Alabama

Details

Submission ID HQG-0XXY-7Y0S9

Form Input

General Instructions

This form should be used to submit the following permit requests for permitted Industrial Individual NPDES facilities

- Permit Transfers
- Permittee/Facility Name Changes
- Minor Modifications, for example:
 - > Frequency of monitoring or reporting modifications
 - > Changes to interim compliance dates in a schedule of compliance, not including the final compliance date.
 - > Removal of a point source outfall, provided the discharge is terminated and does not result in discharge of pollutants from other outfalls, except in accordance with permit limits.
- Major Modifications, (Any modifications not covered by minor mod's, whether Effluent Limit changes occur or not)
- Reissuances
- Reissuance of a permit due to approaching expiration
- Revocation and Reissuance of permit prior to its scheduled expiration

Applicable Base Fees:

- Permit Transfers and/or Permittee/Facility Name Changes
 - > \$800
- Minor Modifications (see examples above)
 - > \$3,940 (Major Sources)
 - > \$3,120 (Minor Sources)
- Major Modifications
 - > \$17,990 (Major Sources)
 - > \$5,615 (Minor Sources)
- Reissuances
 - > \$17,990 (Major Sources)
 - > \$5,615 (Minor Sources)

[For assistance, please click here to determine the permit staff responsible for the site or call \(334\) 271-7799](#)

Processing Information

Purpose of Application

Reissuance of Permit Due to Approaching Expiration

Please indicate if the Permittee is applying for a permit transfer and/or name change in addition to permit modification or reissuance:

None

Action Type

Reissuance

If applicable, briefly describe any planned changes at the facility that are included in this reissuance application:

NONE PROVIDED

General Information

SID Permit Number (if your facility currently holds an SID permit, please provide that number below):

NONE PROVIDED

NPDES or General Permit Numbers (if applicable, please list all permit numbers):

AL0000213

Is this facility/site only applying for permit coverage for discharges from stormwater?

No

Is a new stormwater outfall being added?

No

Permit Information

Permit Number

AL0000213

Current Permittee Name

Occidental Chemical Corporation

Permittee

Permittee Name

Occidental Chemical Corporation

Mailing Address

1000 North Wilson Dam Road

Muscle Shoals, AL 35661

Per ADEM Admin. Code r. 335-6-6-.09 (1), a Responsible Official is defined as CEO, President, any position at a level of Vice President or higher, Owner, Partner, Managing Member (LLC), or ranking elected official. Please provide the contact information for the person meeting this definition.

Do NOT enter information for a person that is/will be a Duly Authorized Representative (DAR) (i.e. a person that has been delegated signatory permissions by a Responsible Official). A person that is a Duly Authorized Representative is NOT considered a RESPONSIBLE OFFICIAL.

Responsible Official

Prefix

Mr.

First Name

David

Last Name

Mullins

Title

Plant Manager

Organization Name

Occidental Chemical Corporation

Phone Type

Number

Extension

Business

256-389-2224

Email

david_w._@oxy.com

Mailing Address

1000 North Wilson Dam Road

Muscle Shoals, AL 35661

Does the Responsible Official intend to delegate signatory authority for DMRs or other compliance reports to an individual as a duly authorized representative (DAR) for this site?

No

Existing Permit Contacts

Affiliation Type	Contact Information	Remove?
Designated Agent,DMR Contact,Environmental Contact	Bryan Lindsey, Occidental Chemical Corporation	NONE PROVIDED
Responsible Official,Notification Recipient	David Mullins, Occidental Chemical Corporation	NONE PROVIDED
MMS Contact,Engineer	Gina Cox, Occidental Chemical Corporation	NONE PROVIDED
Permittee	Occidental Chemical Corporation	NONE PROVIDED

Facility/Site Information

Facility/Site Name

Armand Products OxyChem

Organization/Ownership Type

Corporation

Facility/Site Address or Location Description

1000 N WILSON DAM RD
MUSCLE SHOALS, AL 35661

Facility/Site County

Colbert

Detailed Directions to the Facility/Site

From Montgomery: I-65 North, Exit 310 to AL 157 North, Turn Right onto AL-133/AL-157, go north 5 miles and plant/facility on the right.

Facility Map

[Form 187 - Facility Map.pdf - 10/01/2025 09:50 AM](#)

Comment

NONE PROVIDED

Please refer to the link below for Lat/Long map instruction help:

[Map Instruction Help](#)

Facility/Site Front Gate Latitude and Longitude

34.77201584386867,-87.62784812164307

1000 N WILSON DAM RD, MUSCLE SHOALS, AL

SIC Code(s) [Please enter Primary SIC Code first followed by any additional applicable SIC Codes]

2812-Alkalies and Chlorine

2813-Industrial Gases

NAICS Code(s) [Please enter Primary NAICS Code first followed by any additional applicable NAICS Codes]

325180-Other Basic Inorganic Chemical Manufacturing

Facility/Site Contact

Prefix

Mr.

First Name

Last Name

Bryan

Lindsey

Title

Health, Environmental, Safety, Security Superintendent

Organization Name

Occidental Chemical Corporation Muscle Shoals

Phone Type

Number

Extension

Business

2563892219

Email

Bryan_Lindsey@OXY.COM

Address

1000 North Wilson Dam Road

Muscle Shoals, AL 35661

DMR Contact(s) (1 of 1)

DMR Contact

Prefix

Mr.

First Name

Last Name

Bryan

Lindsey

Title

Health, Environmental, Safety & Security Superintendent

Phone Type

Number

Extension

Business

2563892219

Email

Bryan_Lindsey@OXY.COM

Address

1000 North Wilson Dam Road

1000 North Wilson Dam Road

Muscle Shoals, AL 35661

Applicant Business Entity Information

Address of Incorporation
1633 Broadway, New York, NY 10019

Agent Designated by the Corporation for Purposes of Service

Name	Address
CT Corporation System	2 North Jackson Street, Suite 605

Please provide all corporate officers

Name	Title	Address
Wade Alleman	President	14555 Dallas Parkway, Suite 400, Dallas, TX 75254

Does the applicant applying for coverage have a Parent Corporation?
Yes

Parent Corporation of Applicant

Name	Address
Occidental Petroleum Corporation	5 Greenway Plaza, Suite 110, Houston, TX 77046

Does the applicant applying for coverage have Subsidiary Corporations?

Yes

Subsidiary Corporation(s) of Applicant

Name	Address
Armand Products Company	500 Charles Ewing Boulevard, Ewing, NJ 08628

Enforcement History

Has the applicant been issued any Notices of Violation, Orders (Consent or Administrative/Unilateral), or Judicial Actions (Complaint, Settlement Agreement, Consent Decree, or Court Order) concerning water pollution or other permit violations within the State of Alabama in the past five years?

No

Business Activity

A facility with processes inclusive in the business areas shown below may be covered by Environmental Protection Agency's (EPA) categorical effluent guideline standards. These facilities are termed **categorical users**. If unsure, please call the Industrial Section at (334) 271-7943 to discuss or use the link below to contact the Permit Engineer for the county the facility is/will be located in.

[Industrial Section Assignment Map](#)

If your facility conducts or will be conducting any of the processes listed below (regardless of whether they generate wastewater, waste sludge, or hazardous wastes), please check the category of business activity:

Other: Potassium Carbonate & Potassium Bicarbonate

Give a brief description of all operations at this facility including primary products or services:

Produce potassium carbonate and potassium bicarbonate

Water Supply

Water Sources (check all that apply):

Municipal Water Utility

Surface Water

Please specify the City of the Municipal Water Utility:

Muscle Shoals

Name of Utility	Million Gallons per Day (MGD)
Muscle Shoals	0.053

Operator of Surface Intake	Million Gallons per Day (MGD)
Tennessee Valley Authority	8.1
	Sum: 8.1

Cooling Water Intake Structure Information

Does the provider of your source water operate a surface water intake?

Yes

Name of Provider	Location of Provider	Latitude	Longitude
Tennessee Valley Authority	See attachment	34.788961	-87.6238

Is the provider a public water system (defined as a system which provides water to the public for human consumption or which provides only treated water, not raw water)?

No

Is any water withdrawn from the source water used for cooling?

Yes

Using the average monthly measurements over any 12-month period, approximately what percentage of water withdrawn is used exclusively for cooling purposes?

13

Does the cooling water consist of treated effluent that would otherwise be discharged?

No

Is the cooling water used in a once-through cooling system?

Yes

Is the cooling water used in a closed cycle cooling system?

No

When was the intake installed?

PDW Intake - 1952, Fleet Hollow Intake - 1964

What is the maximum intake volume (maximum pumping capacity in gallons per day)?

11.5

What is the average intake volume (average intake pump rate in gallons per day average in any 30-day period)?

7.9

What is the actual intake flow (AIF) as defined in 40 CFR §125.92(a) (MGD)?

8.1

How is the intake operated?

Continuously

What is the mesh size of the screen on your intake (in inches)?

0.375

What is the intake screen flow-through area (in square feet)?

123

What is the through-screen design intake flow velocity (in ft/sec)?

0.20

What is the through-screen actual velocity (in ft/sec)?

0.04

What is the mechanism for cleaning the screen (e.g., does it rotate for cleaning)?

Both have rotating screens

Do you have any additional fish detraction technology on your intake?

No

Have there been any studies to determine the impact of the intake on aquatic organisms?

No

Attach a site map showing the location of the water intake in relation to the facility, shoreline, water depth, etc.

Form 187 - Water Intake Location.pdf - 10/01/2025 10:11 AM

Comment

NONE PROVIDED

Outfalls (1 of 1)

001

Please click below if this discharge no longer exists or is no longer required:

NONE PROVIDED

Outfall Identifier

001

Receiving Water

Pond Creek

Does the discharge enter the named receiving water via an unnamed tributary?

NONE PROVIDED

Indicate if either of the following characteristics apply to this discharge:

Process Water commingled with Stormwater

Estimated Average Daily Flow (MGD)

7.8

Monitoring/Sampling Point Location

34.77361100000000, -87.63444400000000

Stormwater Outfalls (1 of 1)

003

Please click below if this discharge no longer exists or is no longer required:

NONE PROVIDED

Outfall Identifier

003

Receiving Water

Pond Creek

Does the discharge enter the named receiving water via an unnamed tributary?

Unnamed Tributary

Indicate if either of the following characteristics apply to this discharge:

Stormwater only (no comingled process waste water excluding air conditioner condensate and fire testing waters)

Monitoring/Sampling Point Location

34.77027800000000, -87.45638900000000

Process Flow Schematic with Wastewater Treatment(s), If Applicable

For an example of a process flow diagram, please use the link below.

[Figure 1: Example of Process Flow Schematic](#)

Process Flow Schematic

Form 187 - Flow Diagram.pdf - 10/01/2025 10:07 AM

Comment

NONE PROVIDED

Anti-Degradation Evaluation

Is this a new or increased discharge that began after April 3, 1991?

No

Additional Information

Do you share an outfall with another facility?

No

Indicate if automatic sampling equipment or continuous wastewater flow metering equipment is being operated at this facility:

Current	Yes/No
Continuous Wastewater Flow Metering Equipment	Yes
Automatic Sampling Equipment	Yes

Indicate if installation automatic sampling equipment or continuous wastewater flow metering equipment planned at this facility:

Planned	Yes/No
Continuous Wastewater Flow Metering Equipment	No
Automatic Sampling Equipment	No

Please describe the equipment below:

For outfall DSN001 the facility uses a refrigerated composite sampler and continuously recording pH, temperature, and flow meters.

Please attach the process schematic with sampling equipment locations.

[Form 187 - Facility Map.pdf - 10/01/2025 10:13 AM](#)

Comment

NONE PROVIDED

Are any process changes or expansions planned during the next three years that could alter wastewater volumes or characteristics (Consider production processes as well as air or water pollution treatment processes that may affect the discharge.)?

No

Do you use biocides, corrosion inhibitors, or chemical additives in your cooling or blowdown water?

Yes

The applicant must provide a list of the following information for each biocide or chemical:

- (1) Name and general composition of biocide or chemical (if composition is not provided on MSDS sheet)
- (2) 48-hour or 96-hour LC50 data for organisms representative of the biota of the waterway into which the discharge will ultimately reach. For freshwater, the fathead minnow (*Pimephales promelas*) and cladoceran (*Ceriodaphnia dubia*) are the test organisms. For salt water, the mysid shrimp and the sheepshead minnow or inland silverside are the test organisms. Other acceptable aquatic organisms may be allowed by the Department if sufficient information is provided. If the MSDS sheet does not provide data for the organisms specified above, the facility must provide the data unless the Department grants approval for an alternate organism.
- (3) Quantities to be used
- (4) Frequencies of use
- (5) Maximum proposed discharge concentrations
- (6) EPA registration of number, if applicable and is not provided on the MSDS sheet.

List of Biocides

Please list biocides below:
See Attachment

Biocide/Corrosion Inhibitor Summary Sheet

[Form 187 - Biocide and Corrosion Inhibitor Summary Sheet.pdf - 10/01/2025 09:38 AM](#)

Comment

NONE PROVIDED

Safety Data Sheets (SDS)

[Control IS3000 SDS.pdf - 10/01/2025 09:43 AM](#)

[Solus AP24 SDS.pdf - 10/01/2025 09:43 AM](#)

[Steamate NA715 SDS.pdf - 10/01/2025 09:43 AM](#)

Comment

NONE PROVIDED

Treatment

Is any form of wastewater treatment (see list below) practiced at this facility?

Yes

Treatment devices or processes used or proposed for treating wastewater or sludge (check as many as appropriate).

Neutralization, pH correction

Is any form of wastewater treatment (or changes to an existing wastewater treatment) planned for this facility within the next three years?

No

Facility Operational Characteristics

Indicate whether the facility discharge is:

Continuous through the year

Comments:

NONE PROVIDED

Non-Discharged Wastes

Are any waste liquids or sludges generated and not disposed of in the sanitary sewer system?

No

Does any outside firm remove any of the above checked wastes?

No

EPA Application Forms

All Applicants must submit certain EPA permit application forms. More than one application form may be required.

Form 1 - General Information Form required for all applications

Form 2C - Should be submitted for facilities with existing discharge(s) of process wastewater.

Form 2D - Should be submitted for facilities that have not yet commenced discharge(s) of process wastewater.

Form 2E - Should be submitted for facilities who discharge non-process wastewater, such as non-contact cooling water or boiler blowdown.

Form 2F - Should be submitted for all discharges of storm water associated with an industrial activity.

[The EPA application forms are found on the Department's website here.](#)

EPA Form 1

[Form 1 - Signed.pdf - 10/01/2025 10:41 AM](#)

Comment

NONE PROVIDED

Additional EPA Forms (EPA Form 2C, 2D, 2E and/or 2F)

[Form 2E - Signed.pdf - 10/01/2025 10:26 AM](#)

[Form 2C - Signed.pdf - 10/01/2025 10:32 AM](#)

[Application to Attach.pdf - 10/01/2025 10:34 AM](#)

[EPA Form 2F - Signed.pdf - 10/01/2025 10:44 AM](#)

Comment

NONE PROVIDED

Other attachments (as needed)

NONE PROVIDED

Comment

NONE PROVIDED

Additional Attachments

Please attach any additional information as needed.

NONE PROVIDED
Comment
NONE PROVIDED

Application Preparer

Application Preparer

Prefix		
Mr.		
First Name	Last Name	
Johnathan	Hall	
Title		
Project Manager		
Organization Name		
Jacobs - CH2MHill		
Phone Type	Number	Extension
Business	205-326-8912	
Email		
johnathan.hall@jacobs.com		
Address		
One Perimeter Park South		
Suite 315N		
Birmingham, AL 35243		

Agreements and Signature(s)

SUBMISSION AGREEMENTS

- ☒ I am the owner of the account used to perform the electronic submission and signature.
- ☒ I have the authority to submit the data on behalf of the facility I am representing.
- ☒ I agree that providing the account credentials to sign the submission document constitutes an electronic signature equivalent to my written signature.
- ☒ I have reviewed the electronic form being submitted in its entirety, and agree to the validity and accuracy of the information contained within it to the best of my knowledge.

"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."

"I further certify under penalty of law that all analyses reported as less than detectable in this application or attachments thereto were performed using the EPA approved test method having the lowest detection limit for the substance tested."

NOTE: 335-6-5-.14 SIGNATORIES TO PERMIT APPLICATIONS AND REPORTS.

The application shall be signed by a responsible official, a request for variance from categorical pretreatment standards, and a category determination request shall be signed by a responsible official, as indicated below:

- In the case of a corporation, by a principal executive officer of at least the level of vice president;*
- In the case of a partnership, by a general partner;*
- In the case of a sole proprietorship, by the proprietor; or*
- In the case of a municipal, state, federal, or other public entity, by either a principal executive officer, or ranking elected official*

Signed
By David Mullins on 10/01/2025 at 10:56 AM

Occidental Chemical Corporation
NPDES Permit AL0000213

ADEM Form 187, Attachment 1
Site Map

**Location of Sampling
Equipment**

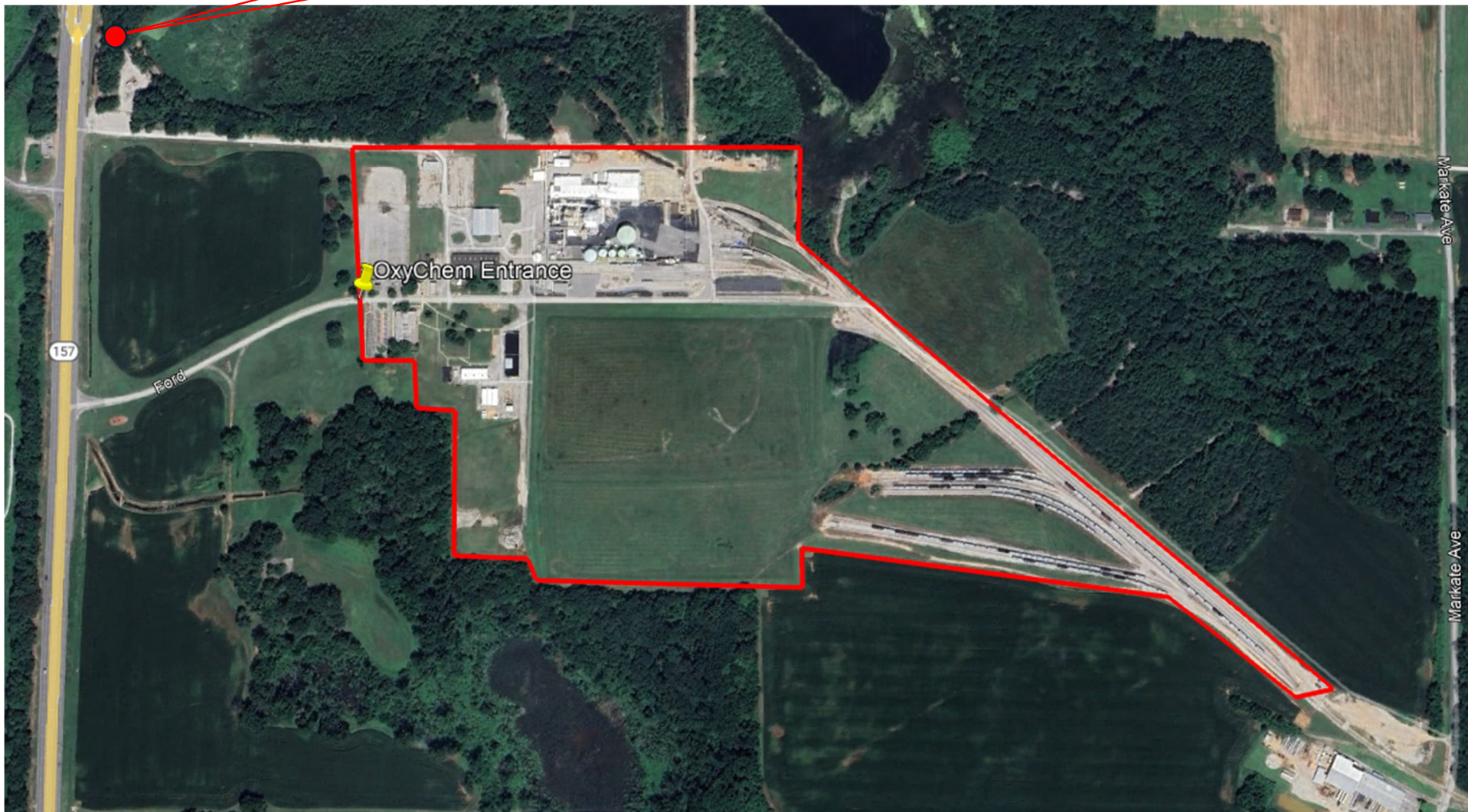
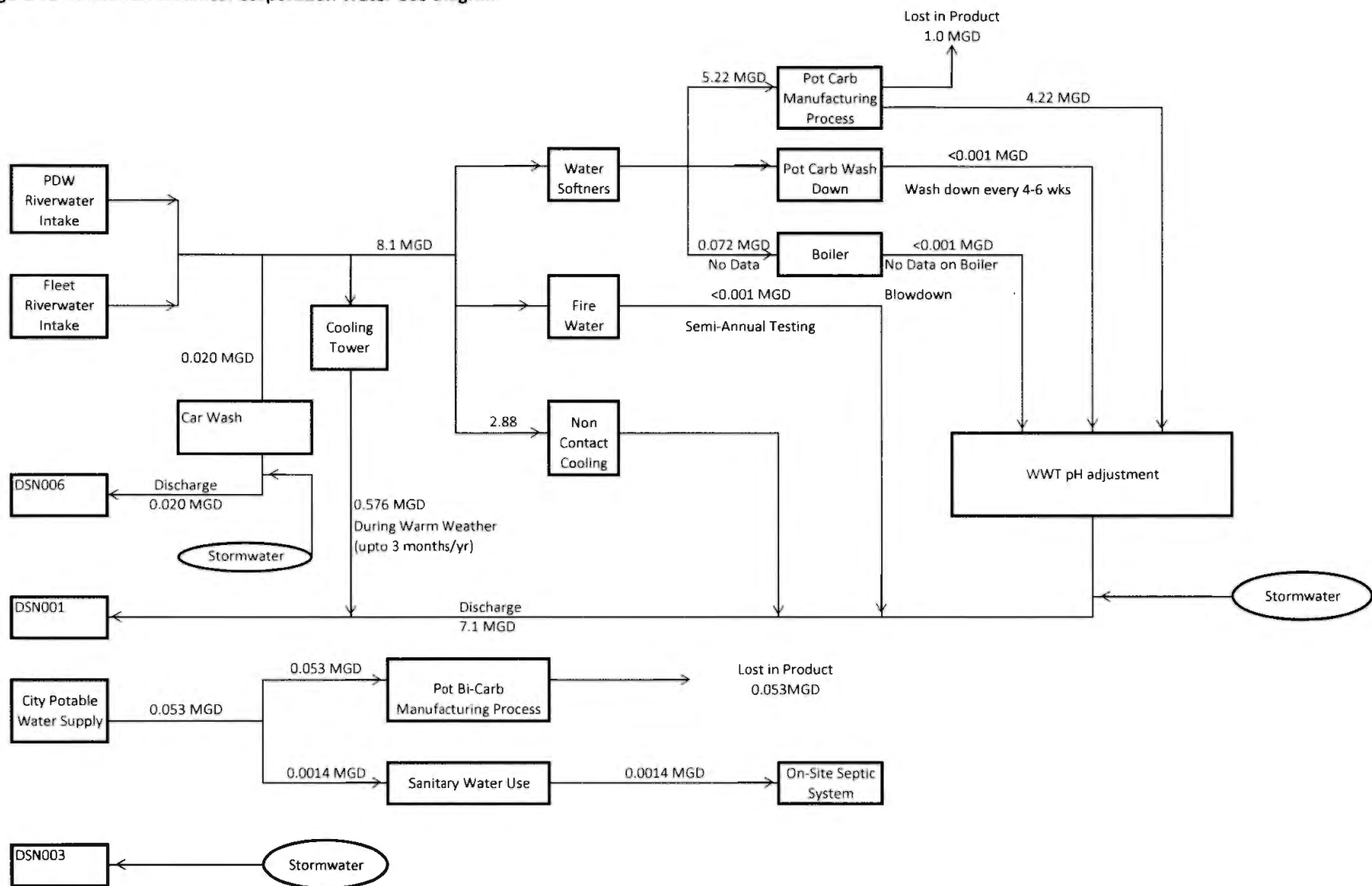


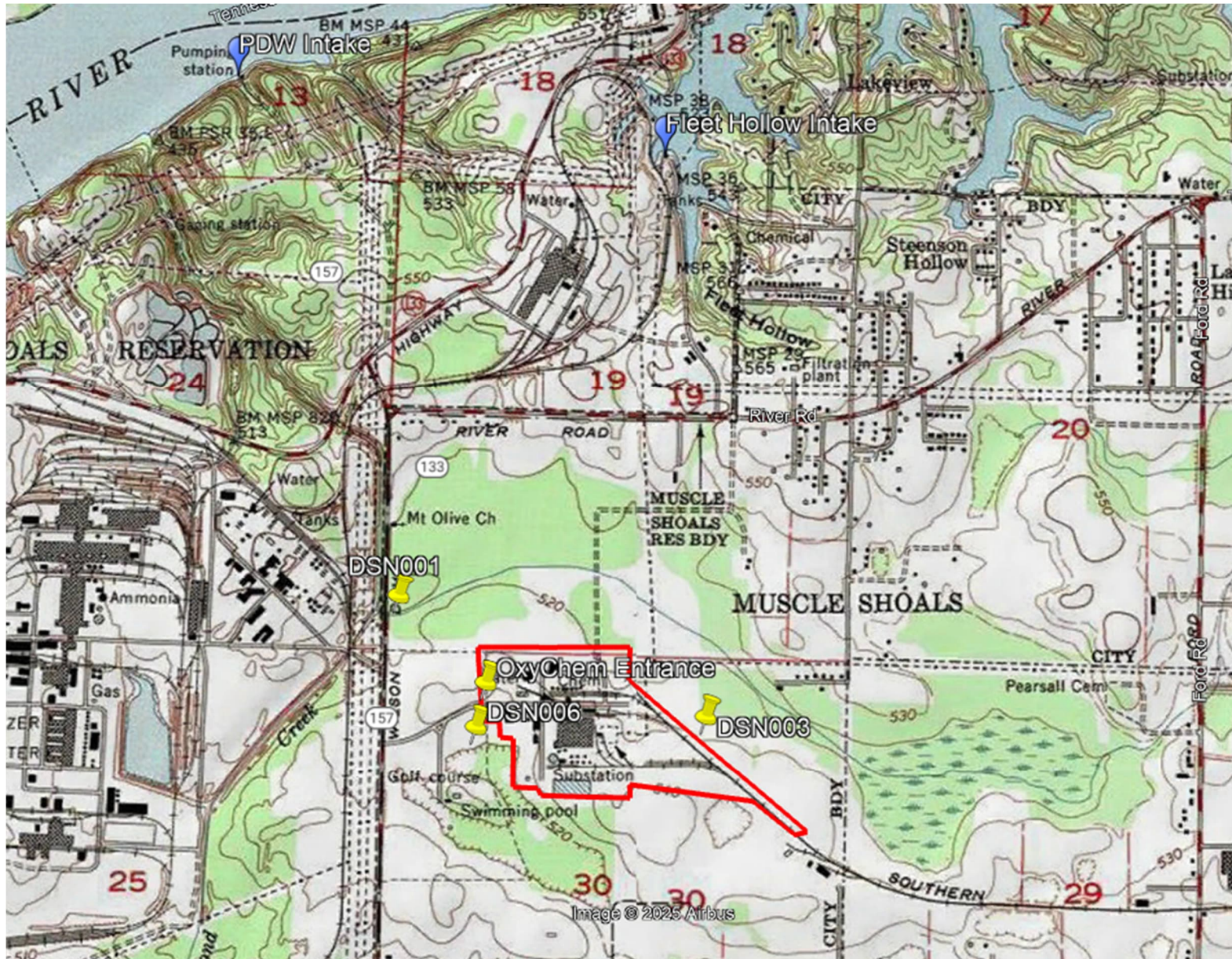
Figure 10 Occidental Chemical Corporation Water Use Diagram



All Flows in MGD - Million Gallons Per Day

Occidental Chemical Corporation
NPDES Permit AL0000213

EPA Form 1, Attachment 1
Topographic Map



January 9, 2026

Via Electronic Mail

Theo Pinson
Alabama Department of Environmental Management
Water Division
P.O. Box 301463
Montgomery, Alabama 36130-1463
tpinson@adem.alabama.gov

Re: Occidental Chemical Corporation – Armand Products, 1010 North Wilson Dam Road, Muscle Shoals, Alabama facility

Dear Mr. Pinson:

I am writing to inform you that on October 1, 2025, Occidental Petroleum Corporation (“Occidental”) and Berkshire Hathaway Inc. (“Berkshire”) announced a definitive agreement for Berkshire to acquire all of Occidental’s equity interests in Occidental Chemical Corporation (“OxyChem”) and its subsidiaries. The transaction was completed on January 2, 2026.

OxyChem holds National Pollutant Discharge Elimination System (NPDES) permit AL0000213 issued by ADEM on March 30, 2021 for the Armand Products/Muscle Shoals facility. By this correspondence and the enclosed ADEM Form 466, OxyChem confirms that there has been no change of name, ownership or operational control of the Muscle Shoals facility as a result of the transaction. OxyChem will continue to be the Permittee, and the pertinent information such as contact information, permit requirements and limitations will remain the same. The only change is that the Muscle Shoals facility now has an address at 1010 North Wilson Dam Road (formerly 1000 North Wilson Dam Road).

This is a courtesy notice, as the transaction noted above does not affect the NPDES permit. Please do not hesitate to contact Mr. Bryan Lindsey by e mail at Bryan_Lindsey@Oxy.com should you have any questions or require any additional information.

Respectfully submitted,



David Mullins
Plant Manager

Copy:

Aileen Hooks, Baker Botts LLP (aileen.hooks@bakerbotts.com)
Annmarie M. Terraciano, Cravath, Swaine & Moore LLP (aterraciano@cravath.com)
Paul D. Tanaka, Kirkland & Ellis (paul.tanaka@kirkland.com)

Note: In submitting this form, Occidental Chemical Corporation is not requesting a transfer of the permit(s) from one entity to another. Instead, this form is being filed at ADEM's request in connection with an upstream change of ownership of the permittee (i.e. the parent company of the permittee will be changing, but the permittee is currently and will remain Occidental Chemical Corporation).

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT (ADEM) NPDES/SID/UIC PERMIT TRANSFER AGREEMENT

ould be submitted when a National Pollutant Discharge Elimination System (NPDES), State Indirect Discharge (SID), Control (UIC) permit is being transferred from one entity to another. Permit transfers are subject to an application fee min. Code r. 335-1-6-.04. Applicants should contact the appropriate permitting section of the Water Division to on or forms may be required in addition to this form. If immediate operational changes that warrant a permit application for such changes should be submitted with this transfer agreement. **Do NOT use this form if only a**

name change has occurred for the facility.

Does this transfer agreement apply to more than one facility? ☒ No ☐ Yes If Yes, please use the Attachment page to identify the additional facilities.

Affected NPDES/SID Permit Number(s): AL0000213

Facility Name (as it appears on the permit): Occidental Chemical Corporation

Facility Location Address (as it appears on the permit): 1010 North Wilson Dam Road, Muscle Shoals, AL 35661 (formerly 1000 North Wilson Dam Road)

This Agreement is entered into this date by Company A and Company B in order to effect a transfer of Alabama Department of Environmental Management NPDES/SID Permit Number(s) referenced above or on the Attachment page of this form and the responsibility, coverage, and liability thereunder from Company A to Company B.

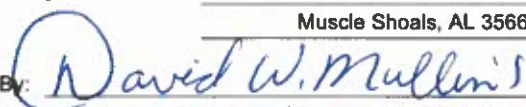
On the date such transfer becomes effective, Company B agrees to assume the responsibility, coverage, and liability of the permit(s). Company B also certifies that operational changes that warrant a permit modification will not be made without submitting the appropriate application. Company A agrees to relinquish all rights which it may have under said permit.

This agreement is entered into by both parties this 09 day of January, 2026; said transfer is to become effective on 02 January 2026.

Company A (Name): Occidental Chemical Corporation

Mailing Address: 1010 North Wilson Dam Road
Muscle Shoals, AL 35661

By:



Signature of Responsible Official
David Mullins

Printed Name of Responsible Official
Plant Manager

Title of Responsible Official
256-389-2224

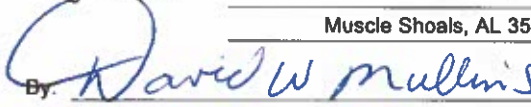
Telephone Number
david_w._mullins@oxychem.com

Email Address

Company B (Name): Occidental Chemical Corporation

Mailing Address: 1010 North Wilson Dam Road
Muscle Shoals, AL 35661

By:



Signature of Responsible Official
David Mullins

Printed Name of Responsible Official
Plant Manager

Title of Responsible Official
1010 North Wilson Dam Road

Mailing Address
Muscle Shoals, AL 35661

Mailing City, State, Zip Code
256-389-2224

Telephone Number
david_w._mullins@oxychem.com

Email Address



Witness Signature



Witness Signature

If the permit contact person for Company B is different from the Responsible Official, please complete the following:

Bryan Lindsey

Contact Name

1010 North Wilson Dam Road

Mailing Address

256-389-2219

Telephone Number

HES&S Superintendent

Contact Title

Muscle Shoals

Mailing City

bryan_lindsey@oxychem.com

Email Address

AL

Mailing State

35661

Mailing Zip

ALABAMA DEPARTMENT OF ENVIRONMENT MANAGEMENT (ADEM)
NPDES/SID/UIC PERMIT TRANSFER AGREEMENT

List the additional facilities to which this transfer agreement applies below:

	Affected NPDES/SID Permit Number(s)	Facility Name	Facility Location Address
2.			
3.			
4.			
5.			
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Pinson, Theo

From: Lindsey, Bryan <Bryan_Lindsey@oxychem.com>
Sent: Tuesday, May 26, 2026 10:27 AM
To: Pinson, Theo
Cc: Mullins, David W.; Hall, Johnathan
Subject: RE: [EXTERNAL] AL0000213 CWIS Clarification

Theo,

OxyChem's transition to only using the PDW intake for cooling water is complete and the piping to the Fleet Hollow intake has been disconnected. The 3/8" mesh rotating screens have been replaced with a fixed 1/2" mesh fixed screen with a 65% open area. The older pumps and motors have been replaced with new pumps (11.5 mgd capacity each) and motors with single-speed drives with a soft starter to protect the motor and pump shaft from sudden starts. The fuses supplying power to the intake are sized to only provide enough power for one motor/pump to operate at a time. The two additional pumps are present for continuity of operations in the event of an equipment failure or required maintenance. Based on this configuration, the current design capacity for the intake is 11.5 mgd.

As documented on page 5 of the report titled 316(b) Supporting Information: Cooling Water Intake Documentation for PDW Intake on Pickwick Reservoir, January 8, 2019, that was included with the NPDES permit application the historical design intake flow velocity was 0.23 feet per second [Note the document incorrectly indicates the units as cfs, but it should have been ft/sec]. This intake design flow velocity was based on a total

intake capacity of 38.9 mgd and 3/8” mesh rotating screens. The intake has historically met the through-screen design velocity requirements.

With a new design intake flow rate of only 11.5 mgd and the new 1/2” mesh screens with a 65% open area the updated design intake flow velocity is 0.20 ft/sec. This is documented in Section 4.3 of the NPDES permit application supplemental information report.

OxyChem is requesting compliance with the BTA standards for impingement mortality requirements listed at 40 CFR 125.94(c)(2) based on the through-screen design velocity being less than 0.5 ft/sec.

Please let us know if you have any additional questions regarding the changes to the PDW intake.

From: Pinson, Theo <tpinson@adem.alabama.gov>

Sent: Friday, May 15, 2026 4:48 PM

To: Lindsey, Bryan <bryan_lindsey@oxy.com>

Cc: Mullins, David W. <David_W._Mullins@OXY.COM>; Hall, Johnathan <Johnathan.Hall@jacobs.com>; Jackson, Scott A <scott.jackson@adem.alabama.gov>

Subject: [EXTERNAL] AL0000213 CWIS Clarification

WARNING - This message is from an EXTERNAL SENDER - be CAUTIOUS, particularly with links and attachments.

Hi Bryan,

We are getting close to sending a proposed draft permit, but first I wanted to get some clarification regarding application information provided for the cooling water intake structure (CWIS). The previous permit made a BTA determination for two separate CWIS (Fleet Hollow and Phosphate Development

Works (PDW)). Based on the application, it is our understanding that you will no longer utilize Fleet Hollow and will only use PDW going forward with the transition having been expected to occur by late 2025 early 2026.

- Will you confirm that the transition has been completed and that the Fleet Hollow intake is no longer utilized?

The application details design changes to the PDW intake including replacement of the 3 intake pumps, upgrades to the electrical supply to the CWIS, and replacement of the 3/8' mesh rotating screen with a 1/2" mesh screen. These changes have either already been completed or were scheduled to be complete soon after the application was submitted.

- Have the modifications already been completed and in operation?
- Does the new screen also rotate like the previous one?

The application states, "The replacement of the 3 pumps at the PDW intake will reduce the total intake capacity from 38.9 mgd to 34.5 mgd. However, the actual capacity of the PDW intake will only be 11.5 MGD because the electrical upgrades for the new pumps will only supply enough power to operate a single pump at a time."

- Will clarify that the CWIS is designed to only allow for one pump to be in operation at any given time and that 2 pumps are held in reserve. (That by design it is not possible to operate more than 1 pump at any given time?) Are the pumps variable speed drive and if so could 2 pumps operate at the same time under reduced capacity?
- Will you clarify that the Permittee is requesting compliance with the impingement mortality option listed at 40 CFR 125.94(c)(2) - 0.5 Feet Per Second Through-Screen **Design** Velocity? I am seeking to clarify that the facility is requesting BTA compliance utilizing **design** through screen velocity and not **actual** through screen velocity specified at 40 CFR 125.94(c)(3) which would require per the regulations, "...you must monitor the velocity at the screen at a minimum frequency of daily. In lieu of velocity monitoring at the screen face, you may calculate the through-screen velocity using water flow, water depth, and the screen open areas." Please provide some supporting justification that you are seeking compliance with maximum design through screen velocity and not actual measured through screen velocity.

Please let me know if we need to discuss and hope you have a great weekend.

Thank you,

Theo

Theo Pinson
Industrial Section

Water Division

[Alabama Department of Environmental Management](#)

(334) 274 – 4202

[Alabama Environmental Permitting and Compliance System \(AEPACS\)](#)

If you need assistance with your AEPACS account, please contact the AEPACS Help Desk at ademwebportal@adem.alabama.gov

EPA Identification Number ALD004019642		NPDES Permit Number AL0000213		Facility Name Occidental Chemical Corp.		OMB No. 2040-0004 Expires 07/31/2026	
Form 1 NPDES			U.S. Environmental Protection Agency Application for NPDES Permit to Discharge Wastewater GENERAL INFORMATION				
SECTION 1. ACTIVITIES REQUIRING AN NPDES PERMIT (40 CFR 122.21(F) AND (F)(1))							
Activities Requiring an NPDES Permit	<u>1.1</u> Applicants <i>Not Required</i> to Submit Form 1						
	1.1.1	Is the facility a new or existing publicly owned treatment works or has your permitting authority directed you to submit Form 2A? If yes, STOP. Do NOT complete Form 1. Complete Form 2A. If the facility is also a treatment works treating domestic sewage , you must also complete Form 2S.			1.1.2	Is the facility a sludge-only facility (i.e., a facility that does not discharge wastewater to surface waters)? If yes, STOP. Do NOT complete Form 1. Complete Form 2S.	
	☒ Yes ☐ No			☒ Yes ☐ No			
	<u>1.2</u> Applicants <i>Required</i> to Submit Form 1						
	1.2.1	Is the facility a concentrated animal feeding operation or a concentrated aquatic animal production facility ? ☐ Yes → Complete Form 1 and ☒ No Form 2B.			1.2.2	Is the facility an existing manufacturing, commercial, mining, or silvicultural facility that is currently discharging process wastewater ? ☒ Yes → Complete Form 1 and Form 2C. ☐ No	
	1.2.3	Is the facility a new manufacturing, commercial, mining, or silvicultural facility that has not yet commenced to discharge ? ☐ Yes → Complete Form 1 and ☒ No Form 2D.			1.2.4	Is the facility a new or existing manufacturing, commercial, mining, or silvicultural facility that discharges only nonprocess wastewater ? ☐ Yes → Complete Form 1 and ☒ No Form 2E.	
1.2.5	Is the facility a new or existing facility whose discharge is composed entirely of stormwater associated with industrial activity or whose discharge is composed of both stormwater and non-stormwater ? ☒ Yes → Complete Form 1 and ☐ No Form 2F unless exempted by 40 CFR 122.26(b)(14)(x) or (b)(15).			1.2.6	Is the facility a new or existing treatment works treating domestic sewage that discharges wastewater to surface waters? ☐ Yes → Complete Form 1, ☒ No Form 2S, and any other applicable forms, as directed by your permitting authority.		
SECTION 2. NAME, MAILING ADDRESS, AND LOCATION (40 CFR 122.21(F)(2))							
Name, Mailing Address, and Location	<u>2.1</u> Facility Name						
	Occidental Chemical Corporation - Armand Products						
	<u>2.2</u> EPA Identification Number						
	ALD004019642						
	<u>2.3</u> Facility Contact						
Name (first and last)		Title			Phone number		
Bryan Lindsey		Health, Environmental, Safety & Security Superi			(256) 389-2219		
Email address							
bryan_lindsey@oxy.com							

EPA Identification Number ALD004019642		NPDES Permit Number AL0000213		Facility Name Occidental Chemical Corp.		OMB No. 2040-0004 Expires 07/31/2026	
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Name, Mailing Address, and Location Continued	2.4	Facility Mailing Address					
		Street or P.O. box 1000 North Wilson Dam Road					
		City or town Muscle Shoals			State AL		ZIP code 35661
	2.5	Facility Location					
		Street, route number, or other specific identifier 1000 North Wilson Dam Road					
		County name Colbert		County code (if known) 033			
		City or town Muscle Shoals		State AL		ZIP code 35661	

SECTION 3. SIC AND NAICS CODES (40 CFR 122.21(F)(3))			
SIC and NAICS Codes	3.1	SIC Code(s)	Description (optional)
		2812	Alkalis and Chlorine - production of potassium carbonate and potassium bicarbonate
	3.2	NAICS Code(s)	Description (optional)
		325180	Potassium carbonate manufacturing

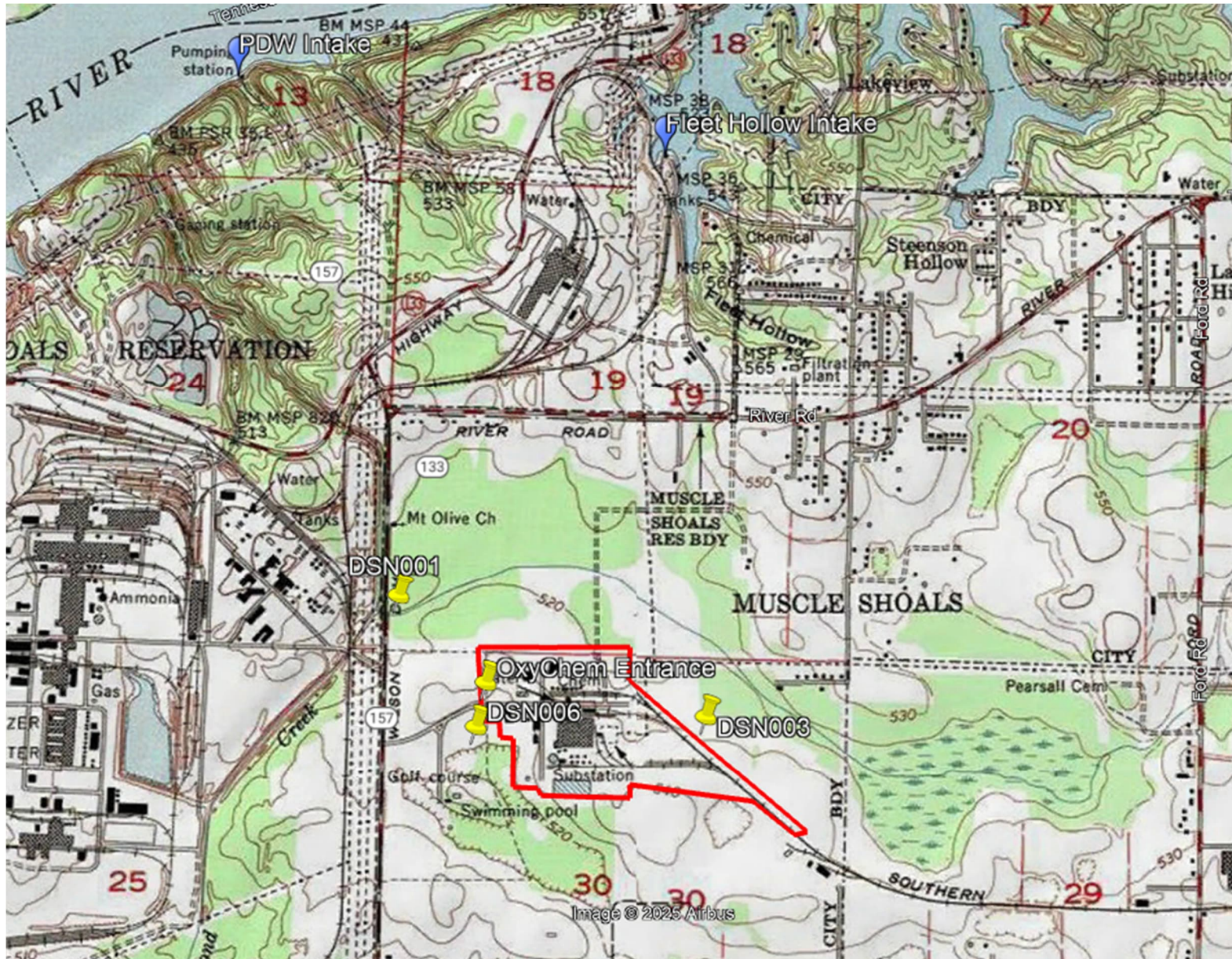
SECTION 4. OPERATOR INFORMATION (40 CFR 122.21(F)(4))	
Operator Information	4.1 Name of Operator Occidental Chemical Corporation
	4.2 Is the name you listed in Item 4.1 also the owner? ☒ Yes ☐ No
	4.3 Operator Status ☐ Public—federal ☐ Public—state ☐ Other public (specify) _____ ☒ Private ☐ Other (specify) _____
	4.4 Phone Number of Operator (972) 404-3800

EPA Identification Number ALD004019642		NPDES Permit Number AL0000213		Facility Name Occidental Chemical Corp.		OMB No. 2040-0004 Expires 07/31/2026	
Operator Information Continued	4.5	Operator Address					
	Street or P.O. Box 14555 Dallas Parkway, Suite 400						
	City or town Dallas		State TX		ZIP code 75254		
	Email address of operator pat_webb@oxy.com						
SECTION 5. INDIAN LAND (40 CFR 122.21(F)(5))							
Indian Land	5.1	Is the facility located on Indian Land? ☐ Yes ☒ No					
SECTION 6. EXISTING ENVIRONMENTAL PERMITS (40 CFR 122.21(F)(6))							
Existing Environmental Permits	6.1	Existing Environmental Permits (check all that apply and print or type the corresponding permit number for each)					
	☒ NPDES (discharges to surface water) AL0000213		☒ RCRA (hazardous wastes) ALD004019642		☐ UIC (underground injection of fluids)		
	☒ PSD (air emissions) 701-0002		☐ Nonattainment program (CAA)		☐ NESHAPs (CAA)		
	☐ Ocean dumping (MPRSA)		☐ Dredge or fill (CWA Section 404)		☐ Other (specify)		
SECTION 7. MAP (40 CFR 122.21(F)(7))							
Map	7.1	Have you attached a topographic map containing all required information to this application? (See instructions for specific requirements.) ☒ Yes ☐ CAFO—Not Applicable (See requirements in Form 2B.)					
SECTION 8. NATURE OF BUSINESS (40 CFR 122.21(F)(8))							
Nature of Business	8.1	Describe the nature of your business. Production of potassium carbonate and potassium bicarbonate from potassium hydroxide, carbon dioxide, and water.					
SECTION 9. COOLING WATER INTAKE STRUCTURES (40 CFR 122.21(F)(9))							
Cooling Water Intake Structures	9.1	Does your facility use cooling water? ☒ Yes ☐ No → SKIP to Item 10.1.					
	9.2	Identify the source of cooling water. (Note that facilities that use a cooling water intake structure as described at 40 CFR 125, Subparts I and J may have additional application requirements at 40 CFR 122.21(r). Consult with your NPDES permitting authority to determine what specific information needs to be submitted and when.) Tennessee River (Pickwick Lake and Wilson Lake)					

EPA Identification Number ALD0004019642	NPDES Permit Number AL00000213	Facility Name Occidental Chemical Corp.	OMB No. 2040-0004 Expires 07/31/2026
SECTION 10. VARIANCE REQUESTS (40 CFR 122.21(F)(10))			
Variance Requests	10.1	Do you intend to request or renew one or more of the variances authorized at 40 CFR 122.21(m)? (Check all that apply. Consult with your NPDES permitting authority to determine what information needs to be submitted and when.)	
		☐ Fundamentally different factors (CWA Section 301(n)) ☐ Water quality related effluent limitations (CWA Section 302(b)(2))	
		☐ Non-conventional pollutants (CWA Section 301(c) and (g)) ☐ Thermal discharges (CWA Section 316(a))	
		☒ Not applicable	
SECTION 11. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(A) AND (D))			
Checklist and Certification Statement	11.1	In Column 1 below, mark the sections of Form 1 that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to provide attachments.	
		Column 1	Column 2
		☒ Section 1: Activities Requiring an NPDES Permit	☐ w/ attachments
		☒ Section 2: Name, Mailing Address, and Location	☐ w/ attachments
		☒ Section 3: SIC Codes	☐ w/ attachments
		☒ Section 4: Operator Information	☐ w/ attachments
		☒ Section 5: Indian Land	☐ w/ attachments
		☒ Section 6: Existing Environmental Permits	☐ w/ attachments
		☒ Section 7: Map	☒ w/ topographic map ☐ w/ additional attachments
		☒ Section 8: Nature of Business	☐ w/ attachments
		☒ Section 9: Cooling Water Intake Structures	☐ w/ attachments
		☒ Section 10.: Variance Requests	☐ w/ attachments
		☒ Section 11: Checklist and Certification Statement	☐ w/ attachments
	11.2	Provide the following certification. (See instructions to determine the appropriate person to sign the application.)	
	Certification Statement <i>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.</i>		
	Name (print or type first and last name) David Mullins	Official title Plant Manager	
	Signature 	Date signed 10/1/25	

Occidental Chemical Corporation
NPDES Permit AL0000213

EPA Form 1, Attachment 1
Topographic Map



EPA Identification Number ALD004019642		NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	OMB No. 2040-0004 Expires 07/31/2026
Form 2C NPDES		U.S. Environmental Protection Agency Application for NPDES Permit to Discharge Wastewater EXISTING MANUFACTURING, COMMERCIAL, MINING, AND SILVICULTURE OPERATIONS		
SECTION 1. OUTFALL LOCATION (40 CFR 122.21(G)(1))				
Outfall Location	<u>1.1</u>	Provide information on each of the facility's outfalls in the table below.		
		Outfall Number	Receiving Water Name	Latitude
				Longitude
	DSN001	Pond Creek	34° 46' 27.11" N	-87° 38' 2.88" E
SECTION 2. LINE DRAWING (40 CFR 122.21(G)(2))				
Line Drawing	<u>2.1</u>	Have you attached a line drawing to this application that shows the water flow through your facility with a water balance? (See instructions for drawing requirements. See Exhibit 2C-1 at end of instructions for example.) ☒ Yes		
SECTION 3. AVERAGE FLOWS AND TREATMENT (40 CFR 122.21(G)(3))				
Average Flows and Treatment	<u>3.1</u>	For each outfall identified under Item 1.1, provide average flow and treatment information. Add additional sheets if necessary.		
		Outfall Number <u>DSN001</u>		
		Operations Contributing to Flow		
		Operation	Average Flow	
		Non-Contact Cooling Water	1.17 mgd	
		Process Water	0.18 mgd	
		Stormwater	0.03 mgd	
		Other Waters	6.42 mgd	
		Treatment Units		
		Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Exhibit 2C-2	Final Disposal of Solid or Liquid Wastes Other Than by Discharge
		Neutralization / pH Adjustment	2-K	not applicable
		Discharge to Surface Water	4-A	not applicable

EPA Identification Number ALD004019642		NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	OMB No. 2040-0004 Expires 07/31/2026		
Average Flows and Treatment Continued	3.1 cont.	**Outfall Number** _____				
		Operations Contributing to Flow				
		Operation	Average Flow			
			mgd			
			mgd			
			mgd			
			mgd			
		Treatment Units				
		Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Exhibit 2C-2	Final Disposal of Solid or Liquid Wastes Other Than by Discharge		
		Outfall Number _____				
		Operations Contributing to Flow				
		Operation	Average Flow			
			mgd			
			mgd			
			mgd			
			mgd			
		Treatment Units				
		Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Exhibit 2C-2	Final Disposal of Solid or Liquid Wastes Other Than by Discharge		
		System Users	3.2	Are you applying for an NPDES permit to operate a privately owned treatment works? ☐ Yes ☒ No → SKIP to Section 4.		
			3.3	Have you attached a list that identifies each user of the treatment works? ☐ Yes		

EPA Identification Number ALD004019642		NPDES Permit Number AL0000213		Facility Name Occidental Chemical Corp.		OMB No. 2040-0004 Expires 07/31/2026	
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SECTION 4. INTERMITTENT FLOWS (40 CFR 122.21(G)(4))

Intermittent Flows	4.1	Except for storm runoff, leaks, or spills, are any discharges described in Sections 1 and 3 intermittent or seasonal? ☐ Yes ☒ No → SKIP to Section 5.						
	4.2	Provide information on intermittent or seasonal flows for each applicable outfall. Attach additional pages, if necessary.						
		Outfall Number	Operation (list)	Frequency		Flow Rate		Duration
				Average Days/Week	Average Months/Year	Long-Term Average	Maximum Daily	
				days/week	months/year	mgd	mgd	days
				days/week	months/year	mgd	mgd	days
				days/week	months/year	mgd	mgd	days
				days/week	months/year	mgd	mgd	days
				days/week	months/year	mgd	mgd	days
				days/week	months/year	mgd	mgd	days
				days/week	months/year	mgd	mgd	days
				days/week	months/year	mgd	mgd	days

SECTION 5. PRODUCTION (40 CFR 122.21(G)(5))

Applicable ELGs	5.1	Do any effluent limitation guidelines (ELGs) promulgated by EPA under Section 304 of the CWA apply to your facility? ☐ Yes ☒ No → SKIP to Section 6.			
	5.2	Provide the following information on applicable ELGs.			
		ELG Category	ELG Subcategory	Regulatory Citation	
Production-Based Limitations	5.3	Are any of the applicable ELGs expressed in terms of production (or other measure of operation)? ☐ Yes ☐ No → SKIP to Section 6.			
	5.4	Provide an actual measure of daily production expressed in terms and units of applicable ELGs.			
		Outfall Number	Operation, Product, or Material	Quantity per Day	Unit of Measure

EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	OMB No. 2040-0004 Expires 07/31/2026	
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	5.5	Are you requesting alternative limits based on an anticipated increase in the actual production during the next permit term? (Consult with your NPDES permitting authority to determine what information needs to be submitted and when.)		
		☐ Yes ☐ No		

SECTION 6. IMPROVEMENTS (40 CFR 122.21(G)(6))					
Upgrades and Improvements	6.1	Are you presently required by any federal, state, or local authority to meet an implementation schedule for constructing, upgrading, or operating wastewater treatment equipment or practices or any other environmental programs that could affect the discharges described in this application?			
		☐ Yes ☒ No → SKIP to Item 6.3.			
	6.2	Briefly identify each applicable project in the table below.			
		Brief Identification and Description of Project	Affected Outfalls (list outfall number)	Source(s) of Discharge	Final Compliance Dates
					Required Projected
	6.3	Have you attached sheets describing any additional water pollution control programs (or other environmental projects that may affect your discharges) that you now have underway or planned? (<i>optional item</i>)			
		☐ Yes ☒ No ☐ Not applicable			

SECTION 7. EFFLUENT AND INTAKE CHARACTERISTICS (40 CFR 122.21(G)(7))		
Effluent and Intake Characteristics	See the instructions to determine the pollutants and parameters you are required to monitor and, in turn, the tables you must complete. Not all applicants need to complete each table.	
	Table A. Conventional and Non-Conventional Pollutants	
	7.1	Are you requesting a waiver from your NPDES permitting authority for any Table A pollutants for any of your outfalls?
		☐ Yes ☒ No → SKIP to Item 7.3.
	7.2	If yes, indicate the applicable outfalls below or check the appropriate box to indicate that you are requesting a waiver for all outfalls. Attach waiver request and other required information to the application. Outfall number _____ Outfall number _____ Outfall number _____ ☐ I am requesting a waiver for some pollutants at all outfalls. ☐ I am requesting a waiver for all pollutants at all outfalls → SKIP to Item 7.4.
	7.3	Have you completed monitoring for all Table A pollutants at each of your outfalls for which a waiver has not been requested and attached the results to this application package?
		☒ Yes
	Table B. Toxic Metals, Cyanide, Total Phenols, and Organic Toxic Pollutants	
7.4	Do any of the facility's processes that contribute wastewater fall into one or more of the primary industry categories listed in Exhibit 2C-3? (See end of instructions for exhibit.)	
	☒ Yes ☐ No → SKIP to Item 7.8.	
7.5	Have you checked "Testing Required" for all toxic metals, cyanide, and total phenols in Section 1 of Table B?	
	☒ Yes	

EPA Identification Number ALD004019642		NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.		OMB No. 2040-0004 Expires 07/31/2026
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	7.6	List the applicable primary industry categories and check the boxes indicating the required GC/MS fraction(s) identified in Exhibit 2C–3.																				
		<table border="1"> <thead> <tr> <th>Primary Industry Category</th> <th colspan="4">Required GC/MS Fraction(s) (check applicable boxes)</th> </tr> </thead> <tbody> <tr> <td>Inorganic Chemical Manufacturing</td> <td>☒ Volatile</td> <td>☒ Acid</td> <td>☒ Base/neutral</td> <td>☐ Pesticide</td> </tr> <tr> <td></td> <td>☐ Volatile</td> <td>☐ Acid</td> <td>☐ Base/neutral</td> <td>☐ Pesticide</td> </tr> <tr> <td></td> <td>☐ Volatile</td> <td>☐ Acid</td> <td>☐ Base/neutral</td> <td>☐ Pesticide</td> </tr> </tbody> </table>	Primary Industry Category	Required GC/MS Fraction(s) (check applicable boxes)				Inorganic Chemical Manufacturing	☒ Volatile	☒ Acid	☒ Base/neutral	☐ Pesticide		☐ Volatile	☐ Acid	☐ Base/neutral	☐ Pesticide		☐ Volatile	☐ Acid	☐ Base/neutral	☐ Pesticide
	Primary Industry Category	Required GC/MS Fraction(s) (check applicable boxes)																				
	Inorganic Chemical Manufacturing	☒ Volatile	☒ Acid	☒ Base/neutral	☐ Pesticide																	
		☐ Volatile	☐ Acid	☐ Base/neutral	☐ Pesticide																	
	☐ Volatile	☐ Acid	☐ Base/neutral	☐ Pesticide																		
7.7	Have you checked “Testing Required” for all required pollutants in Sections 2 through 5 of Table B for each of the GC/MS fractions checked in Item 7.6? ☒ Yes																					
7.8	Have you checked “Believed Present” or “Believed Absent” for all pollutants listed in Sections 1 through 5 of Table B where testing is not required? ☒ Yes																					
7.9	Have you provided (1) quantitative data for those Section 1, Table B, pollutants for which you have indicated testing is required or (2) quantitative data or other required information for those Section 1, Table B, pollutants that you have indicated are “Believed Present” in your discharge? ☒ Yes																					
Effluent and Intake Characteristics Continued	7.10	Does the applicant qualify for a small business exemption under the criteria specified in the instructions? ☐ Yes → Note that you qualify at the top of Table B, then SKIP to Item 7.12. ☒ No																				
	7.11	Have you provided (1) quantitative data for those Sections 2 through 5, Table B, pollutants for which you have determined testing is required or (2) quantitative data or an explanation for those Sections 2 through 5, Table B, pollutants you have indicated are “Believed Present” in your discharge? ☒ Yes																				
	Table C. Certain Conventional and Non-Conventional Pollutants																					
	7.12	Have you indicated whether pollutants are “Believed Present” or “Believed Absent” for all pollutants listed in Table C for all outfalls? ☒ Yes																				
	7.13	Have you completed Table C by providing quantitative data for those pollutants that are limited either directly or indirectly in an ELG? You must provide quantitative data even if the pollutant is “Believed Absent.” ☐ Yes ☒ Not applicable																				
	7.14	Have you completed Table C by providing quantitative data or an explanation for those pollutants for which you have indicated “Believed Present”? ☒ Yes																				
	Table D. Certain Hazardous Substances and Asbestos																					
	7.15	Have you indicated whether pollutants are “Believed Present” or “Believed Absent” for all pollutants listed in Table D for all outfalls? ☒ Yes																				
	7.16	Have you completed Table D by (1) describing the reasons the applicable pollutants are expected to be discharged and (2) providing quantitative data, if available? ☒ Yes ☐ No																				
	Table E. 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (2,3,7,8-TCDD)																					
	7.17	Does the facility use or manufacture one or more of the 2,3,7,8-TCDD congeners listed in the instructions, or do you know or have reason to believe that TCDD is or may be present in the effluent? ☐ Yes → Complete Table E. ☒ No → SKIP to Section 8.																				
	7.18	Have you completed Table E by reporting <i>qualitative</i> data for TCDD? ☐ Yes																				

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SECTION 8. USED OR MANUFACTURED TOXICS (40 CFR 122.21(G)(9))

Used or Manufactured Toxics	8.1	Is any pollutant listed in Table B a substance or a component of a substance used or manufactured at your facility as an intermediate or final product or byproduct? ☐ Yes ☒ No → SKIP to Section 9.		
	8.2	List the pollutants below. Attach additional sheets, if necessary.		
	1.	4.	7.	
	2.	5.	8.	
	3.	6.	9.	

SECTION 9. BIOLOGICAL TOXICITY TESTS (40 CFR 122.21(G)(11))

Biological Toxicity Tests	9.1	Do you have any knowledge or reason to believe that any biological test for acute or chronic toxicity has been made within the last three years on (1) any of your discharges or (2) a receiving water in relation to your discharge? ☒ Yes ☐ No → SKIP to Section 10.			
	9.2	Identify the tests and their purposes below.			
		Test(s)	Purpose of Test(s)	Submitted to NPDES Permitting Authority?	Date Submitted
		24-hour acute toxicity using fathead minnow	NPDES Permit Required	☒ Yes ☐ No	07/21/2025
		48-hr acute toxicity using ceriodaphnia	NPDES Permit Required	☒ Yes ☐ No	07/21/2025
		* Additional toxicity test results available. OxyChem conducts toxicity testing at outfall DSN001 as required by the current NPDES permit.			

SECTION 10. CONTRACT ANALYSES (40 CFR 122.21(G)(12))

Contract Analyses	10.1	Were any of the analyses reported in Section 7 performed by a contract laboratory or consulting firm? ☒ Yes ☐ No → SKIP to Section 11.			
	10.2	Provide information for each contract laboratory or consulting firm below.			
			Laboratory Number 1	Laboratory Number 2	Laboratory Number 3
		Name of laboratory/firm	Waypoint Analytical	Southern Environmental Testing	Pace
		Laboratory address	2790 Whitten Road Memphis, TN 38133	3103 Northington Court Florence, AL 35630	12065 Lebanon Road Mount Juliet, TN 37122
		Phone number	(901) 213-2400	(256) 740-5532	(615) 758-5858
		Pollutant(s) analyzed	All pollutants other than fecal coliform and toxicity testing	Fecal Coliform	Toxicity tests

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SECTION 11. ADDITIONAL INFORMATION (40 CFR 122.21(G)(13))							
Additional Information	<u>11.1</u>	Has the NPDES permitting authority requested additional information? ☐ Yes ☒ No → SKIP to Section 12.					
	<u>11.2</u>	List the information requested and attach it to this application.					
	1.			4.			
	2.			5.			
	3.			6.			
SECTION 12. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(A) AND (D))							
Checklist and Certification Statement	<u>12.1</u>	In Column 1 below, mark the sections of Form 2C that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to complete all sections or provide attachments.					
		Column 1		Column 2			
	☒	Section 1: Outfall Location		☐	w/ attachments		
	☒	Section 2: Line Drawing		☒	w/ line drawing	☐	w/ additional attachments
	☒	Section 3: Average Flows and Treatment		☐	w/ attachments	☐	w/ list of each user of privately owned treatment works
	☒	Section 4: Intermittent Flows		☐	w/ attachments		
	☒	Section 5: Production		☐	w/ attachments		
	☒	Section 6: Improvements		☐	w/ attachments	☐	w/ optional additional sheets describing any additional pollution control plans
	☒	Section 7: Effluent and Intake Characteristics		☐	w/ request for a waiver and supporting information	☐	w/ explanation for identical outfalls
				☐	w/ small business exemption request	☐	w/ other attachments
				☒	w/ Table A	☒	w/ Table B
				☒	w/ Table C	☒	w/ Table D
				☒	w/ Table E	☐	w/ analytical results as an attachment
	☒	Section 8: Used or Manufactured Toxics		☐	w/ attachments		
☒	Section 9: Biological Toxicity Tests		☐	w/ attachments			
☒	Section 10: Contract Analyses		☐	w/ attachments			
☒	Section 11: Additional Information		☐	w/ attachments			
☒	Section 12: Checklist and Certification Statement		☐	w/ attachments			

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SECTION 12. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d)) (Continued)

Checklist and Certification Statement	12.2	Provide the following certification. (See instructions to determine the appropriate person to sign the application.)	
		Certification Statement	
		<i>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.</i>	
		Name (print or type first and last name) David Mullins	Official title Plant Manager
	Signature 	Date signed 10/1/2025	

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TABLE A. CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(iii))¹

	Pollutant	Waiver Requested (if applicable)	Units (specify)	Effluent				Intake (optional)	
				Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
☐	Check here if you have applied to your NPDES permitting authority for a waiver for <i>all</i> of the pollutants listed on this table for the noted outfall.								
1.	Biochemical oxygen demand (BOD ₅)	☐	Concentration	mg/L	< 5.0		13	< 5.0	1
			Mass	lbs/day	< 364.5		13		
2.	Chemical oxygen demand (COD)	☐	Concentration	mg/L	< 15.0		1	< 15.0	1
			Mass	lbs/day	< 1,093		1		
3.	Total organic carbon (TOC)	☐	Concentration	mg/L	3.32		1	2.96	1
			Mass	lbs/day	242.1		1		
4.	Total suspended solids (TSS)	☐	Concentration	mg/L	31		13	2	1
			Mass	lbs/day	1,972		13		
5.	Ammonia (as N)	☐	Concentration	mg/L	0.22		12	< 0.100	1
			Mass	lbs/day	15.7		12		
6.	Flow	☐	Rate	mgd	13.1	7.8	365		
7.	Temperature (winter)	☐	°C	°C	11.4		13		
	Temperature (summer)	☐	°C	°C	31.8		13		
8.	pH (minimum)	☐	Standard units	s.u.	6.1		365		
	pH (maximum)	☐	Standard units	s.u.	8.2		365		

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)	Effluent				Intake (optional)			
			Believed Present	Believed Absent		Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses		
☐	Check here if you qualify as a small business per the instructions to Form 2C and, therefore, do not need to submit quantitative data for any of the organic toxic pollutants in Sections 2 through 5 of this table. Note, however, that you must still indicate in the appropriate column of this table if you believe any of the pollutants listed are present in your discharge.												
Section 1. Toxic Metals, Cyanide, and Total Phenols													
1.1	Antimony, total (7440-36-0)	☒	☐	☐	Concentration	mg/L	< 0.010			1			
					Mass	lbs/day	< 0.729			1			
1.2	Arsenic, total (7440-38-2)	☒	☐	☐	Concentration	mg/L	< 0.010			1	< 0.010		
					Mass	lbs/day	< 0.729			1	1		
1.3	Beryllium, total (7440-41-7)	☒	☐	☐	Concentration	mg/L	< 0.001			1			
					Mass	lbs/day	< 0.073			1			
1.4	Cadmium, total (7440-43-9)	☒	☐	☐	Concentration	mg/L	< 0.002			1			
					Mass	lbs/day	< 0.146			1			
1.5	Chromium, total (7440-47-3)	☒	☐	☐	Concentration	mg/L	< 0.005			1			
					Mass	lbs/day	< 0.365			1			
1.6	Copper, total (7440-50-8)	☒	☐	☐	Concentration	mg/L	< 0.005			1			
					Mass	lbs/day	< 0.365			1			
1.7	Lead, total (7439-92-1)	☒	☐	☐	Concentration	mg/L	< 0.006			1			
					Mass	lbs/day	< 0.438			1			
1.8	Mercury, total (7439-97-6)	☒	☐	☐	Concentration	ng/L	72.5	26.7	13	< 0.500	1		
					Mass	lbs/day	0.00533	0.00192	13				
1.9	Nickel, total (7440-02-0)	☒	☐	☐	Concentration	mg/L	< 0.005			1			
					Mass	lbs/day	< 0.365			1			
1.10	Selenium, total (7782-49-2)	☒	☐	☐	Concentration	mg/L	< 0.010			1			
					Mass	lbs/day	< 0.729			1			
1.11	Silver, total (7440-22-4)	☒	☐	☐	Concentration	mg/L	< 0.005			1			
					Mass	lbs/day	< 0.365			1			

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses
1.12	Thallium, total (7440-28-0)	☒	☐	☐	Concentration	mg/L	< 0.020			1		
					Mass	lbs/day	< 1.46			1		
1.13	Zinc, total (7440-66-6)	☒	☐	☐	Concentration	mg/L	< 0.020			1		
					Mass	lbs/day	< 1.46			1		
1.14	Cyanide, total (57-12-5)	☒	☐	☐	Concentration	mg/L	< 0.005			1	< 0.005	1
					Mass	lbs/day	< 0.365			1		
1.15	Phenols, total	☒	☐	☐	Concentration	mg/L	< 0.005			1		
					Mass	lbs/day	< 0.365			1		
Section 2. Organic Toxic Pollutants (GC/MS Fraction—Volatile Compounds)												
2.1	Acrolein (107-02-8)	☒	☐	☐	Concentration	µg/L	< 20.0			1		
					Mass	lbs/day	< 1.46			1		
2.2	Acrylonitrile (107-13-1)	☒	☐	☐	Concentration	µg/L	< 20.0			1		
					Mass	lbs/day	< 1.46			1		
2.3	Benzene (71-43-2)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.4	Bromoform (75-25-2)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.5	Carbon tetrachloride (56-23-5)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.6	Chlorobenzene (108-90-7)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.7	Chlorodibromomethane (124-48-1)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.8	Chloroethane (75-00-3)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses
2.9	2-chloroethylvinyl ether (110-75-8)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
2.10	Chloroform (67-66-3)	☒	☐	☐	Concentration	µg/L	1.44			1		
					Mass	lbs/day	0.105			1		
2.11	Dichlorobromomethane (75-27-4)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.12	1,1-dichloroethane (75-34-3)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.13	1,2-dichloroethane (107-06-2)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.14	1,1-dichloroethylene (75-35-4)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.15	1,2-dichloropropane (78-87-5)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.16	1,3-dichloropropylene (542-75-6)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.17	Ethylbenzene (100-41-4)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.18	Methyl bromide (74-83-9)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.19	Methyl chloride (74-87-3)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		
2.20	Methylene chloride (75-09-2)	☒	☐	☐	Concentration	µg/L	< 10.0			1		
					Mass	lbs/day	< 0.729			1		
2.21	1,1,2,2- tetrachloroethane (79-34-5)	☒	☐	☐	Concentration	µg/L	< 1.00			1		
					Mass	lbs/day	< 0.0729			1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)		
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses	
2.22	Tetrachloroethylene (127-18-4)	☒	☐	☐	Concentration	µg/L	< 1.00				1		
					Mass	lbs/day	< 0.0729				1		
2.23	Toluene (108-88-3)	☒	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
2.24	1,2-trans-dichloroethylene (156-60-5)	☒	☐	☐	Concentration	µg/L	< 1.00				1		
					Mass	lbs/day	< 0.0729				1		
2.25	1,1,1-trichloroethane (71-55-6)	☒	☐	☐	Concentration	µg/L	< 1.00				1		
					Mass	lbs/day	< 0.0729				1		
2.26	1,1,2-trichloroethane (79-00-5)	☒	☐	☐	Concentration	µg/L	< 1.00				1		
					Mass	lbs/day	< 0.0729				1		
2.27	Trichloroethylene (79-01-6)	☒	☐	☐	Concentration	µg/L	< 1.00				1		
					Mass	lbs/day	< 0.0729				1		
2.28	Vinyl chloride (75-01-4)	☒	☐	☐	Concentration	µg/L	< 1.00				1		
					Mass	lbs/day	< 0.0729				1		
Section 3. Organic Toxic Pollutants (GC/MS Fraction—Acid Compounds)													
3.1	2-chlorophenol (95-57-8)	☒	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
3.2	2,4-dichlorophenol (120-83-2)	☒	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
3.3	2,4-dimethylphenol (105-67-9)	☒	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
3.4	4,6-dinitro-o-cresol (534-52-1)	☒	☐	☐	Concentration	µg/L	< 10.0				1		
					Mass	lbs/day	< 0.729				1		
3.5	2,4-dinitrophenol (51-28-5)	☒	☐	☐	Concentration	µg/L	< 20.0				1		
					Mass	lbs/day	< 1.46				1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)		
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses	
3.6	2-nitrophenol (88-75-5)	☑	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
3.7	4-nitrophenol (100-02-7)	☑	☐	☐	Concentration	µg/L	< 10.0				1		
					Mass	lbs/day	< 0.729				1		
3.8	p-chloro-m-cresol (59-50-7)	☑	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
3.9	Pentachlorophenol (87-86-5)	☑	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
3.10	Phenol (108-95-2)	☑	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
3.11	2,4,6-trichlorophenol (88-05-2)	☑	☐	☐	Concentration	µg/L	< 5.00				1		
					Mass	lbs/day	< 0.365				1		
Section 4. Organic Toxic Pollutants (GC/MS Fraction—Base /Neutral Compounds)													
4.1	Acenaphthene (83-32-9)	☑	☐	☐	Concentration	µg/L	< 2.00				1		
					Mass	lbs/day	< 0.146				1		
4.2	Acenaphthylene (208-96-8)	☑	☐	☐	Concentration	µg/L	< 2.00				1		
					Mass	lbs/day	< 0.146				1		
4.3	Anthracene (120-12-7)	☑	☐	☐	Concentration	µg/L	< 2.00				1		
					Mass	lbs/day	< 0.146				1		
4.4	Benzidine (92-87-5)	☑	☐	☐	Concentration	µg/L	< 10.0				1		
					Mass	lbs/day	< 0.729				1		
4.5	Benzo (a) anthracene (56-55-3)	☑	☐	☐	Concentration	µg/L	< 2.00				1		
					Mass	lbs/day	< 0.146				1		
4.6	Benzo (a) pyrene (50-32-8)	☑	☐	☐	Concentration	µg/L	< 2.00				1		
					Mass	lbs/day	< 0.146				1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses
4.7	3,4-benzofluoranthene (205-99-2)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		
4.8	Benzo (ghi) perylene (191-24-2)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		
4.9	Benzo (k) fluoranthene (207-08-9)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		
4.10	Bis (2-chloroethoxy) methane (111-91-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.11	Bis (2-chloroethyl) ether (111-44-4)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.12	Bis (2-chloroisopropyl) ether (102-80-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.13	Bis (2-ethylhexyl) phthalate (117-81-7)	☒	☐	☐	Concentration	µg/L	< 10.0			1		
					Mass	lbs/day	< 0.729			1		
4.14	4-bromophenyl phenyl ether (101-55-3)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.15	Butyl benzyl phthalate (85-68-7)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.16	2-chloronaphthalene (91-58-7)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.17	4-chlorophenyl phenyl ether (7005-72-3)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.18	Chrysene (218-01-9)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		
4.19	Dibenzo (a,h) anthracene (53-70-3)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses
4.20	1,2-dichlorobenzene (95-50-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.21	1,3-dichlorobenzene (541-73-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.22	1,4-dichlorobenzene (106-46-7)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.23	3,3-dichlorobenzidine (91-94-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.24	Diethyl phthalate (84-66-2)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.25	Dimethyl phthalate (131-11-3)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.26	Di-n-butyl phthalate (84-74-2)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.27	2,4-dinitrotoluene (121-14-2)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.28	2,6-dinitrotoluene (606-20-2)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.29	Di-n-octyl phthalate (117-84-0)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.30	1,2-Diphenylhydrazine (as azobenzene) (122-66-7)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.31	Fluoranthene (206-44-0)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		
4.32	Fluorene (86-73-7)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses
4.33	Hexachlorobenzene (118-74-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.34	Hexachlorobutadiene (87-68-3)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.35	Hexachlorocyclopentadiene (77-47-4)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.36	Hexachloroethane (67-72-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.37	Indeno (1,2,3-cd) pyrene (193-39-5)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		
4.38	Isophorone (78-59-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.39	Naphthalene (91-20-3)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		
4.40	Nitrobenzene (98-95-3)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.41	N-nitrosodimethylamine (62-75-9)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.42	N-nitrosodi-n-propylamine (621-64-7)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
4.43	N-nitrosodiphenylamine (86-30-6)	☒	☐	☐	Concentration	µg/L	< 10.0			1		
					Mass	lbs/day	< 0.729			1		
4.44	Phenanthrene (85-01-8)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		
4.45	Pyrene (129-00-0)	☒	☐	☐	Concentration	µg/L	< 2.00			1		
					Mass	lbs/day	< 0.146			1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses
4.46	1,2,4-trichlorobenzene (120-82-1)	☒	☐	☐	Concentration	µg/L	< 5.00			1		
					Mass	lbs/day	< 0.365			1		
Section 5. Organic Toxic Pollutants (GC/MS Fraction—Pesticides)												
5.1	Aldrin (309-00-2)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.2	α-BHC (319-84-6)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.3	β-BHC (319-85-7)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.4	γ-BHC (58-89-9)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.5	δ-BHC (319-86-8)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.6	Chlordane (57-74-9)	☐	☐	☒	Concentration	µg/L	< 0.200			1		
					Mass	lbs/day	< 0.0146			1		
5.7	4,4'-DDT (50-29-3)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.8	4,4'-DDE (72-55-9)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.9	4,4'-DDD (72-54-8)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.10	Dieldrin (60-57-1)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.11	α-endosulfan (115-29-7)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses
5.12	β-endosulfan (115-29-7)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.13	Endosulfan sulfate (1031-07-8)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.14	Endrin (72-20-8)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.15	Endrin aldehyde (7421-93-4)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.16	Heptachlor (76-44-8)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.17	Heptachlor epoxide (1024-57-3)	☐	☐	☒	Concentration	µg/L	< 0.040			1		
					Mass	lbs/day	< 0.00292			1		
5.18	PCB-1242 (53469-21-9)	☐	☐	☒	Concentration	µg/L	< 0.200			1		
					Mass	lbs/day	< 0.0146			1		
5.19	PCB-1254 (11097-69-1)	☐	☐	☒	Concentration	µg/L	< 0.200			1		
					Mass	lbs/day	< 0.0146			1		
5.20	PCB-1221 (11104-28-2)	☐	☐	☒	Concentration	µg/L	< 0.200			1		
					Mass	lbs/day	< 0.0146			1		
5.21	PCB-1232 (11141-16-5)	☐	☐	☒	Concentration	µg/L	< 0.200			1		
					Mass	lbs/day	< 0.0146			1		
5.22	PCB-1248 (12672-29-6)	☐	☐	☒	Concentration	µg/L	< 0.200			1		
					Mass	lbs/day	< 0.0146			1		
5.23	PCB-1260 (11096-82-5)	☐	☐	☒	Concentration	µg/L	< 0.200			1		
					Mass	lbs/day	< 0.0146			1		
5.24	PCB-1016 (12674-11-2)	☐	☐	☒	Concentration	µg/L	< 0.200			1		
					Mass	lbs/day	< 0.0146			1		

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TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))¹

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long- Term Average Value	Number of Analyses
5.25	Toxaphene (8001-35-2)	☐	☐	☒	Concentration		< 0.300			1		
					Mass	lbs/day	< 0.0219			1		

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))¹

	Pollutant	Presence or Absence (check one)		Units (specify)	Effluent				Intake (optional)			
		Believed Present	Believed Absent		Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses		
☐ Check here if you believe all pollutants in Table C to be present in your discharge from the noted outfall. You need <i>not</i> complete the "Presence or Absence" column of Table C for <i>each</i> pollutant.												
☐ Check here if you believe all pollutants in Table C to be absent in your discharge from the noted outfall. You need <i>not</i> complete the "Presence or Absence" column of Table C for <i>each</i> pollutant.												
1.	Bromide (24959-67-9)	☐	☒	Concentration	mg/L	< 0.100			1			
				Mass	lbs/day	< 7.29			1			
2.	Chlorine, total residual	☒	☐	Concentration	mg/L	< 0.022		< 0.022	13			
				Mass	lbs/day	< 1.82		< 1.56	13			
3.	Color	☐	☒	Concentration								
				Mass								
4.	Fecal coliform	☒	☐	Concentration	MPN/100	107		80	2			
				Mass								
5.	Fluoride (16984-48-8)	☒	☐	Concentration	mg/L	0.128			1			
				Mass	lbs/day	9.33			1			
6.	Nitrate-nitrite	☒	☐	Concentration	mg/L	0.461		0.254	7			
				Mass	lbs/day	36.8		18.7	7			
7.	Nitrogen, total organic (as N)	☒	☐	Concentration	mg/L	< 0.500			1			
				Mass	lbs/day	< 36.5			1			
8.	Oil and grease	☒	☐	Concentration	mg/L	< 1.7			1			
				Mass	lbs/day	< 124			1			
9.	Phosphorus (as P), total (7723-14-0)	☒	☐	Concentration	mg/L	< 0.500			7			
				Mass	lbs/day	< 36.5			7			
10.	Sulfate (as SO ₄) (14808-79-8)	☒	☐	Concentration	mg/L	29.0			1			
				Mass	lbs/day	2,115			1			
11.	Sulfide (as S)	☐	☒	Concentration								
				Mass								

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TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))¹

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
12.	Sulfite (as SO ₃) (14265-45-3)	☒	☐	Concentration	mg/L	0.64			1		
				Mass	lbs/day	46.7			1		
13.	Surfactants	☐	☒	Concentration	mg/L	< 0.200			1		
				Mass	lbs/day	< 14.6			1		
14.	Aluminum, total (7429-90-5)	☒	☐	Concentration	mg/L	0.147			1		
				Mass	lbs/day	10.7			1		
15.	Barium, total (7440-39-3)	☒	☐	Concentration	mg/L	0.0229			1		
				Mass	lbs/day	1.67			1		
16.	Boron, total (7440-42-8)	☐	☒	Concentration	mg/L	< 0.050			1		
				Mass	lbs/day	< 3.65			1		
17.	Cobalt, total (7440-48-4)	☐	☒	Concentration	mg/L	< 0.010			1		
				Mass	lbs/day	< 0.729			1		
18.	Iron, total (7439-89-6)	☒	☐	Concentration	mg/L	0.115			1		
				Mass	lbs/day	8.39			1		
19.	Magnesium, total (7439-95-4)	☒	☐	Concentration	mg/L	3.81			1		
				Mass	lbs/day	278			1		
20.	Molybdenum, total (7439-98-7)	☐	☒	Concentration	mg/L	< 0.050			1		
				Mass	lbs/day	< 3.65			1		
21.	Manganese, total (7439-96-5)	☒	☐	Concentration	mg/L	0.0336			1		
				Mass	lbs/day	2.45			1		
22.	Tin, total (7440-31-5)	☐	☒	Concentration	mg/L	< 0.050			1		
				Mass	lbs/day	< 3.65			1		
23.	Titanium, total (7440-32-6)	☐	☒	Concentration	mg/L	< 0.010			1		
				Mass	lbs/day	< 0.729			1		

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TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))¹

	Pollutant	Presence or Absence (check one)		Units (specify)	Effluent				Intake (optional)		
		Believed Present	Believed Absent		Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses	
24.	Radioactivity										
	Alpha, total	☐	☒	Concentration							
				Mass							
	Beta, total	☐	☒	Concentration							
				Mass							
	Radium, total	☐	☒	Concentration							
				Mass							
	Radium 226, total	☐	☒	Concentration							
				Mass							

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))¹

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
1.	Asbestos	☐	☒		
2.	Acetaldehyde	☐	☒		
3.	Allyl alcohol	☐	☒		
4.	Allyl chloride	☐	☒		
5.	Amyl acetate	☐	☒		
6.	Aniline	☐	☒		
7.	Benzonitrile	☐	☒		
8.	Benzyl chloride	☐	☒		
9.	Butyl acetate	☐	☒		
10.	Butylamine	☐	☒		
11.	Captan	☐	☒		
12.	Carbaryl	☐	☒		
13.	Carbofuran	☐	☒		
14.	Carbon disulfide	☐	☒		
15.	Chlorpyrifos	☐	☒		
16.	Coumaphos	☐	☒		
17.	Cresol	☐	☒		
18.	Crotonaldehyde	☐	☒		
19.	Cyclohexane	☐	☒		

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TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))¹

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
20.	2,4-D (2,4-dichlorophenoxyacetic acid)	☐	☒		
21.	Diazinon	☐	☒		
22.	Dicamba	☐	☒		
23.	Dichlobenil	☐	☒		
24.	Dichlone	☐	☒		
25.	2,2-dichloropropionic acid	☐	☒		
26.	Dichlorvos	☐	☒		
27.	Diethyl amine	☐	☒		
28.	Dimethyl amine	☐	☒		
29.	Dinitrobenzene	☐	☒		
30.	Diquat	☐	☒		
31.	Disulfoton	☐	☒		
32.	Diuron	☐	☒		
33.	Epichlorohydrin	☐	☒		
34.	Ethion	☐	☒		
35.	Ethylene diamine	☐	☒		
36.	Ethylene dibromide	☐	☒		
37.	Formaldehyde	☐	☒		
38.	Furfural	☐	☒		

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TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))¹

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
39.	Guthion	☐	☒		
40.	Isoprene	☐	☒		
41.	Isopropanolamine	☐	☒		
42.	Kelthane	☐	☒		
43.	Kepone	☐	☒		
44.	Malathion	☐	☒		
45.	Mercaptodimethur	☐	☒		
46.	Methoxychlor	☐	☒		
47.	Methyl mercaptan	☐	☒		
48.	Methyl methacrylate	☐	☒		
49.	Methyl parathion	☐	☒		
50.	Mevinphos	☐	☒		
51.	Mexacarbate	☐	☒		
52.	Monoethyl amine	☐	☒		
53.	Monomethyl amine	☐	☒		
54.	Naled	☐	☒		
55.	Naphthenic acid	☐	☒		
56.	Nitrotoluene	☐	☒		
57.	Parathion	☐	☒		

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TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))¹

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
58.	Phenolsulfonate	☐	☒		
59.	Phosgene	☐	☒		
60.	Propargite	☐	☒		
61.	Propylene oxide	☐	☒		
62.	Pyrethrins	☐	☒		
63.	Quinoline	☐	☒		
64.	Resorcinol	☐	☒		
65.	Strontium	☐	☒		
66.	Strychnine	☐	☒		
67.	Styrene	☐	☒		
68.	2,4,5-T (2,4,5-trichlorophenoxyacetic acid)	☐	☒		
69.	TDE (tetrachlorodiphenyl ethane)	☐	☒		
70.	2,4,5-TP [2-(2,4,5-trichlorophenoxy) propanoic acid]	☐	☒		
71.	Trichlorofon	☐	☒		
72.	Triethanolamine	☐	☒		
73.	Triethylamine	☐	☒		
74.	Trimethylamine	☐	☒		
75.	Uranium	☐	☒		
76.	Vanadium	☐	☒		

EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN001
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TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))¹

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
77.	Vinyl acetate	☐	☒		
78.	Xylene	☐	☒		
79.	Xylenol	☐	☒		
80.	Zirconium	☐	☒		

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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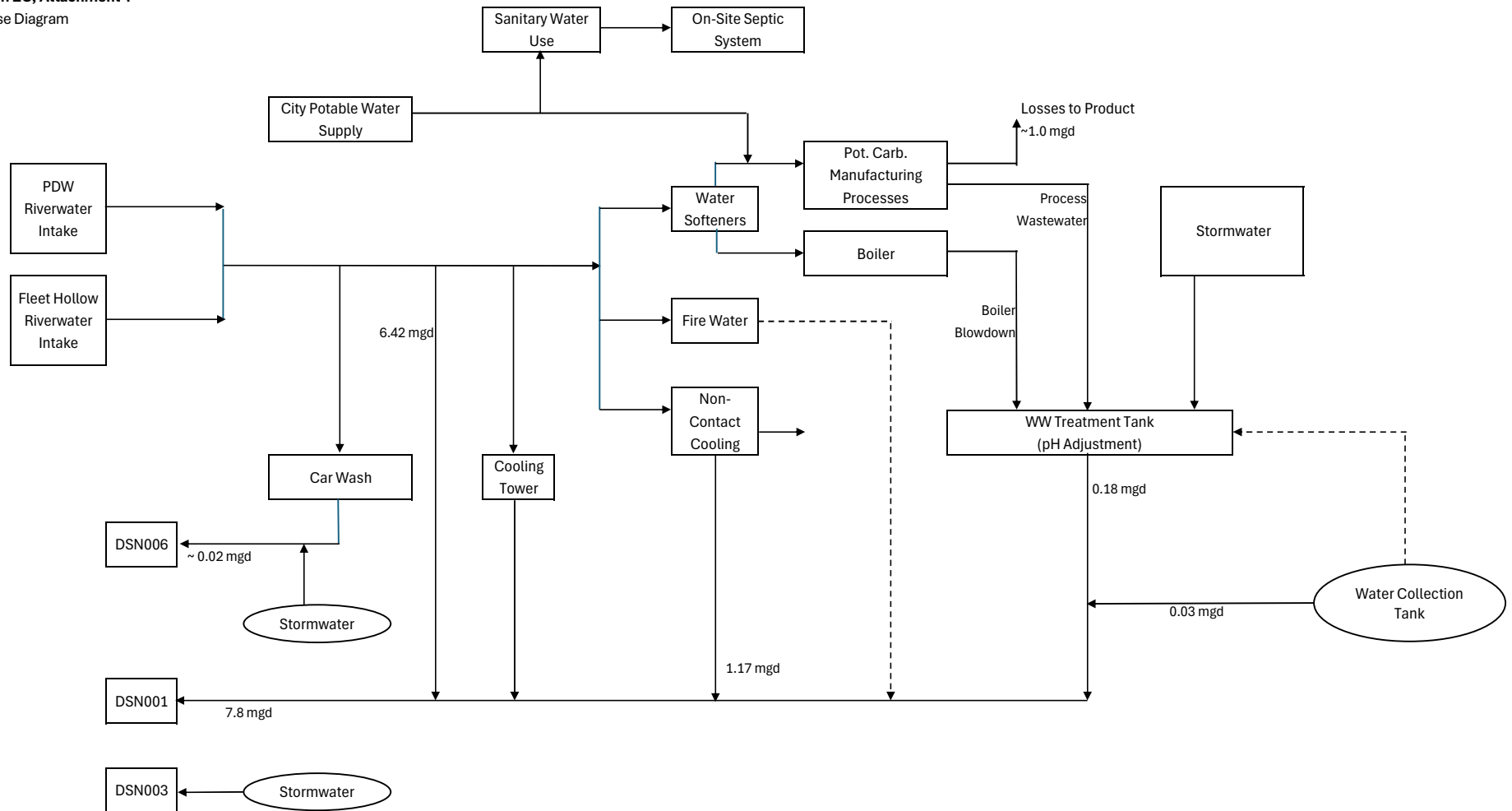
EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN001
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TABLE E. 2,3,7,8 TETRACHLORODIBENZO P DIOXIN (2,3,7,8 TCDD) (40 CFR 122.21(g)(7)(viii))

Pollutant	TCDD Congeners Used or Manufactured	Presence or Absence (check one)		Results of Screening Procedure
		Believed Present	Believed Absent	
2,3,7,8-TCDD	☐	☐	☒	

EPA Form 2C, Attachment 1
Water Use Diagram



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FORM 2E NPDES		U.S. Environmental Protection Agency Application for NPDES Permit to Discharge Wastewater MANUFACTURING, COMMERCIAL, MINING, AND SILVICULTURAL FACILITIES WHICH DISCHARGE ONLY NONPROCESS WASTEWATER
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SECTION 1. OUTFALL LOCATION (40 CFR 122.21(H)(1))

Outfall Location	<u>1.1</u>	Provide information on each of the facility's outfalls in the table below.			
		Outfall Number	Receiving Water Name	Latitude	Longitude
		DSN006	Pond Creek	34° 46' 11.05" N	-87° 37' 55.53" E

SECTION 2. DISCHARGE DATE (40 CFR 122.21(H)(2))

Discharge Date	<u>2.1</u>	Are you a new or existing discharger? (Check only one response.) ☐ New discharger ☒ Existing discharger → SKIP to Section 3.
	<u>2.2</u>	Specify your anticipated discharge date:

SECTION 3. WASTE TYPES (40 CFR 122.21(H)(3))

Waste Types	<u>3.1</u>	What types of wastes are currently being discharged if you are an existing discharger or will be discharged if you are a new discharger? (Check all that apply.)	
		☐ Sanitary wastes ☒ Other nonprocess wastewater (describe/explain directly below) ☐ Restaurant or cafeteria waste Employee car wash ☐ Non-contact cooling water	
	<u>3.2</u>	Does the facility use cooling water additives? ☐ Yes ☒ No → SKIP to Section 4.	
	<u>3.3</u>	List the cooling water additives used and describe their composition.	
		Cooling Water Additives (list)	Composition of Additives (if available to you)

SECTION 4. EFFLUENT CHARACTERISTICS (40 CFR 122.21(H)(4))

Effluent Characteristics	<u>4.1</u>	Have you completed monitoring for all parameters in the table below at each of your outfalls and attached the results to this application package? ☒ Yes ☐ No; a waiver has been requested for one or more parameters from my NPDES permitting authority (attach waiver request and additional information).					
	<u>4.2</u>	Provide data as requested in the table below. ¹ Enter "Waiver" in the "Number of Analyses" column for those parameters for which you are requesting a waiver. (See instructions for specifics.)					
		Parameter or Pollutant	Number of Analyses (if actual data reported)	Maximum Daily Discharge (specify units)	Average Daily Discharge (specify units)	Source (use codes per instructions)	
				Mass	Conc.	Mass	Conc.
		Biochemical oxygen demand (BOD ₅)	1		< 5 mg/L		
		Total suspended solids (TSS)	1		2 mg/L		
		Oil and grease	1		7.3 mg/L		
		Ammonia (as N)	1		< 0.1 mg/L		
		Discharge flow	estimated	0.02 mgd			
		pH (report as range)	1	7.54			
		Temperature (winter)		Ambient			
	Temperature (summer)		Ambient				

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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Effluent Characteristics Continued	4.3	Is fecal coliform believed present, or is sanitary waste discharged (or will it be discharged)? ☐ Yes ☒ No → SKIP to Item 4.5.						
	4.4	Provide data as requested in the table below. ¹ (See instructions for specifics.)						
		Parameter or Pollutant	Number of Analyses (if actual data reported)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Source (use codes per instructions)
				Mass	Conc.	Mass	Conc.	
		Fecal coliform						
		<i>E. coli</i>						
		Enterococci						
	4.5	Is chlorine used (or will it be used)? ☐ Yes ☒ No → SKIP to Item 4.7.						
	4.6	Provide data as requested in the table below. ² (See instructions for specifics.)						
		Parameter or Pollutant	Number of Analyses (if actual data reported)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Source (use codes per instructions)
			Mass	Conc.	Mass	Conc.		
	Total residual chlorine							
4.7	Is non-contact cooling water discharged (or will it be discharged)? ☐ Yes ☒ No → SKIP to Section 5.							
4.8	Provide data as requested in the table below. ¹ (See instructions for specifics.)							
	Parameter or Pollutant	Number of Analyses (if actual data reported)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Source (use codes per instructions)	
			Mass	Conc.	Mass	Conc.		
	Chemical oxygen demand (COD)							
	Total organic carbon (TOC)							

SECTION 5. FLOW (40 CFR 122.21(H)(5))		
Flow	5.1	Except for stormwater water runoff, leaks, or spills, are any of the discharges you described in Sections 1 and 3 of this application intermittent or seasonal? ☐ Yes → Complete this section. ☒ No → SKIP to Section 6.
	5.2	Briefly describe the frequency and duration of flow. The non-process, non-stormwater discharge for this outfall is from the employee car wash. The source of the water is the surface water intake on the Tennessee River and there are no chemicals or detergents added to the water. Stormwater for this outfall is from a small area of the plant site, the northern area of the capped former chlor-alkali facility, and the employee parking area.

SECTION 6. TREATMENT SYSTEM (40 CFR 122.21(H)(6))		
Treatment System	6.1	Briefly describe any treatment system(s) used (or to be used). None

² Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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SECTION 7. OTHER INFORMATION (40 CFR 122.21(H)(7))

Other Information	7.1	Use the space below to expand upon any of the above items. Use this space to provide any information you believe the reviewer should consider in establishing permit limitations. Attach additional sheets as needed. (optional item)

SECTION 8. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(A) AND (D))

Checklist and Certification Statement	8.1	In Column 1 below, mark the sections of Form 2E that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to provide attachments.								
		Column 1	Column 2							
		☒ Section 1: Outfall Location	☐ w/ attachments (e.g., responses for additional outfalls)							
		☒ Section 2: Discharge Date	☐ w/ attachments							
		☒ Section 3: Waste Types	☐ w/ attachments							
		☒ Section 4: Effluent Characteristics	☐ w/ attachments							
		☒ Section 5: Flow	☐ w/ attachments							
		☒ Section 6: Treatment System	☐ w/ attachments							
		☒ Section 7: Other Information	☐ w/ attachments							
		☒ Section 8: Checklist and Certification Statement	☐ w/ attachments							
	8.2	Certification Statement <i>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.</i>								
	<table border="1"> <tr> <td>Name (print or type first and last name)</td> <td>Official title</td> </tr> <tr> <td>David Mullins</td> <td>Plant Manager</td> </tr> <tr> <td>Signature</td> <td>Date signed</td> </tr> <tr> <td></td> <td>10/1/25</td> </tr> </table>		Name (print or type first and last name)	Official title	David Mullins	Plant Manager	Signature	Date signed		10/1/25
Name (print or type first and last name)	Official title									
David Mullins	Plant Manager									
Signature	Date signed									
	10/1/25									

EPA Identification Number ALD004019642		NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.		OMB No. 2040-0004 Expires 07/31/2026	
Form 2F NPDES		U.S Environmental Protection Agency Application for NPDES Permit to Discharge Wastewater STORMWATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITY				
SECTION 1. OUTFALL LOCATION (40 CFR 122.21(G)(1))						
Outfall Location	<u>1.1</u>	Provide information on each of the facility's outfalls in the table below				
		Outfall Number	Receiving Water Name	Latitude	Longitude	
		DSN001	Pond Creek	34° 46' 27.11" N	-87° 38' 2.88" E	
		DSN003	UT to Pond Creek	34° 46' 13" N	-87° 27' 23" E	
		DSN006	Pond Creek	34° 46' 11.05" N	-87° 37' 55.53" E	
SECTION 2. IMPROVEMENTS (40 CFR 122.21(G)(6))						
Improvements	<u>2.1</u>	Are you presently required by any federal, state, or local authority to meet an implementation schedule for constructing, upgrading, or operating wastewater treatment equipment or practices or any other environmental programs that could affect the discharges described in this application? ☐ Yes ☒ No → SKIP to Section 3.				
	<u>2.2</u>	Briefly identify each applicable project in the table below.				
		Brief Identification and Description of Project	Affected Outfalls (list outfall numbers)	Source(s) of Discharge	Final Compliance Dates	
					Required	Projected
	<u>2.3</u>	Have you attached sheets describing any additional water pollution control programs (or other environmental projects that may affect your discharges) that you now have underway or planned? <i>(optional item)</i> ☐ Yes ☐ No				

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SECTION 3. SITE DRAINAGE MAP (40 CFR 122.26(C)(1)(I)(A))

Site Drainage Map	<u>3.1</u>	Have you attached a site drainage map containing all required information to this application? (See instructions for specific guidance.)
	☒	Yes

SECTION 4. POLLUTANT SOURCES (40 CFR 122.26(C)(1)(I)(B))

Pollutant Sources	<u>4.1</u>	Provide information on the facility's pollutant sources in the table below.			
		Outfall Number	Impervious Surface Area (within a mile radius of the facility)	Total Surface Area Drained (within a mile radius of the facility)	
		DSN001	12.6	specify units acres	96 * specify units acres
		DSN003	0	specify units acres	38 specify units acres
		DSN006	2.4	specify units acres	18 specify units acres
		* DSN001 drainage includes 26 acres at the plant site and the remaining area consists of the former cooling pond and surrounding areas.			
				specify units	specify units
				specify units	specify units
	<u>4.2</u>	Provide a narrative description of the facility's significant material in the space below. (See instructions for content requirements.)			
		Potassium hydroxide (KOH) and sulfuric acid are stored in tanks with secondary containment within the drainage area of DSN001. Exposed production areas are curbed to manage any spills through the wastewater treatment system prior to discharge.			
<u>4.3</u>	Provide the location and a description of existing structural and non-structural control measures to reduce pollutants in stormwater runoff. (See instructions for specific guidance.)				
	Stormwater Treatment				
	Outfall Number	Control Measures and Treatment		Codes from Exhibit 2F-1 (list)	
	DSN001	Oil booms, sedimentation, pH adjustment (neutralization)		1-U, 1-X	
				2-K, 4-A	
	DSN003	None			
	DSN006	None			

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SECTION 5. NON STORMWATER DISCHARGES (40 CFR 122.26(C)(1)(I)(C))

Non-Stormwater Discharges	<u>5.1</u>	Provide the following certification. (See instructions to determine the appropriate person to sign the application.) <i>I certify under penalty of law that the outfall(s) covered by this application have been tested or evaluated for the presence of non-stormwater discharges. Moreover, I certify that the outfalls identified as having non-stormwater discharges are described in either an accompanying NPDES Form 2C, 2D, or 2E application.</i>			
		Name (print or type first and last name)	Official title		
		David Mullins	Plant Manager		
		Signature	Date signed		
			10/11/25		
	<u>5.2</u>	Provide the testing information requested in the table below.			
		Outfall Number	Description of Testing Method Used	Date(s) of Testing	Onsite Drainage Points Directly Observed During Test
		DSN001	DSN001 also contains non-contact cooling water and		
			treated process wastewater		
		DSN003	Visual observation of no non-stormwater discharges	09/18/2025	DSN003
	DSN006	DSN006 also contains non-stormwater discharge from			
		the employee car wash			

SECTION 6. SIGNIFICANT LEAKS OR SPILLS (40 CFR 122.26(C)(1)(I)(D))

Significant Leaks or Spills	<u>6.1</u>	Describe any significant leaks or spills of toxic or hazardous pollutants in the last three years. None
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SECTION 7. DISCHARGE INFORMATION (40 CFR 122.26(C)(1)(I)(E))

Discharge Information	See the instructions to determine the pollutants and parameters you are required to monitor and, in turn, the tables you must complete. Not all applicants need to complete each table.	
	<u>7.1</u>	Is this a new source or new discharge? ☐ Yes → See instructions regarding submission of <i>estimated data</i>. ☒ No → See instructions regarding submission of <i>actual data</i>.
	Tables A, B, C, and D	
	<u>7.2</u>	Have you completed Table A for each outfall? ☒ Yes

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Discharge Information Continued	7.3	Is the facility subject to an effluent limitation guideline (ELG) or effluent limitations in an NPDES permit for its process wastewater? ☐ Yes ☒ No → SKIP to Item 7.5.
	7.4	Have you completed Table B by providing quantitative data for those pollutants that are (1) limited either directly or indirectly in an ELG and/or (2) subject to effluent limitations in an NPDES permit for the facility's process wastewater? ☐ Yes
	7.5	Do you know or have reason to believe any pollutants in Exhibit 2F–2 are present in the discharge? ☒ Yes ☐ No → SKIP to Item 7.7.
	7.6	Have you listed all pollutants in Exhibit 2F–2 that you know or have reason to believe are present in the discharge and provided quantitative data or an explanation for those pollutants in Table C? ☒ Yes
	7.7	Do you qualify for a small business exemption under the criteria specified in the Instructions? ☐ Yes → SKIP to Item 7.18. ☒ No
	7.8	Do you know or have reason to believe any pollutants in Exhibit 2F–3 are present in the discharge? ☒ Yes ☐ No → SKIP to Item 7.10.
	7.9	Have you listed all pollutants in Exhibit 2F–3 that you know or have reason to believe are present in the discharge in Table C? ☒ Yes
	7.10	Do you expect any of the pollutants in Exhibit 2F–3 to be discharged in concentrations of 10 ppb or greater? ☐ Yes ☒ No → SKIP to Item 7.12.
	7.11	Have you provided quantitative data in Table C for those pollutants in Exhibit 2F–3 that you expect to be discharged in concentrations of 10 ppb or greater? ☐ Yes
	7.12	Do you expect acrolein, acrylonitrile, 2,4-dinitrophenol, or 2-methyl-4,6-dinitrophenol to be discharged in concentrations of 100 ppb or greater? ☐ Yes ☒ No → SKIP to Item 7.14.
	7.13	Have you provided quantitative data in Table C for the pollutants identified in Item 7.12 that you expect to be discharged in concentrations of 100 ppb or greater? ☐ Yes
	7.14	Have you provided quantitative data or an explanation in Table C for pollutants you expect to be present in the discharge at concentrations less than 10 ppb (or less than 100 ppb for the pollutants identified in Item 7.12)? ☒ Yes
	7.15	Do you know or have reason to believe any pollutants in Exhibit 2F–4 are present in the discharge? ☐ Yes ☒ No → SKIP to Item 7.17.

EPA Identification Number ALD004019642		NPDES Permit Number AL0000213		Facility Name Occidental Chemical Corp.		OMB No. 2040-0004 Expires 07/31/2026								
Discharge Information Continued	7.16	Have you listed pollutants in Exhibit 2F–4 that you know or believe to be present in the discharge and provided an explanation in Table C? ☐ Yes												
	7.17	Have you provided information for the storm event(s) sampled in Table D? ☒ Yes												
	Used or Manufactured Toxics													
	7.18	Is any pollutant listed on Exhibits 2F–2 through 2F–4 a substance or a component of a substance used or manufactured as an intermediate or final product or byproduct? ☐ Yes ☒ No → SKIP to Section 8.												
	7.19	List the pollutants below, including TCDD if applicable. Attach additional sheets, if necessary.												
	<table border="1"> <tr> <td>1.</td> <td>4.</td> <td>7.</td> </tr> <tr> <td>2.</td> <td>5.</td> <td>8.</td> </tr> <tr> <td>3.</td> <td>6.</td> <td>9.</td> </tr> </table>						1.	4.	7.	2.	5.	8.	3.	6.
1.	4.	7.												
2.	5.	8.												
3.	6.	9.												
SECTION 8. BIOLOGICAL TOXICITY TESTING DATA (40 CFR 122.21(G)(11))														
Biological Toxicity Testing Data	8.1	Do you have any knowledge or reason to believe that any biological test for acute or chronic toxicity has been made on any of your discharges or on a receiving water in relation to your discharge within the last three years? ☒ Yes ☐ No → SKIP to Section 9.												
	8.2	Identify the tests and their purposes below.												
	Test(s)		Purpose of Test(s)		Submitted to NPDES Permitting Authority?		Date Submitted							
	24-hour acute toxicity using fatf		NPDES Permit Required		☒ Yes ☐ No		07/21/2025							
	48-hr acute toxicity using cerioc		NPDES Permit Required		☒ Yes ☐ No		07/21/2025							
				☐ Yes ☐ No										
SECTION 9. CONTRACT ANALYSIS INFORMATION (40 CFR 122.21(G)(12))														
Contract Analysis Information	9.1	Were any of the analyses reported in Section 7 (in Tables A through C) performed by a contract laboratory or consulting firm? ☒ Yes ☐ No → SKIP to Section 10.												
	9.2	Provide information for each contract laboratory or consulting firm below.												
			Laboratory Number 1		Laboratory Number 2		Laboratory Number 3							
	Name of laboratory/firm		Waypoint Analytical											
	Laboratory address		2790 Whitten Road Memphis, TN 38133											
	Phone number		(901) 213-2400											
Pollutant(s) analyzed		All pollutants included on Form 2F												

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SECTION 10. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(A) AND (D))

Checklist and Certification Statement

10.1

In Column 1 below, mark the sections of Form 2F that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to complete all sections or provide attachments.

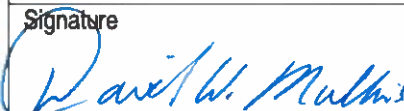
Column 1	Column 2
☒ Section 1	☐ w/ attachments (e.g., responses for additional outfalls)
☒ Section 2	☐ w/ attachments
☒ Section 3	☐ w/ site drainage map
☒ Section 4	☐ w/ attachments
☒ Section 5	☐ w/ attachments
☒ Section 6	☐ w/ attachments
☒ Section 7	☒ Table A ☐ w/ small business exemption request ☒ Table B ☐ w/ analytical results as an attachment ☒ Table C ☒ Table D
☒ Section 8	☐ w/ attachments
☒ Section 9	☐ w/ attachments (e.g., responses for additional contact laboratories or firms)
☒ Section 10	

10.2

Provide the following certification. (See instructions to determine the appropriate person to sign the application.)

Certification Statement

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 (print or type first and last name)	Official title
David Mullins	Plant Manager
Signature 	Date signed 10/1/25

EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN001
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OMB No. 2040-0004
Expires 07/31/2026

TABLE A. CONVENTIONAL AND NON CONVENTIONAL PARAMETERS (40 CFR 122.26(C)(1)(I)(E)(3))¹

You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details and requirements.

Pollutant or Parameter		Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
		Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
1.	Oil and grease	< 1.7 mg/L				1	
2.	Biochemical oxygen demand (BOD ₅)	< 5.0 mg/L	< 5.0 mg/L			1	
3.	Chemical oxygen demand (COD)	< 15.0 mg/L	< 15.0 mg/L			1	
4.	Total suspended solids (TSS)	15 mg/L	12 mg/L			1	
5.	Total phosphorus	< 0.500 mg/L	< 0.500 mg/L			1	
6.	Total Kjeldahl nitrogen (TKN)	< 0.500 mg/L	< 0.500 mg/L			1	
7.	Total nitrogen (as N)	0.218 mg/L	0.236 mg/L			1	
8.	pH (minimum)	7.22				1	
	pH (maximum)						

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN001
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OMB No. 2040-0004
Expires 07/31/2026

TABLE B. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.26(C)(1)(I)(E)(4) AND 40 CFR 122.21(G)(7)(VI)(A))¹

List each pollutant that is limited in an effluent limitation guideline (ELG) that the facility is subject to or any pollutant listed in the facility's NPDES permit for its process wastewater (if the facility is operating under an existing NPDES permit). Complete one table for each outfall. See the instructions for additional details and requirements.

Pollutant and CAS Number (if available)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
Temperature	77.85 °F	N/A			1	
Dissolved Oxygen	5.65 mg/L	N/A			1	
Total Ammonia Nitrogen	< 0.100 mg/L	< 0.100 mg/L			1	
Chlorine, Total Residual	0.05 mg/L	N/A			1	
Mercury, Total Recoverable	53.1 ng/L	186 ng/L			1	
Arsenic, Total Recoverable	< 0.0100 mg/L	< 0.0100 mg/L			1	
Cyanide, Total	< 0.005 mg/L	N/A			1	

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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OMB No. 2040-0004
Expires 07/31/2026

List each pollutant shown in Exhibits 2F-2, 2F-3, and 2F-4 that you know or have reason to believe is present. Complete one table for each outfall. See the instructions for additional details and requirements.

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility name Occidental Chemical Corp.	Outfall Number DSN001
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OMB No. 2040-0004
Expires 07/31/2026

TABLE D. STORM EVENT INFORMATION (40 CFR 122.26(C)(1)(I)(E)(6))

Provide data for the storm event(s) that resulted in the maximum daily discharges for the flow-weighted composite sample.

Date of Storm Event	Duration of Storm Event (in hours)	Total Rainfall During Storm Event (in inches)	Number of Hours Between Beginning of Storm Measured and End of Previous Measurable Rain Event	Maximum Flow Rate During Rain Event (in gpm or specify units)	Total Flow from Rain Event (in gallons or specify units)
08/13/2025	2.52 hours	0.98 inches	348 hours	5.07 mgd from stormwa	531,222 gallons from stormwater

Provide a description of the method of flow measurement or estimate.

Rational Method was used to calculate the stormwater flow using a runoff coefficient of 0.95 for impervious areas and a runoff coefficient of 0.6 for the remaining drainage area. Outfall DSN001 also receives discharges from other sources and the daily discharge for outfall DSN001 on 8/13/2025 was 9.21 mgd.

EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE A. CONVENTIONAL AND NON CONVENTIONAL PARAMETERS (40 CFR 122.26(C)(1)(I)(E)(3))¹							
You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details and requirements.							
Pollutant or Parameter		Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
		Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
1.	Oil and grease						
2.	Biochemical oxygen demand (BOD ₅)						
3.	Chemical oxygen demand (COD)						
4.	Total suspended solids (TSS)						
5.	Total phosphorus						
6.	Total Kjeldahl nitrogen (TKN)						
7.	Total nitrogen (as N)						
8.	pH (minimum)						
	pH (maximum)						

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

* OxyChem began monitoring rainfall for a qualified storm event for sampling in June 2025. At the time of permit application submittal OxyChem has been unable to collect a sample of a discharge from outfall DSN003 from a qualifying storm event. OxyChem will continue to attempt to collect a sample from outfall DSN003 from a qualifying storm event and submit the sample results when available.

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE B. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.26(C)(1)(I)(E)(4) AND 40 CFR 122.21(G)(7)(VI)(A))¹

List each pollutant that is limited in an effluent limitation guideline (ELG) that the facility is subject to or any pollutant listed in the facility's NPDES permit for its process wastewater (if the facility is operating under an existing NPDES permit). Complete one table for each outfall. See the instructions for additional details and requirements.

Pollutant and CAS Number (if available)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
Temperature						
Dissolved Oxygen						
Total Ammonia Nitrogen						
Chlorine, Total Residual						
Mercury, Total Recoverable						
Arsenic, Total Recoverable						
Cyanide, Total						

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE C. TOXIC POLLUTANTS, CERTAIN HAZARDOUS SUBSTANCES, AND ASBESTOS (40 CFR 122.26(C)(1)(I)(E)(4) AND 40 CFR 122.21(G)(7)(VI)(B) AND (VII))¹

List each pollutant shown in Exhibits 2F-2, 2F-3, and 2F-4 that you know or have reason to believe is present. Complete one table for each outfall. See the instructions for additional details and requirements.

Pollutant and CAS Number (if available)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
Parameters from Exhibits 2F-2, 2F-3, and 2F-4						
believed present are included in Table B						

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility name Occidental Chemical Corp.	Outfall Number DSN003
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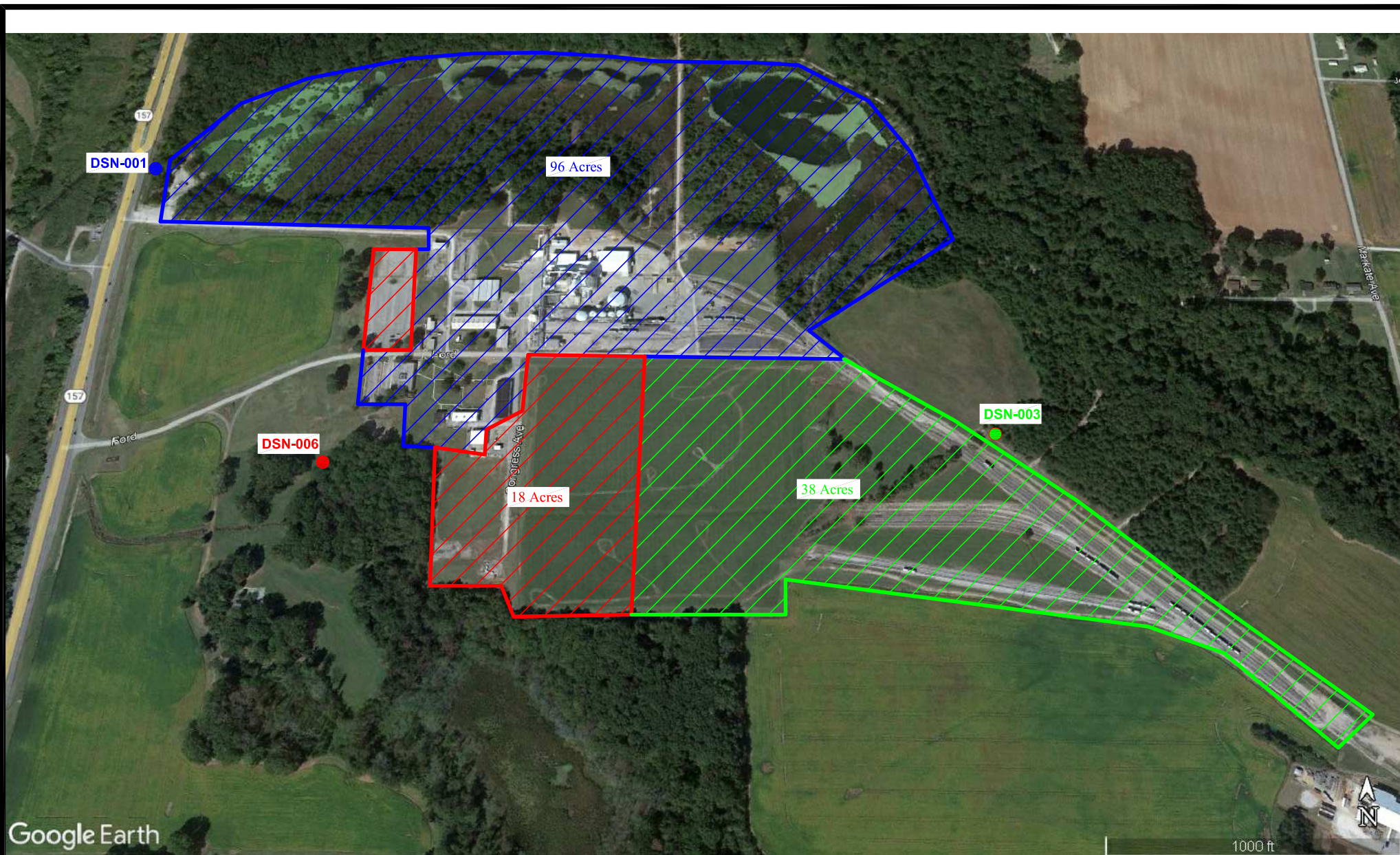
OMB No. 2040-0004
Expires 07/31/2026

TABLE D. STORM EVENT INFORMATION (40 CFR 122.26(C)(1)(I)(E)(6))

Provide data for the storm event(s) that resulted in the maximum daily discharges for the flow-weighted composite sample.

Date of Storm Event	Duration of Storm Event (in hours)	Total Rainfall During Storm Event (in inches)	Number of Hours Between Beginning of Storm Measured and End of Previous Measurable Rain Event	Maximum Flow Rate During Rain Event (in gpm or specify units)	Total Flow from Rain Event (in gallons or specify units)

Provide a description of the method of flow measurement or estimate.



Site Drainage Map

Armand Products

Muscle Shoals, Alabama

Drawn By: E. Curtis

Project No.: 2025-117

Scale: See Map

SEE 
ENVIRONMENTAL
SOUTHERN ENVIRONMENTAL ENGINEERING

EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE A. CONVENTIONAL AND NON CONVENTIONAL PARAMETERS (40 CFR 122.26(C)(1)(I)(E)(3))¹

You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details and requirements.

Pollutant or Parameter		Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
		Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
1.	Oil and grease	< 1.5 mg/L				1	
2.	Biochemical oxygen demand (BOD ₅)	< 5.0 mg/L	< 5.0 mg/L			1	
3.	Chemical oxygen demand (COD)	50.4 mg/L	116 mg/L			1	
4.	Total suspended solids (TSS)	72.5 mg/L	20.2 mg/L			1	
5.	Total phosphorus	< 1.00 mg/L	< 0.500 mg/L			1	
6.	Total Kjeldahl nitrogen (TKN)	2.72 mg/L	0.763 mg/L			1	
7.	Total nitrogen (as N)	2.72 mg/L	0.763 mg/L			1	
8.	pH (minimum)	6.87				1	
	pH (maximum)						

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE C. TOXIC POLLUTANTS, CERTAIN HAZARDOUS SUBSTANCES, AND ASBESTOS (40 CFR 122.26(C)(1)(I)(E)(4) AND 40 CFR 122.21(G)(7)(VI)(B) AND (VII))¹

List each pollutant shown in Exhibits 2F-2, 2F-3, and 2F-4 that you know or have reason to believe is present. Complete one table for each outfall. See the instructions for additional details and requirements.

Pollutant and CAS Number (if available)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
Parameters from Exhibits 2F-2, 2F-3, and 2F-4						
believed present are included in Table B						

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE D. STORM EVENT INFORMATION (40 CFR 122.26(C)(1)(I)(E)(6))

Provide data for the storm event(s) that resulted in the maximum daily discharges for the flow-weighted composite sample.

Date of Storm Event	Duration of Storm Event (in hours)	Total Rainfall During Storm Event (in inches)	Number of Hours Between Beginning of Storm Measured and End of Previous Measurable Rain Event	Maximum Flow Rate During Rain Event (in gpm or specify units)	Total Flow from Rain Event (in gallons or specify units)
12/18/2025	2.33 hours	0.97 inches	336	5.90 mgd	573,989 gallons

Provide a description of the method of flow measurement or estimate.

Rational Method was used to calculate the stormwater flow using a runoff coefficient of 0.95 for impervious areas and a runoff coefficient of 0.6 for the remaining drainage area.

Pinson, Theo

From: John Simmons <jsimmons@see-env.com>
Sent: Wednesday, September 2, 2026 4:18 PM
To: Pinson, Theo
Cc: Lindsey, Bryan
Subject: Form 2F for DSN003
Attachments: OxyChem_Muscle_Shoals_EPA_Form_2F_DSN003.pdf; Occidental Chemical - Permit Renewal 2025 - Form 2F Table A (003).PDF; Occidental Chemical - Permit Renewal 2025 - Form 2F Table B (003).PDF; Occidental Chemical - Permit Renewal 2025 - DSN003 CN.pdf; Topographic Map.pdf

Theo,

Bryan said you had asked about the Form 2F for DSN003. I'm not sure why you didn't receive the form. We did not do the application, but we did do the sample collection and I did have access to the completed Form. It is attached along with the associated laboratory data. Bryan also said you had questions about DSN003 going to a UT of Pond Creek rather than directly to Pond Creek. It does go to a UT of Pond Creek. As shown in the attached Topo Map, the stream originates about 2 miles northeast of the site and flows around the cooling ponds to the north. DSN003 flows into it east of the cooling ponds.

Please feel free to give me a call to discuss if you have any additional questions.

John E. Simmons, P.E.



1222 Helton Dr
Florence, AL 35630
(256) 443-8319

EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE A. CONVENTIONAL AND NON CONVENTIONAL PARAMETERS (40 CFR 122.26(C)(1)(I)(E)(3))¹

You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details and requirements.

Pollutant or Parameter		Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
		Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
1.	Oil and grease	< 1.5 mg/L				1	
2.	Biochemical oxygen demand (BOD ₅)	< 5.0 mg/L	< 5.0 mg/L			1	
3.	Chemical oxygen demand (COD)	50.4 mg/L	116 mg/L			1	
4.	Total suspended solids (TSS)	72.5 mg/L	20.2 mg/L			1	
5.	Total phosphorus	< 1.00 mg/L	< 0.500 mg/L			1	
6.	Total Kjeldahl nitrogen (TKN)	2.72 mg/L	0.763 mg/L			1	
7.	Total nitrogen (as N)	2.72 mg/L	0.763 mg/L			1	
8.	pH (minimum)	6.87				1	
	pH (maximum)						

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE B. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.26(C)(1)(I)(E)(4) AND 40 CFR 122.21(G)(7)(VI)(A))¹

List each pollutant that is limited in an effluent limitation guideline (ELG) that the facility is subject to or any pollutant listed in the facility's NPDES permit for its process wastewater (if the facility is operating under an existing NPDES permit). Complete one table for each outfall. See the instructions for additional details and requirements.

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¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility Name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE C. TOXIC POLLUTANTS, CERTAIN HAZARDOUS SUBSTANCES, AND ASBESTOS (40 CFR 122.26(C)(1)(I)(E)(4) AND 40 CFR 122.21(G)(7)(VI)(B) AND (VII))¹

List each pollutant shown in Exhibits 2F-2, 2F-3, and 2F-4 that you know or have reason to believe is present. Complete one table for each outfall. See the instructions for additional details and requirements.

Pollutant and CAS Number (if available)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
Parameters from Exhibits 2F-2, 2F-3, and 2F-4						
believed present are included in Table B						

¹ Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number ALD004019642	NPDES Permit Number AL0000213	Facility name Occidental Chemical Corp.	Outfall Number DSN003
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OMB No. 2040-0004
Expires 07/31/2026

TABLE D. STORM EVENT INFORMATION (40 CFR 122.26(C)(1)(I)(E)(6))

Provide data for the storm event(s) that resulted in the maximum daily discharges for the flow-weighted composite sample.

Date of Storm Event	Duration of Storm Event (in hours)	Total Rainfall During Storm Event (in inches)	Number of Hours Between Beginning of Storm Measured and End of Previous Measurable Rain Event	Maximum Flow Rate During Rain Event (in gpm or specify units)	Total Flow from Rain Event (in gallons or specify units)
12/18/2025	2.33 hours	0.97 inches	336	5.90 mgd	573,989 gallons

Provide a description of the method of flow measurement or estimate.

Rational Method was used to calculate the stormwater flow using a runoff coefficient of 0.95 for impervious areas and a runoff coefficient of 0.6 for the remaining drainage area.

[Click to go back to the beginning of Form](#)



December 26, 2025

Eric Curtis
Southern Environmental Engineering
1222 Helton Dr
Florence, AL 35630

We appreciate the opportunity to provide our services to you on this project. Please find attached the data for the sample(s) listed below:

Lab ID	Sample Description	Date Collected	Date Submitted
FF02987-01	DSN003	12/18/2025	12/19/2025

Southern Environmental Testing is accredited to ISO/IEC 17025:2017 by the ANSI National Accreditation Board (ANAB) and certified by the Alabama Department of Environmental Management (ADEM) for specific tests. Our quality system meets the relevant quality system requirements of ISO 9001:2015. Not all tests performed by Southern Environmental Testing are covered by accreditation and certification. Tests within our ANAB scope of accreditation are indicated by a plus symbol (+) in the Test Result section of this report. Tests not included in our accreditation and certification are performed in accordance with Southern Environmental Testing standard operating procedures and our quality control program using, where applicable, US EPA approved methodology.

This cover page and the attached chain-of-custody records are integral parts of your report. Southern Environmental Testing considers this report your official record. This information shall remain in Southern Environmental Testing's active database for a period of one (1) calendar year before archiving. Any replacement of this information after archiving may result in an administrative fee to cover the cost of retrieval.

If you have any questions or would like more information regarding these analyses, please call us at 256-280-2567.

Reviewed by:

A handwritten signature in black ink that reads "Taylor McDonald".

Taylor McDonald
Assistant Project Manager

2919 Fairgrounds Road SW
Decatur, AL 35603
(256) 280-2567

PO Box 2084
Decatur, AL 35602
(256) 350-0686 Fax

3103 Northington Court
Florence, AL 35630
(256) 740-5532

SAMPLE RESULTS REPORT**Report Date/Time:** 12/26/2025 09:07

REPORT TO
Eric Curtis Southern Environmental Engineering 1222 Helton Dr Florence, AL 35630

Southern Environmental Testing maintains ANAB accreditation to ISO/IEC 17025:2017 for testing (certificate AT-3114, AT-3114.01); Enersolv's certificate, AT-2597. Tests within the scope of accreditation and/or certification are denoted by a plus symbol (+).

This report may contain information that is confidential and proprietary. The information is intended for the addressee only and may not be copied or disseminated, except in full, without the written consent of Southern Environmental Testing.

The contents of this report apply to the sample(s) analyzed in accordance with the chain of custody document. Results are only representative of the sample(s) received and information supplied by the client may affect the validity of results.

Disclaimer: Information provided by the customer can affect the validity of results.

Analyte Name	Result	Units	Qualifier	Regulatory Limit
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Sample Point: DSN003**Sample ID:** FF02987-01**Collected:** 12/18/2025**Submitted:** 12/19/2025**Inorganics**

+ Available Cyanide

<0.00200

mg/l

SAMPLE RESULTS REPORT
Report Date/Time: 12/26/2025 09:07

REPORT TO Eric Curtis Southern Environmental Engineering 1222 Helton Dr Florence, AL 35630

Southern Environmental Testing maintains ANAB accreditation to ISO/IEC 17025:2017 for testing (certificate AT-3114, AT-3114.01); Enersolv's certificate, AT-2597. Tests within the scope of accreditation and/or certification are denoted by a plus symbol (+).

This report may contain information that is confidential and proprietary. The information is intended for the addressee only and may not be copied or disseminated, except in full, without the written consent of Southern Environmental Testing.

The contents of this report apply to the sample(s) analyzed in accordance with the chain of custody document. Results are only representative of the sample(s) received and information supplied by the client may affect the validity of results.

Disclaimer: Information provided by the customer can affect the validity of results.

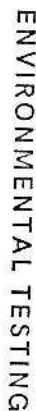
All calculations are performed prior to rounding per EPA and *Standard Methods* requirements. Calibration data for field analyses conducted by SET or *ENERSOLV* personnel are available upon request.

Data Qualifiers

< Less than reporting limit

Analysis Information

Lab Number	Analysis	Referenced Method	Analyst	SET Facility	Collection Date/Time	Analysis Start Date/Time	Analysis End Date/Time (BOD, CBOD, Coliforms)
FF02987-01	Available Cyanide	OIA-1677-09	SH	Decatur	12/18/2025 19:00	12/24/2025 10:51	



2519 FAIRGROUNDS ROAD SW, DECATUR AL 35603
3103 NORTHINGTON COURT, FLORENCE, AL 35630

(256) 350-0846 www.setesting.com

PAGE 1 of
Occidental Chemical
Permit Renewal 2F Tab

Page 4 of 4

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12/31/2025

Southern Environmental Engineering
Mr. Eric Curtis
1222 Helton Drive
Florence, AL, 35630

Ref: Analytical Testing
Lab Report Number: 25-354-0033
Client Project Description: Occidental Chemical
Permit Renewal 2F Table A
Muscle Shoals, AL

Dear Mr. Eric Curtis:

Waypoint Analytical, LLC. received sample(s) on 12/20/2025 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method. Where the laboratory was not responsible for the sampling stage (refer to the chain of custody) results apply to the sample as received.

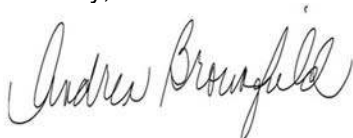
The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA (including 40 CFR 136 Method Update Rule May 2021) and NELAC. A full list of certifications is available upon request.

Certain parameters (chlorine, pH, dissolved oxygen, sulfite...) are required to be analyzed within 15 minutes of sampling. Usually, but not always, any field parameter analyzed at the laboratory is outside of this holding time. Refer to sample analysis time for confirmation of holding time compliance.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,



Andrea R Brownfield
Project manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.



Certification Summary

Laboratory ID: WP MTN: Waypoint Analytical, LLC. (Memphis), Memphis, TN

State	Program	Lab ID	Expiration Date
Alabama	State Program	40750	11/14/2026
Arkansas	State Program	88-00650	02/06/2026
California	State Program	2904	06/30/2026
Florida	State Program - NELAP	E871157	06/30/2026
Georgia	State Program	C044	08/11/2028
Georgia	State Program	04015	06/30/2025
Illinois	State Program - NELAP	200078	10/31/2026
Kentucky	State Program	KY90047	12/31/2025
Kentucky	State Program	80215	06/30/2026
Kentucky	State Program	KY90047	12/31/2025
Louisiana	State Program - NELAP	LA037	12/31/2025
Louisiana	State Program - NELAP	04015	06/30/2026
Mississippi	State Program	MS	11/14/2025
North Carolina	State Program	47701	07/31/2026
North Carolina	State Program	415	12/31/2025
Oklahoma	State Program - NELAP	9311	12/31/2025
Pennsylvania	State Program - NELAP	68-03195	05/31/2026
South Carolina	State Program	84002	06/30/2026
Tennessee	State Program	02027	08/11/2028
Texas	State Program - NELAP	T104704180	09/30/2026
Virginia	State Program	00106	06/30/2026
Virginia	State Program - NELAP	460181	09/30/2026



Sample Summary Table

Report Number: 25-354-0033
Client Project Description: Occidental Chemical
Permit Renewal 2F Table A
Muscle Shoals, AL

Lab No	Client Sample ID	Matrix	Date Collected	Date Received
82558	DSN003 - Grab	Aqueous	12/18/2025 19:00	12/20/2025
82559	DSN003 - Comp	Aqueous	12/18/2025 21:00	12/20/2025



Client: Southern Environmental Engineering
Project: Occidental Chemical
Lab Report Number: 25-354-0033
Date: 12/31/2025

CASE NARRATIVE

Oil and Grease Method 1664B

Analyte: Oil and Grease

QC Batch No: L858012

Low recovery was found for the matrix spike. All other quality control is within acceptable limits. Sample interference is suspected.

Total Phosphorus Method 365.4

Sample 82558 (DSN003 - Grab)

Analyte: Phosphorus

QC Batch No: L858813/L858588

The weight/volume extracted was reduced during the extraction procedure due to the nature of the sample. Reporting limits are factored for the sample size reduction.

Block Digestion and FIA Method 4500NORGD-2021

Analyte: Total Kjeldahl Nitrogen

QC Batch No: L858814/L858588

Relative percent difference (RPD) for the duplicate analysis was outside of the allowable quality control limits. The sample and duplicate results are less than two times the reporting limit. At this level, RPD is not applicable. The data is considered to be acceptable.

Biochemical Oxygen Demand (BOD) Method 5210B-2016

Analyte: BOD (5-day)

QC Batch No: L858069

The BOD glucose-glutamic acid (GGA) check standard did not meet the criteria established by the reference method. The acceptance range provided in the reference method is 167.5 - 228.5 mg/L. The GGA result obtained for this analytical batch was 145 mg/L.

23184

Southern Environmental Engineering
Mr. Eric Curtis
1222 Helton Drive
Florence , AL 35630

Project Occidental Chemical
Information : Permit Renewal 2F Table A
Muscle Shoals, AL

Report Date : 12/31/2025
Received : 12/20/2025



Andrea R. Brownfield
Project manager

Report Number : **25-354-0033**

REPORT OF ANALYSIS

Lab No : **82558**

Matrix: **Aqueous**

Sample ID : **DSN003 - Grab**

Sampled: **12/18/2025 19:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Biochemical Oxygen Demand (5-day)	<5 g	mg/L	5	1	12/20/25 12:57	CWJ	5210B-2016
COD (Chemical Oxygen Demand)	50.4	mg/L	15.0	1	12/23/25 12:00	LLD	5220D-2011
Total Suspended Solids	72.5	mg/L	12.6	1	12/24/25 12:20	ADT	2540D-2020
Nitrate+Nitrite-N	<0.100	mg/L	0.100	1	12/24/25 09:51	LJT	4500NO3F-2019
HEM: Oil and Grease	<1.5	mg/L	1.5	1	12/24/25 08:03	VFP	1664B
Phosphorus	<1.00	mg/L	1.00	1	12/31/25 14:52	KAC	365.4
Total Kjeldahl Nitrogen	2.72	mg/L	1.00	1	12/31/25 14:45	KAC	4500NORGD-2021
Total Nitrogen	2.72	mg/L	0.100	1	12/24/25 09:51		CALCULATION

Qualifiers/ Definitions

DF Dilution Factor
MQL Method Quantitation Limit

g GGA Outside QC Limits

23184

Southern Environmental Engineering
Mr. Eric Curtis
1222 Helton Drive
Florence , AL 35630

Project Occidental Chemical
Information : Permit Renewal 2F Table A
Muscle Shoals, AL

Report Date : 12/31/2025
Received : 12/20/2025



Andrea R. Brownfield
Project manager

Report Number : **25-354-0033**

REPORT OF ANALYSIS

Lab No : **82559**

Matrix: **Aqueous**

Sample ID : **DSN003 - Comp**

Sampled: **12/18/2025 21:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Biochemical Oxygen Demand (5-day)	<5 g	mg/L	5	1	12/20/25 12:57	CWJ	5210B-2016
COD (Chemical Oxygen Demand)	116	mg/L	15.0	1	12/23/25 08:10	LLD	5220D-2011
Total Suspended Solids	20.2	mg/L	5.0	1	12/24/25 10:53	SDS	2540D-2020
Nitrate+Nitrite-N	<0.100	mg/L	0.100	1	12/24/25 09:51	LJT	4500NO3F-2019
Phosphorus	<0.500	mg/L	0.500	1	12/31/25 14:53	KAC	365.4
Total Kjeldahl Nitrogen	0.763	mg/L	0.500	1	12/31/25 14:46	KAC	4500NORGD-2021
Total Nitrogen	0.763	mg/L	0.100	1	12/24/25 09:51		CALCULATION

Qualifiers/ Definitions

DF Dilution Factor
MQL Method Quantitation Limit

g GGA Outside QC Limits

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Analytical Batch: L858012
Analysis Method: 1664B
Analysis Description: Oil and Grease

Lab Reagent Blank LRB Matrix: AQU
Associated Lab Samples: 82558

Parameter	Units	Blank Result	MQL	Analyzed
HEM: Oil and Grease	mg/L	< 1.4	1.4	12/24/25 08:03

Ongoing Precision and Recovery OPR

Parameter	Units	Spike Conc.	OPR Result	% Recovery	Analyzed	%Rec Limits	Qualifie
HEM: Oil and Grease	mg/L	40.0	35.9	90.0	12/24/25 08:03	78-114	

Matrix Spike Q 97610-MS

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	%Rec Limits	Max RPD
HEM: Oil and Grease	mg/L	< 1.5	43.2		60.1		139*	78-114	

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Analytical Batch: L858045
Analysis Method: 2540D-2020
Analysis Description: Total Suspended Solids

Lab Reagent Blank LRB Matrix: AQU
Associated Lab Samples: 82558

Parameter	Units	Blank Result	MQL	Analyzed
Total Suspended Solids	mg/L	< 2.5	2.5	12/24/25 12:20

Laboratory Control Sample LCS

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Total Suspended Solids	mg/L	100	104	104	90-110

Duplicate L 82197-DUP

Parameter	Units	Result	DUP Result	RPD	Max RPD	Analyzed
Total Suspended Solids	mg/L	2140	2180	1.8	10.0	12/24/25 12:20

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Analytical Batch: L858096
Analysis Method: 2540D-2020
Analysis Description: Total Suspended Solids

Lab Reagent Blank LRB Matrix: AQU
Associated Lab Samples: 82559

Parameter	Units	Blank Result	MQL	Analyzed
Total Suspended Solids	mg/L	< 2.5	2.5	12/24/25 10:53

Laboratory Control Sample LCS

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Total Suspended Solids	mg/L	100	92.0	92.0	90-110

Duplicate L 82746-DUP

Parameter	Units	Result	DUP Result	RPD	Max RPD	Analyzed
Total Suspended Solids	mg/L	201	266	27.8*	10.0	12/24/25 10:53

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Prep: L858588 **QC Analytical Batch(es):** L858813,L858814
QC Prep Batch Method: TKN/TKP Digestion **Analysis Method:** 365.4
Analysis Description: Total Phosphorus

Lab Reagent Blank LRB-L858588 Matrix: AQU
Associated Lab Samples: 82558, 82559

Parameter	Units	Blank Result	MQL	Analyzed
Phosphorus	mg/L	< 0.500	0.500	12/31/25 14:40

Laboratory Control Sample LCS-L858588

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Phosphorus	mg/L	2.00	2.09	105	80-120

Duplicate L 82800-DUP-L858588

Parameter	Units	Result	DUP Result	RPD	Max RPD	Analyzed
Phosphorus	mg/L	2.12	2.13	0.4	20.0	12/31/25 14:44

Matrix Spike L 82800-MS-L858588

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	%Rec Limits	Max RPD
Phosphorus	mg/L	2.12	2.00		4.00		94.0	70-130	

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Prep: L857799 **QC Analytical Batch(es):** L857893
QC Prep Batch Method: SM-4500-NO3F (PREP) **Analysis Method:** 4500NO3F-2019
Analysis Description: Nitrate + Nitrite Nitrogen

Lab Reagent Blank LRB-L857799 Matrix: AQU
Associated Lab Samples: 82558, 82559

Parameter	Units	Blank Result	MQL	Analyzed
Nitrate+Nitrite-N	mg/L	< 0.100	0.100	12/24/25 09:45

Laboratory Control Sample LCS-L857799

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Nitrate+Nitrite-N	mg/L	5.00	4.59	92.0	90-110

Matrix Spike & Matrix Spike Duplicate L 82542-MS-L857799 L 82542-MSD-L857799

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	MSD %Rec	%Rec Limits	RPD	Max RPD
Nitrate+Nitrite-N	mg/L	0.611	4.17	4.17	4.56	4.58	95.0	95.0	70-130	0.4	20.0

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Prep: L858588 **QC Analytical Batch(es):** L858813,L858814
QC Prep Batch Method: TKN/TKP Digestion **Analysis Method:** 4500NORGD-2021
Analysis Description: Block Digestion and FIA

Lab Reagent Blank LRB-L858588 Matrix: AQU
Associated Lab Samples: 82558, 82559

Parameter	Units	Blank Result	MQL	Analyzed
Total Kjeldahl Nitrogen	mg/L	< 0.500	0.500	12/31/25 14:38

Laboratory Control Sample LCS-L858588

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Total Kjeldahl Nitrogen	mg/L	10.0	9.29	93.0	90-110

Duplicate L 82800-DUP-L858588

Parameter	Units	Result	DUP Result	RPD	Max RPD	Analyzed
Total Kjeldahl Nitrogen	mg/L	0.729	0.902	21.2*	20.0	12/31/25 14:41

Matrix Spike L 82800-MS-L858588

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	%Rec Limits	Max RPD
Total Kjeldahl Nitrogen	mg/L	0.729	10.0		10.4		97.0	70-130	

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Analytical Batch: L858069
Analysis Method: 5210B-2016
Analysis Description: Biochemical Oxygen Demand (BOD)

Glucose-Glutamic Acid GGA

Parameter	Units	Result	Range	Analyzed
Biochemical Oxygen Demand (5-day)	mg/L	145*	167.5-228.5	12/20/25 12:57

Duplicate L 82547-DUP

Parameter	Units	Result	DUP Result	RPD	Max RPD	Analyzed
Biochemical Oxygen Demand (5-day)	mg/L	2570	2530	1.5	30	12/20/25 12:57

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Analytical Batch: L857888
Analysis Method: 5220D-2011
Analysis Description: Chemical Oxygen Demand (COD)

Lab Reagent Blank 2 LRB2 Matrix: AQU
Associated Lab Samples: 82559

Parameter	Units	Blank Result	MQL	Analyzed
COD (Chemical Oxygen Demand)	mg/L	< 15.0	15.0	12/23/25 08:10

Laboratory Control Sample LCS

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
COD (Chemical Oxygen Demand)	mg/L	75.0	77.9	104	95-105

Duplicate L 82180-DUP

Parameter	Units	Result	DUP Result	RPD	Max RPD	Analyzed
COD (Chemical Oxygen Demand)	mg/L	32.2	31.1	3.4	10.0	12/23/25 08:10

Matrix Spike L 82180-MS

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	%Rec Limits	Max RPD
COD (Chemical Oxygen Demand)	mg/L	32.2	78.9		119		110	70-130	

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0033

QC Analytical Batch: L857944
Analysis Method: 5220D-2011
Analysis Description: Chemical Oxygen Demand (COD)

Lab Reagent Blank 2 LRB2 Matrix: AQU
Associated Lab Samples: 82558

Parameter	Units	Blank Result	MQL	Analyzed
COD (Chemical Oxygen Demand)	mg/L	< 15.0	15.0	12/23/25 12:00

Laboratory Control Sample LCS

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
COD (Chemical Oxygen Demand)	mg/L	75.0	77.9	104	95-105

Duplicate L 82604-DUP

Parameter	Units	Result	DUP Result	RPD	Max RPD	Analyzed
COD (Chemical Oxygen Demand)	mg/L	< 15.0	<15.0	0.0	10.0	12/23/25 12:00

Matrix Spike L 82604-MS

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	%Rec Limits	Max RPD
COD (Chemical Oxygen Demand)	mg/L	< 15.7	78.9		86.2		109	70-130	

Shipment Receipt Form

Customer Number: **23184**

Customer Name: **Southern Environmental Engineering**

Report Number: **25-354-0033**

Shipping Method

☐ Fed Ex	☐ US Postal	☐ Lab	☐ Other :	
☐ UPS	☐ Client	☒ Courier	Thermometer ID:	T245

Shipping container/cooler uncompromised?	☒ Yes	☐ No	
Number of coolers/boxes received	1		
Custody seals intact on shipping container/cooler?	☒ Yes	☐ No	☐ Not Present
Custody seals intact on sample bottles?	☐ Yes	☐ No	☒ Not Present
Chain of Custody (COC) present?	☒ Yes	☐ No	
COC agrees with sample label(s)?	☒ Yes	☐ No	
COC properly completed	☒ Yes	☐ No	
Samples in proper containers?	☒ Yes	☐ No	
Sample containers intact?	☒ Yes	☐ No	
Sufficient sample volume for indicated test(s)?	☒ Yes	☐ No	
All samples received within holding time?	☒ Yes	☐ No	
Cooler temperature in compliance?	☒ Yes	☐ No	☐ Not Present
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	☒ Yes	☐ No	
Water - Sample containers properly preserved	☒ Yes	☐ No	☐ N/A
Water - Sulfuric containers verified pH <2	☒ Yes	☐ No	☐ N/A
Water - VOA vials free of headspace	☐ Yes	☐ No	☒ N/A
Trip Blanks received with VOAs	☐ Yes	☐ No	☒ N/A
Soil VOA method 5035 – compliance criteria met	☐ Yes	☐ No	☒ N/A
☐ High concentration container (48 hr)	☐ Low concentration EnCore samplers (48 hr)		
☐ High concentration pre-weighed (methanol -14 d)	☐ Low conc pre-weighed vials (Sod Bis -14 d)		
Special precautions or instructions included?	☐ Yes	☒ No	

Comments:

Signature:

Mallory Earle

Date & Time:

12/20/2025 16:13:51

Client Name/Address			Client Project Manager/Contact			Billing Information			For Laboratory Use Only					
SEE PO Box 3241 Florence, AL 35630			Eric Curtis (256) 443-8306 ecurtis@see-env.com			Same								
Project Description Occidental Chemical Permit Renewal 2F Table A			Project/Site Location (City/State) Muscle Shoals, AL			☒ RUSH - Additional charges apply ☐ Special Detection Limit(s) ☐ Date Results Needed			Method of Shipment ☐ Fed Ex ☐ UPS ☒ Courier ☐ Client Drop Off ☐ Other			Matrix Key WW - Wastewater GW - Groundwater DW - Drinking Water S - Soil /Solid O - Oil P - Product M - Misc		
Project Number			Project Manager Phone #			Project Manager Email			Purchase Order Number			Site/Facility ID #		
Waypoint ANALYTICAL 2790 Whitten Road Memphis, TN 38133 (901) 213-2400			(256) 443-8306			ecurtis@see-env.com								
Sample Identification			Matrix (Refer to Key)			Number of Containers			Oil and Grease			COD, TP, TKN, TN		
Date	Time													
12/16/20	1900	DSN003 (Grab)	2	SW	G	✓								
		DSN003 (Grab)	12	SW	G	✓								
		DSN003 (Grab)	1	SW	G				✓					
	2100	DSN003 (Composite)	1	SW	C	✓								
	2100	DSN003 (Composite)	1	SW	C				✓					
Custody Seals received on:														
Cooler(s)/Container(s)														
25-354-0033 23184 12-20-2025 16:12:58 Southern Environmental Engineering Occidental Chemical														
For Laboratory Use Only			Lab Comments			Sampled by (Name - Print)			Client Remarks/Comments			pH: 6.87		
Ice	Custody Seals					Eric Curtis			Date			Time		
✓/N	✓/N					Relinquished by: (SIGNATURE)			Date			Time		
Blank/Cooler Temp						Relinquished by: (SIGNATURE)			Date			Time		
0.9°C						Relinquished by: (SIGNATURE)			Date			Time		
T245 ME									Date			Time		
									Date			Time		

1/7/2026

Southern Environmental Engineering
Mr. Eric Curtis
1222 Helton Drive
Florence, AL, 35630

Ref: Analytical Testing
Lab Report Number: 25-354-0023
Client Project Description: Occidental Chemical
Permit Renewal 2F Table B
Muscle Shoals, AL

Dear Mr. Eric Curtis:

Waypoint Analytical, LLC. received sample(s) on 12/20/2025 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method. Where the laboratory was not responsible for the sampling stage (refer to the chain of custody) results apply to the sample as received.

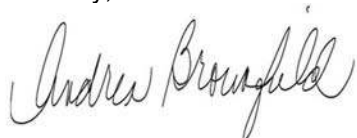
The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA (including 40 CFR 136 Method Update Rule May 2021) and NELAC. A full list of certifications is available upon request.

Certain parameters (chlorine, pH, dissolved oxygen, sulfite...) are required to be analyzed within 15 minutes of sampling. Usually, but not always, any field parameter analyzed at the laboratory is outside of this holding time. Refer to sample analysis time for confirmation of holding time compliance.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,



Andrea R Brownfield
Project manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.



Certification Summary

Laboratory ID: WP MTN: Waypoint Analytical, LLC. (Memphis), Memphis, TN

State	Program	Lab ID	Expiration Date
Alabama	State Program	40750	11/14/2026
Arkansas	State Program	88-00650	02/06/2026
California	State Program	2904	06/30/2026
Florida	State Program - NELAP	E871157	06/30/2026
Georgia	State Program	C044	08/11/2028
Georgia	State Program	04015	06/30/2025
Illinois	State Program - NELAP	200078	10/31/2026
Kentucky	State Program	KY90047	12/31/2025
Kentucky	State Program	80215	06/30/2026
Kentucky	State Program	KY90047	12/31/2026
Louisiana	State Program - NELAP	LA037	12/31/2026
Louisiana	State Program - NELAP	04015	06/30/2026
Mississippi	State Program	MS	11/14/2025
North Carolina	State Program	47701	07/31/2026
North Carolina	State Program	415	12/31/2026
Oklahoma	State Program - NELAP	9311	12/31/2025
Pennsylvania	State Program - NELAP	68-03195	05/31/2026
South Carolina	State Program	84002	06/30/2026
Tennessee	State Program	02027	08/11/2028
Texas	State Program - NELAP	T104704180	09/30/2026
Virginia	State Program	00106	06/30/2026
Virginia	State Program - NELAP	460181	09/30/2026

Laboratory ID: WP RMS: Waypoint Analytical Mississippi, Inc., Ridgeland, MS

State	Program	Lab ID	Expiration Date
Arkansas	State Program	88-1409	02/01/2026
Kentucky	State Program	KY98013	12/31/2025
Louisiana	State Program - NELAP	04023	06/30/2026

Sample Summary Table

Report Number: 25-354-0023
Client Project Description: Occidental Chemical
Permit Renewal 2F Table B
Muscle Shoals, AL

Lab No	Client Sample ID	Matrix	Date Collected	Date Received	Method	Lab ID
82544	DSN003 - Grab	Aqueous	12/18/2025	12/20/2025		
82544	DSN003 - Grab	Aqueous	12/18/2025	12/20/2025	1631E	WP RMS
82545	DSN003 - Comp	Aqueous	12/18/2025	12/20/2025		
82545	DSN003 - Comp	Aqueous	12/18/2025	12/20/2025	1631E	WP RMS

23184

Southern Environmental Engineering
Mr. Eric Curtis
1222 Helton Drive
Florence , AL 35630

Project Occidental Chemical
Information : Permit Renewal 2F Table B
Muscle Shoals, AL

Report Date : 01/07/2026
Received : 12/20/2025



Andrea R. Brownfield
Project manager

Report Number : **25-354-0023**

REPORT OF ANALYSIS

Lab No : **82544**

Matrix: **Aqueous**

Sample ID : **DSN003 - Grab**

Sampled: **12/18/2025 00:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Mercury	44.0	ng/L	0.500	1	01/06/26 22:19	KAE	1631E
Nitrate+Nitrite-N	<0.100	mg/L	0.100	1	12/24/25 09:50	LJT	4500NO3F-2019
Arsenic	<0.0100	mg/L	0.0100	1	12/24/25 15:30	SML	EPA-200.7
Cyanide, Total	<0.005	mg/L	0.005	1	12/29/25 09:06	AXMR	4500CNE-2021
Ammonia Nitrogen	0.124	mg/L	0.100	1	12/24/25 14:00	CNB	4500NH3D-2021

Qualifiers/ Definitions

DF

Dilution Factor

MQL

Method Quantitation Limit

23184

Southern Environmental Engineering
Mr. Eric Curtis
1222 Helton Drive
Florence , AL 35630

Project Occidental Chemical
Information : Permit Renewal 2F Table B
Muscle Shoals, AL

Report Date : 01/07/2026
Received : 12/20/2025



Andrea R. Brownfield
Project manager

Report Number : **25-354-0023**

REPORT OF ANALYSIS

Lab No : **82545**

Matrix: **Aqueous**

Sample ID : **DSN003 - Comp**

Sampled: **12/18/2025 00:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Mercury	71.8	ng/L	0.500	1	01/06/26 22:12	KAE	1631E
Nitrate+Nitrite-N	<0.100	mg/L	0.100	1	12/24/25 09:50	LJT	4500NO3F-2019
Arsenic	<0.0100	mg/L	0.0100	1	12/24/25 15:35	SML	EPA-200.7
Ammonia Nitrogen	<0.100	mg/L	0.100	1	12/24/25 14:00	CNB	4500NH3D-2021

Qualifiers/ Definitions

DF

Dilution Factor

MQL

Method Quantitation Limit

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0023

QC Prep: G216107 **QC Analytical Batch(es):** G216162
QC Prep Batch Method: 1631E (PREP) **Analysis Method:** 1631E
Analysis Description: Low Level Mercury

Lab Reagent Blank LRB-G216107 Matrix: AQU
Associated Lab Samples: 82544, 82545

Parameter	Units	Blank Result	MQL	Analyzed
Mercury	ng/L	< 0.500	0.500	01/06/26 17:29

Lab Reagent Blank 2 LRB2-G216107 Matrix: AQU
Associated Lab Samples: 82544, 82545

Parameter	Units	Blank Result	MQL	Analyzed
Mercury	ng/L	< 0.500	0.500	01/06/26 17:37

Matrix Spike & Matrix Spike Duplicate G 67070-MS-G216107 G 67070-MSD-G216107

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	MSD %Rec	%Rec Limits	RPD	Max RPD
Mercury	ng/L	< 0.500	10.0	10.0	9.11	9.05	91.0	91.0	71-125	0.6	24.0

Matrix Spike & Matrix Spike Duplicate L 83309-MS-G216107 L 83309-MSD-G216107

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	MSD %Rec	%Rec Limits	RPD	Max RPD
Mercury	ng/L	< 0.500	10.0	10.0	8.49	8.33	85.0	83.0	71-125	1.9	24.0

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0023

QC Analytical Batch: L858281
Analysis Method: 4500CNE-2021
Analysis Description: Total Cyanide

Lab Reagent Blank LRB Matrix: AQU
Associated Lab Samples: 82544

Parameter	Units	Blank Result	MQL	Analyzed
Cyanide, Total	mg/L	< 0.005	0.005	12/29/25 09:06

Laboratory Control Sample LCS

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Cyanide, Total	mg/L	0.200	0.188	94.0	90-110

Matrix Spike & Matrix Spike Duplicate L 82700-MS L 82700-MSD

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	MSD %Rec	%Rec Limits	RPD	Max RPD
Cyanide, Total	mg/L	< 0.005	0.204	0.204	0.198	0.199	97.0	98.0	70-130	0.5	20.0

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0023

QC Analytical Batch: L858155
Analysis Method: 4500NH3D-2021
Analysis Description: Ammonia Nitrogen (ISE)

Lab Reagent Blank LRB Matrix: AQU
Associated Lab Samples: 82544, 82545

Parameter	Units	Blank Result	MQL	Analyzed
Ammonia Nitrogen	mg/L	< 0.100	0.100	12/24/25 14:00

Laboratory Control Sample LCS

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Ammonia Nitrogen	mg/L	5.00	4.79	96.0	90-110

Matrix Spike & Matrix Spike Duplicate L 83330-MS L 83330-MSD

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	MSD %Rec	%Rec Limits	RPD	Max RPD
Ammonia Nitrogen	mg/L	< 0.102	2.04	2.04	2.26	2.28	111	112	70-130	0.8	20.0

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0023

QC Prep: L857799 **QC Analytical Batch(es):** L857893
QC Prep Batch Method: SM-4500-NO3F (PREP) **Analysis Method:** 4500NO3F-2019
Analysis Description: Nitrate + Nitrite Nitrogen

Lab Reagent Blank LRB-L857799 Matrix: AQU
Associated Lab Samples: 82544, 82545

Parameter	Units	Blank Result	MQL	Analyzed
Nitrate+Nitrite-N	mg/L	< 0.100	0.100	12/24/25 09:45

Laboratory Control Sample LCS-L857799

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Nitrate+Nitrite-N	mg/L	5.00	4.59	92.0	90-110

Matrix Spike & Matrix Spike Duplicate L 82542-MS-L857799 L 82542-MSD-L857799

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	MSD %Rec	%Rec Limits	RPD	Max RPD
Nitrate+Nitrite-N	mg/L	0.611	4.17	4.17	4.56	4.58	95.0	95.0	70-130	0.4	20.0

Quality Control Data

Client ID: Southern Environmental Engineering
Project Description: Occidental Chemical
Report No: 25-354-0023

QC Prep: L857750 **QC Analytical Batch(es):** L858272
QC Prep Batch Method: EPA-200.7 (PREP) **Analysis Method:** EPA-200.7
Analysis Description: Total Metals

Lab Reagent Blank LRB-L857750 Matrix: AQU
Associated Lab Samples: 82544, 82545

Parameter	Units	Blank Result	MQL	Analyzed
Arsenic	mg/L	< 0.0100	0.0100	12/24/25 14:38

Laboratory Control Sample LCS-L857750

Parameter	Units	Spike Conc.	LCS Result	LCS %Rec	% Rec Limits
Arsenic	mg/L	0.100	0.103	103	85-115

Matrix Spike & Matrix Spike Duplicate L 81978-MS-L857750 L 81978-MSD-L857750

Parameter	Units	Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS %Rec	MSD %Rec	%Rec Limits	RPD	Max RPD
Arsenic	mg/L	< 0.0100	0.100	0.100	0.101	0.101	101	101	70-130	0.0	20.0

Shipment Receipt Form

Customer Number: **23184**

Customer Name: **Southern Environmental Engineering**

Report Number: **25-354-0023**

Shipping Method

☐ Fed Ex	☐ US Postal	☐ Lab	☐ Other :	
☐ UPS	☐ Client	☒ Courier	Thermometer ID:	T245

Shipping container/cooler uncompromised?	☒ Yes	☐ No	
Number of coolers/boxes received	1		
Custody seals intact on shipping container/cooler?	☒ Yes	☐ No	☐ Not Present
Custody seals intact on sample bottles?	☐ Yes	☐ No	☒ Not Present
Chain of Custody (COC) present?	☒ Yes	☐ No	
COC agrees with sample label(s)?	☒ Yes	☐ No	
COC properly completed	☒ Yes	☐ No	
Samples in proper containers?	☒ Yes	☐ No	
Sample containers intact?	☒ Yes	☐ No	
Sufficient sample volume for indicated test(s)?	☒ Yes	☐ No	
All samples received within holding time?	☒ Yes	☐ No	
Cooler temperature in compliance?	☒ Yes	☐ No	☐ Not Present
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	☒ Yes	☐ No	
Water - Sample containers properly preserved	☒ Yes	☐ No	☐ N/A
Water - Sulfuric containers verified pH <2	☒ Yes	☐ No	☐ N/A
Water - VOA vials free of headspace	☐ Yes	☐ No	☒ N/A
Trip Blanks received with VOAs	☐ Yes	☐ No	☒ N/A
Soil VOA method 5035 – compliance criteria met	☐ Yes	☐ No	☒ N/A
☐ High concentration container (48 hr)	☐ Low concentration EnCore samplers (48 hr)		
☐ High concentration pre-weighed (methanol -14 d)	☐ Low conc pre-weighed vials (Sod Bis -14 d)		
Special precautions or instructions included?	☐ Yes	☒ No	

Comments:

Signature:

Mallory Earle

Date & Time:

12/20/2025 15:13:20

Billing Information
Same

Client Project Manager/Contact
Eric Curtis
(256) 443-8306
ecurtis@see-env.com

Project/Site Location (City/State)
Muscle Shoals, AL

Project Description
Occidental Chemical
Permit Renewal
2F Table B

Method of Shipment
☐ Fed Ex ☐ UPS
☒ Courier ☐ Client Drop Off
Other

RUSH - Additional charges apply
Special Detection Limit(s)
Date Results Needed

Project Manager Email
ecurtis@see-env.com

Project Number
(256) 443-8306

Site/Facility ID #

Purchase Order Number

Project Manager Email
ecurtis@see-env.com

Project Manager Phone #
(256) 443-8306

Project Number
(256) 443-8306

Waypoint ANALYTICAL		Sample Identification		Number of Containers		Matrix (Refer to Key)		(Grab or Composite)		NH3-N		Nitrate+Nitrite		Total CN		LL Hg		Total As		Comments/Notes	
Date	Time	Sample Identification		Number of Containers		Matrix (Refer to Key)		(Grab or Composite)		NH3-N		Nitrate+Nitrite		Total CN		LL Hg		Total As		Comments/Notes	
12/16/25	1900	DSN003 (Grab)		1		SW		G		✓										Cool < 10C Na2S2O3 (Micro Only)	
		DSN003 (Grab)		1		SW		G				✓								Cool < 6C	
		DSN003 (Grab)		1		SW		G												H2SO4 pH<2	
		DSN003 (Grab)		1		SW		G												None Required	
		DSN003 (Grab)		1		SW		G												NaOH pH>10	
		DSN003 (Grab)		1		SW		G												HN03 pH<2	
		DSN003 (Grab)		1		SW		G												HCL pH<2	
		DSN003 (Grab)		1		SW		G												H3PO4 pH<2	
		DSN003 (Composite)		1		SW		C		✓										Cool < 6C Na2S2O3	
		DSN003 (Composite)		1		SW		C													
		DSN003 (Composite)		1		SW		C													
		DSN003 (Composite)		7		SW		C													
		DSN003 (Composite)		1		SW		C													
		DSN003 (Composite)		1		SW		C													

Custody Seals
received on:
Cooler(s) Container(s)

All LL Hg samples should be composited
in lab and analyzed with method 1631E

Client Remarks/Comments

Sampled by (Name - Print)
Eric Curtis

Relinquished by: (SIGNATURE)
Eric Curtis

Relinquished by: (SIGNATURE)
Eric Curtis

Relinquished by: (SIGNATURE)
Eric Curtis

For Laboratory Use Only		Lab Comments	
Ice	Custody Seals		
✓/N	✓/N	Each container for LL Hg (composite) has a % written on it.	
Blank/Cooler Temp			
3.1°C			
T245 ME			
Date	Time	Received by: (SIGNATURE)	Date
12/19/25	1230		
Date	Time	Received by: (SIGNATURE)	Date
Date	Time	Received by: (SIGNATURE)	Date
12/20/25	1030		

Pinson, Theo

From: Pinson, Theo
Sent: Thursday, January 29, 2026 2:29 PM
To: Bryan_Lindsey@oxychem.com
Subject: ADEM Model Review
Attachments: WQ_Comments_OccidentalMZ_1_29_26.docx

Bryan,

The Water Quality Branch provided the attached comments as part of their model review. Will you distribute to your team? We can discuss after you have had a chance to review.

Thank you,

Theo

Theo Pinson
Industrial Section
Water Division
[Alabama Department of Environmental Management](#)
(334) 274 – 4202

Alabama Environmental Permitting and Compliance System (AEPACS)

If you need assistance with your AEPACS account, please contact the AEPACS Help Desk at ademwebportal@adem.alabama.gov

General Comments

1. On Form 455 please correct the "Depth of waterbody at discharge point" from 16.1 meters to 16.1 feet.

IWC Mixing Zone Comments

1. When evaluating the ZID Criterion "*Five times the local water depth in any horizontal direction*" the depth of discharge (in this case 16.1 ft) should be used (i.e. not the Average Depth of 23 ft). Therefore, the resulting ZID criteria is $5 \times 16.1 \text{ ft} = 80.5 \text{ feet}$ (24.53 meters).
2. In order to evaluate the ZID Criterion "*No more than 10% of the distance from the edge of the outfall structure to the leading edge of the Mixing Zone in any spatial direction.*" each of the mixing zone prohibitions need to be considered using CORMIX 3 at the 7Q10 low flow condition to determine the applicable leading edge of the mixing zone. The figures below illustrate the predicted mixing zone for each of the three mixing zone prohibitions as identified by CORMIX session reports.

Figure 1. Mixing Zone: 50% of Stream Width

```
***** REGULATORY MIXING ZONE SUMMARY *****
The plume conditions at the boundary of the specified RMZ are as follows:
Pollutant concentration          c = 3.153825 %
Corresponding dilution          s = 31.7
Plume location:                  x = 1059.19 m
    (centerline coordinates)      y = 60.96 m
                                   z = 0 m
Plume dimensions:                half-width (bh) = 289.56 m
                                   thickness (bv) = 0.68 m
Cumulative travel time:          19227.8574 sec.
```

Figure 2. Mixing Zone: Length = 5 x MZ width

```
***** REGULATORY MIXING ZONE SUMMARY *****
The plume conditions at the boundary of the specified RMZ are as follows:
Pollutant concentration          c = 1.657271 %
Corresponding dilution          s = 60.4
Plume location:                  x = 1447.8 m
    (centerline coordinates)      y = 60.96 m
                                   z = 0 m
Plume dimensions:                half-width (bh) = 358.78 m
                                   thickness (bv) = 1.05 m
Cumulative travel time:          26280.4551 sec.
```


Figure 3. Mixing Zone: 25% of Stream Cross Sectional Area of Stream Width

```
***** REGULATORY MIXING ZONE SUMMARY *****
The plume conditions at the boundary of the specified RMZ are as follows:
Pollutant concentration      c = 0.612735  %
Corresponding dilution      s = 163.2
Plume location:              x = 2263.22 m
    (centerline coordinates) y = 60.96 m
                                z = 0 m
Plume dimensions:            half-width (bh) = 489.31 m
                                thickness (bv) = 2.07 m
Cumulative travel time:      41078.8789 sec.
```

Evaluating the output reveals the most stringent mixing zone is the following: Mixing Zones shall not exceed a width of 50 percent of the stream width. The distance from the outfall to the leading edge of the mixing zone is 1059 meters. Therefore, 10% of the mixing zone distance is 105.9 meters.

Upon reviewing the three ZID criteria, the applicable distance to the edge of the ZID is 80.5 feet (24.53 meters), based upon the criterion stating the ZID distance is equal to "Five times the local water depth, in any horizontal direction."

The 1Q10 flow of 5916 cfs will be used when evaluating the applicable IWC at the edge of the ZID. At the edge of the ZID (24.53 meters), CORMIX3 predicts the instream waste concentration (IWC) to be 75%

Figure 4. Predicted CORMIX 3 output at ZID

```
***** REGULATORY MIXING ZONE SUMMARY *****
The plume conditions at the boundary of the specified RMZ are as follows:
Pollutant concentration      c = 75.022102  %
Corresponding dilution      s = 1.3
Plume location:              x = 24.53 m
    (centerline coordinates) y = 0 m
                                z = 0 m
Plume dimensions:            half-width (bh) = 48.42 m
                                thickness (bv) = 0.22 m
Cumulative travel time:      598.7504 sec. (RMZ is within NFR)
```


Temperature Mixing Zone Comments

1. Assuming a wind speed of 2 mps and the ambient temperature of 28 C, the correct heat loss coefficient of 28 w/m² should be used (see below)

Table 4.1 Heat Loss Coefficients (W/m², °C). Ref: "Heat Disposal in the Water Environment", E.E. Adams, D.R.F. Harleman, G.H. Jirka, and K.D. Stolzenbach, Course Notes, R.M. Parsons Laboratory, Mass. Inst. of Tech., 1981.

Ambient Water Temp (°C)	Wind Speed (m/s)					
	0	1	2	3	4	5
5	5	10	14	24	33	42
10	5	11	16	27	38	49
15	5	12	18	31	44	59
20	5	14	21	38	52	68
25	6	16	25	45	63	82
30	6	19	30	54	76	100

Pinson, Theo

Subject: FW: ADEM Model Review for OxyChem Muscle Shoals
Attachments: 2026-02-13_OxyChem_Tennessee_River_CORMIX_Modeling_TM_Rev_1.pdf

From: Hall, Johnathan <Johnathan.Hall@jacobs.com>
Sent: Tuesday, February 24, 2026 8:05 AM
To: Pinson, Theo <tpinson@adem.alabama.gov>; Mooney, James J <jjmooney@adem.alabama.gov>
Cc: Bryan Lindsey <bryan_lindsey@oxy.com> <bryan_lindsey@oxy.com>; David W. Mullins <David_W._Mullins@oxy.com> <David_W._Mullins@OXY.COM>
Subject: RE: ADEM Model Review for OxyChem Muscle Shoals

Theo,

We have reviewed the comments provided by ADEM on the mixing zone modeling completed for the OxyChem discharge. A revised technical memorandum and ADEM Form 455 that addresses and incorporates ADEM's comments is attached. Please let us know if you have any additional comments on the mixing zone modeling.

Regards,
Johnathan

Johnathan E. Hall, P.E.

Jacobs Engineering Group Inc.
4121 Carmichael Rd., Suite 400
Montgomery, AL 36106
251-593-1093 (mobile)
johnathan.hall@jacobs.com

Occidental Chemical Company Tennessee River CORMIX Modeling – Revision 1

Date:	February 13, 2026 - Revision 1	1100 112th Avenue NE
Project no:	D3619800 Task 7	Suite 500
Attention:	Occidental Chemical Corporation, Muscle Shoals, AL	Bellevue, WA 98004-5118
Prepared by:	Erin Thatcher, PE	United States
Reviewed by:	Johnathan Hall, PE	T +1.425.453.5000
		www.jacobs.com

1 Introduction

Occidental Chemical Corporation (OxyChem) in Muscle Shoals, Alabama discharges effluent to Pond Creek, which then flows into the Tennessee River (Pickwick Lake), under National Pollutant Discharge Elimination System (NPDES) Permit No. AL0000213. CORMIX modeling of the discharge's dilution was completed in 2014 (CH2M HILL) in response to a request from the NPDES Permit authority, the Alabama Department of Environmental Management (ADEM). This modeling was completed to 1) confirm that an effluent temperature limit of 90 degrees Fahrenheit (°F) was protective of the Tennessee River water quality criteria for temperature (86 °F), and 2) to determine the instream waste concentration (IWC) of the discharge in the Tennessee River. This technical memorandum provides updated CORMIX dilution modeling results for the current discharge and receiving water flow rates.

2 Regulatory Criteria

OxyChem's outfall DSN001 is a surface water outfall that discharges to Pond Creek, which has a use classification of Agricultural and Industrial Water Supply (A&I). Pond Creek flows into the Tennessee River (Pickwick Lake), which has a higher classification of Public Water Supply (PWS) and Fish and Wildlife (F&W), approximately 1.27 miles downstream of the OxyChem discharge. Per ADEM guidance, permit limitations must be protective of the higher classification of the downstream receiving water because the discharge reaches it within 24 hours of travel time. Therefore, the OxyChem discharge's permit limitations must be protective of the A&I use for Pond Creek as well as the PWS and F&W uses in the Tennessee River after allowing for mixing.

Federal and state regulations require discharges to waters with F&W use classifications to demonstrate compliance with acute toxicity at the edge of the zone of initial dilution (ZID), and compliance with chronic toxicity at the edge of the mixing zone (MZ). The MZ and ZID established for this discharge apply in the Tennessee River (Pickwick Lake).

ADEM's guidance documents dictate the dilution modeling should be based on the acute toxicity guidelines since the completely mixed ratio for OxyChem's discharge into the Tennessee River at its 7Q10 flow is greater than 100 (i.e., the IWC is less than 1%). The instream waste concentration for the acute toxicity is determined by the CORMIX model using the Tennessee River's 1Q10 flow and limiting ZID. The temperature limit is determined by the CORMIX model using the Tennessee River's 7Q10 flow and the limiting MZ.

Mixing Zone.

Per ADEM Admin. Code r. 335-6-6-.15, the MZ is defined as the most stringent of the following criteria:

1. Width Criteria: MZ shall not exceed 50 percent of stream width:

$$MZ = 0.50 \times \text{Stream Width} = 0.50 \times 1,900 \text{ ft} = \mathbf{950 \text{ ft}}$$

2. Length Criteria: MZ shall not exceed a length of five times the width of the MZ:

$$MZ = 5 \times \text{MZ Width} = 5 \times 950 \text{ ft} = \mathbf{4,750 \text{ ft}}$$

3. Area Criteria: MZ must not exceed an area of 25 percent of the stream cross sectional area:

$$MZ = 0.25 \times (\text{Cross - Sectional Area}) = 0.25 \times (1,900 \times 23) = \mathbf{10,925 \text{ ft}^2}$$

4. The total area of all mixing zones in a lake shall not encompass more than ten percent of the surface area of the lake, the radius of any one zone shall not be greater than 750 ft.
5. A mixing zone shall not encompass water intakes.

ADEM has advised that the mixing zone criteria for lakes is not applicable to the Tennessee River. The city of Sheffield has a drinking water intake on the Tennessee River downstream of Pond Creek, but it is over 3.5 miles away and beyond the distance of the mixing zone length criteria.

CORMIX models were completed and evaluated to determine the limiting mixing zone criterion for the temperature and toxicity scenarios. Based on the CORMIX model results, the limiting mixing zone criterion for the thermal model and the toxicity model is the width, because the 1,056 m distance from the outfall to the leading edge of the mixing zone is more than 50 percent of the stream width, which is the shortest distance. See the results summarized below in Table 1. CORMIX model output files for these evaluations are included in Attachment B.

Table 1. Limiting MZ Criteria Determined by CORMIX3

Mixing Zone Criterion	Receiving Stream Value	CORMIX3 Modeled Distance to Mixing Zone Boundary
Width	950 ft (289.56 m)	3,464.6 ft (1,056 m)
Length	4,750 ft (1,447.8 m)	4750 ft (1,448 m)
Area	10,925 sq ft (1,015.0 sq m)	24,068 sq ft (2,236 m)

Zone of Initial Dilution.

Per ADEM Admin. Code r. 335-6-6-.03, the length of the ZID is defined as the most stringent of the following:

1. Fifty times the discharge length scale (DLS) in any spatial direction, where the DLS is the square root of the cross-sectional area of any discharge outlet:

$$\text{Outlet cross sectional area} = (\text{outlet width} \times \text{depth}) = (25 \text{ ft} \times 2.5 \text{ ft}) = 62.5 \text{ ft}^2$$

$$50 \times \text{DLS} = 50 \times \sqrt{\text{Outlet cross sectional area}} = 50 \times \sqrt{62.5} = \mathbf{395.3 \text{ ft}}$$

2. Five times the water depth in any horizontal direction from the discharge outlet:

$$5 \times \text{water depth} = 5 \times 16.1 \text{ ft} = \mathbf{80.5 \text{ ft}}$$

3. No more than 10 percent of the distance from the edge of the outfall structure to the leading edge of the mixing zone in any spatial direction:

$$0.10 \times \text{Mixing Zone} = 0.10 \times 3,464.6 \text{ ft} = \mathbf{346 \text{ ft}}$$

Therefore, the ZID for the OxyChem discharge is a distance equal to five times the water depth (depth at discharge), which is **80.5 feet (24.54 m)** from the mouth of Pond Creek in any spatial direction within the Tennessee River.

Critical conditions for water quality compliance include the lowest 7-day average flow that occurs (on average) once every 10 years (7Q10), which is zero for Pond Creek (CH2M HILL, 2014). The sum of the average discharge flow rates from the three main dischargers to Pond Creek was used to evaluate the excess temperature at the edge of the MZ in the Tennessee River. These three major dischargers are the OxyChem discharge, the Muscle Shoals Wastewater Treatment Plant (WWTP), and the Tennessee Valley Authority (TVA) Environmental Research Center (ERC). Only the OxyChem discharge flow rate was used to determine the IWC at the edge of the ZID. This approach is based on previous communication from ADEM (CH2M HILL, 2014).

3 Model Inputs

The following sections summarize the inputs and assumptions for the updated CORMIX dilution model to simulate the discharge plume at critical low flow river conditions for the current discharge and receiving water flows to determine 1) the excess temperature at the MZ and 2) the IWC at the ZID. This 2025 modeling utilized the CORMIX3 module (surface discharges) within CORMIX Version 12.0.1.0 (August 2021).

3.1 Ambient Conditions

Updated river flows for critical conditions were provided by ADEM based on April 1, 2005, through March 31, 2025, flow data provided by the TVA. Critical conditions for compliance with acute toxicity criteria for protection of aquatic life include the lowest 1-day average flow that occurs (on average) once every 10 years (1Q10 flow). The current 1Q10 flow for the Tennessee River at the Pond Creek confluence provided by ADEM is 5,915.8 cfs.

Critical conditions compliance with the temperature criteria for aquatic life include the 7Q10 flow. The current 7Q10 flow for the Tennessee River provided by ADEM for this analysis is 7,888 cfs.

Other ambient model inputs for critical conditions for both models (temperature and acute IWC) were brought forward unchanged from the 2014 (CH2M HILL) analysis:

- Average depth: 23 ft
- Depth at discharge: 16.1 ft (30% less than the average depth)
- Bounded river channel width: 1,900 ft
- Ambient water temperature: 28 °C (82.4 °F)
- Wind speed: 2 m/s (recommended default value from CORMIX that is only meaningful to farfield dilution)
- Manning's n: 0.032

3.2 Effluent and Discharge Configuration Parameters

Updated discharge flow rates were obtained for OxyChem and the other two main dischargers to Pond Creek (Muscle Shoals WWTP and TVA ERC based on July 2003 through June 2025 average discharge flow). Constellium Muscle Shoals, LLC also discharges to Pond Creek upstream of OxyChem, but it was not included in the model. Average discharge flow data used in this updated model are as follows:

- OxyChem: 7.79 mgd (used for acute IWC model)
- Muscle Shoals WWTP: 1.33 mgd
- TVA ERC: 0.47 mgd
- Total (used for temperature compliance model): 9.6 mgd

The previous (CH2M HILL 2014) model applied very similar discharge flow rates to these updated values.

The geometry of Pond Creek's confluence with the Tennessee River are assumed to be the same as that determined in 2014 based on aerial photography and a reasonable conservative assumption for discharge channel depth within CORMIX model constraints. The following effluent and discharge configuration parameters were brought forward unchanged from the 2014 (CH2M HILL) analysis:

- Effluent temperature: 32.22 °C (90 °C), which is the effluent temperature limit for OxyChem in its NPDES permit
- Discharge excess concentration
 - o Temperature compliance model:
 - Excess temperature of 4.22 °C (excess above ambient temperature of 28 °C)
 - Heat loss coefficient of 28 W/m² °C based on CORMIX User Manual recommendations (EPA, 2021)
 - o Acute IWC model: 100% (conservative pollutant)
- Discharge located on left bank
- Protruding discharge configuration
- Distance from bank: 200 ft
- Horizontal angle: 90 degrees
- Bottom slope: 20 degrees
- Local depth at discharge outlet: 2.5 ft
- Discharge width: 25 ft
- Discharge depth: 2.5 ft

4 Modeling Results

CORMIX assigns a flow class to the discharge of PL 1, which is characterized by an area of upstream intrusion where the discharge plume spreads upstream because of its buoyancy combined with weak ambient crosscurrents. This behavior is apparent in the graphical representations of the modeled plumes shown below in Figure 1 (temperature compliance model) and Figure 2 (acute IWC model).

The model predictions of excess temperature and IWC correspond to hydrodynamic average (bulk) dilutions at the specified mixing zone boundaries. The temperature compliance model predicts an excess temperature of 0.15 °C at the MZB (a downstream distance of 3,465 ft). This means the mixed temperature at the MZB under critical conditions would be 28.15 °C and the effluent temperature limit of 90 °F (32.2 °C) is protective of the Tennessee River water quality criteria of 86 °F (30 °C).

The IWC model predicts an IWC of 75% at the downstream ZID of 80.5 ft with the current flow rates (ambient and discharge). Table 2 below summarizes the current and previous (2014) model results.

The ADEM required information for mixing zone modeling (ADEM Form 455) is included as Attachment A. The full CORMIX model output files are included as Attachment B.

Table 2. CORMIX Model Results Summary

Dilution Model Parameter	2014 (CH2M HILL)	2026 (Current Analysis)
Temperature Model		
Muscle Shoals WWTP Flow to Pond Creek	1.3 mgd	1.3 mgd
TVA ERC Flow to Pond Creek	1.4 mgd	0.47 mgd
OxyChem Discharge Flow to Pond Creek	7.3 mgd	7.8 mgd
Total Discharge Flow to Tennessee River (Muscle Shoals, TVA ERC, and OxyChem)	10.0 mgd	9.6 mgd
7Q10 River Flow	6,750 cfs	7,888 cfs
Mixing Zone Boundary (MZB)	Distance of 228.6 m (750 ft)	Width of 289.6 m (950 ft)
Excess Temperature (°C) at MZB	0.91 °C	0.15 °C
Instream Waste Concentration (IWC) Model		
Discharge Flow (OxyChem Average Flow Only)	7.3 mgd	7.8 mgd
1Q10 River Flow	5,060 cfs	5,916 cfs
Zone of Initial Dilution (ZID)	22.86 m (75 ft)	24.53 m (80.5 ft)
IWC at Upstream ZID	82.2%	38.3%
IWC at Downstream ZID	87.9%	75%

^a IWC at the upstream ZID is an estimated value from linear interpolation of model predictions (see Attachment B).

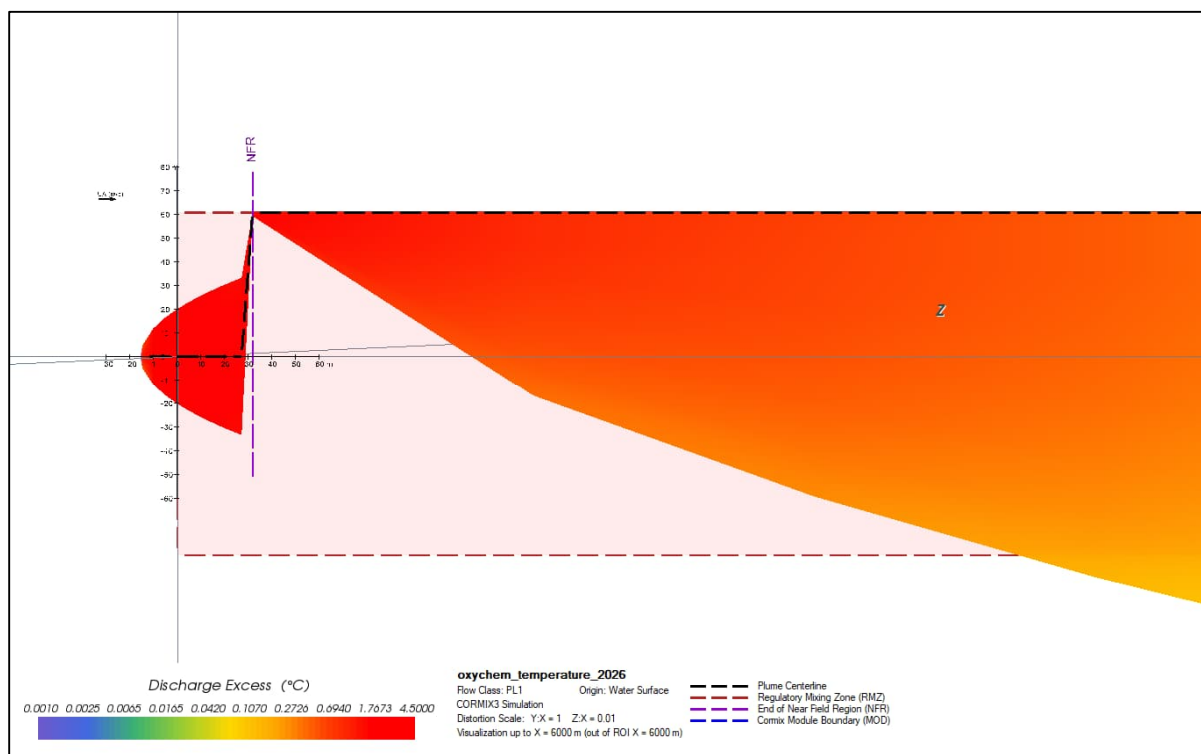


Figure 1. Plan View of CORMIX3 Model-Predicted Discharge Plume for the Temperature Compliance Analysis (CorVue image from CORMIX)

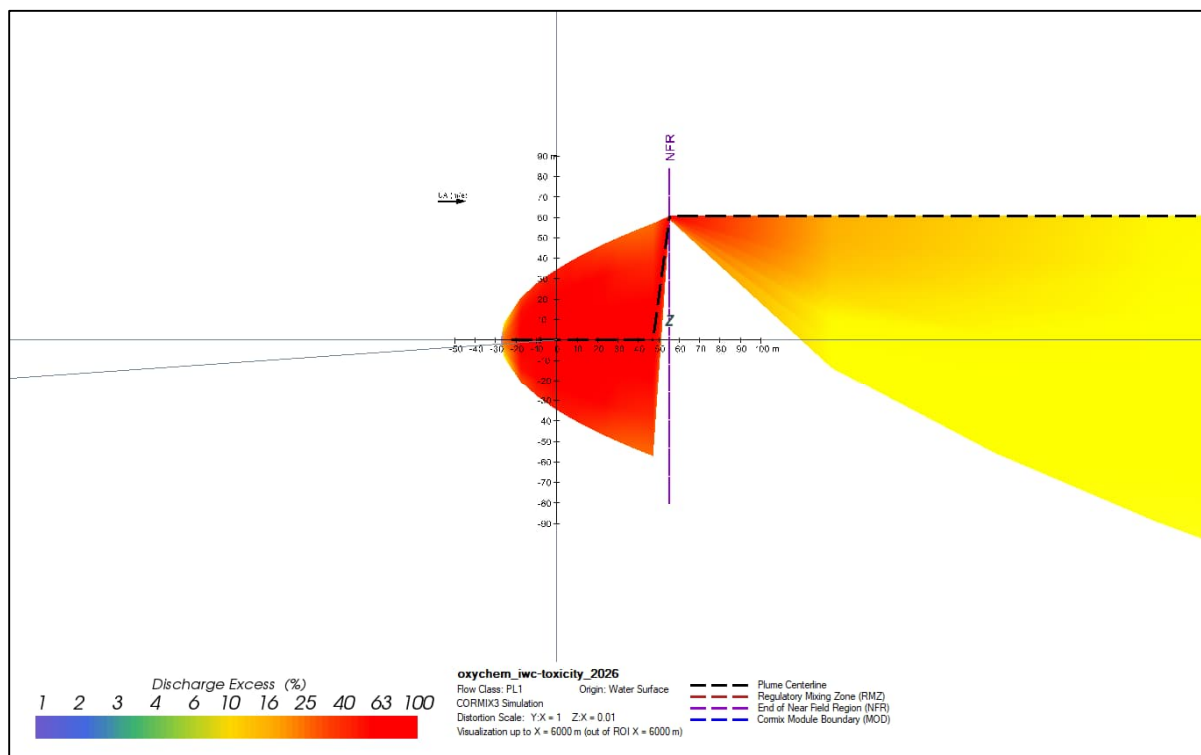


Figure 2. Plan View of CORMIX3 Model-Predicted Discharge Plume for the Acute IWC Analysis (CorVue image from CORMIX)

5 References

CH2M HILL. 2014. *Technical Memorandum: Tennessee River CORMIX Modeling*. Prepared for Occidental Chemical Company, Muscle Shoals, AL. Revised March 17, 2014.

Alabama Department of Environmental Management (ADEM). Administrative Code Chapter 335-6-6. Accessed at <https://admincode.legislature.state.al.us/api/chapter/335-6-6>.

U.S. Environmental Protection Agency (EPA). 2021. *CORMIX User Manual: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters*. EPA-823-K-07-001. Prepared by Robert L. Doneker and Gerhard H. Jirka. December 2007; updated July 2021.

Attachments

Attachment A – ADEM Form 455 – Required Information for Mixing Zone Modeling

Attachment B - CORMIX Model Output Files

Attachment A – ADEM Form 455 - Required Information for Mixing Zone Modeling

REQUIRED INFORMATION FOR MIXING ZONE MODELING

GENERAL INFORMATION

1. Applicant Name: Occidental Chemical Corporation
2. Permit No.: AL0000213
3. Project Name (if different from applicant): Armand Products Division
4. Contact name and phone number: David Mullins, 256-389-2224
5. Date submitted: _____
5. Facility type (new, existing or upgrade): Existing

AMBIENT CONDITIONS

1. Receiving waterbody: Tennessee River (Pickwick Lake) at Pond Creek
2. Width of waterbody at discharge point (m): 579.12 m (1900 ft)
3. Depth of waterbody at discharge point (m): 4.91 m (16.1 ft)
4. Average depth of waterbody at discharge point (m): 7.01 m (23 ft)

DISCHARGE TYPE:

Submerged endpipe or submerged multiport diffuser? Surface Endpipe (Pond Creek into the Tennessee River)

Effluent Density (kg/m^3): 994.9584

Note: Fill out box A below for endpipe discharges; box B for diffuser discharges.

A. DISCHARGE CONDITIONS FOR SUBMERGED ENDPIPE DISCHARGES

1. Nearest bank (right or left) to the outfall looking downstream: Left
2. Distance from nearest bank to discharge (m): 60.96 m (200 ft) based on delta where Pond Creek enters the TN River
3. Endpipe diameter (m): 2.5ft x 25ft channel
4. Contraction ratio (if known): N/A
5. Height of discharge above stream bottom (m): N/A
6. Effluent flow rate (mgd): 7.79 mgd (0.420222 m³/s)

B. DISCHARGE CONDITIONS FOR SUBMERGED MULTIPORT DIFFUSERS

NOTE:

Diffuser length is defined as the distance between the first and last diffuser ports.

1. Diffuser length (m): _____
2. Nearest bank (right or left) to the outfall looking downstream: _____
3. Distance from nearest bank to first diffuser port (m): _____
4. Total number of ports: _____
5. Diameter of a single port (m): _____
6. Distance between adjacent ports (i.e., port spacing, m): _____
7. Height of ports above stream bottom (m): _____
8. Port contraction ratio (if known): _____
9. Diameter of diffuser manifold (m): _____
10. Effluent flow rate (mgd): _____

SPECIAL REQUIREMENTS

1. Please submit a map displaying the outfall location along with the appropriate latitude/longitude coordinates.
2. Please submit the appropriate engineering plans that depict the outfall configuration.

Attachment B – CORMIX Model Output Files

***** FLOW CLASS DESCRIPTION *****

The following description of flow class PL1 applies to the FULL WATER DEPTH at the discharge site:

FLOW_CLASS_PL1

The discharge is issued with relatively low velocity and high buoyancy into an environment with a relatively low ambient velocity. For this reason, the effluent will spread upstream along the shoreline against the ambient current. The receiving water is relatively deep in the vicinity of the discharge so no significant interaction with the bottom takes place in the near-field.

The flow will consist of the following flow regimes:

- 1) Upstream intrusion: Upstream of the discharge will be a steady layer of effluent. This upstream spreading is caused by the strong buoyancy of the effluent and a relatively weak ambient crossflow. This regime ends just downstream of the discharge where far-field buoyant spreading takes over.
- 2) Far-field buoyant spreading: The plume spreads laterally along the surface while being advected downstream with the ambient current. The mixing rate is relatively small and the thickness may decrease in this regime. The plume remains attached to the shoreline.
- 3) Passive ambient diffusion: The ambient turbulence becomes the predominant mixing process in this regime. The plume will grow in both the vertical and horizontal directions at a rate that is dependent on the magnitude of the ambient turbulence. The flow may interact with the bottom or the opposite shoreline in this regime.

END OF FLOW CLASS DESCRIPTION *****

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: Width
FILE NAME: C:\Users\ETHatche\OneDrive - Jacobs\Documents\CORMIX Models-Misc\Occidental Chemical\oxychem MZ
criteria 2026.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 02/11/2026--11:12:46

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section	=	bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 223.36 m^3/s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0550 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m^3
Bottom density	RHOAB	= 996.2338 kg/m^3

DISCHARGE PARAMETERS:

Discharge located on	=	left bank/shoreline
Discharge configuration	=	protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m^2
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.342634 m^3/s
Discharge velocity	U0	= 0.06 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m^3
Density difference	DRHO	= 1.2790 kg/m^3
Buoyant acceleration	GP0	= 0.0126 m/s^2
Discharge concentration	C0	= 100 %
Surface heat exchange coeff.	KS	= 0 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ	= 2.41 m	Lm	= 2.58 m	Lbb	= 25.90 m
LM	= 0.82 m				

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.34 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.60 (based on H0)
Velocity ratio	R	= 1.07

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge	=	no
Water quality standard specified	=	no
Regulatory mixing zone	=	yes
Regulatory mixing zone specification	=	width
Regulatory mixing zone value	=	289.56 m (m^2 if area)
Region of interest	=	6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 652.9

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 70.459700 %

Dilution at edge of NFR s = 1.4

NFR Location: x = 23.04 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 26.90 m

thickness (bv) = 0.33 m

Cumulative travel time: 423.5371 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.

Plume becomes laterally fully mixed at 2877.19 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts nearest bank at -11.52 m downstream.

Plume contacts second bank at 2877.19 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****

No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****

The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 3.164435 %

Corresponding dilution s = 31.6

Plume location: x = 1055.75 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 289.56 m

thickness (bv) = 0.68 m

Cumulative travel time: 19165.3945 sec.

REGULATORY MIXING ZONE criteria were satisfied in the Upstream Intrusion region.

Carefully review the prediction file.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian $1/e$ (37%) vertical thickness
- BH = Gaussian $1/e$ (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution
- C = centerline concentration (includes reaction effects, if any)
- Uc = Local centerline excess velocity (above ambient)
- TT = Cumulative travel time

Control volume outflow: SIGMAE= 311.35

X	Y	Z	S	C	BV	BH	UC	TT
0.16	-0.42	0.00	1.0	0.100E+03	0.92	3.22	0.059	.76602E+01

Cumulative travel time = 7.6602 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
0.16	-0.42	0.00	1.0	0.100E+03	0.92	3.22	.76602E+01

UPSTREAM INTRUSION PROPERTIES:

Upstream intrusion length	=	11.52 m
X-position of upstream stagnation point	=	-11.52 m
Thickness in intrusion region	=	0.33 m
Half-width at downstream end	=	26.90 m
Thickness at downstream end	=	0.33 m

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-11.52	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.76602E+01
-10.83	0.00	0.00	3.3	0.305E+02	0.10	3.80	.76602E+01
-7.44	0.00	0.00	1.4	0.722E+02	0.24	9.24	.76602E+01
-4.06	0.00	0.00	1.1	0.918E+02	0.30	12.50	.76602E+01
-0.67	0.00	0.00	1.0	0.997E+02	0.33	15.07	.76602E+01
2.72	0.00	0.00	1.0	0.980E+02	0.33	17.27	.54123E+02
6.11	0.00	0.00	1.1	0.910E+02	0.33	19.21	.11569E+03
9.49	0.00	0.00	1.2	0.831E+02	0.33	20.98	.17726E+03
12.88	0.00	0.00	1.3	0.771E+02	0.33	22.60	.23883E+03
16.27	0.00	0.00	1.4	0.734E+02	0.33	24.12	.30040E+03
19.66	0.00	0.00	1.4	0.716E+02	0.33	25.55	.36197E+03
23.04	0.00	0.00	1.4	0.705E+02	0.33	26.90	.42354E+03

Cumulative travel time = 423.5370 sec (0.12 hrs)

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
23.04	60.96	0.00	1.4	0.705E+02	7.01	1.26	.42354E+03
80.13	60.96	0.00	3.5	0.284E+02	0.48	45.26	.14595E+04
137.21	60.96	0.00	4.1	0.245E+02	0.36	70.98	.24954E+04
194.29	60.96	0.00	4.6	0.216E+02	0.31	92.03	.35314E+04
251.38	60.96	0.00	5.2	0.191E+02	0.29	110.45	.45674E+04
308.46	60.96	0.00	6.0	0.168E+02	0.29	127.13	.56033E+04
365.54	60.96	0.00	6.8	0.147E+02	0.30	142.57	.66393E+04
422.62	60.96	0.00	7.8	0.128E+02	0.31	157.09	.76752E+04
479.71	60.96	0.00	9.0	0.111E+02	0.33	170.90	.87112E+04
536.79	60.96	0.00	10.3	0.969E+01	0.35	184.14	.97471E+04
593.87	60.96	0.00	11.8	0.845E+01	0.37	196.91	.10783E+05
650.96	60.96	0.00	13.5	0.739E+01	0.40	209.29	.11819E+05
708.04	60.96	0.00	15.4	0.648E+01	0.43	221.34	.12855E+05
765.12	60.96	0.00	17.5	0.570E+01	0.47	233.10	.13891E+05
822.21	60.96	0.00	19.8	0.504E+01	0.50	244.61	.14927E+05
879.29	60.96	0.00	22.4	0.447E+01	0.54	255.89	.15963E+05
936.37	60.96	0.00	25.1	0.398E+01	0.59	266.97	.16999E+05
993.45	60.96	0.00	28.1	0.356E+01	0.63	277.87	.18035E+05
1050.54	60.96	0.00	31.3	0.319E+01	0.67	288.59	.19071E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the TOTAL plume width meets or exceeds the regulatory value = 289.56 m.

This is the extent of the REGULATORY MIXING ZONE.

1107.62	60.96	0.00	34.8	0.288E+01	0.72	299.16	.20107E+05
1164.70	60.96	0.00	38.4	0.260E+01	0.77	309.57	.21143E+05
1221.79	60.96	0.00	42.4	0.236E+01	0.82	319.86	.22179E+05
1278.87	60.96	0.00	46.6	0.215E+01	0.88	330.01	.23215E+05
1335.95	60.96	0.00	51.0	0.196E+01	0.93	340.04	.24250E+05
1393.03	60.96	0.00	55.8	0.179E+01	0.99	349.95	.25286E+05
1450.12	60.96	0.00	60.8	0.165E+01	1.05	359.75	.26322E+05

1507.20	60.96	0.00	66.0	0.151E+01	1.11	369.45	.27358E+05
1564.28	60.96	0.00	71.6	0.140E+01	1.17	379.05	.28394E+05
1621.37	60.96	0.00	77.4	0.129E+01	1.24	388.55	.29430E+05
1678.45	60.96	0.00	83.5	0.120E+01	1.30	397.96	.30466E+05
1735.53	60.96	0.00	89.9	0.111E+01	1.37	407.28	.31502E+05
1792.62	60.96	0.00	96.6	0.103E+01	1.44	416.52	.32538E+05
1849.70	60.96	0.00	103.6	0.965E+00	1.51	425.68	.33574E+05
1906.78	60.96	0.00	110.9	0.901E+00	1.59	434.76	.34610E+05
1963.86	60.96	0.00	118.5	0.844E+00	1.66	443.76	.35646E+05
2020.95	60.96	0.00	126.5	0.791E+00	1.74	452.68	.36682E+05
2078.03	60.96	0.00	134.7	0.742E+00	1.81	461.54	.37718E+05
2135.11	60.96	0.00	143.3	0.698E+00	1.89	470.33	.38754E+05
2192.20	60.96	0.00	152.2	0.657E+00	1.97	479.05	.39790E+05
2249.28	60.96	0.00	161.4	0.620E+00	2.06	487.71	.40826E+05
2306.36	60.96	0.00	170.9	0.585E+00	2.14	496.30	.41862E+05
2363.45	60.96	0.00	180.8	0.553E+00	2.23	504.83	.42898E+05
2420.53	60.96	0.00	191.0	0.524E+00	2.31	513.30	.43934E+05
2477.61	60.96	0.00	201.5	0.496E+00	2.40	521.72	.44970E+05
2534.69	60.96	0.00	212.4	0.471E+00	2.49	530.08	.46006E+05
2591.78	60.96	0.00	223.6	0.447E+00	2.58	538.38	.47041E+05
2648.86	60.96	0.00	235.2	0.425E+00	2.68	546.63	.48077E+05
2705.94	60.96	0.00	247.1	0.405E+00	2.77	554.83	.49113E+05
2763.03	60.96	0.00	259.4	0.385E+00	2.87	562.98	.50149E+05
2820.11	60.96	0.00	272.1	0.368E+00	2.96	571.08	.51185E+05
2877.19	60.96	0.00	285.1	0.351E+00	3.06	579.12	.52221E+05

Cumulative travel time = 52221.2461 sec (14.51 hrs)
 Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.589E-02 m²/s
 Horizontal diffusivity (initial value) = 0.147E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
 = or equal to water depth, if fully mixed
 BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
 measured horizontally in Y-direction
 S = hydrodynamic centerline dilution
 C = centerline concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2877.19	60.96	0.00	285.1	0.351E+00	3.06	579.12	.52221E+05
2939.65	60.96	0.00	288.1	0.347E+00	3.09	579.12	.53355E+05
3002.10	60.96	0.00	291.2	0.343E+00	3.13	579.12	.54488E+05
3064.56	60.96	0.00	294.4	0.340E+00	3.16	579.12	.55622E+05
3127.02	60.96	0.00	297.6	0.336E+00	3.20	579.12	.56755E+05
3189.47	60.96	0.00	300.9	0.332E+00	3.23	579.12	.57889E+05
3251.93	60.96	0.00	304.2	0.329E+00	3.27	579.12	.59022E+05
3314.38	60.96	0.00	307.7	0.325E+00	3.30	579.12	.60155E+05
3376.84	60.96	0.00	311.2	0.321E+00	3.34	579.12	.61289E+05
3439.30	60.96	0.00	314.7	0.318E+00	3.38	579.12	.62422E+05
3501.75	60.96	0.00	318.4	0.314E+00	3.42	579.12	.63556E+05
3564.21	60.96	0.00	322.1	0.310E+00	3.46	579.12	.64689E+05
3626.66	60.96	0.00	325.9	0.307E+00	3.50	579.12	.65823E+05
3689.12	60.96	0.00	329.8	0.303E+00	3.54	579.12	.66956E+05
3751.58	60.96	0.00	333.8	0.300E+00	3.58	579.12	.68090E+05
3814.03	60.96	0.00	337.9	0.296E+00	3.63	579.12	.69223E+05
3876.49	60.96	0.00	342.0	0.292E+00	3.67	579.12	.70357E+05
3938.94	60.96	0.00	346.3	0.289E+00	3.72	579.12	.71490E+05
4001.40	60.96	0.00	350.6	0.285E+00	3.76	579.12	.72624E+05
4063.86	60.96	0.00	355.1	0.282E+00	3.81	579.12	.73757E+05
4126.31	60.96	0.00	359.6	0.278E+00	3.86	579.12	.74891E+05
4188.77	60.96	0.00	364.3	0.275E+00	3.91	579.12	.76024E+05
4251.23	60.96	0.00	369.0	0.271E+00	3.96	579.12	.77157E+05
4313.68	60.96	0.00	373.9	0.267E+00	4.01	579.12	.78291E+05
4376.14	60.96	0.00	378.9	0.264E+00	4.07	579.12	.79424E+05
4438.59	60.96	0.00	384.0	0.260E+00	4.12	579.12	.80558E+05
4501.05	60.96	0.00	389.2	0.257E+00	4.18	579.12	.81691E+05
4563.51	60.96	0.00	394.6	0.253E+00	4.24	579.12	.82825E+05
4625.96	60.96	0.00	400.1	0.250E+00	4.30	579.12	.83958E+05
4688.42	60.96	0.00	405.7	0.246E+00	4.36	579.12	.85092E+05
4750.87	60.96	0.00	411.5	0.243E+00	4.42	579.12	.86225E+05
4813.33	60.96	0.00	417.4	0.240E+00	4.48	579.12	.87359E+05
4875.79	60.96	0.00	423.4	0.236E+00	4.55	579.12	.88492E+05
4938.24	60.96	0.00	429.6	0.233E+00	4.61	579.12	.89626E+05
5000.70	60.96	0.00	436.0	0.229E+00	4.68	579.12	.90759E+05
5063.15	60.96	0.00	442.5	0.226E+00	4.75	579.12	.91893E+05
5125.61	60.96	0.00	449.2	0.223E+00	4.82	579.12	.93026E+05
5188.07	60.96	0.00	456.1	0.219E+00	4.90	579.12	.94159E+05
5250.52	60.96	0.00	463.1	0.216E+00	4.97	579.12	.95293E+05
5312.98	60.96	0.00	470.3	0.213E+00	5.05	579.12	.96426E+05
5375.43	60.96	0.00	477.8	0.209E+00	5.13	579.12	.97560E+05
5437.89	60.96	0.00	485.4	0.206E+00	5.21	579.12	.98693E+05
5500.35	60.96	0.00	493.2	0.203E+00	5.30	579.12	.99827E+05

Simulation limit based on maximum specified distance = 6000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

[illegible]

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: Length
FILE NAME: C:\Users\EThatc\OneDrive - Jacobs\Documents\CORMIX Models-Misc\Occidental Chemical\oxychem MZ
criteria 2026.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 02/11/2026--11:26:40

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section		= bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 223.36 m ³ /s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0550 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m ³
Bottom density	RHOAB	= 996.2338 kg/m ³

DISCHARGE PARAMETERS:

Discharge located on		= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m ²
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.342634 m ³ /s
Discharge velocity	U0	= 0.06 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m ³
Density difference	DRHO	= 1.2790 kg/m ³
Buoyant acceleration	GP0	= 0.0126 m/s ²
Discharge concentration	C0	= 100 %
Surface heat exchange coeff.	KS	= 0 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ	= 2.41 m	Lm	= 2.58 m	Lbb	= 25.90 m
LM	= 0.82 m				

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.34 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.60 (based on H0)
Velocity ratio	R	= 1.07

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge		= no
Water quality standard specified		= no
Regulatory mixing zone		= yes
Regulatory mixing zone specification		= distance
Regulatory mixing zone value		= 1447.80 m (m ² if area)
Region of interest		= 6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 652.9

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory
implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 70.459700 %

Dilution at edge of NFR s = 1.4

NFR Location: x = 23.04 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 26.90 m

thickness (bv) = 0.33 m

Cumulative travel time: 423.5371 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.

Plume becomes laterally fully mixed at 2877.19 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts nearest bank at -11.52 m downstream.

Plume contacts second bank at 2877.19 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****
No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****
The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 1.651679 %

Corresponding dilution s = 60.6

Plume location: x = 1447.8 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 359.35 m

thickness (bv) = 1.05 m

Cumulative travel time: 26280.3262 sec.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian 1/e (37%) vertical thickness
- BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution
- C = centerline concentration (includes reaction effects, if any)
- Uc = Local centerline excess velocity (above ambient)
- TT = Cumulative travel time

Control volume outflow: SIGMAE= 311.35

X	Y	Z	S	C	BV	BH	UC	TT
0.16	-0.42	0.00	1.0	0.100E+03	0.92	3.22	0.059	.76602E+01

Cumulative travel time = 7.6602 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
0.16	-0.42	0.00	1.0	0.100E+03	0.92	3.22	.76602E+01

UPSTREAM INTRUSION PROPERTIES:

Upstream intrusion length	=	11.52 m
X-position of upstream stagnation point	=	-11.52 m
Thickness in intrusion region	=	0.33 m
Half-width at downstream end	=	26.90 m
Thickness at downstream end	=	0.33 m

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-11.52	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.76602E+01
-10.83	0.00	0.00	3.3	0.305E+02	0.10	3.80	.76602E+01
-7.44	0.00	0.00	1.4	0.722E+02	0.24	9.24	.76602E+01
-4.06	0.00	0.00	1.1	0.918E+02	0.30	12.50	.76602E+01
-0.67	0.00	0.00	1.0	0.997E+02	0.33	15.07	.76602E+01
2.72	0.00	0.00	1.0	0.980E+02	0.33	17.27	.54123E+02
6.11	0.00	0.00	1.1	0.910E+02	0.33	19.21	.11569E+03
9.49	0.00	0.00	1.2	0.831E+02	0.33	20.98	.17726E+03
12.88	0.00	0.00	1.3	0.771E+02	0.33	22.60	.23883E+03
16.27	0.00	0.00	1.4	0.734E+02	0.33	24.12	.30040E+03
19.66	0.00	0.00	1.4	0.716E+02	0.33	25.55	.36197E+03
23.04	0.00	0.00	1.4	0.705E+02	0.33	26.90	.42354E+03

Cumulative travel time = 423.5370 sec (0.12 hrs)

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
23.04	60.96	0.00	1.4	0.705E+02	7.01	1.26	.42354E+03
80.13	60.96	0.00	3.5	0.284E+02	0.48	45.26	.14595E+04
137.21	60.96	0.00	4.1	0.245E+02	0.36	70.98	.24954E+04
194.29	60.96	0.00	4.6	0.216E+02	0.31	92.03	.35314E+04
251.38	60.96	0.00	5.2	0.191E+02	0.29	110.45	.45674E+04
308.46	60.96	0.00	6.0	0.168E+02	0.29	127.13	.56033E+04
365.54	60.96	0.00	6.8	0.147E+02	0.30	142.57	.66393E+04
422.62	60.96	0.00	7.8	0.128E+02	0.31	157.09	.76752E+04
479.71	60.96	0.00	9.0	0.111E+02	0.33	170.90	.87112E+04
536.79	60.96	0.00	10.3	0.969E+01	0.35	184.14	.97471E+04
593.87	60.96	0.00	11.8	0.845E+01	0.37	196.91	.10783E+05
650.96	60.96	0.00	13.5	0.739E+01	0.40	209.29	.11819E+05
708.04	60.96	0.00	15.4	0.648E+01	0.43	221.34	.12855E+05
765.12	60.96	0.00	17.5	0.570E+01	0.47	233.10	.13891E+05
822.21	60.96	0.00	19.8	0.504E+01	0.50	244.61	.14927E+05
879.29	60.96	0.00	22.4	0.447E+01	0.54	255.89	.15963E+05
936.37	60.96	0.00	25.1	0.398E+01	0.59	266.97	.16999E+05
993.45	60.96	0.00	28.1	0.356E+01	0.63	277.87	.18035E+05
1050.54	60.96	0.00	31.3	0.319E+01	0.67	288.59	.19071E+05
1107.62	60.96	0.00	34.8	0.288E+01	0.72	299.16	.20107E+05
1164.70	60.96	0.00	38.4	0.260E+01	0.77	309.57	.21143E+05
1221.79	60.96	0.00	42.4	0.236E+01	0.82	319.86	.22179E+05
1278.87	60.96	0.00	46.6	0.215E+01	0.88	330.01	.23215E+05
1335.95	60.96	0.00	51.0	0.196E+01	0.93	340.04	.24250E+05
1393.03	60.96	0.00	55.8	0.179E+01	0.99	349.95	.25286E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the plume DOWNSTREAM distance meets or exceeds the regulatory value = 1447.80 m.

This is the extent of the REGULATORY MIXING ZONE.

1450.12	60.96	0.00	60.8	0.165E+01	1.05	359.75	.26322E+05
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1507.20	60.96	0.00	66.0	0.151E+01	1.11	369.45	.27358E+05
1564.28	60.96	0.00	71.6	0.140E+01	1.17	379.05	.28394E+05
1621.37	60.96	0.00	77.4	0.129E+01	1.24	388.55	.29430E+05
1678.45	60.96	0.00	83.5	0.120E+01	1.30	397.96	.30466E+05
1735.53	60.96	0.00	89.9	0.111E+01	1.37	407.28	.31502E+05
1792.62	60.96	0.00	96.6	0.103E+01	1.44	416.52	.32538E+05
1849.70	60.96	0.00	103.6	0.965E+00	1.51	425.68	.33574E+05
1906.78	60.96	0.00	110.9	0.901E+00	1.59	434.76	.34610E+05
1963.86	60.96	0.00	118.5	0.844E+00	1.66	443.76	.35646E+05
2020.95	60.96	0.00	126.5	0.791E+00	1.74	452.68	.36682E+05
2078.03	60.96	0.00	134.7	0.742E+00	1.81	461.54	.37718E+05
2135.11	60.96	0.00	143.3	0.698E+00	1.89	470.33	.38754E+05
2192.20	60.96	0.00	152.2	0.657E+00	1.97	479.05	.39790E+05
2249.28	60.96	0.00	161.4	0.620E+00	2.06	487.71	.40826E+05
2306.36	60.96	0.00	170.9	0.585E+00	2.14	496.30	.41862E+05
2363.45	60.96	0.00	180.8	0.553E+00	2.23	504.83	.42898E+05
2420.53	60.96	0.00	191.0	0.524E+00	2.31	513.30	.43934E+05
2477.61	60.96	0.00	201.5	0.496E+00	2.40	521.72	.44970E+05
2534.69	60.96	0.00	212.4	0.471E+00	2.49	530.08	.46006E+05
2591.78	60.96	0.00	223.6	0.447E+00	2.58	538.38	.47041E+05
2648.86	60.96	0.00	235.2	0.425E+00	2.68	546.63	.48077E+05
2705.94	60.96	0.00	247.1	0.405E+00	2.77	554.83	.49113E+05
2763.03	60.96	0.00	259.4	0.385E+00	2.87	562.98	.50149E+05
2820.11	60.96	0.00	272.1	0.368E+00	2.96	571.08	.51185E+05
2877.19	60.96	0.00	285.1	0.351E+00	3.06	579.12	.52221E+05

Cumulative travel time = 52221.2461 sec (14.51 hrs)
 Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.589E-02 m²/s
 Horizontal diffusivity (initial value) = 0.147E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
 = or equal to water depth, if fully mixed
 BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
 measured horizontally in Y-direction
 S = hydrodynamic centerline dilution
 C = centerline concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2877.19	60.96	0.00	285.1	0.351E+00	3.06	579.12	.52221E+05
2939.65	60.96	0.00	288.1	0.347E+00	3.09	579.12	.53355E+05
3002.10	60.96	0.00	291.2	0.343E+00	3.13	579.12	.54488E+05
3064.56	60.96	0.00	294.4	0.340E+00	3.16	579.12	.55622E+05
3127.02	60.96	0.00	297.6	0.336E+00	3.20	579.12	.56755E+05
3189.47	60.96	0.00	300.9	0.332E+00	3.23	579.12	.57889E+05
3251.93	60.96	0.00	304.2	0.329E+00	3.27	579.12	.59022E+05
3314.38	60.96	0.00	307.7	0.325E+00	3.30	579.12	.60155E+05
3376.84	60.96	0.00	311.2	0.321E+00	3.34	579.12	.61289E+05
3439.30	60.96	0.00	314.7	0.318E+00	3.38	579.12	.62422E+05
3501.75	60.96	0.00	318.4	0.314E+00	3.42	579.12	.63556E+05
3564.21	60.96	0.00	322.1	0.310E+00	3.46	579.12	.64689E+05
3626.66	60.96	0.00	325.9	0.307E+00	3.50	579.12	.65823E+05
3689.12	60.96	0.00	329.8	0.303E+00	3.54	579.12	.66956E+05
3751.58	60.96	0.00	333.8	0.300E+00	3.58	579.12	.68090E+05
3814.03	60.96	0.00	337.9	0.296E+00	3.63	579.12	.69223E+05
3876.49	60.96	0.00	342.0	0.292E+00	3.67	579.12	.70357E+05
3938.94	60.96	0.00	346.3	0.289E+00	3.72	579.12	.71490E+05
4001.40	60.96	0.00	350.6	0.285E+00	3.76	579.12	.72624E+05
4063.86	60.96	0.00	355.1	0.282E+00	3.81	579.12	.73757E+05
4126.31	60.96	0.00	359.6	0.278E+00	3.86	579.12	.74891E+05
4188.77	60.96	0.00	364.3	0.275E+00	3.91	579.12	.76024E+05
4251.23	60.96	0.00	369.0	0.271E+00	3.96	579.12	.77157E+05
4313.68	60.96	0.00	373.9	0.267E+00	4.01	579.12	.78291E+05
4376.14	60.96	0.00	378.9	0.264E+00	4.07	579.12	.79424E+05
4438.59	60.96	0.00	384.0	0.260E+00	4.12	579.12	.80558E+05
4501.05	60.96	0.00	389.2	0.257E+00	4.18	579.12	.81691E+05
4563.51	60.96	0.00	394.6	0.253E+00	4.24	579.12	.82825E+05
4625.96	60.96	0.00	400.1	0.250E+00	4.30	579.12	.83958E+05
4688.42	60.96	0.00	405.7	0.246E+00	4.36	579.12	.85092E+05
4750.87	60.96	0.00	411.5	0.243E+00	4.42	579.12	.86225E+05
4813.33	60.96	0.00	417.4	0.240E+00	4.48	579.12	.87359E+05
4875.79	60.96	0.00	423.4	0.236E+00	4.55	579.12	.88492E+05
4938.24	60.96	0.00	429.6	0.233E+00	4.61	579.12	.89626E+05
5000.70	60.96	0.00	436.0	0.229E+00	4.68	579.12	.90759E+05
5063.15	60.96	0.00	442.5	0.226E+00	4.75	579.12	.91893E+05
5125.61	60.96	0.00	449.2	0.223E+00	4.82	579.12	.93026E+05
5188.07	60.96	0.00	456.1	0.219E+00	4.90	579.12	.94159E+05
5250.52	60.96	0.00	463.1	0.216E+00	4.97	579.12	.95293E+05
5312.98	60.96	0.00	470.3	0.213E+00	5.05	579.12	.96426E+05
5375.43	60.96	0.00	477.8	0.209E+00	5.13	579.12	.97560E+05
5437.89	60.96	0.00	485.4	0.206E+00	5.21	579.12	.98693E+05
5500.35	60.96	0.00	493.2	0.203E+00	5.30	579.12	.99827E+05

Simulation limit based on maximum specified distance = 6000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

[illegible]

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: Area
FILE NAME: C:\Users\EThatc\OneDrive - Jacobs\Documents\CORMIX Models-Misc\Occidental Chemical\oxychem MZ
criteria 2026.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 02/11/2026--11:29:54

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section	=	bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 223.36 m^3/s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0550 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m^3
Bottom density	RHOAB	= 996.2338 kg/m^3

DISCHARGE PARAMETERS:

Discharge located on	Surface Discharge	= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m^2
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.342634 m^3/s
Discharge velocity	U0	= 0.06 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m^3
Density difference	DRHO	= 1.2790 kg/m^3
Buoyant acceleration	GP0	= 0.0126 m/s^2
Discharge concentration	C0	= 100 %
Surface heat exchange coeff.	KS	= 0 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ	= 2.41 m	Lm	= 2.58 m	Lbb	= 25.90 m
LM	= 0.82 m				

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.34 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.60 (based on H0)
Velocity ratio	R	= 1.07

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge	= no
Water quality standard specified	= no
Regulatory mixing zone	= yes
Regulatory mixing zone specification	= area
Regulatory mixing zone value	= 1014.97 m (m^2 if area)
Region of interest	= 6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 652.9

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory
implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 70.459700 %

Dilution at edge of NFR s = 1.4

NFR Location: x = 23.04 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 26.90 m

thickness (bv) = 0.33 m

Cumulative travel time: 423.5371 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.

Plume becomes laterally fully mixed at 2877.19 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts nearest bank at -11.52 m downstream.

Plume contacts second bank at 2877.19 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****

No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****

The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 0.612772 %

Corresponding dilution s = 163.2

Plume location: x = 2260.56 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 489.41 m

thickness (bv) = 2.07 m

Cumulative travel time: 41030.5 sec.

REGULATORY MIXING ZONE criteria were satisfied in the Upstream Intrusion region.
Carefully review the prediction file.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +/-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian $1/e$ (37%) vertical thickness
- BH = Gaussian $1/e$ (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution
- C = centerline concentration (includes reaction effects, if any)
- Uc = Local centerline excess velocity (above ambient)
- TT = Cumulative travel time

Control volume outflow: SIGMAE= 311.35

X	Y	Z	S	C	BV	BH	UC	TT
0.16	-0.42	0.00	1.0	0.100E+03	0.92	3.22	0.059	.76602E+01

Cumulative travel time = 7.6602 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
0.16	-0.42	0.00	1.0	0.100E+03	0.92	3.22	.76602E+01

UPSTREAM INTRUSION PROPERTIES:

Upstream intrusion length	=	11.52 m
X-position of upstream stagnation point	=	-11.52 m
Thickness in intrusion region	=	0.33 m
Half-width at downstream end	=	26.90 m
Thickness at downstream end	=	0.33 m

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-11.52	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.76602E+01
-10.83	0.00	0.00	3.3	0.305E+02	0.10	3.80	.76602E+01
-7.44	0.00	0.00	1.4	0.722E+02	0.24	9.24	.76602E+01
-4.06	0.00	0.00	1.1	0.918E+02	0.30	12.50	.76602E+01
-0.67	0.00	0.00	1.0	0.997E+02	0.33	15.07	.76602E+01
2.72	0.00	0.00	1.0	0.980E+02	0.33	17.27	.54123E+02
6.11	0.00	0.00	1.1	0.910E+02	0.33	19.21	.11569E+03
9.49	0.00	0.00	1.2	0.831E+02	0.33	20.98	.17726E+03
12.88	0.00	0.00	1.3	0.771E+02	0.33	22.60	.23883E+03
16.27	0.00	0.00	1.4	0.734E+02	0.33	24.12	.30040E+03
19.66	0.00	0.00	1.4	0.716E+02	0.33	25.55	.36197E+03
23.04	0.00	0.00	1.4	0.705E+02	0.33	26.90	.42354E+03

Cumulative travel time = 423.5370 sec (0.12 hrs)

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
23.04	60.96	0.00	1.4	0.705E+02	7.01	1.26	.42354E+03
80.13	60.96	0.00	3.5	0.284E+02	0.48	45.26	.14595E+04
137.21	60.96	0.00	4.1	0.245E+02	0.36	70.98	.24954E+04
194.29	60.96	0.00	4.6	0.216E+02	0.31	92.03	.35314E+04
251.38	60.96	0.00	5.2	0.191E+02	0.29	110.45	.45674E+04
308.46	60.96	0.00	6.0	0.168E+02	0.29	127.13	.56033E+04
365.54	60.96	0.00	6.8	0.147E+02	0.30	142.57	.66393E+04
422.62	60.96	0.00	7.8	0.128E+02	0.31	157.09	.76752E+04
479.71	60.96	0.00	9.0	0.111E+02	0.33	170.90	.87112E+04
536.79	60.96	0.00	10.3	0.969E+01	0.35	184.14	.97471E+04
593.87	60.96	0.00	11.8	0.845E+01	0.37	196.91	.10783E+05
650.96	60.96	0.00	13.5	0.739E+01	0.40	209.29	.11819E+05
708.04	60.96	0.00	15.4	0.648E+01	0.43	221.34	.12855E+05
765.12	60.96	0.00	17.5	0.570E+01	0.47	233.10	.13891E+05
822.21	60.96	0.00	19.8	0.504E+01	0.50	244.61	.14927E+05
879.29	60.96	0.00	22.4	0.447E+01	0.54	255.89	.15963E+05
936.37	60.96	0.00	25.1	0.398E+01	0.59	266.97	.16999E+05
993.45	60.96	0.00	28.1	0.356E+01	0.63	277.87	.18035E+05
1050.54	60.96	0.00	31.3	0.319E+01	0.67	288.59	.19071E+05
1107.62	60.96	0.00	34.8	0.288E+01	0.72	299.16	.20107E+05
1164.70	60.96	0.00	38.4	0.260E+01	0.77	309.57	.21143E+05
1221.79	60.96	0.00	42.4	0.236E+01	0.82	319.86	.22179E+05
1278.87	60.96	0.00	46.6	0.215E+01	0.88	330.01	.23215E+05
1335.95	60.96	0.00	51.0	0.196E+01	0.93	340.04	.24250E+05
1393.03	60.96	0.00	55.8	0.179E+01	0.99	349.95	.25286E+05
1450.12	60.96	0.00	60.8	0.165E+01	1.05	359.75	.26322E+05
1507.20	60.96	0.00	66.0	0.151E+01	1.11	369.45	.27358E+05
1564.28	60.96	0.00	71.6	0.140E+01	1.17	379.05	.28394E+05
1621.37	60.96	0.00	77.4	0.129E+01	1.24	388.55	.29430E+05
1678.45	60.96	0.00	83.5	0.120E+01	1.30	397.96	.30466E+05

1735.53	60.96	0.00	89.9	0.111E+01	1.37	407.28	.31502E+05
1792.62	60.96	0.00	96.6	0.103E+01	1.44	416.52	.32538E+05
1849.70	60.96	0.00	103.6	0.965E+00	1.51	425.68	.33574E+05
1906.78	60.96	0.00	110.9	0.901E+00	1.59	434.76	.34610E+05
1963.86	60.96	0.00	118.5	0.844E+00	1.66	443.76	.35646E+05
2020.95	60.96	0.00	126.5	0.791E+00	1.74	452.68	.36682E+05
2078.03	60.96	0.00	134.7	0.742E+00	1.81	461.54	.37718E+05
2135.11	60.96	0.00	143.3	0.698E+00	1.89	470.33	.38754E+05
2192.20	60.96	0.00	152.2	0.657E+00	1.97	479.05	.39790E+05
2249.28	60.96	0.00	161.4	0.620E+00	2.06	487.71	.40826E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the plume area meets or exceeds
the regulatory value = 1014.97 m^2.

This is the extent of the REGULATORY MIXING ZONE.

2306.36	60.96	0.00	170.9	0.585E+00	2.14	496.30	.41862E+05
2363.45	60.96	0.00	180.8	0.553E+00	2.23	504.83	.42898E+05
2420.53	60.96	0.00	191.0	0.524E+00	2.31	513.30	.43934E+05
2477.61	60.96	0.00	201.5	0.496E+00	2.40	521.72	.44970E+05
2534.69	60.96	0.00	212.4	0.471E+00	2.49	530.08	.46006E+05
2591.78	60.96	0.00	223.6	0.447E+00	2.58	538.38	.47041E+05
2648.86	60.96	0.00	235.2	0.425E+00	2.68	546.63	.48077E+05
2705.94	60.96	0.00	247.1	0.405E+00	2.77	554.83	.49113E+05
2763.03	60.96	0.00	259.4	0.385E+00	2.87	562.98	.50149E+05
2820.11	60.96	0.00	272.1	0.368E+00	2.96	571.08	.51185E+05
2877.19	60.96	0.00	285.1	0.351E+00	3.06	579.12	.52221E+05

Cumulative travel time = 52221.2461 sec (14.51 hrs)

Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.589E-02 m^2/s
Horizontal diffusivity (initial value) = 0.147E-01 m^2/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to water depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2877.19	60.96	0.00	285.1	0.351E+00	3.06	579.12	.52221E+05
2939.65	60.96	0.00	288.1	0.347E+00	3.09	579.12	.53355E+05
3002.10	60.96	0.00	291.2	0.343E+00	3.13	579.12	.54488E+05
3064.56	60.96	0.00	294.4	0.340E+00	3.16	579.12	.55622E+05
3127.02	60.96	0.00	297.6	0.336E+00	3.20	579.12	.56755E+05
3189.47	60.96	0.00	300.9	0.332E+00	3.23	579.12	.57889E+05
3251.93	60.96	0.00	304.2	0.329E+00	3.27	579.12	.59022E+05
3314.38	60.96	0.00	307.7	0.325E+00	3.30	579.12	.60155E+05
3376.84	60.96	0.00	311.2	0.321E+00	3.34	579.12	.61289E+05
3439.30	60.96	0.00	314.7	0.318E+00	3.38	579.12	.62422E+05
3501.75	60.96	0.00	318.4	0.314E+00	3.42	579.12	.63556E+05
3564.21	60.96	0.00	322.1	0.310E+00	3.46	579.12	.64689E+05
3626.66	60.96	0.00	325.9	0.307E+00	3.50	579.12	.65823E+05
3689.12	60.96	0.00	329.8	0.303E+00	3.54	579.12	.66956E+05
3751.58	60.96	0.00	333.8	0.300E+00	3.58	579.12	.68090E+05
3814.03	60.96	0.00	337.9	0.296E+00	3.63	579.12	.69223E+05
3876.49	60.96	0.00	342.0	0.292E+00	3.67	579.12	.70357E+05
3938.94	60.96	0.00	346.3	0.289E+00	3.72	579.12	.71490E+05
4001.40	60.96	0.00	350.6	0.285E+00	3.76	579.12	.72624E+05
4063.86	60.96	0.00	355.1	0.282E+00	3.81	579.12	.73757E+05
4126.31	60.96	0.00	359.6	0.278E+00	3.86	579.12	.74891E+05
4188.77	60.96	0.00	364.3	0.275E+00	3.91	579.12	.76024E+05
4251.23	60.96	0.00	369.0	0.271E+00	3.96	579.12	.77157E+05
4313.68	60.96	0.00	373.9	0.267E+00	4.01	579.12	.78291E+05
4376.14	60.96	0.00	378.9	0.264E+00	4.07	579.12	.79424E+05
4438.59	60.96	0.00	384.0	0.260E+00	4.12	579.12	.80558E+05
4501.05	60.96	0.00	389.2	0.257E+00	4.18	579.12	.81691E+05
4563.51	60.96	0.00	394.6	0.253E+00	4.24	579.12	.82825E+05
4625.96	60.96	0.00	400.1	0.250E+00	4.30	579.12	.83958E+05
4688.42	60.96	0.00	405.7	0.246E+00	4.36	579.12	.85092E+05
4750.87	60.96	0.00	411.5	0.243E+00	4.42	579.12	.86225E+05
4813.33	60.96	0.00	417.4	0.240E+00	4.48	579.12	.87359E+05
4875.79	60.96	0.00	423.4	0.236E+00	4.55	579.12	.88492E+05
4938.24	60.96	0.00	429.6	0.233E+00	4.61	579.12	.89626E+05
5000.70	60.96	0.00	436.0	0.229E+00	4.68	579.12	.90759E+05
5063.15	60.96	0.00	442.5	0.226E+00	4.75	579.12	.91893E+05
5125.61	60.96	0.00	449.2	0.223E+00	4.82	579.12	.93026E+05
5188.07	60.96	0.00	456.1	0.219E+00	4.90	579.12	.94159E+05
5250.52	60.96	0.00	463.1	0.216E+00	4.97	579.12	.95293E+05
5312.98	60.96	0.00	470.3	0.213E+00	5.05	579.12	.96426E+05
5375.43	60.96	0.00	477.8	0.209E+00	5.13	579.12	.97560E+05
5437.89	60.96	0.00	485.4	0.206E+00	5.21	579.12	.98693E+05
5500.35	60.96	0.00	493.2	0.203E+00	5.30	579.12	.99827E+05

Simulation limit based on maximum specified distance = 6000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

[illegible]

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: 1
FILE NAME: C:\Users\EThatc\OneDrive - Jacobs\Documents\CORMIX Models-Misc\Occidental Chemical\oxychem
temperature 2026.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 02/11/2026--11:55:39

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section		= bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 223.36 m ³ /s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0550 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m ³
Bottom density	RHOAB	= 996.2338 kg/m ³

DISCHARGE PARAMETERS:

Discharge located on	Surface Discharge	= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m ²
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.419089 m ³ /s
Discharge velocity	U0	= 0.07 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m ³
Density difference	DRHO	= 1.2790 kg/m ³
Buoyant acceleration	GP0	= 0.0126 m/s ²
Discharge concentration	C0	= 4.22 deg.C
Surface heat exchange coeff.	KS	= 0.000007 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ = 2.41 m	Lm = 3.16 m	Lbb = 31.68 m
LM = 1.00 m		

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.41 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.74 (based on H0)
Velocity ratio	R	= 1.31

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge	= no
Water quality standard specified	= no
Regulatory mixing zone	= yes
Regulatory mixing zone specification	= width
Regulatory mixing zone value	= 289.56 m (m ² if area)
Region of interest	= 6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 534.0

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory
implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 2.9132 deg.C

Dilution at edge of NFR s = 1.4

NFR Location: x = 31.73 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 35.18 m

thickness (bv) = 0.31 m

Cumulative travel time: 580.5117 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof), but RE-STRATIFIES LATER.

Plume becomes vertically fully mixed again at 4683.19 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts nearest bank at -15.87 m downstream.

Plume contacts second bank at 3007.25 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****

No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****

The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 0.154237 deg.C

Corresponding dilution s = 26.9

Plume location: x = 1035.72 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 289.56 m

thickness (bv) = 0.71 m

Cumulative travel time: 18794.9219 sec.

REGULATORY MIXING ZONE criteria were satisfied in the Upstream Intrusion region.

Carefully review the prediction file.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the

CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian 1/e (37%) vertical thickness
- BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution

C = centerline concentration (includes reaction effects, if any)
 Uc = Local centerline excess velocity (above ambient)
 TT = Cumulative travel time

Control volume outflow: SIGMAE= 303.14

X	Y	Z	S	C	BV	BH	UC	TT
0.14	-0.43	0.00	1.0	0.422E+01	0.92	3.21	0.072	.62374E+01

 Cumulative travel time = 6.2374 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
0.14	-0.43	0.00	1.0	0.422E+01	0.92	3.21	.62374E+01

UPSTREAM INTRUSION PROPERTIES:
 Upstream intrusion length = 15.87 m
 X-position of upstream stagnation point = -15.87 m
 Thickness in intrusion region = 0.31 m
 Half-width at downstream end = 35.18 m
 Thickness at downstream end = 0.31 m

Profile definitions:
 BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-15.87	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.62374E+01
-14.91	0.00	0.00	3.3	0.129E+01	0.10	4.97	.62374E+01
-10.25	0.00	0.00	1.4	0.305E+01	0.23	12.08	.62374E+01
-5.58	0.00	0.00	1.1	0.388E+01	0.29	16.35	.62374E+01
-0.92	0.00	0.00	1.0	0.421E+01	0.31	19.71	.62374E+01
3.74	0.00	0.00	1.0	0.413E+01	0.31	22.58	.71829E+02
8.41	0.00	0.00	1.1	0.381E+01	0.31	25.12	.15661E+03
13.07	0.00	0.00	1.2	0.346E+01	0.31	27.43	.24139E+03
17.74	0.00	0.00	1.3	0.320E+01	0.31	29.56	.32617E+03
22.40	0.00	0.00	1.4	0.304E+01	0.31	31.54	.41095E+03
27.07	0.00	0.00	1.4	0.296E+01	0.31	33.41	.49573E+03
31.73	0.00	0.00	1.4	0.291E+01	0.31	35.18	.58051E+03

 Cumulative travel time = 580.5117 sec (0.16 hrs)

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:
 BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
31.73	60.96	0.00	1.4	0.291E+01	7.01	1.57	.58051E+03
91.24	60.96	0.00	3.5	0.121E+01	0.53	49.72	.16601E+04
150.75	60.96	0.00	4.0	0.105E+01	0.39	77.78	.27398E+04
210.26	60.96	0.00	4.5	0.933E+00	0.34	100.57	.38194E+04
269.77	60.96	0.00	5.1	0.830E+00	0.32	120.32	.48991E+04
329.28	60.96	0.00	5.7	0.734E+00	0.31	138.04	.59787E+04
388.79	60.96	0.00	6.5	0.645E+00	0.32	154.28	.70583E+04
448.30	60.96	0.00	7.4	0.564E+00	0.33	169.41	.81380E+04
507.81	60.96	0.00	8.5	0.492E+00	0.35	183.66	.92176E+04
567.32	60.96	0.00	9.8	0.428E+00	0.38	197.23	.10297E+05
626.83	60.96	0.00	11.2	0.373E+00	0.41	210.22	.11377E+05
686.34	60.96	0.00	12.8	0.325E+00	0.44	222.74	.12457E+05
745.86	60.96	0.00	14.7	0.284E+00	0.48	234.85	.13536E+05
805.37	60.96	0.00	16.7	0.249E+00	0.52	246.62	.14616E+05
864.88	60.96	0.00	19.0	0.219E+00	0.56	258.08	.15695E+05
924.39	60.96	0.00	21.5	0.193E+00	0.61	269.26	.16775E+05
983.90	60.96	0.00	24.3	0.171E+00	0.66	280.21	.17855E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the TOTAL plume width meets or exceeds
 the regulatory value = 289.56 m.

This is the extent of the REGULATORY MIXING ZONE.

X	Y	Z	S	C	BV	BH	TT
1043.41	60.96	0.00	27.3	0.152E+00	0.71	290.94	.18934E+05
1102.92	60.96	0.00	30.5	0.136E+00	0.77	301.46	.20014E+05
1162.43	60.96	0.00	34.1	0.122E+00	0.83	311.80	.21094E+05
1221.94	60.96	0.00	37.8	0.109E+00	0.89	321.97	.22173E+05
1281.45	60.96	0.00	41.9	0.986E-01	0.96	331.98	.23253E+05

1340.96	60.96	0.00	46.2	0.893E-01	1.03	341.84	.24333E+05
1400.47	60.96	0.00	50.8	0.811E-01	1.10	351.56	.25412E+05
1459.98	60.96	0.00	55.7	0.739E-01	1.17	361.15	.26492E+05
1519.49	60.96	0.00	60.9	0.675E-01	1.25	370.62	.27571E+05
1579.00	60.96	0.00	66.4	0.619E-01	1.33	379.97	.28651E+05
1638.51	60.96	0.00	72.2	0.569E-01	1.41	389.20	.29731E+05
1698.02	60.96	0.00	78.3	0.524E-01	1.49	398.33	.30810E+05
1757.53	60.96	0.00	84.7	0.484E-01	1.58	407.36	.31890E+05
1817.04	60.96	0.00	91.4	0.448E-01	1.67	416.29	.32970E+05
1876.55	60.96	0.00	98.5	0.415E-01	1.76	425.12	.34049E+05
1936.06	60.96	0.00	105.9	0.386E-01	1.86	433.87	.35129E+05
1995.57	60.96	0.00	113.6	0.359E-01	1.95	442.53	.36209E+05
2055.08	60.96	0.00	121.6	0.335E-01	2.05	451.11	.37288E+05
2114.59	60.96	0.00	130.0	0.313E-01	2.15	459.61	.38368E+05
2174.10	60.96	0.00	138.7	0.293E-01	2.25	468.03	.39447E+05
2233.61	60.96	0.00	147.8	0.275E-01	2.36	476.38	.40527E+05
2293.12	60.96	0.00	157.2	0.258E-01	2.47	484.65	.41607E+05
2352.64	60.96	0.00	167.0	0.243E-01	2.58	492.86	.42686E+05
2412.15	60.96	0.00	177.1	0.229E-01	2.69	501.00	.43766E+05
2471.66	60.96	0.00	187.6	0.216E-01	2.80	509.07	.44846E+05
2531.17	60.96	0.00	198.4	0.204E-01	2.92	517.09	.45925E+05
2590.68	60.96	0.00	209.6	0.193E-01	3.04	525.04	.47005E+05
2650.19	60.96	0.00	221.2	0.182E-01	3.16	532.93	.48085E+05
2709.70	60.96	0.00	233.2	0.173E-01	3.28	540.76	.49164E+05
2769.21	60.96	0.00	245.5	0.164E-01	3.40	548.54	.50244E+05
2828.72	60.96	0.00	258.2	0.156E-01	3.53	556.26	.51324E+05
2888.23	60.96	0.00	271.3	0.148E-01	3.66	563.94	.52403E+05
2947.74	60.96	0.00	284.8	0.141E-01	3.79	571.55	.53483E+05
3007.25	60.96	0.00	298.7	0.134E-01	3.92	579.12	.54562E+05

Cumulative travel time = 54562.4219 sec (15.16 hrs)
 Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.589E-02 m²/s
 Horizontal diffusivity (initial value) = 0.147E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
 = or equal to water depth, if fully mixed
 BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
 measured horizontally in Y-direction
 S = hydrodynamic centerline dilution
 C = centerline concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
3007.25	60.96	0.00	298.7	0.134E-01	3.92	579.12	.54562E+05
3067.10	60.96	0.00	303.9	0.132E-01	3.99	579.12	.55648E+05
3126.96	60.96	0.00	309.2	0.129E-01	4.06	579.12	.56734E+05
3186.81	60.96	0.00	314.8	0.127E-01	4.13	579.12	.57820E+05
3246.67	60.96	0.00	320.5	0.125E-01	4.21	579.12	.58906E+05
3306.52	60.96	0.00	326.4	0.122E-01	4.28	579.12	.59992E+05
3366.38	60.96	0.00	332.5	0.120E-01	4.37	579.12	.61078E+05
3426.23	60.96	0.00	338.8	0.117E-01	4.45	579.12	.62164E+05
3486.09	60.96	0.00	345.3	0.115E-01	4.53	579.12	.63250E+05
3545.94	60.96	0.00	352.1	0.113E-01	4.62	579.12	.64335E+05
3605.80	60.96	0.00	359.1	0.110E-01	4.71	579.12	.65421E+05
3665.65	60.96	0.00	366.3	0.108E-01	4.81	579.12	.66507E+05
3725.51	60.96	0.00	373.8	0.106E-01	4.91	579.12	.67593E+05
3785.36	60.96	0.00	381.6	0.104E-01	5.01	579.12	.68679E+05
3845.22	60.96	0.00	389.6	0.101E-01	5.12	579.12	.69765E+05
3905.07	60.96	0.00	397.9	0.992E-02	5.22	579.12	.70851E+05
3964.93	60.96	0.00	406.5	0.970E-02	5.34	579.12	.71937E+05
4024.78	60.96	0.00	415.4	0.948E-02	5.45	579.12	.73023E+05
4084.64	60.96	0.00	424.7	0.926E-02	5.58	579.12	.74108E+05
4144.49	60.96	0.00	434.2	0.905E-02	5.70	579.12	.75194E+05
4204.35	60.96	0.00	444.1	0.884E-02	5.83	579.12	.76280E+05
4264.20	60.96	0.00	454.3	0.863E-02	5.96	579.12	.77366E+05
4324.06	60.96	0.00	464.9	0.843E-02	6.10	579.12	.78452E+05
4383.91	60.96	0.00	475.9	0.822E-02	6.25	579.12	.79538E+05
4443.77	60.96	0.00	487.2	0.802E-02	6.40	579.12	.80624E+05
4503.62	60.96	0.00	499.0	0.783E-02	6.55	579.12	.81710E+05
4563.48	60.96	0.00	511.1	0.763E-02	6.71	579.12	.82796E+05
4623.33	60.96	0.00	523.6	0.744E-02	6.87	579.12	.83881E+05

Plume interacts with BOTTOM.

The passive diffusion plume becomes VERTICALLY FULLY MIXED within this prediction interval.

4683.19	60.96	0.00	534.0	0.729E-02	7.01	579.12	.84967E+05
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Effluent is FULLY MIXED over the entire channel cross-section.

Except for possible far-field decay or reaction processes, there are

NO FURTHER CHANGES with downstream direction.

4743.04	60.96	0.00	534.0	0.728E-02	7.01	579.12	.86053E+05
4802.90	60.96	0.00	534.0	0.728E-02	7.01	579.12	.87139E+05
4862.75	60.96	0.00	534.0	0.727E-02	7.01	579.12	.88225E+05
4922.61	60.96	0.00	534.0	0.726E-02	7.01	579.12	.89311E+05

Simulation limit based on maximum specified distance = 6000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

[illegible]

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: 1
FILE NAME: C:\Users\EThatc\OneDrive - Jacobs\Documents\CORMIX Models-Misc\Occidental Chemical\oxychem
iwc-toxicity 2026.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 02/11/2026--12:03:52

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section	=	bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 167.52 m ³ /s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0413 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m ³
Bottom density	RHOAB	= 996.2338 kg/m ³

DISCHARGE PARAMETERS:

Discharge located on		= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m ²
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.342634 m ³ /s
Discharge velocity	U0	= 0.06 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m ³
Density difference	DRHO	= 1.2790 kg/m ³
Buoyant acceleration	GP0	= 0.0126 m/s ²
Discharge concentration	C0	= 100 %
Surface heat exchange coeff.	KS	= 0 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ	= 2.41 m	Lm	= 3.45 m	Lbb	= 61.41 m
LM	= 0.82 m				

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.34 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.60 (based on H0)
Velocity ratio	R	= 1.43

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge	= no
Water quality standard specified	= no
Regulatory mixing zone	= yes
Regulatory mixing zone specification	= trajectory
Regulatory mixing zone value	= 24.54 m (m ² if area)
Region of interest	= 6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 489.9

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory
implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.
Pollutant concentration at NFR edge c = 61.005900 %
Dilution at edge of NFR s = 1.6
NFR Location: x = 55.39 m
(centerline coordinates) y = 0 m
z = 0 m
NFR plume dimensions: half-width (bh) = 60.30 m
thickness (bv) = 0.23 m
Cumulative travel time: 1346.7344 sec.

Buoyancy assessment:
The effluent density is less than the surrounding ambient water density at the discharge level.
Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:
Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 2047.20 m downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -27.70 m downstream.
Plume contacts second bank at 2047.20 m downstream.
***** TOXIC DILUTION ZONE SUMMARY *****
No TDZ was specified for this simulation.
***** REGULATORY MIXING ZONE SUMMARY *****
The plume conditions at the boundary of the specified RMZ are as follows:
Pollutant concentration c = 74.560997 %
Corresponding dilution s = 1.3
Plume location: x = 24.54 m
(centerline coordinates) y = 0 m
z = 0 m
Plume dimensions: half-width (bh) = 47.78 m
thickness (bv) = 0.23 m
Cumulative travel time: 598.9253 sec. (RMZ is within NFR)

Note:
Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

Regulatory Mixing Zone Analysis:
The specified RMZ occurs within the near-field region (NFR). This RMZ specification may be highly restrictive.

***** FINAL DESIGN ADVICE AND COMMENTS *****
REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian $1/e$ (37%) vertical thickness
- BH = Gaussian $1/e$ (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution
- C = centerline concentration (includes reaction effects, if any)
- Uc = Local centerline excess velocity (above ambient)
- TT = Cumulative travel time

Control volume outflow: SIGMAE= 298.92

X	Y	Z	S	C	BV	BH	UC	TT
0.12	-0.40	0.00	1.0	0.100E+03	0.91	3.25	0.059	.70947E+01

Cumulative travel time = 7.0947 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
0.12	-0.40	0.00	1.0	0.100E+03	0.91	3.25	.70947E+01

UPSTREAM INTRUSION PROPERTIES:

Upstream intrusion length	=	27.70 m
X-position of upstream stagnation point	=	-27.70 m
Thickness in intrusion region	=	0.23 m
Half-width at downstream end	=	60.30 m
Thickness at downstream end	=	0.23 m

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-27.70	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.70947E+01
-26.03	0.00	0.00	3.3	0.306E+02	0.07	8.53	.70947E+01
-17.89	0.00	0.00	1.4	0.725E+02	0.16	20.71	.70947E+01
-9.75	0.00	0.00	1.1	0.921E+02	0.21	28.02	.70947E+01
-1.61	0.00	0.00	1.0	0.998E+02	0.23	33.79	.70947E+01
6.54	0.00	0.00	1.0	0.968E+02	0.23	38.70	.16268E+03
14.68	0.00	0.00	1.2	0.866E+02	0.23	43.06	.36002E+03
22.82	0.00	0.00	1.3	0.761E+02	0.23	47.02	.55737E+03

** REGULATORY MIXING ZONE BOUNDARY is within the Near-Field Region **

In this prediction interval the plume TRAJECTORY distance meets or exceeds the regulatory value = 24.54 m.

This is the extent of the REGULATORY MIXING ZONE.

30.96	0.00	0.00	1.5	0.687E+02	0.23	50.66	.75471E+03
39.11	0.00	0.00	1.6	0.644E+02	0.23	54.07	.95205E+03
47.25	0.00	0.00	1.6	0.623E+02	0.23	57.27	.11494E+04
55.39	0.00	0.00	1.6	0.610E+02	0.23	60.30	.13467E+04

Cumulative travel time = 1346.7346 sec (0.37 hrs)

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
55.39	60.96	0.00	1.6	0.610E+02	7.01	1.94	.13467E+04
95.23	60.96	0.00	3.7	0.272E+02	0.64	47.66	.23102E+04
135.06	60.96	0.00	4.2	0.241E+02	0.46	74.80	.32737E+04
174.90	60.96	0.00	4.5	0.221E+02	0.39	97.07	.42372E+04
214.74	60.96	0.00	4.9	0.206E+02	0.35	116.54	.52007E+04
254.57	60.96	0.00	5.2	0.192E+02	0.32	134.11	.61641E+04
294.41	60.96	0.00	5.6	0.180E+02	0.31	150.28	.71276E+04
334.24	60.96	0.00	5.9	0.168E+02	0.30	165.36	.80911E+04
374.08	60.96	0.00	6.4	0.157E+02	0.29	179.58	.90546E+04
413.92	60.96	0.00	6.8	0.147E+02	0.29	193.09	.10018E+05
453.75	60.96	0.00	7.3	0.136E+02	0.29	206.01	.10982E+05
493.59	60.96	0.00	7.9	0.127E+02	0.30	218.44	.11945E+05
533.43	60.96	0.00	8.5	0.118E+02	0.31	230.45	.12908E+05
573.26	60.96	0.00	9.1	0.109E+02	0.31	242.10	.13872E+05
613.10	60.96	0.00	9.8	0.102E+02	0.32	253.44	.14835E+05
652.93	60.96	0.00	10.6	0.943E+01	0.33	264.50	.15799E+05
692.77	60.96	0.00	11.4	0.875E+01	0.34	275.32	.16762E+05
732.61	60.96	0.00	12.3	0.813E+01	0.36	285.93	.17726E+05
772.44	60.96	0.00	13.2	0.756E+01	0.37	296.34	.18689E+05
812.28	60.96	0.00	14.2	0.703E+01	0.38	306.58	.19653E+05
852.11	60.96	0.00	15.3	0.654E+01	0.40	316.66	.20616E+05
891.95	60.96	0.00	16.4	0.609E+01	0.42	326.59	.21580E+05
931.79	60.96	0.00	17.6	0.568E+01	0.43	336.40	.22543E+05
971.62	60.96	0.00	18.9	0.530E+01	0.45	346.08	.23507E+05
1011.46	60.96	0.00	20.2	0.495E+01	0.47	355.65	.24470E+05
1051.29	60.96	0.00	21.6	0.463E+01	0.49	365.11	.25434E+05

1091.13	60.96	0.00	23.0	0.434E+01	0.51	374.48	.26397E+05
1130.97	60.96	0.00	24.6	0.407E+01	0.53	383.75	.27361E+05
1170.80	60.96	0.00	26.2	0.382E+01	0.55	392.93	.28324E+05
1210.64	60.96	0.00	27.9	0.359E+01	0.57	402.04	.29288E+05
1250.47	60.96	0.00	29.6	0.337E+01	0.60	411.06	.30251E+05
1290.31	60.96	0.00	31.5	0.318E+01	0.62	420.01	.31215E+05
1330.15	60.96	0.00	33.4	0.300E+01	0.64	428.89	.32178E+05
1369.98	60.96	0.00	35.4	0.283E+01	0.67	437.70	.33142E+05
1409.82	60.96	0.00	37.4	0.267E+01	0.69	446.45	.34105E+05
1449.66	60.96	0.00	39.6	0.253E+01	0.72	455.13	.35068E+05
1489.49	60.96	0.00	41.8	0.239E+01	0.75	463.75	.36032E+05
1529.33	60.96	0.00	44.1	0.227E+01	0.77	472.32	.36995E+05
1569.16	60.96	0.00	46.5	0.215E+01	0.80	480.83	.37959E+05
1609.00	60.96	0.00	49.0	0.204E+01	0.83	489.28	.38922E+05
1648.84	60.96	0.00	51.6	0.194E+01	0.86	497.69	.39886E+05
1688.67	60.96	0.00	54.2	0.184E+01	0.89	506.04	.40849E+05
1728.51	60.96	0.00	56.9	0.176E+01	0.92	514.34	.41813E+05
1768.34	60.96	0.00	59.8	0.167E+01	0.95	522.60	.42776E+05
1808.18	60.96	0.00	62.7	0.160E+01	0.98	530.80	.43740E+05
1848.02	60.96	0.00	65.7	0.152E+01	1.01	538.97	.44703E+05
1887.85	60.96	0.00	68.8	0.145E+01	1.04	547.09	.45667E+05
1927.69	60.96	0.00	72.0	0.139E+01	1.07	555.16	.46630E+05
1967.52	60.96	0.00	75.3	0.133E+01	1.11	563.20	.47594E+05
2007.36	60.96	0.00	78.6	0.127E+01	1.14	571.19	.48557E+05
2047.20	60.96	0.00	82.1	0.122E+01	1.17	579.12	.49521E+05

Cumulative travel time = 49520.6953 sec (13.76 hrs)
 Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.469E-02 m²/s
 Horizontal diffusivity (initial value) = 0.117E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
 = or equal to water depth, if fully mixed
 BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
 measured horizontally in Y-direction
 S = hydrodynamic centerline dilution
 C = centerline concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2047.20	60.96	0.00	82.1	0.122E+01	1.17	579.12	.49521E+05
2126.25	60.96	0.00	82.3	0.122E+01	1.18	579.12	.51433E+05
2205.31	60.96	0.00	82.4	0.121E+01	1.18	579.12	.53345E+05
2284.36	60.96	0.00	82.6	0.121E+01	1.18	579.12	.55257E+05
2363.42	60.96	0.00	82.7	0.121E+01	1.18	579.12	.57169E+05
2442.48	60.96	0.00	82.9	0.121E+01	1.19	579.12	.59081E+05
2521.53	60.96	0.00	83.1	0.120E+01	1.19	579.12	.60993E+05
2600.59	60.96	0.00	83.2	0.120E+01	1.19	579.12	.62905E+05
2679.65	60.96	0.00	83.4	0.120E+01	1.19	579.12	.64817E+05
2758.70	60.96	0.00	83.5	0.120E+01	1.20	579.12	.66729E+05
2837.76	60.96	0.00	83.7	0.119E+01	1.20	579.12	.68641E+05
2916.81	60.96	0.00	83.9	0.119E+01	1.20	579.12	.70553E+05
2995.87	60.96	0.00	84.0	0.119E+01	1.20	579.12	.72465E+05
3074.93	60.96	0.00	84.2	0.119E+01	1.20	579.12	.74377E+05
3153.98	60.96	0.00	84.3	0.119E+01	1.21	579.12	.76290E+05
3233.04	60.96	0.00	84.5	0.118E+01	1.21	579.12	.78202E+05
3312.09	60.96	0.00	84.7	0.118E+01	1.21	579.12	.80114E+05
3391.15	60.96	0.00	84.8	0.118E+01	1.21	579.12	.82026E+05
3470.21	60.96	0.00	85.0	0.118E+01	1.22	579.12	.83938E+05
3549.26	60.96	0.00	85.2	0.117E+01	1.22	579.12	.85850E+05
3628.32	60.96	0.00	85.3	0.117E+01	1.22	579.12	.87762E+05
3707.38	60.96	0.00	85.5	0.117E+01	1.22	579.12	.89674E+05
3786.43	60.96	0.00	85.7	0.117E+01	1.23	579.12	.91586E+05
3865.49	60.96	0.00	85.9	0.116E+01	1.23	579.12	.93498E+05
3944.54	60.96	0.00	86.0	0.116E+01	1.23	579.12	.95410E+05
4023.60	60.96	0.00	86.2	0.116E+01	1.23	579.12	.97322E+05
4102.66	60.96	0.00	86.4	0.116E+01	1.24	579.12	.99234E+05
4181.71	60.96	0.00	86.5	0.116E+01	1.24	579.12	.10115E+06
4260.77	60.96	0.00	86.7	0.115E+01	1.24	579.12	.10306E+06
4339.82	60.96	0.00	86.9	0.115E+01	1.24	579.12	.10497E+06
4418.88	60.96	0.00	87.1	0.115E+01	1.25	579.12	.10688E+06
4497.94	60.96	0.00	87.2	0.115E+01	1.25	579.12	.10879E+06
4576.99	60.96	0.00	87.4	0.114E+01	1.25	579.12	.11071E+06
4656.05	60.96	0.00	87.6	0.114E+01	1.25	579.12	.11262E+06
4735.10	60.96	0.00	87.8	0.114E+01	1.26	579.12	.11453E+06
4814.16	60.96	0.00	88.0	0.114E+01	1.26	579.12	.11644E+06
4893.22	60.96	0.00	88.1	0.113E+01	1.26	579.12	.11835E+06
4972.27	60.96	0.00	88.3	0.113E+01	1.26	579.12	.12027E+06
5051.33	60.96	0.00	88.5	0.113E+01	1.27	579.12	.12218E+06
5130.39	60.96	0.00	88.7	0.113E+01	1.27	579.12	.12409E+06
5209.44	60.96	0.00	88.9	0.113E+01	1.27	579.12	.12600E+06
5288.50	60.96	0.00	89.0	0.112E+01	1.27	579.12	.12792E+06
5367.55	60.96	0.00	89.2	0.112E+01	1.28	579.12	.12983E+06

Simulation limit based on maximum specified distance = 6000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

[illegible]

ADEM Form 187, Attachment 2
Biocides and Corrosion Inhibitors

Product Name	Product Type	Purpose	Plant Location	Active Ingredient(s)	Frequency of Use	Estimated Quantity Used (lbs/year)	Daily Usage (lb)	Proposed Discharge Concentration (mg/L) *	96-hour Median Tolerance Limit(s)	EPA Registration Number
CORTROL IS3000	Boiler Water Treatment	Oxygen Scavenger	Potassium Carbonate/Potassium Bicarbonate Production	Sodium Bisulfite	Continuous	2,877	7.88	0.121	Fathead Minnow: 210 mg/L	N/A
SOLUS AP24	Boiler Water Treatment	Boiler Water Treatment	Potassium Carbonate/Potassium Bicarbonate Production	None listed	Continuous	1,161	3.18	0.049	Fathead Minnow: > 5,000 mg/L	N/A
STEAMATE NA715	Boiler Water Treatment	Corrosion Inhibitor	Potassium Carbonate/Potassium Bicarbonate Production	2-Diethylaminoethanol, Cyclohexylamine, Morpholine	Continuous	1,492	4.09	0.063	Fathead Minnow: 241 mg/L	N/A
Chlorine (liquid gas)	Cooling Water Treatment	Biocide	Potassium Carbonate/Potassium Bicarbonate Production	Chlorine	Continuous	32,850	90.0	0.069	Fish: 0.2135 mg/L Atlantic Silverside: 0.037 mg/L	N/A

* Proposed Discharge Concentration for chlorine is based on a 95% oxidation rate for the chlorine gas

N/A - Not Applicable



SAFETY DATA SHEET

SOLUS AP24

1. Identification

Product identifier	SOLUS AP24
Other means of identification	None.
Recommended use	Internal boiler water treatment
Recommended restrictions	None known.

Company/undertaking identification

Veolia WTS USA, Inc.
3600 Horizon Blvd.
Trevose, PA 19053
T 215 355 3300, F 215 953 5524

Emergency telephone

(800) 877 1940

2. Hazard(s) identification

Physical hazards	Not classified.
Health hazards	Not classified.
OSHA defined hazards	Not classified.

Label elements

Hazard symbol	None.
Signal word	None.
Hazard statement	The mixture does not meet the criteria for classification.
Precautionary statement	
Prevention	Wash thoroughly after handling.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of contents/container to an approved facility.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Mixtures

The manufacturer lists no ingredients as hazardous to health according to OSHA 29 CFR 1910.1200.

Composition comments	Information for specific product ingredients as required by the U.S. OSHA HAZARD COMMUNICATION STANDARD is listed. Refer to additional sections of this SDS for our assessment of the potential hazards of this formulation.
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4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Skin contact	Wash thoroughly with soap and water. Remove contaminated clothing. Wash clothing separately before reuse. Get medical attention if irritation develops and persists.

Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Do not feed anything by mouth to an unconscious or convulsive victim. Do NOT induce vomiting!
Most important symptoms/effects, acute and delayed	Direct contact with eyes may cause temporary irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO ₂).
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Use standard firefighting procedures and consider the hazards of other involved materials. Move containers from fire area if you can do so without risk. Cool containers / tanks with water spray.
General fire hazards	No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away.
Methods and materials for containment and cleaning up	Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use.
Environmental precautions	Water contaminated with this product may be sent to a sanitary sewer treatment facility, or a permitted waste treatment facility, in accordance with any local agreements.

7. Handling and storage

Precautions for safe handling	Avoid prolonged exposure.
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container.

8. Exposure controls/personal protection

Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Not available.
Individual protection measures, such as personal protective equipment	
Eye/face protection	Splash proof chemical goggles.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. The choice of an appropriate glove does not only depend on its material but also on other quality features and is different from one producer to the other. Glove selection must take into account any solvents and other hazards present.
Other	Wear suitable protective clothing.
Respiratory protection	If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. A respiratory protection program that meets OSHA's 29 CFR 1910.34 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations

Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	Liquid
Physical state	Liquid.
Form	Not available.
Color	Yellow to amber
Odor	Slight ammonia odor
Odor threshold	Not available.
pH (concentrated product)	12.3 Neat
Melting point/freezing point	28 °F (-2 °C)
Initial boiling point and boiling range	219 °F (104 °C)
Flash point	Not Applicable
Evaporation rate	Slower than Ether
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	18 mmHg
Vapor pressure temp.	70 °F (21 °C)
Vapor density	< 1
Relative density	1.09
Relative density temperature	70 °F (21 °C)
Solubility(ies)	
Solubility (water)	100 %
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	11 mPa.s
Viscosity temperature	70 °F (21 °C)
Other information	
Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.
pH in aqueous solution	11 (5% Solution)
Pour point	33 °F (1 °C)
VOC	0 % ESTIMATED

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	Oxides of carbon, nitrogen, phosphorus, and sulphur evolved in fire.

11. Toxicological information**Information on likely routes of exposure**

Inhalation	May cause irritation to respiratory organs.
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Skin contact	Prolonged or repeated contact may cause irritation.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	May cause slight gastrointestinal irritation with possible nausea, vomiting, abdominal discomfort and diarrhea.

Symptoms related to the physical, chemical and toxicological characteristics Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity

Product	Species	Test Results
SOLUS AP24		
Acute		
Dermal		
LD50	Rabbit	> 5000 mg/kg (Calculated according to GHS additivity formula)
Oral		
LD50	Rat	> 5000 mg/kg (Calculated according to GHS additivity formula)

Skin corrosion/irritation Prolonged skin contact may cause temporary irritation.

Serious eye damage/eye irritation Direct contact with eyes may cause temporary irritation.

Respiratory or skin sensitization

Respiratory sensitization This product is not expected to cause respiratory sensitization.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure Not classified.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard Based on available data, the classification criteria are not met.

12. Ecological information

Ecotoxicity

Product	Species	Test Results
Aquatic		
Crustacea	LC50	Daphnia magna
	NOEL	Daphnia magna
Fish	LC50	Fathead Minnow
		Rainbow Trout
	NOEL	Fathead Minnow
		Rainbow Trout

Bioaccumulative potential

Mobility in soil No data available.

Other adverse effects Not available.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT	Not regulated as dangerous goods.
IATA	Not regulated as dangerous goods.
IMDG	Not regulated as dangerous goods.

15. Regulatory information

US federal regulations

Toxic Substances Control Act (TSCA)

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical

No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)

Contains component(s) regulated under the Safe Drinking Water Act.

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

Food and drug administration	ALL ingredients in this product are authorized in 21CFR173.310 for use as boiler water additives where the steam may contact food. The maximum level of Solus AP24 permitted in the boiler water where steam contacts food is 625 ppm.
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**NSF Registered and/or meets
USDA (according to 1998
guidelines):**

Registration No. – 152247
Category Code(s):
G5 Cooling and retort water treatment products G6 Boiler treatment products, steam line
products – food contact

US state regulations

California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 2016 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins. For more information go to www.P65Warnings.ca.gov.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Developmental toxin

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Female reproductive toxin

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Male reproductive toxin

No ingredient listed.

16. Other information, including date of preparation or last revision

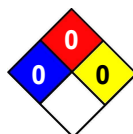
Issue date Jan-20-2015

Revision date Feb-19-2023

Version # 2.1

NFPA ratings Health: 0
Flammability: 0
Instability: 0

NFPA ratings



List of abbreviations

CAS: Chemical Abstract Service Registration Number
OSHA: Occupational Safety & Health Administration.
ACGIH: American Conference of Governmental Industrial Hygienists
NOEL: No Observed Effect Level
STEL: Short Term Exposure Limit
LC50: Lethal Concentration, 50%
TWA: Time Weighted Average
BOD: Biochemical Oxygen Demand
COD: Chemical Oxygen Demand
TOC: Total Organic Carbon
IATA: International Air Transport Association
NFPA: National Fire Protection Association
IMDG: International Maritime Dangerous Goods Code
LD50: Lethal Dose, 50%

References: No data available

Disclaimer The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Revision information This document has undergone significant changes and should be reviewed in its entirety.

Prepared by This SDS has been prepared by Veolia Water Technologies & Solutions' Regulatory Department (1-215-355-3300).



SAFETY DATA SHEET

STEAMATE* NA715

1. Identification

Product identifier	STEAMATE NA715
Other means of identification	None.
Recommended use	Condensate return line treatment
Recommended restrictions	None known.

Company/undertaking identification

Veolia WTS USA, Inc.
3600 Horizon Blvd.
Trevose, PA 19053
T 215 355 3300, F 215 953 5524

Emergency telephone

(800) 877 1940

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 4
Health hazards	Acute toxicity, oral	Category 4
	Acute toxicity, dermal	Category 3
	Acute toxicity, inhalation	Category 4
	Skin corrosion/irritation	Category 1B
	Serious eye damage/eye irritation	Category 1
	Reproductive toxicity	Category 2
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
OSHA defined hazards	Not classified.	

Label elements



Signal word Danger

Hazard statement Combustible liquid. Harmful if swallowed. Toxic in contact with skin. Harmful if inhaled. Causes severe skin burns and eye damage. Causes serious eye damage. Suspected of damaging fertility or the unborn child. May cause respiratory irritation.

Precautionary statement

Prevention

Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Do not breathe mist or vapor. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.

Response	If swallowed: Rinse mouth. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. Take off immediately all contaminated clothing and wash it before reuse. In case of fire: Use appropriate media to extinguish.
Storage	Store in a well-ventilated place. Keep container tightly closed. Store in a well-ventilated place. Keep cool. Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Mixtures

Components	CAS #	Percent
2-Diethylaminoethanol	100-37-8	20 - 40
Cyclohexylamine	108-91-8	10 - 20
Morpholine	110-91-8	10 - 20

Composition comments	Information for specific product ingredients as required by the U.S. OSHA HAZARD COMMUNICATION STANDARD is listed. Refer to additional sections of this SDS for our assessment of the potential hazards of this formulation.
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4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Oxygen or artificial respiration if needed. Call a POISON CENTER or doctor/physician if you feel unwell.
Skin contact	Take off immediately all contaminated clothing. Rinse skin with water/shower. Call a physician or poison control center immediately. Chemical burns must be treated by a physician. Wash contaminated clothing before reuse.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a physician or poison control center immediately.
Ingestion	Call a physician or poison control center immediately. Rinse mouth. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.
Most important symptoms/effects, acute and delayed	Nausea, vomiting. Burning pain and severe corrosive skin damage. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result. May cause respiratory irritation. Coughing.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Chemical burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	Take off immediately all contaminated clothing. IF exposed or concerned: Get medical advice/attention. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Alcohol resistant foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Water. Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	The product is combustible, and heating may generate vapors which may form explosive vapor/air mixtures. During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Use standard firefighting procedures and consider the hazards of other involved materials. Move containers from fire area if you can do so without risk. Cool containers / tanks with water spray.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	Combustible liquid.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Keep out of low areas. Wear appropriate protective equipment and clothing during clean-up. Do not breathe mist or vapor. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained.

Methods and materials for containment and cleaning up

Use water spray to reduce vapors or divert vapor cloud drift. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Keep combustibles (wood, paper, oil, etc.) away from spilled material. Prevent entry into waterways, sewer, basements or confined areas.

Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Following product recovery, flush area with water.

Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills to original containers for re-use.

Environmental precautions

Avoid discharge into drains, water courses or onto the ground. Water contaminated with this product may be sent to a sanitary sewer treatment facility, or a permitted waste treatment facility, in accordance with any local agreements.

7. Handling and storage

Precautions for safe handling

Keep away from open flames, hot surfaces and sources of ignition. Material can accumulate static charges which may cause an electrical spark (ignition source). Use proper bonding and/or grounding procedures. Do not breathe mist or vapor. Do not get this material in contact with eyes. Do not get this material in contact with skin. Do not taste or swallow. Do not get this material on clothing. Avoid contact during pregnancy/while nursing. Avoid prolonged exposure. When using, do not eat, drink or smoke. Use only outdoors or in a well-ventilated area. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Wash contaminated clothing before reuse. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities

Store locked up. Keep away from heat, sparks and open flame. Store in a cool, dry place out of direct sunlight. Store in original tightly closed container. Store in a well-ventilated place. Keep in an area equipped with sprinklers. Store in accordance with local/regional/national/international regulation.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
2-Diethylaminoethanol (CAS 100-37-8)	PEL	50 mg/m3
		10 ppm
Morpholine (CAS 110-91-8)	PEL	70 mg/m3
		20 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value
2-Diethylaminoethanol (CAS 100-37-8)	TWA	2 ppm
Cyclohexylamine (CAS 108-91-8)	TWA	10 ppm
Morpholine (CAS 110-91-8)	TWA	20 ppm

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
2-Diethylaminoethanol (CAS 100-37-8)	TWA	50 mg/m3
		10 ppm
Cyclohexylamine (CAS 108-91-8)	TWA	40 mg/m3

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
Morpholine (CAS 110-91-8)	STEL	10 ppm
		105 mg/m3
		30 ppm
	TWA	70 mg/m3
		20 ppm

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines**US ACGIH Threshold Limit Values: Skin designation**

2-Diethylaminoethanol (CAS 100-37-8)	Danger of cutaneous absorption
Morpholine (CAS 110-91-8)	Danger of cutaneous absorption

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

2-Diethylaminoethanol (CAS 100-37-8)	Can be absorbed through the skin.
Morpholine (CAS 110-91-8)	Can be absorbed through the skin.

Appropriate engineering controls Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles) and a face shield.

Skin protection

Hand protection Chemical resistant gloves. The choice of an appropriate glove does not only depend on its material but also on other quality features and is different from one producer to the other. Glove selection must take into account any solvents and other hazards present.

Other Wear appropriate chemical resistant clothing. Use of an impervious apron is recommended.

Respiratory protection If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. A respiratory protection program that meets OSHA's 29 CFR 1910.34 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using, do not eat, drink or smoke. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	Liquid
Physical state	Liquid.
Form	Not available.
Color	Colorless to yellow
Odor	Amine odor
Odor threshold	Not available.
pH (concentrated product)	12.7 Neat
Melting point/freezing point	-0.04 °F (-18 °C)
Initial boiling point and boiling range	Not available.
Flash point	144 °F (62 °C) P-M(CC)
Evaporation rate	Slower than Ether
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	18 mmHg

Vapor pressure temp.	70 °F (21 °C)
Vapor density	Not available.
Relative density	0.98
Relative density temperature	70 °F (21 °C)
Solubility(ies)	
Solubility (water)	100 %
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Other information	
VOC	52.5 % ESTIMATED

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Avoid heat, sparks, open flames and other ignition sources. Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Strong acids. Strong oxidizing agents.
Hazardous decomposition products	Oxides of carbon and nitrogen evolved in fire.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Harmful if inhaled.
Skin contact	Toxic in contact with skin. Causes severe skin burns.
Eye contact	Causes serious eye damage.
Ingestion	Causes digestive tract burns. Harmful if swallowed.

Symptoms related to the physical, chemical and toxicological characteristics	Nausea, vomiting. Burning pain and severe corrosive skin damage. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result. May cause respiratory irritation. Coughing.
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Information on toxicological effects

Acute toxicity	Toxic in contact with skin. Harmful if inhaled. Harmful if swallowed. May cause respiratory irritation.
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Product	Species	Test Results
STEAMATE NA715		
Acute		
Dermal		
LD50	Rabbit	917 mg/kg (Calculated according to GHS additivity formula)
Inhalation		
<i>Vapor</i>		
LC50	Rat	14.58 mg/l, 4 Hours (Calculated according to GHS additivity formula)
Oral		
LD50	Rat	821 mg/kg (Calculated according to GHS additivity formula)

Components	Species	Test Results
2-Diethylaminoethanol (CAS 100-37-8)		
<u>Acute</u>		
Dermal		
LD50	Guinea pig	885 mg/kg
Inhalation		
<i>Vapor</i>		
LC50	Rat	4.6 mg/l, 4 Hour
Oral		
LD50	Rat	1320 mg/kg
Cyclohexylamine (CAS 108-91-8)		
<u>Acute</u>		
Dermal		
LD50	Rabbit	277 mg/kg
Oral		
LD50	Rat	156 mg/kg
Morpholine (CAS 110-91-8)		
<u>Acute</u>		
Dermal		
LD50	Rabbit	505 mg/kg
Inhalation		
LC50	Rat	8 mg/l, 4 Hour
Oral		
LD50	Rat	1680 mg/kg
Skin corrosion/irritation	Causes severe skin burns and eye damage.	
Serious eye damage/eye irritation	Causes serious eye damage.	
Respiratory or skin sensitization		
Respiratory sensitization	This product is not expected to cause respiratory sensitization.	
Skin sensitization	This product is not expected to cause skin sensitization.	
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.	
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.	
IARC Monographs. Overall Evaluation of Carcinogenicity		
Morpholine (CAS 110-91-8)	3 Not classifiable as to carcinogenicity to humans.	
OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)		
Not listed.		
US. National Toxicology Program (NTP) Report on Carcinogens		
Not listed.		
Reproductive toxicity	Suspected of damaging fertility or the unborn child.	
Specific target organ toxicity - single exposure	May cause respiratory irritation.	
Specific target organ toxicity - repeated exposure	Not classified.	
Aspiration hazard	Based on available data, the classification criteria are not met.	
Chronic effects	Prolonged inhalation may be harmful.	

12. Ecological information

Ecotoxicity

Product	Species	Test Results
Aquatic		
Crustacea	LC50 Daphnia magna	114.1 mg/L, 48 hour

Product		Species	Test Results
Fish	NOEL	Daphnia magna	65 mg/L, 48 hour
	LC50	Fathead Minnow	241 mg/L, 96 hour (pH adjusted)
	NOEL	Fathead Minnow	125 mg/L, 96 hour (pH adjusted)

Persistence and degradability

- COD (mgO ₂ /g)	1217 (calculated data)
- BOD 5 (mgO ₂ /g)	0 (calculated data)
- BOD 28 (mgO ₂ /g)	266 (calculated data)
- Closed Bottle Test (% Degradation in 28 days)	24 (calculated data)
- Zahn-Wellens Test (% Degradation in 28 days)	50 (calculated data)
- TOC (mg C/g)	312 (calculated data)

Bioaccumulative potential

No data available.

Partition coefficient n-octanol / water (log K_{ow})

2-Diethylaminoethanol	0.05
Cyclohexylamine	1.49
Morpholine	-0.86

Bioconcentration factor (BCF)

2-Diethylaminoethanol	< 6.1
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Mobility in soil

No data available.

Other adverse effects

Not available.

13. Disposal considerations

Disposal instructions

Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Incinerate the material under controlled conditions in an approved incinerator. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations

Dispose in accordance with all applicable regulations.

Hazardous waste code

The waste code should be assigned in discussion between the user, the producer and the waste disposal company. D002= Corrosive

Waste from residues / unused products

Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging

Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number	UN2735
UN proper shipping name	Amines, liquid, corrosive, n.o.s. (Cyclohexylamine, 2-Diethylaminoethanol)
Transport hazard class(es)	
Class	8
Subsidiary risk	-
Packing group	II
Special precautions for user	Not available.
ERG number	153

Some containers may be exempt from Dangerous Goods/Hazmat Transport Regulations, please check BOL for exact container classification.

IATA

UN number	UN2735
UN proper shipping name	Amines, liquid, corrosive, n.o.s. (Cyclohexylamine, 2-Diethylaminoethanol)
Transport hazard class(es)	
Class	8
Subsidiary risk	-
Packing group	II

Environmental hazards No.
ERG Code 153
Special precautions for user Not available.

IMDG

UN number UN2735
UN proper shipping name AMINES, LIQUID, CORROSIVE, N.O.S. (CYCLOHEXYLAMINE, 2-Diethylaminoethanol)
Transport hazard class(es)
Class 8
Subsidiary risk -
Packing group II
Environmental hazards
Marine pollutant No.
EmS F-A, S-B
Special precautions for user Not available.

DOT



IATA; IMDG



15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Toxic Substances Control Act (TSCA)

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Cyclohexanamine (CAS 108-91-8) 10000 LBS

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Chemical name	CAS number	Reportable quantity (pounds)	Threshold planning quantity (pounds)	Threshold planning quantity, lower value (pounds)	Threshold planning quantity, upper value (pounds)
Cyclohexylamine	108-91-8	10000	10000		

SARA 311/312 Hazardous chemical Yes

Classified hazard categories

Flammable (gases, aerosols, liquids, or solids)
Acute toxicity (any route of exposure)
Skin corrosion or irritation
Serious eye damage or eye irritation
Reproductive toxicity
Specific target organ toxicity (single or repeated exposure)

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations**Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List**

2-methoxyethanol (CAS 109-86-4)
ACETALDEHYDE (CAS 75-07-0)
Aniline (CAS 62-53-3)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

1,2-Diaminoethane (Ethylene diamine) (CAS 107-15-3)
ACETALDEHYDE (CAS 75-07-0)
Cyclohexylamine (CAS 108-91-8)

Safe Drinking Water Act (SDWA)

Contains component(s) regulated under the Safe Drinking Water Act.

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

Food and drug administration

ALL ingredients in this product are authorized in 21CFR173.310 for use as boiler water additives where the steam may contact food.

NSF Registered and/or meets USDA (according to 1998 guidelines):

Registration No. – 146016
Category Code(s):
G5 Cooling and retort water treatment products
G6 Boiler treatment products, steam line products – food contact

US state regulations**California Proposition 65**

WARNING: WARNING: This product can expose you to chemicals including Aniline, which is known to the State of California to cause cancer, and 2-methoxyethanol, which is known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

ACETALDEHYDE (CAS 75-07-0)	Listed: April 1, 1988
Aniline (CAS 62-53-3)	Listed: January 1, 1990

US - California Proposition 65 - CRT: Listed date/Developmental toxin

2-methoxyethanol (CAS 109-86-4)	Listed: January 1, 1989
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US - California Proposition 65 - CRT: Listed date/Female reproductive toxin

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Male reproductive toxin

2-methoxyethanol (CAS 109-86-4)	Listed: January 1, 1989
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16. Other information, including date of preparation or last revision

Issue date	Oct-17-2014
Revision date	Feb-11-2023
Version #	5.1
NFPA ratings	Health: 3 Flammability: 2 Instability: 0

NFPA ratings**List of abbreviations**

CAS: Chemical Abstract Service Registration Number
ACGIH: American Conference of Governmental Industrial Hygienists
NOEL: No Observed Effect Level
STEL: Short Term Exposure Limit
LC50: Lethal Concentration, 50%
LD50: Lethal Dose, 50%
TWA: Time Weighted Average
BOD: Biochemical Oxygen Demand
COD: Chemical Oxygen Demand
TOC: Total Organic Carbon
IATA: International Air Transport Association
IMDG: International Maritime Dangerous Goods Code
TSRN indicates a Trade Secret Registry Number is used in place of the CAS number.
NFPA: National Fire Protection Association
OSHA: Occupational Safety & Health Administration.

References:

No data available

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Revision information

Composition / Information on Ingredients: Ingredients
Exposure controls/personal protection: Appropriate engineering controls
Exposure controls/personal protection: Respiratory protection
Transport Information: Agency Name, Packaging Type, and Transport Mode Selection
Other information, including date of preparation or last revision: Prepared by

Prepared by

This SDS has been prepared by Veolia Water Technologies & Solutions' Regulatory Department (1-215-355-3300).

* Trademark of Veolia. May be registered in one or more countries.



SAFETY DATA SHEET

CORTROL* IS3000

1. Identification

Product identifier	CORTROL IS3000
Other means of identification	None.
Recommended use	Water based dissolved oxygen scavenger
Recommended restrictions	Industrial use only.

Company/undertaking identification

Veolia WTS USA, Inc.
3600 Horizon Blvd.
Trevose, PA 19053
T 215 355 3300, F 215 953 5524

Emergency telephone

(800) 877 1940

2. Hazard(s) identification

Physical hazards	Not classified.	
Health hazards	Serious eye damage/eye irritation	Category 2B
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
OSHA defined hazards	Not classified.	

Label elements



Signal word	Warning
Hazard statement	Causes eye irritation. May cause respiratory irritation.
Precautionary statement	
Prevention	Avoid breathing mist/vapor. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area.
Response	If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.
Storage	Store in a well-ventilated place. Keep container tightly closed. Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Mixtures

Components	CAS #	Percent
Sodium bisulphite	7631-90-5	20 - 40

Composition comments Information for specific product ingredients as required by the U.S. OSHA HAZARD COMMUNICATION STANDARD is listed. Refer to additional sections of this SDS for our assessment of the potential hazards of this formulation.

4. First-aid measures

Inhalation Remove victim to fresh air and keep at rest in a position comfortable for breathing. Give oxygen if necessary. Call a poison center or doctor/physician if you feel unwell.

Skin contact Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation develops and persists. Wash contaminated clothing before reuse. Wash off with soap and water.

Eye contact Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.

Ingestion Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.

Most important symptoms/effects, acute and delayed Irritation of eyes. Exposed individuals may experience eye tearing, redness, and discomfort. May cause respiratory irritation.

Indication of immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.

General information If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).

Unsuitable extinguishing media Do not use water jet as an extinguisher, as this will spread the fire.

Specific hazards arising from the chemical During fire, gases hazardous to health may be formed.

Special protective equipment and precautions for firefighters Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.

Fire fighting equipment/instructions In case of fire and/or explosion do not breathe fumes. Use standard firefighting procedures and consider the hazards of other involved materials. Move containers from fire area if you can do so without risk. Cool containers / tanks with water spray.

Specific methods Use standard firefighting procedures and consider the hazards of other involved materials.

General fire hazards No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Keep unnecessary personnel away. Wear appropriate protective equipment and clothing during clean-up. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. Avoid breathing mist/vapor. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up Stop the flow of material, if this is without risk. Following product recovery, flush area with water.

Environmental precautions Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS. Avoid discharge into drains, water courses or onto the ground. Water contaminated with this product may be sent to a sanitary sewer treatment facility, or a permitted waste treatment facility, in accordance with any local agreements.

7. Handling and storage

Precautions for safe handling Avoid contact with eyes. Avoid prolonged exposure. Vent carefully before opening. Sulfur dioxide can be formed during the normal use and handling of this product. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Use care in handling/storage.

Conditions for safe storage, including any incompatibilities Store locked up. Store in tightly closed container. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value
Sodium bisulphite (CAS 7631-90-5)	TWA	5 mg/m3

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
Sodium bisulphite (CAS 7631-90-5)	TWA	5 mg/m3

Biological limit values

No biological exposure limits noted for the ingredient(s).

Appropriate engineering controls

Provide adequate ventilation. Provide eyewash station. Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles) and a face shield.

Skin protection

Hand protection

Wear appropriate chemical resistant gloves. The choice of an appropriate glove does not only depend on its material but also on other quality features and is different from one producer to the other. Glove selection must take into account any solvents and other hazards present.

Other

Wear appropriate chemical resistant clothing.

Respiratory protection

In case of insufficient ventilation, wear suitable respiratory equipment. A respiratory protection program that meets OSHA's 29 CFR 1910.34 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

Thermal hazards

Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations

Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance

Liquid

Physical state

Liquid.

Form

Not available.

Color

Pink

Odor

Strong odor

Odor threshold

Not available.

pH (concentrated product)

3.2 Neat

Melting point/freezing point

39 °F (4 °C)

Initial boiling point and boiling range

219 °F (104 °C)

Flash point

Not Applicable

Evaporation rate

Slower than Ether

Flammability (solid, gas)

Not applicable.

Upper/lower flammability or explosive limits

Explosive limit - lower (%) Not available.

Explosive limit - upper (%) Not available.

Vapor pressure

18 mmHg

Vapor pressure temp.

70 °F (21 °C)

Vapor density

< 1

Relative density

1.26

Relative density temperature

70 °F (21 °C)

Solubility(ies)	
Solubility (water)	100 %
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	6 mPa.s
Viscosity temperature	70 °F (21 °C)
Other information	
Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.
pH in aqueous solution	3.5 (5% Solution)
Pour point	23 °F (-5 °C)
VOC	0 % CALCULATED

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur. Contact with acid may generate sulfur dioxide gas.
Conditions to avoid	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. Contact with incompatible materials.
Incompatible materials	Acids. Strong oxidizing agents.
Hazardous decomposition products	Elemental oxides

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause irritation to the respiratory system. Prolonged inhalation may be harmful.
Skin contact	Prolonged or repeated contact may cause irritation.
Eye contact	Causes eye irritation.
Ingestion	Expected to be a low ingestion hazard.

Symptoms related to the physical, chemical and toxicological characteristics	Irritation of eyes. Exposed individuals may experience eye tearing, redness, and discomfort. May cause respiratory irritation.
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Information on toxicological effects

Acute toxicity

Product	Species	Test Results
CORTROL IS3000		
<u>Acute</u>		
Dermal		
LD50	Rabbit	> 5000 mg/kg (Calculated according to GHS additivity formula)
Inhalation		
<i>Mist</i>		
LC50	Rat	495.5 mg/l/4h (Calculated according to GHS additivity formula)
Oral		
LD50	Rat	4191 mg/kg (Calculated according to GHS additivity formula)

Components	Species	Test Results
Sodium bisulphite (CAS 7631-90-5)		
<u>Acute</u>		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Inhalation		
LC50	Rat	> 5.5 mg/l, 4 Hour
Oral		
LD50	Rat	1420 mg/kg
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.	
Serious eye damage/eye irritation	Causes eye irritation.	
Respiratory or skin sensitization		
Respiratory sensitization	Not a respiratory sensitizer. This product is not expected to cause respiratory sensitization.	
Skin sensitization	This product is not expected to cause skin sensitization.	
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.	
Carcinogenicity	Not classified.	
IARC Monographs. Overall Evaluation of Carcinogenicity		
Sodium bisulphite (CAS 7631-90-5)		3 Not classifiable as to carcinogenicity to humans.
OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)		
Not listed.		
US. National Toxicology Program (NTP) Report on Carcinogens		
Not listed.		
Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.	
Specific target organ toxicity - single exposure	May cause respiratory irritation.	
Specific target organ toxicity - repeated exposure	Not classified.	
Aspiration hazard	Based on available data, the classification criteria are not met. Not an aspiration hazard.	
Chronic effects	Prolonged inhalation may be harmful.	

12. Ecological information

Ecotoxicity

Product	Species		Test Results
Aquatic			
Crustacea	0% Mortality	Daphnia magna	100 mg/L, 48 hour
	100% Mortality	Daphnia magna	500 mg/L, 48 hour
	LC50	Daphnia magna	204 mg/L, 48 hour (Estimated)
	NOEL	Daphnia magna	150 mg/L, 48 hour (Estimated)
Fish	0% Mortality	Rainbow Trout	500 mg/L, 48 hour
	100% Mortality	Rainbow Trout	1000 mg/L, 48 hour
	LC50	Fathead Minnow	210 mg/L, 96 hour (Estimated)
	NOEL	Fathead Minnow	150 mg/L, 96 hour (Estimated)

Persistence and degradability

- COD (mgO2/g) 54 (calculated data)

Bioaccumulative potential No data available.

Mobility in soil No data available.

Other adverse effects Not available.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number	UN3082
UN proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (SODIUM BISULFITE), RQ(SODIUM BISULFITE)
Transport hazard class(es)	
Class	9
Subsidiary risk	-
Packing group	III
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
ERG number	171
Some containers may be exempt from Dangerous Goods/Hazmat Transport Regulations, please check BOL for exact container classification.	

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

DOT



15. Regulatory information

US federal regulations	This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
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Toxic Substances Control Act (TSCA)

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Sodium bisulphite (CAS 7631-90-5) Listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical Yes

Classified hazard categories Serious eye damage or eye irritation
Specific target organ toxicity (single or repeated exposure)

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations**Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List**

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)

Contains component(s) regulated under the Safe Drinking Water Act.

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

Food and drug administration

ALL ingredients in this product are authorized in 21CFR173.310 for use as boiler water additives where the steam may contact food.

NSF Registered and/or meets USDA (according to 1998 guidelines):

Registration No. – 141465

Category Code(s):

G5 Cooling and retort water treatment products

G6 Boiler treatment products, steam line products – food contact

US state regulations**California Proposition 65**

California Safe Drinking Water and Toxic Enforcement Act of 2016 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins. For more information go to www.P65Warnings.ca.gov.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Developmental toxin

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Female reproductive toxin

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Male reproductive toxin

No ingredient listed.

16. Other information, including date of preparation or last revision**Issue date**

Oct-17-2014

Revision date

Feb-11-2023

Version #

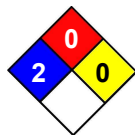
4.2

NFPA ratings

Health: 2

Flammability: 0

Instability: 0

NFPA ratings

List of abbreviations

CAS: Chemical Abstract Service Registration Number
OSHA: Occupational Safety & Health Administration.
ACGIH: American Conference of Governmental Industrial Hygienists
TWA: Time Weighted Average
STEL: Short Term Exposure Limit
LD50: Lethal Dose, 50%
LC50: Lethal Concentration, 50%
NOEL: No Observed Effect Level
COD: Chemical Oxygen Demand
BOD: Biochemical Oxygen Demand
TOC: Total Organic Carbon
TSRN indicates a Trade Secret Registry Number is used in place of the CAS number.
ATA: International Air Transport Association
IMDG: International Maritime Dangerous Goods Code
NFPA: National Fire Protection Association
DOT: Department of Transportation (49 CFR 172.101).
GHS: Globally Harmonized System of Classification and Labeling of Chemicals.
IARC: International Agency for Research on Cancer.

References:

No data available

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Revision information

This document has undergone significant changes and should be reviewed in its entirety.

Prepared by

This SDS has been prepared by Veolia Water Technologies & Solutions' Regulatory Department (1-215-355-3300).

* Trademark of Veolia. May be registered in one or more countries.

**Occidental Chemical Corporation:
Muscle Shoals, Alabama**

**Application for NPDES Permit Renewal
AL0000213**

September 2025

Prepared by

Jacobs

Prepared for
Alabama Department of Environmental Management



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Acronyms and Abbreviations

1Q ₁₀	Lowest 1-day average flow that occurs (on average) once every 10 years
7Q ₁₀	Lowest 7-day average flow that occurs (on average) once every 10 years
7Q ₂	Lowest 7-day average flow that occurs (on average) once every 2 years
ADEM	Alabama Department of Environmental Management
BMP	best management practices
BPJ	best professional judgement
BTA	best technology available
CFR	Code of Federal Regulations
cfs	cubic feet per second
CWIS	cooling water intake structure
ELG	Effluent Limitation Guidelines
EPA	U.S. Environmental Protection Agency
gpm	gallons per minute
mgd	million gallons per day
mg/L	milligrams per liter
NPDES	National Pollutant Discharge Elimination System
PDW	Phosphate Development Works
s.u.	standard units
TVA	Tennessee Valley Authority

1. Introduction

Occidental Chemical Corporation (OxyChem) located in Muscle Shoals, AL is herein submitting to the Alabama Department of Environmental Management (ADEM) an application for renewal of its National Pollutant Discharge Elimination System (NPDES) permit number AL0000213 that was effective on April 1, 2021, and expires on March 31, 2026. OxyChem is authorized to discharge treated process wastewater, non-process wastewater, and stormwater to Pond Creek via three outfalls under its existing NPDES permit.

This NPDES permit application is being submitted to ADEM to provide the information needed for permit renewal. This application includes completed ADEM Form 187 and Environmental Protection Agency (EPA) Forms 1, 2C, 2E, and 2F.

1.1 Facility Description

OxyChem, located in Muscle Shoals, Alabama in Colbert County, produces potassium carbonate and potassium bicarbonate at the Armand Products plant, which is a joint venture of Occidental Chemical Corporation and Church & Dwight Company, Inc.

The facility formerly included a chlor-alkali plant that ceased operation on April 28, 2008, has been decommissioned, and had the chlor-alkali production plant area capped. No significant changes have been made to the facility since the current NPDES permit was issued on March 30, 2021.

1.2 Facility Modifications

Production operations at the facility have not had any major changes during the current NPDES permit period. Beginning in 2026 OxyChem will start blending a small amount of magnesium oxide with potassium bicarbonate based on order requests (less than 1% of the total production will have magnesium oxide added). This blending process will take place when the anhydrous potassium bicarbonate is bagged and will not directly contribute to the process wastewater. Any exposure of magnesium oxide to the wastewater would be from periodic washdown of blending/bagging equipment and cleanup of spills from the floor. As indicated in the EPA Form 2C sample results, OxyChem's discharge from outfall DSN001 has a small amount of magnesium present and this additional process isn't expected to have any significant changes to the magnesium that may be present in the discharge from outfall DSN001.

OxyChem has utilized two surface water intakes located on the Tennessee River for cooling water. These surface water intakes are owned by the Tennessee Valley Authority (TVA) but operated and maintained by OxyChem. The Fleet Hollow intake is located on Wilson Lake and the Phosphate Development Works (PDW) intake is located in Pickwick Lake located approximately 0.9 miles downstream of Wilson Dam. The Fleet Hollow intake has been used as the primary intake, and the PDW intake was used during the warmer months of the year when the cooling needs of the plant could not be met by the Fleet Hollow Intake. The location of the PDW intake downstream of Wilson Dam provides cooler water in the summer months as water is released from the lower levels of Wilson Lake for power generation.

OxyChem is currently in the process of replacing two of the three pumps at the PDW intake and will be replacing the third pump in 2026. The rotating screen is also being replaced with a stationary screen that is 5 feet tall by 82 inches wide to protect the new pumps from floating debris. Beginning in late 2025 OxyChem will no longer be using the Fleet Hollow intake and will only be using the PDW intake. The new pumps being installed at the PDW intake are planned to be operated at 8,000 gpm (11.5 mgd) based on pressure requirements at the facility. The electrical system at the PDW intake will only support the operation of a single pump at a time, so the maximum pumping capacity for the intake will be approximately 11.5 mgd once the new pumps are operational.

2. NPDES Permit Outfall Descriptions

OxyChem is permitted to discharge process wastewater, miscellaneous wash down wastewaters, cooling water, boiler blowdown, tank containment released stormwater, stormwater runoff, and rinse water from the employee automobile wash via the existing NPDES permit. OxyChem has three permitted outfalls in its existing NPDES permit. Table 2.1 provides a description of each of these outfalls.

Table 2.1 NPDES Permit Outfall Descriptions

Outfall	Receiving Waters	Description
DSN001	Pond Creek	Process wastewater, miscellaneous wash down wastewaters, cooling water, boiler blowdown, tank containment released stormwater, and stormwater runoff
DSN003	Unnamed Tributary to Pond Creek	Stormwater runoff associated with railyard and tank car storage for Occidental Chemical Corporation
DSN006	DSN006	Rinse water (car wash) and stormwater runoff associated with the employee automobile wash and stormwater from the maintenance building and employee parking area

Throughout the life of the current NPDES permit OxyChem has implemented many mercury minimization activities as documented in the annual mercury minimization plan reports submitted to ADEM. OxyChem is continually evaluating measures to reduce mercury in the discharge from outfall DSN001. Other than these mercury minimization activities, there have been no changes to the operations at the facility that impact wastewater and/or stormwater discharged from the permitted outfalls.

3. Outfall Sampling

OxyChem collected samples for completion of the NPES permit renewal application. Samples were collected from outfall DSN001 for completion of EPA Forms 2C and 2F. OxyChem submitted a representative stormwater sampling request to ADEM on May 20, 2025, to use outfall DSN003 as representative of outfall DSN006 for the NPDES permit renewal application. ADEM approved that request on June 9, 2025. As part of the response to the representative stormwater sampling request, ADEM indicated a sample of the Tennessee River intake water

could be used for the EPA Form 2E requirements for outfall DSN006 because nothing is added to the intake water prior to use at the employee car wash.

Since Pond Creek is on Alabama's §303(d) List, ADEM has requested OxyChem to collect samples from Pond Creek upstream of outfall DSN001 for the parameters on the §303(d) List. Samples of the Tennessee River intake water and Pond Creek upstream of outfall DSN001 were collected on July 23, 2025, and the results of those samples are presented in Table 3.1.

Table 3.1 Tennessee River Intake Water and Pond Creek Sample Results

Parameter (units)	Pond Creek Upstream of DSN001	Tennessee River Intake Water
BOD ₅ (mg/L)	- ^{1/}	< 5.0
Solids, Total Suspended (mg/L)	-	2
Oil & Grease (mg/L)	-	7.3
pH (s.u.)	7.60	7.54
Nitrogen, Ammonia Total (mg/L)	-	< 0.100
Chemical Oxygen Demand (mg/L)	-	< 15.0
Total Organic Carbon (mg/L)	-	2.96
Total Residual Chlorine (mg/L)	-	0.08
Cyanide, Total (mg/L)	< 0.005	< 0.005
Arsenic, Total (mg/L)	< 0.010	< 0.010
Mercury, Total (ng/L) ^{2/}	1.40	< 0.500

^{1/} "-" indicates no sample collected for this parameter

^{2/} Samples for mercury collected and analyzed in accordance with EPA Methods 1669 and 1631E

As of the date of the NPDES permit renewal application submittal, OxyChem has been unable to collect a sample of a discharge from outfall DSN003 from a qualifying storm event. OxyChem will continue to attempt to collect a sample from outfall DSN003 from a qualifying storm event and submit the sample results when available.

4. Derivation of Permit Limitations

This section discusses the requested permit limits for OxyChem's permit renewal.

4.1 Outfall DSN001

OxyChem discharges process wastewater and stormwater via outfall DSN001 to Pond Creek at a location that is approximately 1.3 miles upstream of the Tennessee River (Pickwick Reservoir). Process wastewater is from the production of potassium carbonate and potassium bicarbonate from potassium hydroxide, carbon dioxide, and water. Since EPA has not promulgated specific effluent limitation guidelines for the discharges from the production of potassium carbonate or potassium bicarbonate, best professional judgment and the state water quality standards will be used in establishing permit limitations.

This discharge location is within a 24-hour travel time to the Tennessee River so ADEM evaluates water quality-based limits for outfall DSN001 for Pond Creek and the Tennessee River. At outfall DSN001 discharge location, Pond Creek has a designated use classification of Agricultural and Industrial (A&I). Pond Creek is also on Alabama's 2024 §303(d) List for arsenic, cyanide, mercury, and organic enrichment (BOD). Sources of the impairments are listed as crop production (non-irrigated), natural, and urban runoff/storm sewers. The Tennessee River at the location where Pond Creek enters has a designated use classification of Public Water Supply, Swimming, and Fish & Wildlife.

Flow estimates for Pond Creek at outfall DSN001 are the same as those used for the current NPDES permit:

- $7Q_{10} = 0$ cfs
- $7Q_2 = 0$ cfs
- $1Q_{10} = 0$ cfs
- Annual Average = 47.2 cfs

Flow estimates for the Tennessee River where Pond Creek enters were provided by ADEM (e-mail from James Mooney dated August 5, 2025):

- $7Q_{10} = 7,887.9$ cfs
- $7Q_2 = 12,534.0$ cfs
- $1Q_{10} = 5,915.8$ cfs
- Annual Average = 50,937.0 cfs

The ADEM reasonable potential spreadsheet was used to evaluate the reasonable potential of the discharge from outfall DSN001 to Pond Creek to exceed water quality criteria. The following inputs were used:

- Pond Creek flows statistics presented above
- Upstream Pond Creek flow of 1.80 mgd based on the July 2023 through June 2025 average flows from the Muscle Shoals WWTP (1.33 mgd) and the TVA Environmental Resource Center (0.47 mgd)
- Upstream mercury concentration in Pond Creek of 1.40 ng/L based on a sample collected by OxyChem on July 23, 2025
- OxyChem discharge flow of 7.8 mgd
- OxyChem discharge average mercury concentration of 26.5 ng/L and maximum mercury concentration of 72.5 mg/L (August 2024 – July 2025 data)

Based on the results of the reasonable potential analysis, OxyChem has a reasonable potential for mercury for the human health consumption of fish only water quality criteria. The mercury in the discharge is not associated with current production processes at the facility, it is present in stormwater from areas of the plant site that were impacted by operations of the former mercury cell chlor-alkali that ceased operation in 2008. Since the current permit was issued on March 30, 2021, OxyChem has implemented a mercury minimization plan as required by the NPDES permit. The annual reports submitted to ADEM have documented the activities that have been completed and are planned to continue to reduce mercury in the discharge from DSN001. These mercury minimization activities have had a measurable impact of reducing mercury in discharge of outfall DSN001 and OxyChem requests the mercury minimization requirements be continued in the renewed NPDES permit.

ADEM informed OxyChem the mixing zone modeling for temperature and instream waste concentration would need to be updated for this NPDES permit renewal since the previous modeling was completed in 2014. The mixing zone model for Pond Creek entering the Tennessee River was updated using OxyChem's current outfall DSN001 average discharge flow of 7.8 mgd and the Tennessee River flows provided by ADEM. The updated models indicate a discharge temperature of 90 °F is protective of the Tennessee River water quality criteria of 86 °F and the instream waste concentration for toxicity testing should be updated to 71%. A technical memorandum documenting the mixing zone model results with an ADEM Form 455 – Required Information for Mixing Zone Modeling is included as Attachment 1.

Considering the revised mixing zone modeling indicates a decrease in the instream waste concentration of OxyChem's discharge and there have been no toxicity tests which indicate toxicity during the current NPDES permit cycle, OxyChem requests the monitoring frequency for toxicity for outfall DSN001 be changed from semi-annual to annual.

OxyChem requests the renewed NPDES permit to contain the permit limitations for outfall DSN001 as shown in Table 4.1.

Table 4.1 Requested Permit Limits and Monitoring Requirements for Outfall DSN001

Parameter (units)	Monthly Average	Daily Minimum	Daily Maximum	Monitoring Frequency
Temperature (°F)	-	-	90 ^{1/}	Continuous ^{2/}
Oxygen, Dissolved (mg/L) ^{3/}	-	3.0	-	Monthly
pH (s.u.) ^{4/}	-	Report	Report	Continuous
Solids, Total Suspended (mg/L)	-	-	Report	Monthly
Nitrogen, Ammonia Total (mg/L)	-	-	Report	Monthly
Nitrogen, Kjeldahl Total (mg/L)	-	-	Report	Monthly ^{5/}
Nitrate + Nitrite, Total (mg/L)	-	-	Report	Monthly ^{5/}
Phosphorus, Total (mg/L)	-	-	Report	Monthly ^{5/}
Flow (mgd)	Report	-	Report	Continuous
Chlorine, Total Residual (mg/L) ^{6/}	-	-	0.022	Monthly
Mercury, Total Recoverable (µg/L) ^{7/}	Report	-	Report	Monthly
CBOD ₅ (mg/L)	-	-	Report	Monthly
Arsenic, Total Recoverable (µg/L)	-	-	Report	Annually
Cyanide, Free Available (µg/L) ^{8/}	-	-	Report	Annually
Toxicity, Ceriodaphnia Acute [pass(0)/fail(1)] ^{9/}	-	-	0	Annually
Toxicity, Pimephales Acute [pass(0)/fail(1)] ^{10/}	-	-	0	Annually

^{1/} Temperature shall be reported as the time-weighted average over the course of 24 hours.

^{2/} "Continuous" as it applies to Temperature means a minimum of one sample taken every 20 minutes

^{3/} Dissolved oxygen monitoring and compliance shall occur at the base of the flume on the west side of Alabama Highway 133

^{4/} Where the pH is measured continuously, the total time during which the pH values are outside the required range of 6.0 to 8.5 standard units shall not exceed 7 hours and 26 minutes in any calendar month and no individual excursion outside the range of pH values shall exceed 60 minutes in duration.

^{5/} Monitoring for total Kjeldahl nitrogen, nitrate + nitrite nitrogen, and total phosphorus shall only be required during the growing season months of April through September

^{6/} A measurement of Total Residual Chlorine below 0.05 mg/L shall be considered in compliance with the permit limitations above and should be reported as NODI-B or *B on the discharge monitoring report

^{7/} EPA Methods 1631/1669, or alternative methods specifically approved by ADEM, shall be used for the analysis of mercury

^{8/} For the purpose of demonstration of compliance with this parameter, "cyanide, free available" and "cyanide, free" shall be considered equivalent. The test methods in 40 CFR 136.3 Table 1B for "24.A Cyanide, Free" or equivalent EPA approved methods shall be used for analysis.

^{9/} A 48-hour acute toxicity test diluted to an instream waste concentration of 71% shall be conducted using *ceriodaphnia dubia*. Any test where survival in the effluent concentration is less than 90% and statistically lower than the control indicates acute toxicity.

^{10/} A 24-hour acute toxicity test using undiluted wastewater shall be conducted using *pimephales promelas*. Any test where survival in the effluent concentration is less than 90% and statistically lower than the control indicates acute toxicity.

The OxyChem NPDES permit also contains limitations and monitoring requirements for outfall DSN001 for discharges resulting from a qualifying storm event. Table 4.2 presents a summary of the monitoring results for the storm event samples for outfall DSN001 from January 2023 through July 2025. All the monitoring results for pH are within the water quality criteria values of 6.0 – 8.5 s.u., the maximum oil & grease is less than half the daily maximum permit limit, and all the chemical oxygen demand results were non-detect. Based on the quality of the discharge from storm events, OxyChem requests the monitoring frequency for these storm event discharges be reduced from quarterly to semi-annually.

Table 4.2 DSN001 Quarterly Storm Event Data Summary for January 2023 through July 2025

Parameter (units)	Current Permit Limitations		Current Permit Monitoring Frequency	Range of Monitoring Results
	Monthly Average	Daily Maximum		
pH (s.u.)	Report ^{1/}	Report	Quarterly	7.3 – 7.9
Solids, Total Suspended (mg/L)	-	Report	Quarterly	3.0 – 38
Oil & Grease (mg/L)	-	15.0	Quarterly	0 – 6.3
Flow (mgd)	Report	Report	Quarterly	3.4 – 9.8
Chemical Oxygen Demand (mg/L)	0.022	0.039	Quarterly	ND

^{1/} Daily Minimum

ND = not detected

4.2 Outfalls DSN003 and DSN006

Table 4.3. presents a summary of discharge data for outfall DSN003 from January 2023 through July 2025. Discharges from outfall DSN003 are within the range of expected values from a well-managed stormwater outfall. The current NPDES permit requires monitoring at outfall DSN003 on a quarterly basis. OxyChem requests the monitoring frequency for outfall DSN003 be changed to semi-annually. No changes are requested to the permit limitations or monitoring frequency for outfall DSN006.

Table 4.3 DSN003 Discharge Monitoring Report Data Summary for January 2023 through July 2025

Parameter (units)	Current Permit Limitations		Current Permit Monitoring Frequency	Range of Monitoring Results
	Monthly Average	Daily Maximum		
pH (s.u.)	Report ^{1/}	Report	Quarterly	7.1 – 8.4
Solids, Total Suspended (mg/L)	-	Report	Quarterly	7.0 – 246
Oil & Grease (mg/L)	-	15.0	Quarterly	ND – 3.0
Flow (mgd)	Report	Report	Quarterly	0 – 3.2
Chemical Oxygen Demand (mg/L)	0.022	0.039	Quarterly	18.8 – 107

^{1/} Daily Minimum

ND = not detected

4.3 Determination of Best Technology Available (BTA) for OxyChem's Cooling Water Intake Structure (CWIS) - §316(b) Requirements

OxyChem receives intake water from two CWIS (Fleet Hollow and Phosphate Development Works) that are owned by the Tennessee Valley Authority. The Fleet Hollow intake structure withdraws water from the Tennessee River (Wilson Reservoir) and Phosphate Development Works (PDS) intake is also located on the Tennessee River (Pickwick Reservoir).

As mentioned previously, OxyChem will be transitioning to only using the PDW intake in late 2025. The replacement of the 3 pumps at the PDW intake will reduce the total intake capacity from 38.9 mgd to 34.5 mgd. However, the actual capacity of the PDW intake will only be 11.5 mgd because the electrical upgrades for the new pumps will only supply enough power to operate a single pump at a time.

The 3/8" mesh rotating screen is being replaced with a 1/2" mesh screen. The 1/2" mesh screen has an open area of 65%. The rotating screen that will be removed extended to the bottom of the intake and the new screen is 5 feet tall by 82 inches wide. The elevation of the new screen will be adjusted as the water level in Pickwick Reservoir changes to protect the new pumps from floating debris. The area below the 5-foot screen depth will be open to the bottom of the intake.

The Tennessee Valley Authority operating guide for Pickwick Reservoir indicates the normal operating level in November through March is 409 feet above sea level and for April through September is 413.75 feet above sea level. The water level is reduced from the summer pool to the winter pool level from September through November. The water depth in the intake was measured in January 2024 in preparation for replacing the pumps and screen to be approximately 15 feet. Based on the TVA operating guide, the water depth in the intake in the summer months will be approximately 20 feet.

At a 15-foot water depth and open width of 82", with the top 5 feet screened with a 1/2" mesh screen with a 65% open area, the through-screen velocity at the maximum design flow of 11.5 mgd will be 0.20 feet per second. The velocity will be less during the summer months when the water elevation is increased. After the modifications to the PDW intake, the maximum through-screen design velocity of the PDW intake will be 0.20 feet per second. This value is less than a maximum through-screen design intake velocity of 0.5 feet per second and meets the best technology available for minimizing environmental impacts for impingement mortality in 40 CFR 125.94.

There have been no significant changes in operations of the Pickwick or Wilson reservoirs by TVA nor the biological characteristics of the reservoirs since the previous permit application was submitted. The *316(b) Supporting Information: Cooling Water Intake for Fleet Hollow Intake on Wilson Reservoir, January 8, 2019*, and *316(b) Supporting Information: Cooling Water Intake for PDW Intake on Pickwick Reservoir, January 8, 2019*, have been included to provide the permit application requirements in 40 CFR 122.21(r)(2) through (r)(8).

The TVA PDW intake operated by OxyChem meets the BTA requirements in 40 CFR 125.94 and no permit modifications are required for §316(b) requirements.

5. Attachments

Attachment A – Occidental Chemical Corporation Tennessee River CORMIX Modeling Technical Memorandum

Attachment B - ADEM Form 187

Attachment C – EPA Form 1

Attachment D – EPA Form 2C

Attachment E – EPA Form 2E

Attachment F – EPA Form 2F

Attachment A – Occidental Chemical Corporation Tennessee River CORMIX Modeling Technical Memorandum

Occidental Chemical Corporation Tennessee River CORMIX Modeling

Date:	August 22, 2025	1100 112th Avenue NE
Project no:	D3619800 Task 7	Suite 500
Attention:	Occidental Chemical Corporation, Muscle Shoals, AL	Bellevue, WA 98004-5118
Prepared by:	Erin Thatcher, PE	United States
Reviewed by:	Johnathan Hall, PE	T +1.425.453.5000
		www.jacobs.com

1 Introduction

Occidental Chemical Corporation (OxyChem) in Muscle Shoals, Alabama discharges effluent to Pond Creek, which then flows into the Tennessee River (Pickwick Lake), under National Pollutant Discharge Elimination System (NPDES) Permit No. AL0000213. CORMIX modeling of the discharge's dilution was completed in 2014 (CH2M HILL) in response to a request from the NPDES Permit authority, the Alabama Department of Environmental Management (ADEM). This modeling was completed to 1) confirm that an effluent temperature limit of 90 degrees Fahrenheit (°F) was protective of the Tennessee River water quality criteria for temperature (86 °F), and 2) to determine the instream waste concentration (IWC) of the discharge in the Tennessee River. This technical memorandum provides updated CORMIX dilution modeling results for the current discharge and receiving water flow rates.

2 Regulatory Criteria

OxyChem's outfall DSN001 is a surface water outfall that discharges to Pond Creek, which has a use classification of Agricultural and Industrial Water Supply (A&I). Pond Creek flows into the Tennessee River (Pickwick Lake), which has a higher classification of Public Water Supply (PWS) and Fish and Wildlife (F&W), approximately 1.27 miles downstream of the OxyChem discharge. Per ADEM guidance, permit limitations must be protective of the higher classification of the downstream receiving water because the discharge reaches it within 24 hours of travel time. Therefore, the OxyChem discharge's permit limitations must be protective of the A&I use for Pond Creek as well as the PWS and F&W uses in the Tennessee River after allowing for mixing.

Federal and state regulations require discharges to waters with F&W use classifications to demonstrate compliance with acute toxicity at the edge of the zone of initial dilution (ZID), and compliance with chronic toxicity at the edge of the mixing zone (MZ). The MZ and ZID established for this discharge apply in the Tennessee River (Pickwick Lake).

ADEM's guidance documents dictate the dilution modeling should be based on the acute toxicity guidelines since the completely mixed ratio for OxyChem's discharge into the Tennessee River at its 7Q10 flow is greater than 100 (i.e., the IWC is less than 1%). The instream waste concentration for the acute toxicity is determined by the CORMIX model using the Tennessee River's 1Q10 flow and limiting ZID. The temperature limit is determined by the CORMIX model using the Tennessee River's 7Q10 flow and the limiting MZ.

Mixing Zone.

Per ADEM Admin. Code r. 335-6-6-.15, the MZ is defined as the most stringent of the following criteria:

1. Width Criteria: MZ shall not exceed 50 percent of stream width:

$$MZ = 0.50 \times \text{Stream Width} = 0.50 \times 1,900 \text{ ft} = \mathbf{950 \text{ ft}}$$

2. Length Criteria: MZ shall not exceed a length of five times the width of the MZ:

$$MZ = 5 \times \text{MZ Width} = 5 \times 950 \text{ ft} = \mathbf{4,750 \text{ ft}}$$

3. Area Criteria: MZ must not exceed an area of 25 percent of the stream cross sectional area:

$$MZ = 0.25 \times (\text{Cross - Sectional Area}) = 0.25 \times (1,900 \times 23) = \mathbf{10,925 \text{ ft}^2}$$

4. The total area of all mixing zones in a lake shall not encompass more than ten percent of the surface area of the lake, the radius of any one zone shall not be greater than 750 ft.
5. A mixing zone shall not encompass water intakes.

ADEM has advised that the mixing zone criteria for lakes is not applicable to the Tennessee River. The city of Sheffield has a drinking water intake on the Tennessee River downstream of Pond Creek, but it is over 3.5 miles away and beyond the distance of the mixing zone length criteria.

CORMIX models were completed and evaluated to determine the limiting mixing zone criterion for the temperature and toxicity scenarios. Based on the CORMIX model results, the limiting mixing zone criterion for the thermal model and the toxicity model is the width, as shown below in Table 1. CORMIX model output files for these evaluations are included in Attachment 2.

Table 1. Limiting MZ Criteria Determined by CORMIX3

MZ Criterion	Value	Thermal Model Predicted Dilution at MZB ^a	Toxicity Model Predicted Dilution at MZB ^b
Width	950 ft	26.1	12.6
Length ^c	4,750 ft	53.4	39.4
Area	10,925 sf	133.1	Outside model predictions

^a Model was conducted using a total Pond Creek flow of 9.6 mgd and the 7Q10 flow for the Tennessee River.

^b Model was conducted using the discharge flow of 7.8 mgd from OxyChem and the 1Q10 flow for the Tennessee River.

^c Modeled in CORMIX3 as the length of the plume's trajectory (not downstream length).

Zone of Initial Dilution.

Per ADEM Admin. Code r. 335-6-6-.03, the length of the ZID is defined as the most stringent of the following:

1. Fifty times the discharge length scale (DLS) in any spatial direction, where the DLS is the square root of the cross-sectional area of any discharge outlet:

$$\text{Outlet cross sectional area} = (\text{outlet width} \times \text{depth}) = (25 \text{ ft} \times 2.5 \text{ ft}) = 62.5 \text{ ft}^2$$

$$50 \times DLS = 50 \times \sqrt{\text{Outlet cross sectional area}} = 50 \times \sqrt{62.5} = \mathbf{395.3 \text{ ft}}$$

2. Five times the water depth in any horizontal direction from the discharge outlet:

$$5 \times \text{water depth} = 5 \times 23 \text{ ft} = \mathbf{115 \text{ ft}}$$

3. No more than 10 percent of the distance from the edge of the outfall structure to the leading edge of the mixing zone in any spatial direction:

$$0.10 \times \text{Mixing Zone} = 0.10 \times 950 \text{ ft} = \mathbf{95 \text{ ft}}$$

Therefore, the ZID for the OxyChem discharge is 10 percent of the distance from the edge of the outfall structure to the leading edge of the MZ in any spatial direction, which is **95 feet** from the mouth of Pond Creek in any spatial direction within the Tennessee River.

Critical conditions for water quality compliance include the lowest 7-day average flow that occurs (on average) once every 10 years (7Q10), which is zero for Pond Creek (CH2M HILL, 2014). The sum of the average discharge flow rates from the three main dischargers to Pond Creek was used to evaluate the excess temperature at the edge of the MZ in the Tennessee River. These three major dischargers are the OxyChem discharge, the Muscle Shoals Wastewater Treatment Plant (WWTP), and the Tennessee Valley Authority (TVA) Environmental Research Center (ERC). Only the OxyChem discharge flow rate was used to determine the IWC at the edge of the ZID. This approach is based on previous communication from ADEM (CH2M HILL, 2014).

3 Model Inputs

The following sections summarize the inputs and assumptions for the updated CORMIX dilution model to simulate the discharge plume at critical low flow river conditions for the current discharge and receiving water flows to determine 1) the excess temperature at the MZ and 2) the IWC at the ZID. This 2025 modeling utilized the CORMIX3 module (surface discharges) within CORMIX Version 12.0.1.0 (August 2021).

3.1 Ambient Conditions

Updated river flows for critical conditions were provided by ADEM based on April 1, 2005, through March 31, 2025, flow data provided by the TVA. Critical conditions for compliance with acute toxicity criteria for protection of aquatic life include the lowest 1-day average flow that occurs (on average) once every 10 years (1Q10 flow). The current 1Q10 flow for the Tennessee River at the Pond Creek confluence provided by ADEM is 5,915.8 cfs.

Critical conditions compliance with the temperature criteria for aquatic life include the 7Q10 flow. The current 7Q10 flow for the Tennessee River provided by ADEM for this analysis is 7,888 cfs.

Other ambient model inputs for critical conditions for both models (temperature and acute IWC) were brought forward unchanged from the 2014 (CH2M HILL) analysis:

- Average depth: 23 ft
- Depth at discharge: 16.1 ft (30% less than the average depth)
- Bounded river channel width: 1,900 ft
- Ambient water temperature: 28 °C (82.4 °F)

- Wind speed: 2 m/s (recommended default value from CORMIX that is only meaningful to farfield dilution)
- Manning's n: 0.032

3.2 Effluent and Discharge Configuration Parameters

Updated discharge flow rates were obtained for OxyChem and the other two main dischargers to Pond Creek (Muscle Shoals WWTP and TVA ERC based on July 2003 through June 2025 average discharge flow). Constellium Muscle Shoals, LLC also discharges to Pond Creek upstream of OxyChem, but it was not included in the model. Average discharge flow data used in this updated model are as follows:

- OxyChem: 7.79 mgd (used for acute IWC model)
- Muscle Shoals WWTP: 1.33 mgd
- TVA ERC: 0.47 mgd
- Total (used for temperature compliance model): 9.6 mgd

The previous (CH2M HILL 2014) model applied very similar discharge flow rates to these updated values.

The geometry of Pond Creek's confluence with the Tennessee River are assumed to be the same as that determined in 2014 based on aerial photography and a reasonable conservative assumption for discharge channel depth within CORMIX model constraints. The following effluent and discharge configuration parameters were brought forward unchanged from the 2014 (CH2M HILL) analysis:

- Effluent temperature: 32.22 °C (90 °C), which is the effluent temperature limit for OxyChem in its NPDES permit
- Discharge excess concentration
 - o Temperature compliance model:
 - Excess temperature of 4.22 °C (excess above ambient temperature of 28 °C)
 - Heat loss coefficient of 25 W/m² °C based on CORMIX User Manual recommendations (EPA, 2021)
 - o Acute IWC model: 100% (conservative pollutant)
- Discharge located on left bank
- Protruding discharge configuration
- Distance from bank: 200 ft
- Horizontal angle: 90 degrees
- Bottom slope: 20 degrees
- Local depth at discharge outlet: 2.5 ft
- Discharge width: 25 ft
- Discharge depth: 2.5 ft

4 Modeling Results

CORMIX assigns a flow class to the discharge of PL 1, which is characterized by an area of upstream intrusion where the discharge plume spreads upstream because of its buoyancy combined with weak ambient crosscurrents. This behavior is apparent in the graphical representations of the modeled plumes shown below in Figure 1 (temperature compliance model) and Figure 2 (acute IWC model).

The model predictions of excess temperature and IWC correspond to hydrodynamic average (bulk) dilutions at the distances and are calculated with linear interpolation from the model prediction files. The temperature compliance model predicts an excess temperature of 0.16 °C at the MZB width of 289.56 m (950 ft). This means the mixed temperature at the MZB under critical conditions would be 28.16 °C and the effluent temperature limit of 90 °F (32.2 °C) is protective of the Tennessee River water quality criteria of 86 °F (30 °C).

The IWC model predicts an IWC of 70.5% at the downstream ZID of 28.9 m (95 ft) with the current flow rates (ambient and discharge), and the upstream ZID of -28.9 m (95 ft) is beyond the model-predicted plume boundary. The model-predicted IWC just within the upstream ZID boundary is 30.6% at a distance of 26 m. Table 2 below summarizes the current and previous (2014) model results.

The ADEM required information for mixing zone modeling (ADEM Form 455) is included as Attachment 1. The full CORMIX model output files are included as Attachment 2.

Table 2. CORMIX Model Results Summary

Dilution Model Parameter	2014 (CH2M HILL)	2025 (Current Analysis)
Temperature Model		
Muscle Shoals WWTP Flow to Pond Creek	1.3 mgd	1.3 mgd
TVA ERC Flow to Pond Creek	1.4 mgd	0.47 mgd
OxyChem Discharge Flow to Pond Creek	7.3 mgd	7.8 mgd
Total Discharge Flow to Tennessee River (Muscle Shoals, TVA ERC, and OxyChem)	10.0 mgd	9.6 mgd
7Q10 River Flow	6,750 cfs	7,888 cfs
Mixing Zone Boundary (MZB)	Distance of 228.6 m (750 ft)	Width of 289.6 m (950 ft)
Excess Temperature (°C) at MZB	0.91 °C	0.16 °C
Instream Waste Concentration (IWC) Model		
Discharge Flow (OxyChem Average Flow Only)	7.3 mgd	7.8 mgd
1Q10 River Flow	5,060 cfs	5,916 cfs
Zone of Initial Dilution (ZID)	22.86 m (75 ft)	28.96 m (95 ft)
IWC at Upstream ZID	82.2%	N/A ^a (30.6% at 26 m)
IWC at Downstream ZID	87.9%	70.5%

^a IWC at the upstream ZID was outside the boundaries for the model predictions. Predicted IWC would be less than the 30.6% at the boundary distance of 26 m.

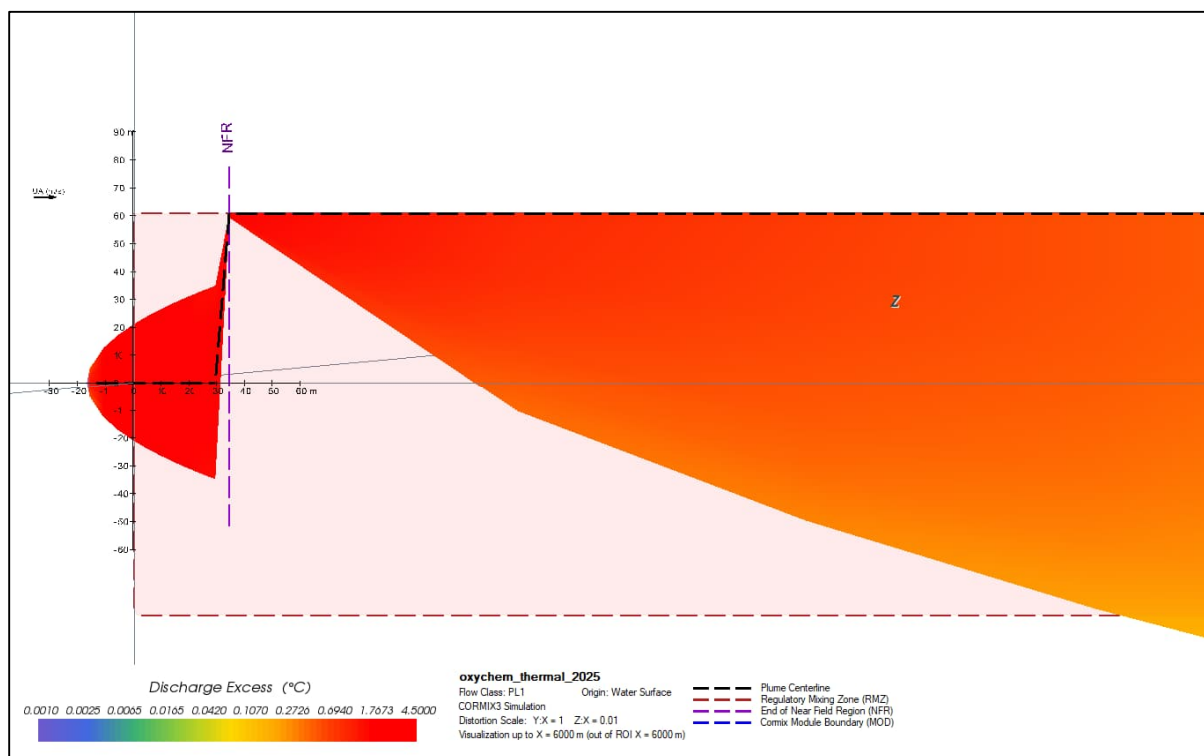


Figure 1. Plan View of CORMIX3 Model-Predicted Discharge Plume for the Temperature Compliance Analysis (CorVue image from CORMIX)

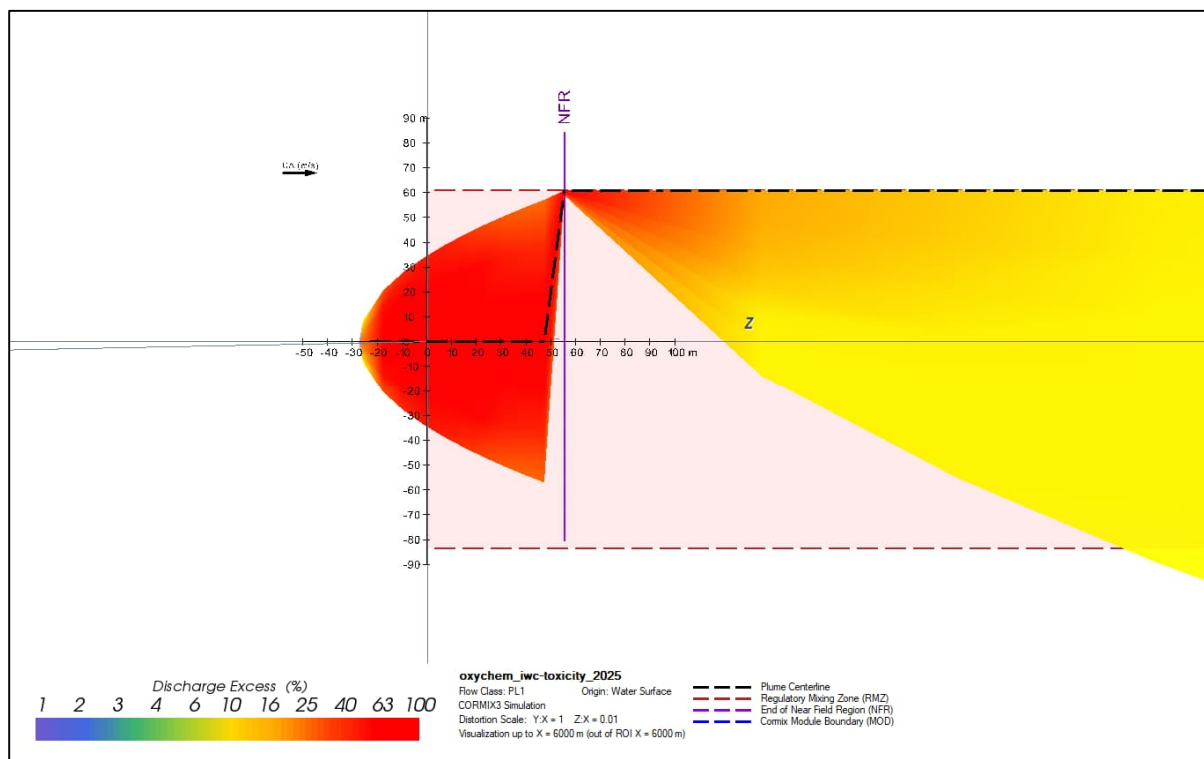


Figure 2. Plan View of CORMIX3 Model-Predicted Discharge Plume for the Acute IWC Analysis (CorVue image from CORMIX)

5 References

CH2M HILL. 2014. *Technical Memorandum: Tennessee River CORMIX Modeling*. Prepared for Occidental Chemical Company, Muscle Shoals, AL. Revised March 17, 2014.

Alabama Department of Environmental Management (ADEM). Administrative Code Chapter 335-6-6. Accessed at <https://admincode.legislature.state.al.us/api/chapter/335-6-6>.

U.S. Environmental Protection Agency (EPA). 2021. *CORMIX User Manual: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters*. EPA-823-K-07-001. Prepared by Robert L. Doneker and Gerhard H. Jirka. December 2007; updated July 2021.

Attachments

Attachment 1 – ADEM Form 455 – Required Information for Mixing Zone Modeling

Attachment 2 - CORMIX Model Output Files

Attachment 1 – ADEM Form 455 - Required Information for Mixing Zone Modeling

REQUIRED INFORMATION FOR MIXING ZONE MODELING

GENERAL INFORMATION

1. Applicant Name: Occidental Chemical Corporation
2. Permit No.: AL0000213
3. Project Name (if different from applicant): _____
4. Contact name and phone number: David Mullins, 256-389-2224
5. Date submitted: _____
5. Facility type (new, existing or upgrade): Existing

AMBIENT CONDITIONS

1. Receiving waterbody: Tennessee River (Pickwick Lake) at Pond Creek
2. Width of waterbody at discharge point (m): 579.12 m (1900 ft)
3. Depth of waterbody at discharge point (m): 16.1 m (4.91 ft)
4. Average depth of waterbody at discharge point (m): 7.01 m (23 ft)

DISCHARGE TYPE:

Submerged endpipe or submerged multiport diffuser? Surface Endpipe (Pond Creek into the Tennessee River)
Effluent Density (kg/m³): 994.9584

Note: Fill out box A below for endpipe discharges; box B for diffuser discharges.

A. DISCHARGE CONDITIONS FOR SUBMERGED ENDPIPE DISCHARGES

1. Nearest bank (right or left) to the outfall looking downstream: Left
2. Distance from nearest bank to discharge (m): 60.96 m (200 ft) based on delta where Pond Creek enters the TN River
3. Endpipe diameter (m): 2.5ft x 25ft channel
4. Contraction ratio (if known): _____
5. Height of discharge above stream bottom (m): N/A
6. Effluent flow rate (mgd): 7.8 mgd (0.420222 m3/s)

B. DISCHARGE CONDITIONS FOR SUBMERGED MULTIPORT DIFFUSERS

NOTE:

Diffuser length is defined as the distance between the first and last diffuser ports.

1. Diffuser length (m): _____
2. Nearest bank (right or left) to the outfall looking downstream: _____
3. Distance from nearest bank to first diffuser port (m): _____
4. Total number of ports: _____
5. Diameter of a single port (m): _____
6. Distance between adjacent ports (i.e., port spacing, m): _____
7. Height of ports above stream bottom (m): _____
8. Port contraction ratio (if known): _____
9. Diameter of diffuser manifold (m): _____
10. Effluent flow rate (mgd): _____

SPECIAL REQUIREMENTS

1. Please submit a map displaying the outfall location along with the appropriate latitude/longitude coordinates.
2. Please submit the appropriate engineering plans that depict the outfall configuration.

Attachment 2 – CORMIX Model Output Files

***** FLOW CLASS DESCRIPTION *****

The following description of flow class PL1 applies to the FULL WATER DEPTH at the discharge site:

FLOW_CLASS_PL1

The discharge is issued with relatively low velocity and high buoyancy into an environment with a relatively low ambient velocity. For this reason, the effluent will spread upstream along the shoreline against the ambient current. The receiving water is relatively deep in the vicinity of the discharge so no significant interaction with the bottom takes place in the near-field.

The flow will consist of the following flow regimes:

- 1) Upstream intrusion: Upstream of the discharge will be a steady layer of effluent. This upstream spreading is caused by the strong buoyancy of the effluent and a relatively weak ambient crossflow. This regime ends just downstream of the discharge where far-field buoyant spreading takes over.
- 2) Far-field buoyant spreading: The plume spreads laterally along the surface while being advected downstream with the ambient current. The mixing rate is relatively small and the thickness may decrease in this regime. The plume remains attached to the shoreline.
- 3) Passive ambient diffusion: The ambient turbulence becomes the predominant mixing process in this regime. The plume will grow in both the vertical and horizontal directions at a rate that is dependent on the magnitude of the ambient turbulence. The flow may interact with the bottom or the opposite shoreline in this regime.

END OF FLOW CLASS DESCRIPTION *****

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: 50 Percent of Stream Width
FILE NAME: \\montgomery\Proj\OccidentalChemicalCo\D3619800 Muscle Shoals\2025 CORMIX Modeling\Modeling
Files\oxychem thermal 2025.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/14/2025--12:13:23

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section		= bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 223.36 m ³ /s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0550 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m ³
Bottom density	RHOAB	= 996.2338 kg/m ³

DISCHARGE PARAMETERS:

Discharge located on		= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m ²
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.420222 m ³ /s
Discharge velocity	U0	= 0.07 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m ³
Density difference	DRHO	= 1.2790 kg/m ³
Buoyant acceleration	GP0	= 0.0126 m/s ²
Discharge concentration	C0	= 4.22 deg.C
Surface heat exchange coeff.	KS	= 0.000006 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ = 2.41 m	Lm = 3.17 m	Lbb = 31.77 m
LM = 1.00 m		

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.42 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.74 (based on H0)
Velocity ratio	R	= 1.32

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge		= no
Water quality standard specified		= no
Regulatory mixing zone		= yes
Regulatory mixing zone specification		= width
Regulatory mixing zone value		= 289.56 m (m ² if area)
Region of interest		= 6000 m

HYDRODYNAMIC CLASSIFICATION:

FLOW CLASS	= PL1
------------	-------

Limiting Dilution S = (QA/Q0) + 1.0 = 532.5

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 2.8787 deg.C

Dilution at edge of NFR s = 1.5

NFR Location: x = 34.24 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 36.81 m

thickness (bv) = 0.30 m

Cumulative travel time: 626.0216 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof), but RE-STRATIFIES LATER.

Plume becomes vertically fully mixed again at 5730.36 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts one bank only at -17.12 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****

No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****

The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 0.159422 deg.C

Corresponding dilution s = 26.1

Plume location: x = 1028.84 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 289.56 m

thickness (bv) = 0.69 m

Cumulative travel time: 18670.0820 sec.

REGULATORY MIXING ZONE criteria were satisfied in the Upstream Intrusion region.

Carefully review the prediction file.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian 1/e (37%) vertical thickness
- BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution

C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

Control volume outflow: SIGMAE= 303.03
X Y Z S C BV BH UC TT
0.14 -0.43 0.00 1.0 0.422E+01 0.92 3.21 0.072 .62202E+01
Cumulative travel time = 6.2202 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:
X Y Z S C BV BH TT
0.14 -0.43 0.00 1.0 0.422E+01 0.92 3.21 .62202E+01

UPSTREAM INTRUSION PROPERTIES:
Upstream intrusion length = 17.12 m
X-position of upstream stagnation point = -17.12 m
Thickness in intrusion region = 0.30 m
Half-width at downstream end = 36.81 m
Thickness at downstream end = 0.30 m

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-17.12	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.62202E+01
-16.09	0.00	0.00	3.3	0.129E+01	0.09	5.21	.62202E+01
-11.06	0.00	0.00	1.4	0.306E+01	0.22	12.65	.62202E+01
-6.03	0.00	0.00	1.1	0.388E+01	0.28	17.11	.62202E+01
-0.99	0.00	0.00	1.0	0.421E+01	0.30	20.63	.62202E+01
4.04	0.00	0.00	1.0	0.412E+01	0.30	23.63	.77189E+02
9.07	0.00	0.00	1.1	0.380E+01	0.30	26.29	.16866E+03
14.10	0.00	0.00	1.2	0.344E+01	0.30	28.71	.26013E+03
19.14	0.00	0.00	1.3	0.317E+01	0.30	30.93	.35161E+03
24.17	0.00	0.00	1.4	0.301E+01	0.30	33.01	.44308E+03
29.20	0.00	0.00	1.4	0.293E+01	0.30	34.96	.53455E+03
34.24	0.00	0.00	1.5	0.288E+01	0.30	36.81	.62602E+03
Cumulative travel time = 626.0216 sec (0.17 hrs)							

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
34.24	60.96	0.00	1.5	0.288E+01	7.01	1.59	.62602E+03
86.14	60.96	0.00	3.4	0.123E+01	0.57	45.54	.15677E+04
138.04	60.96	0.00	3.9	0.108E+01	0.42	71.36	.25093E+04
189.95	60.96	0.00	4.3	0.968E+00	0.36	92.43	.34510E+04
241.85	60.96	0.00	4.8	0.876E+00	0.33	110.75	.43926E+04
293.76	60.96	0.00	5.3	0.790E+00	0.32	127.22	.53343E+04
345.66	60.96	0.00	5.9	0.710E+00	0.32	142.32	.62759E+04
397.57	60.96	0.00	6.6	0.635E+00	0.32	156.39	.72176E+04
449.47	60.96	0.00	7.4	0.565E+00	0.33	169.63	.81593E+04
501.38	60.96	0.00	8.3	0.502E+00	0.35	182.22	.91009E+04
553.28	60.96	0.00	9.4	0.446E+00	0.37	194.26	.10043E+05
605.19	60.96	0.00	10.6	0.396E+00	0.39	205.85	.10984E+05
657.09	60.96	0.00	11.9	0.351E+00	0.42	217.05	.11926E+05
709.00	60.96	0.00	13.4	0.312E+00	0.45	227.92	.12868E+05
760.90	60.96	0.00	15.0	0.278E+00	0.48	238.50	.13809E+05
812.81	60.96	0.00	16.8	0.248E+00	0.51	248.82	.14751E+05
864.71	60.96	0.00	18.7	0.222E+00	0.55	258.91	.15692E+05
916.62	60.96	0.00	20.9	0.199E+00	0.59	268.80	.16634E+05
968.52	60.96	0.00	23.2	0.180E+00	0.63	278.50	.17576E+05
1020.43	60.96	0.00	25.6	0.162E+00	0.68	288.03	.18517E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the TOTAL plume width meets or exceeds the regulatory value = 289.56 m.

This is the extent of the REGULATORY MIXING ZONE.

1072.33	60.96	0.00	28.3	0.147E+00	0.73	297.40	.19459E+05
1124.24	60.96	0.00	31.2	0.133E+00	0.77	306.63	.20401E+05

MZB = width (BH) of 289.56 m (950 ft)

1176.14	60.96	0.00	34.2	0.121E+00	0.83	315.71	.21342E+05
1228.05	60.96	0.00	37.5	0.111E+00	0.88	324.67	.22284E+05
1279.95	60.96	0.00	40.9	0.101E+00	0.93	333.51	.23226E+05
1331.86	60.96	0.00	44.5	0.928E-01	0.99	342.24	.24167E+05
1383.76	60.96	0.00	48.4	0.854E-01	1.05	350.86	.25109E+05
1435.67	60.96	0.00	52.5	0.787E-01	1.11	359.37	.26051E+05
1487.57	60.96	0.00	56.8	0.727E-01	1.18	367.79	.26992E+05
1539.48	60.96	0.00	61.3	0.673E-01	1.24	376.12	.27934E+05
1591.38	60.96	0.00	66.0	0.624E-01	1.31	384.36	.28876E+05
1643.29	60.96	0.00	70.9	0.580E-01	1.38	392.51	.29817E+05
1695.19	60.96	0.00	76.1	0.540E-01	1.45	400.59	.30759E+05
1747.10	60.96	0.00	81.5	0.504E-01	1.52	408.58	.31701E+05
1799.00	60.96	0.00	87.1	0.471E-01	1.60	416.51	.32642E+05
1850.90	60.96	0.00	93.0	0.441E-01	1.67	424.36	.33584E+05
1902.81	60.96	0.00	99.1	0.414E-01	1.75	432.14	.34526E+05
1954.71	60.96	0.00	105.5	0.388E-01	1.83	439.85	.35467E+05
2006.62	60.96	0.00	112.1	0.365E-01	1.91	447.50	.36409E+05
2058.52	60.96	0.00	118.9	0.344E-01	1.99	455.08	.37351E+05
2110.43	60.96	0.00	126.0	0.324E-01	2.08	462.61	.38292E+05
2162.33	60.96	0.00	133.4	0.306E-01	2.16	470.07	.39234E+05
2214.24	60.96	0.00	141.0	0.289E-01	2.25	477.48	.40175E+05
2266.14	60.96	0.00	148.9	0.274E-01	2.34	484.83	.41117E+05
2318.05	60.96	0.00	157.0	0.259E-01	2.43	492.13	.42059E+05
2369.95	60.96	0.00	165.4	0.246E-01	2.52	499.38	.43000E+05
2421.86	60.96	0.00	174.0	0.234E-01	2.62	506.58	.43942E+05
2473.76	60.96	0.00	182.9	0.222E-01	2.71	513.72	.44884E+05
2525.67	60.96	0.00	192.1	0.211E-01	2.81	520.82	.45825E+05
2577.57	60.96	0.00	201.6	0.201E-01	2.91	527.88	.46767E+05
2629.48	60.96	0.00	211.3	0.192E-01	3.01	534.88	.47709E+05
Cumulative travel time =			47708.7266 sec	(	13.25 hrs)		

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.589E-02 m^2/s
Horizontal diffusivity (initial value) = 0.147E-01 m^2/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to water depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2629.48	60.96	0.00	211.3	0.192E-01	3.01	534.88	.47709E+05
2696.89	60.96	0.00	214.1	0.189E-01	3.05	534.93	.48932E+05
2764.30	60.96	0.00	216.9	0.187E-01	3.09	534.99	.50155E+05
2831.71	60.96	0.00	219.8	0.184E-01	3.13	535.04	.51378E+05
2899.12	60.96	0.00	222.9	0.181E-01	3.18	535.09	.52601E+05
2966.53	60.96	0.00	226.0	0.178E-01	3.22	535.15	.53823E+05
3033.94	60.96	0.00	229.1	0.176E-01	3.26	535.20	.55046E+05
3101.35	60.96	0.00	232.4	0.173E-01	3.31	535.25	.56269E+05
3168.76	60.96	0.00	235.8	0.170E-01	3.36	535.30	.57492E+05
3236.17	60.96	0.00	239.3	0.168E-01	3.41	535.36	.58715E+05
3303.58	60.96	0.00	242.9	0.165E-01	3.46	535.41	.59938E+05
3370.99	60.96	0.00	246.6	0.163E-01	3.51	535.46	.61161E+05
3438.40	60.96	0.00	250.4	0.160E-01	3.56	535.52	.62384E+05
3505.81	60.96	0.00	254.3	0.157E-01	3.62	535.57	.63607E+05
3573.22	60.96	0.00	258.4	0.155E-01	3.68	535.62	.64830E+05
3640.63	60.96	0.00	262.6	0.152E-01	3.74	535.67	.66053E+05
3708.04	60.96	0.00	266.9	0.149E-01	3.80	535.73	.67276E+05
3775.45	60.96	0.00	271.3	0.147E-01	3.86	535.78	.68499E+05
3842.86	60.96	0.00	275.9	0.144E-01	3.93	535.83	.69722E+05
3910.27	60.96	0.00	280.7	0.142E-01	3.99	535.89	.70945E+05
3977.69	60.96	0.00	285.6	0.139E-01	4.06	535.94	.72168E+05
4045.10	60.96	0.00	290.7	0.136E-01	4.13	535.99	.73391E+05
4112.51	60.96	0.00	295.9	0.134E-01	4.21	536.04	.74614E+05
4179.92	60.96	0.00	301.3	0.131E-01	4.29	536.10	.75837E+05
4247.33	60.96	0.00	306.9	0.129E-01	4.36	536.15	.77060E+05
4314.74	60.96	0.00	312.7	0.126E-01	4.45	536.20	.78283E+05
4382.15	60.96	0.00	318.8	0.124E-01	4.53	536.25	.79506E+05
4449.56	60.96	0.00	325.0	0.121E-01	4.62	536.31	.80728E+05
4516.97	60.96	0.00	331.4	0.119E-01	4.71	536.36	.81951E+05
4584.38	60.96	0.00	338.1	0.116E-01	4.80	536.41	.83174E+05
4651.79	60.96	0.00	344.9	0.114E-01	4.90	536.47	.84397E+05
4719.20	60.96	0.00	352.1	0.111E-01	5.00	536.52	.85620E+05
4786.61	60.96	0.00	359.5	0.109E-01	5.11	536.57	.86843E+05
4854.02	60.96	0.00	367.2	0.107E-01	5.22	536.62	.88066E+05
4921.43	60.96	0.00	375.1	0.104E-01	5.33	536.68	.89289E+05
4988.84	60.96	0.00	383.3	0.102E-01	5.44	536.73	.90512E+05
5056.25	60.96	0.00	391.9	0.996E-02	5.57	536.78	.91735E+05
5123.67	60.96	0.00	400.7	0.973E-02	5.69	536.83	.92958E+05
5191.08	60.96	0.00	409.9	0.951E-02	5.82	536.89	.94181E+05
5258.49	60.96	0.00	419.4	0.928E-02	5.95	536.94	.95404E+05

[illegible]

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: 50 Percent of Stream Width
FILE NAME: \\montgomery\Proj\OccidentalChemicalCo\D3619800 Muscle Shoals\2025 CORMIX Modeling\Modeling
Files\oxychem iwc-toxicity 2025.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/14/2025--12:57:17

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section		= bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 167.52 m ³ /s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0413 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m ³
Bottom density	RHOAB	= 996.2338 kg/m ³

DISCHARGE PARAMETERS:

Discharge located on		= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m ²
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.342634 m ³ /s
Discharge velocity	U0	= 0.06 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m ³
Density difference	DRHO	= 1.2790 kg/m ³
Buoyant acceleration	GP0	= 0.0126 m/s ²
Discharge concentration	C0	= 100 %
Surface heat exchange coeff.	KS	= 0 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ = 2.41 m	Lm = 3.45 m	Lbb = 61.41 m
LM = 0.82 m		

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.34 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.60 (based on H0)
Velocity ratio	R	= 1.43

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge		= no
Water quality standard specified		= no
Regulatory mixing zone		= yes
Regulatory mixing zone specification		= width
Regulatory mixing zone value		= 289.56 m (m ² if area)
Region of interest		= 6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 489.9

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 61.005900 %

Dilution at edge of NFR s = 1.6

NFR Location: x = 55.39 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 60.30 m

thickness (bv) = 0.23 m

Cumulative travel time: 1346.7344 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.

Plume becomes laterally fully mixed at 2047.20 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts nearest bank at -27.70 m downstream.

Plume contacts second bank at 2047.20 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****

No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****

The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 7.92676 %

Corresponding dilution s = 12.6

Plume location: x = 746.45 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 289.56 m

thickness (bv) = 0.36 m

Cumulative travel time: 18060.5957 sec.

REGULATORY MIXING ZONE criteria were satisfied in the Upstream Intrusion region.

Carefully review the prediction file.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +/-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian $1/e$ (37%) vertical thickness
- BH = Gaussian $1/e$ (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution
- C = centerline concentration (includes reaction effects, if any)
- Uc = Local centerline excess velocity (above ambient)
- TT = Cumulative travel time

Control volume outflow:
X Y Z S C BV BH UC TT
0.12 -0.40 0.00 1.0 0.100E+03 0.91 3.25 0.059 .70947E+01
Cumulative travel time = 7.0947 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:
X Y Z S C BV BH TT
0.12 -0.40 0.00 1.0 0.100E+03 0.91 3.25 .70947E+01

UPSTREAM INTRUSION PROPERTIES:
Upstream intrusion length = 27.70 m
X-position of upstream stagnation point = -27.70 m
Thickness in intrusion region = 0.23 m
Half-width at downstream end = 60.30 m
Thickness at downstream end = 0.23 m

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-27.70	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.70947E+01
-26.03	0.00	0.00	3.3	0.306E+02	0.07	8.53	.70947E+01
-17.89	0.00	0.00	1.4	0.725E+02	0.16	20.71	.70947E+01
-9.75	0.00	0.00	1.1	0.921E+02	0.21	28.02	.70947E+01
-1.61	0.00	0.00	1.0	0.998E+02	0.23	33.79	.70947E+01
6.54	0.00	0.00	1.0	0.968E+02	0.23	38.70	.16268E+03
14.68	0.00	0.00	1.2	0.866E+02	0.23	43.06	.36002E+03
22.82	0.00	0.00	1.3	0.761E+02	0.23	47.02	.55737E+03
30.96	0.00	0.00	1.5	0.687E+02	0.23	50.66	.75471E+03
39.11	0.00	0.00	1.6	0.644E+02	0.23	54.07	.95205E+03
47.25	0.00	0.00	1.6	0.623E+02	0.23	57.27	.11494E+04
55.39	0.00	0.00	1.6	0.610E+02	0.23	60.30	.13467E+04
Cumulative travel time =			1346.7346 sec (0.37 hrs)				

Downstream ZID = Distance of 28.96 m (95 ft)

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
55.39	60.96	0.00	1.6	0.610E+02	7.01	1.94	.13467E+04
95.23	60.96	0.00	3.7	0.272E+02	0.64	47.66	.23102E+04
135.06	60.96	0.00	4.2	0.241E+02	0.46	74.80	.32737E+04
174.90	60.96	0.00	4.5	0.221E+02	0.39	97.07	.42372E+04
214.74	60.96	0.00	4.9	0.206E+02	0.35	116.54	.52007E+04
254.57	60.96	0.00	5.2	0.192E+02	0.32	134.11	.61641E+04
294.41	60.96	0.00	5.6	0.180E+02	0.31	150.28	.71276E+04
334.24	60.96	0.00	5.9	0.168E+02	0.30	165.36	.80911E+04
374.08	60.96	0.00	6.4	0.157E+02	0.29	179.58	.90546E+04
413.92	60.96	0.00	6.8	0.147E+02	0.29	193.09	.10018E+05
453.75	60.96	0.00	7.3	0.136E+02	0.29	206.01	.10982E+05
493.59	60.96	0.00	7.9	0.127E+02	0.30	218.44	.11945E+05
533.43	60.96	0.00	8.5	0.118E+02	0.31	230.45	.12908E+05
573.26	60.96	0.00	9.1	0.109E+02	0.31	242.10	.13872E+05
613.10	60.96	0.00	9.8	0.102E+02	0.32	253.44	.14835E+05
652.93	60.96	0.00	10.6	0.943E+01	0.33	264.50	.15799E+05
692.77	60.96	0.00	11.4	0.875E+01	0.34	275.32	.16762E+05
732.61	60.96	0.00	12.3	0.813E+01	0.36	285.93	.17726E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the TOTAL plume width meets or exceeds
the regulatory value = 289.56 m.

This is the extent of the REGULATORY MIXING ZONE.

772.44	60.96	0.00	13.2	0.756E+01	0.37	296.34	.18689E+05
812.28	60.96	0.00	14.2	0.703E+01	0.38	306.58	.19653E+05
852.11	60.96	0.00	15.3	0.654E+01	0.40	316.66	.20616E+05
891.95	60.96	0.00	16.4	0.609E+01	0.42	326.59	.21580E+05
931.79	60.96	0.00	17.6	0.568E+01	0.43	336.40	.22543E+05
971.62	60.96	0.00	18.9	0.530E+01	0.45	346.08	.23507E+05
1011.46	60.96	0.00	20.2	0.495E+01	0.47	355.65	.24470E+05
1051.29	60.96	0.00	21.6	0.463E+01	0.49	365.11	.25434E+05

1091.13	60.96	0.00	23.0	0.434E+01	0.51	374.48	.26397E+05
1130.97	60.96	0.00	24.6	0.407E+01	0.53	383.75	.27361E+05
1170.80	60.96	0.00	26.2	0.382E+01	0.55	392.93	.28324E+05
1210.64	60.96	0.00	27.9	0.359E+01	0.57	402.04	.29288E+05
1250.47	60.96	0.00	29.6	0.337E+01	0.60	411.06	.30251E+05
1290.31	60.96	0.00	31.5	0.318E+01	0.62	420.01	.31215E+05
1330.15	60.96	0.00	33.4	0.300E+01	0.64	428.89	.32178E+05
1369.98	60.96	0.00	35.4	0.283E+01	0.67	437.70	.33142E+05
1409.82	60.96	0.00	37.4	0.267E+01	0.69	446.45	.34105E+05
1449.66	60.96	0.00	39.6	0.253E+01	0.72	455.13	.35068E+05
1489.49	60.96	0.00	41.8	0.239E+01	0.75	463.75	.36032E+05
1529.33	60.96	0.00	44.1	0.227E+01	0.77	472.32	.36995E+05
1569.16	60.96	0.00	46.5	0.215E+01	0.80	480.83	.37959E+05
1609.00	60.96	0.00	49.0	0.204E+01	0.83	489.28	.38922E+05
1648.84	60.96	0.00	51.6	0.194E+01	0.86	497.69	.39886E+05
1688.67	60.96	0.00	54.2	0.184E+01	0.89	506.04	.40849E+05
1728.51	60.96	0.00	56.9	0.176E+01	0.92	514.34	.41813E+05
1768.34	60.96	0.00	59.8	0.167E+01	0.95	522.60	.42776E+05
1808.18	60.96	0.00	62.7	0.160E+01	0.98	530.80	.43740E+05
1848.02	60.96	0.00	65.7	0.152E+01	1.01	538.97	.44703E+05
1887.85	60.96	0.00	68.8	0.145E+01	1.04	547.09	.45667E+05
1927.69	60.96	0.00	72.0	0.139E+01	1.07	555.16	.46630E+05
1967.52	60.96	0.00	75.3	0.133E+01	1.11	563.20	.47594E+05
2007.36	60.96	0.00	78.6	0.127E+01	1.14	571.19	.48557E+05
2047.20	60.96	0.00	82.1	0.122E+01	1.17	579.12	.49521E+05

Cumulative travel time = 49520.6953 sec (13.76 hrs)
 Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.469E-02 m²/s
 Horizontal diffusivity (initial value) = 0.117E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
 = or equal to water depth, if fully mixed
 BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
 measured horizontally in Y-direction
 S = hydrodynamic centerline dilution
 C = centerline concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2047.20	60.96	0.00	82.1	0.122E+01	1.17	579.12	.49521E+05
2126.25	60.96	0.00	82.3	0.122E+01	1.18	579.12	.51433E+05
2205.31	60.96	0.00	82.4	0.121E+01	1.18	579.12	.53345E+05
2284.36	60.96	0.00	82.6	0.121E+01	1.18	579.12	.55257E+05
2363.42	60.96	0.00	82.7	0.121E+01	1.18	579.12	.57169E+05
2442.48	60.96	0.00	82.9	0.121E+01	1.19	579.12	.59081E+05
2521.53	60.96	0.00	83.1	0.120E+01	1.19	579.12	.60993E+05
2600.59	60.96	0.00	83.2	0.120E+01	1.19	579.12	.62905E+05
2679.65	60.96	0.00	83.4	0.120E+01	1.19	579.12	.64817E+05
2758.70	60.96	0.00	83.5	0.120E+01	1.20	579.12	.66729E+05
2837.76	60.96	0.00	83.7	0.119E+01	1.20	579.12	.68641E+05
2916.81	60.96	0.00	83.9	0.119E+01	1.20	579.12	.70553E+05
2995.87	60.96	0.00	84.0	0.119E+01	1.20	579.12	.72465E+05
3074.93	60.96	0.00	84.2	0.119E+01	1.20	579.12	.74377E+05
3153.98	60.96	0.00	84.3	0.119E+01	1.21	579.12	.76290E+05
3233.04	60.96	0.00	84.5	0.118E+01	1.21	579.12	.78202E+05
3312.09	60.96	0.00	84.7	0.118E+01	1.21	579.12	.80114E+05
3391.15	60.96	0.00	84.8	0.118E+01	1.21	579.12	.82026E+05
3470.21	60.96	0.00	85.0	0.118E+01	1.22	579.12	.83938E+05
3549.26	60.96	0.00	85.2	0.117E+01	1.22	579.12	.85850E+05
3628.32	60.96	0.00	85.3	0.117E+01	1.22	579.12	.87762E+05
3707.38	60.96	0.00	85.5	0.117E+01	1.22	579.12	.89674E+05
3786.43	60.96	0.00	85.7	0.117E+01	1.23	579.12	.91586E+05
3865.49	60.96	0.00	85.9	0.116E+01	1.23	579.12	.93498E+05
3944.54	60.96	0.00	86.0	0.116E+01	1.23	579.12	.95410E+05
4023.60	60.96	0.00	86.2	0.116E+01	1.23	579.12	.97322E+05
4102.66	60.96	0.00	86.4	0.116E+01	1.24	579.12	.99234E+05
4181.71	60.96	0.00	86.5	0.116E+01	1.24	579.12	.10115E+06
4260.77	60.96	0.00	86.7	0.115E+01	1.24	579.12	.10306E+06
4339.82	60.96	0.00	86.9	0.115E+01	1.24	579.12	.10497E+06
4418.88	60.96	0.00	87.1	0.115E+01	1.25	579.12	.10688E+06
4497.94	60.96	0.00	87.2	0.115E+01	1.25	579.12	.10879E+06
4576.99	60.96	0.00	87.4	0.114E+01	1.25	579.12	.11071E+06
4656.05	60.96	0.00	87.6	0.114E+01	1.25	579.12	.11262E+06
4735.10	60.96	0.00	87.8	0.114E+01	1.26	579.12	.11453E+06
4814.16	60.96	0.00	88.0	0.114E+01	1.26	579.12	.11644E+06
4893.22	60.96	0.00	88.1	0.113E+01	1.26	579.12	.11835E+06
4972.27	60.96	0.00	88.3	0.113E+01	1.26	579.12	.12027E+06
5051.33	60.96	0.00	88.5	0.113E+01	1.27	579.12	.12218E+06
5130.39	60.96	0.00	88.7	0.113E+01	1.27	579.12	.12409E+06
5209.44	60.96	0.00	88.9	0.113E+01	1.27	579.12	.12600E+06
5288.50	60.96	0.00	89.0	0.112E+01	1.27	579.12	.12792E+06
5367.55	60.96	0.00	89.2	0.112E+01	1.28	579.12	.12983E+06

Simulation limit based on maximum specified distance = 6000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

[illegible]

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: MZ Length
FILE NAME: \\montgomery\Proj\OccidentalChemicalCo\D3619800 Muscle Shoals\2025 CORMIX Modeling\Modeling
Files\oxychem thermal 2025.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/14/2025--12:21:17

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section	=	bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 223.36 m ³ /s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0550 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m ³
Bottom density	RHOAB	= 996.2338 kg/m ³

DISCHARGE PARAMETERS:

Discharge located on	Surface Discharge	= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m ²
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.420222 m ³ /s
Discharge velocity	U0	= 0.07 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m ³
Density difference	DRHO	= 1.2790 kg/m ³
Buoyant acceleration	GP0	= 0.0126 m/s ²
Discharge concentration	C0	= 4.22 deg.C
Surface heat exchange coeff.	KS	= 0.000006 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ	= 2.41 m	Lm	= 3.17 m	Lbb	= 31.77 m
LM	= 1.00 m				

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.42 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.74 (based on H0)
Velocity ratio	R	= 1.32

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge	= no
Water quality standard specified	= no
Regulatory mixing zone	= yes
Regulatory mixing zone specification	= trajectory
Regulatory mixing zone value	= 1447.80 m (m ² if area)
Region of interest	= 6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 532.5

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 2.8787 deg.C

Dilution at edge of NFR s = 1.5

NFR Location: x = 34.24 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 36.81 m

thickness (bv) = 0.30 m

Cumulative travel time: 626.0216 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof), but RE-STRATIFIES LATER.

Plume becomes vertically fully mixed again at 5730.36 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts one bank only at -17.12 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****

No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****

The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 0.077413 deg.C

Corresponding dilution s = 53.4

Plume location: x = 1446.52 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 361.14 m

thickness (bv) = 1.13 m

Cumulative travel time: 26247.5117 sec.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian 1/e (37%) vertical thickness
- BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution

C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

Control volume outflow: SIGMAE= 303.03
X Y Z S C BV BH UC TT
0.14 -0.43 0.00 1.0 0.422E+01 0.92 3.21 0.072 .62202E+01
Cumulative travel time = 6.2202 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:
X Y Z S C BV BH TT
0.14 -0.43 0.00 1.0 0.422E+01 0.92 3.21 .62202E+01

UPSTREAM INTRUSION PROPERTIES:

Upstream intrusion length = 17.12 m
X-position of upstream stagnation point = -17.12 m
Thickness in intrusion region = 0.30 m
Half-width at downstream end = 36.81 m
Thickness at downstream end = 0.30 m

Profile definitions:

BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-17.12	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.62202E+01
-16.09	0.00	0.00	3.3	0.129E+01	0.09	5.21	.62202E+01
-11.06	0.00	0.00	1.4	0.306E+01	0.22	12.65	.62202E+01
-6.03	0.00	0.00	1.1	0.388E+01	0.28	17.11	.62202E+01
-0.99	0.00	0.00	1.0	0.421E+01	0.30	20.63	.62202E+01
4.04	0.00	0.00	1.0	0.412E+01	0.30	23.63	.77189E+02
9.07	0.00	0.00	1.1	0.380E+01	0.30	26.29	.16866E+03
14.10	0.00	0.00	1.2	0.344E+01	0.30	28.71	.26013E+03
19.14	0.00	0.00	1.3	0.317E+01	0.30	30.93	.35161E+03
24.17	0.00	0.00	1.4	0.301E+01	0.30	33.01	.44308E+03
29.20	0.00	0.00	1.4	0.293E+01	0.30	34.96	.53455E+03
34.24	0.00	0.00	1.5	0.288E+01	0.30	36.81	.62602E+03
Cumulative travel time = 626.0216 sec (0.17 hrs)							

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:

BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
34.24	60.96	0.00	1.5	0.288E+01	7.01	1.59	.62602E+03
86.14	60.96	0.00	3.4	0.123E+01	0.57	45.54	.15677E+04
138.04	60.96	0.00	3.9	0.108E+01	0.42	71.36	.25093E+04
189.95	60.96	0.00	4.3	0.968E+00	0.36	92.43	.34510E+04
241.85	60.96	0.00	4.8	0.876E+00	0.33	110.75	.43926E+04
293.76	60.96	0.00	5.3	0.790E+00	0.32	127.22	.53343E+04
345.66	60.96	0.00	5.9	0.710E+00	0.32	142.32	.62759E+04
397.57	60.96	0.00	6.6	0.635E+00	0.32	156.39	.72176E+04
449.47	60.96	0.00	7.4	0.565E+00	0.33	169.63	.81593E+04
501.38	60.96	0.00	8.3	0.502E+00	0.35	182.22	.91009E+04
553.28	60.96	0.00	9.4	0.446E+00	0.37	194.26	.10043E+05
605.19	60.96	0.00	10.6	0.396E+00	0.39	205.85	.10984E+05
657.09	60.96	0.00	11.9	0.351E+00	0.42	217.05	.11926E+05
709.00	60.96	0.00	13.4	0.312E+00	0.45	227.92	.12868E+05
760.90	60.96	0.00	15.0	0.278E+00	0.48	238.50	.13809E+05
812.81	60.96	0.00	16.8	0.248E+00	0.51	248.82	.14751E+05
864.71	60.96	0.00	18.7	0.222E+00	0.55	258.91	.15692E+05
916.62	60.96	0.00	20.9	0.199E+00	0.59	268.80	.16634E+05
968.52	60.96	0.00	23.2	0.180E+00	0.63	278.50	.17576E+05
1020.43	60.96	0.00	25.6	0.162E+00	0.68	288.03	.18517E+05
1072.33	60.96	0.00	28.3	0.147E+00	0.73	297.40	.19459E+05
1124.24	60.96	0.00	31.2	0.133E+00	0.77	306.63	.20401E+05
1176.14	60.96	0.00	34.2	0.121E+00	0.83	315.71	.21342E+05
1228.05	60.96	0.00	37.5	0.111E+00	0.88	324.67	.22284E+05
1279.95	60.96	0.00	40.9	0.101E+00	0.93	333.51	.23226E+05
1331.86	60.96	0.00	44.5	0.928E-01	0.99	342.24	.24167E+05

1383.76	60.96	0.00	48.4	0.854E-01	1.05	350.86	.25109E+05
1435.67	60.96	0.00	52.5	0.787E-01	1.11	359.37	.26051E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the plume TRAJECTORY distance meets or exceeds the regulatory value = 1447.80 m.

This is the extent of the REGULATORY MIXING ZONE.

1487.57	60.96	0.00	56.8	0.727E-01	1.18	367.79	.26992E+05
1539.48	60.96	0.00	61.3	0.673E-01	1.24	376.12	.27934E+05
1591.38	60.96	0.00	66.0	0.624E-01	1.31	384.36	.28876E+05
1643.29	60.96	0.00	70.9	0.580E-01	1.38	392.51	.29817E+05
1695.19	60.96	0.00	76.1	0.540E-01	1.45	400.59	.30759E+05
1747.10	60.96	0.00	81.5	0.504E-01	1.52	408.58	.31701E+05
1799.00	60.96	0.00	87.1	0.471E-01	1.60	416.51	.32642E+05
1850.90	60.96	0.00	93.0	0.441E-01	1.67	424.36	.33584E+05
1902.81	60.96	0.00	99.1	0.414E-01	1.75	432.14	.34526E+05
1954.71	60.96	0.00	105.5	0.388E-01	1.83	439.85	.35467E+05
2006.62	60.96	0.00	112.1	0.365E-01	1.91	447.50	.36409E+05
2058.52	60.96	0.00	118.9	0.344E-01	1.99	455.08	.37351E+05
2110.43	60.96	0.00	126.0	0.324E-01	2.08	462.61	.38292E+05
2162.33	60.96	0.00	133.4	0.306E-01	2.16	470.07	.39234E+05
2214.24	60.96	0.00	141.0	0.289E-01	2.25	477.48	.40175E+05
2266.14	60.96	0.00	148.9	0.274E-01	2.34	484.83	.41117E+05
2318.05	60.96	0.00	157.0	0.259E-01	2.43	492.13	.42059E+05
2369.95	60.96	0.00	165.4	0.246E-01	2.52	499.38	.43000E+05
2421.86	60.96	0.00	174.0	0.234E-01	2.62	506.58	.43942E+05
2473.76	60.96	0.00	182.9	0.222E-01	2.71	513.72	.44884E+05
2525.67	60.96	0.00	192.1	0.211E-01	2.81	520.82	.45825E+05
2577.57	60.96	0.00	201.6	0.201E-01	2.91	527.88	.46767E+05
2629.48	60.96	0.00	211.3	0.192E-01	3.01	534.88	.47709E+05

Cumulative travel time = 47708.7266 sec (13.25 hrs)

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.589E-02 m²/s
Horizontal diffusivity (initial value) = 0.147E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to water depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2629.48	60.96	0.00	211.3	0.192E-01	3.01	534.88	.47709E+05
2696.89	60.96	0.00	214.1	0.189E-01	3.05	534.93	.48932E+05
2764.30	60.96	0.00	216.9	0.187E-01	3.09	534.99	.50155E+05
2831.71	60.96	0.00	219.8	0.184E-01	3.13	535.04	.51378E+05
2899.12	60.96	0.00	222.9	0.181E-01	3.18	535.09	.52601E+05
2966.53	60.96	0.00	226.0	0.178E-01	3.22	535.15	.53823E+05
3033.94	60.96	0.00	229.1	0.176E-01	3.26	535.20	.55046E+05
3101.35	60.96	0.00	232.4	0.173E-01	3.31	535.25	.56269E+05
3168.76	60.96	0.00	235.8	0.170E-01	3.36	535.30	.57492E+05
3236.17	60.96	0.00	239.3	0.168E-01	3.41	535.36	.58715E+05
3303.58	60.96	0.00	242.9	0.165E-01	3.46	535.41	.59938E+05
3370.99	60.96	0.00	246.6	0.163E-01	3.51	535.46	.61161E+05
3438.40	60.96	0.00	250.4	0.160E-01	3.56	535.52	.62384E+05
3505.81	60.96	0.00	254.3	0.157E-01	3.62	535.57	.63607E+05
3573.22	60.96	0.00	258.4	0.155E-01	3.68	535.62	.64830E+05
3640.63	60.96	0.00	262.6	0.152E-01	3.74	535.67	.66053E+05
3708.04	60.96	0.00	266.9	0.149E-01	3.80	535.73	.67276E+05
3775.45	60.96	0.00	271.3	0.147E-01	3.86	535.78	.68499E+05
3842.86	60.96	0.00	275.9	0.144E-01	3.93	535.83	.69722E+05
3910.27	60.96	0.00	280.7	0.142E-01	3.99	535.89	.70945E+05
3977.69	60.96	0.00	285.6	0.139E-01	4.06	535.94	.72168E+05
4045.10	60.96	0.00	290.7	0.136E-01	4.13	535.99	.73391E+05
4112.51	60.96	0.00	295.9	0.134E-01	4.21	536.04	.74614E+05
4179.92	60.96	0.00	301.3	0.131E-01	4.29	536.10	.75837E+05
4247.33	60.96	0.00	306.9	0.129E-01	4.36	536.15	.77060E+05
4314.74	60.96	0.00	312.7	0.126E-01	4.45	536.20	.78283E+05
4382.15	60.96	0.00	318.8	0.124E-01	4.53	536.25	.79506E+05
4449.56	60.96	0.00	325.0	0.121E-01	4.62	536.31	.80728E+05
4516.97	60.96	0.00	331.4	0.119E-01	4.71	536.36	.81951E+05
4584.38	60.96	0.00	338.1	0.116E-01	4.80	536.41	.83174E+05
4651.79	60.96	0.00	344.9	0.114E-01	4.90	536.47	.84397E+05
4719.20	60.96	0.00	352.1	0.111E-01	5.00	536.52	.85620E+05
4786.61	60.96	0.00	359.5	0.109E-01	5.11	536.57	.86843E+05
4854.02	60.96	0.00	367.2	0.107E-01	5.22	536.62	.88066E+05
4921.43	60.96	0.00	375.1	0.104E-01	5.33	536.68	.89289E+05
4988.84	60.96	0.00	383.3	0.102E-01	5.44	536.73	.90512E+05
5056.25	60.96	0.00	391.9	0.996E-02	5.57	536.78	.91735E+05
5123.67	60.96	0.00	400.7	0.973E-02	5.69	536.83	.92958E+05
5191.08	60.96	0.00	409.9	0.951E-02	5.82	536.89	.94181E+05
5258.49	60.96	0.00	419.4	0.928E-02	5.95	536.94	.95404E+05

[illegible]

CORMIX SESSION REPORT:
XX
CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: MZ Area
FILE NAME: \\montgomery\Proj\OccidentalChemicalCo\D3619800 Muscle Shoals\2025 CORMIX Modeling\Modeling
Files\oxychem thermal 2025.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/14/2025--12:24:58

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section	=	bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 223.36 m ³ /s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0550 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m ³
Bottom density	RHOAB	= 996.2338 kg/m ³

DISCHARGE PARAMETERS:

Discharge located on	Surface Discharge	= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m ²
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.420222 m ³ /s
Discharge velocity	U0	= 0.07 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m ³
Density difference	DRHO	= 1.2790 kg/m ³
Buoyant acceleration	GP0	= 0.0126 m/s ²
Discharge concentration	C0	= 4.22 deg.C
Surface heat exchange coeff.	KS	= 0.000006 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ	= 2.41 m	Lm	= 3.17 m	Lbb	= 31.77 m
LM	= 1.00 m				

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.42 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.74 (based on H0)
Velocity ratio	R	= 1.32

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge	= no
Water quality standard specified	= no
Regulatory mixing zone	= yes
Regulatory mixing zone specification	= area
Regulatory mixing zone value	= 1014.97 m (m ² if area)
Region of interest	= 6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 532.5

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory
implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 2.8787 deg.C

Dilution at edge of NFR s = 1.5

NFR Location: x = 34.24 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 36.81 m

thickness (bv) = 0.30 m

Cumulative travel time: 626.0216 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof), but RE-STRATIFIES LATER.

Plume becomes vertically fully mixed again at 5730.36 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts one bank only at -17.12 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****

No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****

The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 0.030674 deg.C

Corresponding dilution s = 133.1

Plume location: x = 2160.51 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 469.81 m

thickness (bv) = 2.16 m

Cumulative travel time: 39200.7891 sec.

REGULATORY MIXING ZONE criteria were satisfied in the Upstream Intrusion region.

Carefully review the prediction file.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:
 BV = Gaussian 1/e (37%) vertical thickness
 BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
 S = hydrodynamic centerline dilution

C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

Control volume outflow: SIGMAE= 303.03
X Y Z S C BV BH UC TT
0.14 -0.43 0.00 1.0 0.422E+01 0.92 3.21 0.072 .62202E+01
Cumulative travel time = 6.2202 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:
X Y Z S C BV BH TT
0.14 -0.43 0.00 1.0 0.422E+01 0.92 3.21 .62202E+01

UPSTREAM INTRUSION PROPERTIES:

Upstream intrusion length = 17.12 m
X-position of upstream stagnation point = -17.12 m
Thickness in intrusion region = 0.30 m
Half-width at downstream end = 36.81 m
Thickness at downstream end = 0.30 m

Profile definitions:

BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-17.12	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.62202E+01
-16.09	0.00	0.00	3.3	0.129E+01	0.09	5.21	.62202E+01
-11.06	0.00	0.00	1.4	0.306E+01	0.22	12.65	.62202E+01
-6.03	0.00	0.00	1.1	0.388E+01	0.28	17.11	.62202E+01
-0.99	0.00	0.00	1.0	0.421E+01	0.30	20.63	.62202E+01
4.04	0.00	0.00	1.0	0.412E+01	0.30	23.63	.77189E+02
9.07	0.00	0.00	1.1	0.380E+01	0.30	26.29	.16866E+03
14.10	0.00	0.00	1.2	0.344E+01	0.30	28.71	.26013E+03
19.14	0.00	0.00	1.3	0.317E+01	0.30	30.93	.35161E+03
24.17	0.00	0.00	1.4	0.301E+01	0.30	33.01	.44308E+03
29.20	0.00	0.00	1.4	0.293E+01	0.30	34.96	.53455E+03
34.24	0.00	0.00	1.5	0.288E+01	0.30	36.81	.62602E+03
Cumulative travel time = 626.0216 sec (0.17 hrs)							

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:

BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
34.24	60.96	0.00	1.5	0.288E+01	7.01	1.59	.62602E+03
86.14	60.96	0.00	3.4	0.123E+01	0.57	45.54	.15677E+04
138.04	60.96	0.00	3.9	0.108E+01	0.42	71.36	.25093E+04
189.95	60.96	0.00	4.3	0.968E+00	0.36	92.43	.34510E+04
241.85	60.96	0.00	4.8	0.876E+00	0.33	110.75	.43926E+04
293.76	60.96	0.00	5.3	0.790E+00	0.32	127.22	.53343E+04
345.66	60.96	0.00	5.9	0.710E+00	0.32	142.32	.62759E+04
397.57	60.96	0.00	6.6	0.635E+00	0.32	156.39	.72176E+04
449.47	60.96	0.00	7.4	0.565E+00	0.33	169.63	.81593E+04
501.38	60.96	0.00	8.3	0.502E+00	0.35	182.22	.91009E+04
553.28	60.96	0.00	9.4	0.446E+00	0.37	194.26	.10043E+05
605.19	60.96	0.00	10.6	0.396E+00	0.39	205.85	.10984E+05
657.09	60.96	0.00	11.9	0.351E+00	0.42	217.05	.11926E+05
709.00	60.96	0.00	13.4	0.312E+00	0.45	227.92	.12868E+05
760.90	60.96	0.00	15.0	0.278E+00	0.48	238.50	.13809E+05
812.81	60.96	0.00	16.8	0.248E+00	0.51	248.82	.14751E+05
864.71	60.96	0.00	18.7	0.222E+00	0.55	258.91	.15692E+05
916.62	60.96	0.00	20.9	0.199E+00	0.59	268.80	.16634E+05
968.52	60.96	0.00	23.2	0.180E+00	0.63	278.50	.17576E+05
1020.43	60.96	0.00	25.6	0.162E+00	0.68	288.03	.18517E+05
1072.33	60.96	0.00	28.3	0.147E+00	0.73	297.40	.19459E+05
1124.24	60.96	0.00	31.2	0.133E+00	0.77	306.63	.20401E+05
1176.14	60.96	0.00	34.2	0.121E+00	0.83	315.71	.21342E+05
1228.05	60.96	0.00	37.5	0.111E+00	0.88	324.67	.22284E+05
1279.95	60.96	0.00	40.9	0.101E+00	0.93	333.51	.23226E+05
1331.86	60.96	0.00	44.5	0.928E-01	0.99	342.24	.24167E+05

1383.76	60.96	0.00	48.4	0.854E-01	1.05	350.86	.25109E+05
1435.67	60.96	0.00	52.5	0.787E-01	1.11	359.37	.26051E+05
1487.57	60.96	0.00	56.8	0.727E-01	1.18	367.79	.26992E+05
1539.48	60.96	0.00	61.3	0.673E-01	1.24	376.12	.27934E+05
1591.38	60.96	0.00	66.0	0.624E-01	1.31	384.36	.28876E+05
1643.29	60.96	0.00	70.9	0.580E-01	1.38	392.51	.29817E+05
1695.19	60.96	0.00	76.1	0.540E-01	1.45	400.59	.30759E+05
1747.10	60.96	0.00	81.5	0.504E-01	1.52	408.58	.31701E+05
1799.00	60.96	0.00	87.1	0.471E-01	1.60	416.51	.32642E+05
1850.90	60.96	0.00	93.0	0.441E-01	1.67	424.36	.33584E+05
1902.81	60.96	0.00	99.1	0.414E-01	1.75	432.14	.34526E+05
1954.71	60.96	0.00	105.5	0.388E-01	1.83	439.85	.35467E+05
2006.62	60.96	0.00	112.1	0.365E-01	1.91	447.50	.36409E+05
2058.52	60.96	0.00	118.9	0.344E-01	1.99	455.08	.37351E+05
2110.43	60.96	0.00	126.0	0.324E-01	2.08	462.61	.38292E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the plume area meets or exceeds
the regulatory value = 1014.97 m².

This is the extent of the REGULATORY MIXING ZONE.

2162.33	60.96	0.00	133.4	0.306E-01	2.16	470.07	.39234E+05
2214.24	60.96	0.00	141.0	0.289E-01	2.25	477.48	.40175E+05
2266.14	60.96	0.00	148.9	0.274E-01	2.34	484.83	.41117E+05
2318.05	60.96	0.00	157.0	0.259E-01	2.43	492.13	.42059E+05
2369.95	60.96	0.00	165.4	0.246E-01	2.52	499.38	.43000E+05
2421.86	60.96	0.00	174.0	0.234E-01	2.62	506.58	.43942E+05
2473.76	60.96	0.00	182.9	0.222E-01	2.71	513.72	.44884E+05
2525.67	60.96	0.00	192.1	0.211E-01	2.81	520.82	.45825E+05
2577.57	60.96	0.00	201.6	0.201E-01	2.91	527.88	.46767E+05
2629.48	60.96	0.00	211.3	0.192E-01	3.01	534.88	.47709E+05

Cumulative travel time = 47708.7266 sec (13.25 hrs)

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.589E-02 m²/s
Horizontal diffusivity (initial value) = 0.147E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to water depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2629.48	60.96	0.00	211.3	0.192E-01	3.01	534.88	.47709E+05
2696.89	60.96	0.00	214.1	0.189E-01	3.05	534.93	.48932E+05
2764.30	60.96	0.00	216.9	0.187E-01	3.09	534.99	.50155E+05
2831.71	60.96	0.00	219.8	0.184E-01	3.13	535.04	.51378E+05
2899.12	60.96	0.00	222.9	0.181E-01	3.18	535.09	.52601E+05
2966.53	60.96	0.00	226.0	0.178E-01	3.22	535.15	.53823E+05
3033.94	60.96	0.00	229.1	0.176E-01	3.26	535.20	.55046E+05
3101.35	60.96	0.00	232.4	0.173E-01	3.31	535.25	.56269E+05
3168.76	60.96	0.00	235.8	0.170E-01	3.36	535.30	.57492E+05
3236.17	60.96	0.00	239.3	0.168E-01	3.41	535.36	.58715E+05
3303.58	60.96	0.00	242.9	0.165E-01	3.46	535.41	.59938E+05
3370.99	60.96	0.00	246.6	0.163E-01	3.51	535.46	.61161E+05
3438.40	60.96	0.00	250.4	0.160E-01	3.56	535.52	.62384E+05
3505.81	60.96	0.00	254.3	0.157E-01	3.62	535.57	.63607E+05
3573.22	60.96	0.00	258.4	0.155E-01	3.68	535.62	.64830E+05
3640.63	60.96	0.00	262.6	0.152E-01	3.74	535.67	.66053E+05
3708.04	60.96	0.00	266.9	0.149E-01	3.80	535.73	.67276E+05
3775.45	60.96	0.00	271.3	0.147E-01	3.86	535.78	.68499E+05
3842.86	60.96	0.00	275.9	0.144E-01	3.93	535.83	.69722E+05
3910.27	60.96	0.00	280.7	0.142E-01	3.99	535.89	.70945E+05
3977.69	60.96	0.00	285.6	0.139E-01	4.06	535.94	.72168E+05
4045.10	60.96	0.00	290.7	0.136E-01	4.13	535.99	.73391E+05
4112.51	60.96	0.00	295.9	0.134E-01	4.21	536.04	.74614E+05
4179.92	60.96	0.00	301.3	0.131E-01	4.29	536.10	.75837E+05
4247.33	60.96	0.00	306.9	0.129E-01	4.36	536.15	.77060E+05
4314.74	60.96	0.00	312.7	0.126E-01	4.45	536.20	.78283E+05
4382.15	60.96	0.00	318.8	0.124E-01	4.53	536.25	.79506E+05
4449.56	60.96	0.00	325.0	0.121E-01	4.62	536.31	.80728E+05
4516.97	60.96	0.00	331.4	0.119E-01	4.71	536.36	.81951E+05
4584.38	60.96	0.00	338.1	0.116E-01	4.80	536.41	.83174E+05
4651.79	60.96	0.00	344.9	0.114E-01	4.90	536.47	.84397E+05
4719.20	60.96	0.00	352.1	0.111E-01	5.00	536.52	.85620E+05
4786.61	60.96	0.00	359.5	0.109E-01	5.11	536.57	.86843E+05
4854.02	60.96	0.00	367.2	0.107E-01	5.22	536.62	.88066E+05
4921.43	60.96	0.00	375.1	0.104E-01	5.33	536.68	.89289E+05
4988.84	60.96	0.00	383.3	0.102E-01	5.44	536.73	.90512E+05
5056.25	60.96	0.00	391.9	0.996E-02	5.57	536.78	.91735E+05
5123.67	60.96	0.00	400.7	0.973E-02	5.69	536.83	.92958E+05
5191.08	60.96	0.00	409.9	0.951E-02	5.82	536.89	.94181E+05
5258.49	60.96	0.00	419.4	0.928E-02	5.95	536.94	.95404E+05

[illegible]

CORMIX SESSION REPORT:
XX

CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: MZ Length
FILE NAME: \\montgomery\Proj\OccidentalChemicalCo\D3619800 Muscle Shoals\2025 CORMIX Modeling\Modeling
Files\oxychem iwc-toxicity 2025.prd

Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/14/2025--13:03:47

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section	=	bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 167.52 m^3/s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0413 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m^3
Bottom density	RHOAB	= 996.2338 kg/m^3

DISCHARGE PARAMETERS:

Discharge located on	Surface Discharge	= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m^2
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.342634 m^3/s
Discharge velocity	U0	= 0.06 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m^3
Density difference	DRHO	= 1.2790 kg/m^3
Buoyant acceleration	GP0	= 0.0126 m/s^2
Discharge concentration	C0	= 100 %
Surface heat exchange coeff.	KS	= 0 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ	= 2.41 m	Lm	= 3.45 m	Lbb	= 61.41 m
LM	= 0.82 m				

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.34 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.60 (based on H0)
Velocity ratio	R	= 1.43

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge	= no
Water quality standard specified	= no
Regulatory mixing zone	= yes
Regulatory mixing zone specification	= trajectory
Regulatory mixing zone value	= 1447.80 m (m^2 if area)
Region of interest	= 6000 m

HYDRODYNAMIC CLASSIFICATION:

FLOW CLASS	= PL1
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Limiting Dilution S = (QA/Q0) + 1.0 = 489.9

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory
implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 61.005900 %

Dilution at edge of NFR s = 1.6

NFR Location: x = 55.39 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 60.30 m

thickness (bv) = 0.23 m

Cumulative travel time: 1346.7344 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.

Plume becomes laterally fully mixed at 2047.20 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts nearest bank at -27.70 m downstream.

Plume contacts second bank at 2047.20 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****
No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****
The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 2.537877 %

Corresponding dilution s = 39.4

Plume location: x = 1446.52 m

(centerline coordinates) y = 60.96 m

z = 0 m

Plume dimensions: half-width (bh) = 454.45 m

thickness (bv) = 0.72 m

Cumulative travel time: 34992.5781 sec.

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian 1/e (37%) vertical thickness
- BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution
- C = centerline concentration (includes reaction effects, if any)
- Uc = Local centerline excess velocity (above ambient)
- TT = Cumulative travel time

Control volume outflow: SIGMAE= 298.92

X	Y	Z	S	C	BV	BH	UC	TT
0.12	-0.40	0.00	1.0	0.100E+03	0.91	3.25	0.059	.70947E+01

Cumulative travel time = 7.0947 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
0.12	-0.40	0.00	1.0	0.100E+03	0.91	3.25	.70947E+01

UPSTREAM INTRUSION PROPERTIES:

Upstream intrusion length	=	27.70 m
X-position of upstream stagnation point	=	-27.70 m
Thickness in intrusion region	=	0.23 m
Half-width at downstream end	=	60.30 m
Thickness at downstream end	=	0.23 m

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-27.70	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.70947E+01
-26.03	0.00	0.00	3.3	0.306E+02	0.07	8.53	.70947E+01
-17.89	0.00	0.00	1.4	0.725E+02	0.16	20.71	.70947E+01
-9.75	0.00	0.00	1.1	0.921E+02	0.21	28.02	.70947E+01
-1.61	0.00	0.00	1.0	0.998E+02	0.23	33.79	.70947E+01
6.54	0.00	0.00	1.0	0.968E+02	0.23	38.70	.16268E+03
14.68	0.00	0.00	1.2	0.866E+02	0.23	43.06	.36002E+03
22.82	0.00	0.00	1.3	0.761E+02	0.23	47.02	.55737E+03
30.96	0.00	0.00	1.5	0.687E+02	0.23	50.66	.75471E+03
39.11	0.00	0.00	1.6	0.644E+02	0.23	54.07	.95205E+03
47.25	0.00	0.00	1.6	0.623E+02	0.23	57.27	.11494E+04
55.39	0.00	0.00	1.6	0.610E+02	0.23	60.30	.13467E+04

Cumulative travel time = 1346.7346 sec (0.37 hrs)

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
55.39	60.96	0.00	1.6	0.610E+02	7.01	1.94	.13467E+04
95.23	60.96	0.00	3.7	0.272E+02	0.64	47.66	.23102E+04
135.06	60.96	0.00	4.2	0.241E+02	0.46	74.80	.32737E+04
174.90	60.96	0.00	4.5	0.221E+02	0.39	97.07	.42372E+04
214.74	60.96	0.00	4.9	0.206E+02	0.35	116.54	.52007E+04
254.57	60.96	0.00	5.2	0.192E+02	0.32	134.11	.61641E+04
294.41	60.96	0.00	5.6	0.180E+02	0.31	150.28	.71276E+04
334.24	60.96	0.00	5.9	0.168E+02	0.30	165.36	.80911E+04
374.08	60.96	0.00	6.4	0.157E+02	0.29	179.58	.90546E+04
413.92	60.96	0.00	6.8	0.147E+02	0.29	193.09	.10018E+05
453.75	60.96	0.00	7.3	0.136E+02	0.29	206.01	.10982E+05
493.59	60.96	0.00	7.9	0.127E+02	0.30	218.44	.11945E+05
533.43	60.96	0.00	8.5	0.118E+02	0.31	230.45	.12908E+05
573.26	60.96	0.00	9.1	0.109E+02	0.31	242.10	.13872E+05
613.10	60.96	0.00	9.8	0.102E+02	0.32	253.44	.14835E+05
652.93	60.96	0.00	10.6	0.943E+01	0.33	264.50	.15799E+05
692.77	60.96	0.00	11.4	0.875E+01	0.34	275.32	.16762E+05
732.61	60.96	0.00	12.3	0.813E+01	0.36	285.93	.17726E+05
772.44	60.96	0.00	13.2	0.756E+01	0.37	296.34	.18689E+05
812.28	60.96	0.00	14.2	0.703E+01	0.38	306.58	.19653E+05
852.11	60.96	0.00	15.3	0.654E+01	0.40	316.66	.20616E+05
891.95	60.96	0.00	16.4	0.609E+01	0.42	326.59	.21580E+05
931.79	60.96	0.00	17.6	0.568E+01	0.43	336.40	.22543E+05
971.62	60.96	0.00	18.9	0.530E+01	0.45	346.08	.23507E+05
1011.46	60.96	0.00	20.2	0.495E+01	0.47	355.65	.24470E+05
1051.29	60.96	0.00	21.6	0.463E+01	0.49	365.11	.25434E+05
1091.13	60.96	0.00	23.0	0.434E+01	0.51	374.48	.26397E+05
1130.97	60.96	0.00	24.6	0.407E+01	0.53	383.75	.27361E+05
1170.80	60.96	0.00	26.2	0.382E+01	0.55	392.93	.28324E+05
1210.64	60.96	0.00	27.9	0.359E+01	0.57	402.04	.29288E+05

1250.47	60.96	0.00	29.6	0.337E+01	0.60	411.06	.30251E+05
1290.31	60.96	0.00	31.5	0.318E+01	0.62	420.01	.31215E+05
1330.15	60.96	0.00	33.4	0.300E+01	0.64	428.89	.32178E+05
1369.98	60.96	0.00	35.4	0.283E+01	0.67	437.70	.33142E+05
1409.82	60.96	0.00	37.4	0.267E+01	0.69	446.45	.34105E+05

** REGULATORY MIXING ZONE BOUNDARY **

In this prediction interval the plume TRAJECTORY distance meets or exceeds the regulatory value = 1447.80 m.

This is the extent of the REGULATORY MIXING ZONE.

1449.66	60.96	0.00	39.6	0.253E+01	0.72	455.13	.35068E+05
1489.49	60.96	0.00	41.8	0.239E+01	0.75	463.75	.36032E+05
1529.33	60.96	0.00	44.1	0.227E+01	0.77	472.32	.36995E+05
1569.16	60.96	0.00	46.5	0.215E+01	0.80	480.83	.37959E+05
1609.00	60.96	0.00	49.0	0.204E+01	0.83	489.28	.38922E+05
1648.84	60.96	0.00	51.6	0.194E+01	0.86	497.69	.39886E+05
1688.67	60.96	0.00	54.2	0.184E+01	0.89	506.04	.40849E+05
1728.51	60.96	0.00	56.9	0.176E+01	0.92	514.34	.41813E+05
1768.34	60.96	0.00	59.8	0.167E+01	0.95	522.60	.42776E+05
1808.18	60.96	0.00	62.7	0.160E+01	0.98	530.80	.43740E+05
1848.02	60.96	0.00	65.7	0.152E+01	1.01	538.97	.44703E+05
1887.85	60.96	0.00	68.8	0.145E+01	1.04	547.09	.45667E+05
1927.69	60.96	0.00	72.0	0.139E+01	1.07	555.16	.46630E+05
1967.52	60.96	0.00	75.3	0.133E+01	1.11	563.20	.47594E+05
2007.36	60.96	0.00	78.6	0.127E+01	1.14	571.19	.48557E+05
2047.20	60.96	0.00	82.1	0.122E+01	1.17	579.12	.49521E+05

Cumulative travel time = 49520.6953 sec (13.76 hrs)

Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.469E-02 m²/s
Horizontal diffusivity (initial value) = 0.117E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to water depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2047.20	60.96	0.00	82.1	0.122E+01	1.17	579.12	.49521E+05
2126.25	60.96	0.00	82.3	0.122E+01	1.18	579.12	.51433E+05
2205.31	60.96	0.00	82.4	0.121E+01	1.18	579.12	.53345E+05
2284.36	60.96	0.00	82.6	0.121E+01	1.18	579.12	.55257E+05
2363.42	60.96	0.00	82.7	0.121E+01	1.18	579.12	.57169E+05
2442.48	60.96	0.00	82.9	0.121E+01	1.19	579.12	.59081E+05
2521.53	60.96	0.00	83.1	0.120E+01	1.19	579.12	.60993E+05
2600.59	60.96	0.00	83.2	0.120E+01	1.19	579.12	.62905E+05
2679.65	60.96	0.00	83.4	0.120E+01	1.19	579.12	.64817E+05
2758.70	60.96	0.00	83.5	0.120E+01	1.20	579.12	.66729E+05
2837.76	60.96	0.00	83.7	0.119E+01	1.20	579.12	.68641E+05
2916.81	60.96	0.00	83.9	0.119E+01	1.20	579.12	.70553E+05
2995.87	60.96	0.00	84.0	0.119E+01	1.20	579.12	.72465E+05
3074.93	60.96	0.00	84.2	0.119E+01	1.20	579.12	.74377E+05
3153.98	60.96	0.00	84.3	0.119E+01	1.21	579.12	.76290E+05
3233.04	60.96	0.00	84.5	0.118E+01	1.21	579.12	.78202E+05
3312.09	60.96	0.00	84.7	0.118E+01	1.21	579.12	.80114E+05
3391.15	60.96	0.00	84.8	0.118E+01	1.21	579.12	.82026E+05
3470.21	60.96	0.00	85.0	0.118E+01	1.22	579.12	.83938E+05
3549.26	60.96	0.00	85.2	0.117E+01	1.22	579.12	.85850E+05
3628.32	60.96	0.00	85.3	0.117E+01	1.22	579.12	.87762E+05
3707.38	60.96	0.00	85.5	0.117E+01	1.22	579.12	.89674E+05
3786.43	60.96	0.00	85.7	0.117E+01	1.23	579.12	.91586E+05
3865.49	60.96	0.00	85.9	0.116E+01	1.23	579.12	.93498E+05
3944.54	60.96	0.00	86.0	0.116E+01	1.23	579.12	.95410E+05
4023.60	60.96	0.00	86.2	0.116E+01	1.23	579.12	.97322E+05
4102.66	60.96	0.00	86.4	0.116E+01	1.24	579.12	.99234E+05
4181.71	60.96	0.00	86.5	0.116E+01	1.24	579.12	.10115E+06
4260.77	60.96	0.00	86.7	0.115E+01	1.24	579.12	.10306E+06
4339.82	60.96	0.00	86.9	0.115E+01	1.24	579.12	.10497E+06
4418.88	60.96	0.00	87.1	0.115E+01	1.25	579.12	.10688E+06
4497.94	60.96	0.00	87.2	0.115E+01	1.25	579.12	.10879E+06
4576.99	60.96	0.00	87.4	0.114E+01	1.25	579.12	.11071E+06
4656.05	60.96	0.00	87.6	0.114E+01	1.25	579.12	.11262E+06
4735.10	60.96	0.00	87.8	0.114E+01	1.26	579.12	.11453E+06
4814.16	60.96	0.00	88.0	0.114E+01	1.26	579.12	.11644E+06
4893.22	60.96	0.00	88.1	0.113E+01	1.26	579.12	.11835E+06
4972.27	60.96	0.00	88.3	0.113E+01	1.26	579.12	.12027E+06
5051.33	60.96	0.00	88.5	0.113E+01	1.27	579.12	.12218E+06
5130.39	60.96	0.00	88.7	0.113E+01	1.27	579.12	.12409E+06
5209.44	60.96	0.00	88.9	0.113E+01	1.27	579.12	.12600E+06
5288.50	60.96	0.00	89.0	0.112E+01	1.27	579.12	.12792E+06
5367.55	60.96	0.00	89.2	0.112E+01	1.28	579.12	.12983E+06

Simulation limit based on maximum specified distance = 6000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

[illegible]

CORMIX SESSION REPORT:
XX
CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 12.0GTS
HYDRO3:Version-12.0.1.0 August, 2021

SITE NAME/LABEL: OxyChem PondCreek
DESIGN CASE: MZ Area
FILE NAME: \\montgomery\Proj\OccidentalChemicalCo\D3619800 Muscle Shoals\2025 CORMIX Modeling\Modeling
Files\oxychem iwc-toxicity 2025.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/14/2025--13:07:26

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section	=	bounded
Width	BS	= 579.12 m
Channel regularity	ICHREG	= 2
Ambient flowrate	QA	= 167.52 m ³ /s
Average depth	HA	= 7.01 m
Depth at discharge	HD	= 4.91 m
Ambient velocity	UA	= 0.0413 m/s
Darcy-Weisbach friction factor	F	= 0.0420
Calculated from Manning's n		= 0.032
Wind velocity	UW	= 2 m/s
Stratification Type	STRCND	= U
Surface temperature		= 28 degC
Bottom temperature		= 28 degC
Calculated FRESH-WATER DENSITY values:		
Surface density	RHOAS	= 996.2338 kg/m ³
Bottom density	RHOAB	= 996.2338 kg/m ³

DISCHARGE PARAMETERS:

Discharge located on	Surface Discharge	= left bank/shoreline
Discharge configuration		= protruding discharge
Distance from bank to outlet	DISTB	= 60.96 m
Discharge angle	SIGMA	= 90 deg
Depth near discharge outlet	HD0	= 0.76 m
Bottom slope at discharge	SLOPE	= 20 deg
Rectangular discharge:		
Discharge cross-section area	A0	= 5.80644 m ²
Discharge channel width	B0	= 7.62 m
Discharge channel depth	H0	= 0.762 m
Discharge aspect ratio	AR	= 0.1
Discharge flowrate	Q0	= 0.342634 m ³ /s
Discharge velocity	U0	= 0.06 m/s
Discharge temperature (freshwater)		= 32.22 degC
Corresponding density	RHO0	= 994.9548 kg/m ³
Density difference	DRHO	= 1.2790 kg/m ³
Buoyant acceleration	GP0	= 0.0126 m/s ²
Discharge concentration	C0	= 100 %
Surface heat exchange coeff.	KS	= 0 m/s
Coefficient of decay	KD	= 0 /s

DISCHARGE/ENVIRONMENT LENGTH SCALES:

LQ = 2.41 m	Lm = 3.45 m	Lbb = 61.41 m
LM = 0.82 m		

NON-DIMENSIONAL PARAMETERS:

Densimetric Froude number	FR0	= 0.34 (based on LQ)
Channel densimetric Froude no.	FRCH	= 0.60 (based on H0)
Velocity ratio	R	= 1.43

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:

Toxic discharge	= no
Water quality standard specified	= no
Regulatory mixing zone	= yes
Regulatory mixing zone specification	= area
Regulatory mixing zone value	= 1014.97 m (m ² if area)
Region of interest	= 6000 m

HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = PL1 |

Limiting Dilution S = (QA/Q0) + 1.0 = 489.9

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel:
60.96 m from the left bank/shore.
Number of display steps NSTEP = 50 per module.

NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory
implication. However, this information may be useful for the discharge

designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 61.005900 %

Dilution at edge of NFR s = 1.6

NFR Location: x = 55.39 m

(centerline coordinates) y = 0 m

z = 0 m

NFR plume dimensions: half-width (bh) = 60.30 m

thickness (bv) = 0.23 m

Cumulative travel time: 1346.7344 sec.

Buoyancy assessment:

The effluent density is less than the surrounding ambient water density at the discharge level.

Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards the surface.

FAR-FIELD MIXING SUMMARY:

Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.

Plume becomes laterally fully mixed at 2047.20 m downstream.

PLUME BANK CONTACT SUMMARY:

Plume in bounded section contacts nearest bank at -27.70 m downstream.

Plume contacts second bank at 2047.20 m downstream.

***** TOXIC DILUTION ZONE SUMMARY *****

No TDZ was specified for this simulation.

***** REGULATORY MIXING ZONE SUMMARY *****

An RMZ was specified but its boundary was not encountered within the predicted plume region.

In a subsequent analysis, use an ROI that extends further downstream.

***** FINAL DESIGN ADVICE AND COMMENTS *****

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +/-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

Profile definitions:

- BV = Gaussian 1/e (37%) vertical thickness
- BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
- S = hydrodynamic centerline dilution
- C = centerline concentration (includes reaction effects, if any)
- Uc = Local centerline excess velocity (above ambient)
- TT = Cumulative travel time

Control volume outflow: SIGMAE= 298.92

X	Y	Z	S	C	BV	BH	UC	TT
0.12	-0.40	0.00	1.0	0.100E+03	0.91	3.25	0.059	.70947E+01

Cumulative travel time = 7.0947 sec (0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT

BEGIN MOD331: UPSTREAM INTRUDING PLUME

Control volume inflow:

X	Y	Z	S	C	BV	BH	TT
0.12	-0.40	0.00	1.0	0.100E+03	0.91	3.25	.70947E+01

UPSTREAM INTRUSION PROPERTIES:

Upstream intrusion length	=	27.70 m
X-position of upstream stagnation point	=	-27.70 m
Thickness in intrusion region	=	0.23 m
Half-width at downstream end	=	60.30 m
Thickness at downstream end	=	0.23 m

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	TT
-27.70	0.00	0.00	9999.9	0.000E+00	0.00	0.00	.70947E+01
-26.03	0.00	0.00	3.3	0.306E+02	0.07	8.53	.70947E+01
-17.89	0.00	0.00	1.4	0.725E+02	0.16	20.71	.70947E+01
-9.75	0.00	0.00	1.1	0.921E+02	0.21	28.02	.70947E+01
-1.61	0.00	0.00	1.0	0.998E+02	0.23	33.79	.70947E+01
6.54	0.00	0.00	1.0	0.968E+02	0.23	38.70	.16268E+03
14.68	0.00	0.00	1.2	0.866E+02	0.23	43.06	.36002E+03
22.82	0.00	0.00	1.3	0.761E+02	0.23	47.02	.55737E+03
30.96	0.00	0.00	1.5	0.687E+02	0.23	50.66	.75471E+03
39.11	0.00	0.00	1.6	0.644E+02	0.23	54.07	.95205E+03
47.25	0.00	0.00	1.6	0.623E+02	0.23	57.27	.11494E+04
55.39	0.00	0.00	1.6	0.610E+02	0.23	60.30	.13467E+04

Cumulative travel time = 1346.7346 sec (0.37 hrs)

END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: BUOYANT AMBIENT SPREADING

Profile definitions:

BV = top-hat thickness, measured vertically
 BH = top-hat half-width, measured horizontally from bank/shoreline
 S = hydrodynamic average (bulk) dilution
 C = average (bulk) concentration (includes reaction effects, if any)
 TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
55.39	60.96	0.00	1.6	0.610E+02	7.01	1.94	.13467E+04
95.23	60.96	0.00	3.7	0.272E+02	0.64	47.66	.23102E+04
135.06	60.96	0.00	4.2	0.241E+02	0.46	74.80	.32737E+04
174.90	60.96	0.00	4.5	0.221E+02	0.39	97.07	.42372E+04
214.74	60.96	0.00	4.9	0.206E+02	0.35	116.54	.52007E+04
254.57	60.96	0.00	5.2	0.192E+02	0.32	134.11	.61641E+04
294.41	60.96	0.00	5.6	0.180E+02	0.31	150.28	.71276E+04
334.24	60.96	0.00	5.9	0.168E+02	0.30	165.36	.80911E+04
374.08	60.96	0.00	6.4	0.157E+02	0.29	179.58	.90546E+04
413.92	60.96	0.00	6.8	0.147E+02	0.29	193.09	.10018E+05
453.75	60.96	0.00	7.3	0.136E+02	0.29	206.01	.10982E+05
493.59	60.96	0.00	7.9	0.127E+02	0.30	218.44	.11945E+05
533.43	60.96	0.00	8.5	0.118E+02	0.31	230.45	.12908E+05
573.26	60.96	0.00	9.1	0.109E+02	0.31	242.10	.13872E+05
613.10	60.96	0.00	9.8	0.102E+02	0.32	253.44	.14835E+05
652.93	60.96	0.00	10.6	0.943E+01	0.33	264.50	.15799E+05
692.77	60.96	0.00	11.4	0.875E+01	0.34	275.32	.16762E+05
732.61	60.96	0.00	12.3	0.813E+01	0.36	285.93	.17726E+05
772.44	60.96	0.00	13.2	0.756E+01	0.37	296.34	.18689E+05
812.28	60.96	0.00	14.2	0.703E+01	0.38	306.58	.19653E+05
852.11	60.96	0.00	15.3	0.654E+01	0.40	316.66	.20616E+05
891.95	60.96	0.00	16.4	0.609E+01	0.42	326.59	.21580E+05
931.79	60.96	0.00	17.6	0.568E+01	0.43	336.40	.22543E+05
971.62	60.96	0.00	18.9	0.530E+01	0.45	346.08	.23507E+05
1011.46	60.96	0.00	20.2	0.495E+01	0.47	355.65	.24470E+05
1051.29	60.96	0.00	21.6	0.463E+01	0.49	365.11	.25434E+05
1091.13	60.96	0.00	23.0	0.434E+01	0.51	374.48	.26397E+05
1130.97	60.96	0.00	24.6	0.407E+01	0.53	383.75	.27361E+05
1170.80	60.96	0.00	26.2	0.382E+01	0.55	392.93	.28324E+05
1210.64	60.96	0.00	27.9	0.359E+01	0.57	402.04	.29288E+05

1250.47	60.96	0.00	29.6	0.337E+01	0.60	411.06	.30251E+05
1290.31	60.96	0.00	31.5	0.318E+01	0.62	420.01	.31215E+05
1330.15	60.96	0.00	33.4	0.300E+01	0.64	428.89	.32178E+05
1369.98	60.96	0.00	35.4	0.283E+01	0.67	437.70	.33142E+05
1409.82	60.96	0.00	37.4	0.267E+01	0.69	446.45	.34105E+05
1449.66	60.96	0.00	39.6	0.253E+01	0.72	455.13	.35068E+05
1489.49	60.96	0.00	41.8	0.239E+01	0.75	463.75	.36032E+05
1529.33	60.96	0.00	44.1	0.227E+01	0.77	472.32	.36995E+05
1569.16	60.96	0.00	46.5	0.215E+01	0.80	480.83	.37959E+05
1609.00	60.96	0.00	49.0	0.204E+01	0.83	489.28	.38922E+05
1648.84	60.96	0.00	51.6	0.194E+01	0.86	497.69	.39886E+05
1688.67	60.96	0.00	54.2	0.184E+01	0.89	506.04	.40849E+05
1728.51	60.96	0.00	56.9	0.176E+01	0.92	514.34	.41813E+05
1768.34	60.96	0.00	59.8	0.167E+01	0.95	522.60	.42776E+05
1808.18	60.96	0.00	62.7	0.160E+01	0.98	530.80	.43740E+05
1848.02	60.96	0.00	65.7	0.152E+01	1.01	538.97	.44703E+05
1887.85	60.96	0.00	68.8	0.145E+01	1.04	547.09	.45667E+05
1927.69	60.96	0.00	72.0	0.139E+01	1.07	555.16	.46630E+05
1967.52	60.96	0.00	75.3	0.133E+01	1.11	563.20	.47594E+05
2007.36	60.96	0.00	78.6	0.127E+01	1.14	571.19	.48557E+05
2047.20	60.96	0.00	82.1	0.122E+01	1.17	579.12	.49521E+05

Cumulative travel time = 49520.6953 sec (13.76 hrs)
Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.469E-02 m²/s
Horizontal diffusivity (initial value) = 0.117E-01 m²/s

Profile definitions:

BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to water depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
2047.20	60.96	0.00	82.1	0.122E+01	1.17	579.12	.49521E+05
2126.25	60.96	0.00	82.3	0.122E+01	1.18	579.12	.51433E+05
2205.31	60.96	0.00	82.4	0.121E+01	1.18	579.12	.53345E+05
2284.36	60.96	0.00	82.6	0.121E+01	1.18	579.12	.55257E+05
2363.42	60.96	0.00	82.7	0.121E+01	1.18	579.12	.57169E+05
2442.48	60.96	0.00	82.9	0.121E+01	1.19	579.12	.59081E+05
2521.53	60.96	0.00	83.1	0.120E+01	1.19	579.12	.60993E+05
2600.59	60.96	0.00	83.2	0.120E+01	1.19	579.12	.62905E+05
2679.65	60.96	0.00	83.4	0.120E+01	1.19	579.12	.64817E+05
2758.70	60.96	0.00	83.5	0.120E+01	1.20	579.12	.66729E+05
2837.76	60.96	0.00	83.7	0.119E+01	1.20	579.12	.68641E+05
2916.81	60.96	0.00	83.9	0.119E+01	1.20	579.12	.70553E+05
2995.87	60.96	0.00	84.0	0.119E+01	1.20	579.12	.72465E+05
3074.93	60.96	0.00	84.2	0.119E+01	1.20	579.12	.74377E+05
3153.98	60.96	0.00	84.3	0.119E+01	1.21	579.12	.76290E+05
3233.04	60.96	0.00	84.5	0.118E+01	1.21	579.12	.78202E+05
3312.09	60.96	0.00	84.7	0.118E+01	1.21	579.12	.80114E+05
3391.15	60.96	0.00	84.8	0.118E+01	1.21	579.12	.82026E+05
3470.21	60.96	0.00	85.0	0.118E+01	1.22	579.12	.83938E+05
3549.26	60.96	0.00	85.2	0.117E+01	1.22	579.12	.85850E+05
3628.32	60.96	0.00	85.3	0.117E+01	1.22	579.12	.87762E+05
3707.38	60.96	0.00	85.5	0.117E+01	1.22	579.12	.89674E+05
3786.43	60.96	0.00	85.7	0.117E+01	1.23	579.12	.91586E+05
3865.49	60.96	0.00	85.9	0.116E+01	1.23	579.12	.93498E+05
3944.54	60.96	0.00	86.0	0.116E+01	1.23	579.12	.95410E+05
4023.60	60.96	0.00	86.2	0.116E+01	1.23	579.12	.97322E+05
4102.66	60.96	0.00	86.4	0.116E+01	1.24	579.12	.99234E+05
4181.71	60.96	0.00	86.5	0.116E+01	1.24	579.12	.10115E+06
4260.77	60.96	0.00	86.7	0.115E+01	1.24	579.12	.10306E+06
4339.82	60.96	0.00	86.9	0.115E+01	1.24	579.12	.10497E+06
4418.88	60.96	0.00	87.1	0.115E+01	1.25	579.12	.10688E+06
4497.94	60.96	0.00	87.2	0.115E+01	1.25	579.12	.10879E+06
4576.99	60.96	0.00	87.4	0.114E+01	1.25	579.12	.11071E+06
4656.05	60.96	0.00	87.6	0.114E+01	1.25	579.12	.11262E+06
4735.10	60.96	0.00	87.8	0.114E+01	1.26	579.12	.11453E+06
4814.16	60.96	0.00	88.0	0.114E+01	1.26	579.12	.11644E+06
4893.22	60.96	0.00	88.1	0.113E+01	1.26	579.12	.11835E+06
4972.27	60.96	0.00	88.3	0.113E+01	1.26	579.12	.12027E+06
5051.33	60.96	0.00	88.5	0.113E+01	1.27	579.12	.12218E+06
5130.39	60.96	0.00	88.7	0.113E+01	1.27	579.12	.12409E+06
5209.44	60.96	0.00	88.9	0.113E+01	1.27	579.12	.12600E+06
5288.50	60.96	0.00	89.0	0.112E+01	1.27	579.12	.12792E+06
5367.55	60.96	0.00	89.2	0.112E+01	1.28	579.12	.12983E+06
5446.61	60.96	0.00	89.4	0.112E+01	1.28	579.12	.13174E+06
5525.67	60.96	0.00	89.6	0.112E+01	1.28	579.12	.13365E+06
5604.72	60.96	0.00	89.8	0.111E+01	1.28	579.12	.13556E+06
5683.78	60.96	0.00	90.0	0.111E+01	1.29	579.12	.13748E+06

Simulation limit based on maximum specified distance = 6000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

[illegible]

Attachment B - ADEM Form 187

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT (ADEM)
NPDES INDIVIDUAL PERMIT APPLICATION
SUPPLEMENTARY INFORMATION FOR INDUSTRIAL FACILITIES

Instructions: This form should be used to submit the required supplementary information for an application for an NPDES individual permit for industrial facilities. The completed application should be submitted to ADEM in duplicate. If insufficient space is available to address any item, please continue on an attached sheet of paper. Please mark "N/A" in the appropriate box when an item is not applicable to the applicant. **Please type or print legibly in blue or black ink.** Mail the completed application to:

ADEM-Water Division
Industrial Section
P O Box 301463
Montgomery, AL 36130-1463

PURPOSE OF THIS APPLICATION

- ☐ Initial Permit Application for New Facility*
☐ Modification of Existing Permit
☐ Revocation & Reissuance of Existing Permit

- ☐ Initial Permit Application for Existing Facility*
☒ Reissuance of Existing Permit

* An application for participation in the ADEM's Electronic Environmental (E2) Reporting must be submitted to allow permittee to electronically submit reports as required.

SECTION A – GENERAL INFORMATION

1. Permittee Name: Occidental Chemical Corporation
2. NPDES Permit Number: AL 0000213 (not applicable if initial permit application)
3. SID Permit Number (if applicable): IU
4. NPDES General Permit Number (if applicable): ALG
5. Facility Location (Front Gate): Latitude: 34° 46' 14.33" N Longitude: -87° 38' 3.09" E
6. Responsible Official (as described on the last page of this application):
Name: David Mullins Title: Plant Manager
Address: 1000 North Wilson Dam Road
City: Muscle Shoals State: AL Zip: 35661
Phone Number: 256-389-2224 Email Address: david_w._mullins@oxy.com
7. Designated Discharge Monitoring Report (DMR) Contact:
Name: Bryan Lindsey Title: Health, Environmental, Safety & Security Superintendent
Phone Number: 256-389-2219 Email Address: bryan_lindsey@oxy.com
8. Type of Business Entity:
☒ Corporation ☐ General Partnership ☐ Limited Partnership ☐ Limited Liability Company ☐ Sole Proprietorship
☐ Other (Please Specify) _____
8. Complete this section if the Applicant's business entity is a Corporation
a) Location of Incorporation:
Address: 1633 Broadway
City: New York County: New York State: NY Zip: 10019
b) Parent Corporation of Applicant:
Name: Occidental Petroleum Corporation
Address: 5 Greenway Plaza, Suite 110
City: Houston State: TX Zip: 77046

c) Subsidiary Corporation(s) of Applicant:

Name: Armand Products Company (a joint partnership between Occidental Chemical Corporation and Church & Dwight Co., Inc.)

Address: 500 Charles Ewing Boulevard

City: Ewing State: NJ Zip: 08628

d) Corporate Officers:

Name: Wade Alleman, President

Address: 14555 Dallas Parkway, Suite 400

City: Dallas State: TX Zip: 75254

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

e) Agent designated by the corporation for purposes of service:

Name: CT Corporation System

Address: 2 North Jackson Street, Suite 605

City: Montgomery State: AL Zip: 36104

9. If the Applicant's business entity is a Partnership, please list the general partners.

Name: _____ Name: _____

Address: _____ Address: _____

City: _____ State: _____ Zip: _____ City: _____ State: _____ Zip: _____

10. If the Applicant's business entity is a Proprietorship, please enter the proprietor's information.

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

11. Identify all Administrative Complaints, Notices of Violation, Directives, Administrative Orders, or Litigation concerning water if any, against the Applicant, its parent corporation or subsidiary corporations within the State of Alabama within the past five years (attach additional sheets if necessary):

<u>Facility Name</u>	<u>Permit Number</u>	<u>Type of Action</u>	<u>Date of Action</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

SECTION B – BUSINESS ACTIVITY

If your facility conducts or will be conducting any of the processes listed below (regardless of whether they generate wastewater, waste sludge, or hazardous waste), place a check beside the category of business activity (check all that apply):

Industrial Categories

- | | |
|---|--|
| ☐ Aluminum Forming | ☐ Metal Molding and Casting |
| ☐ Asbestos Manufacturing | ☐ Metal Products |
| ☐ Battery Manufacturing | ☐ Nonferrous Metals Forming |
| ☐ Can Making | ☐ Nonferrous Metals Manufacturing |
| ☐ Canned and Preserved Fruit and Vegetables | ☐ Oil and Gas Extraction |
| ☐ Canned and Preserved Seafood | ☐ Organic Chemicals Manufacturing |
| ☐ Cement Manufacturing | ☐ Paint and Ink Formulating |
| ☐ Centralized Waste Treatment | ☐ Paving and Roofing Manufacturing |
| ☐ Carbon Black | ☐ Pesticides Manufacturing |
| ☐ Coal Mining | ☐ Petroleum Refining |
| ☐ Coil Coating | ☐ Phosphate Manufacturing |
| ☐ Copper Forming | ☐ Photographic |
| ☐ Electric and Electronic Components Manufacturing | ☐ Pharmaceutical |
| ☐ Electroplating | ☐ Plastic & Synthetic Materials |
| ☐ Explosives Manufacturing | ☐ Plastics Processing Manufacturing |
| ☐ Feedlots | ☐ Porcelain Enamel |
| ☐ Ferroalloy Manufacturing | ☐ Pulp, Paper, and Fiberboard Manufacturing |
| ☐ Fertilizer Manufacturing | ☐ Rubber |
| ☐ Foundries (Metal Molding and Casting) | ☐ Soap and Detergent Manufacturing |
| ☐ Glass Manufacturing | ☐ Steam and Electric |
| ☐ Grain Mills | ☐ Sugar Processing |
| ☐ Gum and Wood Chemicals Manufacturing | ☐ Textile Mills |
| ☐ Inorganic Chemicals | ☐ Timber Products |
| ☐ Iron and Steel | ☐ Transportation Equipment Cleaning |
| ☐ Leather Tanning and Finishing | ☐ Waste Combustion |
| ☐ Metal Finishing | ☒ Other (specify) <u>Potassium Carbonate & Potassium Bicarbonate</u> |
| ☐ Meat Products | |

A facility with processes inclusive in these business areas may be covered by Environmental Protection (EPA) categorical standards. These facilities are termed “categorical users”.

SECTION C – WASTEWATER DISCHARGE INFORMATION

1. Do you share an outfall with another facility? ☐ Yes ☒ No (If no, continue to C.2)

For each shared outfall, provide the following:

Applicant's Outfall No.	Name of Other Permittee/Facility	NPDES Permit No.	Where is sample collected by Applicant?
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

2. Do you have, or plan to have, automatic sampling equipment or continuous wastewater flow metering equipment at this facility?

Current:	Flow Metering	☒ Yes	☐ No	☐ N/A
	Sampling Equipment	☒ Yes	☐ No	☐ N/A
Planned:	Flow Metering	☐ Yes	☐ No	☐ N/A
	Sampling Equipment	☐ Yes	☐ No	☐ N/A

If so, please attach a schematic diagram of the sewer system indicating the present or future location of this equipment and describe the equipment below:

For outfall DSN001 the facility uses a refrigerated composite sampler and continuously recording pH, temperature, and flow meters.

3. Are any process changes or expansions planned during the next three years that could alter wastewater volumes or characteristics?

☐ Yes ☒ No (If no, continue to C.4)

Briefly describe these changes and their anticipated effects on the wastewater volume and characteristics:

4. List the trade name and chemical composition of all biocides and corrosion inhibitors used:

Trade Name	Chemical Composition
See ADEM Form 187 Attachment 2	

For each biocide and/or corrosion inhibitor used, please include the following information:

- (1) 96-hour median tolerance limit data for organisms representative of the biota of the waterway into which the discharge will ultimately reach,
- (2) quantities to be used,
- (3) frequencies of use,
- (4) proposed discharge concentrations, and
- (5) EPA registration number, if applicable

SECTION D – WATER SUPPLY

Water Sources (check as many as are applicable):

☐ Private Well ☒ Surface Water
☒ Municipal Water Utility (Specify City): ☐ Other (Specify): _____

IF MORE THAN ONE WELL OR SURFACE INTAKE, PROVIDE DATA FOR EACH ON AN ATTACHMENT

City: 0.053 MGD* Well: _____ MGD* Well Depth: _____ Ft. Latitude: _____ Longitude: _____

Surface Intake Volume: 8.1 MGD* Intake Elevation in Relation to Bottom: _____ Ft.

Intake Elevation: _____ Ft. Latitude: _____ Longitude: _____

Name of Surface Water Source: Tennessee River - Wilson and Pickwick Reservoirs (see attachment for additional details)

* MGD – Million Gallons per Day

Cooling Water Intake Structure Information

Complete D.1 and D.2 if your water supply is provided by an outside source and not by an onsite water intake structure? (e.g., another industry, municipality, etc...)

1. Does the provider of your source water operate a surface water intake? ☒ Yes ☐ No
(If yes, continue, if no, go to Section E.)
 - a) Name of Provider: Tennessee Valley Authority
 - b) Location of Provider: (see attachment for additional details)
 - c) Latitude: _____ Longitude: _____
2. Is the provider a public water system (defined as a system which provides water to the public for human consumption or which provides only treated water, not raw water)? ☐ Yes ☒ No (If yes, go to Section E, if no, continue.)

Only to be completed if you have a cooling water intake structure or the provider of your water supply uses an intake structure and does not treat the raw water.

3. Is any water withdrawn from the source water used for cooling? ☒ Yes ☐ No
4. Using the average monthly measurements over any 12-month period, approximately what percentage of water withdrawn is used exclusively for cooling purposes? 13 %
5. Does the cooling water consist of treated effluent that would otherwise be discharged? ☐ Yes ☒ No
(If yes, go to Section E, if no, complete D.6 – D.17)
6. a. Is the cooling water used in a once-through cooling system? ☒ Yes ☐ No
b. Is the cooling water used in a closed cycle cooling system? ☐ Yes ☒ No
7. When was the intake installed? PDW Intake - 1952, Fleet Hollow Intake - 1964
(Please provide dates for all major construction/installation of intake components including screens)
8. What is the maximum intake volume? See ADEM Form 187 Attachment 1 _____
(maximum pumping capacity in gallons per day)
9. What is the average intake volume? See ADEM Form 187 Attachment 1 _____
(average intake pump rate in gallons per day average in any 30-day period)
10. What is the actual intake flow (AIF) as defined in 40 CFR §125.92(a)? See ADEM Form 187 At _____ MGD
11. How is the intake operated? (e.g., continuously, intermittently, batch) Continuously, but only one intake at a time
12. What is the mesh size of the screen on your intake? 3/8" for both intakes
13. What is the intake screen flow-through area? PDW - 123 sq. ft, Fleet Hollow - 347 sq. ft.
14. What is the through-screen design intake flow velocity? 0.20 ft/sec
15. What is the through-screen actual velocity (in ft/sec)? 0.04 ft/sec
16. What is the mechanism for cleaning the screen? (e.g., does it rotate for cleaning) both have rotating screens
17. Do you have any additional fish detraction technology on your intake? ☐ Yes ☒ No
18. Have there been any studies to determine the impact of the intake on aquatic organisms? ☐ Yes ☒ No (If yes, please provide.)
19. Attach a site map showing the location of the water intake in relation to the facility, shoreline, water depth, etc.

SECTION E – WASTE STORAGE AND DISPOSAL INFORMATION

Provide a description of the location of all sites involved in the storage of solids or liquids that could be accidentally discharged to a water of the state, either directly or indirectly via such avenues as storm water drainage, municipal wastewater systems, etc., which are located at the facility for which the NPDES application is being made. Where possible, the location should be noted on a map and included with this application:

Description of Waste	Description of Storage Location
None	

SECTION F – COASTAL ZONE INFORMATION

Is the discharge(s) located within the 10-foot elevation contour and within the limits of Mobile or Baldwin County? ☐ Yes ☒ No
If yes, complete items F.1 – F.12:

	Yes	No
1. Does the project require new construction?	☐	☐
2. Will the project be a source of new air emissions?	☐	☐
3. Does the project involve dredging and/or filling of a wetland area or water way?	☐	☐
If Yes, has the Corps of Engineers (COE) permit been received?	☐	☐
COE Project No. _____		
4. Does the project involve wetlands and/or submersed grassbeds?	☐	☐
5. Are oyster reefs located near the project site?	☐	☐
If Yes, include a map showing project and discharge location with respect to oyster reefs		
6. Does the project involve the site development, construction and operation of an energy facility as defined in ADEM Admin. Code r. 335-8-1-.02(bb)?	☐	☐
7. Does the project involve mitigation of shoreline or coastal area erosion?	☐	☐
8. Does the project involve construction on beaches or dune areas?	☐	☐
9. Will the project interfere with public access to coastal waters?	☐	☐
10. Does the project lie within the 100-year floodplain?	☐	☐
11. Does the project involve the registration, sale, use, or application of pesticides?	☐	☐
12. Does the project propose or require construction of a new well or to alter an existing groundwater well to pump more than 50 gallons per day (GPD)?	☐	☐
If yes, has the applicable permit for groundwater recovery or for groundwater well installation been obtained?	☐	☐

SECTION G – ANTI-DEGRADATION EVALUATION

In accordance with 40 CFR §131.12 and the ADEM Admin. Code r. 335-6-10-.04 for anti-degradation, the following information must be provided, if applicable. It is the applicant's responsibility to demonstrate the social and economic importance of the proposed activity. If further information is required to make this demonstration, attach additional sheets to the application.

1. Is this a new or increased discharge that began after April 3, 1991? ☐ Yes ☒ No
If yes, complete G.2 below. If no, go to Section H.
2. Has an Anti-Degradation Analysis been previously conducted and submitted to the Department for the new or increased discharge referenced in G.1? ☐ Yes ☐ No

If yes, do not complete this section. If no, and the discharge is to a Tier II waterbody as defined in ADEM Admin. Code r. 335-6-10-.12(4), complete G.2.A – G.2.F below and ADEM Forms 311 and 313 (attached). ADEM Form 313 must be provided for each alternative considered technically viable.

Information required for new or increased discharges to high quality waters:

A. What environmental or public health problem will the discharger be correcting?

B. How much will the discharger be increasing employment (at its existing facility or as the result of locating a new facility)?

C. How much reduction in employment will the discharger be avoiding?

D. How much additional state or local taxes will the discharger be paying?

E. What public service to the community will the discharger be providing?

F. What economic or social benefit will the discharger be providing to the community?

SECTION H – EPA Application Forms

All Applicants must submit EPA permit application forms. More than one application form may be required from a facility depending on the number and types of discharges or outfalls found. The EPA application forms are found on the Department's website at <https://adem.alabama.gov/water/forms>. The EPA application forms must be submitted in duplicate as follows:

1. All applicants must submit Form 1.
2. Applicants for existing industrial facilities (including manufacturing facilities, commercial facilities, mining activities, and silvicultural activities) which discharge process wastewater must submit Form 2C.
3. Applicants for new industrial facilities which propose to discharge process wastewater must submit Form 2D.
4. Applicants for new and existing industrial facilities which discharge only non-process wastewater (i.e., non-contact cooling water and/or sanitary wastewater) must submit Form 2E.
5. Applicants for new and existing facilities whose discharge is composed entirely of storm water associated with industrial activity must submit Form 2F, unless exempted by § 122.26(c)(1)(ii). If the discharge is composed of storm water and non-storm water, the applicant must also submit Forms 2C, 2D, and/or 2E, as appropriate (in addition to Form 2F).

SECTION I – ENGINEERING REPORT/BMP PLAN REQUIREMENTS

See ADEM 335-6-6-.08(i) & (j)

SECTION J- RECEIVING WATERS

Outfall No.	Receiving Water(s)	303(d) Segment?		Included in TMDL?*	
DSN001	Pond Creek	☒ Yes	☐ No	☐ Yes	☒ No
DSN003	Unnamed Tributary to Pond Creek	☐ Yes	☒ No	☐ Yes	☒ No
DSN005	Pond Creek	☒ Yes	☐ No	☐ Yes	☒ No
		☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No

*If a TMDL Compliance Schedule is requested, the following should be attached as supporting documentation:

- (1) Justification for the requested Compliance Schedule (e.g. time for design and installation of control equipment, etc.);
- (2) Monitoring results for the pollutant(s) of concern which have not previously been submitted to the Department (sample collection dates, analytical results (mass and concentration), methods utilized, MDL/ML, etc. should be submitted as available);
- (3) Requested interim limitations, if applicable;
- (4) Date of final compliance with the TMDL limitations; and,
- (5) Any other additional information available to support requested compliance schedule.

SECTION K - APPLICATION CERTIFICATION

The information contained in this form must be certified by a responsible official as defined in ADEM Administrative Code r. 335-6-6-.09 "signatories to permit applications and reports" (see below).

"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."

Signature of Responsible Official: _____ Date Signed: _____

Name: David Mullins Title: Plant Manager

If the Responsible Official signing this application is not identified in Section A.7, provide the following information:

Mailing Address: _____

City: _____ State: _____ Zip: _____

Phone Number: _____ Email Address: _____

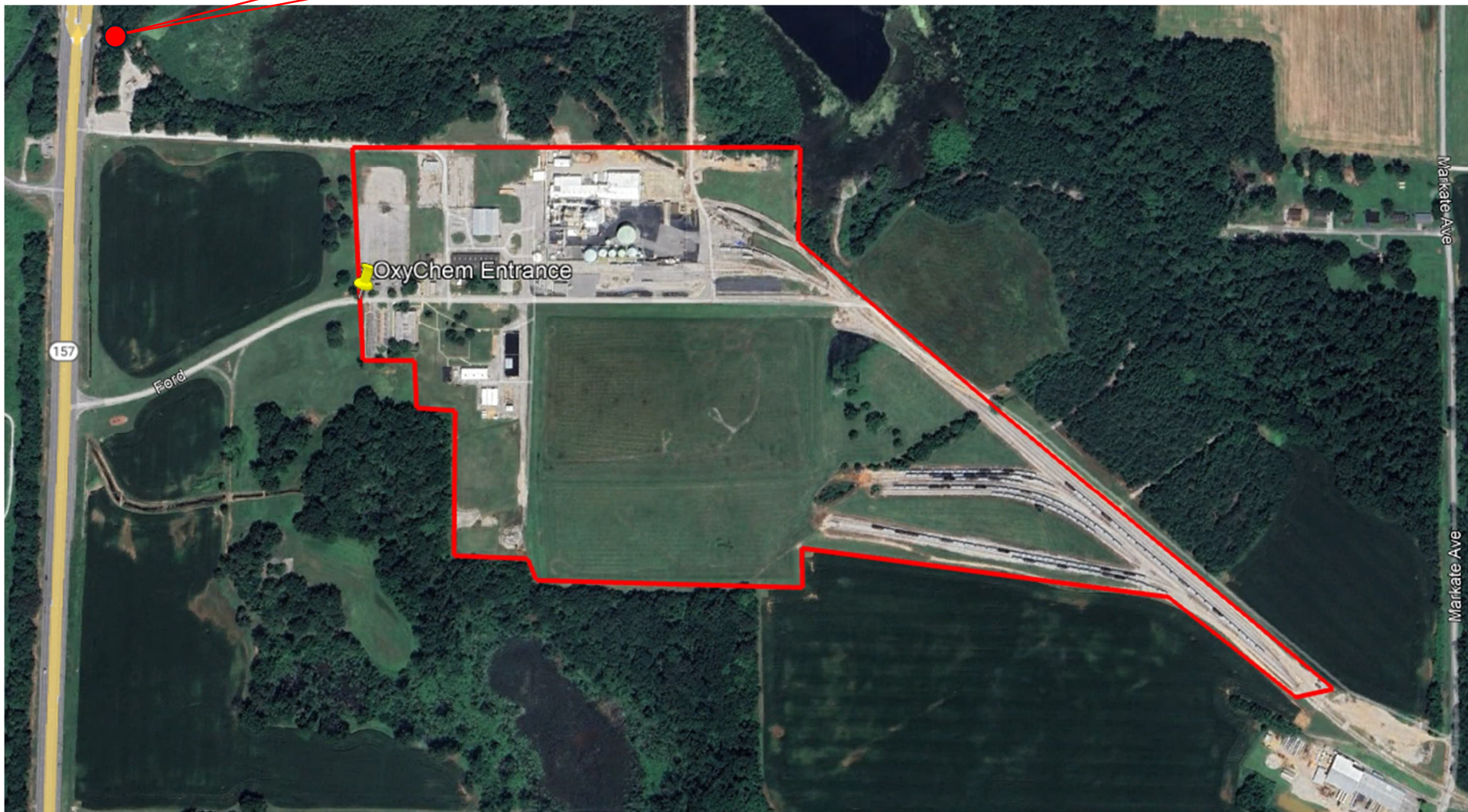
335-6-6-.09 SIGNATORIES TO PERMIT APPLICATIONS AND REPORTS.

- (1) The application for an NPDES permit shall be signed by a responsible official, as indicated below:
 - (a) In the case of a corporation, by a principal executive officer of at least the level of vice president, or a manager assigned or delegated in accordance with corporate procedures, with such delegation submitted in writing if required by the Department, who is responsible for manufacturing, production, or operating facilities and is authorized to make management decisions which govern the operation of the regulated facility;
 - (b) In the case of a partnership, by a general partner;
 - (c) In the case of a sole proprietorship, by the proprietor; or
 - (d) In the case of a municipal, state, federal, or other public entity, by either a principal executive officer, or ranking elected official.

**Occidental Chemical Corporation
NPDES Permit AL0000213**

**ADEM Form 187, Attachment 1
Site Map**

**Location of Sampling
Equipment**



ADEM Form 187, Attachment 2
Biocides and Corrosion Inhibitors

Product Name	Product Type	Purpose	Plant Location	Active Ingredient(s)	Frequency of Use	Estimated Quantity Used (lbs/year)	Daily Usage (lb)	Proposed Discharge Concentration (mg/L) *	96-hour Median Tolerance Limit(s)	EPA Registration Number
CORTROL IS3000	Boiler Water Treatment	Oxygen Scavenger	Potassium Carbonate/Potassium Bicarbonate Production	Sodium Bisulfite	Continuous	2,877	7.88	0.121	Fathead Minnow: 210 mg/L	N/A
SOLUS AP24	Boiler Water Treatment	Boiler Water Treatment	Potassium Carbonate/Potassium Bicarbonate Production	None listed	Continuous	1,161	3.18	0.049	Fathead Minnow: > 5,000 mg/L	N/A
STEAMATE NA715	Boiler Water Treatment	Corrosion Inhibitor	Potassium Carbonate/Potassium Bicarbonate Production	2-Diethylaminoethanol, Cyclohexylamine, Morpholine	Continuous	1,492	4.09	0.063	Fathead Minnow: 241 mg/L	N/A
Chlorine (liquid gas)	Cooling Water Treatment	Biocide	Potassium Carbonate/Potassium Bicarbonate Production	Chlorine	Continuous	32,850	90.0	0.069	Fish: 0.2135 mg/L Atlantic Silverside: 0.037 mg/L	N/A

* Proposed Discharge Concentration for chlorine is based on a 95% oxidation rate for the chlorine gas

N/A - Not Applicable

ADEM Form 187, Attachment 3
Water Supply Information

Occidental Chemical Corporation (OxyChem) utilizes two surface water intakes constructed and owned by the Tennessee Valley Authority (TVA) on the Tennessee River to provide cooling water for the facility. The Fleet Hollow intake is located upstream of Wilson Dam and the Phosphate Development Works intake is located downstream of Wilson Dam. The latitude and longitude of the intakes is noted in Table 1. Typically the Fleet Hollow intake is used during cooler months when the cooling demand for the facility is lower, and the Phosphate Development Works intake is utilized during warmer months when the cooling demand for the facility is higher.

Table 1. Surface Water Intake Locations

Intake Name	Latitude	Longitude
Fleet Hollow	34° 47' 20.26" N	-87° 37' 25.68" E
Phosphate Development Works	34° 47' 29.40" N	-87° 38' 26.27" E

For the past several years OxyChem is the only facility that has used the Fleet Hollow and Phosphate Development Works intakes and has been responsible for maintaining the intakes. OxyChem is currently installing new pumps in the Phosphate Development Works intake and replacing the rotating screens with a stationary screen. Beginning in late 2025, OxyChem will only utilize this intake and no longer be using the Fleet Hollow intake.

Two of the pumps will be replaced in late summer/fall 2025 and the third pump will be replaced in 2026. The new pumps are planned to be operated at 8,000 gallons per minute (11.5 million gallons per day) based on pressure requirements at the facility. The electrical system at the Phosphate Development Works intake will only support the operation of a single pump at a time, so the maximum pumping capacity for the intake will be approximately 11.5 million gallons per day.

The 3/8" mesh rotating screen is being replaced with a 1/2" mesh screen. The 1/2" mesh screen has an open area of 65%. The rotating screen that will be removed extended to the bottom of the intake and the new screen is 5 feet tall by 82 inches wide. The elevation of the new screen will be adjusted as the water level in Pickwick Reservoir changes to protect the new pumps from floating debris. The area below the 5-foot screen depth will be open to the bottom of the intake. The screens will be visually inspected on a routine basis and cleaned as needed. When a screen is removed for cleaning, a duplicate spare screen will be put in its place to protect the pumps.

The Tennessee Valley Authority operating guide for Pickwick Reservoir indicates the normal operating level in November through March is 409 feet above sea level and for April through September is 413.75 feet above sea level. The water level is reduced from the summer pool to the winter pool level from September through November. The water depth in the intake was measured in January 2024, in preparation for replacing the pumps and screen, to be approximately 15 feet.

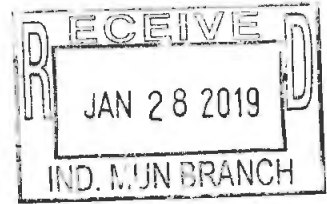
Based on information in the previous permit application, the Phosphate Development Works intake pumps had a maximum design pump rate of 38.9 mgd. Even when all three pumps are replaced, the maximum design pump rate will be approximately 11.5 mgd because the electrical supply will only allow a single pump to be operated at any time. At a 15-foot water depth and open width of 82", with the top 5 feet screened with a 1/2" mesh screen with a 65% open area, the through-screen velocity at the maximum design flow of 11.5 mgd will be 0.20 feet per second. The velocity will be less during the summer months with the water elevation is increased. The updated intake design flow through-screen velocity meets the best technology available for minimizing adverse environmental impact (BTA) requirements for impingement in 40 CFR 125.94.

There have been no significant changes in operations of the reservoirs by TVA nor the biological characteristics since the previous permit application was submitted. The *316(b) Supporting Information: Cooling Water Intake for Fleet Hollow Intake on Wilson Reservoir, January 8, 2019*, and *316(b) Supporting Information: Cooling Water Intake for PDW Intake on Pickwick Reservoir, January 8, 2019*, have been included to document the source water physical data and baseline biological characteristics of the Tennessee River.

AST

Environmental

*Natural Resource Consultants Specializing in
Protected Species, Streams and Wetlands*



316(b) Supporting Information: Cooling Water Intake Documentation for Fleet Hollow Intake on Wilson Reservoir

Prepared for

**Armand Products Facility
Occidental Chemical Corporation**
1000 North Wilson Dam Road
Muscle Shoals, AL 35661

Prepared by

AST Environmental
98 Mark Selby Private Drive
Decatur, Alabama 35603
Phone (256) 476-7355

Project Number TR18-104

January 8, 2019

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1.0 Introduction

The Armand Products Facility operated by Occidental Chemical Corporation (OxyChem or the Facility) uses a cooling water intake structure (CWIS), owned by the Tennessee Valley Authority (TVA), at its facility in Muscle Shoals, Alabama. As a part of the National Pollutant Discharge Elimination System (NPDES) AL0000213 renewal application, the Facility has prepared this 316(b) supplemental information to determine compliance with the provisions set forth in the Clean Water Act (CWA), as amended in 33 US C1251 Section 316(b) regulations – *Final Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities* (316 (b) or the Rule) that became effective on October 14, 2014.

AST Environmental (AST) on behalf of OxyChem is providing a detailed compilation of the currently available data and other resources related to OxyChem's cooling water intake from the Tennessee River to satisfy the applicable CWA 316(b) requirements as requested by ADEM. The purpose of this document is to provide ADEM with the comprehensive application submittal required of OxyChem to renew its NPDES permit and comply with the 316(b) Rule.

1.1 Section 316(b) Regulatory Overview

The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also set water quality standards for all contaminants in surface waters. EPA has given primacy to ADEM to issue NPDES permits that regulate industries that discharge pollutants to surface waters in Alabama.

According to the Federal Register, the purpose of 316(b) regulations is to reduce impingement and entrainment of fish and other aquatic organisms at cooling water intake structures used by certain existing power generation and manufacturing facilities for the withdrawal of cooling water from waters of the United States. This rule establishes requirements under section 316(b) of the Clean Water Act (CWA) for existing power generating facilities and existing manufacturing and industrial facilities that are designed to withdraw more than 2 million gallons per day (MGD) of water from waters of the United States and use at least 25 percent of the water they withdraw exclusively for cooling purposes. This regulation went into effect in October 14, 2014.

1.2 Facility Information

The Armand Products Facility is a joint venture of Chruch and Dwight Company and the Occidental Chemical Corporation. The Facility located at 1000 North Wilson Dam Road in Colbert County, Muscle Shoals, Alabama (Figures 1 and 2) and is operated by Occidental

Chemical Corporation. OxyChem is a manufacturer of potassium carbonate and potassium bicarbonate at a separate facility on the site of Occidental Petroleum Corporation's old chlor-alkali plant closed in April of 2008.

The Facility receives intake water from the Fleet Hollow CWIS that is owned by TVA and operated by OxyChem. The Fleet Hollow intake structure withdraws water from Wilson Lake, an impoundment along the Tennessee River located between Wheeler Reservoir upstream and Pickwick Reservoir downstream. The water is pumped to the facility from Wilson Lake by one of the four (4) river intake pumps located at the TVA Fleet Hollow CWIS. Briefly, the Fleet Hollow CWIS has the following intake characteristics:

- intake pumps have a maximum design pump rate of 43.2 MGD
- through-screen design intake velocity is less than 0.5 ft/sec
- intake is a very small percentage (<1%) of the 7Q10 flow of the Tennessee River

The Facility estimates that less than 5.43 MGD is used from the Fleet Hollow CWIS with 1.95 MGD (36%) used for cooling water. Therefore, since OxyChem has an actual intake flow rate greater than 2 MGD, and at least 25 percent of the actual water withdrawn is used exclusively for cooling purposes, this narrative has been developed to meet the requirements for impingement mortality under 40 CFR 125.94(c) and entrainment under 40 CFR 125.94(d). In accordance with the request of the ADEM and 40 CFR Part 122.21 (r)(1)(ii), this report will focus on the applicable provisions of 40 CFR Part 122.21 (r)(2) through (r)(8).

Based on the location of the Fleet Hollow CWIS in Wilson reservoir of the Tennessee River and this being the point at which water is first drawn from waters of the U.S., it is the Facility's position that the point of compliance for 316(b) at the OxyChem facility will be the Fleet Hollow CWIS. Therefore, the focus of information for (r)(2) and (4) in this narrative will be on the Tennessee River which is considered the source water for OxyChem.

2.0 Source Water Physical Data (40 CFR 122.21(r)(2))

OxyChem uses four river intake pumps within the Fleet Hollow CWIS which is owned by TVA and operated by the Facility. The Fleet Hollow intake pump components are located on the west bank of Fleet Hollow of the Tennessee River (Wilson Lake) near river mile 259.6, immediately upstream from the Wilson Lock and Dam and approximately 15.5 river miles downstream of the Wheeler Lock and Dam, both maintained and operated by the US Army Corps of Engineers (USACE) Mobile, AL District. The topographic map and aerial photo for the section of river containing the Fleet Hollow CWIS is provided in Figures 3 and 4.

Wilson Reservoir receives approximately 31,993 MGD discharge from Wheeler Dam farther upstream. The average annual discharge from Wilson Dam is 33,286 MGD. The normal pool level of Wilson reservoir is 507.5' MSL with a maximum depth in the navigation channel near 114 feet. Base pool level is 501.7' MSL. Based on computer simulations and more than 100 years of rain and runoff data, the 80-percent probability band (the expected operating range of Wilson Reservoir's likelihood of falling within this range of elevation on average in 8 out of every 10 years on any given day) indicates a minimum pool level of approximately 504.7' MSL. The 80% probability band minimum water level at Wilson Dam of 504.7' MSL also corresponds to a minimum water level of 504.7' MSL at the Fleet Hollow CWIS. The Fleet Hollow CWIS withdraws less than 0.5% of the average annual flow of the Tennessee River. The monthly mean discharge of the Tennessee River at Florence, AL from 1936-2005 and annual mean flows from 1937- 2003 are contained in Figure 5 and Figure 6, respectively. Wilson Reservoir morphometric, physical, and chemical characteristics are detailed in Table 1 adapted from Ekema et al (2017, in part).

The monthly mean temperature regime for the Tennessee River at Florence, AL at RM 256.5 is depicted in Figure 7. The temperature readings from 1965 to 2005 ranged from a low of 7°C to a high of 29°C at RM 256.5. Temperature (°C) and dissolved oxygen (mg/L) profiles at the dam forebay of Wilson Reservoir on August 23, 2017 are found in Figure 8 (Ekema et al 2017).

Salinity is a measure of the amount of dissolved salts in the water body. Conductivity and salinity are related because dissolved ions measured in conductivity increase with an increase in salinity. Conductivity at 256.5 between 1965 and 2005 ranged from a low of 134 to a high of 260 microsiemens per cm at 25°C

https://nwis.waterdata.usgs.gov/nwis/qwdata?parameter_cd=00095&site_no=03589500&agency_cd=USGS&format=serial_rdb).

3.0 Cooling Water Intake Structure Data (CFR 122.2 (r)(3))

The CWIS data is required to characterize the configuration and operation of the CWIS. The current configuration and general site arrangement for OxyChem consists of a CWIS located on Wilson Reservoir at Fleet Hollow of the Tennessee River at RM 259.6 (34.7890, -87.6238). The CWIS consists of a nearshore and an onshore component providing cooling water to the Facility and has been in operation since 1964.

Data on the TVA Fleet Hollow CWIS is in Table 2. Nearshore, cooling water enters through two intake structures on the south shore of a point extending into Fleet Hollow of the Tennessee River. The intake center line elevation is approximately 485.5 feet MSL and is located approximately 22 feet below the normal pool level of 507.5 MSL (see Table 2 and Figure 9). Intake elevation in relation to the bottom is 10 feet. The intakes face northeast, and are roughly perpendicular to the main flow of the river. Each intake is fitted with a trash rack for the submerged intake (Figure 11).

The four intake pumps have design capacities of 16.6, 16.6, 28.8 and 10.8 MGD, respectively (Table 2). However, the maximum total design intake volume for Fleet Hollow CWIS is 43.2 MGD. Typical average flows for the intake water is approximately 8.1 MGD. The intake water flows via pipe approximately one mile SSE to the Facility. The Facility operates continuously; therefore, the intake water pump(s) operate continuously, alternating with the TVA PDW CWIS. Only one of the CWISs is in operation at any given time. The PDW CWIS is generally used only for a short period during the summer months if the water temperature at the Fleet Hollow CWIS is too high.

Onshore, the four water intake pumps are situated on a concrete pad located at the river's edge in Fleet Hollow. Any of the four pumps can be utilized for makeup water to the Facility with current normal operations consisting of only one pump running at a time. The shoreline intake structure consists of a two (2) 100% capacity rotating screens. Each screen is a self-cleaning via backwash from a 4 inch wash water supply. There are two screens, one for each of two pumps, with each screen being 9 feet in width. Total screen intake flow-through area is 347 ft². The intake structure is made of concrete and consists of two openings where river water enters the structure in a direction opposite to the screen entrance. After passing through the trash rack, water flows through a 9 feet wide opening to the screen entrance. The CWIS also includes sluice gates and trash racks.

The rotating screens are 3/8 inch mesh with a design intake flow velocity is 0.23 cfs. The mesh assembly rotates about a head shaft driven by water pressure. Debris collected on the screens is washed off by water jets and transferred by a trough to a trash sluice pipe and is removed for disposal.

Pumps are set on the operating floor at elevation 512' MSL. Current TVA data indicate the winter pool elevation is typically maintained at approximately 505.5' MSL and the summer pool elevation is typically maintained at approximately 507.5' MSL (normal pool level). Bottom of the Fleet Hollow channel in the CWIS vicinity is approximately 36' deep at normal pool level.

OxyChem uses 8.1 MGD from Fleet Hollow CWIS of which approximately 2.88 MGD is used for cooling water (35.5%). The water balance and distribution system diagram is in Figure 10. The Engineering Drawings for the CWIS, including the traveling screens can be seen in Figure 11.

4.0 Source Water Baseline Biological Characterization (40 CFR 122.21(r)(4))

The source water baseline biological characterization data is required to characterize the biological community and evaluate how that community may potentially be affected by the CWIS. The following provides the Source Water Baseline Biological Characterization Data for OxyChem's Fleet Hollow CWIS.

4.1 Data Available and Methodology (r)(4)(i)

Baseline biological data for the source water in Tennessee River or Wilson Reservoir near OxyChem's Fleet Hollow CWIS is limited. No studies have been conducted in the immediate vicinity of the Fleet Hollow CWIS that characterizes the fish or benthic communities, including the adult, juvenile, young-of-the-year, or larval fish communities. However, a number of studies were identified elsewhere in Tennessee River (Wheeler and Pickwick Reservoirs) immediately upstream and downstream of the CWIS providing data sufficient for characterizing the biological community near the OxyChem's Fleet Hollow CWIS. The source of these data included technical reports and studies conducted by Alabama Department of Conservation and Natural Resources (ADCNR), US Fish and Wildlife Services (USFWS), Alabama Department of Environmental Management (ADEM) and local universities. Collectively, these studies provide a list of species found in the Tennessee River, an overview for the types of habitats in which biota may occur, and in some cases provide a basis for evaluating relative abundances. Given the overall similarity of biotic communities among Tennessee River reservoirs, all of these data sources support the baseline characterization for the Fleet Hollow CWIS.

There was limited publicly available data describing the fish community within the Tennessee River in Colbert County, Alabama at Fleet Hollow. Most of the available information was conducted in Wheeler Reservoir upstream at the TVA Browns Ferry Nuclear Facility (BFN) and in the Pickwick Reservoir downstream at TVA Colbert Fossil Plant (COF). TVA conducted fish sampling annually from 2000-2009 and 2011 at locations upstream and downstream of BFN. TVA sampling methods included boat electrofishing and gill netting. Electrofishing method consisted of fifteen electrofishing boat runs near the shoreline, each 300 meters long with a duration of approximately 10 minutes each. The total near shore area sampled is approximately 4,500 meters. TVA conducted electrofishing samples upstream and downstream of the COF as well. ADCNR conducted limited studies on Wilson Reservoir in 2013 and 2017, but only included largemouth bass in these studies. Given the overall similarities of Wheeler and Pickwick Reservoirs to Wilson Reservoir and the fact that Wheeler and Pickwick Reservoirs are located immediately upstream and downstream of Wilson Reservoir and the Fleet Hollow CWIS, the data contained in these studies should be directly applicable to Wilson Reservoir. The results of these studies are provided in Tables 3 through 15 and represent a species list and abundance from the compiled studies.

For the BFN studies, experimental gill nets were used as an additional gear type to collect fish from deeper habitats not effectively sampled by electrofishing. Each experimental gill net consists of five 6.1 meter panels for a total length of 30.5 meters. The distinguishing characteristics of experimental gill nets is mesh size that varies between panels. For this application, each net has panels with mesh sizes of 2.5, 5.1, 7.6, 10.2, and 12.7 cm. Experimental gill nets are typically set perpendicular to river flow extending from near-shore to the main channel of the reservoir. Ten overnight experimental gill net sets were used at each area. Gill nets were not employed in the COF survey.

Fish collected were identified by species, counted, and examined for anomalies (such as disease, deformations, or hybridization). TVA utilizes the Reservoir Fish Assemblage Index (RFAI) in order to analyze the collected data.

The RFAI uses 12 fish community metrics from four general categories: Species Richness and Composition; Trophic Composition; Abundance; and Fish Health. Individual Species can be utilized for more than one metric. Together, these 12 metrics provide a balanced evaluation of fish community integrity. The individual metrics are shown below, grouped by category:

Species Richness and Composition

1. Total Number of Indigenous Species-Greater numbers of indigenous species are considered representative of healthier aquatic ecosystems. As conditions degrade, numbers of species at an area decline.
2. Number of Centrarchid Species-Sunfish species (excluding Black Basses) - These are insectivores and a high diversity of this group is indicative of reduced siltation and suitable sediment quality in littoral areas.
3. Number of Benthic Invertivore Species-Due to the special dietary requirement of this species group and the limitation of their food source in degraded environments, numbers of benthic invertivore species increase with better environmental quality.
4. Number of Intolerant Species-This group is made up of species that are particularly intolerant of physical, chemical, and thermal habitat degradation. Higher numbers of intolerant species suggest the presence of fewer environmental stressors.
5. Percentage of Tolerant Individuals-This metric signifies poorer water quality with increasing proportions of individuals tolerant of degraded conditions.
6. Percent Dominance by one Species-Ecological quality is considered reduced if one species inordinately dominates the resident fish community.
7. Percentage of Non-indigenous species-Based on the assumption that non-indigenous species reduce the quality of resident fish communities.
8. Number of Top Carnivore Species-Higher diversity of piscivores is indicative of the availability of diverse and plentiful forage species and the presence of suitable habitat.

Trophic Composition

9. Percentage of Individuals as Top Carnivores-A measure of the functional aspect of top carnivores which feed on major planktivore populations
10. Percentage of Individuals as Omnivores-Omnivores are less sensitive to environmental stresses due to their ability to vary their diets. As trophic links are disrupted due to degraded conditions, specialist species such as insectivores decline while opportunistic omnivorous species increase in relative abundance.

Fish Abundance and Health

11. Average Number per Run-This metric is based upon the assumption that high quality fish assemblages support large numbers of individuals.
12. Percentage of Individuals with Anomalies-Incidence of diseases, lesions, tumors, external parasites, deformities, blindness, and natural hybridization are noted for all fish measured, with higher incidence indicating less favorable environmental conditions.

RFAI methodology addresses all four attributes or characteristics of a “balanced indigenous population” (BIP) defined by the CWA, as described below:

- (1) A biotic community characterized by diversity appropriate to the ecoregion: Diversity is addressed by the metrics in the Species Richness and Composition category, especially metric 1 – “Number of indigenous species.” Determination of reference conditions based on the transition zones of lower mainstream Tennessee River reservoirs (as described below) ensures appropriate species expectations for the ecoregion.
- (2) The capacity for the community to sustain itself through cyclic seasonal change: TVA uses an autumn data collection period for biological indicators, both VS and upstream/downstream monitoring. Autumn monitoring is used to document community condition or health after being subjected to the wide variety of stressors throughout the year. One of the main benefits of using biological indicators is their ability to integrate stressors through time. Examining the condition or health of a community at the end of the “biological year” (i.e., autumn) provides insight into how well the community has dealt with the stresses through an annual seasonal cycle. Likewise, evaluation of the condition of individuals in the community (in this case, individual fish as reflected in Metric 12) provides insight into how well the community can be expected to withstand stressors through winter. Further, multiple sampling years during the permit renewal cycle add to the evidence of whether or not the autumn monitoring approach has correctly demonstrated the ability of the community to sustain itself through repeated seasonal changes.

- (3) The presence of necessary food chain species: Three dominant fish trophic levels exist within Tennessee River reservoirs: insectivores, omnivores, and top carnivores. To determine the presence of necessary food chain species, these three groups should be well represented within the overall fish community. Other fish trophic levels include benthic invertivores, planktivores, herbivores, and parasitic species. Insectivores include most sunfish, minnows, and silversides. Omnivores include gizzard shad, common carp, carpsuckers, buffalo, and channel and blue catfish. Top carnivores include black and temperate bass, gar, skipjack herring, crappie, flathead catfish, sauger, and walleye. Benthic invertivores include drum, suckers, and darters. Planktivores include alewife, threadfin shad, and paddlefish. Herbivores include largescale stonerollers. Lampreys in the genus *Ichthyomyzon* are the only parasitic species occurring in Tennessee River reservoirs. To establish expected proportions of each trophic guild and the expected number of species included in each guild occurring in lower mainstream Tennessee River reservoirs (Kentucky, Pickwick, Wilson, Wheeler, and Guntersville reservoirs), data collected from 1993 through 2010 were analyzed for each reservoir zone (forebay, transition, inflow). Samples collected in the downstream vicinity of thermal discharges were not included in this analysis so that accurate expectations could be calculated with the assumption that these data represent what should occur in lower mainstream Tennessee River reservoirs absent from point source effects (i.e. power plant discharges). Data from 900 electrofishing runs (a total of 405,000 meters of shoreline sampled) and from 600 overnight experimental gill net sets were included in this analysis for transition areas in lower mainstream Tennessee River reservoirs. From these data, the range of proportional values for each trophic level and the range of the number of species included in each trophic level were trisected. This trisection is intended to show less than expected, expected or average, and above expected or average values for trophic level proportions and species occurring within each reservoir zone in lower mainstream Tennessee River reservoirs. These data were also averaged and bound by confidence intervals (95%) to further evaluate expected values for proportions of each trophic level and the number of species expected for each trophic level by reservoir zone.
- (4) A lack of domination by pollution-tolerant species: Domination by pollution-tolerant species is determined by metrics 3 ("Number of benthic invertivore species"), 4 ("Number of intolerant species"), 5 ("Percentage of tolerant individuals"), 6 ("Percent dominance by one species"), and 10 ("Percentage of individuals as omnivores").

Scoring categories are based on "expected" fish community characteristics in the absence of human-induced impacts other than impoundment of the reservoir. These categories were developed from historical fish assemblage data representative of transition zones from lower mainstream Tennessee River reservoirs (Hickman and McDonough, 1996). Attained values for each of the 12 metrics were compared to the scoring criteria and assigned scores to represent

relative degrees of degradation: least degraded (5); intermediate degraded (3); and greatest degraded (1). For both the upstream (TRM 295.9) and the downstream (TRM 292.5) stations, RFAI metrics were scored using evaluation criteria for the “transition” reservoir zone.

If a metric was calculated as a percentage (e.g., “Percentage of tolerant individuals”), the data from electrofishing and gill netting were scored separately and allotted half the total score for that individual metric. Individual metric scores for a sampling area (i.e., downstream or upstream) are summed to obtain the RFAI score for the area.

TVA uses RFAI results to determine maintenance of BIP using two approaches. One is “absolute” in that it compares the RFAI scores and individual metrics to predetermined values. The other is “relative” in that it compares RFAI scores attained downstream to the upstream control site. The “absolute” approach is based on Jennings et al. (1995) who suggested that favorable comparisons of the attained RFAI score from the potential impact zone to a predetermined criterion can be used to identify the presence of normal community structure and function and hence existence of BIP. For multi-metric indices, TVA uses two criteria to ensure a conservative screening of BIP. First, if an RFAI score reaches 70% of the highest attainable score of 60 (adjusted upward to include sample variability as described below), and second, if fewer than half of RFAI metrics receive a low (1) or moderate (3) score, then normal community structure and function would be present indicating that BIP had been maintained, thus no further evaluation would be needed.

RFAI scores range from 12 to 60. Ecological health ratings (12-21 “Very Poor”, 22-31 “Poor”, 32-40 “Fair”, 41-50 “Good”, or 51-60 “Excellent”) are then applied to scores. As discussed in detail below, the average variation for RFAI scores in TVA reservoirs is 6 (+ 3). Therefore, any location that attains an RFAI score of 45 (42 plus the upward sample variation of 3) or higher would be considered to have BIP. It must be stressed that scores below this threshold do not necessarily reflect an adversely impacted fish community. The threshold is used to serve as a conservative screening level; i.e., any fish community that meets these criteria is obviously not adversely impacted. RFAI scores below this level would require a more in-depth look to determine if BIP exists. An inspection of individual RFAI metric results and species of fish used in each metric would be an initial step to help identify if operation of BFN is a contributing factor. This approach is appropriate because a validated multi-metric index is being used and scoring criteria applicable to the zone of study are available.

4.2 List of Species for all Life Stages (r)(4)(ii)

Baseline Data from TVA from Upstream Wheeler Reservoir

Data 2011:

In 2011, fish community RFAI scores of 38 (“Fair”) and 40 (“Fair”) were observed at the downstream and upstream stations, respectively. Fish species collected upstream and downstream of BFN and corresponding catch rates are shown in Tables 5, 10 and 11. Results for each metric, as they apply to the characteristics of BIP, are discussed below.

(1) A biotic community characterized by diversity appropriate to the ecoregion

Twenty-eight indigenous species were collected downstream and 29 upstream, resulting in midrange (3) metric scores for both sites. Four species, black redhorse, chestnut lamprey, redbreast sunfish, and silver redhorse, were collected in small numbers (four individuals or less) downstream of BFN but were not collected upstream. Five species (largescale stoneroller, logperch, longnose gar, northern hogsucker, and yellow bass) were collected at the upstream site only. Largescale stoneroller, logperch, and northern hogsucker were represented by only one individual each.

Eight centrarchid species were collected downstream and 7 upstream, resulting in the highest metric score (5) for both stations. Redbreast sunfish (2 individuals collected downstream) was the only species not collected at both sites. Four benthic invertivore species were collected at each station, resulting in mid-range scores at both sites. Freshwater drum and spotted sucker were collected at both stations, black redhorse and silver redhorse were collected at the downstream site only, and logperch and northern hogsucker were collected at the upstream site only. Five intolerant species were collected at both upstream and downstream sites, resulting in the highest metric score at both sites. Longear sunfish, skipjack herring, smallmouth bass, and spotted sucker were collected at both stations. Black redhorse was collected at the downstream site only and northern hogsucker was collected only at the upstream site. Nine top carnivore species were collected at the downstream site and eleven at the upstream site, which resulted in scores of 5 for both sites. In addition to the top carnivore species encountered at the downstream station (black crappie, flathead catfish, largemouth bass, skipjack herring, smallmouth bass, spotted bass, spotted gar, white bass, and white crappie), longnose gar and yellow bass were collected upstream of BFN.

Both sites received the same scores for each of the metrics discussed above. These results demonstrate the presence of diverse fish communities upstream and downstream of BFN for 2011.

(2) The capacity for the community to sustain itself through cyclic seasonal change

Number of indigenous species (> 30 required for highest score): The species composition of the autumn sample should be indicative of the ability of the fish community to withstand the stressors of an annual seasonal cycle. During autumn 2011, 28 indigenous species were collected downstream of BFN and 29 upstream; total numbers of species at

both sites were within the range of variability observed at each site from autumn 2000 through 2011. Numbers of indigenous species collected from autumn 2000 through 2011 ranged from 23 to 28 at the downstream site and 24 to 32 at the upstream site.

Percentage of anomalies (< 2% required for highest score): The percentage of anomalies (*i.e.*, visible lesions, bacterial and fungal infections, parasites, muscular and skeletal deformities, and hybridization) observed in samples is an indicator of the ability of the fish community to withstand the stressors of an annual seasonal cycle. Percentages of anomalies at both sampling sites were low, resulting in the highest score (5) for this metric at both sites.

During autumn 2011, species diversity was similar and percentages of anomalies were low at both sites, indicating that fish communities were able to sustain themselves through cyclic seasonal change.

(3) The presence of necessary food chain species

The trophic composition of the fish community upstream and downstream of BFN was similar during autumn 2011. Mississippi silversides and bluegill were abundant in samples and accounted for the majority of insectivores at each site. Gizzard shad constituted approximately 90% of omnivores collected at each site. Twice the total number of top carnivores were collected upstream of BFN than downstream, but proportions of top carnivores were lower than expected at both sites. Percentages of planktivores (threadfin shad was the only planktivore species collected) were similar between sites, but the percentages of benthic invertivores were low at both sites. One parasitic species (one chestnut lamprey) was collected downstream and none were collected upstream. One herbivore (one largescale stoneroller) was collected upstream and none downstream.

Proportions of insectivores and planktivores were within the expected range for lower mainstream Tennessee River reservoir transition zones for both sampling sites. Proportions of benthic invertivores and top carnivores were below expected values at both sites. Omnivores were above expected values at both stations which could be an indicator of water quality impairment at both stations. Parasitic and herbivore species are infrequently collected, and when collected, are typically present in low numbers as was the case at both stations.

Overall, the number of species collected met or exceeded expectations at both downstream and upstream sites during autumn 2011. At the downstream site six trophic levels were represented, which included four benthic invertivore, eight insectivore, seven omnivore, one planktivore, one parasitic, and nine top carnivore species. At the upstream

site, six trophic levels were represented and included four benthic invertivore, seven invertivore, seven omnivore, one planktivore, 11 top carnivore, and one herbivore species.

Proportions and numbers of species of each trophic guild were similar between sites; therefore, it was determined that the downstream site was similar to the upstream site during autumn 2011 with respect to the presence of necessary food chain species.

(4) A lack of domination by pollution-tolerant species

Number of intolerant species (> 4 required for highest score):

In autumn 2011, five pollution intolerant species were collected at both upstream and downstream sites. Both sites received the highest score of 5 for this metric. Longear sunfish, skipjack herring, smallmouth bass, and spotted sucker were collected at both stations. Black redhorse was collected at the downstream site only and northern hogsucker at the upstream site only.

Percentage of tolerant individuals (for highest score, < 27% required in electrofishing sample and < 15% required in gill netting sample): At the downstream site, nine pollution tolerant species were collected which consisted of 59.6% of the electrofishing sample and 40.0% of the gill netting sample. Similarly, nine pollution tolerant species were collected upstream composing 54.6% of the electrofishing sample and 36.0% of the gill netting sample. Both sites received the lowest score (1) for this metric.

Eight tolerant species, bluegill, common carp, gizzard shad, golden shiner, green sunfish, largemouth bass, spotfin shiner, and white crappie, were collected at both sites. Redbreast sunfish was collected at the downstream site only and longnose gar at the upstream site only. Gizzard shad was the most abundant species collected by both electrofishing and gill netting methods at both sites (34.6% - electrofishing downstream, 32.2% - gill netting downstream; 36.8% - electrofishing upstream, 15.1% - gill netting upstream).

Percentage of omnivores (for highest score, < 24% required in electrofishing sample; < 16% required in gill netting sample): During autumn of 2011, seven omnivore species (channel catfish, common carp, gizzard shad, golden shiner, smallmouth buffalo, black buffalo, and blue catfish) were collected at both sites. At the downstream site, omnivores constituted 37.8% of the electrofishing sample and 52.9% of the gill netting sample. At the upstream site, omnivores made up 41.0% of the electrofishing sample and 33.7% of the gill netting sample. Both sites received scores of 2 for this metric.

Percent dominance by one species (for highest score, < 29% required in electrofishing sample; < 17% required in gill netting sample): Gizzard shad were dominant in both

electrofishing and gill net samples at the downstream site. Gizzard shad dominated the electrofishing sample and white bass dominated the gill net sample at the upstream site. Both sites received a mid-range score for this metric.

The downstream and upstream sites scored equally in the 4 pollution tolerance metrics. Fish communities at both sites showed relatively low abundance and consisted of relatively high percentages of non-indigenous and pollution-tolerant individuals. It was, therefore, determined that the downstream site was similar to the upstream site during autumn 2011 with respect to the lack of domination by pollution-tolerant species.

2009 Data:

In 2009, fish community RFAI scores of 36 ("Fair") and 39 ("Fair") were observed at the downstream and upstream stations, respectively (Tables 4, 8 and 9). The score at the downstream site was within the 6-point range of acceptable variation when compared to that of the upstream site; therefore, the sites were considered similar and Balanced Indigenous Populations (BIP) was maintained at the downstream site. The upstream and downstream sites were compared using the five characteristics of BIP. For the discussion of each characteristic, the downstream site was compared to the upstream site using those metrics useful in this determination.

(1) A biotic community characterized by diversity appropriate to the ecoregion

Twenty-seven indigenous species were collected at the downstream site, while 26 indigenous species were collected at the upstream site. Thirty-one species were needed to attain the highest score possible for the metric "number of indigenous species"

Both upstream and downstream sites received the highest possible score for the metric "number of centrarchid species." Eight centrarchid species were collected at the upstream site, while 7 were collected at the downstream site. The metrics "number of benthic invertivores" and "number of intolerant species" both scored 2 points lower at the downstream site than at the upstream site. Three (3) benthic invertivore species and 3 intolerant species were collected at the downstream site compared to 4 and 5, respectively, at the upstream site. The benthic invertivore, black redhorse, was collected at the upstream site, but not at the downstream site; only one black redhorse was collected. Black redhorse (1 individual) and spotted sucker (4 individuals) were the intolerant species not collected at the downstream site. Both the downstream and upstream site recorded a score of 5 for the metric "number of top carnivore species." Nine (9) top carnivore species were collected at each site. Although the numbers of benthic invertivore and intolerant species differed between sites the numbers of individuals of those additional species collected were few. The other 3 metrics discussed received the same scores at both sites. Therefore, the downstream site was determined to be similar to

the upstream site. Based on these results, a diverse fish community existed at the downstream site in autumn 2009.

- (2) The capacity for the community to sustain itself through cyclic seasonal change
The percentage of anomalies (*i.e.*, visible lesions, bacterial and fungal infections parasites, muscular and skeletal deformities, and hybridization) in the autumn sample should be indicative of the ability of the fish community to withstand the stressors of an annual seasonal cycle. Both upstream and downstream sites scored the highest possible score for the metric "percent anomalies". The fish community at the downstream site was similar to the upstream site and able to withstand the stressors experienced from autumn 2008 through autumn 2009.
- (3) The presence of necessary food chain species
Scores for the metrics "percent top carnivores," "percent omnivores," "number of top carnivore species," "number of centrarchid species," and "average number per run" were similar between sites. "Number of top carnivore species" and "number of centrarchid species" recorded the highest possible scores (5) at both sites. "Percent top carnivores" scored 4 out of a possible 5 at both sites for both portions of the metric. Average percent omnivores (electrofishing and gill netting) were high at both sites (43% downstream; 46% upstream) resulting in scores of 2 out of a possible 5 for both sites. Average numbers of fish per run for electrofishing and gill netting were low at both sites, and each received the lowest metric score of 1. Given the higher numbers of top carnivore and centrarchid species at the downstream site and the similar percentages of top carnivores and omnivores and average numbers per run between sites, it was determined that the downstream site was similar to the upstream site with respect to the presence of necessary food chain species during autumn 2009.
- (4) A lack of domination by pollution-tolerant species
During autumn 2009, 3 benthic invertivores were collected at the downstream site compared to 4 benthic invertivores at the upstream site, resulting in metric scores of 1 and 3, respectively. Eight (8) benthic invertivore species were needed to attain a score of 5. Three intolerant species were collected at the downstream site compared to 5 intolerant species at the upstream site, resulting in a metric score 2 points lower at the downstream site. As previously stated, the benthic invertivore (black redhorse) not collected at the downstream site consisted of only 1 individual each. Black redhorse and spotted suckers (4 individuals) were the intolerant species not collected at the downstream site. The percentages of tolerant individuals (averages of electrofishing and gill netting) were similar between sites (43.3% downstream; 36.9% upstream). Given these results, the downstream site was determined to be similar to the upstream site with respect to domination by pollution-tolerant species.

(5) Indigenous

In autumn 2009, twenty-seven indigenous and 2 non-indigenous species (common carp and inland silverside) were collected at the downstream site compared to 26 indigenous and 3 nonindigenous species (common carp, striped bass, and inland silverside) at the upstream site. Percentages of non-indigenous species collected in the electrofishing sample were high at both sites, with inland silverside being the dominant non-indigenous species. The percentage of nonindigenous species collected in the gill netting portion of the sample was 3.4% (only common carp) at the upstream site; no non-indigenous species were collected at the downstream site. Compared to the upstream site, the downstream site was similar with respect to the indigenousness of its fish communities.

Wheeler Reservoir Fish Community Summary

In conclusion, analysis of the characteristics of BIP and their respective metrics indicated the downstream site was similar to the upstream site and that a balanced fish community was present at the downstream site in autumn 2009 and 2011. Eight (8) of the RFAI metrics and 11 of the RFAI metrics received the same scores at both sites in 2009 and 2011, respectively.

In the 2009 sample, of the four metrics that scored differently, "number of benthic invertivore species", "number of intolerant species," "percent dominance by one species," and "percent nonindigenous species," three (3) recorded a lower score at the downstream site, while one metric ("percent non-indigenous species") scored higher at the downstream site.

In the 2011 sample, upstream and downstream sites received identical combined scores for 11 of the twelve RFAI metrics. The downstream station earned scores of 3 or 5 for eight RFAI metrics, but earned the lowest score (1) for the metrics "Percent tolerant individuals," "Average number per run," the electrofishing portion of "Percent top carnivores," and the gill netting portion of "Percent omnivores." The upstream site earned scores of 3 or 5 for nine of the twelve RFAI metrics, but earned the lowest score (1; 0.5 for metrics portioned by gear) for metrics "Percent tolerant individuals," "Average number per run," and the gill netting portion of "Percent omnivores."

In 2009, twenty-six (26) indigenous species were collected at the upstream site, while 27 were collected at the downstream site. Twenty-nine (29) representative important species were collected at both the upstream and downstream stations. Representative important species are defined in EPA guidance as those species which are representative in terms of their biological requirements of a balanced, indigenous community of fish, shellfish, and wildlife in the body of water into which the discharge is made (EPA and NRC 1977). The same two aquatic nuisance species (common carp and inland silverside) were collected at both sites. There was one species collected at the downstream site (logperch) which is intolerant of thermal pollution. White sucker

and spotted sucker were thermally-sensitive species collected at the upstream site. Water temperatures greater than 32.2°C (90°F) are known to be lethal to the aforementioned species (Yoder et al. 2006). The same number of commercially valuable species (4) was collected at both sites. Eighteen (18) recreationally valuable species were collected at the upstream site, one more than the downstream site.

In 2011, two thermally sensitive species were collected at the upstream site and one downstream. Nine (9) commercially valuable species were collected at the downstream site and seven (7) at the upstream site. Commercially valuable species include freshwater drum, buffalo, and all members of the catfish and sucker families (ALDCNR, 2012). Twenty-one (21) recreationally valuable species were collected both sites. Recreationally valuable species are those species that are commonly sought by anglers, bow fishermen, or used for bait. All fish species collected were considered Representative Important Species because all species were used to obtain overall RFAI scores.

As discussed above, RFAI scores have an intrinsic variability of ± 3 points. This variability comes from various sources, including annual variations in air temperature and stream flow; variations in pollutant loadings from nonpoint sources; changes in habitat, such as extent and density of aquatic vegetation; natural population cycles and movements of the species being measured (TWRC 2006). Another source of variability arises from the fact that nearly any practical measurement, lethal or non-lethal, of a biological community is a sample rather than a measurement of the entire population. As long as the score is within the 6-point range, there is no certainty that any real change has taken place beyond method variability.

Over the ten sample years, both sites have averaged a score of 41 ("Good"). Both sites have been within the 6-point range of accepted variability each year, with the exception of 2005 when the upstream site scored 10 points higher, indicating the sites were similar annually and that the BFN heated effluent is not adversely affecting the fish community in the vicinity of the plant. The "Fair" rating in the 2005 sample at the downstream site was a result of a high percentage of tolerant individuals in the gill net samples and dominance by one species in both gill net and electrofishing samples. Individual metric scores and overall RFAI scores for the upstream and downstream sampling sites of BFN for sample years 2008, 2009, and 2011 are listed in Tables 3-5, respectively. Species collected and catch per effort during electrofishing at the upstream and downstream sampling sites of BFN for sample years 2008, 2009, and 2011 are listed in Tables 6-11, respectively.

Due to the similarity among Tennessee River reservoir fish communities and that the BFN sites are from upstream adjacent Wheeler Reservoir, AST can reasonably expect similar species are present at the Fleet Hollow CWIS location at TRM 259.6, downstream of the two TVA sample locations.

Baseline Data from Wilson Reservoir

2013 and 2017 Data:

The Alabama Department of Conservation and Natural Resources conducted an electrofishing and creel survey of the Wilson Reservoir in the spring of 2013 and 2017. The objective of the survey was to evaluate the sport fishery at the Wilson Reservoir, specifically for largemouth bass. The electrofishing sampling locations for the survey were spread throughout Wilson Reservoir and included sampling sites at or near Fleet Hollow. The target species included largemouth bass, smallmouth bass, and crappie with over 500 individuals of target fish species shocked (Ekema et al., 2013 and 2017). The creel survey was conducted in 2013 and consisted of anglers being surveyed upon completion of their fishing trip. The creel survey focused on four sports species with anglers reporting that 4,903 had been caught in Wilson Reservoir (Ekema et al., 2013).

Baseline Data from Downstream Pickwick Reservoir

ADCNR 2008 Data:

The Alabama Department of Conservation and Natural Resources conducted an electrofishing and creel survey of the Pickwick Reservoir which took place in the spring of 2008. The objective of the survey was to evaluate the sport fishery at the Reservoir. The electrofishing sampling locations for the survey were spread throughout the Pickwick Reservoir. The target species included largemouth bass, spotted bass, and smallmouth bass with over 500 target fish species shocked (Ekema et al., 2009). The creel survey was completed over 11 survey days and anglers were surveyed upon completion of their fishing trip. The creel survey focused on four sports species with anglers reporting that 1,932 had been caught in the Pickwick Reservoir (Ekema et al., 2009).

TVA 2011 Data:

In the autumn of 2011, a study was completed above and below the CWIS of the Tennessee Valley Authority's (TVA) Colbert Fossil Plant (COF) located at RM 245, 14.5 miles downstream of the Fleet Hollow CWIS. The TVA's COF was operating under a 316(a) thermal variance that had been continued with each permit renewal based on monitoring conducted in the mid-1970s. In 1999, EPA Region IV began requesting additional data in conjunction with NPDES permit renewal applications to verify that Balanced Indigenous Populations (BIP) were being maintained at TVA's power plants with thermal variances. TVA proposed that its existing Vital Signs monitoring program, supplemented with additional fish and macroinvertebrate community monitoring of the Tennessee River upstream and downstream of COF with thermal variances, was appropriate for that purpose. Fish communities were surveyed using electrofishing equipment and resulted in over 1,691 fish being shocked with 39 species found (Table 12). These

benthic macroinvertebrate data were also assessed using the Reservoir Benthic Index (RBI) methodology and resulted in 85 taxa found (Tennessee Valley Authority, 2012) (Table 13).

The Tennessee Wildlife Resource Agency (TWRA) conducts annual survey and management summaries for reservoirs managed by TWRA, including the Pickwick Reservoir (Table 12). The survey and management summaries are collected using creel surveys and electrofishing survey efforts that focused on the sports fishery in the Reservoirs. The creel survey results are reported as statistics such as catch rate, harvest rate, percent released and mean weight, therefore will not be used in this biological characterization. However, there were 11 species identified through electrofishing efforts. Electrofishing has been conducted on an annual basis from 2006-2015. In 2015, 772 fish were shocked from Pickwick Lake just below the Pickwick Landing Lock and Dam Highway Bridge at Tennessee River Mile 207.8 (Broadbent et al., 2015)(Table 12).

The TWRA publishes a statewide creel survey that includes abundances of fish caught by anglers. The report does not indicate the exact locations where creel surveys were conducted, instead the reservoir was split into sections to ensure the entire reservoir had surveys conducted. The latest creel survey was conducted in 2015 for the Pickwick Reservoir, 18 species with over 122,500 fish were reported to have been caught by anglers when roving and access point surveys were conducted (Black, 2016).

The Geological Survey of Alabama has provided survey data that was conducted in the Tennessee River (Pickwick Reservoir) near Buck Island and Phippen Island along with data from Panther Creek and Second Creek which are tributaries of the Tennessee River (Table 12). The survey was completed in the spring of 2013 using electrofishing equipment in both the Tennessee River and the creek sites that resulted in the identification of 46 species with an abundance of 7,194 fish from the 4 locations (McGregor and O'Neil, 2017).

The Alabama Department of Conservation and Natural Resources conducts a quantitative mussel population survey on an annual basis in the Tennessee River near the Wilson Dam tailwaters (Table 14). The surveys began in 2008 with the objective of monitoring the mussel population following changes in the water release schedule at Wilson Dam. A cumulative total of 79 species have been reported from that river reach. Two federally-protected species have been collected during quantitative sampling since 2008; the Pink mucket, *Lampsilis abrupta*, and the Rough pigtoe, *Pleurobema plenum*. Neither of these were encountered during the 2016 sampling. No protected species were found during two other sampling years, 2008 and 2013. During the course of this study, never have more than two individuals of either species been found during a given year, and in only two years have both been encountered. *Lampsilis abrupta* and *P. plenum* appear to be so rare in the study reach that finding one or both in 120 samples is not assured, so their absence in 2016 does not appear to be cause for alarm (Garner and Holifield, 2017).

Analysis of the fish species and relative abundance studies conducted downstream of the Fleet Hollow CWIS indicate a total of 58 species of fish occurring in the Tennessee River (Table 12) (Black, 2016; Broadbent et al., 2015; Ekema et al., 2009; McGregor and O'Neil, 2017; Tennessee Valley Authority, 2012). The benthic macroinvertebrates were assessed for the study that was completed above and below the CWIS of the Tennessee Valley Authority's COF during the autumn of 2011. Details from the benthic macroinvertebrates assessed are in Table 13 (Tennessee Valley Authority, 2012). A quantitative mussel survey was completed by the Alabama Department of Conservation and Natural Resources in the Tennessee River near the Wilson Dam tailwaters. The survey has been conducted annually since 2008, results from the survey are included in Table 14 (Garner and Holifield, 2017). Of the 27 mussel species surveyed since 2008, 20 species are primarily riverine species; only about 7 or 8 of the species surveyed would be expected to be found in the backwaters of Fleet Hollow. Neither of the federally listed species would be expected to be found in Fleet Hollow.

Due to the similarity among Tennessee River reservoir fish and invertebrate communities, with the exception of freshwater mussels, AST can reasonably expect similar species are present at the location of the Fleet Hollow CWIS at TRM 259.6, upstream of the Pickwick Reservoir locations.

4.3 Identification of Species and Life Stages Most Susceptible to Impingement and Entrainment (r)(4)(iii)

Table 15 identifies the Species of Fish that are most common and predominant from the 2008, 2009, and 2011 fish studies that were conducted by TVA at TRM 292.5 and TRM 295.9 near the BFN. These findings generally agree with those of Ekema et al. (2013 and 2017) for Wilson Reservoir and represent the relatively important fish species for the Tennessee River. Due to the similarity among Tennessee River reservoir fish communities, AST can reasonably expect similar species predominance at the location of the Fleet Hollow CWIS at TRM 259.6.

Impingement and entrainment studies on Wilson Reservoir at the immediate vicinity of the Fleet Hollow CWIS were not available. A review of available data included several studies pertaining to impingement and one on entrainment that have been completed on the Tennessee River System. For the purposes of this section, only studies completed on Pickwick Reservoir for COF and on Wheeler Reservoir for BFN were used. These studies are located upstream and downstream of the Fleet Hollow CWIS and provide the best documentation of species and life stages susceptible to impingement and entrainment. Considering both Pickwick Reservoir and Wheeler Reservoir are freshwater reservoirs and contain warm water fisheries, species occurring within them are very similar and utilize similar habitats to those in the vicinity of Fleet Hollow CWIS. Below are a list of studies used to identify species and life stages that are most susceptible to impingement and entrainment:

- Baxter *et al.* (2006) - Biological Assessment: Effects of Condenser Cooling Water Withdrawal on the Fish Community Near Browns Ferry Nuclear Plant Intake;
- Tennessee Valley Authority (2007) - Fish Impingement at Colbert Fossil Plant During 2005 through 2007;
- Saalfeld (2006) - Variables Influencing Fish Impingement at Five Alabama Power Steam Plants

Susceptibility to impingement and entrainment is dependent upon a variety of interrelated factors including size, life stage, swimming speed, intake flow velocity, seasonal variation, habitat preference, etc. Studies have shown that smaller, juvenile individuals are more susceptible to impingement than their larger, adult counterpart (Baxter *et al.* 2006, Saalfeld 2006). Young fish often exhibit higher natural mortality or weakened swimming ability due to stresses including extreme water temperature, low dissolved oxygen, strong flow velocity, physical damage, and infectious disease (Saalfeld 2006).

Impingement of large fish sizes is predominantly excluded by bar screen structures designed to prevent the entry of trash and debris into the cooling system. Placement of bar screen structures typically occurs at the entry of the intake pipe extended into the source waterbody or at the face of a shoreline intake located on the source waterbody prior to passing through rotating screen or fixed screen structures and entering condenser tubes.

Impingement and Entrainment data from Browns Ferry Nuclear Plant

Impingement and entrainment studies have been conducted at BFN. BFN is located along the Tennessee River approximately 34.5 miles upstream from Fleet Hollow CWIS. Thirty-seven species of fish representing eleven families were collected in the 2003 and 2004 impingement study. Threadfin shad was the dominant species in numbers, 61% of total, and freshwater drum contributed the most biomass, 38% of total weight. Other species occurring in significant numbers were freshwater drum (21.2%), gizzard shad (7.8%), skipjack herring (4.8%), channel catfish (1.4%), and yellow bass (1.3%). In terms of biomass, other important species were gizzard shad (23.1%), threadfin shad (18.3%), channel catfish (6.4%), yellow bass (2.6%), and blue catfish (1.6%). Three species were the primary drivers in the fluctuations in daily estimates observed in the 2003 and 2004 impingement study. The abundance of threadfin shad had the most significant effect on total numbers impinged and was a major contributor to the total biomass. Gizzard shad and freshwater drum were also significant contributors to total biomass impinged (Baxter *et al.*, 2006).

To estimate BFN Plant's entrainment rate, ichthyoplankton (fish eggs and larvae) samples were collected upstream to estimate densities of fish eggs and larvae in the water column flowing past

the plant and in the intake basin near the skimmer wall. Ninety five percent of the total entrained fish collected were shad; other families contributing at least 1% of total composition were temperate basses 1.8%, sunfishes 1.0%, drum 1.1 %, and silversides 1.0%. The hydraulic entrainment estimate for all sampling periods, 2003 and 2004 combined, averaged 8.4%. In 2003, hydraulic entrainment estimate averaged 6.2% (range 4 to 27.6%) and in 2004 averaged 12.7% (range 5.9 to 42%). A decrease in river flow past BFN during most of the 2004 sampling season was the most significant contributing factor to the higher entrainment in 2004 (Baxter et al., 2006). The average rate of entrainment for the different fish taxa can be seen in Table 17. The overall entrainment estimate based on the two year study averaged 7.6% for fish eggs and 10.8% for larval fish. Spatial-temporal distribution varied significantly between sampling periods and stations for both fish eggs and larvae, demonstrating the heterogeneous distribution of individuals both vertically and horizontally in the water column. (Baxter *et al.*, 2006).

The location of BFN is probably a contributing factor to the fluctuations in the annual entrainment estimates. The area of Wheeler Reservoir near BFN is characterized as a transition zone where the velocity of water flowing past BFN depends on the rate water released through Guntersville and Wheeler Dams. The rate of water flow past BFN increases and the reservoir surface elevation decreases when the rate of water released through Wheeler Dam exceeds the release through Guntersville Dam (Baxter et al., 2006). Condenser cooling water demand for BFN remains fairly constant during normal two unit operation, therefore, hydraulic and fish entrainment estimates will increase as reservoir flow past BFN decreases.

Impingement data from Colbert Fossil Plant

The Colbert plant is located on the Tennessee River approximately 14.5 miles downstream from Fleet Hollow CWIS. The Plant completed an impingement study in 2007 to demonstrate compliance as part of their National Pollutant Discharge Elimination System (NPDES) permit's 316(b) monitoring program. While the study did not evaluate entrainment, the data does provide information related to impingement and a comparison to historical impingement rates from 1974 through 1976. Historical impingement data from 1974 through 1976 indicated that threadfin shad and gizzard shad was the dominate species impinged at greater than 80% of all impinged species. Estimated annual impingement rate based on the 2005 through 2007 data indicated that threadfin shad comprised 87% of the total fish impinged, followed by gizzard shad at 5.0%, bluegill at 4.0%, freshwater drum at 2.0%, and skipjack herring and channel catfish both at 1% (Tennessee Valley Authority, 2006).

Impingement data from five Alabama Power steam plants

Saalfeld (2006), presented impingement data in 2006 for five Alabama Power steam plants (Berry, Gadsden, E.C. Gaston, Gorgas, and Green County Steam Plants) across different regions

in Alabama. His findings showed the five dominant species for all intakes combined were threadfin shad (69.3%), blue catfish (8.8%), freshwater drum (7.4%), black crappie (3.5%), and gizzard shad (2.5%). While his findings were not specifically on the Tennessee River, it does show similar dominant species as the studies above and provides usable data when evaluating species susceptible to impingement at Fleet Hollow CWIS.

The Saalfeld (2006) study also found that size class affected impingement rates as the majority of fish impinged were small length classes with threadfin shad being most prevalent species. Of all the threadfin shad found to be impinged, 94% were smaller threadfin shad (less than 100mm). Of the freshwater drum found to be impinged, 64% were less than 140mm in length. Over 68% of the all the blue catfish found to be impinged were less than 100mm in length. While impingement rates varies with species, historically, threadfin shad, gizzard shad and freshwater drum have become impinged more than other species. Life history traits may be accountable as these species are planktonic in early life stages, spawn near shore areas, and are smaller as adults (Saalfeld 2006).

Species Susceptible to Impingement at Fleet Hollow CWIS

Based on the information presented in the aforementioned studies, OxyChem has compiled a list of those species most susceptible to impingement and entrainment impacts at the Fleet Hollow CWIS. Combination of species (or species within listed genus) results in the identification of potential species susceptible to impingement are listed in Table 16 and potential fish families susceptible to entrainment are presented in Table 17 (Baxter *et al.*, 2006). Due to the similarity among Tennessee River reservoir fish assemblages, AST can reasonably expect similar species are present at the location of the Fleet Hollow CWIS at TRM 259.6, and that these impingement and entrainment studies herein apply to the Fleet Hollow CWIS.

4.4 Life Histories of Relatively Important Species and Seasonal/Daily Actives (r)(4)(iv-v)

The following are the life histories of prominent species that were identified by TVA during their 2008, 2009, and 2011 studies.

Gizzard Shad- The Gizzard shad (*Dorosoma cepedianum*) is a member of the herring family of fish, and is native to large swaths of fresh and brackish waters of the United States of America. The adult has a deep body, with a silvery-green coloration above fading to plain silver below. The gizzard shad commonly resides in freshwater lakes, reservoirs, rivers, and streams but can reside in brackish waters, as it does on the Atlantic coast of the United States. They are large parts of many of the ecosystems they inhabit, and can drive changes in phyto- and zooplankton, thereby indirectly affecting other planktivorous fishes. The gizzard shad has been widely used as

a food source for game fish, with varied success in management and effectiveness. The gizzard shad can range from millimeter and milligram size when fry to a maximum recorded length of 477 mm (18.8 in) and maximum weight of 1.56 kilograms (3.4 lb). The average length is typically larger in northern waters, and ranges from 284 mm (11.2 in) at age three years to 399 mm (15.7 in) at age 10. They have a highly reduced lateral line system, a feature shared by other members of the herring family. The start of the spawning period is typically between mid-May and early June, and is triggered by rising water temperatures. The number of eggs per individual varies between populations, but typically it is 12,500 eggs for a two year old individual and peaks at 38,000 eggs in an age 4 individual. The eggs are laid in shallow water in clumps, with seemingly no pairing off occurring between individuals. They spawn during the evening and the early hours of the night, and the eggs adhere to underwater vegetation and do not receive any parental attention. Feeding begins three to four days after hatching, and most individuals are 3.25 mm long upon hatching. The gizzard shad has very high fecundity and a rapid growth rate, meaning it can become a large part of an ecosystem, in terms of abundance and biomass, very quickly. They are capable of hybridizing with the closely related threadfin shad.

Spotfin Shiner- Spotfin shiners (*Cyprinella spiloptera*) are silver-blue in color with a darker back and lighter cream colored belly. They are laterally compressed (flat side to side) and have a distinctive diamond shaped crosshatching pattern on the sides formed by dark scale edges. They have a dusky blotch on the webbing of the dorsal fin between the 3 rear fin rays. The front half of their dorsal fin lacks dark pigment in front of this blotch and has a straight rear edge. They have 8 anal fin rays.

Breeding male spotfin shiners have intensely steel blue colored sides, and fins flushed with white. The closely related steelcolor shiner differs by having a rounded rear edge to the dorsal fin, dark speckles of pigment in the front half of the dorsal fin, 9 anal fin rays, and a slightly deeper body. Additionally breeding male steelcolor shiners have a red tip to their snout and have fins flushed with yellow rather than white. Breeding males of both species have white tips to the fins which are often visible to an observer above the water's surface. This shiner is in the Cyprinidae (minnows and carps) family, and is typically 2-4, sometimes 5 inches long. Spotfin shiners spawn in crevices between rocks or in bark on submerged fallen trees. Spawning takes place throughout the warmer months of the year starting in late May or early June.

Bluegill- The bluegill (*Lepomis macrochirus*) is a species of freshwater fish sometimes referred to as bream, brim, or copper nose. It is a member of the sunfish family Centrarchidae of the order Perciformes. It is native to North America and lives in streams, rivers, lakes, and ponds. It is commonly found east of the Rockies. It usually hides around, and inside, old tree stumps and other underwater structures. It can live in either deep or very shallow water, and will often move back and forth, depending on the time of day or season. Bluegills also like to find shelter among water plants and in the shade of trees along banks.

Bluegills can grow up to 12 inches (30 cm) long and about 4 1/2 pounds. They have very distinctive coloring, with deep blue and purple on the face and gill cover, dark olive-colored bands down the side, and a fiery orange to yellow belly. The fish are omnivores and will eat anything they can fit in their mouth. They mostly feed on small aquatic insects and fish. The fish play a key role in the food chain, and are prey for muskies, walleye, trout, bass, herons, kingfishers, snapping turtles, and otters.

Spawning season for bluegills starts late in May and extends into August. The peak of the spawning season usually occurs in June in waters of 67 to 80 °F (19 to 27 °C). The male bluegills arrive first at the mating site. They will make a spawning bed of six to 12 inches in diameter in shallow water, clustering as many as 50 beds together. The males scoop out these beds in gravel or sand. Males tend to be very protective and chase everything away from their nests, especially other male bluegills. Some bluegills, regardless of their small size, will even attack snorkelers if they approach the edge of the nest. As a female approaches, the male will begin circling and making grunting noises. The motion and sound of the males seem to attract the females. Females are very choosy and will usually pick males with larger bodies and "ears", making larger size a desirable trait for males to have. If the female enters the nest, both the male and female will circle each other, with the male expressing very aggressive behavior toward the female. If the female stays, the pair will enter the nest and come to rest in the middle. With the male in an upright posture, the pair will touch bellies, quiver, and spawn. These actions are repeated at irregular intervals several times in a row. Once the spawning is done, the male will chase the female out of the nest and guard the eggs. The fertilization process is entirely external. The male's sperm combines with the female's eggs in the water. Smaller males will often hide in nearby weeds and dart into the nest as they attempt to fertilize the eggs. They then quickly dart away. The size of the female plays a large role in how many eggs will be produced. A small female can produce as few as 1,000 eggs, and a large, healthy female can produce up to 100,000 eggs. The male continues to watch over the nest until the larvae are able to hatch and swim away on their own. The bluegill generally begins its spawning career at one year of age, but has been found to spawn as early as four months of age under favorable conditions. Anglers find spawning season to be a very successful time to fish for bluegills, as they aggressively attack anything that comes near including a hook.

The growth of the bluegill is very rapid in the first three years, but slows considerably once the fish reaches maturity. Many fish reach five to eight years old, and in extreme cases, can live 11 years.

Largemouth Bass- The largemouth bass (*Micropterus salmoides*) is a freshwater gamefish in the sunfish family, a species of black bass native to North America. It is known by a variety of regional names, such as the widemouth bass, bigmouth bass, black bass, bucketmouth, Potter's fish, Florida bass, Florida largemouth, green bass, green trout, gilsdorf bass, Oswego bass,

southern largemouth and (paradoxically) northern largemouth. The largemouth bass is the state fish of Georgia, Mississippi, and Indiana, the state freshwater fish of Florida and Alabama, and the state sport fish of Tennessee. The largemouth bass is an olive-green fish, in the northeast right after ice-out, it most often has a gray color, marked by a series of dark, sometimes black, blotches forming a jagged horizontal stripe along each flank. The upper jaw (maxilla) of a largemouth bass extends beyond the rear margin of the orbit. In comparison to age, a female bass is larger than a male. The largemouth is the largest of the black basses, reaching a maximum recorded overall length of 29.5 in (75 cm) and a maximum unofficial weight of 25 pounds 1 ounce (11.4 kg). The fish lives 16 years on average.

Longear Sunfish- The longear sunfish (*Lepomis megalotis*) is a freshwater fish in the sunfish family, Centrarchidae, of order Perciformes. The longear sunfish reaches a maximum recorded length of about 24 cm (9.5 in), with a maximum recorded weight of 790g (1.7 lb). Most do not live beyond six years. The longear sunfish is quite colorful, with an olive to rusty-brown back, bright orange belly and blue-green bars on the sides of its head. A unique characteristic is their elongated opercular flap, giving an appearance of a "long ear". The species prefers densely vegetated, shallow waters in lakes, ponds, and sluggish streams. Its diet can include insects, aquatic invertebrates, and small fish. Avoiding strong currents, longear sunfish are usually present in small to moderate flowing streams, rivers, and reservoirs. The genus *Lepomis* has a well characterized mating behavior where parental care is done by the male. He makes and defends the nest. Males fan the eggs to remove silt and other debris until the larvae hatch. Some longear females produce 4,000 eggs. They spawn in groups but do not form large colonies. Longear sunfish are better at getting food in moving waters than still waters. This may explain why they are more abundant in streams than lakes. For the most part, longear sunfish are active during the day and inactive at night. There are very few conservation acts currently being performed in order to maintain the distribution and abundance of this species. Longear sunfish tend to breed during the late spring and early summer (late May to late August). During breeding seasons they are generally found in shallower, warmer waters near the sources of streams which have pools. Like most other members of *Lepomis*, longear sunfish are colonial nesters. Male longear sunfish build the nests without assistance from the females. Preferred substrate for nesting is gravel, if available, but they will build in sand or hard mud if necessary. A male longear will guard the nest territory during all phases of reproduction. The clutch size can be anywhere from 140 to 2800 eggs per reproductive cycle. After hatching, it only takes the longear sunfish 2–3 years to reach sexual maturity. The average life-span of the *Lepomis megalotis* in the wild is usually 4–6 years, but there have been cases where individuals have lived up to 9 years. Longear sunfish cannot tolerate cloudy or mucky water. Throughout the 20th century their populations have been reduced in areas where their native streams have suffered increased cloudiness. This cloudiness could potentially be a result of human induced erosion for agriculture or industry purposes. Increased human disturbance along streams and rivers could continue to increase the reduction of longear populations due to the murkiness of rivers and streams.

Smallmouth Bass- The smallmouth bass (*Micropterus dolomieu*) is a species of freshwater fish in the sunfish family (Centrarchidae) of the order Perciformes. It is the type species of its genus. One of the black basses, it is a popular game fish sought by anglers throughout the temperate zones of North America, and has been spread by stocking -- as well as illegal introductions -- to many cool-water tributaries and lakes in Canada and more so introduced in the United States. The maximum recorded size is approximately 27 inches and 12 pounds. The smallmouth bass is native to the upper and middle Mississippi River basin, the Saint Lawrence River–Great Lakes system, and up into the Hudson Bay basin. Its common names include smallmouth, bronzeback, brown bass, brownie, smallie, bronze bass, and bareback bass. The smallmouth bass is found in clearer water than the largemouth, especially streams, rivers, and the rocky areas and stumps and also sandy bottoms of lakes and reservoirs. The smallmouth prefers cooler water temperatures than its cousin the largemouth bass, and may be found in both still and running water. Because it is intolerant of pollution, the smallmouth bass is a good natural indicator of a healthy environment, though it can better adjust to changes in water condition than most trout species. Carnivorous, its diet comprises crayfish, insects, and smaller fish; the young also feeding on zooplankton. The female can lay up to 21,100 eggs, which are guarded by the male in his nest.

Threadfin Shad- The threadfin shad (*Dorosoma petenense*) is a small pelagic fish common in rivers, large streams, and reservoirs of the Southeastern United States. Like the American gizzard shad, the threadfin shad has an elongated dorsal ray, but unlike the gizzard shad its mouth is more terminal without projecting upper jaw. The fins of threadfin shad often have a yellowish color, especially the caudal fin. The back is grey to blue with a dark spot on the shoulder. *Dorosoma petenense* is more often found in moving water, and is rarely found deep in the water column. It occurs in large schools, sometimes with gizzard shad, and can be seen on the surface at dawn and dusk. The threadfin shad may reach lengths of 8 inches, but only rarely. This fish is very sensitive to changes in temperature and dissolved oxygen, and die-offs are frequent in late summer and fall, especially when water temperature reaches 42 °F. The threadfin shad is a favorite food for many game fishes including striped bass, largemouth bass, smallmouth bass, and catfishes. This fish is widely introduced throughout the United States as a forage for game fish. The adult may reach up to 8 inches in length but most shad are about one inch long. It feeds on plankton near the surface of the water late in the day. It is a very important food source for many game fish such as the largemouth bass. It has little known competition, but one species that is known to have a similar lifestyle is the gizzard shad (*Dorosoma cepedianum*). The threadfin lives a pelagic life in reservoirs and for the most part in large streams. The shad spawns in the spring when the water temperature is in the upper 60's F. A pelagic (open water) schooling species often introduced as a supplemental forage, threadfin shad spawn in the spring and early summer with a secondary spawn often occurring in the early fall. Spawning usually occurs early in the morning on available vegetation. The eggs adhere to submerged and floating objects. Females lay from 2,000 to 24,000 eggs. The young and adults feed on a variety of planktonic

organisms and organic debris. Many researchers believe that threadfin shad often compete for plankton with young-of-the-year predator species, especially largemouth bass. Life expectancy seldom exceeds 2 to 3 years.

Channel Catfish- Channel catfish (*Ictalurus punctatus*) is North America's most numerous catfish species. It is the official fish of Kansas, Missouri, Iowa, Nebraska, and Tennessee, and is informally referred to as a "channel cat". In the United States, they are the most fished catfish species with approximately 8 million anglers targeting them per year. The popularity of channel catfish for food has contributed to the rapid expansion of aquaculture of this species in the United States. Channel catfish possess very keen senses of smell and taste. At the pits of their nostrils (nares) are very sensitive odor sensing organs with a very high concentration of olfactory receptors. In channel catfish, these organs are sensitive enough to detect several amino acids at about one part per 100 million in water. In addition, the channel catfish has taste buds distributed over the surface of its entire body. These buds are especially concentrated on the fish's four pair of barbels (whiskers) surrounding the mouth — about 25 buds per square millimeter. This combination of exceptional senses of taste and smell allows the channel catfish to find food in dark, stained, or muddy water with relative ease. Channel catfish also possess a Weberian apparatus, which amplifies sound waves that would otherwise not be perceivable. A member of the *Ictalurus* genus of American catfishes, channel catfish have a top-end size of about 40–50 pounds (18–23 kg). The world record channel catfish weighed 58 pounds, and was taken from the Santee-Cooper Reservoir in South Carolina, on July 7, 1964. Realistically, a channel catfish over 20 lb (9 kg) is a spectacular specimen, and most catfish anglers view a 10-lb (4.5-kg) fish as a very admirable catch. Furthermore, the average size channel catfish an angler could expect to find in most waterways would be between two and four pounds.

Channel catfish will often coexist in the same waterways with its close relative, the blue catfish, which is somewhat less common, but tends to grow much larger (with several specimens confirmed to weigh above 100 lb).

White Bass- The white bass, silver bass, or sand bass (*Morone chrysops*) is a freshwater fish of the temperate bass family Moronidae. The species' main color is silver-white to pale green. Its back is dark, with white sides and belly, and with narrow dark stripes running lengthwise on its sides. It has large, rough scales and two dorsal fins. The more anterior dorsal fin is much harder and appears to have spines on them. Although these are not true spines, this type of fin is called a spinous ray. The more posterior of the two dorsal fins is much softer, and is thus called a soft-ray. Because the vertebrae do not extend into the tail, the white bass has what is called a homocercal tail. The body is deep and compressed laterally. Most grow to a length between 10 and 12 inches (25 and 30 cm), though they can reach 17 inches (43 cm) or more. Because the dorsal and ventral portions of the tail angle inward toward a point to create a clear angle, the tail is said to be notched. White bass inhabit large reservoirs and rivers. When mating in the spring,

they are more often found in shallow rivers, creeks, and streams. White bass are found in high densities in the upstream segment of rivers. This portion of the river becomes the most degraded, as a number of different kinds of fish live in this segment, as well. The spawning season for the white bass is mid-March to late May. The optimal water temperatures are 12 to 20 °C (54 to 68 °F). They are known to find their home spawning in the ground. They often spawn in moving water in a tributary stream, but they will spawn in windswept lake shores. They spawn during daylight. Females release 242,000 to 933,000 eggs which stick to the surface of objects. Eggs are laid in clear, relatively shallow water on plants, submerged logs, gravel, or rocks. The parents move to deeper water and do not care for the young fish. The young fish live in shallow water for a while until they move to deeper water.

When trying to find a female with whom to mate, males will bump against a female's abdominal area. The female will then rise closer to the surface and begin spinning and releasing eggs. Several males that have stayed in the area will be able to fertilize the eggs the female releases.

Inland Silverside- The inland silverside (*Menidia beryllina*) is a neotropical silverside native to eastern North America, and introduced into California. It is a fish of estuaries and freshwater environments. Inland silversides are quite elongate even for silverside, with lengths 6 to 7 times the depth. They have large eyes, a considerably upturned mouth, and a head noticeably flattened on top. Of the two widely separated dorsal fins, the anterior fin is small and has 4-5 weak spines, while the posterior fin is larger, with one spine and 8 or 9 rays. The lengthy anal fin is somewhat sickle-shaped, has one spine and 16 to 18 rays. As befits the name, they are silvery on the sides; the back is somewhat yellowish, and the underside is a translucent greenish. These are small fish, with 15 cm recorded, but most adults 10 cm or less. They primarily feed on zooplankton, moving in enormous schools capable of depleting populations of the small arthropods and crustaceans they favor. In turn, they are prey for a variety of fish and birds. The silversides congregate in the shallows, generally over sand or gravel bottoms with overhead cover if possible, but then move out to open water in search of additional food, which increases predation risk. They are often observed in a sort of daily migration pattern as a result. Inland Silversides are currently an EPA approved indicator species for acute marine aquatic toxicity testing and short-term chronic toxicity estimating of marine and estuarine organisms.

Mississippi Silverside- Mississippi silversides (*Menidia audens*) are most common in shallow, warm water lakes, reservoirs, and estuaries. They school here in very large numbers, concentrated near protected areas with sand or gravel bottoms. Temperatures between 20°C and 25°C are preferred but Mississippi silversides have been found in waters as cold as 8°C and as warm as 34°C. They can also withstand salinities up to 33 ppt, but 15 ppt is the optimal salinity for larval growth. This hardiness allows them to do well in disturbed areas with heavy amounts of agricultural pollution. Schools are organized by size and make dramatic group movements within a lake circling each other in patterns or crossing over one another with no mixing of the

two sizes. Feeding occurs in deep water but Mississippi silversides are a common prey choice and will quickly return to shallow areas for protection. Zooplankton is their main prey followed by copepods and cladocerans and peak feeding hours are 1 to 3 hours after daybreak and just before dusk.

Spawning occurs any time of the day in April-September when temperatures are between 15°C and 30°C. Groups of males wait in beds of aquatic vegetation for a school of females to pass and then chase after a single or pair of females. The males will nip at her swollen abdomen until she settles into the vegetation bed where the group quivers violently and releases eggs and milt together. The eggs are attached to the substrate and stay there on their own until they hatch 4-30 days later. The young are planktonic for several weeks until they join a larger school. They will grow to 8-10 cm in their first year and most die immediately after spawning in their 1st or 2nd summer. A single female could produce 200-2,000 eggs per day for 3 months in proper conditions but most die before that 3 month time is complete.

Spawning

From the biological and creel surveys and reports, fish spawning periods have been well-studied and information on fish spawning periods is readily available. Table 18 includes the primary periods of reproduction when larval recruitment occurs, which also coincides with peak abundance for the fish taxa that have been reported to be found above and below the Fleet Hollow CWIS.

Spawning in the Tennessee River and Pickwick Reservoir may be influenced by environmental variables including water temperature, river stage, and photoperiod. These variances in spawning are independent of any CWIS. Variances that are considered when a CWIS is of concern are spawning habitat, fecundity, and spatial distribution. The study completed upstream and downstream of BFN calculated impingement and entrainment rates and found that abundance also plays a role on these rates. The more abundant a species is, the more likely it is to be impinged or entrained. For example, freshwater drum spawn in open water while shad spawn near shore and each female produces thousands of eggs, creating areas in the reservoir with high densities of fish eggs and larvae. As these areas of high density larvae and eggs drift around, their rate of entrainment may significantly increase. Juvenile and adult clupeids move throughout the reservoir in large schools, consequently, a large school near a CWIS would have a significantly larger impingement and entrainment rates (Baxter *et al.*, 2006).

The same BFN entrainment and impingement study looked at egg and larval rates of entrainment. To estimate the BFN's entrainment rate fish eggs and larvae samples were collected upstream of BFN to estimate densities of fish eggs and larvae that were drifting in the water column past the intake structure and took samples from the intake basin near the skimmer wall. There were 20 samples taken weekly between late March and early July 2003. The results can

are detailed in Table 19. Clupeidae eggs and larvae were more likely to be entrained than any other family collected (Baxter *et al.*, 2006).

Data representative of the seasonal spawning activities of the fish in the vicinity of the CWIS of Fleet Hollow can be found above in Table 18. Additional seasonal and abundance data for the biological studies completed in the general vicinity of the Fleet Hollow CWIS can be found in Table 20. Due to the similarity among Tennessee River reservoir fish assemblages, AST can reasonably expect similar species are present at the location of the Fleet Hollow CWIS at TRM 259.6, and that these seasonal spawning activities of fish apply to the Fleet Hollow CWIS.

4.5 Threatened, endangered and other protected species (r)(4)(vi)

Review of the United States Fish and Wildlife (USFWS) Threatened and Endangered List on December 22, 2018 for Colbert County, Alabama identified 29 aquatic species (Table 21). However, in the review of the biological reports and surveys only two listed mussel species have been found in the vicinity of Fleet Hollow CWIS. The mussel survey identified Pink mucket, *Lampsilis abrupta*, and Rough pigtoe, *Pleurobema plenum*, during the course of the seven year study by ADCNR. However, never have more than two individuals of either species been found during a given year, and in only two years have both been encountered. *Lampsilis abrupta* and *P. plenum* appear to be so rare in the study reach that finding one or both in 120 samples is not assured, so their absence in 2016 does not appear to be cause for alarm (Garner and Holifield, 2017). Furthermore, the appropriate habitat for the federally listed pink mucket and Rough pigtoe is not present at the Fleet Hollow CWIS. AST expects the Fleet Hollow CWIS will have no impact on federally listed species.

4.6 Federal and State Agency Consultation (r)(4)(vii)

Formal agency consultation is not required at this time for permit renewal. Therefore, the Facility has not conducted consultation with state or federal agencies nor has sought the need for an incidental take permit or authorization related to federally or state protected species under the protection of the USFWS or National Marine Fisheries Service (NMFS). However, a 60-day review by the USFWS is required for all permit applications upon receipt by the ADEM under a Memorandum of Agreement (MOA). Based upon the current regulations and/or requirements of the ADEM, the permittee must evaluate the environmental impacts of their CWIS by characterizing the fish and shellfish in the vicinity of the CWIS and assessing impingement mortality and entrainment.

5.0 Cooling Water System Data (40 CFR 122.21(r)(5))

The cooling water system data is required to characterize the operation and use of the CWIS. The following provides the cooling water system data for Fleet Hollow CWIS.

The Fleet Hollow CWIS used by OxyChem consists of two intake pipes, trash racks, two 100% capacity traveling screens (with a flow through area of 347 sq. ft. and through screen design intake flow velocity of 0.23ft/sec), and four river intake pumps, as well as the water pipe lines from the CWIS to the Facility (Figure 11). The maximum total design intake volume for Fleet Hollow CWIS is 43.2 MGD. The ratio of the design intake flow rate to the source waterbody mean annual flow rate is 0.13% for the Fleet Hollow CWIS, well below the 5% criterion. The typical average flows for the intake water is approximately 8.1 MGD which is <0.025% of source waterbody mean annual flow (approximately 51,500 cfs or 33,286 MGD) withdrawn on a daily basis and is <0.14% of the 7Q10 (9,391 cfs or 6,070 MGD) of the Tennessee River near the Facility. OxyChem uses 8.1 MGD from the Tennessee River of which approximately 2.88 MGD (based on average intake volume) is used for cooling water (35.5%). The 2.88 MGD river water used by OxyChem for cooling represents <0.009% of source waterbody mean annual flow used on a daily basis and is <0.05% of the 7Q10 of the Tennessee River near the Facility. The water balance and distribution system diagram for OxyChem is in Figure 10.

OxyChem operates twenty-four hours per day, 365 days annually and is only non-operational during scheduled down time. Seasonal variation in cooling water requirements is believed to occur due to environmental factors with less water required in winter months and additional water required in the summer months. There is no set number of pumps that operate at any given time, although typically only a single pump is in operation at any given time. The four intake pumps have design capacities of 16.6, 16.6, 28.8 and 10.8 MGD, respectively (Table 2).

6.0 Chosen Method of Compliance with Impingement Mortality Standard (40CFR 122.21(r)(6))

The Impingement Options for complying with the impingement standards of 40 CFR 125.94(c) include the following:

Section	Compliance Option	Description
(c)(1)	Closed-cycle recirculating system.	Wet, dry or hybrid cooling towers, a system of impoundments that are not waters of the United States, or any combination thereof.
(c)(2)	0.5 feet/second Through-Screen Design Velocity	The maximum design intake velocity as water passes through the structural components of a screen measured perpendicular to the screen mesh does not exceed 0.5 feet/second under all intake water conditions.
(c)(3)	0.5 feet/second Through-Screen Actual Velocity	The maximum actual operating intake velocity as water passes through the structural components of a screen measured perpendicular to the screen mesh does not exceed 0.5 feet/second under all intake water conditions.
(c)(4)	Existing offshore velocity cap	An existing offshore velocity cap as defined at 40 CFR 125.92(v) that was installed on or before Oct. 14, 2014.
(c)(5)	Modified traveling screens	A modified traveling screen as defined in 40 CFR 125.92(s).
(c)(6)	Systems of technologies	Combination of technologies, management practices and operational measures that reduce impingement.
(c)(7)	Impingement mortality performance standard	A 12-month impingement mortality performance standard of all life stages of fish and shellfish of no more than 24 percent mortality, including latent mortality.

OxyChem meets (c)(2) and (c)(3) on the Impingement Options for complying with the impingement standards of 40 CFR 125.94(c). For (c)(2) a maximum 0.5 ft/sec through-screen design velocity is required. The Fleet Hollow CWIS through-screen design velocity is 0.23ft/sec assuming maximum total design intake of 43.2 MGD with four pumps. For (c)(3) a maximum actual operating through-screen velocity 0.5 ft/sec is required. Average intake flows are approximately 8.1 MGD with only one of two intakes operating which provides a through-screen actual velocity of 0.061ft/sec. The Fleet Hollow CWIS uses two 100% capacity traveling screens with a flow through area of 347 sq. ft. and with a 3/8" mesh. The Facility complies with the standards of 40 CFR 125.94(c) through both Option (c)(2) and (c)(3).

7.0 Entrainment Performance Studies (40 CFR 122.21(r)(7))Water System Data (40 CFR 122.21(r)(7))

No entrainment mortality studies have been conducted on site at the Fleet Hollow CWIS. Through an extensive search, no available entrainment data were identified for other nearby facilities. The closest study that was identified was 34.4 miles upstream at BFN located at River Mile 294. However, AST believes the BFN study provides a good representation of entrainment at the Fleet Hollow CWIS. The following is the information collected by TVA at their BFN Plant in 2003-2004.

Sample Collection:

To estimate BFN's plant entrainment rate, ichthyoplankton (fish eggs and larvae) samples were collected upstream at TRM 294.5 to estimate densities of fish eggs and larvae in the water column flowing past the plant and in the intake basin near the skimmer wall. Twenty samples were collected weekly from late March through early July in 2003 and 2004. Eight reservoir samples (four day and night) were collected at three stations; a full stratum sample on both left and right over banks; and two mid-channel stratified samples, surface to mid-depth and mid-depth to near bottom. Twelve samples (six day and night) were collected in the intake basin near the skimmer wall. Samples were collected with a beam net 0.5 m square, 1.8 m long, with 505 μm "nitex" mesh netting. Nets were equipped with a large-vanned General Oceanics flowmeter® used to measure sample volume. Reservoir samples were ten-minute upstream oblique tows with a boat speed of 1 m/sec, filtering approximately 150 m³ of water. Intake samples were passive, collected in the inflow of the Condenser Cooling Water (CCW) under the skimmer wall gates, and volume filtered during the ten-minute sample was dependent on intake velocity.

Sample Processing:

In the laboratory, all fish eggs and larvae were removed from each sample, identified to the lowest practical taxon, and enumerated. Taxonomic decisions were based on TVA's "Preliminary Guide to the Identification of Larval Fishes in the Tennessee River" (Hogue *et al.*, 1976) and other pertinent literature. The term "unspecified" preceding a taxon indicates taxonomic resolution is not practical beyond this level and "unidentifiable" indicates the specimen(s) were mutilated. A minimum of 100 specimens of each taxon were measured to the nearest millimeter to obtain length frequency data.

Data Analysis:

Data were summarized by type (eggs or larvae), family, number, composition, and relative abundance. Relative abundance of fish eggs and larvae is presented as numbers per 1000 m³ of water sampled. Estimated entrainment is derived from the formula:

$$E = \frac{100 D_i Q_i}{D_r Q_r}$$

where,

D_i = mean density (N/1000 m³) of eggs or larvae in intake samples

D_r = mean density (N/1000 m³) of eggs or larvae in river

Q_i = plant intake water demands (m³/day)

Q_r = river flow (m³/day)

Temporal occurrence and relative abundance were evaluated for each significant taxon.

Results:

Densities of fish eggs and larvae are expressed as numbers per volume of water sampled. Average volume (m³) of water filtered in each intake sample was consistently less than the volume filtered in reservoir samples; however, more samples were collected each sampling period in the intake. To evaluate volume filtered per sampling period in the intake and reservoir, the total volume of water filtered in the twelve intake samples was compared to the total volume filtered in the eight reservoir samples (Table 22). In 2003, an average of 1,137 m³ of water was filtered per sampling period in the intake and 1,218 m³ in the reservoir. Total water filtered in the 2004 intake sampling averaged 1,087 m³ per sampling period and 1,277 m³ in the reservoir. Therefore, densities of fish and eggs in the intake and reservoir were calculated based on similar sample volumes. Tables 23 and 24 present scientific and common names of taxa collected in the 2003 and 2004 study and the taxonomic resolution used in processing samples. Although identification to subfamily, genus, or species was possible for some individuals, results are presented by family for comparative analysis.

Fish Eggs:

A total of 25,364 fish eggs representing four families was collected during the two year project. Freshwater drum eggs comprised 94% of the eggs collected (Table 25). The only other taxon collected in significant numbers were clupeids, comprising 5.5% of total eggs collected.

Drum egg densities were higher in 2004, 577/1000 m³ in the intake basin and 693/1000 m³ in the reservoir, than observed in 2003, 76/1000 m³ and 376/1000 m³, respectively (Table 26). In 2003, drum eggs were collected May 1 through July 3 and April 23 through July 8 in 2004. Peak density occurred on May 29 in 2003, 763/1000 m³, and on May 20 in 2004, 3771/1000 m³.

Densities of shad eggs were similar in 2003 and 2004, 28/1000 m³ and 26/1000 m³, respectively. Although densities were similar, spatial distribution differed with abundance greater in the intake in 2003 and the reservoir in 2004 (Table 26). Shad eggs were collected April 17 through June 26 in 2003 with a peak density (124/1000 m³) occurring May 1. In 2004, shad eggs were collected from April 22 through July 8; however, 93% of the season total were collected on May 13, with a density of 880/1000 m³.

Larval and Juvenile Fish:

A total of 476,434 fish representing twelve families was collected in 2003 and 2004 entrainment sampling. In the reservoir samples, fish densities averaged 3,857/1000 m³ and intake samples averaged 2,836/1000 m³ (Table 26). Fish densities were higher in 2004 than observed in 2003, primarily a result of the high numbers of shad. Ninety five percent of the total number of fish collected were shad; other families contributing at least 1% of total composition were temperate basses 1.8%, sunfishes 1.0%, drum 1.1%, and silversides 1.0% (Table 25). Shad densities were significantly higher in 2004, 3,656/1000 m³, than observed in 2003, 2,671/1000 m³. Shad were collected from early April to early July in both 2003 and 2004; however, peak densities occurred earlier in the season in 2004. In 2003, densities peaked on June 12, 13,319/1000 m³, and on May 13 in 2004, 35,282/1000 m³.

Temperate basses in Wheeler Reservoir include three *Morone* species: striped bass, yellow bass, and white bass. *Morone* were collected during all sampling periods in both 2003 and 2004 averaging 122/1000 m³. During the two year evaluation, densities ranged from 170/1000 m³ in 2003 to 79/1000 m³ in 2004. Typically, *Morone* are among the earlier spawners in Wheeler Reservoir; a trend reflected in this study. Densities were greater in April and early May in both 2003 and 2004 with peak density of 1,350/1000 m³ occurring April 3, 2003. Centrarchids (sunfishes) averaged 22/1000 m³ in 2003 and 100/1000 m³ in 2004. In 2003, peak centrarchid densities occurred in June and in 2004 the peak occurred in May. Composition of the three genera of centrarchids collected in entrainment samples was crappie (5%), black basses (4%), and lepomis (91%).

Average freshwater drum density was significantly higher in 2003 (138/1000 m³) than observed in 2004 (14/1000 m³). Freshwater drum larvae were collected late April through early July with peak density occurring on June 19 in 2003 (771/1000 m³) and on May 27 in 2004 (70/1000 m³).

Silversides averaged 11/1000 m³ in 2003 entrainment samples and 120/1000 m³ in 2004. Silversides were collected early April through early July with peak densities occurring June 19 in 2003 (20/1000 m³) and May 13 in 2004 (706/1 000 m³). Both brook and inland silverside occur in Wheeler Reservoir; however, all late post yolk-sac larvae and juveniles collected were inland silversides.

Hydraulic Entrainment Estimates:

The hydraulic entrainment estimate for all sampling periods, 2003 and 2004 combined, averaged 8.4%. In 2003, hydraulic entrainment estimate averaged 6.2% (range 4 to 27.6%) and in 2004 averaged 12.7% (range 5.9 to 42%) (Table 27). A decrease in river flow past BFN during most of the 2004 sampling season was the most significant contributing factor to the higher entrainment in 2004. Estimated daily CCW intake was consistent during entrainment sampling in 2003 and 2004; however, average daily volume transported past BFN was $1.3 \times 10^8 \text{ m}^3$ in 2003 and decreased to $6.0 \times 10^7 \text{ m}^3$ in 2004.

Fish Entrainment Estimates:

Entrainment estimates for all numerically significant taxa of fish eggs and larvae were higher in 2004 (Table 28). The entrainment rate for fish eggs was 1.3% in 2003 and 18.8% in 2004. An estimated 4.5% of fish larvae transported past BFN were entrained in 2003 compared to 18.7% in 2004. The overall entrainment estimate based on the two year study averaged 7.6% for fish eggs and 10.8% for larval fish. Spatial-temporal distribution varied significantly between sampling periods and stations for both fish eggs and larvae, demonstrating the heterogeneous distribution of individuals both vertically and horizontally in the water column. The unrealistically high entrainment estimate (18.8%) for shad eggs in 2004 is an example of this distribution pattern. In 2004, a total of 922 shad eggs was collected during the sampling season and 859 of these were collected May 13. The majority of these were found in intake samples and only two in samples collected in the reservoir immediately upstream from BFN intake structure. Similar events may have contributed to the fluctuations in entrainment estimates for other taxa.

Historical Comparisons:

The methodology used to estimate entrainment at BFN was changed in 1977. Prior to 1977, reservoir ichthyoplankton populations were estimated based on data collected at three transects in Wheeler Reservoir. Entrainment estimates were calculated by comparing reservoir populations with data collected in the BFN intake. Beginning in 1977, reservoir sampling was designed to estimate transport of fish eggs and larvae past BFN. Data collected across a single plant transect, located immediately upstream from BFN intake at TRM 294.5, provided estimates of fish transport past BFN and was compared to data collected in the intake to estimate entrainment. The 2003 and 2004 assessment used data collected at TRM 294.5 to estimate transport past BFN; therefore, historical comparisons were limited to baseline data collected in 1977 through 1979. Hydraulic entrainment estimates in 2003 and 2004 were within the range observed in the historical evaluations; the 6.2% in 2003 was near historical lows and the 12.7% in 2004 near the historical high (Table 29). The 2003 and 2004 data demonstrate the significant effect of river flow on the entrainment estimates. The daily rate of entrainment for fish eggs and larvae was similar in 2003 and 2004; however, a significantly higher percentage of the total volume of water

moving past BFN was entrained during the low flow conditions in 2004. Based on historical, 2003, and 2004 data, fluctuations in the annual entrainment estimates at BFN are common.

Entrainment Conclusions at BFN:

Both historical data and the 2003 and 2004 study demonstrate the variability in the occurrence and spatial-temporal distribution of fish in Wheeler Reservoir near BFN. This variability translates into significant fluctuation in the entrainment and impingement rates associated with plant operation. Factors contributing to these fluctuations include year-class strength of individual species, life history of selected species, and the physical parameters of Wheeler Reservoir in the vicinity of BFN. Cyclic variation in the year-class strength of the fish species found in Wheeler Reservoir is well documented. In calculating entrainment and impingement estimates, these variations are exacerbated in scenarios where one or two species represent a high percentage of the total composition, as is the case with clupeids and freshwater drum in the vicinity of BFN. Spawning habitat, fecundity, and spatial distribution of these two species are significant in the fluctuations observed in the entrainment rates at BFN. Freshwater drum spawn in open water while shad spawn near shore and each female produces thousands of eggs, creating areas in the reservoir with high densities of fish eggs and early larvae. As these areas of high density eggs or larvae drift downstream, their occurrence within a sampling area (either intake or reservoir) may significantly affect the entrainment estimate. Juvenile and adult clupeids move in large schools throughout the reservoir; consequently, a large school occurring within a sampling area will significantly affect both entrainment and impingement rates.

The location of BFN is probably a contributing factor to the fluctuations in the annual entrainment estimates. Reservoirs are characterized by three zones; the inflow having characteristics more riverine, the fore bay is a more lacustrine area immediately upstream from a dam, and the transition zone provides a buffer in the middle of the reservoir. As water flows downstream from the inflow, velocity decreases as the cross-sectional area of the reservoir increases. Areas within the transition zone may exhibit high flow, low flow, or even negative flows depending on the rate water is released through the upstream and downstream dams. The area of Wheeler Reservoir near BFN is characterized as a transition zone where the velocity of water flowing past BFN depends on the rate water released through Guntersville and Wheeler Dams. The rate of water flow past BFN increases and the reservoir surface elevation decreases when the rate of water released through Wheeler Dam exceeds the release through Guntersville Dam. Inversely, the surface elevation increases and rate of flow decreases near BFN when rate of water released through Guntersville Dam exceeds the release in Wheeler Reservoir. CCW demand for BFN remains fairly constant during normal two unit operation, therefore, hydraulic and fish entrainment estimates will increase as reservoir flow past BFN decreases. Entrainment at BFN is significantly influenced by the large overbank located immediately upstream from the

intake structure. Historical hydrodynamic studies show 53 to 63 percent of the CCW used by BFN is drawn from this overbank and the quantity of flow along the overbank varies with reservoir stage and flow. Based on the spatial distribution of larval fish collected in 2003 and 2004, this overbank is highly productive and may provide a spawning area and nursery for several species of fish. Densities and composition of fish collected in the 2004 intake sampling suggest a higher percentage of the CCW is drawn from the overbank during low flow thus, elevating the entrainment estimate for these fish species.

TVA's valley-wide vital signs monitoring program is an additional tool used to evaluate the condition of the fish community near BFN. The Reservoir Fish Assemblage Index (RFAI), a component of the vital signs program, is used to evaluate reservoir health by rating the system based on community structure and function. A RFAI sampling station was established upstream from BFN at TRM 295.5 in 1992 and a second transition zone station was added downstream at TRM 292.5 in 2000. Based on RFAI scoring criteria from reservoirs throughout the Tennessee Valley, scores of 51-60 were classified as excellent, 41-50 as good, 21-40 as fair, and 22-31 as poor. As observed in the BFN 316(b) studies, annual RFAI scores in Wheeler Reservoir near BFN vary; scores range from 30 to 47 at TRM 292.5 (1993-2004) and 42 to 45 at TRM 292.5 (2000-2004). Based on the average RFAI scores for all years sampled, the fish community near BFN is classified as "Good," averaging 41 at TRM 295.5 and 43 at TRM 292.5.

The 2003 and 2004 316(b) data and recent fish community assessments in Wheeler Reservoir near BFN show no significant impacts from current operation of BFN on the fish community near the plant. Furthermore, current 316(b) data support conclusions presented in the 1977-1979 historical assessments. Results demonstrate annual variations in the relative abundance and spatial-temporal distribution of fish and fluctuations in reservoir flow are common in the vicinity of BFN. Life cycles of the dominant fish species and fluctuation in reservoir flow past BFN are significant factors influencing variations observed in the annual entrainment estimates. These variations in fish density and reservoir flow in the Wheeler transition zone has apparently had little effect on the fish community. Based on the 2003 and 2004 316(b) evaluation and the annual RFAI scores for Wheeler Reservoir, a viable balanced indigenous aquatic community is present in Wheeler Reservoir in the vicinity of BFN.

Based on the information presented in the aforementioned TVA study (Baxter *et al.* 2006) and due to the similarity among Tennessee River reservoir fish assemblages, AST can reasonably expect similar species are present at the location of the Fleet Hollow CWIS at TRM 259.6. However, AST expects entrainment of these species to be far less significant than at the BFN because Fleet Hollow average percent volume hydraulic entrainment at 0.04% is far below the minimum average percent hydraulic entrainment of 6.2% at BFN.

8.0 Operational Status 40 CFR 122.21(r)(7))Water System Data (40 CFR 122.21(r)(8))

Oxychem does not use any intake water from PDW CWIS for power production; however, approximately 0.072 MGD (0.89%) of intake water is used for steam generation for operations at its Muscle Shoals facility.

OxyChem has selected 40 CFR 125.94(c) compliance alternatives (c)(2) and (c)(3) based on a through-screen design velocity of 0.23 ft/sec and 0.043 ft/sec through-screen actual velocity at Fleet Hollow CWIS.

OxyChem intends to continue the current operational schedule in the future; no increases or reductions in manufacturing are known or foreseen at this time. No installation of new units is currently planned within the next 5 years.

9.0 Summary and Conclusions

OxyChem maintains an NPDES permit through ADEM. The facility withdraws an average of 5.43 MGD of water from the Tennessee River and utilizes more than 25% of the water for cooling purposes. As a result, OxyChem is subject to the CWA Section 316(b) regulations. OxyChem has provided the information as required in 40 CFR 122.21(r)(2-8), including CWIS operation and structural data, source water physical and biological data, and a chosen method of compliance with the impingement mortality standard. Based on the actual intake flow, OxyChem is not required to submit information under paragraphs 40 CFR 122.21(r)(9-14).

Relevant biological data for the Tennessee River are available through publicly available studies conducted by ADCNR, TWRA, USFWS, ALGS, and TVA. Tennessee Valley Authority conducted studies at their Browns Ferry Nuclear (BFN) Plant located upstream of OxyChem in Wheeler Reservoir and Colbert Fossil Plant (COF) downstream from OxyChem in the Pickwick Reservoir. The data collected by TVA and these other sources occurred in 2003-2015; however, they should still be considered relevant to the OxyChem Facility as no major changes in the environmental conditions have occurred that would make these reports inappropriate to use.

The current configuration of the OxyChem facility's Fleet Hollow CWIS meets the requirement of BTA and would continue to be compliant with the preapproved impingement mortality compliance alternative as referenced in 40 CFR 125.94(c)(2) as the design through-screen velocity is below 0.5 ft/sec and 40 CFR 125.94(c)(3) the actual through-screen velocity is currently below 0.5 ft/sec. Therefore, the Fleet Hollow CWIS does not represent an adverse impact to aquatic biota for impingement. Also, the low percentage of water withdrawal from the mean annual flow of the Tennessee River suggest that the CWIS operation has minimal effect on aquatic life and offers a potential BTA determination for entrainment at the OxyChem facility. In review of the intake volume for BFN (2,066 MGD) verses the Fleet Hollow CWIS, the Fleet Hollow CWIS (8.1 MGD) intake is <0.4% of the minimum estimated intake volume for the BFN; therefore OxyChem's environmental impacts via the Fleet Hollow CWIS should be significantly less than that of BFN. The BFN facility is documented as in compliance with the BTA, therefore, by extension, it can be concluded that OxyChem's Fleet Hollow CWIS entrainment should also meet the BTA for entrainment. The selected compliance alternative for impingement is a preapproved BTA by EPA and no additional reporting should be necessary upon approval from ADEM.

10.0 References

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11.0 Figures and Tables

Figure 1. Topographic map showing location of Occidental Chemical Corporation in Muscle Shoals, AL.

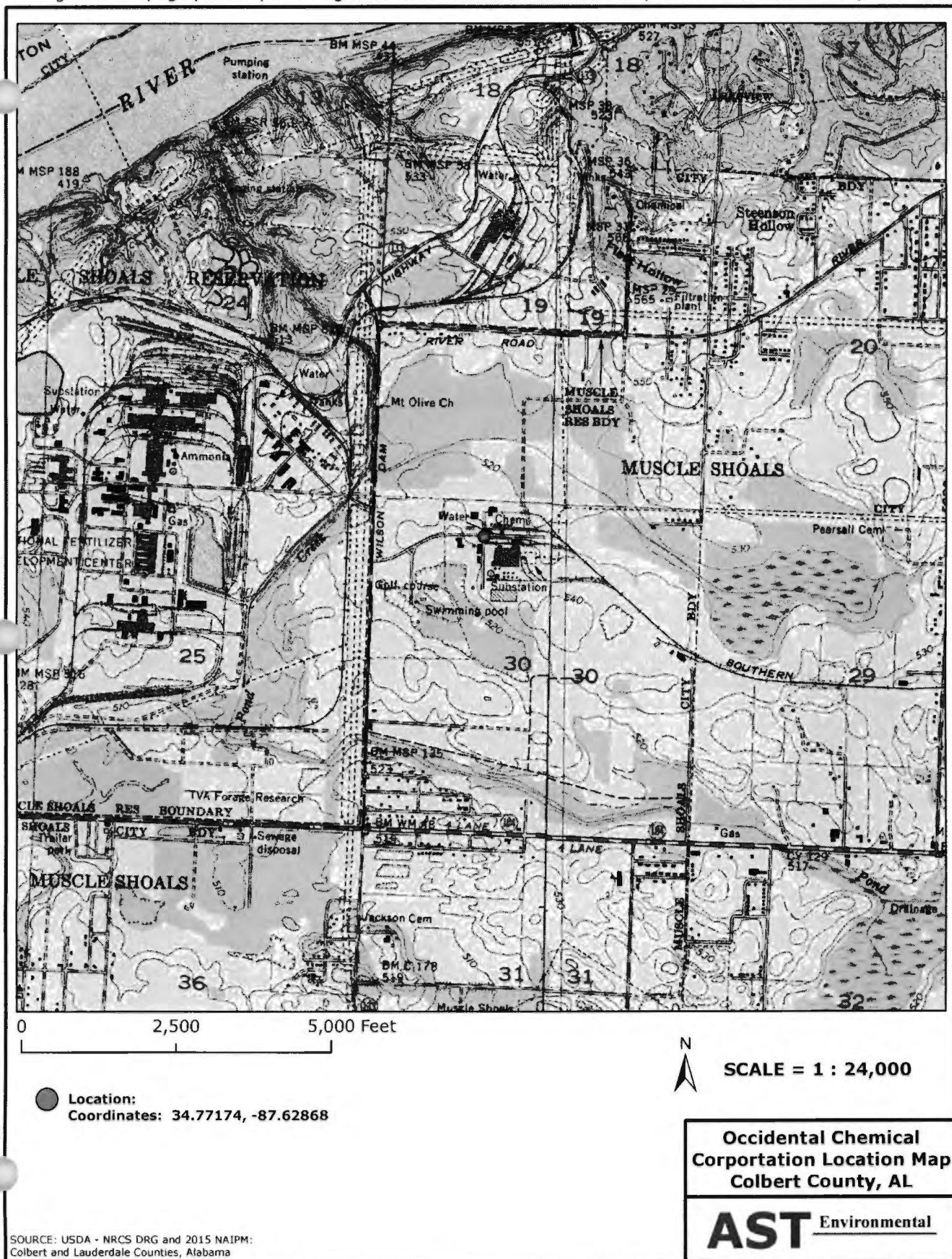


Figure 2. Aerial photograph showing location of Occidental Chemical Corporation in Muscle Shoals, AL.



Figure 3. Topographic map showing location of Fleet Hollow CWIS.

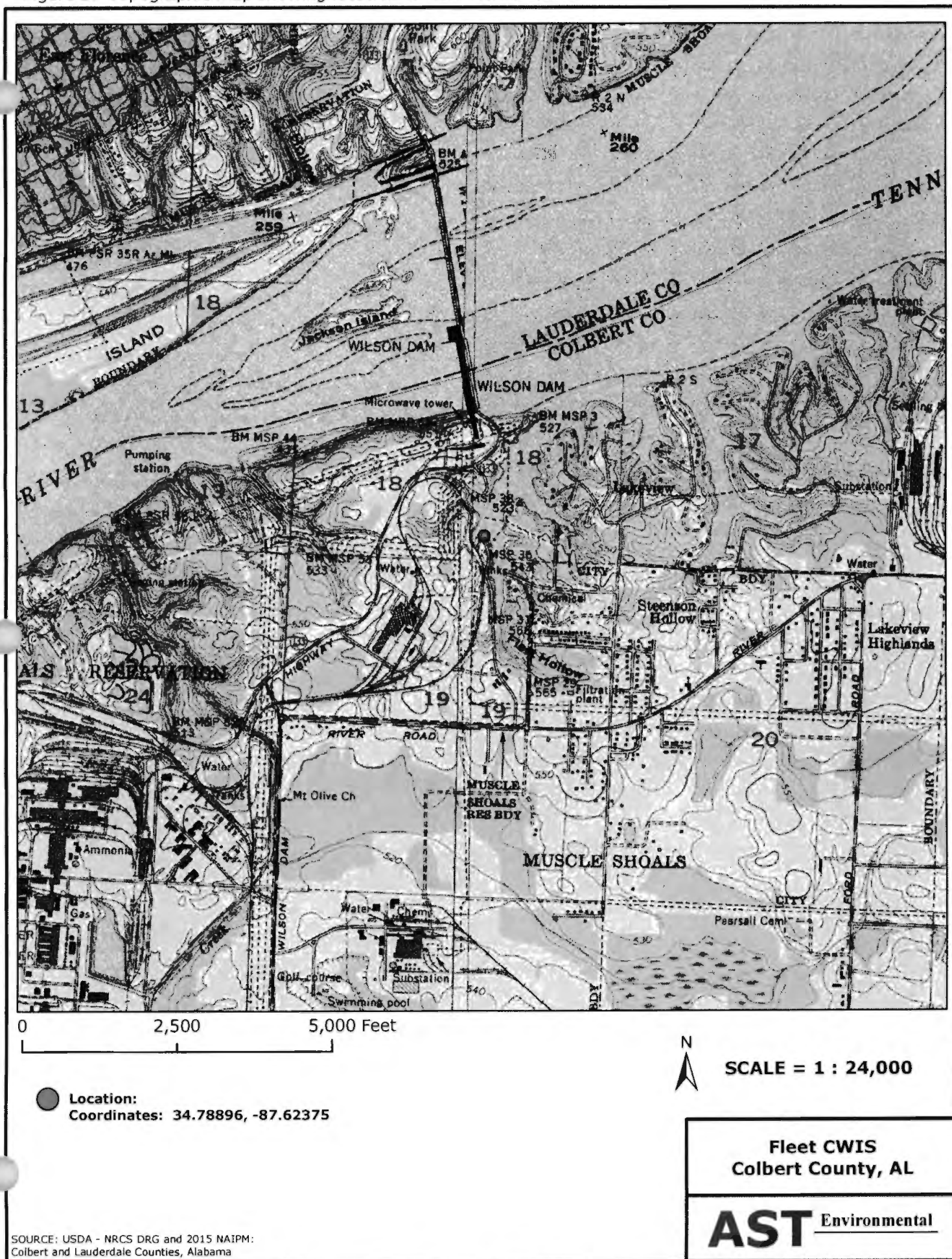


Figure 4. Aerial photograph showing location of Fleet Hollow CWIS.



Mean Monthly Discharge 1936-2005 Tennessee River

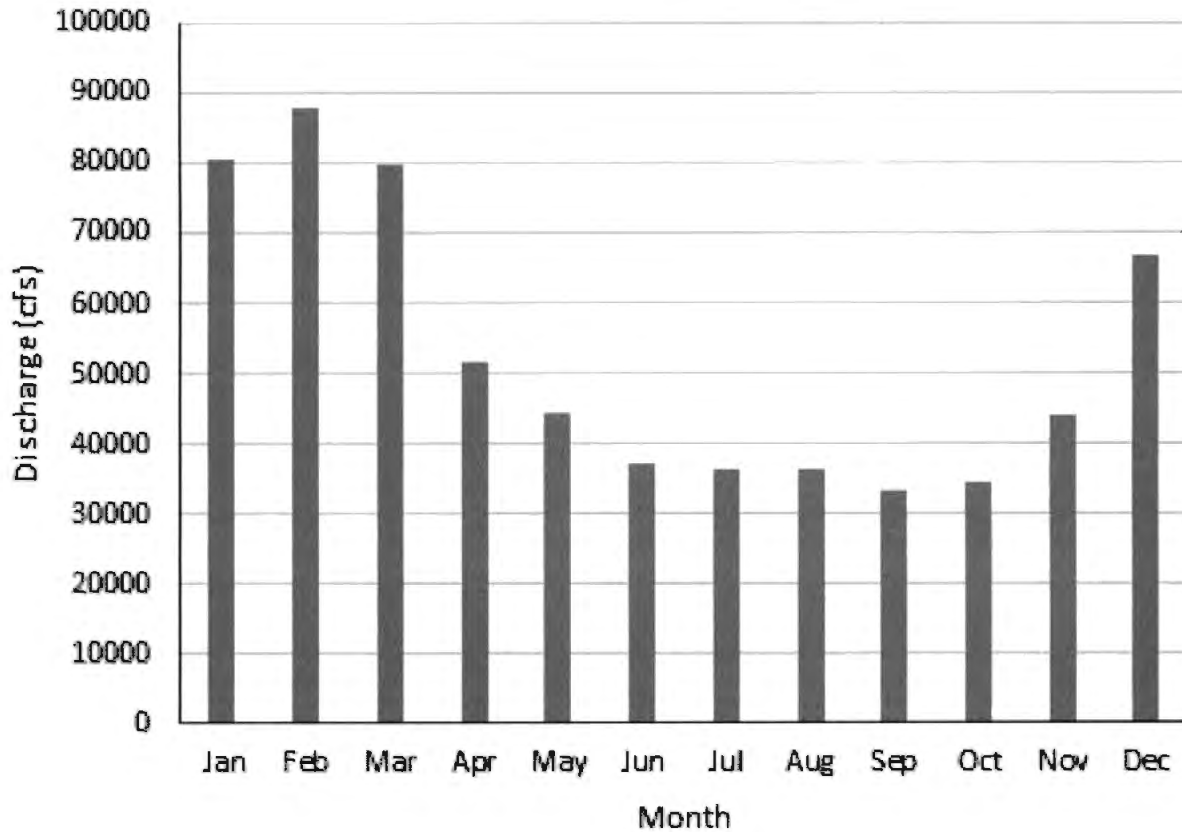


Figure 5. Mean monthly discharge (cfs) of the Tennessee River at Florence, AL.

USGS https://waterdata.usgs.gov/nwis/monthly?referred_module=sw&site_no=03589500&por_03589500_2702=848982,00060,2702,1894-10,2005-11&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list.

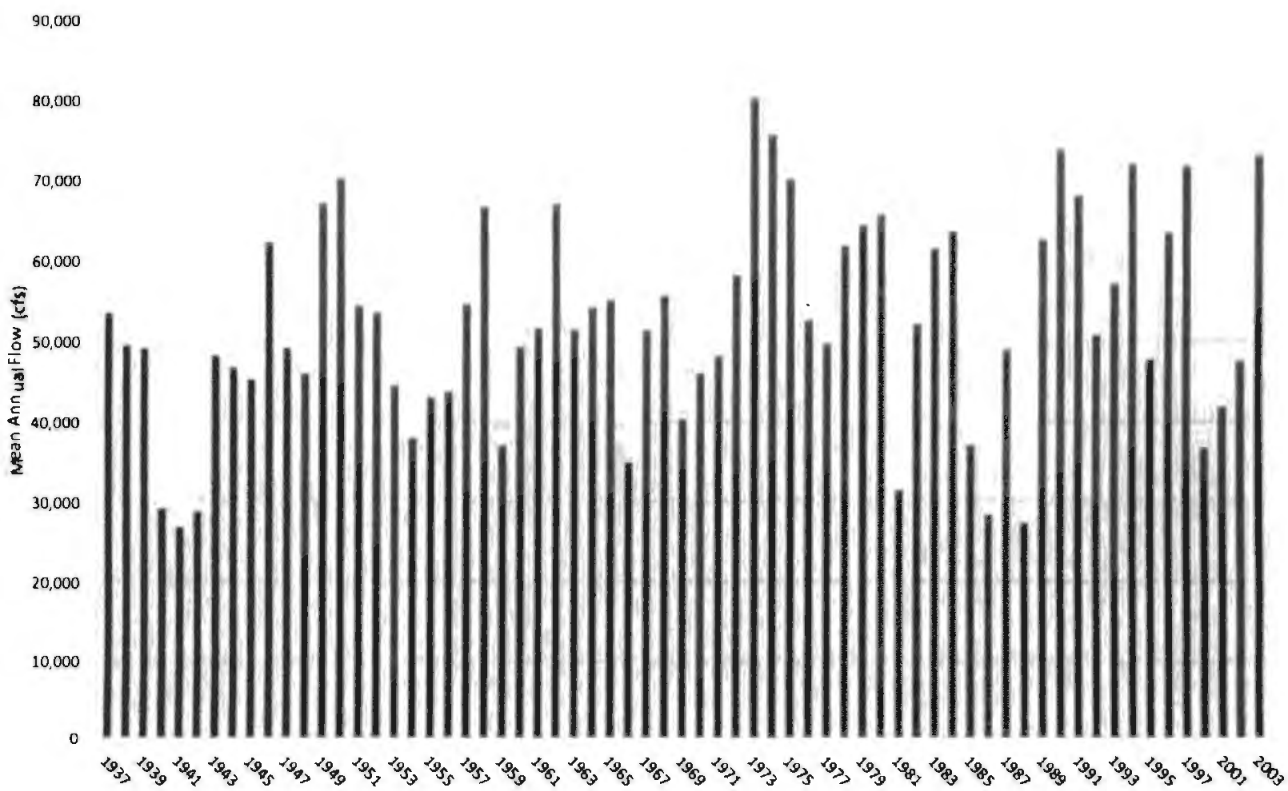


Figure 6. Mean Annual Flow (cfs) of the Tennessee River at Florence, AL 1937-2003.

USGS 03589500 TENNESSEE RIVER AT FLORENCE AL
https://waterdata.usgs.gov/al/nwis/uv/?site_no=03589500

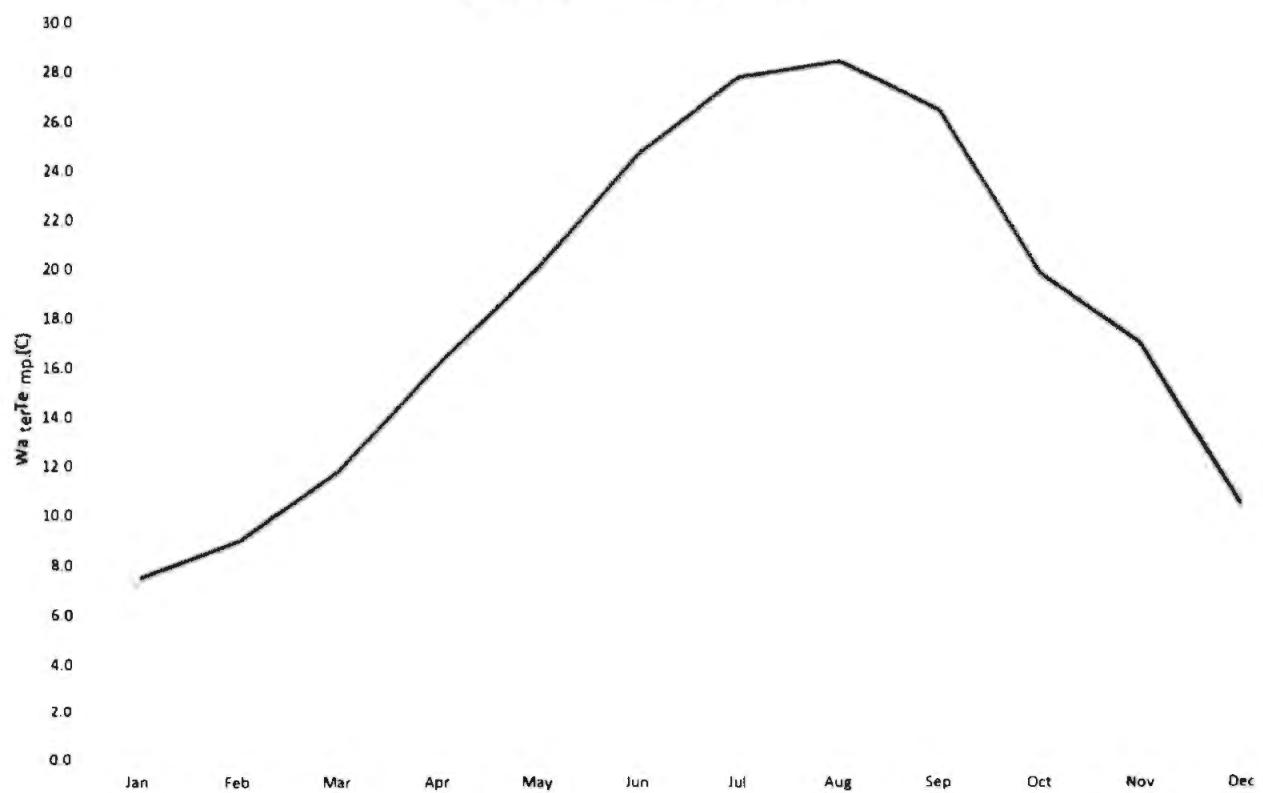


Figure 7. Mean Monthly Water Temperature ($^{\circ}\text{C}$) of the Tennessee River at Florence, AL 1965- 2005.

USGS 03589500 TENNESSEE RIVER AT FLORENCE AL
https://waterdata.usgs.gov/al/nwis/uv/?site_no=03589500

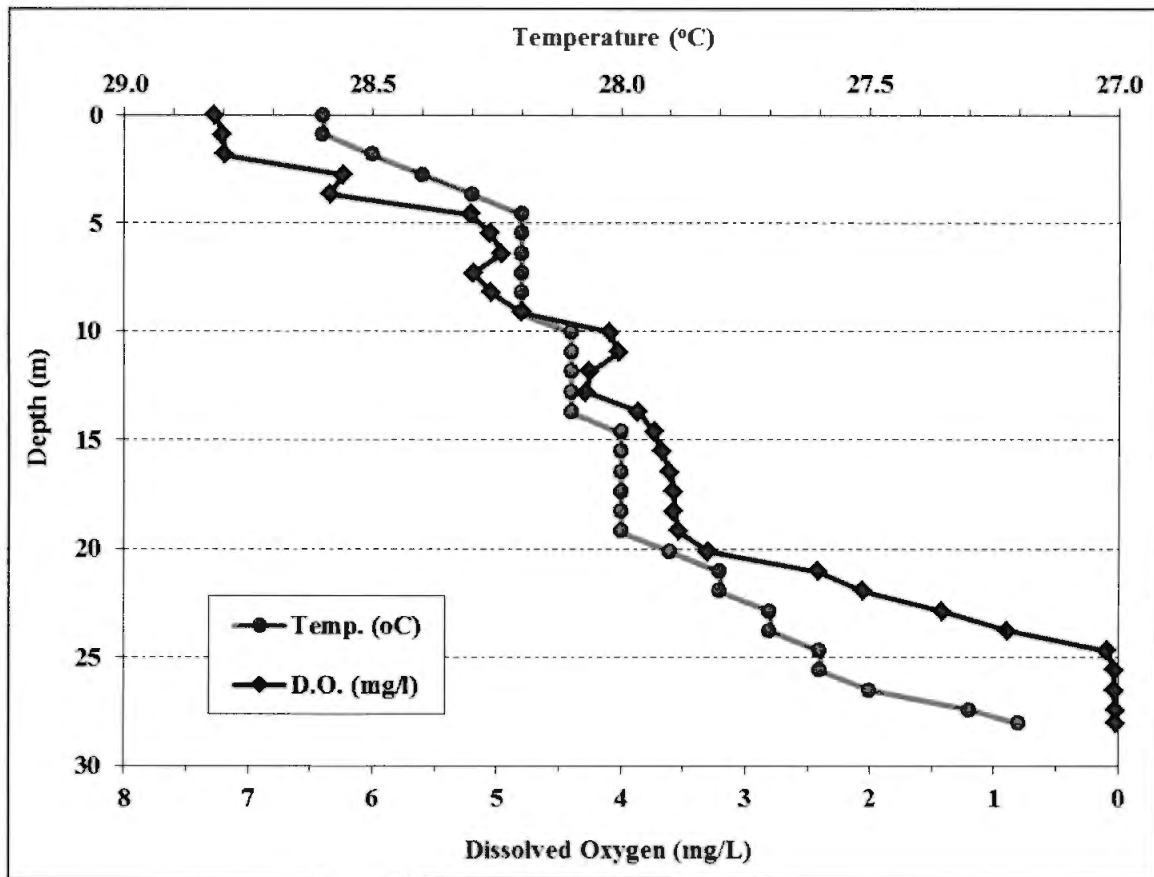
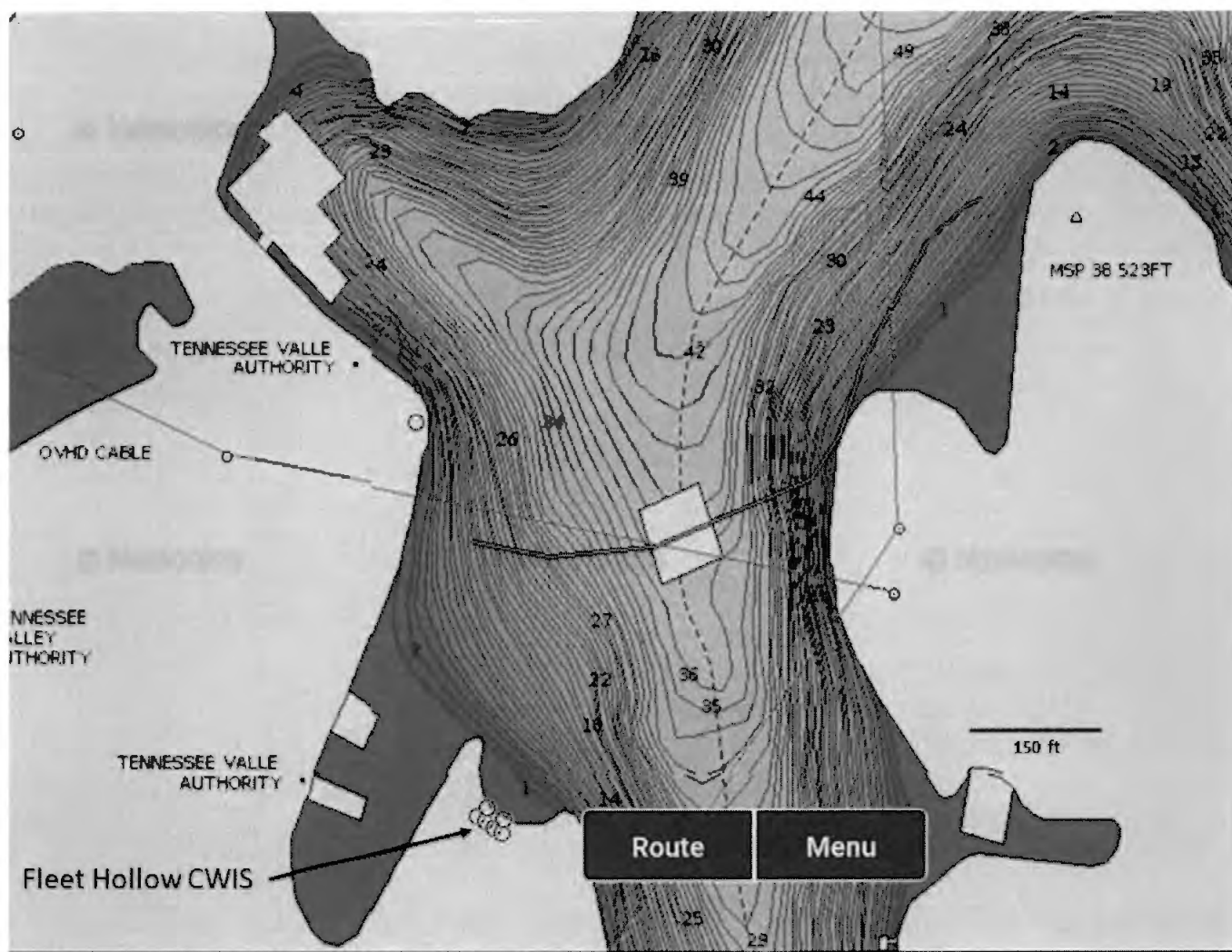


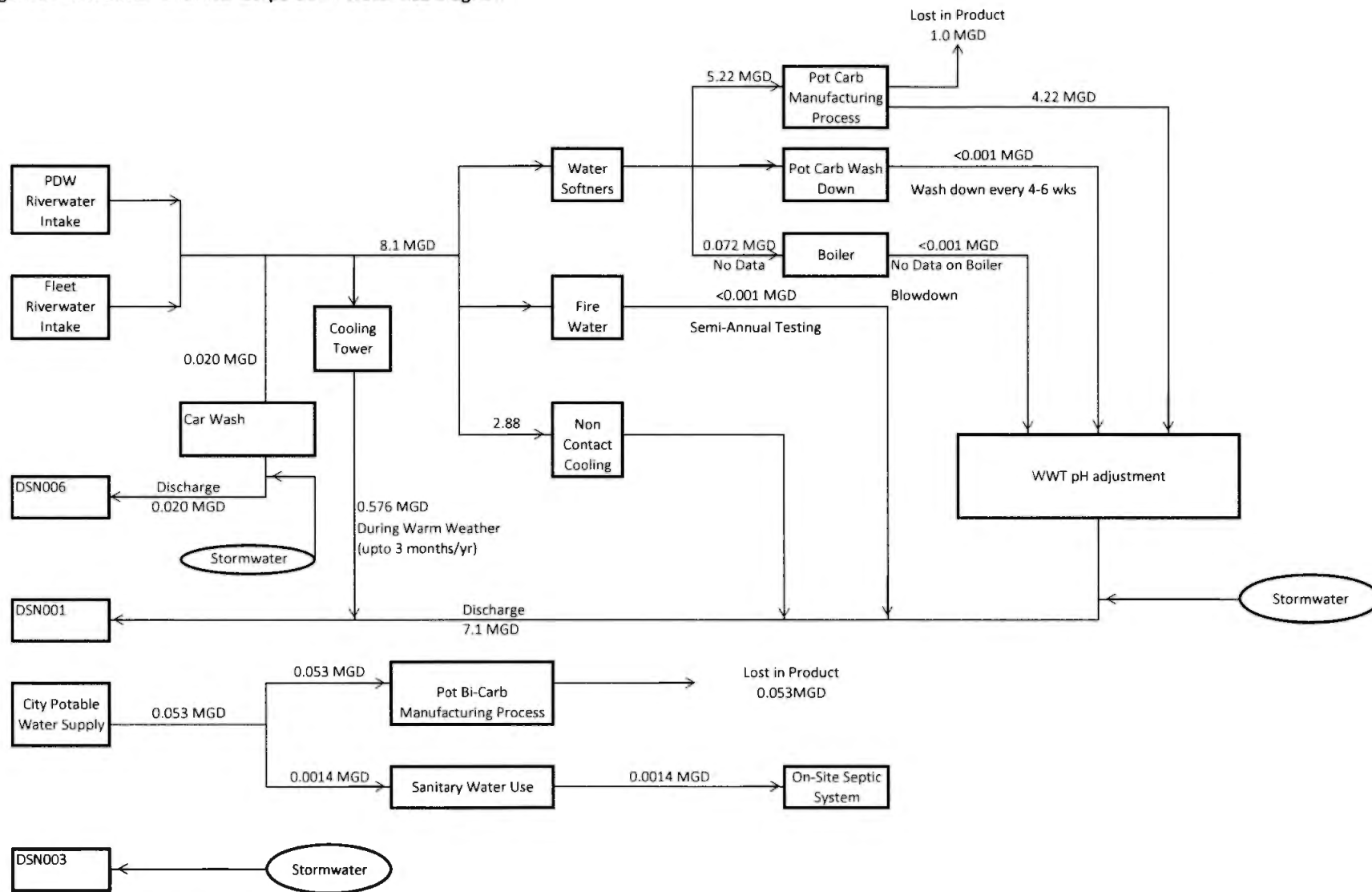
Figure 8. Temperature ($^{\circ}\text{C}$) and dissolved oxygen (mg/l) profiles at the dam forebay of Wilson Reservoir on August 23, 2017 (Ekema et al 2017).

Figure 9. Fleet Hollow CWIS bathymetric map.



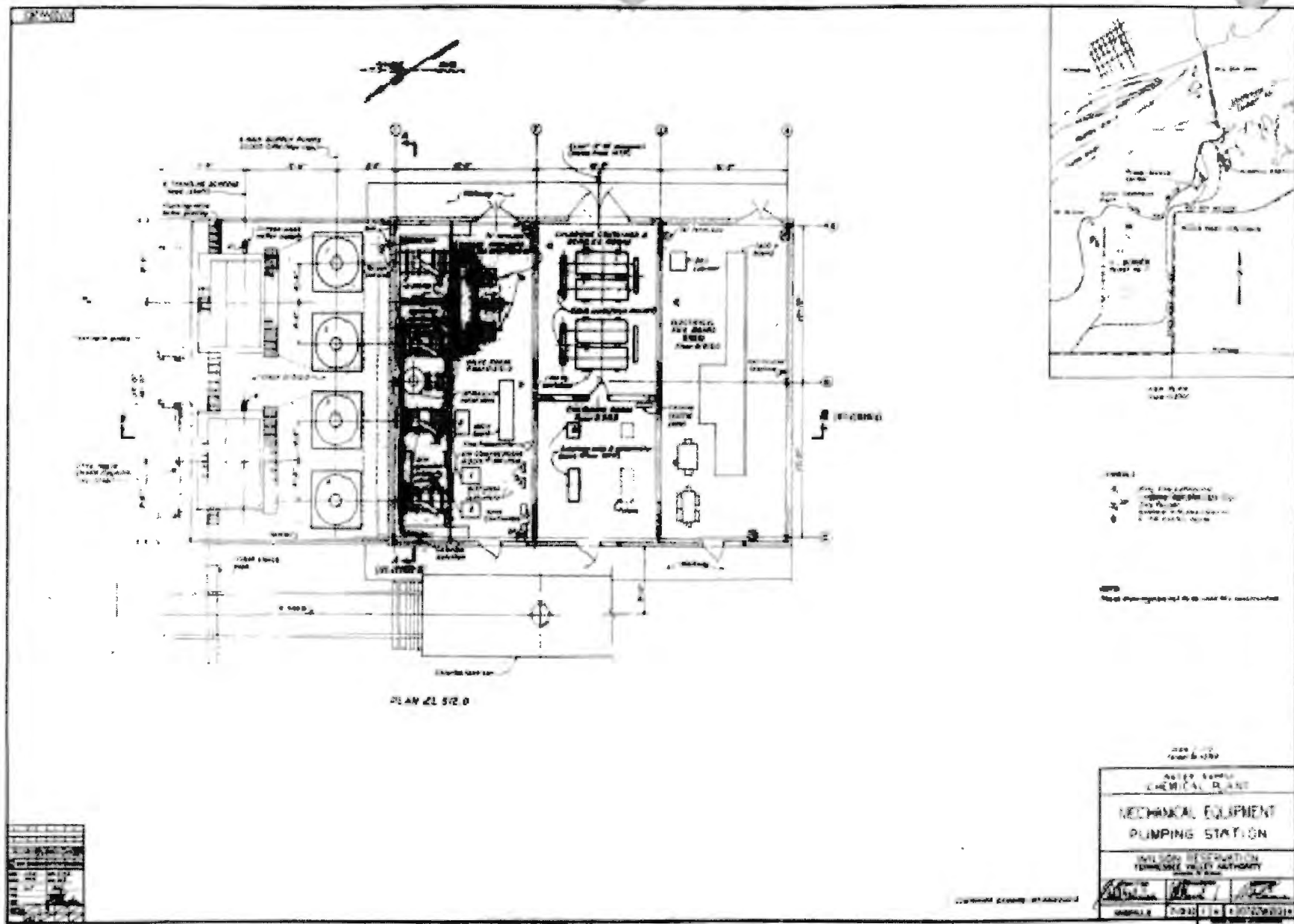
<https://webapp.navionics.com/?lang=en#boating@15&key=%7DzisEnzxuO>

Figure 10 Occidental Chemical Corporation Water Use Diagram



All Flows in MGD - Million Gallons Per Day

Figure 11. Fleet Hollow TVA CWIS design drawing.



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Table 1. Wilson Reservoir morphometric, physical, and chemical characteristics Ekema et al 2017, in part).

Surface area	15,500 acres
Drainage area	30,750 sq. mi.
Full pool elevation	507.5 feet-msl
7Q10	9,391 cfs
Mean annual flow	54,900 cfs
Mean annual fluctuation	3 feet
Shoreline distance	166 miles
Shoreline development index	10.3
Mean depth	40.9 feet
Maximum depth	93 feet
Outlet depth	97.5 feet
Total dissolved solids	92 mg/l
Year of Impoundment	1924
Classification	Public water supply, Fish and Wildlife, Swimming

Table 2. Fleet Hollow CWIS data.

<u>FLEET PUMPS</u>				
Pump Number	1	2	3	4
Date water intake installed	1964	1964	1964	1964
Intake location (latitude and longitude)	34.7890 -87.6238	34.7890 -87.6238	34.7890 -87.6238	34.7890 -87.6238
What depth is intake	22'	22'	22'	22'
Maximum pumping capacity in gallons per day	16.6 MM	16.6 MM	28.8 MM	10.8 MM
Mesh size of intake	3/8"	3/8"	3/8"	3/8"
Mechanism for cleaning screen	Rotating screen with backwash	Rotating screen with backwash	Rotating screen with backwash	Rotating screen with backwash
Fish detraction technology on intake And data available on actual impingement (if available)	2.5" Bar Screens on river intake - 1.5" Bar Screens on pumps	2.5" Bar Screens on river intake - 1.5" Bar Screens on pumps	2.5" Bar Screens on river intake - 1.5" Bar Screens on pumps	2.5" Bar Screens on river intake - 1.5" Bar Screens on pumps

Table 3. Individual metrics observed by TVA near Brown's Ferry Nuclear facility (BFN), Autumn 2008.

Metric		TRM 292.5		TRM 293.9	
A. Species Richness and Composition		Observed		Observed	
1. Number of Indigenous Species		28		26	
2. Number of Centrarchid Species		6	Green Sunfish Bluegill Longear Sunfish Warmouth Black Crappie Redear Sunfish	7	Green Sunfish Bluegill Longear Sunfish Warmouth Redear Sunfish White Crappie Black Crappie
3. Number of Benthic Invertivore Species		5	Spotted Sucker Black redbreast Golden Redhorse Freshwater Drum Logperch	4	Spotted Sucker Northern Hog Sucker Freshwater Drum Logperch
4. Number of Intolerant Species		5	Spotted Sucker Skipjack Herring Black redbreast Longear Sunfish Smallmouth Bass	5	Spotted Sucker Northern Hog Sucker Skipjack Herring Longear Sunfish Smallmouth Bass
5. Percent Tolerant Individuals	Electrofishing	37.40%	Bluegill 10.30% Gizzard Shad 19.30% Largemouth Bass 7.20% Spotfin Shiner 0.20% Green Sunfish 0.30%	50.60%	Bluegill 8.20% Gizzard Shad 31.70% Common Carp 0.30% Largemouth Bass 9.40% Spotfin Shiner 0.20% Golden Shiner 0.20% Green Sunfish 0.40%
	Gill Netting	23.60%	Gizzard Shad 14.10% Common Carp 0.50% Bluegill 1.00% Largemouth Bass 8.00%	32.10%	Gizzard Shad 12.30% Common Carp 0.50% Bluegill 3.20% Largemouth Bass 7.00% Longnose Gar 4.80% Golden Shiner 2.70% White Crappie 1.60%
6. Percent Dominance by one Species	Electrofishing	52.70%	Inland Silverside	31.70%	Gizzard Shad
	Gill netting	28.60%	White Bass	19.80%	Channel Catfish
7. Percent Non-Indigenous Species	Electrofishing	52.70%	Inland Silverside 52.70%	29.50%	Inland Silverside 29.00% Atlantic Needlefish 0.10% Common Carp 0.30%
	Gill Netting	0.5%	Common Carp 0.50%	1.6%	Common Carp 0.50% Striped Bass 1.10%
8. Number of Top Carnivore Species		10	Spotted Gar Largemouth Bass Spotted Bass Smallmouth Bass Skipjack Herring Flathead Catfish White Bass Yellow Bass Black Crappie Sauger	11	Longnose Gar Spotted Gar Largemouth Bass Spotted Bass Smallmouth Bass Skipjack Herring Flathead Catfish White Bass Yellow Bass Black Crappie White Crappie
B. Trophic Composition					
9. Percent Top Carnivores	Electrofishing	8.50%	Largemouth Bass 7.20% Spotted Bass 0.20% Smallmouth Bass 1.00% Flathead Catfish 0.06%	12.60%	Largemouth Bass 9.40% Spotted Bass 0.70% Smallmouth Bass 0.70% Flathead Catfish 0.30% White Bass 0.20% Yellow Bass 1.00% Spotted Gar 0.20%
	Gill Netting	61.30%	Spotted Gar 0.50% Largemouth Bass 8.00% Spotted Bass 1.00% Skipjack Herring 15.60% Flathead Catfish 4.50% White Bass 28.60% Yellow Bass 1.50% Black Crappie 0.50% Sauger 1.00%	39.60%	Longnose Gar 4.80% Largemouth Bass 7.00% Spotted Bass 1.60% Skipjack Herring 1.60% Flathead Catfish 2.10% White Bass 14.00% Yellow Bass 5.30% White Crappie 1.60% Black Crappie 0.50%
10. Percent Omnivores	Electrofishing	20.70%	Gizzard Shad 19.30% Channel Catfish 1.20% Blue Catfish 0.20%	38.50%	Gizzard Shad 31.70% Channel Catfish 5.80% Smallmouth Buffalo 0.40% Common Carp 0.30% Golden Shiner 0.20%
	Gill Netting	26.60%	Gizzard Shad 14.10% Blue Catfish 6.00% Channel Catfish 3.50% Smallmouth Buffalo 2.00% Black Buffalo 0.50% Common Carp 0.50%	54.20%	Gizzard Shad 12.30% Blue Catfish 5.30% Channel Catfish 19.80% Golden Shiner 2.70% Smallmouth Buffalo 3.70% Common Carp 0.50%
C. Fish Abundance and Health					
11. Average Number Per Run	Electrofishing	112.2		59.9	
	Gill netting	19.9		18.7	
12. Percent Anomalies	Electrofishing	0.40%		1.00%	
	Gill netting	0.50%		0.50%	

Table 4. Individual metrics observed by TVA near Brown's Ferry Nuclear facility (BFN), Autumn 2009.

Metric		Observed	TRM 292.5		Observed	TRM 295.9	
A. Species Richness and Composition							
1. Number of Ingenous Species		27			26		
2. Nubmer of Centrarchid Species		7	Black Crappie		6	Black Crappie	
			Bluegill			Bluegill	
			Green Sunfish			Green Sunfish	
			Longear Sunfish			Longear Sunfish	
			Redbreast Sunfish			Redear Sunfish	
			Redear Sunfish			Warmouth	
			Warmouth				
3. Number of Benthic Invertivore Species		3			4		
			Freshwater Drum			Black redhorse	
			Golden Redhorse			Freshwater Drum	
			Logperch			Golden Redhorse	
						Spotted Sucker	
4. Nubmer of Intolerant Species		3			5		
			Longear Sunfish			Black redhorse	
			Skipjack Herring			Longear Sunfish	
			Smallmouth Bass			Skipjack Herring	
						Smallmouth Bass	
						Spotted Sucker	
5. Percent Tolerant Individuals	Electrofishing	40.90%	Bluegill	5.67%	43.10%	Bluegill	5.30%
			Bluntnose Minnow	0.07%		Common Carp	0.18%
			Common Carp	0.07%		Gizzard Shad	26.97%
			Gizzard Shad	24.93%		Golden Shiner	0.46%
			Golden Shiner	0.07%		Green Sunfish	0.73%
			Green Sunfish	1.00%		Largemouth Bass	9.05%
			Largemouth Bass	7.07%		Spotfin Shinner	0.46%
			Redbreast Sunfish	0.07%			
			Spotfin Shinner	1.93%			
	Gill Netting	45.70%	Bluegill	4.35%	30.50%	Common Carp	3.39%
			Gizzard Shad	39.13%		Gizzard Shad	23.73%
			Largemouth Bass	2.17%		White Sucker	3.39%
6. Percent Dominance by one Species	Electrofishing	42.60%	Inland Silverside		35.60%	Inland Silverside	
			Gizzard Shad			Gizzard Shad	
	Gill netting	39.10%		23.70%			
7. Percent Non-Ingenous Species	Electrofishing	42.70%	Common Carp	0.07%	35.80%	Common Carp	0.18%
			Inland Silverside	42.60%		Inland Silverside	35.56%
						Striped Bass	0.09%
	Gill Netting	0%		3.40%	Common Carp	3.39%	
8. Number of Top Carnivore Species		9	Black Crappies		9	Black Crappies	
			Flathead Catfish			Flathead Catfish	
			Largemouth Bass			Largemouth Bass	
			Skipjack Herring			Skipjack Herring	
			Smallmouth Bass			Smallmouth Bass	
			Spotted Bass			Spotted Bass	
			Spotted Gar			Spotted Gar	
			White Bass			White Bass	
			Yellow Bass			Yellow Bass	
			B. Trophic Composition				
9. Percent Top Carnivores	Electrofishing	11.50%	Black Crappies	0.07%	14.40%	Black Crappies	0.09%
			Flathead Catfish	0.03%		Flathead Catfish	1.28%
			Largemouth Bass	7.07%		Largemouth Bass	9.05%
			Smallmouth Bass	3.73%		Smallmouth Bass	0.18%
			White Bass	0.07%		Spotted Bass	0.46%
			Yellow Bass	0.27%		Spotted Gar	0.46%
						Striped Bass	0.09%
						Yellow Bass	2.83%
	Gill Netting	32.60%	Flathead Catfish	6.52%	30.50%	Black Crappie	1.69%
			Largemouth Bass	2.17%		Flathead Catfish	1.69%
			Skipjack Herring	2.17%		Skipjack Herring	8.47%
			Spotted Bass	6.52%		Spotted Bass	1.69%
			Spotted Gar	8.70%		Spotted Gar	1.69%
White Bass			4.35%	White Bass		6.78%	
Yellow Bass	2.17%	Yellow Bass	8.47%				
10. Percent Omnivores	Electrofishing	29.50%	Bluntnose Minnow	0.07%	36.80%	Blue Catfish	0.18%
			Channel Catfish	4.20%		Channel Catfish	8.96%
			Common Carp	0.07%		Common Carp	0.18%
			Gizzard Shad	24.93%		Gizzard Shad	26.97%
			Golden Shiner	0.07%		Golden Shiner	0.46%
			Smallmouth Buffalo	0.20%		Smallmouth Buffalo	0.09%
	Gill Netting	56.50%	Blue Catfish	4.35%	54.20%	Blue Catfish	3.39%
			Channel Catfish	6.52%		Channel Catfish	20.34%
			Gizzard Shad	39.13%		Common Carp	3.39%
			Smallmouth Buffalo	6.52%		Gizzard Shad	23.73%
					White Sucker	3.39%	
C. Fish Abundance and Health							
11. Average Number Per Run	Electrofishing	100			72.9		
	Gill netting	4.6			5.9		
12. Percent Anomalies	Electrofishing	0.50%			0.60%		
	Gill netting	0.00%			0.00%		

Table 5. Individual metrics observed by TVA near Brown's Ferry Nuclear facility (BFN), Autumn 2011.

Metric		TRM 292.5			TRM 293.9		
Observed		Observed			Observed		
A. Species Richness and Composition							
1. Number of Ingenious Species		28			26		
2. Nubmer of Centrarchid Species		8	Black Crappie		7	Black Crappie	
			Bluegill			Bluegill	
			Green Sunfish			Green Sunfish	
			Longear Sunfish			Longear Sunfish	
			Redbreast Sunfish			Redear Sunfish	
			Redear Sunfish			Warmouth	
			Warmouth			White Crappie	
			White Crappie				
3. Number of Benthic Invertivore Species		4	Black Redhorse		4	Freshwater Drum	
			Freshwater Drum			Loggerch	
			Silver Redhorse			Northern Hog Sucker	
			Spotted Sucker			Spotted Sucker	
4. Nubmer of Intolerant Species		5	Black Redhorse		5	Longear Sunfish	
			Longear Sunfish			Northern Hog Sucker	
			Skipjack Herring			Skipjack Herring	
			Smallmouth Bass			Smallmouth Bass	
			Spotted Sucker			Spotted Sucker	
5. Percent Tolerant Individuals	Electrofishing	59.60%	Gizzard Shad	34.60%	54.60%	Gizzard Shad	36.80%
			Blue gill	13.30%		Blue gill	6.70%
			Spotffin Shiner	6.10%		Largemouth Bass	5.90%
			Green Sunfish	3.70%		Green Sunfish	2.60%
			Largemouth Bass	1.60%		Golden Shiner	1.40%
			Common Carp	0.10%		Spotfin Shlner	0.80%
			Golden Shiner	0.10%		Common Carp	0.30%
			Redbreast Sunfish	0.10%		White Crappie	0.10%
	Gill Netting	40.20%	Gizzard Shad	32.20%	36.00%	Gizzard Shad	15.1%
			White Crappie	4.60%		Longnose Gar	14.0%
			Largemouth Bass	3.40%		Largemouth Bass	3.50%
						Bluegill	1.20%
						Golden Shiner	1.20%
						White Crappie	1.20%
6. Percent Dominance by one Species	Electrofishing	34.60%	Gizzard Shad		36.80%	Gizzard Shad	
	Gill netting	32.20%	Gizzard Shad		20.90%	White Bass	
7. Percent Non-Ingenous Species	Electrofishing	15.70%	Mississippi Silverside	15.60%	19.80%	Mississippi Silverside	19.40%
			Common Carp	0.10%		Common Carp	0.30%
	Gill Netting	0%			0.00%		
8. Number of Top Carnivore Species		9	Black Crappies		11	Black Crappies	
			Flathead Catfish			Flathead Catfish	
			Largemouth Bass			Largemouth Bass	
			Skipjack Herring			Longnose Gar	
			Smallmouth Bass			Skipjack Herring	
			Spotted Bass			Smallmouth Bass	
			Spotted Gar			Spotted Bass	
			White Bass			Spotted Gar	
			White Crappie			White Bass	
						White Crappie	
						Yellow Bass	
B. Trophic Composition							
9. Percent Top Carnivores	Electrofishing	3.80%	Largemouth Bass	1.60%	8.40%	Largemouth Bass	5.90%
			Smallmouth Bass	1.60%		Smallmouth Bass	1.00%
			Flathead Catfish	0.20%		Flathead Catfish	0.50%
			Spotted Gar	0.20%		Spotted Gar	0.50%
			Black Crappie	0.10%		Spotted Bass	0.20%
			Spotted Bass	0.10%		Black Crappie	0.10%
						White Crappie	0.10%
						Yellow Bass	0.10%
	Gill Netting	35.60%	Flathead Catfish	11.50%	57.00%	White Bass	20.90%
			White Bass	9.20%		Longnose Gar	14.00%
			Skipjack Herring	4.60%		Yellow Bass	11.60%
			White Crappie	4.60%		Largemouth Bass	3.50%
			Largemouth Bass	3.40%		Flathead Catfish	2.30%
			Spotted Gar	2.30%		Skipjack Herring	2.30%
						Smallmouth Bass	1.20%
						White Crappie	1.20%
10. Percent Omnivores	Electrofishing	37.80%	Gizzard Shad	34.60%	41.00%	Gizzard Shad	36.80%
			Channel Catfish	2.60%		Channel Catfish	2.20%
			Smallmouth Buffalo	0.50%		Golden Shiner	1.40%
			Common Carp	0.10%		Common Carp	0.30%
			Golden Shiner	0.10%		Smallmouth Buffalo	0.30%
	Gill Netting	52.90%	Gizzard Shad	32.20%	33.70%	Gizzard Shad	15.10%
			Channel Catfish	10.30%		Channel Catfish	11.60%
			Black Buffalo	4.60%		Black Buffalo	2.30%
			Blue Catfish	4.60%		Blue Catfish	2.30%
			Smallmouth Buffalo	1.10%		Golden Shiner	1.20%
						Smallmouth Buffalo	1.20%
C. Fish Abundance and Health							
11. Average Number Per Run	Electrofishing	118.9			120.7		
	Gill netting	8.7			8.6		
12. Percent Anomalies	Electrofishing	0.30%			0.40%		
	Gill netting	0.00%			0.00%		

Table 6. Fish species identified by TVA at TRM 292.5 in Autumn 2008

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Gizzard Shad	Dorosoma Cepedianum	21.67	103.83	325	2.8	28	353
Common Carp	Cyprinus Carpio				0.1	1	1
Spotfin Shiner	Cyprinella Spiroptera	0.2	0.96	3			3
Green Sunfish	Lepomis Cyanellus	0.33	1.6	5			5
Bluegill	Lepomis Macrochirus	11.6	55.59	174	0.2	2	176
Largemouth Bass	Micropterus Salmoides	8.13	38.98	122	1.6	16	138
Skipjack Herring	Alosa Chrysochloris				3.1	31	31
Spotted Sucker	Minytrema Melanops	0.07	0.32	1	0.3	3	4
Black Redhorse	Moxostoma Duquenei	0.07	0.32	1			1
Longear Sunfish	Lepomis Megalotis	5.6	26.84	84			84
Smallmouth Bass	Micropterus Dolomieu	1.13	5.43	17			17
Spotted Gar	Lepisosteus Oculatus				0.1	1	1
Threadfin Shad	Dorosoma Petenense	0.07	0.32	1			1
Largescale Stoneroller	Campostoma Oligolepis	0.07	0.32	1			1
Smallmouth Buffalo	Ictiobus Bubalus				0.4	4	4
Black Buffalo	Ictiobus Niger				0.1	1	1
Golden Redhorse	Moxostoma Erythrurum	0.13	0.64	2	0.1	1	3
Blue Catfish	Ictalurus Furcatus	0.2	0.96	3	1.2	12	15
Channel Catfish	Ictalurus Punctatus	1.33	6.39	20	0.7	7	27
Flathead Catfish	Pylodictis Olivaris	0.07	0.32	1	0.9	9	10
White Bass	Morone Chrysops				5.7	57	57
Yellow Bass	Morone Mississippienses				0.3	3	3
Warmouth	Lepomis Gluosus	0.07	0.32	1			1
Readear Sunfish	Lepomis Microlophus	1.4	6.71	21	1.1	11	32
Spotted Bass	Micropterus Punctulatus	0.2	0.96	3	0.2	2	5
Black Crappie	Pomoxis Nigromaculatus				0.1	1	1
Longperch	Percina Caprodes	0.2	0.96	3			3
Sauger	Sander Canadensis				0.2	2	2
Freshwater Drum	Aplodinotus Grunniens	0.53	2.56	8	0.7	7	15
Inland Silverside	Menidia Beryllina	59.13	283.39	887			887

Table 7. Fish species identified by TVA at TRM 295.9 in Autumn 2008

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Longnose Gar	Lepisosteus Osseus				0.9	9	9
Gizzard Shad	Dorosoma Cepedianum	19	96.28	285	2.3	23	308
Common Carp	Cyprinus Carpio	0.2	1.01	3	0.1	1	4
Golden Shinner	Notemigonus Crysoleucas	0.13	0.68	2	0.5	5	7
Spotfin Shiner	Cyprinella Spiloptera	0.13	0.68	2			2
Green Sunfish	Lepomis Cyanellus	0.27	1.35	4			4
Bluegill	Lepomis Macrochirus	4.93	25	74	0.6	6	80
Largemouth Bass	Micropterus Salmoides	5.6	28.37	84	1.3	13	97
White Crappie	Pomoxis Annularis				0.3	3	3
Skipjack Herring	Alosa Chrysochloris				0.3	3	3
Northern Hog Sucker	Hypentelium Nigricans	0.13	0.68	2			2
Spotted Sucker	Minytrema Melanops	0.6	3.04	9			9
Longear Sunfish	Lepomis Megalotis	1.53	7.77	23			23
Smallmouth Bass	Micropterus Dolomieu	0.4	2.03	6			6
Spotted Gar	Lepisosteus Oculatus	0.13	0.68	2			2
Threadfin Shad	Dorosoma Petenense	0.27	1.35	4			4
Bullhead Minnow	Pimephales Vigilax	0.07	0.34	1			1
Smallmouth Buffalo	Lctiobus Bubalus	0.27	1.35	4	0.7	7	11
Blue Catfish	Ictalurus Furcatus				1	10	10
Channel Catfish	Ictalurus Punctatus	3.47	17.57	52	3.7	37	89
Flathead Catfish	Pylodictis Olivaris	0.2	1.01	3	0.4	4	7
White Bass	Morone Chrysops	0.13	0.68	2	2.6	26	28
Yellow Bass	Morone Mississippienses	0.6	3.04	9	1	10	19
Striped Bass	Morone Saxatilis				0.2	2	2
Warmouth	Lepomis Gluosus	0.07	0.34	1			1
Readeare Sunfish	Lepomis Microlophus	2.67	13.51	40	0.6	6	46
Spotted Bass	Micropterus Punctulatus	0.4	2.03	6	0.3	3	9
Black Crappie	Pomoxis Nigromaculatus				0.1	1	1
Logperch	Percina Caprodes	0.33	1.69	5			5
Freshwater Drum	Aplodinotus Grunniens	0.87	4.39	13	1.8	18	31
Inland Silverside	Menidia Beryllina	17.4	88.18	261			261
Atlantic Needlefish	Strongylura Marina	0.07	0.34	1			1

Table 8. Fish species identified by TVA at TRM 292.5 in Autumn 2009

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Gizzard Shad	Dorosoma Cepedianum	24.93	112.99	374	1.8	18	392
Common Carp	Cyprinus Carpio	0.07	0.3	1			1
Golden Shinner	Notemigonus Crysoleucas	0.07	0.3	1			1
Spotfin Shiner	Cyprinella Spiloptera	1.93	8.76	29			29
Bluntnose Minnow	Pimephales Notatus	0.07	0.3	1			1
Redbreast Sunfish	Lepomis Auritus	0.07	0.3	1			1
Green Sunfish	Lepomis Cyanellus	1	4.53	15			15
Bluegill	Lepomis Macrochirus	5.67	25.68	85	0.2	2	87
Large mouth Bass	Micropterus Salmoides	7.07	32.02	106	0.1	1	107
Skipjack Herring	Alosa Chrysochloris				0.1	1	1
Longear Sunfish	Lepomis Megalotis	2.13	9.67	32			32
Smallmouth Bass	Micropterus Dolomieu	3.73	16.92	56			56
Spotted Gar	Lepisosteus Oculatus				0.4	4	4
Threadfin Shad	Dorosoma Petenense	1.07	4.83	16			16
Smallmouth Buffalo	Lctiobus Bubalus	0.2	0.91	3	0.3	3	6
Golden Redhorse	Moxostoma Erythrurum	0.27	1.21	4			4
Blue Catfish	Ictalurus Furcatus				0.2	2	2
Channel Catfish	Ictalurus Punctatus	4.2	19.03	63	0.3	3	66
Flathead Catfish	Pylodictis Olivaris	0.27	1.21	4	0.3	3	7
White Bass	Morone Chrysops	0.07	0.3	1	0.2	2	3
Yellow Bass	Morone Mississippienses	0.27	1.21	4	0.1	1	5
Warmouth	Lepomis Gluosus	0.07	0.3	1			1
Readear Sunfish	Lepomis Microlophus	1.47	6.65	22	0.2	2	24
Spotted Bass	Micropterus Punctulatus				0.3	3	3
Black Crappie	Pomoxis Nigromaculatus	0.07	0.3	1			1
Stripetail Darter	Etheostoma Kennicotti	0.07	0.3	1			1
Longperch	Percina Caprodes	0.07	0.3	1			1
Freshwater Drum	Aplodinotus Grunniens	2.6	11.78	39	0.1	1	40
Inland Silverside	Menidia Beryllina	42.6	193.05	639			639

Table 9. Fish species identified by TVA at TRM 295.9 in Autumn 2009

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Gizzard Shad	Dorosoma Cepedianum	19.67	89.94	295	1.4	14	309
Common Carp	Cyprinus Carpio	0.13	0.61	2	0.2	2	4
Golden Shinner	Notemigonus Crysoleucas	0.33	1.52	5			5
Spotfin Shiner	Cyprinella Spiloptera	0.33	1.52	5			5
White Sucker	Catostomus Commersoni				0.2	2	2
Green Sunfish	Lepomis Cyanellus	0.53	2.44	8			8
Bluegill	Lepomis Macrochirus	3.87	17.68	58			58
Largemouth Bass	Micropterus Salmoides	6.6	30.18	99			99
Skipjack Herring	Alosa Chrysochloris				0.5	5	5
Spotted Sucker	Minytrema Melanops	0.27	1.22	4			4
Black Redhorse	Moxostoma Duquesnei	0.07	0.3	1			1
Longear Sunfish	Lepomis Megalotis	0.87	3.96	13			13
Smallmouth Bass	Micropterus Dolomieu	0.13	0.61	2			2
Spotted Gar	Lepisosteus Oculatus	0.33	1.52	5	0.1	1	6
Threadfin Shad	Dorosoma Petenense	0.93	4.27	14			14
Smallmouth Buffalo	Lctiobus Bubalus	0.07	0.3	1			1
Golden Redhorse	Moxostoma Erythrurum	0.07	0.3	1			1
Blue Catfish	Ictalurus Furcatus	0.13	0.61	2	0.2	2	4
Channel Catfish	Ictalurus Punctatus	6.53	29.88	98	1.2	12	110
Flathead Catfish	Pylodictis Olivaris	0.93	4.27	14	0.1	1	15
White Bass	Morone Chrysops				0.4	4	4
Yellow Bass	Morone Mississippienses	2.07	9.45	31	0.5	5	36
Striped Bass	Morone Saxatilis	0.07	0.3	1			1
Warmouth	Lepomis Gluosus	0.07	0.3	1			1
Readeare Sunfish	Lepomis Microlophus	1.33	6.1	20	0.6	6	26
Spotted Bass	Micropterus Punctulatus	0.33	1.52	5	0.1	1	6
Black Crappie	Pomoxis Nigromaculatus	0.07	0.3	1	0.1	1	2
Freshwater Drum	Aplodinotus Grunniens	1.27	5.79	19	0.3	3	22
Inland Silverside	Menidia Beryllina	25.93	118.6	389			389

Table 10. Fish species identified by TVA at TRM 292.5 in Autumn 2011

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Longnose Gar	Lepisosteus Osseus				1.2	12	12
Gizzard Shad	Dorosoma Cepedianum	44.4	197.63	666	1.3	13	679
Common Carp	Cyprinus Carpio	0.4	1.78	6			6
Golden Shinner	Notemigonus Crysoleucas	1.6	7.42	25	0.1	1	26
Spotfin Shiner	Cyprinella Spiloptera	0.93	4.15	14			14
Green Sunfish	Lepomis Cyanellus	3.13	13.95	47			47
Bluegill	Lepomis Macrochirus	8.13	36.2	122	0.1	1	123
Largemouth Bass	Micropterus Salmoides	7.13	31.75	107	0.3	3	110
White Crappie	Pomoxis Annularis	0.13	0.59	2	0.1	1	3
Skipjack Herring	Alosa Chrysochloris				0.2	2	2
Northern Hog Sucker	Hypentelium Nigricans	0.07	0.3	1			1
Spotted Sucker	Minytrema Melanops	0.93	4.15	14			14
Longear Sunfish	Lepomis Megalotis	1.8	8.01	27			27
Smallmouth Bass	Micropterus Dolomieu	1.27	5.64	19	0.1	1	20
Spotted Gar	Lepisosteus Oculatus	0.6	2.67	9			9
Threadfin Shad	Dorosoma Petenense	20.2	89.91	303			303
Largescale Stoneroller	Camptostoma Oligolepis	0.07	0.3	1			1
Smallmouth Buffalo	Ictiobus Bubalus	0.33	1.48	5	0.1	1	6
Black Buffalo	Ictiobus Niger				0.2	2	2
Blue Catfish	Ictalurus Furcatus				0.2	2	2
Channel Catfish	Ictalurus Punctatus	2.67	11.87	40	1	10	50
Flathead Catfish	Pylodictis Olivaris	0.6	2.67	9	0.2	2	11
White Bass	Morone Chrysops				1.8	18	18
Yellow Bass	Morone Mississippienses	0.07	0.3	1	1	10	11
Warmouth	Lepomis Gluosus	0.07	0.3	1			1
Redear Sunfish	Lepomis Microlophus	1.73	7.72	26	0.2	2	28
Spotted Bass	Micropterus Punctulatus	0.2	0.89	3			3
Black Crappie	Pomoxis Nigromaculatus	0.13	0.59	2			2
Longperch	Percina Caprodes	0.07	0.3	1			1
Freshwater Drum	Aplodinotus Grunniens	0.47	2.08	7	0.5	5	12
Mississippi Silverside	Menidia Audens	23.47	104.45	352			352

Table 11. Fish species identified by TVA at TRM 295.9 in Autumn 2011

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Gizzard Shad	Dorosoma Cepedianum	41.13	188.69	617	2.8	28	645
Common Carp	Cyprinus Carpio	0.07	0.31	1			1
Golden Shinner	Notemigonus Crysoleucas	0.07	0.31	1			1
Spotfin Shiner	Cyprinella Spiloptera	7.27	33.33	109			109
Redbreast Sunfish	Lepomis Auritus	0.13	0.61	2			2
Green Sunfish	Lepomis Cyanellus	4.4	20.18	66			66
Bluegill	Lepomis Macrochirus	15.87	72.78	238			238
Largemouth Bass	Micropterus Salmoides	1.93	8.87	29	0.3	3	32
White Crappie	Pomoxis Annularis				0.4	4	4
Skipjack Herring	Alosa Chrysochloris				0.4	4	4
Spotted Sucker	Minytrema Melanops	0.47	2.14	7			7
Black Redhorse	Moxostoma Duquesnei	0.53	2.45	8			8
Longear Sunfish	Lepomis Megalotis	3.67	16.82	55	0.1	1	56
Smallmouth Bass	Micropterus Dolomieu	1.93	8.87	29			29
Spotted Gar	Lepisosteus Oculatus	0.2	0.92	3	0.2	2	5
Threadfin Shad	Dorosoma Petenense	16	73.39	240			240
Smallmouth Buffalo	Ictiobus Bubalus	0.6	2.75	9	0.1	1	10
Black Buffalo	Ictiobus Niger				0.4	4	4
Silver Redhorse	Moxostoma Anisurum	0.07	0.31	1			1
Blue Catfish	Ictalurus Furcatus				0.4	4	4
Channel Catfish	Ictalurus Punctatus	3.07	14.07	46	0.9	9	55
Flathead Catfish	Pylodictis Olivaris	0.27	1.22	4	1	10	14
White Bass	Morone Chrysops				0.8	8	8
Warmouth	Lepomis Gluosus	0.13	0.61	2			2
Redear Sunfish	Lepomis Microlophus	0.93	4.28	14			14
Spotted Bass	Micropterus Punctulatus	0.07	0.31	1			1
Black Crappie	Pomoxis Nigromaculatus	0.07	0.31	1			1
Freshwater Drum	Aplodinotus Grunniens	1.4	6.42	21	0.9	9	30
Mississippi Silverside	Menidia Audens	18.6	85.32	279			279
Chestnut Lamprey	Ichthyomyzon Castaneus	0.07	0.31	1			1

Table 12. Fish species collected from the Tennessee River from 2006-2015.

Family	Species	Common name										
Tennessee Reservoir Fisheries - Tennessee Wildlife Resources Agency Electrofishing												
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	236	223	329	382	357	298	235	351	342	236
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	23	52	44	17	38	57	45	31	73	45
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	42	17	17	12	18	8	10	1	8	3
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie	2	2	—	—	—	—	—	—	—	—
Centrarchidae	<i>Lepomis microlophus</i>	Redear Sunfish	25	18	38	87	26	34	12	26	16	6
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	115	148	181	236	128	282	252	223	86	181
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black Crappie	—	—	—	—	—	—	—	—	—	7
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	172	291	208	201	60	217	118	22	304	161
Clupeidae	<i>Dorosoma petenense</i>	Threadfin Shad	361	224	308	250	14	214	439	287	161	118
Percidae	<i>Sander canadensis</i>	Sauger	—	—	—	—	—	—	—	—	—	1
Percidae	<i>Perca flavescens</i>	Yellow Perch	—	—	—	—	—	—	—	—	—	4
Tennessee Statewide Creel Survey - Tennessee Wildlife Resources Agency Creel Survey												
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Clupeidae	<i>Alosa chrysocloris</i>	Skipjack Herring	—	—	—	—	—	—	—	—	—	620
Ictaluridae	<i>Ictalurus furcatus</i>	Blue Catfish	—	—	—	—	—	—	—	—	—	21,997
Ictaluridae	<i>Ictalurus punctatus</i>	Channel Catfish	—	—	—	—	—	—	—	—	—	23,119
Ictaluridae	<i>Pylodictis olivaris</i>	Flathead Catfish	—	—	—	—	—	—	—	—	—	204
Moronidae	<i>Morone chrysops</i>	White Bass	—	—	—	—	—	—	—	—	—	832
Moronidae	<i>Morone mississippiensis</i>	Yellow Bass	—	—	—	—	—	—	—	—	—	837
Moronidae	<i>Morone saxatilis</i>	Striped Bass	—	—	—	—	—	—	—	—	—	198
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	—	—	—	—	—	—	—	—	—	44,707
Centrarchidae	<i>Lepomis megalotis</i>	Longear Sunfish	—	—	—	—	—	—	—	—	—	46
Centrarchidae	<i>Lepomis microlophus</i>	Redear Sunfish	—	—	—	—	—	—	—	—	—	325
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	—	—	—	—	—	—	—	—	—	10,326
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	—	—	—	—	—	—	—	—	—	4,865
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	—	—	—	—	—	—	—	—	—	96,049
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie	—	—	—	—	—	—	—	—	—	5,813
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black Crappie	—	—	—	—	—	—	—	—	—	1,373
Percidae	<i>Sander canadensis</i>	Sauger	—	—	—	—	—	—	—	—	—	494
Percidae	<i>Sander vitreus</i>	Walleye	—	—	—	—	—	—	—	—	—	494
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater Drum	—	—	—	—	—	—	—	—	—	564
Picnic Reservoir 2006 Management Report- Alabama Division of Conservation and Natural Resources - Electrofishing Results - 2006												
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	—	—	431	—	—	—	—	—	—	—
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	—	—	63	—	—	—	—	—	—	—
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	—	—	11	—	—	—	—	—	—	—

Table 12. Continued.

Family	Species	Common name											
Pickwick Reservoir 2008 Management Report - Alabama Division of Conservation and Natural Resources - Creel Survey Results - 2008													
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	--	--	1379	--	--	--	--	--	--	--	--
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	--	--	167	--	--	--	--	--	--	--	--
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	--	--	90	--	--	--	--	--	--	--	--
Centrarchidae	<i>Pomoxis</i>	Croaker	--	--	296	--	--	--	--	--	--	--	--
Geological Survey of Alabama - Electrofishing data - 2013										Panther Creek	Second Creek	TN River (Buck Island)	TN River (Pippen Island)
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted Gar	--	--	--	--	--	--	--	90	76	43	16
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose Gar	--	--	--	--	--	--	--	3	0	4	0
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	--	--	--	--	--	--	--	339	561	159	18
Clupeidae	<i>Dorosoma petenense</i>	Threadfin Shad	--	--	--	--	--	--	--	9	208	128	41
Cyprinidae	<i>Campestris oligolepis</i>	Largescale Stoneroller	--	--	--	--	--	--	--	76	20	0	1
Cyprinidae	<i>Cyprinella spiloptera</i>	Spottfin Shiner	--	--	--	--	--	--	--	361	383	75	86
Cyprinidae	<i>Cyprinus carpio</i>	Carp	--	--	--	--	--	--	--	8	17	0	0
Cyprinidae	<i>Notropis crysoleucas</i>	Golden Shiner	--	--	--	--	--	--	--	126	47	7	2
Cyprinidae	<i>Notropis atherinoides</i>	Emerald Shiner	--	--	--	--	--	--	--	21	24	0	2
Cyprinidae	<i>Notropis texanus</i>	Weed Shiner	--	--	--	--	--	--	--	63	7	19	3
Cyprinidae	<i>Notropis volucellus</i>	Mimic Shiner	--	--	--	--	--	--	--	99	31	0	1
Cyprinidae	<i>Pimephales vigilax</i>	Bullhead Minnow	--	--	--	--	--	--	--	0	0	0	5
Catostomidae	<i>Hypentelium nigricans</i>	Northern Hog Sucker	--	--	--	--	--	--	--	1	4	0	1
Catostomidae	<i>Ictalurus bubalus</i>	Smallmouth Buffalo	--	--	--	--	--	--	--	0	4	5	0
Catostomidae	<i>Minytrema melanops</i>	Spotted Sucker	--	--	--	--	--	--	--	27	29	7	0
Catostomidae	<i>Moxostoma duquesnoi</i>	Black Redhorse	--	--	--	--	--	--	--	0	5	1	1
Catostomidae	<i>Moxostoma erythrurum</i>	Golden Redhorse	--	--	--	--	--	--	--	0	0	6	0
Ictaluridae	<i>Ameiurus natalis</i>	Yellow Bullhead	--	--	--	--	--	--	--	5	2	0	0
Ictaluridae	<i>Ictalurus furcatus</i>	Blue Catfish	--	--	--	--	--	--	--	1	1	1	0
Ictaluridae	<i>Ictalurus punctatus</i>	Channel Catfish	--	--	--	--	--	--	--	5	22	6	3
Ictaluridae	<i>Pylodictis olivaris</i>	Flathead Catfish	--	--	--	--	--	--	--	0	3	11	4
Esocidae	<i>Esox niger</i>	Chain Pickerel	--	--	--	--	--	--	--	2	4	0	0
Atherinopsidae	<i>Labidesthes sicculus</i>	Brook Silverside	--	--	--	--	--	--	--	81	52	90	47
Atherinopsidae	<i>Menidia beryllina</i>	Inland Silverside	--	--	--	--	--	--	--	119	114	167	156
Fundulidae	<i>Fundulus notatus</i>	Blackstripe Topminnow	--	--	--	--	--	--	--	0	1	0	0
Moronidae	<i>Morone chrysops</i>	White Bass	--	--	--	--	--	--	--	0	0	1	0
Moronidae	<i>Morone mississippiensis</i>	Yellow Bass	--	--	--	--	--	--	--	0	0	2	1
Moronidae	<i>Morone chrysops x saxatilis</i>	Palmetto Bass	--	--	--	--	--	--	--	0	6	2	0
Centrarchidae	<i>Ambloplites rupestris</i>	Rock Bass	--	--	--	--	--	--	--	1	0	0	0
Centrarchidae	<i>Lepomis aeneus</i>	Redbreast Sunfish	--	--	--	--	--	--	--	6	12	22	1
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish	--	--	--	--	--	--	--	18	39	2	7

Table 12. Continued.

[illegible]

Table 12. Continued.

Family	Species	Common name										
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth bass	--	--	--	--	--	--	--	128	112	
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black crappie	--	--	--	--	--	--	--	6	2	
Clupeidae	<i>Alosa chrysichthys</i>	Striped herring	--	--	--	--	--	--	--	1	--	
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard shad	--	--	--	--	--	--	--	343	264	
Clupeidae	<i>Dorosoma petenense</i>	Threadfin shad	--	--	--	--	--	--	--	7	1	
Cyprinidae	<i>Cyprinella spiloptera</i>	Spotfin shiner	--	--	--	--	--	--	--	24	2	
Cyprinidae	<i>Cyprinus carpio</i>	Common carp	--	--	--	--	--	--	--	1	1	
Cyprinidae	<i>Pimephales notatus</i>	Bluntnose minnow	--	--	--	--	--	--	--	2	1	
Ictaluridae	<i>Ictalurus furcatus</i>	Blue catfish	--	--	--	--	--	--	--	3	11	
Ictaluridae	<i>Ictalurus punctatus</i>	Channel catfish	--	--	--	--	--	--	--	21	18	
Ictaluridae	<i>Pylodictis olivaris</i>	Flathead catfish	--	--	--	--	--	--	--	7	3	
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted gar	--	--	--	--	--	--	--	--	1	
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose gar	--	--	--	--	--	--	--	1	2	
Moronidae	<i>Morone chrysops</i>	White bass	--	--	--	--	--	--	--	9	1	
Moronidae	<i>Morone mississippiensis</i>	Yellow bass	--	--	--	--	--	--	--	3	6	
Percidae	<i>Percina caprodes</i>	Logperch	--	--	--	--	--	--	--	--	1	
Percidae	<i>Sander canadensis</i>	Sauger	--	--	--	--	--	--	--	--	1	
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater drum	--	--	--	--	--	--	--	10	3	

Table 13. Benthic macroinvertebrates assessed for the study that was completed above and below the CWIS of the Tennessee Valley Authority's (TVA) Colbert Fossil Plant (COF) during the autumn of 2011.

Taxon	Downstream		Upstream
	TRM 240.4	TRM 244	TRM 245
Cnidaria			
<i>Hydra</i> sp.	8	10	2
Platyhelminthes	---	2	---
<i>Dugesia tigrina</i>	40	68	23
Annelida			
Oligochaeta			
Lumbriculidae	---	2	---
Naididae	---	2	7
<i>Arctonais lomondi</i>	7	---	---
<i>Bratislava unidentata</i>	2	---	---
<i>Dero</i> sp.	5	6	2
<i>Pristina</i> sp.	2	---	---
Tubificidae	208	83	60
<i>Branchiura sowerbyi</i>	---	---	3
<i>Limnodrilus hoffmeisteri</i>	2	4	---
Hirudinea			
Rhynchobdellida			
Glossiphoniidae	2	14	---
<i>Actinobdella inequiannulata</i>	---	---	---
<i>Actinobdella</i> sp.	8	5	2
<i>Helobdella stagnalis</i>	---	---	---
<i>Helobdella</i> sp.	2	2	2
Arachnoidea			
Acariformes	---	---	2
Malacostraca			
Amphipoda			
Corophiidae			
<i>Apocorophium lacustre</i>	7	---	---
Isopoda			
Asellidae			
<i>Caecidotea</i> sp.	---	2	---
<i>Lirceus</i> sp.	---	2	---
Gammaridae			
<i>Gammarus lacustris</i>	415	208	25
Maxillopoda			
Cyclopoida	---	---	2
Ostracoda	3	3	---
Candoniidae			
<i>Candona</i> sp.	26	---	---
Insecta			
Odonata			
Anisoptera			
Gomphidae			
<i>Stylurus</i> sp.	2	---	---
Diptera			
Chironomidae			

Table 13. Continued.

Taxon	Downstream		Upstream
	TRM 240.4	TRM 244	TRM 246
<i>Ablabesmyia rhamphe</i> gp.	2	8	2
<i>Axarus</i> sp.	---	27	---
<i>Cladotanytarsus</i> sp.	---	3	---
<i>Coelotanypus</i> sp.	160	8	4
<i>Cricotopus bicinctus</i>	10	---	---
<i>Cricotopus reverses</i> gp.	2	---	---
<i>Cricotopus</i> sp.	7	---	---
<i>Cynlochironomus</i> sp.	97	42	43
<i>Dicrotendipes lucifer</i>	4	4	---
<i>Dicrotendipes modestus</i>	14	25	2
<i>Dicrotendipes neomodestus</i>	20	22	---
<i>Dicrotendipes simpsoni</i>	2	2	---
<i>Dicrotendipes</i> sp.	---	---	---
<i>Eukiefferiella devonica</i> gp.	3	---	---
<i>Glyptotendipes</i> sp.	13	17	---
<i>Harnischia</i> sp.	8	---	---
<i>Nanocladius alternantherae</i>	2	6	---
<i>Nanocladius</i> <i>crassicornus/rectinervis</i>	---	2	---
<i>Nanocladius distinctus</i>	---	4	---
<i>Nanocladius</i> sp.	2	2	---
<i>Orthocladius</i> sp.	2	---	---
<i>Polypedilum halterale</i> gp.	7	---	---
<i>Polypedilum scalaenum</i> gp.	13	7	48
<i>Procladius</i> sp.	27	2	---
<i>Rheocricotopus robacki</i>	5	---	---
<i>Rheotanytarsus exiguus</i> gp.	3	4	---
<i>Stelechomyia perpulchra</i>	---	---	2
<i>Stictochironomus cafrarius</i> gp.	8	---	---
Tanypodinae			
<i>Tanytarsus</i> sp.	13	4	---
<i>Thienemanniella xena</i>	5	---	---
<i>Xenochironomus xenolabis</i>	6	2	---
Simuliidae			
<i>Simulium</i> sp.	4	---	4
Ephemeroptera			
Caenidae			
<i>Caenis</i> sp.	8	7	---
Ephemeridae			
<i>Hexagenia limbata</i>	137	21	2
Heptageniidae			
<i>Stenacron interpunctatum</i>	---	3	---
Trichoptera			
Polycentropodidae			
<i>Cynellus fraternus</i>	17	18	---
Leptoceridae			
<i>Oecetis</i> sp.	30	2	---
Mollusca			
Gastropoda	10	2	3
Basommatophora			

Table 13. Continued.

Taxon	Downstream		Upstream
	TRM 240.4	TRM 244	TRM 246
Ancylidae			
<i>Ferrissia rivularis</i>	4	4	---
Mesogastropoda			
Hydrobiidae			
<i>Amnicola limosa</i>	9	---	3
<i>Birgella subglobosa</i>	7	---	---
<i>Somatogyrus</i> sp.	127	2	---
Planorbidae			
<i>Menetus dilatatus</i>	5	11	4
Pleuroceridae			
<i>Pleurocera caniculata</i>	12	3	22
<i>Pleurocera</i> sp.	30	28	---
Viviparidae			
<i>Campeoloma</i> sp.			
<i>Lioplax sulculosa</i>	2	2	---
<i>Viviparus</i> sp.	13	11	---
Bivalvia			
Veneroida			
Corbiculidae			
<i>Corbicula fluminea</i>	725	1078	330
Sphaeriidae			
<i>Eupera cubensis</i>	9	77	67
<i>Musculium transversum</i>	120	103	23
Unionidae	---	3	27
<i>Ellipsaria lineolata</i>	---	4	---
<i>Fusconaia ebena</i>	4	2	---
<i>Obliquaria reflexa</i>	10	9	4
<i>Pleurobema sintoxia</i>	---	2	---
<i>Quadrula pustulosa</i>			
<i>Toxolasma</i> sp.	---	2	---
<i>Truncilla donaciformis</i>	4	9	4
<i>Truncilla truncata</i>	---	---	---
<i>Utterbackia imbecillis</i>	2	8	---

Table 14. Table of overall (all river miles averaged) density (per m²) by species from the 2015-2016 Draft Annual Report. Sampling conducted by the Alabama Department of Conservation and Natural Resources at Sevenmile Island secondary channel, 2008 through 2016. (*Utterbackia imbecillis* numbers not included since most of the individuals do not survive to adulthood).

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016
<i>Amblema plicata</i>	0.13	0.17	0.2	0.3	0.23	0.4	0.37	0.13	0.2
<i>Arcidens confragosus</i>	0	0	0	0	0	0	0.03	0.03	0.07
<i>Cyclonaias tuberculata</i>	2.17	2.1	2.57	2.4	2.73	3.2	2.8	3	3.87
<i>Ellipsaria lineolata</i>	3.43	3.03	2.33	3.03	3.8	3.67	3.87	4.7	4.6
<i>Elliptio crassidens</i>	0.7	0.37	0.63	0.77	0.7	0.6	0.57	0.7	0.57
<i>Lampsilis abrupta*</i>	0	0.03	0	0	0.03	0	0.07	0.03	0
<i>Lampsilis ovata</i>	0.13	0.13	0.07	0.13	0.17	0.2	0.07	0.33	0.07
<i>Leptodea fragilis</i>	1.27	2.1	0.87	2	2.27	0.27	2.13	1.43	0.07
<i>Ligumia recta</i>	0.07	0.07	0.07	0.07	0.17	0.1	0.07	0.03	0
<i>Megalanaia nervosa</i>	0.23	0.13	0.23	0.13	0.2	0.2	0.37	0.23	0.27
<i>Obliquaria reflexa</i>	9.93	9.43	8	8.57	10.7	10.97	11.9	10.93	11.37
<i>Pleurobema cordatum</i>	0.03	0.13	0.07	0.03	0.03	0	0.07	0.1	0.13
<i>Pleurobema plenum*</i>	0	0.03	0.03	0.03	0	0	0.07	0	0
<i>Pleurobema rubrum</i>	0	0.03	0	0	0	0	0	0	0
<i>Potamilus alatus</i>	0.43	0.53	0.27	0.77	0.9	0.37	0.73	0.43	0.5
<i>Ptychobranhus fasciolaris</i>	0	0.03	0	0.07	0	0	0.03	0.1	0.1
<i>Pyganodon grandis</i>	0	0	0.03	0	0	0	0	0	0
<i>Quadrula apiculata</i>	0.07	0.17	0.13	0	0.13	0.2	0.27	0.43	0.6
<i>Quadrula metanevra</i>	0.03	0	0	0	0	0	0	0	0
<i>Quadrula pustulosa</i>	16	15.93	14.13	18.2	19.47	17.87	18.7	18.07	19.67
<i>Quadrula quadrula</i>	1.2	1.77	1.53	1.2	1.6	1.33	2.53	1	2.27
<i>Reginaia ebena</i>	21.37	21.3	13.27	15.17	6.2	7	6.33	7	10.23
<i>Toxolasma lividum</i>	0.63	0.7	0.4	0.77	0.87	0.7	0.33	0.33	0.2
<i>Toxolasma parvum</i>	0.1	0.03	0	0	0.07	0.07	0.03	0	0
<i>Truncilla donaciformis</i>	1.63	4.9	4.27	9.87	12.9	10.83	6.6	5.87	4.07
<i>Truncilla truncata</i>	1.4	1.67	1.93	3.57	6.1	6.87	5.83	7.97	7.33
<i>Utterbackia imbecillis</i>	0.77	3.37	0.87	11.27	49.97	0.07	na	na	na
*Federally protect species									

Table 15. Relative abundance of most common and predominant fish species from TVA study

Common Name	2008				2009				2011			
	TRM 292.5		TRM 295.9		TRM 292.5		TRM 295.9		TRM 292.5		TRM 295.9	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Gizzard Shad	353	19%	308	28%	382	25%	309	27%	679	36%	645	34%
Spotfin Shiner	3	0.2%	2	0.2%	29	2%	5	0.4%	14	0.7%	109	6%
Bluegill	176	9%	80	7%	87	6%	58	5%	123	6%	238	13%
Largemouth Bass	138	7%	97	9%	107	7%	99	9%	110	6%	32	2%
Longear Sunfish	84	4%	23	2%	32	2%	13	1%	27	1%	56	3%
Smallmouth Bass	17	1%	6	1%	56	4%	2	0%	20	1%	29	2%
Threadfin Shad	1	0.1%	4	0.4%	16	1%	14	1%	303	16%	240	13%
Channel Catfish	27	1%	89	8%	66	4%	110	10%	50	3%	55	3%
White Bass	57	3%	28	3%	3	0%	4	0%	18	1%	8	0.4%
Inland Silverside	887	47%	261	24%	639	41%	389	34%	0	0%	0	0%
Mississippi Silverside	0	0%	0	0%	0	0%	0	0%	352	19%	279	15%

Table 16. Fish impinged at an average rate of more than one per day during the 2003 and 2004 study completed near Browns Ferry Nuclear Plant in 2006. The same species of fish are susceptible to impingement at Fleet Hollow CWIS.

Common Name	2003-2004 Number/Day
Threadfin Shad	1,358
Freshwater Drum	471
Gizzard Shad	173
Skipjack herring	107
Channel Catfish	30
Yellow Bass	29
Redear Sunfish	11
Alewife	10
Bluegill	10
Blue Catfish	5
Silver Chub	2
White Bass	2
Striped Bass	2
White Crappie	2
Spotted Sucker	1
Green Sunfish	1
Black Crappie	1

Table 17. Average rate of entrainment found during the 2003 and 2004 study completed near Browns Ferry Nuclear Plant in 2006. The same fish families may be susceptible to entrainment at Fleet Hollow CWIS.

Family Name	2003-2004 % Entrained
Ictaluridae (Catfishes)	30.4
Centrarchidae (Sunfishes)	26.2
Atherinopsidae (Siversides)	24.95
Clupeidae (Shad)	20.6
Catostomidae (Suckers)	15.2
Moronidae (Temperate Basses)	13.9
Percidae (Perches)	11.35
Cyprinidae (Minnows and Carps)	10.5
Sciaenidae (Drums)	5.3
Hiodontidae (Mooneyes)	2

Table 18. Typical spawning periods for fish species found upstream and downstream of Fleet Hollow CWIS in Pickwick Reservoir

Family	Species	Common name	January	February	March	April	May	June	July	August	September	October	November	December
Amidae	<i>Amia calva</i>	Bowfin												
Atherinopsidae	<i>Labidesthes sicculus</i>	Brook Silverside												
Atherinopsidae	<i>Morone chrysops</i>	Mississippi silverside												
Atherinopsidae	<i>Morone beryllina</i>	Inland Silverside												
Catostomidae	<i>Hypentelium nigricans</i>	Northern Hog Sucker												
Catostomidae	<i>Ictalurus bubalus</i>	Smallmouth buffalo												
Catostomidae	<i>Moxostoma valenciennesi</i>	Spotted Sucker												
Catostomidae	<i>Moxostoma valenciennesi</i>	Silver redhorse												
Catostomidae	<i>Moxostoma valenciennesi</i>	Smallmouth redhorse												
Catostomidae	<i>Moxostoma valenciennesi</i>	River redhorse												
Catostomidae	<i>Moxostoma valenciennesi</i>	Black redhorse												
Catostomidae	<i>Moxostoma valenciennesi</i>	Golden Redhorse												
Centrarchidae	<i>Ambloplites rupestris</i>	Rock bass												
Centrarchidae	<i>Hybrid leucurus</i> sp.	Hybrid sunfish												
Centrarchidae	<i>Lepomis auritus</i>	Redbreast sunfish												
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish												
Centrarchidae	<i>Lepomis gibbosus</i>	Warmouth												
Centrarchidae	<i>Lepomis gibbosus</i>	Orangespotted Sunfish												
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill												
Centrarchidae	<i>Lepomis megalotis</i>	Longear sunfish												
Centrarchidae	<i>Lepomis microlophus</i>	Reade's Sunfish												
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass												
Centrarchidae	<i>Micropterus dolomieu</i>	Spotted Bass												
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth bass												
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie												
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black crappie												
Clupeidae	<i>Alosa chrysostomus</i>	Striped Herring												
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard shad												
Clupeidae	<i>Dorosoma petenense</i>	Threadfin Shad												
Cyprinidae	<i>Campestris oligolepis</i>	Largescale Stoneroller												
Cyprinidae	<i>Cyprinella spiloptera</i>	Spottin Shiner												
Cyprinidae	<i>Cyprinus carpio</i>	Common carp												
Cyprinidae	<i>Notropis crassicauda</i>	Golden Shiner												
Cyprinidae	<i>Notropis atherinoides</i>	Emerald Shiner												
Cyprinidae	<i>Notropis texanus</i>	Weed Shiner												
Cyprinidae	<i>Notropis volucellus</i>	Mimic Shiner												
Cyprinidae	<i>Pimephales notatus</i>	Bluntnose minnow												

Table 18. Continued.

Family	Species	Common name	January	February	March	April	May	June	July	August	September	October	November	December
Cyprinidae	<i>Pimephales vigilax</i>	Bullhead Minnow												
Esocidae	<i>Esox niger</i>	Chain Pickerel												
Fundulidae	<i>Fundulus notatus</i>	Blackstripe Topminnow												
Ictaluridae	<i>Amiurus natalis</i>	Yellow Bullhead												
Ictaluridae	<i>Ictalurus fuscus</i>	Blue Catfish												
Ictaluridae	<i>Ictalurus punctatus</i>	Channel catfish												
Ictaluridae	<i>Pseudocritus olivans</i>	Flathead Catfish												
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted gar												
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose Gar												
Moronidae	<i>Morone chrysops</i>	White bass												
Moronidae	<i>Morone chrysops x saxatilis</i> *	Palmetto Bass*												
Moronidae	<i>Morone mississippiensis</i>	Yellow Bass												
Moronidae	<i>Morone saxatilis</i>	Striped Bass												
Percidae	<i>Etheostoma nigranum</i> *	Blackfin Darter*												
Percidae	<i>Perca flavescens</i>	Yellow Perch												
Percidae	<i>Perca caurina</i>	Logperch												
Percidae	<i>Sander canadense</i>	Sauger												
Percidae	<i>Sander vitreus</i>	Walleye												
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater Drum												

*Breeding information was not available.

Sources: Tennessee Valley Authority, 2012; McGregor and O'Neil, 2017; IUCN, 2017 and Etnier and Starnes, 1993.

Table 19. Average seasonal density of fish eggs and larvae in the entrainment samples during 2003 and 2004 at BFN.

	Intake Samples			Reservoir Samples			All Samples
	2003	2004	2003-2004 Combined	2003	2004	2003-2004 Combined	
	# of eggs or larvae/1000m ³ water filtered						
Eggs							
Unspecified	5	T	1	T	T	T	1
Clupeidae	15	56	17	40	4	11	27
Catostomidae	T	T	T	T	T	T	T
Percidae	T	T	T	T	T	T	T
Sciaenidae	76	577	152	376	693	294	447
Totals	96	633	170	416	697	305	475
Larvae							
Lepisosteidae	T	T	T	T	T	T	T
Clupeidae	2,943	8,354	2,671	3,877	9,241	3,656	6,372
Hiodontidae	T	T	T	T	T	T	T
Cyprinidae	8	18	6	11	14	7	13
Catostomidae	43	3	11	34	3	9	19
Ictaluridae	4	6	2	1	1	1	3
Poeciliidae	T	T	T	T	T	T	T
Moronidae	56	90	35	275	72	87	122
Centrarchidae	24	157	42	20	55	21	64
Percidae	8	3	3	6	3	2	5
Sciaenidae	104	8	25	170	19	47	72
Atherinopsidae	16	160	41	6	90	28	69
Totals	3,205	8,800	2,836	4,399	9,497	3,857	6,693

Table 20. Season abundance and spawning of fish in the general vicinity of Fleet Hollow CWIS.

Family	Species	Common name	Seasonal Occurrence			Abundance
			Spring	Summer	Fall/Winter	
Amiidae	<i>Amia calva</i>	Bowfin	X	X		Rare
Atherinopsidae	<i>Labidesthes sicculus</i>	Brook Silverside		X		Common
Atherinopsidae	<i>Menidia audens</i>	Mississippi silverside	X			Uncommon
Atherinopsidae	<i>Menidia beryllina</i>	Inland Silverside	X	X		Common
Catostomidae	<i>Hypentelium nigricans</i>	Northern Hog Sucker	X			Rare
Catostomidae	<i>Ichtiobus bubalus</i>	Smallmouth Buffalo	X			Rare
Catostomidae	<i>Minytrema melanops</i>	Spotted Sucker	X		X	Uncommon
Catostomidae	<i>Moxostoma anisurum</i>	Silver redbhorse	X			Rare
Catostomidae	<i>Moxostoma breviceps</i>	Smallmouth redbhorse				Rare
Catostomidae	<i>Moxostoma carinatum</i>	River redbhorse	X			Rare
Catostomidae	<i>Moxostoma duquesnei</i>	black Redhorse	X			Rare
Catostomidae	<i>Moxostoma erythrurum</i>	Golden Redhorse	X	X		Rare
Centrarchidae	<i>Ambloplites rupestris</i>	Rock Bass	X	X		Rare
Centrarchidae	<i>Lepomis auritus</i>	Redbreast Sunfish		X		Uncommon
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish	X	X		Uncommon
Centrarchidae	<i>Lepomis gulosus</i>	Warmouth	X	X		Rare
Centrarchidae	<i>Lepomis humilis</i>	Orangespotted Sunfish	X	X		Rare
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	X	X		Abundant
Centrarchidae	<i>Lepomis megalotis</i>	Longear Sunfish		X		Common
Centrarchidae	<i>Lepomis microlophus</i>	Redear Sunfish	X	X		Common
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	X			Uncommon
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	X			Uncommon
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	X	X		Abundant
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie	X	X		Rare

Table 20. Continued.

Family	Species	Common name	Seasonal Occurrence			Abundance
			Spring	Summer	Fall/Winter	
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black Crappie	X	X		Rare
Centrarchidae		Hybrid Centrarchid	X	X		Rare
Clupeidae	<i>Alosa chrysochloris</i>	Skipjack herring	X	X		Rare
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	X	X		Abundant
Clupeidae	<i>Dorosoma petenense</i>	Threadfin Shad	X	X		Common
Cyprinidae	<i>Campostoma oligolepis</i>	Largescale Stoneroller				Uncommon
Cyprinidae	<i>Cyprinella spiloptera</i>	Spotfin Shiner		X		Common
Cyprinidae	<i>Cyprinus carpio</i>	Carp	X	X		Rare
Cyprinidae	<i>Notemigonus crysoleucas</i>	Golden Shiner	X	X		Uncommon
Cyprinidae	<i>Notropis atherinoides</i>	Emerald Shiner	X	X		Uncommon
Cyprinidae	<i>Notropis texanus</i>	Weed Shiner	X	X		Uncommon
Cyprinidae	<i>Notropis volucellus</i>	Mimic Shiner	X	X	X	Uncommon
Cyprinidae	<i>Pimephales notatus</i>	Bluntnose minnow	X	X	X	Rare
Cyprinidae	<i>Pimephales vigilax</i>	Bullhead Minnow	X	X		
Esocidae	<i>Esox niger</i>	Chain Pickerel	X	X		Rare
Fundulidae	<i>Fundulus notatus</i>	Blackstripe Topminnow	X	X		Rare
Ictaluridae	<i>Ameiurus natalis</i>	Yellow Bullhead	X	X		Rare
Ictaluridae	<i>Ictalurus furcatus</i>	Blue Catfish	X	X		Rare
Ictaluridae	<i>Ictalurus punctatus</i>	Channel Catfish	X	X		Uncommon
Ictaluridae	<i>Pylodictis olivans</i>	Fathead Catfish		X		Rare
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted Gar	X			Common
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose Gar	X	X		Rare
Moronidae	<i>Morone chrysops</i>	White Bass	X			Rare
Moronidae	<i>Morone chrysops</i> x <i>saxatilis</i>	Palmetto Bass				Rare
Moronidae	<i>Morone mississippiensis</i>	Yellow Bass	X			Rare
Percidae	<i>Etheostoma nigripinne</i>	Blackfin Darter				Rare

Table 20. Continued.

Family	Species	Common name	Seasonal Occurrence			Abundance
			Spring	Summer	Fall/Winter	
Percidae	<i>Perca flavescens</i>	Yellow Perch	X			Rare
Percidae	<i>Percina caprodes</i>	Logperch	X	X		Uncommon
Percidae	<i>Sander canadense</i>	Sauger	X			Rare
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater Drum	X	X		Rare

*Breeding information was not available.

Sources: Tennessee Valley Authority, 2012, McGregor and O'Neil, 2017, IUCN, 2017 and Etnier and Starnes, 1993

Table 21. U.S. Fish and Wildlife Service (USFWS) Threatened and Endangered Species list for Colbert County, AL. List includes only freshwater species.

Group	Common Name	Scientific Name	Status
Clams	Cumberland bean (pearlymussel)	<i>Villosa trabalis</i>	Experimental Population, Non-Essential
Clams	Tubercled blossom (pearlymussel)	<i>Epioblasma toruloso torulosa</i>	Experimental Population, Non-Essential
Clams	Turgid blossom (pearlymussel)	<i>Epioblasma turgidula</i>	Experimental Population, Non-Essential
Clams	Yellow blossom (pearlymussel)	<i>Epioblasma florentina florentin</i>	Experimental Population, Non-Essential
Clams	Alabama lampmussel	<i>Lampsilis virescens</i>	Experimental Population, Non-Essential
Clams	Winged Mapleleaf	<i>Quadrula fragosa</i>	Experimental Population, Non-Essential
Clams	Cumberland monkeyface (pearlymussel)	<i>Quadrula intermedia</i>	Endangered
Clams	Cumberland monkeyface (pearlymussel)	<i>Quadrula intermedia</i>	Experimental Population, Non-Essential
Clams	Pink mucket (pearlymussel)	<i>Lampsilis abrupta</i>	Endangered
Clams	Birdwing pearlymussel	<i>Lemiox rimosus</i>	Experimental Population, Non-Essential
Clams	Dromedary pearlymussel	<i>Dromus dramos</i>	Endangered
Clams	White wartyback (pearlymussel)	<i>Plethobasus cicatricosus</i>	Endangered
Clams	Rough pigtoe	<i>Pleurobema plenum</i>	Endangered
Clams	Shiny pigtoe	<i>Fusconaia cor</i>	Experimental Population, Non-Essential
Clams	Orangefoot pimpleback (pearlymussel)	<i>Plethobasus cooperianus</i>	Endangered
Clams	Ring pink (mussel)	<i>Obovaria retusa</i>	Endangered
Clams	Spectaclecase (mussel)	<i>Cumberlandia monodonta</i>	Endangered
Clams	Clubshell	<i>Pleurobema clava</i>	Experimental Population, Non-Essential
Clams	Oyster mussel	<i>Epioblasma capsaeformis</i>	Endangered
Clams	Oyster mussel	<i>Epioblasma capsaeformis</i>	Experimental Population, Non-Essential
Clams	Slabside Pearlymussel	<i>Pleuranoia dolobelloides</i>	Endangered
Clams	Fanshell	<i>Cyprogenia stegaria</i>	Endangered
Clams	Snuffbox mussel	<i>Epioblasma triquetra</i>	Endangered
Clams	Rabbitsfoot	<i>Quadrula cylindrica cylindrica</i>	Threatened
Clams	Sheepnose Mussel	<i>Plethobasus cyphus</i>	Endangered
Fishes	Snail darter	<i>Percina tanosi</i>	Threatened
Fishes	Alabama cavefish	<i>Speoplatyrhinus poulsoni</i>	Endangered
Fishes	Spotfin Chub	<i>Erimonax monachus</i>	Threatened
Snails	Anthony's riversnail	<i>Athearnia anthonyi</i>	Experimental Population, Non-Essential

<https://ecos.fws.gov/ecp0/reports/species-by-current-range-county?fips=01033>
 Accessed 12/22/2108.

Table 22. Total volume of water filtered by sample period during 2003-2004 to estimate entrainment of fish eggs and larvae.

Sample Date	Volume			Sample Date	Volume		
	Intake m ³ day	Reservoir m ³ day	Total m ³ day		Intake m ³ day	Reservoir m ³ day	Total m ³ day
2003				2004			
28-Mar	598	456	1054	25-Mar	1334	1336	2670
3-Apr	1170	1280	2450	1-Apr	1392	1353	2745
10-Apr	1204	1287	2491	7-Apr	1259	1381	2640
17-Apr	1209	1317	2526	15-Apr	1282	1324	2606
24-Apr				22-Apr	555	540	1095
1-May	1185	1291	2476	29-Apr	1222	1275	2497
8-May	1219	1212	2431	6-May	1106	1404	2510
15-May	1262	1294	2556	13-May	974	1266	2240
22-May	1141	1273	2414	20-May	112	1436	1548
29-May	1181	1287	2468	27-May	1074	1261	2335
5-Jun	1205	1284	2489	3-Jun	917	1356	2273
12-Jun	1160	1252	2412	10-Jun	995	1351	2346
19-Jun	1259	1231	2490	17-Jun	1108	1329	2437
26-Jun	933	1310	2243	24-Jun	937	1270	2207
3-Jul	1188	1273	2461	1-Jul	1042	1276	2318
				7-Jul	1048	1282	2330
Total	15914	17047	32961	Total	15309	19158	34467
Average	1137	1218	2354	Average	1021	1277	2298

Table 23. List of fish eggs by Family collected in 2003 and 2004 entrainment samples and lowest level of taxonomic resolution for each Family.

Scientific Name	Common Name	Lowest Level of Taxonomic Identificaiton
	Unspecified	Identificaiton to family was not possible. Limiting Factors were size, stage of development, and season when egg was collected
Clupeidae	Shad	Family
Catostomidae	Sucker	Family
Percidae	Perches	Family
Sciaenidae	Drums	Species, Freshwater Drum

Table 24. List of fish by Family collected in 2003 and 2004 entrainment samples and lowest level of taxonomic resolution for each Family.

Scientific Name	Common Name	Lowest Level of Taxonomic Identificaiton
Lepisosteidae Clupeidae	Gars Shad	Species-Spotted Gar Family-All Larvae <20 mm TL Genus or Species - Larger individuals to Alosa spp.- alewife, skipjack, Dorosoma Spp. Gizzard and Threadfin Shad
Hiodontidae Cyprinidae	Mooneyes Minnows and Carps	Species-Mooneye Family-Most Minnows, shiners, clubs, dace. Genus or Species - common carp, golden shiner, and larger individuals to emerald shiner, mimic shiner, Pimephales spp.
Catostomidae	Sucker	Subfamily-ictiobines (buffalo carpsuckers, and redhorse) Genus-Larger individual to buffalo Species - Spotted Sucker
Ictaluridae	Catfishes	Species-Blue, Channel, and Flathead Catfish
Poeciliidae	Livebearers	Species-Western Mosquitofish
Moronidae	Temperate Basses	Genus- Most Larva life phases Species- yolk-sack larvae $\geq$ 5mm TL (Striped bass), larger indivuals to white, yellow and striped bass
Centrarchidae	Sunfishes	Genus-Crappie, Lepomids (sunfishes), and black bass. Species- Larger individuals to largemouth and smallmouth bass.
Percidae	Perches	Family-darters (Percina or Etheostoma), no yellow perch or sauger were collected. Genus or Species - Larger individuals to logperch and Percina sp.
Sciaenidae	Drum	Species-Freshwater drum
Atherinopsidae	Silversides	Family-Most Larvae (either brook or inland silverside) Species - Larger individuals to inland silverside

Table 25. Percent composition of fish eggs and larvae by Family in entrainment samples during 2003 and 2004.

	Intake Samples			Reservoir Samples			All Samples
	2003	2004	Combined 2003-2004	2003	2004	Combined 2003-2004	
	%	%	%	%	%	%	
Eggs							
Unspecified	4.7	T	0.6	0.1	T	T	0.2
Clupeidae	16.5	8.2	9.3	9.5	0.3	3.4	5.5
Catostomidae	T	T	T	T	T	T	T
Percidae	T	T	T	T	T	T	T
Sciaenidae	78.7	91.8	90.1	90.3	99.7	96.5	94.3
Larvae							
Lepisosteidae	T	T	T	T	T	T	T
Clupeidae	91.8	95	94.2	88.1	97.3	94.7	94.5
Hiodontidae	T	T	T	T	T	T	T
Cyprinidae	0.2	0.2	0.2	0.3	0.1	0.2	0.2
Catostomidae	1.3	T	0.4	0.8	T	0.2	0.3
Ictaluridae	0.1	0.1	0.1	T	T	T	T
Poeciliidae	T	T	T	T	T	T	T
Moronidae	1.8	1	1.2	6.3	0.7	2.3	1.8
Centrarchidae	0.8	1.7	1.5	0.5	0.6	0.6	1
Percidae	0.2	T	0.1	0.1	T	0.1	0.1
Sciaenidae	3.2	0.1	0.9	3.8	0.2	1.2	1.1
Atherinopsidae	0.5	1.8	1.5	0.1	1	0.7	1

T - Taxon was collected in samples but composition was less than 0.1%

Table 26. Average seasonal density of fish eggs and larvae in entrainment samples during 2003 and 2004.

	Intake Samples			Reservoir Samples			All Samples
	2003	2004	Combined 2003-2004	2003	2004	Combined 2003-2004	
	1000 m ³	1000 m ³	1000 m ³	1000 m ³	1000 m ³	1000 m ³	
Eggs							
Unspecified	5	T	1	T	T	T	1
Clupeidae	15	56	17	40	4	11	27
Catostomidae	T	T	T	T	T	T	T
Percidae	T	T	T	T	T	T	T
Sciaenidae	76	577	152	376	693	294	447
Totals	96	633	170	416	697	305	475
Larvae							
Lepisosteidae	T	T	T	T	T	T	T
Clupeidae	2943	8354	2671	3877	9241	3656	6327
Hiodontidae	T	T	T	T	T	T	T
Cyprinidae	8	18	6	11	14	7	13
Catostomidae	43	3	11	34	3	9	19
Ictaluridae	4	6	2	1	1	1	3
Poeciliidae	T	T	T	T	T	T	T
Moronidae	56	90	35	275	72	87	122
Centrarchidae	24	157	42	20	55	21	64
Percidae	8	3	3	6	3	2	5
Sciaenidae	104	8	25	170	19	47	72
Atherinopsidae	16	160	41	6	90	28	69
Totals	3205	8800	2836	4399	9497	3857	6693

T - Taxon was collected in samples but density averaged less than 1 individual per 1000 m³

Table 27. Estimated daily hydraulic entrainment at BFN by sample period during 2003 and 2004.

Volume				Volume			
Sample Date	Intake m ³ day	Reservoir m ³ day	Entrained %	Sample Date	Intake m ³ day	Reservoir m ³ day	Entrained %
2003				2004			
28-Mar	8.00E+06	5.30E+07	15.1%	25-Mar	4.00E+06	5.30E+07	7.5%
3-Apr	8.00E+06	2.90E+07	27.6%	1-Apr	6.90E+06	6.90E+07	10.0%
10-Apr	8.00E+06	8.40E+07	9.5%	7-Apr	8.00E+06	1.90E+07	42.0%
17-Apr	8.00E+06	1.30E+08	6.3%	15-Apr	8.00E+06	3.00E+07	27.0%
24-Apr	8.00E+06	1.20E+08	6.7%	22-Apr	8.00E+06	4.30E+07	18.6%
1-May	8.00E+06	1.00E+08	7.6%	29-Apr	8.00E+06	4.10E+07	19.5%
8-May	7.90E+06	1.90E+08	4.1%	6-May	7.90E+06	4.40E+07	17.9%
15-May	8.00E+06	2.00E+08	4.0%	13-May	8.00E+06	3.50E+07	22.9%
22-May	8.00E+06	2.00E+08	4.1%	20-May	8.00E+06	3.90E+07	20.6%
29-May	8.00E+06	1.10E+08	7.1%	27-May	8.00E+06	3.00E+07	26.6%
5-Jun	8.00E+06	1.20E+08	6.8%	3-Jun	7.90E+06	7.20E+07	33.0%
12-Jun	8.00E+06	1.10E+08	7.4%	10-Jun	8.00E+06	5.30E+07	15.1%
19-Jun	8.00E+06	1.30E+08	6.1%	17-Jun	8.00E+06	7.00E+07	11.4%
26-Jun	5.40E+06	1.30E+08	4.2%	24-Jun	8.00E+06	1.10E+08	7.2%
3-Jul	8.00E+06	1.80E+08	4.4%	1-Jul	8.00E+06	1.40E+08	5.9%
				7-Jul	8.00E+06	1.20E+08	6.7%
Average	7.82E+06	1.26E+08	6.2%	Average	7.67E+06	6.05E+07	12.7%

Table 28. Seasonal entrainment estimates for numerically significant fish taxa collected during 2003 and 2004.

	2003			2004			2003-2004		
	Intake Number Entrained Per Day	Reservoir Total Number Per Day	Entrainment Estimate %	Intake Number Entrained Per Day	Reservoir Total Number Per Day	Entrainment Estimate %	Intake Number Entrained Per Day	Reservoir Total Number Per Day	Entrainment Estimate %
Eggs									
Clupeidae	1.20E+08	6.20E+09	2.0%	4.50E+08	2.20E+08	225.7%	3.00E+08	3.00E+09	9.9%
Sciaenidae	5.80E+08	4.90E+10	1.2%	4.60E+09	2.70E+10	17.3%	2.70E+09	3.70E+10	7.3%
Total Eggs	7.40E+08	5.50E+10	1.3%	5.00E+09	2.70E+10	18.8%	3.00E+09	4.00E+10	7.6%
Larvae									
Clupeidae	2.30E+10	5.00E+11	4.6%	6.70E+10	3.60E+11	18.3%	4.60E+10	4.30E+11	10.8%
Hiodontidae	4.50E+05	2.20E+07	2.0%	*	*	*	2.10E+05	1.00E+07	2.0%
Cyprinidae	5.90E+07	1.50E+09	3.9%	1.50E+08	8.50E+08	17.1%	1.10E+08	1.20E+09	9.0%
Catostomidae	3.40E+08	2.70E+09	13.0%	2.30E+07	1.30E+08	17.4%	1.70E+08	1.30E+09	13.2%
Ictaluridae	2.80E+07	1.20E+08	23.4%	4.80E+07	1.30E+08	37.1%	3.90E+07	1.30E+08	31.0%
Moronidae	4.40E+08	1.50E+10	3.0%	7.20E+08	2.90E+09	24.8%	5.90E+08	8.40E+09	7.0%
Centrarchidae	1.90E+08	2.90E+09	6.6%	1.20E+09	2.40E+09	51.8%	7.40E+08	3.30E+08	28.5%
Percidae	6.10E+07	5.50E+08	10.9%	1.60E+07	1.40E+08	11.8%	3.70E+07	3.30E+08	11.1%
Sciaenidae	7.70E+08	2.40E+10	3.2%	6.30E+07	8.50E+08	7.4%	3.90E+08	1.20E+10	3.3%
Atherinopsidae	1.30E+08	8.20E+08	15.4%	1.30E+09	3.70E+09	34.5%	7.40E+08	2.30E+09	31.4%
Total Larvae	2.50E+10	5.40E+11	4.5%	7.00E+10	3.80E+11	18.7%	4.90E+10	4.50E+11	10.8%

* Not Collected

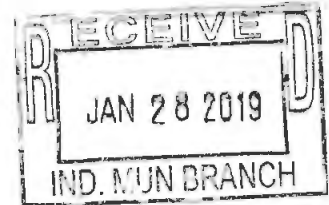
Table 29. Historical and current entrainment estimates at BFN.

Year	Hydraulic Rate %	Eggs			Larvae		
		Reservoir	Intake	Rate	Reservoir	Intake	Rate
		Mean	Mean		Mean	Mean	
		Daily Number	Daily Number		Daily Number	Daily Number	
Historical Baseline							
1977	12.0%	6.40E+09	1.50E+08	2.3%	3.20E+10	3.70E+09	11.7%
1978	13.3%	1.30E+09	5.00E+07	3.7%	5.40E+10	2.90E+09	5.3%
1979	9.0%	2.30E+09	1.90E+08	8.2%	3.00E+10	1.30E+09	4.5%
Currently Evaluation							
2003	6.2%	5.50E+10	7.40E+08	1.3%	5.40E+11	2.50E+10	4.5%
2004	12.7%	2.70E+10	5.00E+09	18.8%	3.80E+11	7.00E+10	18.7%
2003-2004							
Totals	8.4%	4.00E+10	3.00E+09	7.6%	4.50E+11	4.90E+10	10.8%



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316(b) Supporting Information: Cooling Water Intake Documentation for PDW Intake on Pickwick Reservoir

Prepared for

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Project Number TR18-104

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1.0 Introduction

The Armand Products Facility operated by Occidental Chemical Corporation (OxyChem or the Facility) uses a cooling water intake structure (CWIS), owned by the Tennessee Valley Authority (TVA), at its facility in Muscle Shoals, Alabama. As a part of the National Pollutant Discharge Elimination System (NPDES) AL0000213 renewal application, the Facility has prepared this 316(b) supplemental information to determine compliance with the provisions set forth in the Clean Water Act (CWA), as amended in 33 US C1251 Section 316(b) regulations – *Final Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities* (316 (b) or the Rule) that became effective on October 14, 2014.

AST Environmental (AST) on behalf of OxyChem is providing a detailed compilation of the currently available data and other resources related to OxyChem's cooling water intake from the Tennessee River to satisfy the applicable CWA 316(b) requirements as requested by ADEM. The purpose of this document is to provide ADEM with the comprehensive application submittal required of OxyChem to renew its NPDES permit and comply with the 316(b) Rule.

1.1 Section 316(b) Regulatory Overview

The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also set water quality standards for all contaminants in surface waters. EPA has given primacy to ADEM to issue NPDES permits that regulate industries that discharge pollutants to surface waters in Alabama.

According to the Federal Register, the purpose of 316(b) regulations is to reduce impingement and entrainment of fish and other aquatic organisms at cooling water intake structures used by certain existing power generation and manufacturing facilities for the withdrawal of cooling water from waters of the United States. This rule establishes requirements under section 316(b) of the Clean Water Act (CWA) for existing power generating facilities and existing manufacturing and industrial facilities that are designed to withdraw more than 2 million gallons per day (MGD) of water from waters of the United States and use at least 25 percent of the water they withdraw exclusively for cooling purposes. This regulation went into effect in October 14, 2014.

1.2 Facility Information

The Armand Products Facility is a joint venture of Chruch and Dwight Company and the Occidental Chemical Corporation. The Facility located at 1000 North Wilson Dam Road in Colbert County, Muscle Shoals, Alabama (Figures 1 and 2) and is operated by Occidental

Chemical Corporation. OxyChem is a manufacturer of potassium carbonate and potassium bicarbonate at a separate facility on the site of Occidental Petroleum Corporation's old chlor-alkali plant closed in April of 2008.

The Facility receives intake water from the Phosphate Development Works (PDW) CWIS that is owned by TVA and operated by OxyChem. The PDW intake structure withdraws water from Pickwick Reservoir, an impoundment along the Tennessee River located between Wilson Reservoir upstream and Kentucky Reservoir downstream. The water is pumped to the facility from Pickwick Reservoir by one of the three (3) river intake pumps located at the TVA PDW CWIS. Briefly, the PDW CWIS has the following intake characteristics:

- intake pumps have a maximum design pump rate of 38.9 MGD
- through-screen design intake velocity is less than 0.5 ft/sec
- intake is a very small percentage (<1%) of the 7Q10 flow of the Tennessee River

The Facility estimates that less than 8.1 MGD is used from the PDW CWIS with 2.88 MGD (35.5% of intake) used for cooling water. Therefore, since OxyChem has an actual intake flow rate greater than 2 MGD, and at least 25 percent of the actual water withdrawn is used exclusively for cooling purposes, this narrative has been developed to meet the requirements for impingement mortality under 40 CFR 125.94(c) and entrainment under 40 CFR 125.94(d). In accordance with the request of the ADEM and 40 CFR Part 122.21 (r)(1)(ii), this report will focus on the applicable provisions of 40 CFR Part 122.21 (r)(2) through (r)(8).

Based on the location of the PDW CWIS in Pickwick Reservoir of the Tennessee River and this being the point at which water is first drawn from waters of the U.S., it is the Facility's position that the point of compliance for 316(b) at the OxyChem facility will be the PDW CWIS. Therefore, the focus of information for (r)(2) and (4) in this narrative will be on the Tennessee River which is considered the source water for OxyChem.

2.0 Source Water Physical Data (40 CFR 122.21(r)(2))

OxyChem uses three river intake pumps within the PDW CWIS which is owned by TVA and operated by the Facility. The PDW intake pump components are located on the south bank of the Tennessee River (Pickwick Reservoir) near river mile 258.2, 1.3 miles downstream from the Wilson Lock and Dam and approximately 51.5 river miles upstream of the Pickwick Lock and Dam, both maintained and operated by the US Army Corps of Engineers (USACE) Mobile, AL District. The topographic map and aerial photo for the section of river containing the PDW CWIS is provided in Figures 3 and 4.

Pickwick Reservoir receives approximately 33,286 MGD average annual discharge from Wilson Dam farther upstream. The average annual discharge from Pickwick Dam is 35,483 MGD. The reservoir is 52.7 miles long with 490.6 miles of shoreline. Morphometric and physical characteristics of Pickwick Reservoir are in Table 1. At Pickwick Lock and Dam the normal summer pool level of Pickwick Reservoir is 414' MSL with a maximum depth in the navigation channel near 35 feet. Base pool level is 401.1' MSL. The mean waterline at the PDW CWIS is 415' MSL. By interpolation, the normal summer pool level at the PDW CWIS is 414' MSL and base pool level is 410' MSL. Based on computer simulations and more than 100 years of rain and runoff data, the 80-percent probability band (the expected operating range of Pickwick Reservoir's likelihood of falling within this range of elevation on average in 8 out of every 10 years on any given day) indicates a minimum winter pool level of approximately 409' MSL. The 80% probability band minimum water level at Pickwick Dam of 409' MSL by interpolation corresponds to a minimum water level of approximately 414' MSL at the PDW CWIS. The PDW CWIS withdraws less than 0.5% of the average annual flow of the Tennessee River. The monthly mean discharge of the Tennessee River at Florence, AL from 1936-2005 and annual mean flows from 1937- 2003 are contained in Figure 5 and Figure 6, respectively, and are from a USGS gauging station located at RM 256.5 or 1.7 miles downstream of the PDW CWIS. Pickwick Reservoir morphometric, physical, and chemical characteristics are detailed in Table 1 adapted from Ekema et al (2009).

The monthly mean temperature regime for the Tennessee River at Florence, AL at RM 256.5 is depicted in Figure 7. The temperature readings from 1965 to 2005 ranged from a low of 7°C to a high of 29°C at RM 256.5. Temperature (°C) and dissolved oxygen (mg/L) profiles just upstream above Wilson Dam in the forebay area of Wilson Reservoir on August 23, 2017 are found in Figure 8 (Ekema et al 2017).

Salinity is a measure of the amount of dissolved salts in the water body. Conductivity and salinity are related because dissolved ions measured in conductivity increase with an increase in salinity. Conductivity at 256.5 between 1965 and 2005 ranged from a low of 134 to a high of 260 microsiemens per cm at 25°C at RM 256.5

(https://nwis.waterdata.usgs.gov/nwis/qwdata?parameter_cd=00095&site_no=03589500&agency_cd=USGS&format=serial_rdb).

3.0 Cooling Water Intake Structure Data (CFR 122.2 (r)(3))

The CWIS data is required to characterize the configuration and operation of the CWIS. The current configuration and general site arrangement for OxyChem consists of a CWIS located on Pickwick Reservoir at PDW of the Tennessee River at RM 258.2 (34.7914, -87.6404). The CWIS consists of a nearshore and an onshore component providing cooling water to the Facility and has been in operation since 1952.

Data on the TVA PDW CWIS is in Table 2. Nearshore, cooling water enters through a single intake structure on the south shore of a point extending into the Tennessee River. The intake center line elevation is approximately 398 feet MSL. The intake is located approximately 7.5 feet below the normal pool level of 414 MSL (see Table 2 and Figure 11) and 15 feet above the bottom. The intake faces west northwest, and angles just downstream of perpendicular to the main flow of the river. The intake is fitted with a trash rack (2.5" bar screens) for the submerged intake (Table 2).

The three intake pumps have design capacities of 10.0, 12.9, and 12.9 MGD, respectively (Table 2). However, the maximum total design intake volume for PDW CWIS is 38.9 MGD. Maximum intake volume is 25.9 MGD. Typical average flows for the intake water is approximately 8.1 MGD. The intake water flows via pipe approximately 1.4 mile SE to the Facility. The Facility operates continuously; therefore, the intake water pump(s) operate continuously, alternating with the TVA Fleet Hollow CWIS. Only one of the CWISs is in operation at any given time. The PDW CWIS is generally used only for a short period during the summer months if the water temperature at the Fleet Hollow CWIS is too high.

Onshore, the three water intake pumps are situated on a concrete pad located at the river's edge. Any of the three pumps can be utilized for makeup water to the Facility with current normal operations consisting of only 1-2 pumps running at a time. The shoreline intake structure consists of 1.5" bar screens on the pumps and three 100% capacity rotating screens. Each screen is a self-cleaning via backwash water supply. There are three screens, one for each pump. Total screen intake flow-through area is 123 ft². The intake structure is made of concrete and consists of a single opening where river water enters the structure in a direction opposite to the screen entrance. After passing through the 2.5" bar screen trash rack, water flows through a 7 feet wide opening to the screen entrance.

The rotating screens are 3/8 inch mesh with a design intake flow velocity is 0.23 cfs. The mesh assembly rotates about a head shaft driven by water pressure. Debris collected on the screens is washed off by water jets and transferred by a trough to a trash sluice pipe and is removed for disposal.

Pumps are set on the operating floor at elevation 438' MSL. Current TVA data indicate the winter pool elevation is typically maintained at approximately 409' MSL and the summer pool elevation is typically maintained at approximately 414' MSL (normal pool level). Bottom of the PDW channel in the CWIS vicinity is approximately 14' deep at normal pool level.

OxyChem uses 8.1 MGD from PDW CWIS of which approximately 2.88 MGD is used for cooling water (35.5% of intake). The water balance and distribution system diagram is in Figure 10. The Engineering Drawings for the CWIS can be seen in Figure 11.

4.0 Source Water Baseline Biological Characterization (40 CFR 122.21(r)(4))

The source water baseline biological characterization data is required to characterize the biological community and evaluate how that community may potentially be affected by the CWIS. The following provides the Source Water Baseline Biological Characterization Data for OxyChem's PDW CWIS.

4.1 Data Available and Methodology (r)(4)(i)

Baseline biological data for the source water in Tennessee River or Wilson Reservoir near OxyChem's PDW CWIS is limited. No studies have been conducted in the immediate vicinity of the PDW CWIS that characterizes the fish or benthic communities, including the adult, juvenile, young-of-the-year, or larval fish communities. However, a number of studies were identified elsewhere in Tennessee River (Wheeler and Pickwick Reservoirs) immediately upstream and downstream of the PDW CWIS providing data sufficient for characterizing the biological community near the OxyChem's PDW CWIS. The source of these data included technical reports and studies conducted by Alabama Department of Conservation and Natural Resources (ADCNR), US Fish and Wildlife Services (USFWS), Alabama Department of Environmental Management (ADEM) and local universities. Collectively, these studies provide a list of species found in the Tennessee River, an overview for the types of habitats in which biota may occur, and in some cases provide a basis for evaluating relative abundances. Given the overall similarity of biotic communities among Tennessee River reservoirs, all of these data sources support the baseline characterization for the PDW CWIS.

There was limited publicly available data describing the fish community within the Tennessee River in Colbert County, Alabama at PDW. Most of the available information was conducted in Wheeler Reservoir upstream at the TVA Browns Ferry Nuclear Facility (BFN) and in the Pickwick Reservoir downstream at TVA Colbert Fossil Plant (COF). TVA conducted fish sampling annually from 2000-2009 and 2011 at locations upstream and downstream of BFN. TVA sampling methods included boat electrofishing and gill netting. Electrofishing method consisted of fifteen electrofishing boat runs near the shoreline, each 300 meters long with a duration of approximately 10 minutes each. The total near shore area sampled is approximately 4,500 meters. TVA conducted electrofishing samples upstream and downstream of the COF as well. ADCNR conducted limited studies on Wilson Reservoir in 2013 and 2017, but only included largemouth bass in these studies. Given the overall similarities of Wheeler Reservoir and downstream areas of Pickwick Reservoir to the PDW site and the fact that Wheeler and Pickwick Reservoirs studies were located upstream and downstream of the PDW CWIS, the data contained in these studies should be directly applicable to Pickwick Reservoir in the vicinity of PDW. The results of these studies are provided in Tables 3 through 15 and represent a species list and abundance from the compiled studies.

For the BFN studies, experimental gill nets were used as an additional gear type to collect fish from deeper habitats not effectively sampled by electrofishing. Each experimental gill net consists of five 6.1 meter panels for a total length of 30.5 meters. The distinguishing characteristics of experimental gill nets is mesh size that varies between panels. For this application, each net has panels with mesh sizes of 2.5, 5.1, 7.6, 10.2, and 12.7 cm. Experimental gill nets are typically set perpendicular to river flow extending from near-shore to the main channel of the reservoir. Ten overnight experimental gill net sets were used at each area. Gill nets were not employed in the COF survey.

Fish collected were identified by species, counted, and examined for anomalies (such as disease, deformations, or hybridization). TVA utilizes the Reservoir Fish Assemblage Index (RFAI) in order to analyze the collected data.

The RFAI uses 12 fish community metrics from four general categories: Species Richness and Composition; Trophic Composition; Abundance; and Fish Health. Individual Species can be utilized for more than one metric. Together, these 12 metrics provide a balanced evaluation of fish community integrity. The individual metrics are shown below, grouped by category:

Species Richness and Composition

1. Total Number of Indigenous Species-Greater numbers of indigenous species are considered representative of healthier aquatic ecosystems. As conditions degrade, numbers of species at an area decline.
2. Number of Centrarchid Species-Sunfish species (excluding Black Basses) - These are insectivores and a high diversity of this group is indicative of reduced siltation and suitable sediment quality in littoral areas.
3. Number of Benthic Invertivore Species-Due to the special dietary requirement of this species group and the limitation of their food source in degraded environments, numbers of benthic invertivore species increase with better environmental quality.
4. Number of Intolerant Species-This group is made up of species that are particularly intolerant of physical, chemical, and thermal habitat degradation. Higher numbers of intolerant species suggest the presence of fewer environmental stressors.
5. Percentage of Tolerant Individuals-This metric signifies poorer water quality with increasing proportions of individuals tolerant of degraded conditions.
6. Percent Dominance by one Species-Ecological quality is considered reduced if one species inordinately dominates the resident fish community.
7. Percentage of Non-indigenous species-Based on the assumption that non-indigenous species reduce the quality of resident fish communities.
8. Number of Top Carnivore Species-Higher diversity of piscivores is indicative of the availability of diverse and plentiful forage species and the presence of suitable habitat.

Trophic Composition

9. Percentage of Individuals as Top Carnivores-A measure of the functional aspect of top carnivores which feed on major planktivore populations
10. Percentage of Individuals as Omnivores-Omnivores are less sensitive to environmental stresses due to their ability to vary their diets. As trophic links are disrupted due to degraded conditions, specialist species such as insectivores decline while opportunistic omnivorous species increase in relative abundance.

Fish Abundance and Health

11. Average Number per Run-This metric is based upon the assumption that high quality fish assemblages support large numbers of individuals.
12. Percentage of Individuals with Anomalies-Incidence of diseases, lesions, tumors, external parasites, deformities, blindness, and natural hybridization are noted for all fish measured, with higher incidence indicating less favorable environmental conditions.

RFAI methodology addresses all four attributes or characteristics of a “balanced indigenous population” (BIP) defined by the CWA, as described below:

- (1) A biotic community characterized by diversity appropriate to the ecoregion: Diversity is addressed by the metrics in the Species Richness and Composition category, especially metric 1 – “Number of indigenous species.” Determination of reference conditions based on the transition zones of lower mainstream Tennessee River reservoirs (as described below) ensures appropriate species expectations for the ecoregion.
- (2) The capacity for the community to sustain itself through cyclic seasonal change: TVA uses an autumn data collection period for biological indicators, both VS and upstream/downstream monitoring. Autumn monitoring is used to document community condition or health after being subjected to the wide variety of stressors throughout the year. One of the main benefits of using biological indicators is their ability to integrate stressors through time. Examining the condition or health of a community at the end of the “biological year” (i.e., autumn) provides insight into how well the community has dealt with the stresses through an annual seasonal cycle. Likewise, evaluation of the condition of individuals in the community (in this case, individual fish as reflected in Metric 12) provides insight into how well the community can be expected to withstand stressors through winter. Further, multiple sampling years during the permit renewal cycle add to the evidence of whether or not the autumn monitoring approach has correctly demonstrated the ability of the community to sustain itself through repeated seasonal changes.
- (3) The presence of necessary food chain species: Three dominant fish trophic levels exist within Tennessee River reservoirs: insectivores, omnivores, and top carnivores. To

determine the presence of necessary food chain species, these three groups should be well represented within the overall fish community. Other fish trophic levels include benthic invertivores, planktivores, herbivores, and parasitic species. Insectivores include most sunfish, minnows, and silversides. Omnivores include gizzard shad, common carp, carpsuckers, buffalo, and channel and blue catfish. Top carnivores include black and temperate bass, gar, skipjack herring, crappie, flathead catfish, sauger, and walleye. Benthic invertivores include drum, suckers, and darters. Planktivores include alewife, threadfin shad, and paddlefish. Herbivores include largescale stonerollers. Lampreys in the genus *Ichthyomyzon* are the only parasitic species occurring in Tennessee River reservoirs. To establish expected proportions of each trophic guild and the expected number of species included in each guild occurring in lower mainstream Tennessee River reservoirs (Kentucky, Pickwick, Wilson, Wheeler, and Guntersville reservoirs), data collected from 1993 through 2010 were analyzed for each reservoir zone (forebay, transition, inflow). Samples collected in the downstream vicinity of thermal discharges were not included in this analysis so that accurate expectations could be calculated with the assumption that these data represent what should occur in lower mainstream Tennessee River reservoirs absent from point source effects (i.e. power plant discharges). Data from 900 electrofishing runs (a total of 405,000 meters of shoreline sampled) and from 600 overnight experimental gill net sets were included in this analysis for transition areas in lower mainstream Tennessee River reservoirs. From these data, the range of proportional values for each trophic level and the range of the number of species included in each trophic level were trisected. This trisection is intended to show less than expected, expected or average, and above expected or average values for trophic level proportions and species occurring within each reservoir zone in lower mainstream Tennessee River reservoirs. These data were also averaged and bound by confidence intervals (95%) to further evaluate expected values for proportions of each trophic level and the number of species expected for each trophic level by reservoir zone.

- (4) A lack of domination by pollution-tolerant species: Domination by pollution-tolerant species is determined by metrics 3 ("Number of benthic invertivore species"), 4 ("Number of intolerant species"), 5 ("Percentage of tolerant individuals"), 6 ("Percent dominance by one species"), and 10 ("Percentage of individuals as omnivores").

Scoring categories are based on "expected" fish community characteristics in the absence of human-induced impacts other than impoundment of the reservoir. These categories were developed from historical fish assemblage data representative of transition zones from lower mainstream Tennessee River reservoirs (Hickman and McDonough, 1996). Attained values for each of the 12 metrics were compared to the scoring criteria and assigned scores to represent relative degrees of degradation: least degraded (5); intermediate degraded (3); and greatest degraded (1). For both the upstream (TRM 295.9) and the downstream (TRM 292.5) stations,

RFAI metrics were scored using evaluation criteria for the “transition” reservoir zone.

If a metric was calculated as a percentage (e.g., “Percentage of tolerant individuals”), the data from electrofishing and gill netting were scored separately and allotted half the total score for that individual metric. Individual metric scores for a sampling area (i.e., downstream or upstream) are summed to obtain the RFAI score for the area.

TVA uses RFAI results to determine maintenance of BIP using two approaches. One is “absolute” in that it compares the RFAI scores and individual metrics to predetermined values. The other is “relative” in that it compares RFAI scores attained downstream to the upstream control site. The “absolute” approach is based on Jennings et al. (1995) who suggested that favorable comparisons of the attained RFAI score from the potential impact zone to a predetermined criterion can be used to identify the presence of normal community structure and function and hence existence of BIP. For multi-metric indices, TVA uses two criteria to ensure a conservative screening of BIP. First, if an RFAI score reaches 70% of the highest attainable score of 60 (adjusted upward to include sample variability as described below), and second, if fewer than half of RFAI metrics receive a low (1) or moderate (3) score, then normal community structure and function would be present indicating that BIP had been maintained, thus no further evaluation would be needed.

RFAI scores range from 12 to 60. Ecological health ratings (12-21 “Very Poor”, 22-31 “Poor”, 32-40 “Fair”, 41-50 “Good”, or 51-60 “Excellent”) are then applied to scores. As discussed in detail below, the average variation for RFAI scores in TVA reservoirs is 6 (+ 3). Therefore, any location that attains an RFAI score of 45 (42 plus the upward sample variation of 3) or higher would be considered to have BIP. It must be stressed that scores below this threshold do not necessarily reflect an adversely impacted fish community. The threshold is used to serve as a conservative screening level; i.e., any fish community that meets these criteria is obviously not adversely impacted. RFAI scores below this level would require a more in-depth look to determine if BIP exists. An inspection of individual RFAI metric results and species of fish used in each metric would be an initial step to help identify if operation of BFN is a contributing factor. This approach is appropriate because a validated multi-metric index is being used and scoring criteria applicable to the zone of study are available.

4.2 List of Species for all Life Stages (r)(4)(ii)

Baseline Data from TVA from Upstream Wheeler Reservoir

Data 2011:

In 2011, fish community RFAI scores of 38 (“Fair”) and 40 (“Fair”) were observed at the downstream and upstream stations, respectively. Fish species collected upstream and

downstream of BFN and corresponding catch rates are shown in Tables 5, 10 and 11. Results for each metric, as they apply to the characteristics of BIP, are discussed below.

(1) A biotic community characterized by diversity appropriate to the ecoregion

Twenty-eight indigenous species were collected downstream and 29 upstream, resulting in midrange (3) metric scores for both sites. Four species, black redhorse, chestnut lamprey, redbreast sunfish, and silver redhorse, were collected in small numbers (four individuals or less) downstream of BFN but were not collected upstream. Five species (largescale stoneroller, logperch, longnose gar, northern hogsucker, and yellow bass) were collected at the upstream site only. Largescale stoneroller, logperch, and northern hogsucker were represented by only one individual each.

Eight centrarchid species were collected downstream and 7 upstream, resulting in the highest metric score (5) for both stations. Redbreast sunfish (2 individuals collected downstream) was the only species not collected at both sites. Four benthic invertivore species were collected at each station, resulting in mid-range scores at both sites. Freshwater drum and spotted sucker were collected at both stations, black redhorse and silver redhorse were collected at the downstream site only, and logperch and northern hogsucker were collected at the upstream site only. Five intolerant species were collected at both upstream and downstream sites, resulting in the highest metric score at both sites. Longear sunfish, skipjack herring, smallmouth bass, and spotted sucker were collected at both stations. Black redhorse was collected at the downstream site only and northern hogsucker was collected only at the upstream site. Nine top carnivore species were collected at the downstream site and eleven at the upstream site, which resulted in scores of 5 for both sites. In addition to the top carnivore species encountered at the downstream station (black crappie, flathead catfish, largemouth bass, skipjack herring, smallmouth bass, spotted bass, spotted gar, white bass, and white crappie), longnose gar and yellow bass were collected upstream of BFN.

Both sites received the same scores for each of the metrics discussed above. These results demonstrate the presence of diverse fish communities upstream and downstream of BFN for 2011.

(2) The capacity for the community to sustain itself through cyclic seasonal change

Number of indigenous species (> 30 required for highest score): The species composition of the autumn sample should be indicative of the ability of the fish community to withstand the stressors of an annual seasonal cycle. During autumn 2011, 28 indigenous species were collected downstream of BFN and 29 upstream; total numbers of species at both sites were within the range of variability observed at each site from autumn 2000

through 2011. Numbers of indigenous species collected from autumn 2000 through 2011 ranged from 23 to 28 at the downstream site and 24 to 32 at the upstream site.

Percentage of anomalies (< 2% required for highest score): The percentage of anomalies (*i.e.*, visible lesions, bacterial and fungal infections, parasites, muscular and skeletal deformities, and hybridization) observed in samples is an indicator of the ability of the fish community to withstand the stressors of an annual seasonal cycle. Percentages of anomalies at both sampling sites were low, resulting in the highest score (5) for this metric at both sites.

During autumn 2011, species diversity was similar and percentages of anomalies were low at both sites, indicating that fish communities were able to sustain themselves through cyclic seasonal change.

(3) The presence of necessary food chain species

The trophic composition of the fish community upstream and downstream of BFN was similar during autumn 2011. Mississippi silversides and bluegill were abundant in samples and accounted for the majority of insectivores at each site. Gizzard shad constituted approximately 90% of omnivores collected at each site. Twice the total number of top carnivores were collected upstream of BFN than downstream, but proportions of top carnivores were lower than expected at both sites. Percentages of planktivores (threadfin shad was the only planktivore species collected) were similar between sites, but the percentages of benthic invertivores were low at both sites. One parasitic species (one chestnut lamprey) was collected downstream and none were collected upstream. One herbivore (one largescale stoneroller) was collected upstream and none downstream.

Proportions of insectivores and planktivores were within the expected range for lower mainstream Tennessee River reservoir transition zones for both sampling sites. Proportions of benthic invertivores and top carnivores were below expected values at both sites. Omnivores were above expected values at both stations which could be an indicator of water quality impairment at both stations. Parasitic and herbivore species are infrequently collected, and when collected, are typically present in low numbers as was the case at both stations.

Overall, the number of species collected met or exceeded expectations at both downstream and upstream sites during autumn 2011. At the downstream site six trophic levels were represented, which included four benthic invertivore, eight insectivore, seven omnivore, one planktivore, one parasitic, and nine top carnivore species. At the upstream site, six trophic levels were represented and included four benthic invertivore, seven

invertivore, seven omnivore, one planktivore, 11 top carnivore, and one herbivore species.

Proportions and numbers of species of each trophic guild were similar between sites; therefore, it was determined that the downstream site was similar to the upstream site during autumn 2011 with respect to the presence of necessary food chain species.

(4) A lack of domination by pollution-tolerant species

Number of intolerant species (> 4 required for highest score):

In autumn 2011, five pollution intolerant species were collected at both upstream and downstream sites. Both sites received the highest score of 5 for this metric. Longear sunfish, skipjack herring, smallmouth bass, and spotted sucker were collected at both stations. Black redhorse was collected at the downstream site only and northern hogsucker at the upstream site only.

Percentage of tolerant individuals (for highest score, < 27% required in electrofishing sample and < 15% required in gill netting sample): At the downstream site, nine pollution tolerant species were collected which consisted of 59.6% of the electrofishing sample and 40.0% of the gill netting sample. Similarly, nine pollution tolerant species were collected upstream composing 54.6% of the electrofishing sample and 36.0% of the gill netting sample. Both sites received the lowest score (1) for this metric.

Eight tolerant species, bluegill, common carp, gizzard shad, golden shiner, green sunfish, largemouth bass, spotfin shiner, and white crappie, were collected at both sites. Redbreast sunfish was collected at the downstream site only and longnose gar at the upstream site only. Gizzard shad was the most abundant species collected by both electrofishing and gill netting methods at both sites (34.6% - electrofishing downstream, 32.2% - gill netting downstream; 36.8% - electrofishing upstream, 15.1% - gill netting upstream).

Percentage of omnivores (for highest score, < 24% required in electrofishing sample; < 16% required in gill netting sample): During autumn of 2011, seven omnivore species (channel catfish, common carp, gizzard shad, golden shiner, smallmouth buffalo, black buffalo, and blue catfish) were collected at both sites. At the downstream site, omnivores constituted 37.8% of the electrofishing sample and 52.9% of the gill netting sample. At the upstream site, omnivores made up 41.0% of the electrofishing sample and 33.7% of the gill netting sample. Both sites received scores of 2 for this metric.

Percent dominance by one species (for highest score, < 29% required in electrofishing sample; < 17% required in gill netting sample): Gizzard shad were dominant in both electrofishing and gill net samples at the downstream site. Gizzard shad dominated the

electrofishing sample and white bass dominated the gill net sample at the upstream site. Both sites received a mid-range score for this metric.

The downstream and upstream sites scored equally in the 4 pollution tolerance metrics. Fish communities at both sites showed relatively low abundance and consisted of relatively high percentages of non-indigenous and pollution-tolerant individuals. It was, therefore, determined that the downstream site was similar to the upstream site during autumn 2011 with respect to the lack of domination by pollution-tolerant species.

2009 Data:

In 2009, fish community RFAl scores of 36 ("Fair") and 39 ("Fair") were observed at the downstream and upstream stations, respectively (Tables 4, 8 and 9). The score at the downstream site was within the 6-point range of acceptable variation when compared to that of the upstream site; therefore, the sites were considered similar and Balanced Indigenous Populations (BIP) was maintained at the downstream site. The upstream and downstream sites were compared using the five characteristics of BIP. For the discussion of each characteristic, the downstream site was compared to the upstream site using those metrics useful in this determination.

- (1) A biotic community characterized by diversity appropriate to the ecoregion
Twenty-seven indigenous species were collected at the downstream site, while 26 indigenous species were collected at the upstream site. Thirty-one species were needed to attain the highest score possible for the metric "number of indigenous species"

Both upstream and downstream sites received the highest possible score for the metric "number of centrarchid species." Eight centrarchid species were collected at the upstream site, while 7 were collected at the downstream site. The metrics "number of benthic invertivores" and "number of intolerant species" both scored 2 points lower at the downstream site than at the upstream site. Three (3) benthic invertivore species and 3 intolerant species were collected at the downstream site compared to 4 and 5, respectively, at the upstream site. The benthic invertivore, black redhorse, was collected at the upstream site, but not at the downstream site; only one black redhorse was collected. Black redhorse (1 individual) and spotted sucker (4 individuals) were the intolerant species not collected at the downstream site. Both the downstream and upstream site recorded a score of 5 for the metric "number of top carnivore species." Nine (9) top carnivore species were collected at each site. Although the numbers of benthic invertivore and intolerant species differed between sites the numbers of individuals of those additional species collected were few. The other 3 metrics discussed received the same scores at both sites. Therefore, the downstream site was determined to be similar to the upstream site. Based on these results, a diverse fish community existed at the downstream site in autumn 2009.

- (2) The capacity for the community to sustain itself through cyclic seasonal change
The percentage of anomalies (*i.e.*, visible lesions, bacterial and fungal infections, parasites, muscular and skeletal deformities, and hybridization) in the autumn sample should be indicative of the ability of the fish community to withstand the stressors of an annual seasonal cycle. Both upstream and downstream sites scored the highest possible score for the metric "percent anomalies". The fish community at the downstream site was similar to the upstream site and able to withstand the stressors experienced from autumn 2008 through autumn 2009.
- (3) The presence of necessary food chain species
Scores for the metrics "percent top carnivores," "percent omnivores," "number of top carnivore species," "number of centrarchid species," and "average number per run" were similar between sites. "Number of top carnivore species" and "number of centrarchid species" recorded the highest possible scores (5) at both sites. "Percent top carnivores" scored 4 out of a possible 5 at both sites for both portions of the metric. Average percent omnivores (electrofishing and gill netting) were high at both sites (43% downstream; 46% upstream) resulting in scores of 2 out of a possible 5 for both sites. Average numbers of fish per run for electrofishing and gill netting were low at both sites, and each received the lowest metric score of 1. Given the higher numbers of top carnivore and centrarchid species at the downstream site and the similar percentages of top carnivores and omnivores and average numbers per run between sites, it was determined that the downstream site was similar to the upstream site with respect to the presence of necessary food chain species during autumn 2009.
- (4) A lack of domination by pollution-tolerant species
During autumn 2009, 3 benthic invertivores were collected at the downstream site compared to 4 benthic invertivores at the upstream site, resulting in metric scores of 1 and 3, respectively. Eight (8) benthic invertivore species were needed to attain a score of 5. Three intolerant species were collected at the downstream site compared to 5 intolerant species at the upstream site, resulting in a metric score 2 points lower at the downstream site. As previously stated, the benthic invertivore (black redhorse) not collected at the downstream site consisted of only 1 individual each. Black redhorse and spotted suckers (4 individuals) were the intolerant species not collected at the downstream site. The percentages of tolerant individuals (averages of electrofishing and gill netting) were similar between sites (43.3% downstream; 36.9% upstream). Given these results, the downstream site was determined to be similar to the upstream site with respect to domination by pollution-tolerant species.
- (5) Indigenous

In autumn 2009, twenty-seven indigenous and 2 non-indigenous species (common carp and inland silverside) were collected at the downstream site compared to 26 indigenous and 3 nonindigenous species (common carp, striped bass, and inland silverside) at the upstream site. Percentages of non-indigenous species collected in the electrofishing sample were high at both sites, with inland silverside being the dominant non-indigenous species. The percentage of nonindigenous species collected in the gill netting portion of the sample was 3.4% (only common carp) at the upstream site; no non-indigenous species were collected at the downstream site. Compared to the upstream site, the downstream site was similar with respect to the indigenoussness of its fish communities.

Wheeler Reservoir Fish Community Summary

In conclusion, analysis of the characteristics of BIP and their respective metrics indicated the downstream site was similar to the upstream site and that a balanced fish community was present at the downstream site in autumn 2009 and 2011. Eight (8) of the RFAI metrics and 11 of the RFAI metrics received the same scores at both sites in 2009 and 2011, respectively.

In the 2009 sample, of the four metrics that scored differently, "number of benthic invertivore species", "number of intolerant species," "percent dominance by one species," and "percent nonindigenous species," three (3) recorded a lower score at the downstream site, while one metric ("percent non-indigenous species") scored higher at the downstream site.

In the 2011 sample, upstream and downstream sites received identical combined scores for 11 of the twelve RFAI metrics. The downstream station earned scores of 3 or 5 for eight RFAI metrics, but earned the lowest score (1) for the metrics "Percent tolerant individuals," "Average number per run," the electrofishing portion of "Percent top carnivores," and the gill netting portion of "Percent omnivores." The upstream site earned scores of 3 or 5 for nine of the twelve RFAI metrics, but earned the lowest score (1; 0.5 for metrics portioned by gear) for metrics "Percent tolerant individuals," "Average number per run," and the gill netting portion of "Percent omnivores."

In 2009, twenty-six (26) indigenous species were collected at the upstream site, while 27 were collected at the downstream site. Twenty-nine (29) representative important species were collected at both the upstream and downstream stations. Representative important species are defined in EPA guidance as those species which are representative in terms of their biological requirements of a balanced, indigenous community of fish, shellfish, and wildlife in the body of water into which the discharge is made (EPA and NRC 1977). The same two aquatic nuisance species (common carp and inland silverside) were collected at both sites. There was one species collected at the downstream site (logperch) which is intolerant of thermal pollution. White sucker and spotted sucker were thermally-sensitive species collected at the upstream site. Water temperatures greater than 32.2°C (90°F) are known to be lethal to the aforementioned species

(Yoder et al. 2006). The same number of commercially valuable species (4) was collected at both sites. Eighteen (18) recreationally valuable species were collected at the upstream site, one more than the downstream site.

In 2011, two thermally sensitive species were collected at the upstream site and one downstream. Nine (9) commercially valuable species were collected at the downstream site and seven (7) at the upstream site. Commercially valuable species include freshwater drum, buffalo, and all members of the catfish and sucker families (ALDCNR, 2012). Twenty-one (21) recreationally valuable species were collected both sites. Recreationally valuable species are those species that are commonly sought by anglers, bow fishermen, or used for bait. All fish species collected were considered Representative Important Species because all species were used to obtain overall RFAI scores.

As discussed above, RFAI scores have an intrinsic variability of ± 3 points. This variability comes from various sources, including annual variations in air temperature and stream flow; variations in pollutant loadings from nonpoint sources; changes in habitat, such as extent and density of aquatic vegetation; natural population cycles and movements of the species being measured (TWRC 2006). Another source of variability arises from the fact that nearly any practical measurement, lethal or non-lethal, of a biological community is a sample rather than a measurement of the entire population. As long as the score is within the 6-point range, there is no certainty that any real change has taken place beyond method variability.

Over the ten sample years, both sites have averaged a score of 41 ("Good"). Both sites have been within the 6-point range of accepted variability each year, with the exception of 2005 when the upstream site scored 10 points higher, indicating the sites were similar annually and that the BFN heated effluent is not adversely affecting the fish community in the vicinity of the plant. The "Fair" rating in the 2005 sample at the downstream site was a result of a high percentage of tolerant individuals in the gill net samples and dominance by one species in both gill net and electrofishing samples. Individual metric scores and overall RFAI scores for the upstream and downstream sampling sites of BFN for sample years 2008, 2009, and 2011 are listed in Tables 3-5, respectively. Species collected and catch per effort during electrofishing at the upstream and downstream sampling sites of BFN for sample years 2008, 2009, and 2011 are listed in Tables 6-11, respectively.

Due to the similarity among Tennessee River reservoir fish communities and that the BFN sites are from upstream Wheeler Reservoir, AST can reasonably expect similar species are present at the PDW CWIS location at TRM 258.2, downstream of the two TVA sample locations.

Baseline Data from Wilson Reservoir

2013 and 2017 Data:

The Alabama Department of Conservation and Natural Resources conducted an electrofishing and creel survey of the Wilson Reservoir in the spring of 2013 and 2017. The objective of the survey was to evaluate the sport fishery at the Wilson Reservoir, specifically for largemouth bass. The electrofishing sampling locations for the survey were spread throughout Wilson Reservoir. The target species included largemouth bass, smallmouth bass, and crappie with over 500 individuals of target fish species shocked (Ekema et al., 2013 and 2017). The creel survey was conducted in 2013 and consisted of anglers being surveyed upon completion of their fishing trip. The creel survey focused on four sports species with anglers reporting that 4,903 had been caught in Wilson Reservoir (Ekema et al., 2013).

Baseline Data from Pickwick Reservoir

ADCNR 2008 Data:

The Alabama Department of Conservation and Natural Resources conducted an electrofishing and creel survey of the Pickwick Reservoir which took place in the spring of 2008. The objective of the survey was to evaluate the sport fishery at the Reservoir. The electrofishing sampling locations for the survey were spread throughout the Pickwick Reservoir. The target species included largemouth bass, spotted bass, and smallmouth bass with over 500 target fish species shocked (Ekema et al., 2009). The creel survey was completed over 11 survey days and anglers were surveyed upon completion of their fishing trip. The creel survey focused on four sports species with anglers reporting that 1,932 had been caught in the Pickwick Reservoir (Ekema et al., 2009).

TVA 2011 Data:

In the autumn of 2011, a study was completed above and below the CWIS of the Tennessee Valley Authority's (TVA) Colbert Fossil Plant (COF) located at RM 245, 13.2 miles downstream of the PDW CWIS. The TVA's COF was operating under a 316(a) thermal variance that had been continued with each permit renewal based on monitoring conducted in the mid-1970s. In 1999, EPA Region IV began requesting additional data in conjunction with NPDES permit renewal applications to verify that Balanced Indigenous Populations (BIP) were being maintained at TVA's power plants with thermal variances. TVA proposed that its existing Vital Signs monitoring program, supplemented with additional fish and macroinvertebrate community monitoring of the Tennessee River upstream and downstream of COF with thermal variances, was appropriate for that purpose. Fish communities were surveyed using electrofishing equipment and resulted in over 1,691 fish being shocked with 39 species found (Table 12). The benthic macroinvertebrate data were also assessed using the Reservoir Benthic Index (RBI) methodology and resulted in 85 taxa found (Tennessee Valley Authority, 2012) (Table 13).

The Tennessee Wildlife Resource Agency (TWRA) conducts annual survey and management summaries for reservoirs managed by TWRA, including the Pickwick Reservoir (Table 12). The survey and management summaries are collected using creel surveys and electrofishing survey efforts that focused on the sports fishery in the Reservoirs. The creel survey results are reported as statistics such as catch rate, harvest rate, percent released and mean weight, therefore will not be used in this biological characterization. However, there were 11 species identified through electrofishing efforts. Electrofishing has been conducted on an annual basis from 2006-2015. In 2015, 772 fish were shocked from Pickwick Lake just below the Pickwick Landing Lock and Dam Highway Bridge at Tennessee River Mile 207.8 (Broadbent et al., 2015)(Table 12).

The TWRA publishes a statewide creel survey that includes abundances of fish caught by anglers. The report does not indicate the exact locations where creel surveys were conducted, instead the reservoir was split into sections to ensure the entire reservoir had surveys conducted. The latest creel survey was conducted in 2015 for the Pickwick Reservoir, 18 species with over 122,500 fish were reported to have been caught by anglers when roving and access point surveys were conducted (Black, 2016).

The Geological Survey of Alabama has provided survey data that was conducted in the Tennessee River (Pickwick Reservoir) near Buck Island and Pippen Island along with data from Panther Creek and Second Creek which are tributaries of the Pickwick Reservoir, Tennessee River (Table 12). The survey was completed in the spring of 2013 using electrofishing equipment in both the Tennessee River and the creek sites that resulted in the identification of 46 species with an abundance of 7,194 fish from the 4 locations (McGregor and O'Neil, 2017).

The Alabama Department of Conservation and Natural Resources conducts a quantitative mussel population survey on an annual basis in the Tennessee River near the Wilson Dam tailwaters, 5.3 miles downstream of PDW CWIS (Table 14). The surveys began in 2008 with the objective of monitoring the mussel population following changes in the water release schedule at Wilson Dam. A cumulative total of 79 species have been reported from that river reach. Two federally-protected species have been collected during quantitative sampling since 2008; the Pink mucket, *Lampsilis abrupta*, and the Rough pigtoe, *Pleurobema plenum*. Neither of these were encountered during the 2016 sampling. No protected species were found during two other sampling years, 2008 and 2013. During the course of this study, never have more than two individuals of either species been found during a given year, and in only two years have both been encountered. *Lampsilis abrupta* and *P. plenum* appear to be so rare in the study reach that finding one or both in 120 samples is not assured, so their absence in 2016 does not appear to be cause for alarm (Garner and Holifield, 2017).

Analysis of the fish species and relative abundance studies conducted downstream of the PDW CWIS indicate a total of 58 species of fish occurring in the Tennessee River (Table 12) (Black,

2016; Broadbent et al., 2015; Ekema et al., 2009; McGregor and O'Neil, 2017; Tennessee Valley Authority, 2012). The benthic macroinvertebrates were assessed for the study that was completed above and below the CWIS of the Tennessee Valley Authority's COF during the autumn of 2011. Details from the benthic macroinvertebrates assessed are in Table 13 (Tennessee Valley Authority, 2012). A quantitative mussel survey was completed by the Alabama Department of Conservation and Natural Resources in the Tennessee River near the Wilson Dam tailwaters. The survey has been conducted annually since 2008, results from the survey are included in Table 14 (Garner and Holifield, 2017).

Due to the similarity among Tennessee River reservoir fish and invertebrate communities, AST can reasonably expect similar species are present at the location of the PDW CWIS at TRM 258.2, upstream of the Pickwick Reservoir locations.

4.3 Identification of Species and Life Stages Most Susceptible to Impingement and Entrainment (r)(4)(iii)

Table 15 identifies the Species of Fish that are most common and predominant from the 2008, 2009, and 2011 fish studies that were conducted by TVA at TRM 292.5 and TRM 295.9 near the BFN. These findings generally agree with those of Ekema et al. (2009) for Pickwick Reservoir and represent the relatively important fish species for the Tennessee River. Due to the similarity among Tennessee River reservoir fish communities, AST can reasonably expect similar species predominance at the location of the PDW CWIS at TRM 258.2.

Impingement and entrainment studies on Pickwick Reservoir at the immediate vicinity of the PDW CWIS were not available. A review of available data included several studies pertaining to impingement and one on entrainment that have been completed on the Tennessee River System. For the purposes of this section, only studies completed on Pickwick Reservoir for COF and on Wheeler Reservoir for BFN were used. These studies are located upstream and downstream of the PDW CWIS and provide the best documentation of species and life stages susceptible to impingement and entrainment. Considering both Pickwick Reservoir and Wheeler Reservoir are freshwater reservoirs and contain warm water fisheries, species occurring within them are very similar and utilize similar habitats to those in the vicinity of PDW CWIS. Below are a list of studies used to identify species and life stages that are most susceptible to impingement and entrainment:

- Baxter *et al.* (2006) - Biological Assessment: Effects of Condenser Cooling Water Withdrawal on the Fish Community Near Browns Ferry Nuclear Plant Intake;
- Tennessee Valley Authority (2007) - Fish Impingement at Colbert Fossil Plant During 2005 through 2007;

- Saalfeld (2006) - Variables Influencing Fish Impingement at Five Alabama Power Steam Plants

Susceptibility to impingement and entrainment is dependent upon a variety of interrelated factors including size, life stage, swimming speed, intake flow velocity, seasonal variation, habitat preference, etc. Studies have shown that smaller, juvenile individuals are more susceptible to impingement than their larger, adult counterpart (Baxter et al. 2006, Saalfeld 2006). Young fish often exhibit higher natural mortality or weakened swimming ability due to stresses including extreme water temperature, low dissolved oxygen, strong flow velocity, physical damage, and infectious disease (Saalfeld 2006).

Impingement of large fish sizes is predominantly excluded by bar screen structures designed to prevent the entry of trash and debris into the cooling system. Placement of bar screen structures typically occurs at the entry of the intake pipe extended into the source waterbody or at the face of a shoreline intake located on the source waterbody prior to passing through rotating screen or fixed screen structures and entering condenser tubes.

Impingement and Entrainment data from Browns Ferry Nuclear Plant

Impingement and entrainment studies have been conducted at BFN. BFN is located along the Tennessee River approximately 35.8 miles upstream from PDW CWIS. Thirty-seven species of fish representing eleven families were collected in the 2003 and 2004 impingement study (Table 16). Threadfin shad was the dominant species in numbers, 61% of total, and freshwater drum contributed the most biomass, 38% of total weight. Other species occurring in significant numbers were freshwater drum (21.2%), gizzard shad (7.8%), skipjack herring (4.8%), channel catfish (1.4%), and yellow bass (1.3%). In terms of biomass, other important species were gizzard shad (23.1%), threadfin shad (18.3%), channel catfish (6.4%), yellow bass (2.6%), and blue catfish (1.6%). Three species were the primary drivers in the fluctuations in daily estimates observed in the 2003 and 2004 impingement study. The abundance of threadfin shad had the most significant effect on total numbers impinged and was a major contributor to the total biomass. Gizzard shad and freshwater drum were also significant contributors to total biomass impinged (Baxter *et al.*, 2006).

To estimate BFN Plant's entrainment rate, ichthyoplankton (fish eggs and larvae) samples were collected upstream to estimate densities of fish eggs and larvae in the water column flowing past the plant and in the intake basin near the skimmer wall. Ninety five percent of the total entrained fish collected were shad; other families contributing at least 1% of total composition were temperate basses 1.8%, sunfishes 1.0%, drum 1.1 %, and silversides 1.0%. The hydraulic entrainment estimate for all sampling periods, 2003 and 2004 combined, averaged 8.4%. In 2003, hydraulic entrainment estimate averaged 6.2% (range 4 to 27.6%) and in 2004 averaged

12.7% (range 5.9 to 42%). A decrease in river flow past BFN during most of the 2004 sampling season was the most significant contributing factor to the higher entrainment in 2004 (Baxter et al., 2006). The average rate of entrainment for the different fish taxa can be seen in Table 17. The overall entrainment estimate based on the two year study averaged 7.6% for fish eggs and 10.8% for larval fish. Spatial-temporal distribution varied significantly between sampling periods and stations for both fish eggs and larvae, demonstrating the heterogeneous distribution of individuals both vertically and horizontally in the water column. (Baxter *et al.*, 2006).

The location of BFN is probably a contributing factor to the fluctuations in the annual entrainment estimates. The area of Wheeler Reservoir near BFN is characterized as a transition zone where the velocity of water flowing past BFN depends on the rate water released through Guntersville and Wheeler Dams. The rate of water flow past BFN increases and the reservoir surface elevation decreases when the rate of water released through Wheeler Dam exceeds the release through Guntersville Dam (Baxter et al., 2006). Condenser cooling water demand for BFN remains fairly constant during normal two unit operation, therefore, hydraulic and fish entrainment estimates will increase as reservoir flow past BFN decreases.

Impingement data from Colbert Fossil Plant

The Colbert plant is located on the Tennessee River approximately 15.8 miles downstream from PDW CWIS. The COF completed an impingement study in 2007 to demonstrate compliance as part of their National Pollutant Discharge Elimination System (NPDES) permit's 316(b) monitoring program. While the study did not evaluate entrainment, the data does provide information related to impingement and a comparison to historical impingement rates from 1974 through 1976. Historical impingement data from 1974 through 1976 indicated that threadfin shad and gizzard shad was the dominate species impinged at greater than 80% of all impinged species. Estimated annual impingement rate based on the 2005 through 2007 data indicated that threadfin shad comprised 87% of the total fish impinged, followed by gizzard shad at 5.0%, bluegill at 4.0%, freshwater drum at 2.0%, and skipjack herring and channel catfish both at 1% (Tennessee Valley Authority, 2006).

Impingement data from five Alabama Power steam plants

Saalfeld (2006), presented impingement data in 2006 for five Alabama Power steam plants (Berry, Gadsden, E.C. Gaston, Gorgas, and Green County Steam Plants) across different regions in Alabama. His findings showed the five dominant species for all intakes combined were threadfin shad (69.3%), blue catfish (8.8%), freshwater drum (7.4%), black crappie (3.5%), and gizzard shad (2.5%). While his findings were not specifically on the Tennessee River, it does show similar dominant species as the studies above and provides usable data when evaluating species susceptible to impingement at PDW CWIS.

The Saalfeld (2006) study also found that size class affected impingement rates as the majority of fish impinged were small length classes with threadfin shad being most prevalent species. Of all the threadfin shad found to be impinged, 94% were smaller threadfin shad (less than 100mm). Of the freshwater drum found to be impinged, 64% were less than 140mm in length. Over 68% of the all the blue catfish found to be impinged were less than 100mm in length. While impingement rates varies with species, historically, threadfin shad, gizzard shad and freshwater drum have become impinged more than other species. Life history traits may be accountable as these species are planktonic in early life stages, spawn near shore areas, and are smaller as adults (Saalfeld 2006).

Species Susceptible to Impingement at PDW CWIS

Based on the information presented in the aforementioned studies, OxyChem has compiled a list of those species most susceptible to impingement and entrainment impacts at the PDW CWIS. Combination of species (or species within listed genus) results in the identification of potential species susceptible to impingement are listed in Table 16 and potential fish families susceptible to entrainment are presented in Table 17 (Baxter *et al.*, 2006). Due to the similarity among Tennessee River reservoir fish assemblages, as well as the similarities among Tennessee River findings to findings elsewhere in Alabama, AST can reasonably expect similar species are present at the location of the PDW CWIS at TRM 258.2, and that these impingement and entrainment studies herein apply to the PDW CWIS.

4.4 Life Histories of Relatively Important Species and Seasonal/Daily Actives (r)(4)(iv-v)

The following are the life histories of prominent species that were identified by TVA during their 2008, 2009, and 2011 studies.

Gizzard Shad- The Gizzard shad (*Dorosoma cepedianum*) is a member of the herring family of fish, and is native to large swaths of fresh and brackish waters of the United States of America. The adult has a deep body, with a silvery-green coloration above fading to plain silver below. The gizzard shad commonly resides in freshwater lakes, reservoirs, rivers, and streams but can reside in brackish waters, as it does on the Atlantic coast of the United States. They are large parts of many of the ecosystems they inhabit, and can drive changes in phyto- and zooplankton, thereby indirectly affecting other planktivorous fishes. The gizzard shad has been widely used as a food source for game fish, with varied success in management and effectiveness. The gizzard shad can range from millimeter and milligram size when fry to a maximum recorded length of 477 mm (18.8 in) and maximum weight of 1.56 kilograms (3.4 lb). The average length is typically larger in northern waters, and ranges from 284 mm (11.2 in) at age three years to 399

mm (15.7 in) at age 10. They have a highly reduced lateral line system, a feature shared by other members of the herring family. The start of the spawning period is typically between mid-May and early June, and is triggered by rising water temperatures. The number of eggs per individual varies between populations, but typically it is 12,500 eggs for a two year old individual and peaks at 38,000 eggs in an age 4 individual. The eggs are laid in shallow water in clumps, with seemingly no pairing off occurring between individuals. They spawn during the evening and the early hours of the night, and the eggs adhere to underwater vegetation and do not receive any parental attention. Feeding begins three to four days after hatching, and most individuals are 3.25 mm long upon hatching. The gizzard shad has very high fecundity and a rapid growth rate, meaning it can become a large part of an ecosystem, in terms of abundance and biomass, very quickly. They are capable of hybridizing with the closely related threadfin shad.

Spotfin Shiner- Spotfin shiners (*Cyprinella spiloptera*) are silver-blue in color with a darker back and lighter cream colored belly. They are laterally compressed (flat side to side) and have a distinctive diamond shaped crosshatching pattern on the sides formed by dark scale edges. They have a dusky blotch on the webbing of the dorsal fin between the 3 rear fin rays. The front half of their dorsal fin lacks dark pigment in front of this blotch and has a straight rear edge. They have 8 anal fin rays.

Breeding male spotfin shiners have intensely steel blue colored sides, and fins flushed with white. The closely related steelcolor shiner differs by having a rounded rear edge to the dorsal fin, dark speckles of pigment in the front half of the dorsal fin, 9 anal fin rays, and a slightly deeper body. Additionally breeding male steelcolor shiners have a red tip to their snout and have fins flushed with yellow rather than white. Breeding males of both species have white tips to the fins which are often visible to an observer above the water's surface. This shiner is in the Cyprinidae (minnows and carps) family, and is typically 2-4, sometimes 5 inches long. Spotfin shiners spawn in crevices between rocks or in bark on submerged fallen trees. Spawning takes place throughout the warmer months of the year starting in late May or early June.

Bluegill- The bluegill (*Lepomis macrochirus*) is a species of freshwater fish sometimes referred to as bream, brim, or copper nose. It is a member of the sunfish family Centrarchidae of the order Perciformes. It is native to North America and lives in streams, rivers, lakes, and ponds. It is commonly found east of the Rockies. It usually hides around, and inside, old tree stumps and other underwater structures. It can live in either deep or very shallow water, and will often move back and forth, depending on the time of day or season. Bluegills also like to find shelter among water plants and in the shade of trees along banks.

Bluegills can grow up to 12 inches (30 cm) long and about 4 1/2 pounds. They have very distinctive coloring, with deep blue and purple on the face and gill cover, dark olive-colored bands down the side, and a fiery orange to yellow belly. The fish are omnivores and will eat anything they can fit in their mouth. They mostly feed on small aquatic insects and fish. The fish

play a key role in the food chain, and are prey for muskies, walleye, trout, bass, herons, kingfishers, snapping turtles, and otters.

Spawning season for bluegills starts late in May and extends into August. The peak of the spawning season usually occurs in June in waters of 67 to 80 °F (19 to 27 °C). The male bluegills arrive first at the mating site. They will make a spawning bed of six to 12 inches in diameter in shallow water, clustering as many as 50 beds together. The males scoop out these beds in gravel or sand. Males tend to be very protective and chase everything away from their nests, especially other male bluegills. Some bluegills, regardless of their small size, will even attack snorkelers if they approach the edge of the nest. As a female approaches, the male will begin circling and making grunting noises. The motion and sound of the males seem to attract the females. Females are very choosy and will usually pick males with larger bodies and "ears", making larger size a desirable trait for males to have. If the female enters the nest, both the male and female will circle each other, with the male expressing very aggressive behavior toward the female. If the female stays, the pair will enter the nest and come to rest in the middle. With the male in an upright posture, the pair will touch bellies, quiver, and spawn. These actions are repeated at irregular intervals several times in a row. Once the spawning is done, the male will chase the female out of the nest and guard the eggs. The fertilization process is entirely external. The male's sperm combines with the female's eggs in the water. Smaller males will often hide in nearby weeds and dart into the nest as they attempt to fertilize the eggs. They then quickly dart away. The size of the female plays a large role in how many eggs will be produced. A small female can produce as few as 1,000 eggs, and a large, healthy female can produce up to 100,000 eggs. The male continues to watch over the nest until the larvae are able to hatch and swim away on their own. The bluegill generally begins its spawning career at one year of age, but has been found to spawn as early as four months of age under favorable conditions. Anglers find spawning season to be a very successful time to fish for bluegills, as they aggressively attack anything that comes near including a hook.

The growth of the bluegill is very rapid in the first three years, but slows considerably once the fish reaches maturity. Many fish reach five to eight years old, and in extreme cases, can live 11 years.

Largemouth Bass- The largemouth bass (*Micropterus salmoides*) is a freshwater gamefish in the sunfish family, a species of black bass native to North America. It is known by a variety of regional names, such as the widemouth bass, bigmouth bass, black bass, bucketmouth, Potter's fish, Florida bass, Florida largemouth, green bass, green trout, gilsdorf bass, Oswego bass, southern largemouth and (paradoxically) northern largemouth. The largemouth bass is the state fish of Georgia, Mississippi, and Indiana, the state freshwater fish of Florida and Alabama, and the state sport fish of Tennessee. The largemouth bass is an olive-green fish, in the northeast right after ice-out, it most often has a gray color, marked by a series of dark, sometimes black,

blotches forming a jagged horizontal stripe along each flank. The upper jaw (maxilla) of a largemouth bass extends beyond the rear margin of the orbit. In comparison to age, a female bass is larger than a male. The largemouth is the largest of the black basses, reaching a maximum recorded overall length of 29.5 in (75 cm) and a maximum unofficial weight of 25 pounds 1 ounce (11.4 kg). The fish lives 16 years on average.

Longear Sunfish- The longear sunfish (*Lepomis megalotis*) is a freshwater fish in the sunfish family, Centrarchidae, of order Perciformes. The longear sunfish reaches a maximum recorded length of about 24 cm (9.5 in), with a maximum recorded weight of 790g (1.7 lb). Most do not live beyond six years. The longear sunfish is quite colorful, with an olive to rusty-brown back, bright orange belly and blue-green bars on the sides of its head. A unique characteristic is their elongated opercular flap, giving an appearance of a "long ear". The species prefers densely vegetated, shallow waters in lakes, ponds, and sluggish streams. Its diet can include insects, aquatic invertebrates, and small fish. Avoiding strong currents, longear sunfish are usually present in small to moderate flowing streams, rivers, and reservoirs. The genus *Lepomis* has a well characterized mating behavior where parental care is done by the male. He makes and defends the nest. Males fan the eggs to remove silt and other debris until the larvae hatch. Some longear females produce 4,000 eggs. They spawn in groups but do not form large colonies. Longear sunfish are better at getting food in moving waters than still waters. This may explain why they are more abundant in streams than lakes. For the most part, longear sunfish are active during the day and inactive at night. There are very few conservation acts currently being performed in order to maintain the distribution and abundance of this species. Longear sunfish tend to breed during the late spring and early summer (late May to late August). During breeding seasons they are generally found in shallower, warmer waters near the sources of streams which have pools. Like most other members of *Lepomis*, longear sunfish are colonial nesters. Male longear sunfish build the nests without assistance from the females. Preferred substrate for nesting is gravel, if available, but they will build in sand or hard mud if necessary. A male longear will guard the nest territory during all phases of reproduction. The clutch size can be anywhere from 140 to 2800 eggs per reproductive cycle. After hatching, it only takes the longear sunfish 2–3 years to reach sexual maturity. The average life-span of the *Lepomis megalotis* in the wild is usually 4–6 years, but there have been cases where individuals have lived up to 9 years. Longear sunfish cannot tolerate cloudy or mucky water. Throughout the 20th century their populations have been reduced in areas where their native streams have suffered increased cloudiness. This cloudiness could potentially be a result of human induced erosion for agriculture or industry purposes. Increased human disturbance along streams and rivers could continue to increase the reduction of longear populations due to the murkiness of rivers and streams.

Smallmouth Bass- The smallmouth bass (*Micropterus dolomieu*) is a species of freshwater fish in the sunfish family (Centrarchidae) of the order Perciformes. It is the type species of its genus. One of the black basses, it is a popular game fish sought by anglers throughout the temperate

zones of North America, and has been spread by stocking -- as well as illegal introductions -- to many cool-water tributaries and lakes in Canada and more so introduced in the United States. The maximum recorded size is approximately 27 inches and 12 pounds. The smallmouth bass is native to the upper and middle Mississippi River basin, the Saint Lawrence River--Great Lakes system, and up into the Hudson Bay basin. Its common names include smallmouth, bronzeback, brown bass, brownie, smallie, bronze bass, and bareback bass. The smallmouth bass is found in clearer water than the largemouth, especially streams, rivers, and the rocky areas and stumps and also sandy bottoms of lakes and reservoirs. The smallmouth prefers cooler water temperatures than its cousin the largemouth bass, and may be found in both still and running water. Because it is intolerant of pollution, the smallmouth bass is a good natural indicator of a healthy environment, though it can better adjust to changes in water condition than most trout species. Carnivorous, its diet comprises crayfish, insects, and smaller fish; the young also feeding on zooplankton. The female can lay up to 21,100 eggs, which are guarded by the male in his nest.

Threadfin Shad- The threadfin shad (*Dorosoma petenense*) is a small pelagic fish common in rivers, large streams, and reservoirs of the Southeastern United States. Like the American gizzard shad, the threadfin shad has an elongated dorsal ray, but unlike the gizzard shad its mouth is more terminal without projecting upper jaw. The fins of threadfin shad often have a yellowish color, especially the caudal fin. The back is grey to blue with a dark spot on the shoulder.

Dorosoma petenense is more often found in moving water, and is rarely found deep in the water column. It occurs in large schools, sometimes with gizzard shad, and can be seen on the surface at dawn and dusk. The threadfin shad may reach lengths of 8 inches, but only rarely. This fish is very sensitive to changes in temperature and dissolved oxygen, and die-offs are frequent in late summer and fall, especially when water temperature reaches 42 °F. The threadfin shad is a favorite food for many game fishes including striped bass, largemouth bass, smallmouth bass, and catfishes. This fish is widely introduced throughout the United States as a forage for game fish. The adult may reach up to 8 inches in length but most shad are about one inch long. It feeds on plankton near the surface of the water late in the day. It is a very important food source for many game fish such as the largemouth bass. It has little known competition, but one species that is known to have a similar lifestyle is the gizzard shad (*Dorosoma cepedianum*). The threadfin lives a pelagic life in reservoirs and for the most part in large streams. The shad spawns in the spring when the water temperature is in the upper 60's F. A pelagic (open water) schooling species often introduced as a supplemental forage, threadfin shad spawn in the spring and early summer with a secondary spawn often occurring in the early fall. Spawning usually occurs early in the morning on available vegetation. The eggs adhere to submerged and floating objects. Females lay from 2,000 to 24,000 eggs. The young and adults feed on a variety of planktonic organisms and organic debris. Many researchers believe that threadfin shad often compete for plankton with young-of-the-year predator species, especially largemouth bass. Life expectancy seldom exceeds 2 to 3 years.

Channel Catfish- Channel catfish (*Ictalurus punctatus*) is North America's most numerous catfish species. It is the official fish of Kansas, Missouri, Iowa, Nebraska, and Tennessee, and is informally referred to as a "channel cat". In the United States, they are the most fished catfish species with approximately 8 million anglers targeting them per year. The popularity of channel catfish for food has contributed to the rapid expansion of aquaculture of this species in the United States. Channel catfish possess very keen senses of smell and taste. At the pits of their nostrils (nares) are very sensitive odor sensing organs with a very high concentration of olfactory receptors. In channel catfish, these organs are sensitive enough to detect several amino acids at about one part per 100 million in water. In addition, the channel catfish has taste buds distributed over the surface of its entire body. These buds are especially concentrated on the fish's four pair of barbels (whiskers) surrounding the mouth — about 25 buds per square millimeter. This combination of exceptional senses of taste and smell allows the channel catfish to find food in dark, stained, or muddy water with relative ease. Channel catfish also possess a Weberian apparatus, which amplifies sound waves that would otherwise not be perceivable. A member of the *Ictalurus* genus of American catfishes, channel catfish have a top-end size of about 40–50 pounds (18–23 kg). The world record channel catfish weighed 58 pounds, and was taken from the Santee-Cooper Reservoir in South Carolina, on July 7, 1964. Realistically, a channel catfish over 20 lb (9 kg) is a spectacular specimen, and most catfish anglers view a 10-lb (4.5-kg) fish as a very admirable catch. Furthermore, the average size channel catfish an angler could expect to find in most waterways would be between two and four pounds.

Channel catfish will often coexist in the same waterways with its close relative, the blue catfish, which is somewhat less common, but tends to grow much larger (with several specimens confirmed to weigh above 100 lb).

White Bass- The white bass, silver bass, or sand bass (*Morone chrysops*) is a freshwater fish of the temperate bass family Moronidae. The species' main color is silver-white to pale green. Its back is dark, with white sides and belly, and with narrow dark stripes running lengthwise on its sides. It has large, rough scales and two dorsal fins. The more anterior dorsal fin is much harder and appears to have spines on them. Although these are not true spines, this type of fin is called a spinous ray. The more posterior of the two dorsal fins is much softer, and is thus called a soft-ray. Because the vertebrae do not extend into the tail, the white bass has what is called a homocercal tail. The body is deep and compressed laterally. Most grow to a length between 10 and 12 inches (25 and 30 cm), though they can reach 17 inches (43 cm) or more. Because the dorsal and ventral portions of the tail angle inward toward a point to create a clear angle, the tail is said to be notched. White bass inhabit large reservoirs and rivers. When mating in the spring, they are more often found in shallow rivers, creeks, and streams. White bass are found in high densities in the upstream segment of rivers. This portion of the river becomes the most degraded, as a number of different kinds of fish live in this segment, as well. The spawning season for the white bass is mid-March to late May. The optimal water temperatures are 12 to 20 °C (54 to

68 °F). They are known to find their home spawning in the ground. They often spawn in moving water in a tributary stream, but they will spawn in windswept lake shores. They spawn during daylight. Females release 242,000 to 933,000 eggs which stick to the surface of objects. Eggs are laid in clear, relatively shallow water on plants, submerged logs, gravel, or rocks. The parents move to deeper water and do not care for the young fish. The young fish live in shallow water for a while until they move to deeper water.

When trying to find a female with whom to mate, males will bump against a female's abdominal area. The female will then rise closer to the surface and begin spinning and releasing eggs. Several males that have stayed in the area will be able to fertilize the eggs the female releases.

Inland Silverside- The inland silverside (*Menidia beryllina*) is a neotropical silverside native to eastern North America, and introduced into California. It is a fish of estuaries and freshwater environments. Inland silversides are quite elongate even for silverside, with lengths 6 to 7 times the depth. They have large eyes, a considerably upturned mouth, and a head noticeably flattened on top. Of the two widely separated dorsal fins, the anterior fin is small and has 4-5 weak spines, while the posterior fin is larger, with one spine and 8 or 9 rays. The lengthy anal fin is somewhat sickle-shaped, has one spine and 16 to 18 rays. As befits the name, they are silvery on the sides; the back is somewhat yellowish, and the underside is a translucent greenish. These are small fish, with 15 cm recorded, but most adults 10 cm or less. They primarily feed on zooplankton, moving in enormous schools capable of depleting populations of the small arthropods and crustaceans they favor. In turn, they are prey for a variety of fish and birds. The silversides congregate in the shallows, generally over sand or gravel bottoms with overhead cover if possible, but then move out to open water in search of additional food, which increases predation risk. They are often observed in a sort of daily migration pattern as a result. Inland Silversides are currently an EPA approved indicator species for acute marine aquatic toxicity testing and short-term chronic toxicity estimating of marine and estuarine organisms.

Mississippi Silverside- Mississippi silversides (*Menidia audens*) are most common in shallow, warm water lakes, reservoirs, and estuaries. They school here in very large numbers, concentrated near protected areas with sand or gravel bottoms. Temperatures between 20°C and 25°C are preferred but Mississippi silversides have been found in waters as cold as 8°C and as warm as 34°C. They can also withstand salinities up to 33 ppt, but 15 ppt is the optimal salinity for larval growth. This hardiness allows them to do well in disturbed areas with heavy amounts of agricultural pollution. Schools are organized by size and make dramatic group movements within a lake circling each other in patterns or crossing over one another with no mixing of the two sizes. Feeding occurs in deep water but Mississippi silversides are a common prey choice and will quickly return to shallow areas for protection. Zooplankton is their main prey followed by copepods and cladocerans and peak feeding hours are 1 to 3 hours after daybreak and just before dusk.

Spawning occurs any time of the day in April-September when temperatures are between 15°C and 30°C. Groups of males wait in beds of aquatic vegetation for a school of females to pass and then chase after a single or pair of females. The males will nip at her swollen abdomen until she settles into the vegetation bed where the group quivers violently and releases eggs and milt together. The eggs are attached to the substrate and stay there on their own until they hatch 4-30 days later. The young are planktonic for several weeks until they join a larger school. They will grow to 8-10 cm in their first year and most die immediately after spawning in their 1st or 2nd summer. A single female could produce 200-2,000 eggs per day for 3 months in proper conditions but most die before that 3 month time is complete.

Spawning

From the biological and creel surveys and reports, fish spawning periods have been well-studied and information on fish spawning periods is readily available. Table 18 includes the primary periods of reproduction when larval recruitment occurs, which also coincides with peak abundance for the fish taxa that have been reported to be found above and below the PDW CWIS.

Spawning in the Tennessee River and Pickwick Reservoir may be influenced by environmental variables including water temperature, river stage, and photoperiod. These variances in spawning are independent of any CWIS. Variances that are considered when a CWIS is of concern are spawning habitat, fecundity, and spatial distribution. The study completed upstream and downstream of BFN calculated impingement and entrainment rates and found that abundance also plays a role on these rates. The more abundant a species is, the more likely it is to be impinged or entrained. For example, freshwater drum spawn in open water while shad spawn near shore and each female produces thousands of eggs, creating areas in the reservoir with high densities of fish eggs and larvae. As these areas of high density larvae and eggs drift around, their rate of entrainment may significantly increase. Juvenile and adult clupeids move throughout the reservoir in large schools, consequently, a large school near a CWIS would have a significantly larger impingement and entrainment rates (Baxter *et al.*, 2006).

The same BFN entrainment and impingement study looked at egg and larval rates of entrainment. To estimate the BFN's entrainment rate fish eggs and larvae samples were collected upstream of BFN to estimate densities of fish eggs and larvae that were drifting in the water column past the intake structure and took samples from the intake basin near the skimmer wall. There were 20 samples taken weekly between late March and early July 2003. The results can be detailed in Table 19. Clupeidae eggs and larvae were more likely to be entrained than any other family collected (Baxter *et al.*, 2006).

Data representative of the seasonal spawning activities of the fish in the vicinity of the PDW CWIS can be found above in Table 18. Additional seasonal and abundance data for the biological studies completed in the general vicinity of the PDW CWIS can be found in Table 20. Due to the similarity among Tennessee River reservoir fish assemblages, AST can reasonably expect similar species are present at the location of the PDW CWIS at TRM 258.2, and that these seasonal spawning activities of fish apply to the PDW CWIS.

4.5 Threatened, endangered and other protected species (r)(4)(vi)

Review of the United States Fish and Wildlife (USFWS) Threatened and Endangered List on December 22, 2018 for Colbert County, Alabama identified 29 aquatic species (Table 21). However, in the review of the biological reports and surveys only two listed mussel species have been found in the vicinity of PDW CWIS. The mussel survey identified Pink mucket, *Lampsilis abrupta*, and Rough pigtoe, *Pleurobema plenum*, during the course of the seven year study by ADCNR. However, never have more than two individuals of either species been found during a given year, and in only two years have both been encountered. *Lampsilis abrupta* and *P. plenum* appear to be so rare in the study reach that finding one or both in 120 samples is not assured, so their absence in 2016 does not appear to be cause for alarm (Garner and Holifield, 2017). Appropriate habitat for the federally listed pink mucket and Rough pigtoe is present in the vicinity of the PDW CWIS. However, given the rarity of these listed species, their benthic habitat requirements, and that PDW CWIS has been in operation since 1952, AST expects the PDW CWIS will have no impact on federally listed species.

4.6 Federal and State Agency Consultation (r)(4)(vii)

Formal agency consultation is not required at this time for permit renewal. Therefore, the Facility has not conducted consultation with state or federal agencies nor has sought the need for an incidental take permit or authorization related to federally or state protected species under the protection of the USFWS or National Marine Fisheries Service (NMFS). However, a 60-day review by the USFWS is required for all permit applications upon receipt by the ADEM under a Memorandum of Agreement (MOA). Based upon the current regulations and/or requirements of the ADEM, the permittee must evaluate the environmental impacts of their CWIS by characterizing the fish and shellfish in the vicinity of the CWIS and assessing impingement mortality and entrainment.

5.0 Cooling Water System Data (40 CFR 122.21(r)(5))

The cooling water system data is required to characterize the operation and use of the CWIS. The following provides the cooling water system data for PDW CWIS.

The PDW CWIS used by OxyChem consists of a single intake, bar screens, three 100% capacity traveling screens (with a flow through area of 123 sq. ft. and through screen design intake flow velocity of 0.23ft/sec), and three river intake pumps, as well as the water pipe lines from the CWIS to the Facility (Figure 11). The maximum total design intake volume for PDW CWIS is 38.9 MGD. The ratio of the design intake flow rate to the source waterbody mean annual flow rate is 0.11% for the PDW CWIS, well below the 5% criterion. The typical average flows for the intake water is approximately 8.1 MGD which is <0.023% of source waterbody mean annual flow (approximately 54,900 cfs or 35,483 MGD) withdrawn on a daily basis and is <0.18% of the 7Q10 (7,131 cfs or 4,609 MGD) of the Tennessee River near the Facility. OxyChem uses 8.1 MGD from the Tennessee River of which approximately 2.88 MGD (based on average intake volume) is used for cooling water (35.5% of intake). The 2.88 MGD river water used by OxyChem for cooling represents <0.009% of source waterbody mean annual flow used on a daily basis and is <0.07% of the 7Q10 of the Tennessee River near the Facility. The water balance and distribution system diagram for OxyChem is in Figure 10.

OxyChem operates twenty-four hours per day, 365 days annually and is only non-operational during scheduled down time. Seasonal variation in cooling water requirements is believed to occur due to environmental factors with less water required in winter months and additional water required in the summer months. However, OxyChem typically uses the Fleet Hollow CWIS. The PDW CWIS is only utilized when the water temperature at the Fleet Hollow CWIS is too high or the Fleet Hollow CWIS is down for maintenance. There is no set number of pumps that operate at any given time, although typically only a single pump is in operation at any given time. The three intake pumps have design capacities of 10.0, 12.9, and 12.9 MGD, respectively (Table 2).

6.0 Chosen Method of Compliance with Impingement Mortality Standard (40CFR 122.21(r)(6))

The Impingement Options for complying with the impingement standards of 40 CFR 125.94(c) include the following:

Section	Compliance Option	Description
(c)(1)	Closed-cycle recirculating system.	Wet, dry or hybrid cooling towers, a system of impoundments that are not waters of the United States, or any combination thereof.
(c)(2)	0.5 feet/second Through-Screen Design Velocity	The maximum design intake velocity as water passes through the structural components of a screen measured perpendicular to the screen mesh does not exceed 0.5 feet/second under all intake water conditions.
(c)(3)	0.5 feet/second Through-Screen Actual Velocity	The maximum actual operating intake velocity as water passes through the structural components of a screen measured perpendicular to the screen mesh does not exceed 0.5 feet/second under all intake water conditions.
(c)(4)	Existing offshore velocity cap	An existing offshore velocity cap as defined at 40 CFR 125.92(v) that was installed on or before Oct. 14, 2014.
(c)(5)	Modified traveling screens	A modified traveling screen as defined in 40 CFR 125.92(s).
(c)(6)	Systems of technologies	Combination of technologies, management practices and operational measures that reduce impingement.
(c)(7)	Impingement mortality performance standard	A 12-month impingement mortality performance standard of all life stages of fish and shellfish of no more than 24 percent mortality, including latent mortality.

OxyChem meets (c)(2) and (c)(3) on the Impingement Options for complying with the impingement standards of 40 CFR 125.94(c). For (c)(2) a maximum 0.5 ft/sec through-screen design velocity is required. The PDW CWIS through-screen design velocity is 0.23ft/sec assuming maximum total design intake of 38.9 MGD with three pumps. For (c)(3) a maximum actual operating through-screen velocity 0.5 ft/sec is required. Average intake flows are approximately 8.1 MGD with only one of two intakes operating which provides a through-screen actual velocity of 0.068ft/sec. The PDW CWIS uses three 100% capacity traveling screens with a flow through area of 123 sq. ft. and with a 3/8" mesh. The Facility complies with the standards of 40 CFR 125.94(c) through both Option (c)(2) and (c)(3).

7.0 Entrainment Performance Studies (40 CFR 122.21(r)(7))Water System Data (40 CFR 122.21(r)(7))

No entrainment mortality studies have been conducted on site at the PDW CWIS.

Through an extensive search, no available entrainment data were identified for other nearby facilities. The closest study that was identified was 35.7 miles upstream at BFN located at River Mile 294. However, AST believes the BFN study provides a good representation of entrainment at the PDW CWIS. The following is the information collected by TVA at their BFN Plant in 2003-2004.

Sample Collection:

To estimate BFN's plant entrainment rate, ichthyoplankton (fish eggs and larvae) samples were collected upstream at TRM 294.5 to estimate densities of fish eggs and larvae in the water column flowing past the plant and in the intake basin near the skimmer wall. Twenty samples were collected weekly from late March through early July in 2003 and 2004. Eight reservoir samples (four day and night) were collected at three stations; a full stratum sample on both left and right over banks; and two mid-channel stratified samples, surface to mid-depth and mid-depth to near bottom. Twelve samples (six day and night) were collected in the intake basin near the skimmer wall. Samples were collected with a beam net 0.5 m square, 1.8 m long, with 505 μm "nitex" mesh netting. Nets were equipped with a large-vanned General Oceanics flowmeter® used to measure sample volume. Reservoir samples were ten-minute upstream oblique tows with a boat speed of 1 m/sec, filtering approximately 150 m³ of water. Intake samples were passive, collected in the inflow of the Condenser Cooling Water (CCW) under the skimmer wall gates, and volume filtered during the ten-minute sample was dependent on intake velocity.

Sample Processing:

In the laboratory, all fish eggs and larvae were removed from each sample, identified to the lowest practical taxon, and enumerated. Taxonomic decisions were based on TVA's "Preliminary Guide to the Identification of Larval Fishes in the Tennessee River" (Hogue *et al.*, 1976) and other pertinent literature. The term "unspecified" preceding a taxon indicates taxonomic resolution is not practical beyond this level and "unidentifiable" indicates the specimen(s) were mutilated. A minimum of 100 specimens of each taxon were measured to the nearest millimeter to obtain length frequency data.

Data Analysis:

Data were summarized by type (eggs or larvae), family, number, composition, and relative abundance. Relative abundance of fish eggs and larvae is presented as numbers per 1000 m³ of water sampled. Estimated entrainment is derived from the formula:

$$E = \frac{100 D_i Q_i}{D_r Q_r}$$

where,

D_i = mean density (N/1000 m³) of eggs or larvae in intake samples

D_r = mean density (N/1000 m³) of eggs or larvae in river

Q_i = plant intake water demands (m³/day)

Q_r = river flow (m³/day)

Temporal occurrence and relative abundance were evaluated for each significant taxon.

Results:

Densities of fish eggs and larvae are expressed as numbers per volume of water sampled. Average volume (m³) of water filtered in each intake sample was consistently less than the volume filtered in reservoir samples; however, more samples were collected each sampling period in the intake. To evaluate volume filtered per sampling period in the intake and reservoir, the total volume of water filtered in the twelve intake samples was compared to the total volume filtered in the eight reservoir samples (Table 22). In 2003, an average of 1,137 m³ of water was filtered per sampling period in the intake and 1,218 m³ in the reservoir. Total water filtered in the 2004 intake sampling averaged 1,087 m³ per sampling period and 1,277 m³ in the reservoir. Therefore, densities of fish and eggs in the intake and reservoir were calculated based on similar sample volumes. Tables 23 and 24 present scientific and common names of taxa collected in the 2003 and 2004 study and the taxonomic resolution used in processing samples. Although identification to subfamily, genus, or species was possible for some individuals, results are presented by family for comparative analysis.

Fish Eggs:

A total of 25,364 fish eggs representing four families was collected during the two year project. Freshwater drum eggs comprised 94% of the eggs collected (Table 25). The only other taxon collected in significant numbers were clupeids, comprising 5.5% of total eggs collected.

Drum egg densities were higher in 2004, 577/1000 m³ in the intake basin and 693/1000 m³ in the reservoir, than observed in 2003, 76/1000 m³ and 376/1000 m³, respectively (Table 26). In 2003, drum eggs were collected May 1 through July 3 and April 23 through July 8 in 2004. Peak density occurred on May 29 in 2003, 763/1000 m³, and on May 20 in 2004, 3771/1000 m³.

Densities of shad eggs were similar in 2003 and 2004, 28/1000 m³ and 26/1000 m³, respectively. Although densities were similar, spatial distribution differed with abundance greater in the intake in 2003 and the reservoir in 2004 (Table 26). Shad eggs were collected April 17 through June 26 in 2003 with a peak density (124/1000 m³) occurring May 1. In 2004, shad eggs were collected from April 22 through July 8; however, 93% of the season total were collected on May 13, with a density of 880/1000 m³.

Larval and Juvenile Fish:

A total of 476,434 fish representing twelve families was collected in 2003 and 2004 entrainment sampling. In the reservoir samples, fish densities averaged 3,857/1000 m³ and intake samples averaged 2,836/1000 m³ (Table 26). Fish densities were higher in 2004 than observed in 2003, primarily a result of the high numbers of shad. Ninety five percent of the total number of fish collected were shad; other families contributing at least 1% of total composition were temperate basses 1.8%, sunfishes 1.0%, drum 1.1%, and silversides 1.0% (Table 25). Shad densities were significantly higher in 2004, 3,656/1000 m³, than observed in 2003, 2,671/1000 m³. Shad were collected from early April to early July in both 2003 and 2004; however, peak densities occurred earlier in the season in 2004. In 2003, densities peaked on June 12, 13,319/1000 m³, and on May 13 in 2004, 35,282/1000 m³.

Temperate basses in Wheeler Reservoir include three *Morone* species: striped bass, yellow bass, and white bass. *Morone* were collected during all sampling periods in both 2003 and 2004 averaging 122/1000 m³. During the two year evaluation, densities ranged from 170/1000 m³ in 2003 to 79/1000 m³ in 2004. Typically, *Morone* are among the earlier spawners in Wheeler Reservoir; a trend reflected in this study. Densities were greater in April and early May in both 2003 and 2004 with peak density of 1,350/1000 m³ occurring April 3, 2003. Centrarchids (sunfishes) averaged 22/1000 m³ in 2003 and 100/1000 m³ in 2004. In 2003, peak centrarchid densities occurred in June and in 2004 the peak occurred in May. Composition of the three genera of centrarchids collected in entrainment samples was crappie (5%), black basses (4%), and lepomis (91%).

Average freshwater drum density was significantly higher in 2003 (138/1000 m³) than observed in 2004 (14/1000 m³). Freshwater drum larvae were collected late April through early July with peak density occurring on June 19 in 2003 (771/1000 m³) and on May 27 in 2004 (70/1000 m³).

Silversides averaged 11/1000 m³ in 2003 entrainment samples and 120/1000 m³ in 2004. Silversides were collected early April through early July with peak densities occurring June 19 in 2003 (20/1000 m³) and May 13 in 2004 (706/1 000 m³). Both brook and inland silverside occur in Wheeler Reservoir; however, all late post yolk-sac larvae and juveniles collected were inland silversides.

Hydraulic Entrainment Estimates:

The hydraulic entrainment estimate for all sampling periods, 2003 and 2004 combined, averaged 8.4%. In 2003, hydraulic entrainment estimate averaged 6.2% (range 4 to 27.6%) and in 2004 averaged 12.7% (range 5.9 to 42%) (Table 27). A decrease in river flow past BFN during most of the 2004 sampling season was the most significant contributing factor to the higher entrainment in 2004. Estimated daily CCW intake was consistent during entrainment sampling in 2003 and 2004; however, average daily volume transported past BFN was $1.3 \times 10^8 \text{ m}^3$ in 2003 and decreased to $6.0 \times 10^7 \text{ m}^3$ in 2004.

Fish Entrainment Estimates:

Entrainment estimates for all numerically significant taxa of fish eggs and larvae were higher in 2004 (Table 28). The entrainment rate for fish eggs was 1.3% in 2003 and 18.8% in 2004. An estimated 4.5% of fish larvae transported past BFN were entrained in 2003 compared to 18.7% in 2004. The overall entrainment estimate based on the two year study averaged 7.6% for fish eggs and 10.8% for larval fish. Spatial-temporal distribution varied significantly between sampling periods and stations for both fish eggs and larvae, demonstrating the heterogeneous distribution of individuals both vertically and horizontally in the water column. The unrealistically high entrainment estimate (18.8%) for shad eggs in 2004 is an example of this distribution pattern. In 2004, a total of 922 shad eggs was collected during the sampling season and 859 of these were collected May 13. The majority of these were found in intake samples and only two in samples collected in the reservoir immediately upstream from BFN intake structure. Similar events may have contributed to the fluctuations in entrainment estimates for other taxa.

Historical Comparisons:

The methodology used to estimate entrainment at BFN was changed in 1977. Prior to 1977, reservoir ichthyoplankton populations were estimated based on data collected at three transects in Wheeler Reservoir. Entrainment estimates were calculated by comparing reservoir populations with data collected in the BFN intake. Beginning in 1977, reservoir sampling was designed to estimate transport of fish eggs and larvae past BFN. Data collected across a single plant transect, located immediately upstream from BFN intake at TRM 294.5, provided estimates of fish transport past BFN and was compared to data collected in the intake to estimate entrainment. The 2003 and 2004 assessment used data collected at TRM 294.5 to estimate transport past BFN; therefore, historical comparisons were limited to baseline data collected in 1977 through 1979. Hydraulic entrainment estimates in 2003 and 2004 were within the range observed in the historical evaluations; the 6.2% in 2003 was near historical lows and the 12.7% in 2004 near the historical high (Table 29). The 2003 and 2004 data demonstrate the significant effect of river flow on the entrainment estimates. The daily rate of entrainment for fish eggs and larvae was similar in 2003 and 2004; however, a significantly higher percentage of the total volume of water

moving past BFN was entrained during the low flow conditions in 2004. Based on historical, 2003, and 2004 data, fluctuations in the annual entrainment estimates at BFN are common.

Entrainment Conclusions at BFN:

Both historical data and the 2003 and 2004 study demonstrate the variability in the occurrence and spatial-temporal distribution of fish in Wheeler Reservoir near BFN. This variability translates into significant fluctuation in the entrainment and impingement rates associated with plant operation. Factors contributing to these fluctuations include year-class strength of individual species, life history of selected species, and the physical parameters of Wheeler Reservoir in the vicinity of BFN. Cyclic variation in the year-class strength of the fish species found in Wheeler Reservoir is well documented. In calculating entrainment and impingement estimates, these variations are exacerbated in scenarios where one or two species represent a high percentage of the total composition, as is the case with clupeids and freshwater drum in the vicinity of BFN. Spawning habitat, fecundity, and spatial distribution of these two species are significant in the fluctuations observed in the entrainment rates at BFN. Freshwater drum spawn in open water while shad spawn near shore and each female produces thousands of eggs, creating areas in the reservoir with high densities of fish eggs and early larvae. As these areas of high density eggs or larvae drift downstream, their occurrence within a sampling area (either intake or reservoir) may significantly affect the entrainment estimate. Juvenile and adult clupeids move in large schools throughout the reservoir; consequently, a large school occurring within a sampling area will significantly affect both entrainment and impingement rates.

The location of BFN is probably a contributing factor to the fluctuations in the annual entrainment estimates. Reservoirs are characterized by three zones; the inflow having characteristics more riverine, the fore bay is a more lacustrine area immediately upstream from a dam, and the transition zone provides a buffer in the middle of the reservoir. As water flows downstream from the inflow, velocity decreases as the cross-sectional area of the reservoir increases. Areas within the transition zone may exhibit high flow, low flow, or even negative flows depending on the rate water is released through the upstream and downstream dams. The area of Wheeler Reservoir near BFN is characterized as a transition zone where the velocity of water flowing past BFN depends on the rate water released through Guntersville and Wheeler Dams. The rate of water flow past BFN increases and the reservoir surface elevation decreases when the rate of water released through Wheeler Dam exceeds the release through Guntersville Dam. Inversely, the surface elevation increases and rate of flow decreases near BFN when rate of water released through Guntersville Dam exceeds the release in Wheeler Reservoir. CCW demand for BFN remains fairly constant during normal two unit operation, therefore, hydraulic and fish entrainment estimates will increase as reservoir flow past BFN decreases. Entrainment at BFN is significantly influenced by the large overbank located immediately upstream from the

intake structure. Historical hydrodynamic studies show 53 to 63 percent of the CCW used by BFN is drawn from this overbank and the quantity of flow along the overbank varies with reservoir stage and flow. Based on the spatial distribution of larval fish collected in 2003 and 2004, this overbank is highly productive and may provide a spawning area and nursery for several species of fish. Densities and composition of fish collected in the 2004 intake sampling suggest a higher percentage of the CCW is drawn from the overbank during low flow thus, elevating the entrainment estimate for these fish species.

TVA's valley-wide vital signs monitoring program is an additional tool used to evaluate the condition of the fish community near BFN. The Reservoir Fish Assemblage Index (RFAI), a component of the vital signs program, is used to evaluate reservoir health by rating the system based on community structure and function. A RFAI sampling station was established upstream from BFN at TRM 295.5 in 1992 and a second transition zone station was added downstream at TRM 292.5 in 2000. Based on RFAI scoring criteria from reservoirs throughout the Tennessee Valley, scores of 51-60 were classified as excellent, 41-50 as good, 21-40 as fair, and 22-31 as poor. As observed in the BFN 316(b) studies, annual RFAI scores in Wheeler Reservoir near BFN vary; scores range from 30 to 47 at TRM 292.5 (1993-2004) and 42 to 45 at TRM 292.5 (2000-2004). Based on the average RFAI scores for all years sampled, the fish community near BFN is classified as "Good," averaging 41 at TRM 295.5 and 43 at TRM 292.5.

The 2003 and 2004 316(b) data and recent fish community assessments in Wheeler Reservoir near BFN show no significant impacts from current operation of BFN on the fish community near the plant. Furthermore, current 316(b) data support conclusions presented in the 1977-1979 historical assessments. Results demonstrate annual variations in the relative abundance and spatial-temporal distribution of fish and fluctuations in reservoir flow are common in the vicinity of BFN. Life cycles of the dominant fish species and fluctuation in reservoir flow past BFN are significant factors influencing variations observed in the annual entrainment estimates. These variations in fish density and reservoir flow in the Wheeler transition zone has apparently had little effect on the fish community. Based on the 2003 and 2004 316(b) evaluation and the annual RFAI scores for Wheeler Reservoir, a viable balanced indigenous aquatic community is present in Wheeler Reservoir in the vicinity of BFN.

Based on the information presented in the aforementioned TVA study (Baxter *et al.* 2006) and due to the similarity among Tennessee River reservoir fish assemblages, AST can reasonably expect similar species are present at the location of the PDW CWIS at TRM 258.2. However, AST expects entrainment of these species to be far less significant than at the BFN because PDW average percent volume hydraulic entrainment at <0.04% is far below the minimum average percent hydraulic entrainment of 6.2% at BFN.

8.0 Operational Status 40 CFR 122.21(r)(7))Water System Data (40 CFR 122.21(r)(8))

Oxychem does not use any intake water from PDW CWIS for power production; however, approximately 0.072 MGD (0.89%) of intake water is used for steam generation for operations at its Muscle Shoals facility.

OxyChem has selected 40 CFR 125.94(c) compliance alternatives (c)(2) and (c)(3) based on a through-screen design velocity of 0.23 ft/sec and 0.048 ft/sec through-screen actual velocity at PDW CWIS.

OxyChem intends to continue the current operational schedule in the future; no increases or reductions in manufacturing are known or foreseen at this time. No installation of new units is currently planned within the next 5 years.

9.0 Summary and Conclusions

OxyChem maintains an NPDES permit through ADEM. The facility withdraws an average of 8.1 MGD of water from the Tennessee River and utilizes more than 25% of the water for cooling purposes. As a result, OxyChem is subject to the CWA Section 316(b) regulations. OxyChem has provided the information as required in 40 CFR 122.21(r)(2-8), including CWIS operation and structural data, source water physical and biological data, and a chosen method of compliance with the impingement mortality standard. Based on the actual intake flow, OxyChem is not required to submit information under paragraphs 40 CFR 122.21(r)(9-14).

Relevant biological data for the Tennessee River are available through publicly available studies conducted by ADCNR, TWRA, USFWS, ALGS, and TVA. Tennessee Valley Authority conducted studies at their Browns Ferry Nuclear (BFN) Plant located upstream of OxyChem in Wheeler Reservoir and Colbert Fossil Plant (COF) downstream from OxyChem in the Pickwick Reservoir. The data collected by TVA and these other sources occurred in 2003-2015; however, they should still be considered relevant to the OxyChem Facility as no major changes in the environmental conditions have occurred that would make these reports inappropriate to use.

The current configuration of the OxyChem facility's PDW CWIS meets the requirement of BTA and would continue to be compliant with the preapproved impingement mortality compliance alternative as referenced in 40 CFR 125.94(c)(2) as the design through-screen velocity is below 0.5 ft/sec and 40 CFR 125.94(c)(3) the actual through-screen velocity is currently below 0.5 ft/sec. Therefore, the PDW CWIS does not represent an adverse impact to aquatic biota for impingement. Also, the low percentage of water withdrawal from the mean annual flow of the Tennessee River suggest that the CWIS operation has minimal effect on aquatic life and offers a potential BTA determination for entrainment at the OxyChem facility. In review of the intake volume for BFN verses the PDW CWIS, the PDW CWIS intake (8.1 MGD) is 0.4% of the average estimated intake volume for the BFN (2,066 MGD); therefore OxyChem's environmental impacts via the PDW CWIS should be significantly less than that of BFN. The BFN facility is documented as in compliance with the BTA, therefore, by extension, it can be concluded that OxyChem's PDW CWIS entrainment should also meet the BTA for entrainment. The selected compliance alternative for impingement is a preapproved BTA by EPA and no additional reporting should be necessary upon approval from ADEM.

10.0 References

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11.0 Figures and Tables

Figure 1. Topographic map showing location of Occidental Chemical Corporation in Muscle Shoals, AL.

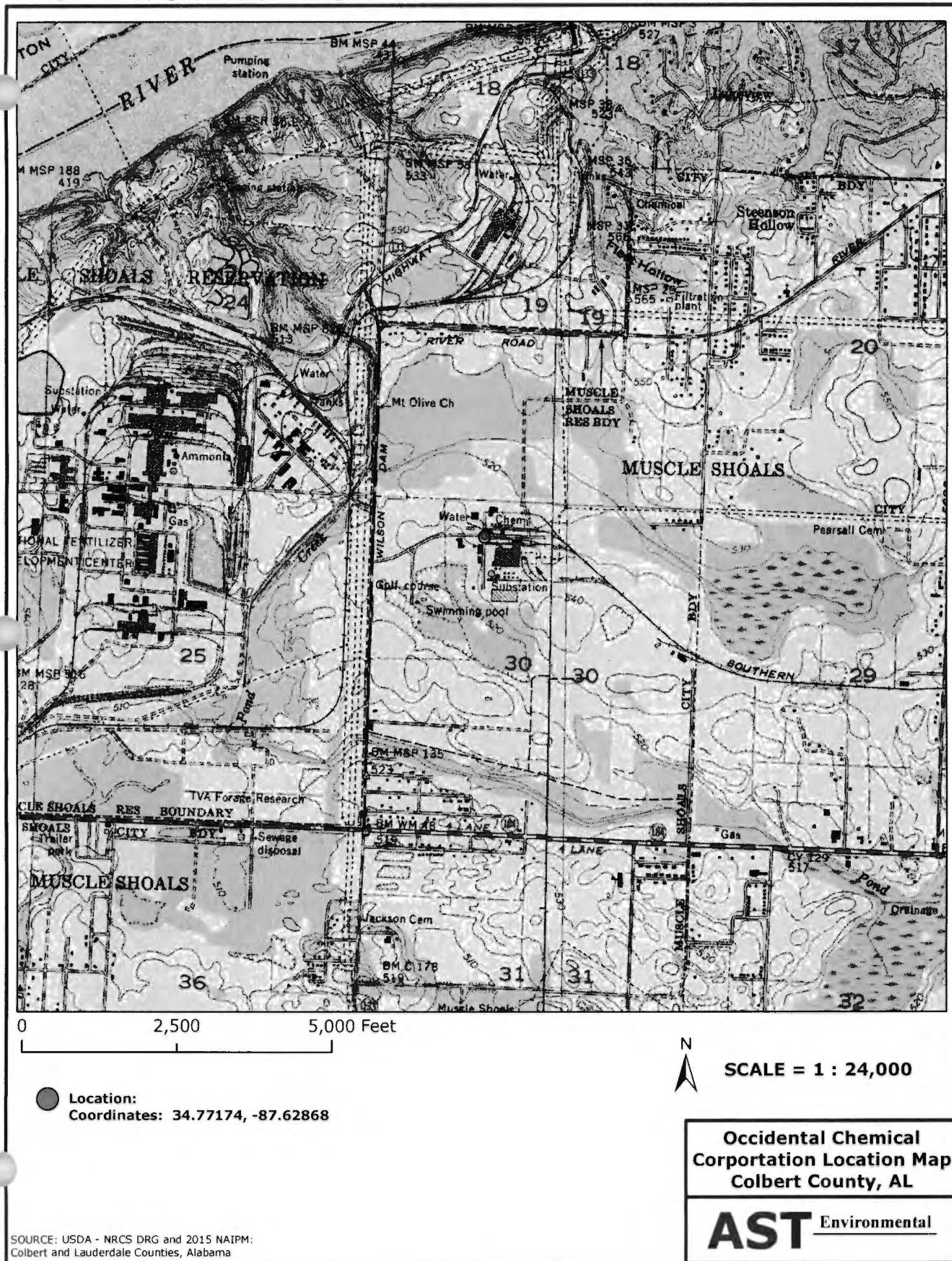


Figure 2. Aerial photograph showing location of Occidental Chemical Corporation in Muscle Shoals, AL.



Figure 3. Topographic map showing location of the Phosphate Development Works (PDW) CWIS.

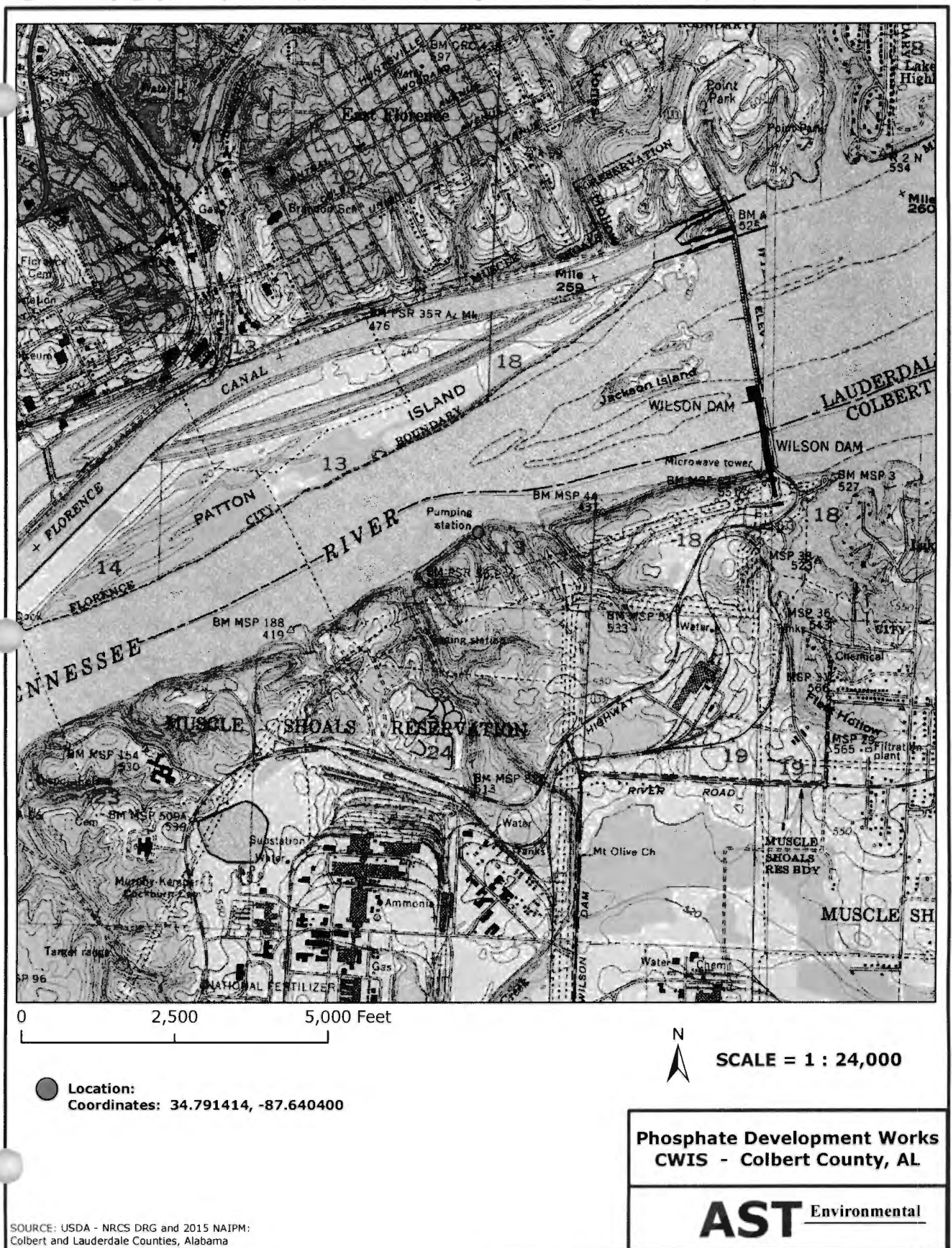


Figure 4. Aerial photograph showing location of the Phosphate Development Works (PDW) CWIS.



Mean Monthly Discharge 1936-2005 Tennessee River

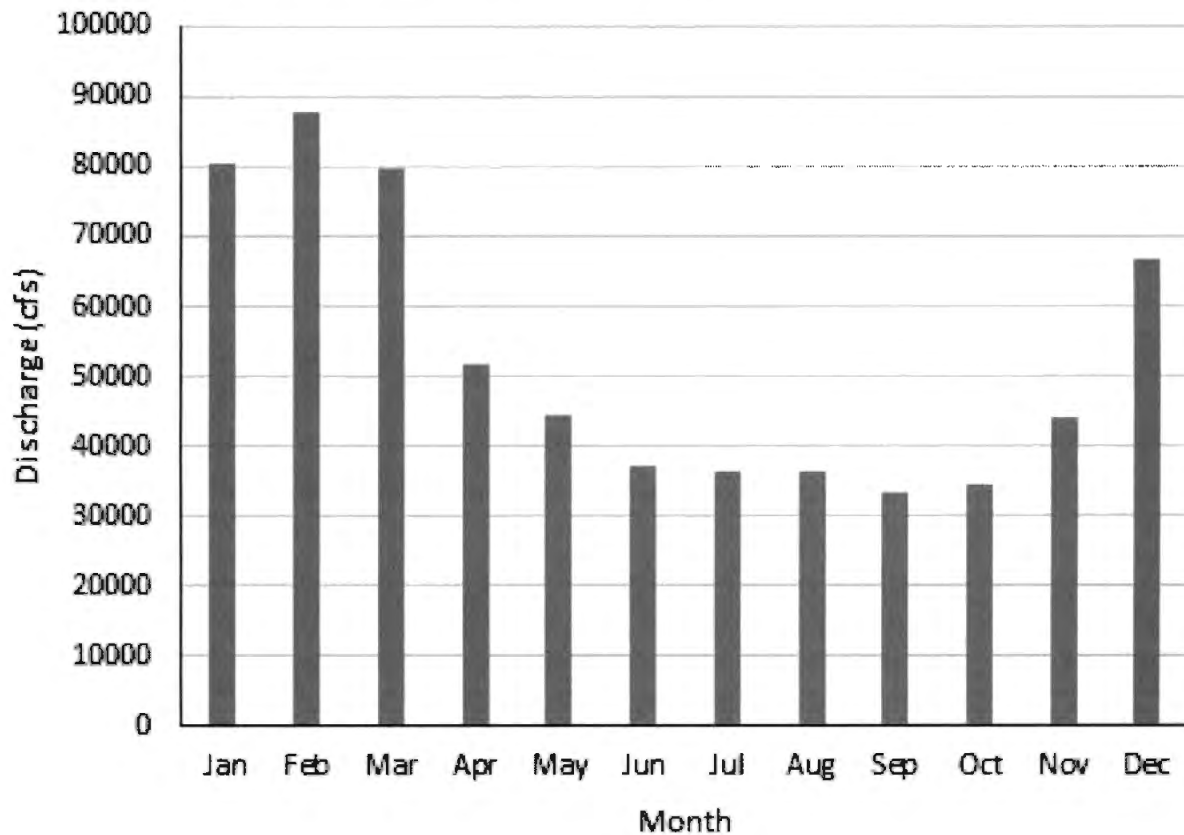


Figure 5. Mean monthly discharge (cfs) of the Tennessee River at Florence, AL.

USGS https://waterdata.usgs.gov/nwis/monthly?referred_module=sw&site_no=03589500&por_03589500_2702=848982,00060,2702,1894-10,2005-11&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list.

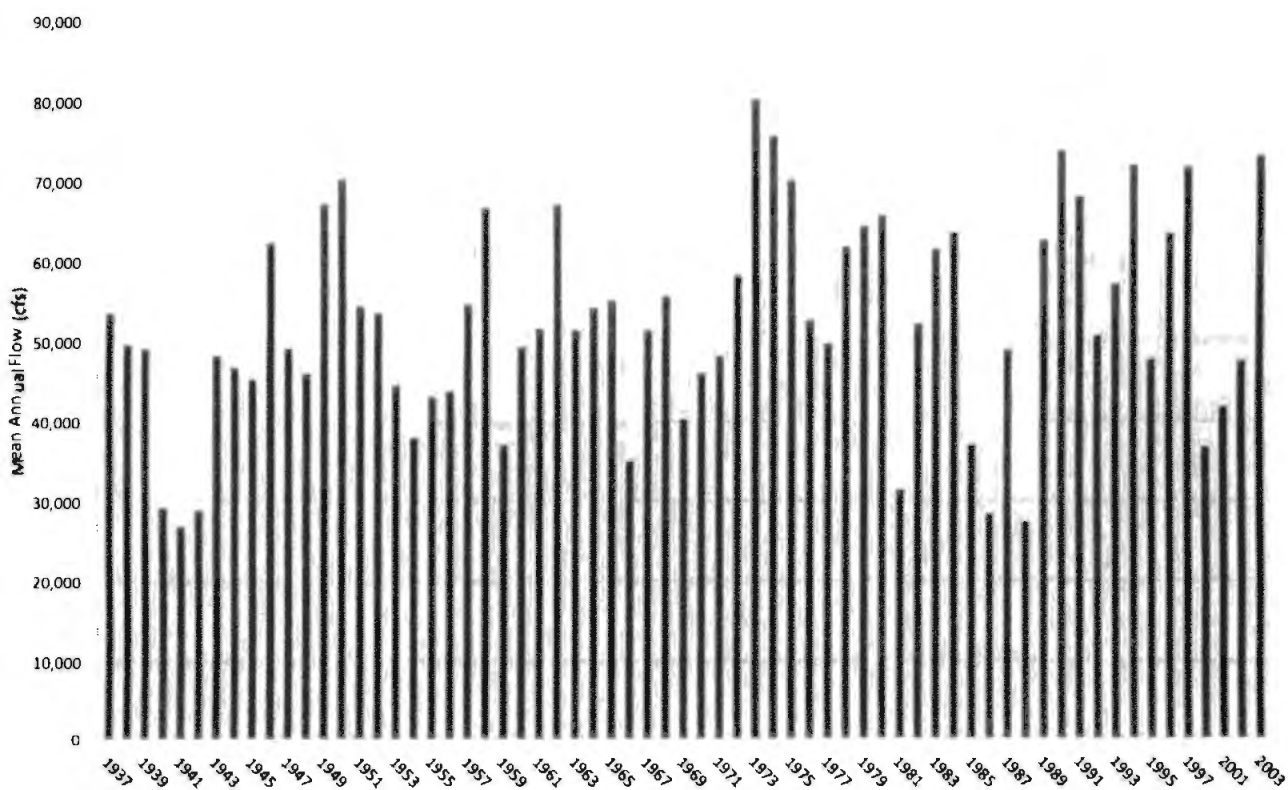


Figure 6. Mean Annual Flow (cfs) of the Tennessee River at Florence, AL 1937-2003.

USGS 03589500 TENNESSEE RIVER AT FLORENCE AL
https://waterdata.usgs.gov/al/nwis/uw/?site_no=03589500

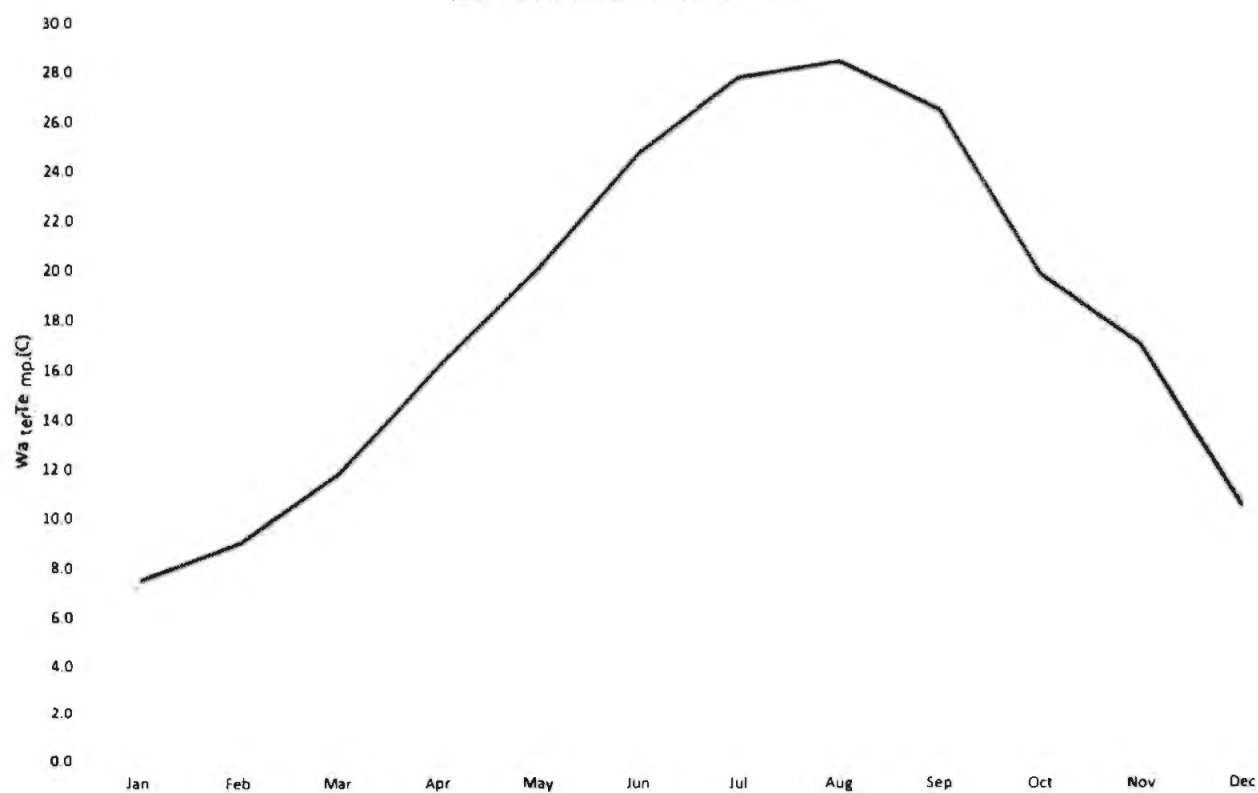


Figure 7. Mean Monthly Water Temperature ($^{\circ}\text{C}$) of the Tennessee River at Florence, AL 1965- 2005.

USGS 03589500 TENNESSEE RIVER AT FLORENCE AL
https://waterdata.usgs.gov/al/nwis/uv/?site_no=03589500

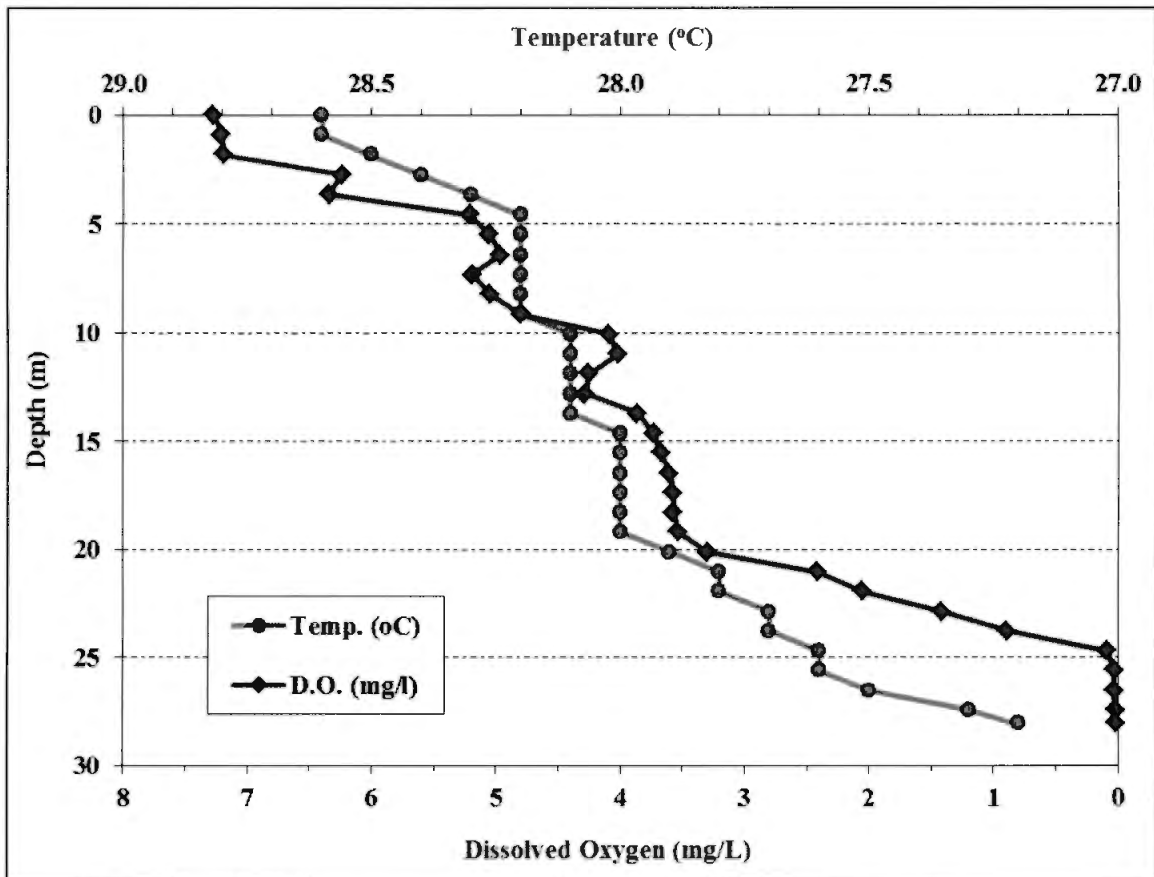
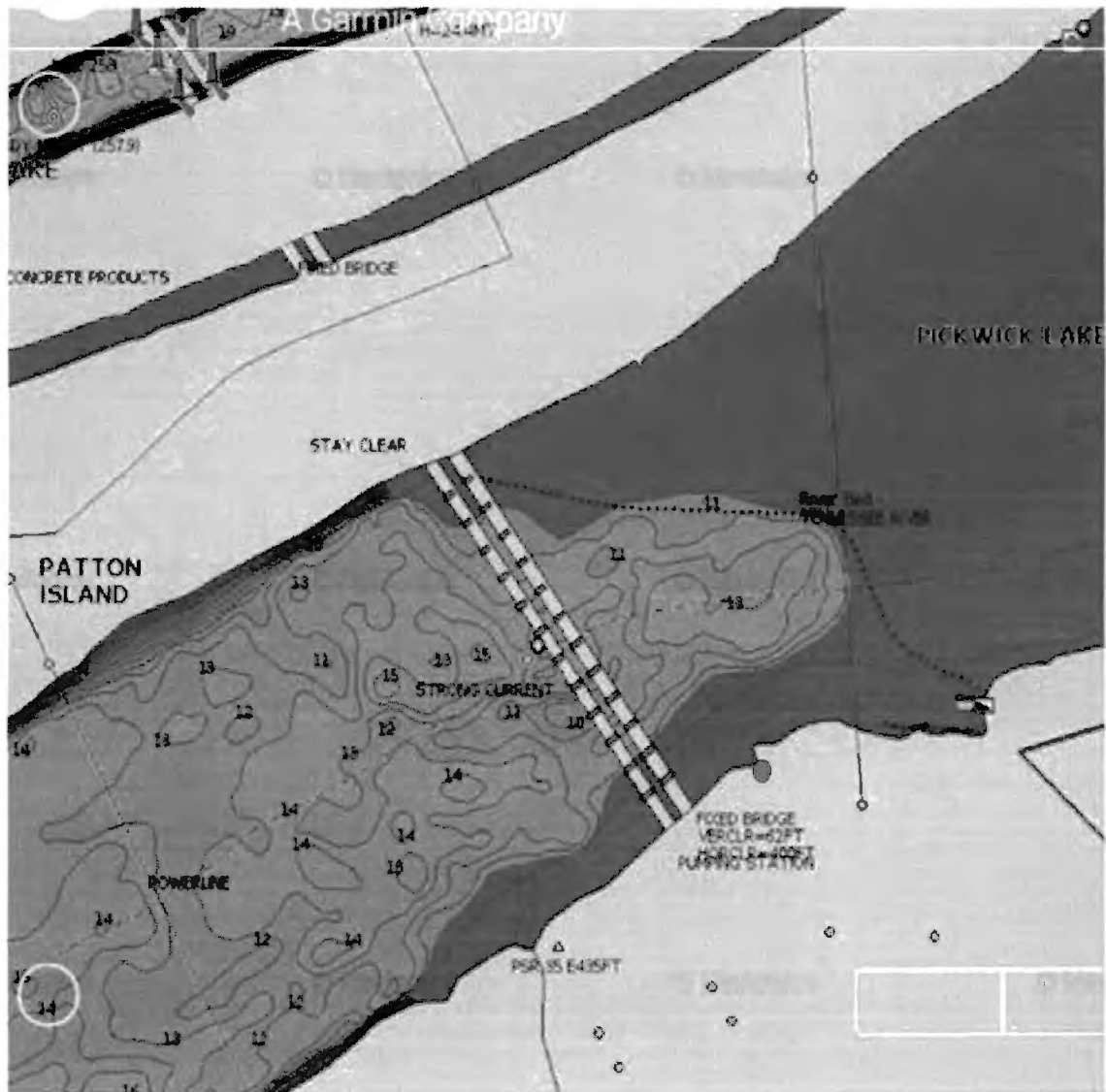


Figure 8. Temperature (°C) and dissolved oxygen (mg/l) profiles at the dam forebay of Wilson Reservoir on August 23, 2017 (Ekema et al 2017).

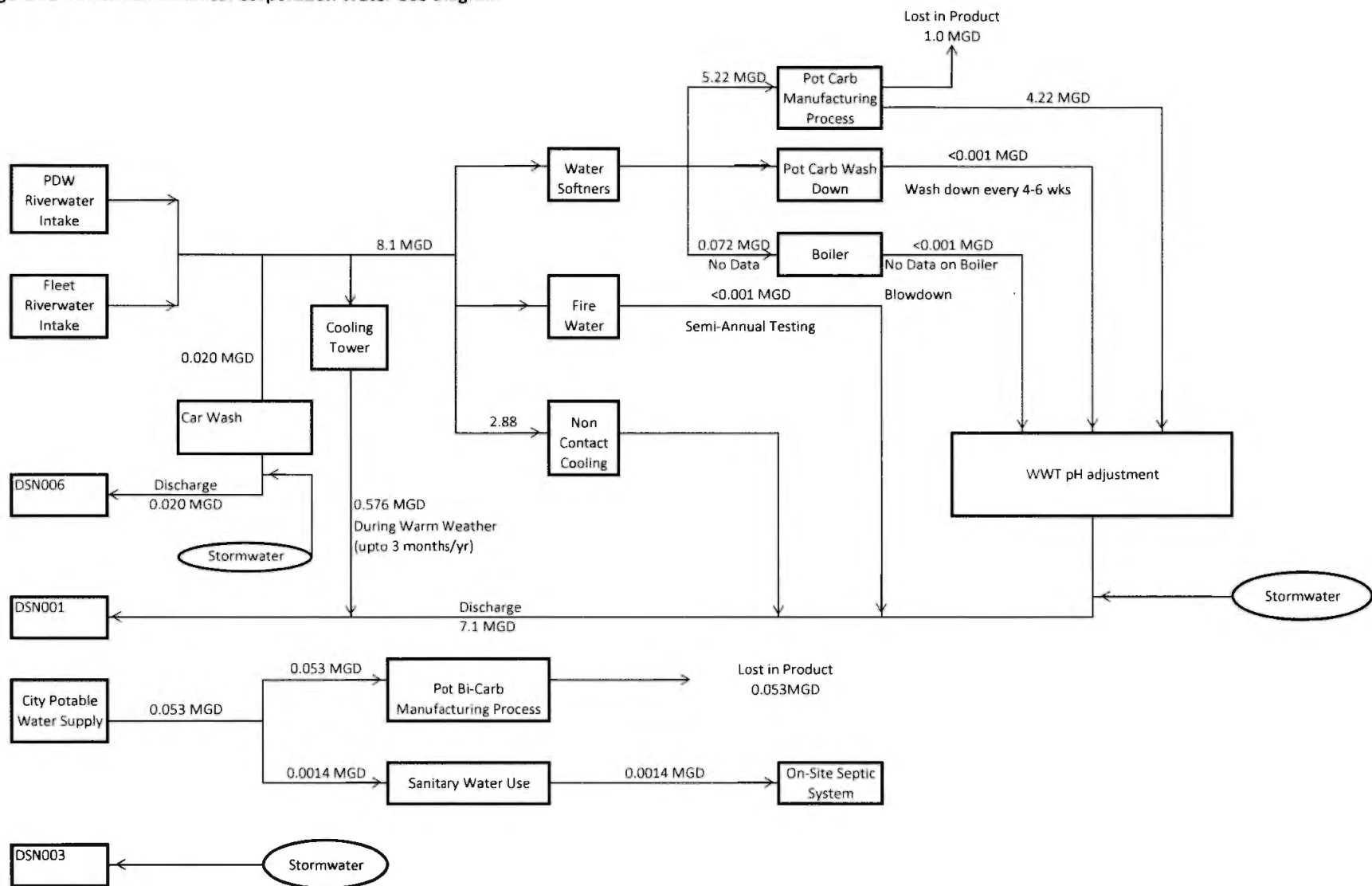
Figure 9. PDW CWIS bathymetric map.



● = PDW CWIS

<https://webapp.navionics.com/?lang=en#boating@15&key=%7DzisEnzxuO>

Figure 10 Occidental Chemical Corporation Water Use Diagram



All Flows in MGD - Million Gallons Per Day

Figure 11. PDW TVA CWIS design drawing.

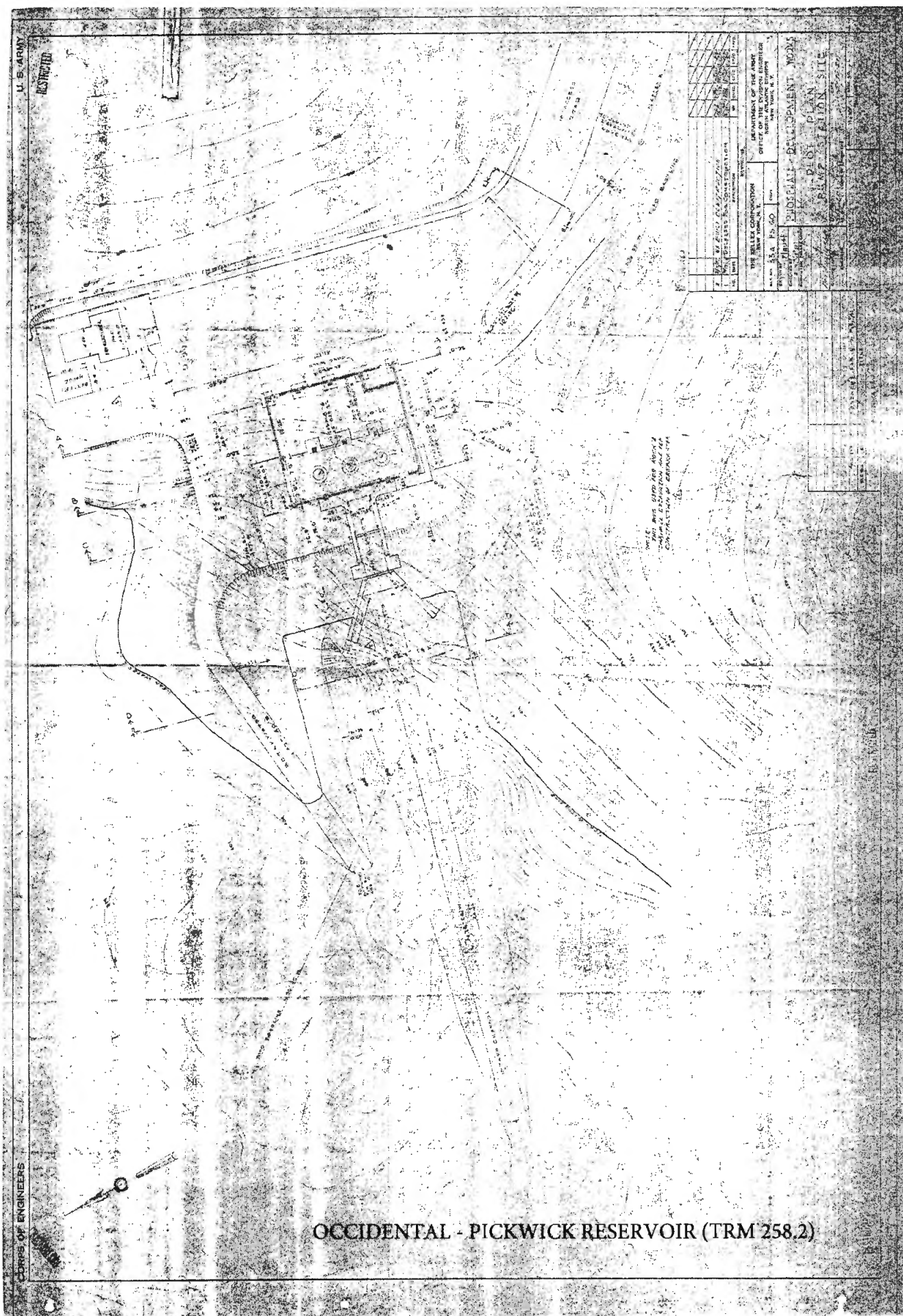


Table 1. Pickwick Reservoir morphometric and physical characteristics (Ekema et al., 2009).

Surface area	43,100 acres
Drainage area	32,820 sq. mi.
Full pool elevation	414 feet-msl
Mean annual fluxuation	6 feet
Shoreline distance	496 miles
Shoreline development index	14.1
Mean depth	21.4 feet
Maximum depth	59 feet
Outlet depth	57 feet
Chlorophyll a (dam forebay)	15.42 ug/l (2000-2004 mean) (TVA unpublished)
Total dissolved solids	92.6 mg/l
Morphoedaphic index	4.3 TDS/mean depth(ft) (Ryder 1965)
Growing season	188 frost free days (Jenkins 1967)
Year of Impoundment	1938

Table 2. PDW CWIS data.

<u>PDW PUMPS</u>			
Pump Number	1	2	3
Date water intake installed	1952	1952	1952
What depth is intake	7.5'	7.5'	7.5'
Maximum pumping capacity in gallons per day	10.0 MM	12.9 MM	12.9 MM
Mesh size of intake	3/8"	3/8"	3/8"
Mechanism for cleaning screen	Rotating screen with backwash	Rotating screen with backwash	Rotating screen with backwash
Fish detraction technology on intake	2.5" Bar Screens on river intake - 1.5" Bar Screens on pumps	2.5" Bar Screens on river intake - 1.5" Bar Screens on pumps	2.5" Bar Screens on river intake - 1.5" Bar Screens on pumps

Table 3. Individual metrics observed by TVA near Brown's Ferry Nuclear facility (BFN), Autumn 2008.

Metric		TRM 282.5		TRM 293.9	
A. Species Richness and Composition		Observed		Observed	
1. Number of Indigenous Species		28		26	
2. Number of Centrarchid Species		6	Green Sunfish Bluegill Longear Sunfish Warmouth Black Crappie Redear Sunfish	7	Green Sunfish Bluegill Longear Sunfish Warmouth Redear Sunfish White Crappie Black Crappie
3. Number of Benthic Invertivore Species		5	Spotted Sucker Black rehorse Golden Redhorse Freshwater Drum Logperch	4	Spotted Sucker Northern Hog Sucker Freshwater Drum Logperch
4. Number of Intolerant Species		5	Spotted Sucker Skipjack Herring Black rehorse Longear Sunfish Smallmouth Bass	5	Spotted Sucker Northern Hog Sucker Skipjack Herring Longear Sunfish Smallmouth Bass
5. Percent Tolerant Individuals	Electrofishing	37.40%	Bluegill 10.30% Gizzard Shad 19.30% Largemouth Bass 7.20% Spotfin Shiner 0.20% Green Sunfish 0.30%	50.60%	Bluegill 8.20% Gizzard Shad 31.70% Common Carp 0.30% Largemouth Bass 9.40% Spotfin Shiner 0.20% Golden Shiner 0.20% Green Sunfish 0.40%
	Gill Netting	23.60%	Gizzard Shad 14.10% Common Carp 0.50% Bluegill 1.00% Largemouth Bass 8.00%	32.10%	Gizzard Shad 12.30% Common Carp 0.50% Bluegill 3.20% Largemouth Bass 7.00% Longnose Gar 4.80% Golden Shiner 2.70% White Crappie 1.60%
6. Percent Dominance by one Species	Electrofishing	52.70%	Inland Silverside	31.70%	Gizzard Shad
	Gill netting	28.60%	White Bass	19.80%	Channel Catfish
7. Percent Non-Indigenous Species	Electrofishing	52.70%	Inland Silverside 52.70%	29.50%	Inland Silverside 29.00% Atlantic Needlefish 0.10% Common Carp 0.30%
	Gill Netting	0.5%	Common Carp 0.50%	1.6%	Common Carp 0.50% Striped Bass 1.10%
8. Number of Top Carnivore Species		10	Spotted Gar Largemouth Bass Spotted Bass Smallmouth Bass Skipjack Herring Flathead Catfish White Bass Yellow Bass Black Crappie Sauger	11	Longnose Gar Spotted Gar Largemouth Bass Spotted Bass Smallmouth Bass Skipjack Herring Flathead Catfish White Bass Yellow Bass Black Crappie White Crappie
B. Trophic Composition					
9. Percent Top Carnivores	Electrofishing	8.50%	Largemouth Bass 7.20% Spotted Bass 0.20% Smallmouth Bass 1.00% Flathead Catfish 0.06%	12.60%	Largemouth Bass 9.40% Spotted Bass 0.70% Smallmouth Bass 0.70% Flathead Catfish 0.30% White Bass 0.20% Yellow Bass 1.00% Spotted Gar 0.20%
	Gill Netting	61.30%	Spotted Gar 0.50% Largemouth Bass 8.00% Spotted Bass 1.00% Skipjack Herring 15.60% Flathead Catfish 4.50% White Bass 28.60% Yellow Bass 1.50% Black Crappie 0.50% Sauger 1.00%	39.60%	Longnose Gar 4.80% Largemouth Bass 7.00% Spotted Bass 1.60% Skipjack Herring 1.60% Flathead Catfish 2.10% White Bass 14.00% Yellow Bass 5.30% White Crappie 1.60% Black Crappie 0.50%
10. Percent Omnivores	Electrofishing	20.70%	Gizzard Shad 19.30% Channel Catfish 1.20% Blue Catfish 0.20%	38.50%	Gizzard Shad 31.70% Channel Catfish 5.80% Smallmouth Buffalo 0.40% Common Carp 0.30% Golden Shiner 0.20%
	Gill Netting	26.60%	Gizzard Shad 14.10% Blue Catfish 6.00% Channel Catfish 3.50% Smallmouth Buffalo 2.00% Black Buffalo 0.50% Common Carp 0.50%	54.20%	Gizzard Shad 12.30% Blue Catfish 5.30% Channel Catfish 19.80% Golden Shiner 2.70% Smallmouth Buffalo 3.70% Common Carp 0.50%
C. Fish Abundance and Health					
11. Average Number Per Run	Electrofishing	112.2		59.9	
	Gill netting	19.9		18.7	
12. Percent Anomalies	Electrofishing	0.40%		1.00%	
	Gill netting	0.50%		0.50%	

Table 4. Individual metrics observed by TVA near Brown's Ferry Nuclear facility (BFN), Autumn 2009.

Metric		TRM 292.5		TRM 295.9	
Observed		Observed		Observed	
A. Species Richness and Composition					
1. Number of Ingenious Species		27		26	
2. Nubmer of Centrarchid Species		7		6	
		Black Crappie		Black Crappie	
		Bluegill		Bluegill	
		Green Sunfish		Green Sunfish	
		Longear Sunfish		Longear Sunfish	
		Redbreast Sunfish		Redear Sunfish	
		Redear Sunfish		Warmouth	
		Warmouth			
3. Number of Benthic Invertivore Species		3		4	
		Freshwater Drum		Black redhorse	
		Golden Redhorse		Freshwater Drum	
		Logperch		Golden Redhorse	
				Spotted Sucker	
4. Nubmer of Intolerant Species		3		5	
		Longear Sunfish		Black redhorse	
		Skipjack Herring		Longear Sunfish	
		Smallmouth Bass		Skipjack Herring	
				Smallmouth Bass	
				Spotted Sucker	
5. Percent Tolerant Individuals	Electrofishing	40.90%		43.10%	
		Bluegill	5.67%	Bluegill	5.30%
		Bluntnose Minnow	0.07%	Common Carp	0.18%
		Common Carp	0.07%	Gizzard Shad	26.97%
		Gizzard Shad	24.93%	Golden Shiner	0.46%
		Golden Shiner	0.07%	Green Sunfish	0.73%
		Green Sunfish	1.00%	Largemouth Bass	9.05%
		Largemouth Bass	7.07%	Spotfin Shinner	0.46%
		Redbreast Sunfish	0.07%		
		Spotfin Shinner	1.93%		
	Gill Netting	45.70%		30.50%	
		Bluegill	4.35%	Common Carp	3.39%
		Gizzard Shad	39.13%	Gizzard Shad	23.73%
		Largemouth Bass	2.17%	White Sucker	3.39%
6. Percent Dominance by one Species	Electrofishing	42.60%		35.60%	
	Gill netting	39.10%		23.70%	
		Inland Silverside		Inland Silverside	
		Gizzard Shad		Gizzard Shad	
7. Percent Non-Ingenious Species	Electrofishing	42.70%		35.80%	
		Common Carp	0.07%	Common Carp	0.18%
		Inland Silverside	42.60%	Inland Silverside	35.56%
				Striped Bass	0.09%
	Gill Netting	0%		3.40%	
				Common Carp	3.39%
8. Number of Top Carnivore Species		9		9	
		Black Crappies		Black Crappies	
		Flathead Catfish		Flathead Catfish	
		Largemouth Bass		Largemouth Bass	
		Skipjack Herring		Skipjack Herring	
		Smallmouth Bass		Smallmouth Bass	
		Spotted Bass		Spotted Bass	
		Spotted Gar		Spotted Gar	
		White Bass		White Bass	
		Yellow Bass		Yellow Bass	
B. Trophic Composition					
9. Percent Top Carnivores	Electrofishing	11.50%		14.40%	
		Black Crappies	0.07%	Black Crappies	0.09%
		Flathead Catfish	0.03%	Flathead Catfish	1.28%
		Largemouth Bass	7.07%	Largemouth Bass	9.05%
		Smallmouth Bass	3.73%	Smallmouth Bass	0.18%
		White Bass	0.07%	Spotted Bass	0.46%
		Yellow Bass	0.27%	Spotted Gar	0.46%
				Striped Bass	0.09%
				Yellow Bass	2.83%
	Gill Netting	32.60%		30.50%	
		Flathead Catfish	6.52%	Black Crappie	1.69%
		Largemouth Bass	2.17%	Flathead Catfish	1.69%
		Skipjack Herring	2.17%	Skipjack Herring	8.47%
		Spotted Bass	6.52%	Spotted Bass	1.69%
		Spotted Gar	8.70%	Spotted Gar	1.69%
		White Bass	4.35%	White Bass	6.78%
		Yellow Bass	2.17%	Yellow Bass	8.47%
10. Percent Omnivores	Electrofishing	29.50%		36.80%	
		Bluntnose Minnow	0.07%	Blue Catfish	0.18%
		Channel Catfish	4.20%	Channel Catfish	8.96%
		Common Carp	0.07%	Common Carp	0.18%
		Gizzard Shad	24.93%	Gizzard Shad	26.97%
		Golden Shiner	0.07%	Golden Shiner	0.46%
		Smallmouth Buffalo	0.20%	Smallmouth Buffalo	0.09%
	Gill Netting	56.50%		54.20%	
		Blue Catfish	4.35%	Blue Catfish	3.39%
		Channel Catfish	6.52%	Channel Catfish	20.34%
		Gizzard Shad	39.13%	Common Carp	3.39%
		Smallmouth Buffalo	6.52%	Gizzard Shad	23.73%
				White Sucker	3.39%
C. Fish Abundance and Health					
11. Average Number Per Run	Electrofishing	100		72.9	
	Gill netting	4.6		5.9	
12. Percent Anomalies	Electrofishing	0.50%		0.60%	
	Gill netting	0.00%		0.00%	

Table 5. Individual metrics observed by TVA near Brown's Ferry Nuclear facility (BFN), Autumn 2011.

Metric		Observed	TRM 202.5		Observed	TRM 205.9	
A. Species Richness and Composition							
1. Number of Ingenious Species		28			26		
2. Nubmer of Centrarchid Species		8	Black Crappie		7	Black Crappie	
			Bluegill			Bluegill	
			Green Sunfish			Green Sunfish	
			Longear Sunfish			Longear Sunfish	
			Redbreast Sunfish			Redear Sunfish	
			Redear Sunfish			Warmouth	
			Warmouth			White Crappie	
			White Crappie				
3. Number of Benthic Invertivore Species		4	Black Redhorse		4	Freshwater Drum	
			Freshwater Drum			Logperch	
			Silver Redhorse			Northern Hog Sucker	
			Spotted Sucker			Spotted Sucker	
4. Nubmer of Intolerant Species		5	Black Redhorse		5	Longear Sunfish	
			Longear Sunfish			Northern Hog Sucker	
			Skipjack Herring			Skipjack Herring	
			Smallmouth Bass			Smallmouth Bass	
			Spotted Sucker			Spotted Sucker	
5. Percent Tolerant Individuals	Electrofishing	59.60%	Gizzard Shad	34.60%	54.60%	Gizzard Shad	36.80%
			Blue gill	13.30%		Blue gill	6.70%
			Spottfin Shiner	6.10%		Largemouth Bass	5.90%
			Green Sunfish	3.70%		Green Sunfish	2.60%
			Largemouth Bass	1.60%		Golden Shiner	1.40%
			Common Carp	0.10%		Spotfin Shiner	0.80%
			Golden Shiner	0.10%		Common Carp	0.30%
			Redbreast Sunfish	0.10%		White Crappie	0.10%
	Gill Netting	40.20%	Gizzard Shad	32.20%	36.00%	Gizzard Shad	15.1%
			White Crappie	4.60%		Longnose Gar	14.0%
			Largemouth Bass	3.40%		Largemouth Bass	3.50%
						Bluegill	1.20%
						Golden Shiner	1.20%
						White Crappie	1.20%
6. Percent Dominance by one Species	Electrofishing	34.60%	Gizzard Shad		36.80%	Gizzard Shad	
	Gill netting	32.20%	Gizzard Shad		20.90%	White Bass	
7. Percent Non-Ingenous Species	Electrofishing	15.70%	Mississippi Silverside	15.60%	19.80%	Mississippi Silverside	19.40%
			Common Carp	0.10%		Common Carp	0.30%
	Gill Netting	0%			0.00%		
8. Number of Top Carnivore Species		9	Black Crappies		11	Black Crappies	
			Flathead Catfish			Flathead Catfish	
			Largemouth Bass			Largemouth Bass	
			Skipjack Herring			Longnose Gar	
			Smallmouth Bass			Skipjack Herring	
			Spotted Bass			Smallmouth Bass	
			Spotted Gar			Spotted Bass	
			White Bass			Spotted Gar	
			White Crappie			White Bass	
						White Crappie	
						Yellow Bass	
B. Trophic Composition							
9. Percent Top Carnivores	Electrofishing	3.80%	Largemouth Bass	1.60%	8.40%	Largemouth Bass	5.90%
			Smallmouth Bass	1.60%		Smallmouth Bass	1.00%
			Flathead Catfish	0.20%		Flathead Catfish	0.50%
			Spotted Gar	0.20%		Spotted Gar	0.50%
			Black Crappie	0.10%		Spotted Bass	0.20%
			Spotted Bass	0.10%		Black Crappie	0.10%
						White Crappie	0.10%
						Yellow Bass	0.10%
	Gill Netting	35.60%	Flathead Catfish	11.50%	57.00%	White Bass	20.90%
			White Bass	9.20%		Longnose Gar	14.00%
			Skipjack Herring	4.60%		Yellow Bass	11.60%
			White Crappie	4.60%		Largemouth Bass	3.50%
			Largemouth Bass	3.40%		Flathead Catfish	2.30%
			Spotted Gar	2.30%		Skipjack Herring	2.30%
						Smallmouth Bass	1.20%
						White Crappie	1.20%
10. Percent Omnivores	Electrofishing	37.80%	Gizzard Shad	34.60%	41.00%	Gizzard Shad	36.80%
			Channel Catfish	2.60%		Channel Catfish	2.20%
			Smallmouth Buffalo	0.50%		Golden Shiner	1.40%
			Common Carp	0.10%		Common Carp	0.30%
			Golden Shiner	0.10%		Smallmouth Buffalo	0.30%
	Gill Netting	52.90%	Gizzard Shad	32.20%	33.70%	Gizzard Shad	15.10%
			Channel Catfish	10.30%		Channel Catfish	11.60%
			Black Buffalo	4.60%		Black Buffalo	2.30%
			Blue Catfish	4.60%		Blue Catfish	2.30%
			Smallmouth Buffalo	1.10%		Golden Shiner	1.20%
						Smallmouth Buffalo	1.20%
C. Fish Abundance and Health							
11. Average Number Per Run	Electrofishing	118.9			120.7		
	Gill netting	8.7			8.6		
12. Percent Anomalies	Electrofishing	0.30%			0.40%		
	Gill netting	0.00%			0.00%		

Table 6. Fish species identified by TVA at TRM 292.5 in Autumn 2008

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Gizzard Shad	Dorosoma Cepedianum	21.67	103.83	325	2.8	28	353
Common Carp	Cyprinus Carpio				0.1	1	1
Spotfin Shiner	Cyprinella Spiloptera	0.2	0.96	3			3
Green Sunfish	Lepomis Cyanellus	0.33	1.6	5			5
Bluegill	Lepomis Macrochirus	11.6	55.59	174	0.2	2	176
Largemouth Bass	Micropterus Salmoides	8.13	38.98	122	1.6	16	138
Skipjack Herring	Alosa Chrysochloris				3.1	31	31
Spotted Sucker	Minytrema Melanops	0.07	0.32	1	0.3	3	4
Black Redhorse	Moxostoma Duquenei	0.07	0.32	1			1
Longear Sunfish	Lepomis Megalotis	5.6	26.84	84			84
Smallmouth Bass	Micropterus Dolomieu	1.13	5.43	17			17
Spotted Gar	Lepisosteus Oculatus				0.1	1	1
Threadfin Shad	Dorosoma Petenense	0.07	0.32	1			1
Largescale Stoneroller	Campostoma Oligolepis	0.07	0.32	1			1
Smallmouth Buffalo	Ictiobus Bubalus				0.4	4	4
Black Buffal	Ictiobus Niger				0.1	1	1
Golden Redhorse	Moxostoma Erythrurum	0.13	0.64	2	0.1	1	3
Blue Catfish	Ictalurus Furcatus	0.2	0.96	3	1.2	12	15
Channel Catfish	Ictalurus Punctatus	1.33	6.39	20	0.7	7	27
Flathead Catfish	Pylodictis Olivaris	0.07	0.32	1	0.9	9	10
White Bass	Morone Chrysops				5.7	57	57
Yellow Bass	Morone Mississippienses				0.3	3	3
Warmouth	Lepomis Gluosus	0.07	0.32	1			1
Readeare Sunfish	Lepomis Microlophus	1.4	6.71	21	1.1	11	32
Spotted Bass	Micropterus Punctulatus	0.2	0.96	3	0.2	2	5
Black Crappie	Pomoxis Nigromaculatus				0.1	1	1
Longperch	Percina Caprodes	0.2	0.96	3			3
Sauger	Sander Canadensis				0.2	2	2
Freshwater Drum	Aplodinotus Grunniens	0.53	2.56	8	0.7	7	15
Inland Silverside	Menidia Beryllina	59.13	283.39	887			887

Table 7. Fish species identified by TVA at TRM 295.9 in Autumn 2008

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Longnose Gar	Lepisosteus Osseus				0.9	9	9
Gizzard Shad	Dorosoma Cepedianum	19	96.28	285	2.3	23	308
Common Carp	Cyprinus Carpio	0.2	1.01	3	0.1	1	4
Golden Shinner	Notemigonus Crysoleucas	0.13	0.68	2	0.5	5	7
Spotfin Shiner	Cyprinella Spiloptera	0.13	0.68	2			2
Green Sunfish	Lepomis Cyanellus	0.27	1.35	4			4
Bluegill	Lepomis Macrochirus	4.93	25	74	0.6	6	80
Largemouth Bass	Micropterus Salmoides	5.6	28.37	84	1.3	13	97
White Crappie	Pomoxis Annularis				0.3	3	3
Skipjack Herring	Alosa Chrysochloris				0.3	3	3
Northern Hog Sucker	Hypentelium Nigricans	0.13	0.68	2			2
Spotted Sucker	Minytrema Melanops	0.6	3.04	9			9
Longear Sunfish	Lepomis Megalotis	1.53	7.77	23			23
Smallmouth Bass	Micropterus Dolomieu	0.4	2.03	6			6
Spotted Gar	Lepisosteus Oculatus	0.13	0.68	2			2
Threadfin Shad	Dorosoma Petenense	0.27	1.35	4			4
Bullhead Minnow	Pimephales Vigilax	0.07	0.34	1			1
Smallmouth Buffalo	Lctiobus Bubalus	0.27	1.35	4	0.7	7	11
Blue Catfish	Ictalurus Furcatus				1	10	10
Channel Catfish	Ictalurus Punctatus	3.47	17.57	52	3.7	37	89
Flathead Catfish	Pylodictis Olivaris	0.2	1.01	3	0.4	4	7
White Bass	Morone Chrysops	0.13	0.68	2	2.6	26	28
Yellow Bass	Morone Mississippienses	0.6	3.04	9	1	10	19
Striped Bass	Morone Saxatilis				0.2	2	2
Warmouth	Lepomis Gluosus	0.07	0.34	1			1
Readeare Sunfish	Lepomis Microlophus	2.67	13.51	40	0.6	6	46
Spotted Bass	Micropterus Punctulatus	0.4	2.03	6	0.3	3	9
Black Crappie	Pomoxis Nigromaculatus				0.1	1	1
Logperch	Percina Caprodes	0.33	1.69	5			5
Freshwater Drum	Aplodinotus Grunniens	0.87	4.39	13	1.8	18	31
Inland Silverside	Menidia Beryllina	17.4	88.18	261			261
Atlantic Needlefish	Strongylura Marina	0.07	0.34	1			1

Table 8. Fish species identified by TVA at TRM 292.5 in Autumn 2009

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Gizzard Shad	Dorosoma Cepedianum	24.93	112.99	374	1.8	18	392
Common Carp	Cyprinus Carpio	0.07	0.3	1			1
Golden Shinner	Notemigonus Crysoleucas	0.07	0.3	1			1
Spotfin Shiner	Cyprinella Spiloptera	1.93	8.76	29			29
Bluntnose Minnow	Pimephales Notatus	0.07	0.3	1			1
Redbreast Sunfish	Lepomis Auritus	0.07	0.3	1			1
Green Sunfish	Lepomis Cyanellus	1	4.53	15			15
Bluegill	Lepomis Macrochirus	5.67	25.68	85	0.2	2	87
Largemouth Bass	Micropterus Salmoides	7.07	32.02	106	0.1	1	107
Skipjack Herring	Alosa Chrysochloris				0.1	1	1
Longear Sunfish	Lepomis Megalotis	2.13	9.67	32			32
Smallmouth Bass	Micropterus Dolomieu	3.73	16.92	56			56
Spotted Gar	Lepisosteus Oculatus				0.4	4	4
Threadfin Shad	Dorosoma Petenense	1.07	4.83	16			16
Smallmouth Buffalo	Lctiobus Bubalus	0.2	0.91	3	0.3	3	6
Golden Redhorse	Moxostoma Erythrurum	0.27	1.21	4			4
Blue Catfish	Ictalurus Furcatus				0.2	2	2
Channel Catfish	Ictalurus Punctatus	4.2	19.03	63	0.3	3	66
Flathead Catfish	Pylodictis Olivaris	0.27	1.21	4	0.3	3	7
White Bass	Morone Chrysops	0.07	0.3	1	0.2	2	3
Yellow Bass	Morone Mississippienses	0.27	1.21	4	0.1	1	5
Warmouth	Lepomis Gluosus	0.07	0.3	1			1
Readeare Sunfish	Lepomis Microlophus	1.47	6.65	22	0.2	2	24
Spotted Bass	Micropterus Punctulatus				0.3	3	3
Black Crappie	Pomoxis Nigromaculatus	0.07	0.3	1			1
Stripetail Darter	Etheostoma Kennicotti	0.07	0.3	1			1
Longperch	Percina Caprodes	0.07	0.3	1			1
Freshwater Drum	Aplodinotus Grunniens	2.6	11.78	39	0.1	1	40
Inland Silverside	Menidia Beryllina	42.6	193.05	639			639

Table 9. Fish species identified by TVA at TRM 295.9 in Autumn 2009

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Gizzard Shad	Dorosoma Cepedianum	19.67	89.94	295	1.4	14	309
Common Carp	Cyprinus Carpio	0.13	0.61	2	0.2	2	4
Golden Shinner	Notemigonus Crysoleucas	0.33	1.52	5			5
Spotfin Shiner	Cyprinella Spiloptera	0.33	1.52	5			5
White Sucker	Catostomus Commersoni				0.2	2	2
Green Sunfish	Lepomis Cyanellus	0.53	2.44	8			8
Bluegill	Lepomis Macrochirus	3.87	17.68	58			58
Largemouth Bass	Micropterus Salmoides	6.6	30.18	99			99
Skipjack Herring	Alosa Chrysochloris				0.5	5	5
Spotted Sucker	Minytrema Melanops	0.27	1.22	4			4
Black Redhorse	Moxostoma Duquesnei	0.07	0.3	1			1
Longear Sunfish	Lepomis Megalotis	0.87	3.96	13			13
Smallmouth Bass	Micropterus Dolomieu	0.13	0.61	2			2
Spotted Gar	Lepisosteus Oculatus	0.33	1.52	5	0.1	1	6
Threadfin Shad	Dorosoma Petenense	0.93	4.27	14			14
Smallmouth Buffalo	Lctiobus Bubalus	0.07	0.3	1			1
Golden Redhorse	Moxostoma Erythrurum	0.07	0.3	1			1
Blue Catfish	Ictalurus Furcatus	0.13	0.61	2	0.2	2	4
Channel Catfish	Ictalurus Punctatus	6.53	29.88	98	1.2	12	110
Flathead Catfish	Pylodictis Olivaris	0.93	4.27	14	0.1	1	15
White Bass	Morone Chrysops				0.4	4	4
Yellow Bass	Morone Mississippienses	2.07	9.45	31	0.5	5	36
Striped Bass	Morone Saxatilis	0.07	0.3	1			1
Warmouth	Lepomis Gluosus	0.07	0.3	1			1
Readear Sunfish	Lepomis Microlophus	1.33	6.1	20	0.6	6	26
Spotted Bass	Micropterus Punctulatus	0.33	1.52	5	0.1	1	6
Black Crappie	Pomoxis Nigromaculatus	0.07	0.3	1	0.1	1	2
Freshwater Drum	Aplodinotus Grunniens	1.27	5.79	19	0.3	3	22
Inland Silverside	Menidia Beryllina	25.93	118.6	389			389

Table 10. Fish species identified by TVA at TRM 292.5 in Autumn 2011

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Longnose Gar	Lepisosteus Osseus				1.2	12	12
Gizzard Shad	Dorosoma Cepedianum	44.4	197.63	666	1.3	13	679
Common Carp	Cyprinus Carpio	0.4	1.78	6			6
Golden Shinner	Notemigonus Crysoleucas	1.6	7.42	25	0.1	1	26
Spotfin Shiner	Cyprinella Spiloptera	0.93	4.15	14			14
Green Sunfish	Lepomis Cyanellus	3.13	13.95	47			47
Bluegill	Lepomis Macrochirus	8.13	36.2	122	0.1	1	123
Largemouth Bass	Micropterus Salmoides	7.13	31.75	107	0.3	3	110
White Crappie	Pomoxis Annularis	0.13	0.59	2	0.1	1	3
Skipjack Herring	Alosa Chrysochloris				0.2	2	2
Northern Hog Sucker	Hypentelium Nigricans	0.07	0.3	1			1
Spotted Sucker	Minytrema Melanops	0.93	4.15	14			14
Longear Sunfish	Lepomis Megalotis	1.8	8.01	27			27
Smallmouth Bass	Micropterus Dolomieu	1.27	5.64	19	0.1	1	20
Spotted Gar	Lepisosteus Oculatus	0.6	2.67	9			9
Threadfin Shad	Dorosoma Petenense	20.2	89.91	303			303
Largescale Stoneroller	Camptostoma Oligolepis	0.07	0.3	1			1
Smallmouth Buffalo	Ictiobus Bubalus	0.33	1.48	5	0.1	1	6
Black Buffalo	Ictiobus Niger				0.2	2	2
Blue Catfish	Ictalurus Furcatus				0.2	2	2
Channel Catfish	Ictalurus Punctatus	2.67	11.87	40	1	10	50
Flathead Catfish	Pylodictis Olivaris	0.6	2.67	9	0.2	2	11
White Bass	Morone Chrysops				1.8	18	18
Yellow Bass	Morone Mississippienses	0.07	0.3	1	1	10	11
Warmouth	Lepomis Gluosus	0.07	0.3	1			1
Redear Sunfish	Lepomis Microlophus	1.73	7.72	26	0.2	2	28
Spotted Bass	Micropterus Punctulatus	0.2	0.89	3			3
Black Crappie	Pomoxis Nigromaculatus	0.13	0.59	2			2
Longperch	Percina Caprodes	0.07	0.3	1			1
Freshwater Drum	Aplodinotus Grunniens	0.47	2.08	7	0.5	5	12
Mississippi Silverside	Menidia Audens	23.47	104.45	352			352

Table 11. Fish species identified by TVA at TRM 295.9 in Autumn 2011

Common Name	Scientific Name	Electrofishing Catch Rate per Run	Electrofishing Catch Rate per Hour	Total Fish by Electrofishing	Gill Netting Catch Rate per Net Night	Total Gill Net Fish	Total Fish Combined
Gizzard Shad	Dorosoma Cepedianum	41.13	188.69	617	2.8	28	645
Common Carp	Cyprinus Carpio	0.07	0.31	1			1
Golden Shinner	Notemigonus Crysoleucas	0.07	0.31	1			1
Spotfin Shiner	Cyprinella Spiloptera	7.27	33.33	109			109
Redbreast Sunfish	Lepomis Auritus	0.13	0.61	2			2
Green Sunfish	Lepomis Cyanellus	4.4	20.18	66			66
Bluegill	Lepomis Macrochirus	15.87	72.78	238			238
Largemouth Bass	Micropterus Salmoides	1.93	8.87	29	0.3	3	32
White Crappie	Pomoxis Annularis				0.4	4	4
Skipjack Herring	Alosa Chrysochloris				0.4	4	4
Spotted Sucker	Minytrema Melanops	0.47	2.14	7			7
Black Redhorse	Moxostoma Duquesnei	0.53	2.45	8			8
Longear Sunfish	Lepomis Megalotis	3.67	16.82	55	0.1	1	56
Smallmouth Bass	Micropterus Dolomieu	1.93	8.87	29			29
Spotted Gar	Lepisosteus Oculatus	0.2	0.92	3	0.2	2	5
Threadfin Shad	Dorosoma Petenense	16	73.39	240			240
Smallmouth Buffalo	Ictiobus Bubalus	0.6	2.75	9	0.1	1	10
Black Buffalo	Ictiobus Niger				0.4	4	4
Silver Redhorse	Moxostoma Anisurum	0.07	0.31	1			1
Blue Catfish	Ictalurus Furcatus				0.4	4	4
Channel Catfish	Ictalurus Punctatus	3.07	14.07	46	0.9	9	55
Flathead Catfish	Pylodictis Olivaris	0.27	1.22	4	1	10	14
White Bass	Morone Chrysops				0.8	8	8
Warmouth	Lepomis Gluosus	0.13	0.61	2			2
Redear Sunfish	Lepomis Microlophus	0.93	4.28	14			14
Spotted Bass	Micropterus Punctulatus	0.07	0.31	1			1
Black Crappie	Pomoxis Nigromaculatus	0.07	0.31	1			1
Freshwater Drum	Aplodinotus Grunniens	1.4	6.42	21	0.9	9	30
Mississippi Silverside	Menidia Audens	18.6	85.32	279			279
Chestnut Lamprey	Ichthyomyzon Castaneus	0.07	0.31	1			1

Table 12. Fish species collected from the Pickwick Reservoir, Tennessee River from 2006-2015.

Family	Species	Common name											
Tennessee Reservoir Fisheries - Tennessee Wildlife Resources Agency Electrofishing													
			2006	2007	2008	2009	2010	2011		2012	2013	2014	2015
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	236	223	329	382	357	298		235	351	342	238
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	23	52	44	17	38	57		45	37	73	45
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	42	17	17	12	19	8		10	1	8	3
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie	2	2	--	--	--	--		--	--	--	--
Centrarchidae	<i>Lepomis microlophus</i>	Redear Sunfish	25	18	38	87	26	34		12	28	16	6
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	115	146	181	236	126	262		252	229	86	181
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black Crappie	--	--	--	--	--	--		--	--	--	7
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	172	291	208	201	60	217		118	22	304	161
Clupeidae	<i>Dorosoma petenense</i>	Threadfin Shad	361	234	309	250	14	214		439	287	161	118
Percidae	<i>Sander canadensis</i>	Sauger	--	--	--	--	--	--		--	--	--	1
Percidae	<i>Perca flavescens</i>	Yellow Perch	--	--	--	--	--	--		--	--	--	4
Tennessee Statewide Creel Survey - Tennessee Wildlife Resources Agency Creel Survey													
			2006	2007	2008	2009	2010	2011		2012	2013	2014	2015
Clupeidae	<i>Alosa chrysichloris</i>	Skipjack Herring	--	--	--	--	--	--		--	--	--	620
Ictaluridae	<i>Ictalurus furcatus</i>	Blue Catfish	--	--	--	--	--	--		--	--	--	21,997
Ictaluridae	<i>Ictalurus punctatus</i>	Channel Catfish	--	--	--	--	--	--		--	--	--	23,119
Ictaluridae	<i>Pylodictis olivaris</i>	Flathead Catfish	--	--	--	--	--	--		--	--	--	204
Moronidae	<i>Morone chrysops</i>	White Bass	--	--	--	--	--	--		--	--	--	832
Moronidae	<i>Morone mississippiensis</i>	Yellow Bass	--	--	--	--	--	--		--	--	--	837
Moronidae	<i>Morone saxatilis</i>	Striped Bass	--	--	--	--	--	--		--	--	--	198
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	--	--	--	--	--	--		--	--	--	44,707
Centrarchidae	<i>Lepomis megalotis</i>	Longear Sunfish	--	--	--	--	--	--		--	--	--	46
Centrarchidae	<i>Lepomis microlophus</i>	Redear Sunfish	--	--	--	--	--	--		--	--	--	325
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	--	--	--	--	--	--		--	--	--	10,328
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	--	--	--	--	--	--		--	--	--	4,865
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	--	--	--	--	--	--		--	--	--	96,049
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie	--	--	--	--	--	--		--	--	--	5,813
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black Crappie	--	--	--	--	--	--		--	--	--	1,373
Percidae	<i>Sander canadensis</i>	Sauger	--	--	--	--	--	--		--	--	--	494
Percidae	<i>Sander vitreus</i>	Walleye	--	--	--	--	--	--		--	--	--	494
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater Drum	--	--	--	--	--	--		--	--	--	564
Pickwick Reservoir 2006 Management Report- Alabama Division of Conservation and Natural Resources - Electrofishing Results - 2006													
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	--	--	431	--	--	--		--	--	--	--
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	--	--	63	--	--	--		--	--	--	--
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	--	--	11	--	--	--		--	--	--	--

Table 12. Continued.

Family	Species	Common name											
Pickett Reservoir 2008 Management Report, Alabama Division of Conservation and Natural Resources - Creel Survey Results - 2008													
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	--	--	1379	--	--	--	--	--	--	--	--
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	--	--	167	--	--	--	--	--	--	--	--
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	--	--	90	--	--	--	--	--	--	--	--
Centrarchidae	<i>Pomoxis</i>	Crookers	--	--	296	--	--	--	--	--	--	--	--
Geological Survey of Alabama - Electrofishing data - 2013										Panther Creek	Second Creek	TN River (Buck Island)	TN River (Pippen Island)
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted Gar	--	--	--	--	--	--	--	90	76	43	16
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose Gar	--	--	--	--	--	--	--	3	0	4	0
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	--	--	--	--	--	--	--	339	561	159	18
Clupeidae	<i>Dorosoma petenense</i>	Threadfin Shad	--	--	--	--	--	--	--	9	208	128	41
Cyprinidae	<i>Camptostoma obolepis</i>	Largemouth Stoneroller	--	--	--	--	--	--	--	76	20	0	1
Cyprinidae	<i>Cyprinella spiloptera</i>	Spotfin Shiner	--	--	--	--	--	--	--	361	363	75	86
Cyprinidae	<i>Cyprinus carpio</i>	Carp	--	--	--	--	--	--	--	8	17	0	0
Cyprinidae	<i>Notemigonus crysoleucas</i>	Golden Shiner	--	--	--	--	--	--	--	126	47	7	2
Cyprinidae	<i>Notropis atherinoides</i>	Emerald Shiner	--	--	--	--	--	--	--	21	24	0	2
Cyprinidae	<i>Notropis texanus</i>	Weed Shiner	--	--	--	--	--	--	--	63	7	19	3
Cyprinidae	<i>Notropis volucellus</i>	Mimic Shiner	--	--	--	--	--	--	--	99	31	0	1
Cyprinidae	<i>Pimephales vigilax</i>	Bullhead Minnow	--	--	--	--	--	--	--	0	0	0	5
Catostomidae	<i>Hypentelium nigricans</i>	Northern Hog Sucker	--	--	--	--	--	--	--	1	4	0	1
Catostomidae	<i>Ichthyobus bubalus</i>	Smallmouth Buffalo	--	--	--	--	--	--	--	0	4	5	0
Catostomidae	<i>Minyrama melanops</i>	Spotted Sucker	--	--	--	--	--	--	--	27	29	7	0
Catostomidae	<i>Moxostoma valenciennesi</i>	Black Redhorse	--	--	--	--	--	--	--	0	5	1	1
Catostomidae	<i>Moxostoma erythrum</i>	Golden Redhorse	--	--	--	--	--	--	--	0	0	6	0
Ictaluridae	<i>Ameiurus natalis</i>	Yellow Bullhead	--	--	--	--	--	--	--	5	2	0	0
Ictaluridae	<i>Ictalurus furcatus</i>	Blue Catfish	--	--	--	--	--	--	--	1	1	1	0
Ictaluridae	<i>Ictalurus punctatus</i>	Channel Catfish	--	--	--	--	--	--	--	5	22	6	3
Ictaluridae	<i>Pylodictis olivaris</i>	Flathead Catfish	--	--	--	--	--	--	--	0	3	11	4
Esocidae	<i>Esox niger</i>	Chain Pickerel	--	--	--	--	--	--	--	2	4	0	0
Atherinopidae	<i>Labidesthes sicculus</i>	Brook Silverside	--	--	--	--	--	--	--	81	52	90	47
Atherinopidae	<i>Menidia beryllina</i>	Inland Silverside	--	--	--	--	--	--	--	119	114	167	156
Fundulidae	<i>Fundulus notatus</i>	Blackstripe Topminnow	--	--	--	--	--	--	--	0	1	0	0
Moronidae	<i>Morone chrysops</i>	White Bass	--	--	--	--	--	--	--	0	0	1	0
Moronidae	<i>Morone mississippiensis</i>	Yellow Bass	--	--	--	--	--	--	--	0	0	2	1
Moronidae	<i>Morone chrysops x saxatilis</i>	Palmetto Bass	--	--	--	--	--	--	--	0	6	2	0
Centrarchidae	<i>Ambloplites rupestris</i>	Rock Bass	--	--	--	--	--	--	--	1	0	0	0
Centrarchidae	<i>Lepomis auratus</i>	Redbreast Sunfish	--	--	--	--	--	--	--	6	12	22	1
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish	--	--	--	--	--	--	--	18	39	2	7

Table 12. Continued.

Family	Species	Common name										
Centrarchidae	<i>Lepomis gibbosus</i>	Warmouth	--	--	--	--	--	6	3	0	0	
Centrarchidae	<i>Lepomis humilis</i>	Orangespotted Sunfish	--	--	--	--	--	0	0	1	3	
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	--	--	--	--	--	549	294	121	285	
Centrarchidae	<i>Lepomis megalotis</i>	Longear Sunfish	--	--	--	--	--	95	162	31	183	
Centrarchidae	<i>Lepomis microlophus</i>	Redear Sunfish	--	--	--	--	--	49	43	70	100	
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	--	--	--	--	--	30	30	8	12	
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	--	--	--	--	--	11	7	24	27	
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	--	--	--	--	--	129	220	82	77	
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie	--	--	--	--	--	2	0	0	0	
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black Crappie	--	--	--	--	--	0	1	1	2	
Peridae	<i>Etheostoma nigranum</i>	Blackfin Darter	--	--	--	--	--	1	0	0	0	
Peridae	<i>Perca flavescens</i>	Yellow Perch	--	--	--	--	--	44	12	0	0	
Peridae	<i>Perca schisticeps</i>	Loosejaw	--	--	--	--	--	44	80	5	2	
Scleridae	<i>Aplodinotus grunniens</i>	Freshwater Drum	--	--	--	--	--	2	11	3	0	
Centrarchidae		Hybrid Centrarchid	--	--	--	--	--	0	1	0	0	
Biological Monitoring of the Tennessee River in the Vicinity of Colbert Fossil Plant during Autumn 2011											TN River (Upstream TRM #47)	TN River (Downstream TRM #62)
Astionidae	<i>Amia calva</i>	Bowfin	--	--	--	--	--	--	--	1	--	
Atherinopidae	<i>Labidesthes sicculus</i>	Brook silverside	--	--	--	--	--	--	--	33	--	
Atherinopidae	<i>Morone chrysops</i>	Mississippi silverside	--	--	--	--	--	--	--	22	8	
Catostomidae	<i>Hypentelium nigricans</i>	Northern hog sucker	--	--	--	--	--	--	--	1	--	
Catostomidae	<i>Ictalurus punctatus</i>	Smallmouth buffalo	--	--	--	--	--	--	--	4	4	
Catostomidae	<i>Moxostoma valenciennesi</i>	Spotted sucker	--	--	--	--	--	--	--	1	5	
Catostomidae	<i>Moxostoma valenciennesi</i>	Silver redhorse	--	--	--	--	--	--	--	1	1	
Catostomidae	<i>Moxostoma valenciennesi</i>	Smallmouth redbreast	--	--	--	--	--	--	--	--	1	
Catostomidae	<i>Moxostoma valenciennesi</i>	River redbreast	--	--	--	--	--	--	--	2	4	
Catostomidae	<i>Moxostoma valenciennesi</i>	Black redbreast	--	--	--	--	--	--	--	5	11	
Catostomidae	<i>Moxostoma valenciennesi</i>	Golden redbreast	--	--	--	--	--	--	--	--	3	
Centrarchidae	<i>Ambloplites rupestris</i>	Rock bass	--	--	--	--	--	--	--	1	--	
Centrarchidae	<i>Hybrid Lepomis sp.</i>	Hybrid sunfish	--	--	--	--	--	--	--	2	--	
Centrarchidae	<i>Lepomis auratus</i>	Redbreast sunfish	--	--	--	--	--	--	--	1	--	
Centrarchidae	<i>Lepomis cyanellus</i>	Green sunfish	--	--	--	--	--	--	--	5	--	
Centrarchidae	<i>Lepomis gibbosus</i>	Warmouth	--	--	--	--	--	--	--	2	2	
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	--	--	--	--	--	--	--	308	30	
Centrarchidae	<i>Lepomis megalotis</i>	Longear sunfish	--	--	--	--	--	--	--	85	10	
Centrarchidae	<i>Lepomis microlophus</i>	Redear sunfish	--	--	--	--	--	--	--	69	27	
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth bass	--	--	--	--	--	--	--	12	11	
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted bass	--	--	--	--	--	--	--	24	6	

Table 12. Continued.

Family	Species	Common name											
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth bass	--	--	--	--	--	--	--	--	--	128	112
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black crappie	--	--	--	--	--	--	--	--	--	6	2
Clupeidae	<i>Alosa chrysochloris</i>	Striped herring	--	--	--	--	--	--	--	--	--	1	--
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard shad	--	--	--	--	--	--	--	--	--	343	264
Clupeidae	<i>Dorosoma petenense</i>	Threadfin shad	--	--	--	--	--	--	--	--	--	7	1
Cyprinidae	<i>Cyprinella spiloptera</i>	Spottin shiner	--	--	--	--	--	--	--	--	--	24	2
Cyprinidae	<i>Cyprinus carpio</i>	Common carp	--	--	--	--	--	--	--	--	--	1	1
Cyprinidae	<i>Pimephales notatus</i>	Bluntnose minnow	--	--	--	--	--	--	--	--	--	2	1
Ichthyidae	<i>Ichthyurus furcatus</i>	Blue catfish	--	--	--	--	--	--	--	--	--	3	11
Ichthyidae	<i>Ichthyurus punctatus</i>	Channel catfish	--	--	--	--	--	--	--	--	--	21	18
Ichthyidae	<i>Pylodictis olivaris</i>	Flathead catfish	--	--	--	--	--	--	--	--	--	7	3
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted gar	--	--	--	--	--	--	--	--	--	--	1
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose gar	--	--	--	--	--	--	--	--	--	1	2
Moronidae	<i>Morone chrysops</i>	White bass	--	--	--	--	--	--	--	--	--	9	1
Moronidae	<i>Morone mississippiensis</i>	Yellow bass	--	--	--	--	--	--	--	--	--	3	6
Percidae	<i>Percina caprodes</i>	Logperch	--	--	--	--	--	--	--	--	--	--	1
Percidae	<i>Sander canadense</i>	Sauger	--	--	--	--	--	--	--	--	--	--	1
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater drum	--	--	--	--	--	--	--	--	--	10	3

Table 13. Benthic macroinvertebrates assessed for the study that was completed above and below the CWIS of the Tennessee Valley Authority's (TVA) Colbert Fossil Plant (COF), Pickwick Reservoir, during the autumn of 2011.

Taxon	Downstream		Upstream
	TRM 240.4	TRM 244	TRM 246
Cnidaria			
<i>Hydra</i> sp.	8	10	2
Platyhelminthes	---	2	---
<i>Dugesia tigrina</i>	40	68	23
Annelida			
Oligochaeta			
Lumbriculidae	---	2	---
Naididae	---	2	7
<i>Arcteonais lomondi</i>	7	---	---
<i>Bratislava unidentata</i>	2	---	---
<i>Dero</i> sp.	5	6	2
<i>Pristina</i> sp.	2	---	---
Tubificidae	208	83	60
<i>Branchiura sowerbyi</i>	---	---	3
<i>Limnodrilus hoffmeisteri</i>	2	4	---
Hirudinea			
Rhynchobdellida			
Glossiphoniidae	2	14	---
<i>Actinobdella inequiannulata</i>	---	---	---
<i>Actinobdella</i> sp.	8	5	2
<i>Helobdella stagnalis</i>	---	---	---
<i>Helobdella</i> sp.	2	2	2
Arachnoidea			
Acariformes	---	---	2
Malacostraca			
Amphipoda			
Corophiidae			
<i>Apocorophium lacustre</i>	7	---	---
Isopoda			
Asellidae			
<i>Caecidotea</i> sp.	---	2	---
<i>Lirceus</i> sp.	---	2	---
Gammaridae			
<i>Gammarus lacustris</i>	415	208	25
Maxillopoda			
Cyclopoida	---	---	2
Ostracoda	3	3	---
Candoniidae			
<i>Candona</i> sp.	26	---	---
Insecta			
Odonata			
Anisoptera			
Gomphidae			
<i>Stylurus</i> sp.	2	---	---
Diptera			
Chironomidae			

Table 13. Continued.

Taxon	Downstream		Upstream
	TRM 240.4	TRM 244	TRM 246
<i>Ablabesmyia rhamphe</i> gp.	2	8	2
<i>Axarus</i> sp.	---	27	---
<i>Cladotanytarsus</i> sp.	---	3	---
<i>Coelotanypus</i> sp.	160	8	4
<i>Cricotopus bicinctus</i>	10	---	---
<i>Cricotopus reverses</i> gp.	2	---	---
<i>Cricotopus</i> sp.	7	---	---
<i>Cryptochironomus</i> sp.	97	42	43
<i>Dicrotendipes lucifer</i>	4	4	---
<i>Dicrotendipes modestus</i>	14	25	2
<i>Dicrotendipes neomodestus</i>	20	22	---
<i>Dicrotendipes simpsoni</i>	2	2	---
<i>Dicrotendipes</i> sp.	---	---	---
<i>Eukiefferiella devonica</i> gp.	3	---	---
<i>Glyptotendipes</i> sp.	13	17	---
<i>Harnischia</i> sp.	8	---	---
<i>Nanocladius alternantherae</i>	2	6	---
<i>Nanocladius crassicornus/rectinervis</i>	---	2	---
<i>Nanocladius distinctus</i>	---	4	---
<i>Nanocladius</i> sp.	2	2	---
<i>Orthocladius</i> sp.	2	---	---
<i>Polypedilum halterale</i> gp.	7	---	---
<i>Polypedilum scalaenum</i> gp.	13	7	48
<i>Procladius</i> sp.	27	2	---
<i>Rheocricotopus robacki</i>	5	---	---
<i>Rheotanytarsus exiguus</i> gp.	3	4	---
<i>Stelechomyia perpulchra</i>	---	---	2
<i>Stictochironomus cafrarius</i> gp.	8	---	---
Tanypodinae			
<i>Tanytarsus</i> sp.	13	4	---
<i>Thienemanniella xena</i>	5	---	---
<i>Xenochironomus xenolabis</i>	6	2	---
Simuliidae			
<i>Simulium</i> sp.	4	---	4
Ephemeroptera			
Caenidae			
<i>Caenis</i> sp.	8	7	---
Ephemeridae			
<i>Hexagenia limbata</i>	137	21	2
Heptageniidae			
<i>Stenacron interpunctatum</i>	---	3	---
Trichoptera			
Polycentropodidae			
<i>Cymellus fraternus</i>	17	18	---
Leptoceridae			
<i>Oecetis</i> sp.	30	2	---
Mollusca			
Gastropoda	10	2	3
Basommatophora			

Table 13. Continued.

Taxon	Downstream		Upstream
	TRM 240.4	TRM 244	TRM 246
Ancylidae			
<i>Ferrissia rivularis</i>	4	4	---
Mesogastropoda			
Hydrobiidae			
<i>Amnicola limosa</i>	9	---	3
<i>Birgella subglobosa</i>	7	---	---
<i>Somatogyrus</i> sp.	127	2	---
Planorbidae			
<i>Menetus dilatatus</i>	5	11	4
Pleuroceridae			
<i>Pleurocera caniculata</i>	12	3	22
<i>Pleurocera</i> sp.	30	28	---
Viviparidae			
<i>Campeoloma</i> sp.			
<i>Lioplax sulculosa</i>	2	2	---
<i>Viviparus</i> sp.	13	11	---
Bivalvia			
Veneroida			
Corbiculidae			
<i>Corbicula fluminea</i>	725	1078	330
Sphaeriidae			
<i>Eupera cubensis</i>	9	77	67
<i>Musculium transversum</i>	120	103	23
Unionidae	---	3	27
<i>Ellipsaria lineolata</i>	---	4	---
<i>Fusconaia ebena</i>	4	2	---
<i>Obliquaria reflexa</i>	10	9	4
<i>Pleurobema sintoxia</i>	---	2	---
<i>Quadrula pustulosa</i>			
<i>Toxolasma</i> sp.	---	2	---
<i>Truncilla donaciformis</i>	4	9	4
<i>Truncilla truncata</i>	---	---	---
<i>Utterbackia imbecillis</i>	2	8	---

Table 14. Table of overall (all river miles averaged) density (per m²) by species from the 2015-2016 Draft Annual Report. Sampling conducted by the Alabama Department of Conservation and Natural Resources at Sevenmile Island secondary channel, 2008 through 2016. (*Utterbackia imbecillis* numbers not included since most of the individuals do not survive to adulthood).

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016
<i>Amblema plicata</i>	0.13	0.17	0.2	0.3	0.23	0.4	0.37	0.13	0.2
<i>Arcidens confragosus</i>	0	0	0	0	0	0	0.03	0.03	0.07
<i>Cyclonaias tuberculata</i>	2.17	2.1	2.57	2.4	2.73	3.2	2.8	3	3.87
<i>Ellipsaria lineolata</i>	3.43	3.03	2.33	3.03	3.8	3.67	3.87	4.7	4.6
<i>Elliptio crassidens</i>	0.7	0.37	0.63	0.77	0.7	0.6	0.57	0.7	0.57
<i>Lampsilis abrupta</i> *	0	0.03	0	0	0.03	0	0.07	0.03	0
<i>Lampsilis ovata</i>	0.13	0.13	0.07	0.13	0.17	0.2	0.07	0.33	0.07
<i>Leptodea fragilis</i>	1.27	2.1	0.87	2	2.27	0.27	2.13	1.43	0.07
<i>Ligumia recta</i>	0.07	0.07	0.07	0.07	0.17	0.1	0.07	0.03	0
<i>Megalanaias nervosa</i>	0.23	0.13	0.23	0.13	0.2	0.2	0.37	0.23	0.27
<i>Obliquaria reflexa</i>	9.93	9.43	8	8.57	10.7	10.97	11.9	10.93	11.37
<i>Pleurobema cordatum</i>	0.03	0.13	0.07	0.03	0.03	0	0.07	0.1	0.13
<i>Pleurobema plenum</i> *	0	0.03	0.03	0.03	0	0	0.07	0	0
<i>Pleurobema rubrum</i>	0	0.03	0	0	0	0	0	0	0
<i>Potamilus alatus</i>	0.43	0.53	0.27	0.77	0.9	0.37	0.73	0.43	0.5
<i>Ptychobranhus fasciolaris</i>	0	0.03	0	0.07	0	0	0.03	0.1	0.1
<i>Pyganodon grandis</i>	0	0	0.03	0	0	0	0	0	0
<i>Quadrula apiculata</i>	0.07	0.17	0.13	0	0.13	0.2	0.27	0.43	0.6
<i>Quadrula metanevra</i>	0.03	0	0	0	0	0	0	0	0
<i>Quadrula pustulosa</i>	16	15.93	14.13	18.2	19.47	17.87	18.7	18.07	19.67
<i>Quadrula quadrula</i>	1.2	1.77	1.53	1.2	1.6	1.33	2.53	1	2.27
<i>Reginaia ebena</i>	21.37	21.3	13.27	15.17	6.2	7	6.33	7	10.23
<i>Toxolasma lividum</i>	0.63	0.7	0.4	0.77	0.87	0.7	0.33	0.33	0.2
<i>Toxolasma parvum</i>	0.1	0.03	0	0	0.07	0.07	0.03	0	0
<i>Truncilla donaciformis</i>	1.63	4.9	4.27	9.87	12.9	10.83	6.6	5.87	4.07
<i>Truncilla truncata</i>	1.4	1.67	1.93	3.57	6.1	6.87	5.83	7.97	7.33
<i>Utterbackia imbecillis</i>	0.77	3.37	0.87	11.27	49.97	0.07	na	na	na
*Federally protect species									

Table 15. Relative abundance of most common and predominant fish species from TVA study

Common Name	2008				2009				2011			
	TRM 292.5		TRM 295.9		TRM 292.5		TRM 295.9		TRM 292.5		TRM 295.9	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Gizzard Shad	353	19%	308	28%	382	25%	309	27%	679	36%	645	34%
Spotfin Shiner	3	0.2%	2	0.2%	29	2%	5	0.4%	14	0.7%	109	6%
Bluegill	176	9%	80	7%	87	6%	58	5%	123	6%	238	13%
Largemouth Bass	138	7%	97	9%	107	7%	99	9%	110	6%	32	2%
Longear Sunfish	84	4%	23	2%	32	2%	13	1%	27	1%	56	3%
Smallmouth Bass	17	1%	6	1%	56	4%	2	0%	20	1%	29	2%
Threadfin Shad	1	0.1%	4	0.4%	16	1%	14	1%	303	16%	240	13%
Channel Catfish	27	1%	89	8%	66	4%	110	10%	50	3%	55	3%
White Bass	57	3%	28	3%	3	0%	4	0%	18	1%	8	0.4%
Inland Silverside	887	47%	261	24%	639	41%	389	34%	0	0%	0	0%
Mississippi Silverside	0	0%	0	0%	0	0%	0	0%	352	19%	279	15%

Table 16. Fish impinged at an average rate of more than one per day during the 2003 and 2004 study completed near Browns Ferry Nuclear Plant in 2006. The same species of fish are susceptible to impingement at PDW CWIS.

Common Name	2003-2004 Number/Day
Threadfin Shad	1,358
Freshwater Drum	471
Gizzard Shad	173
Skipjack herring	107
Channel Catfish	30
Yellow Bass	29
Redear Sunfish	11
Alewife	10
Bluegill	10
Blue Catfish	5
Silver Chub	2
White Bass	2
Striped Bass	2
White Crappie	2
Spotted Sucker	1
Green Sunfish	1
Black Crappie	1

Table 17. Average rate of entrainment found during the 2003 and 2004 study completed near Browns Ferry Nuclear Plant in 2006. The same fish families may be susceptible to entrainment at PDW CWIS.

Family Name	2003-2004 % Entrained
Ictaluridae (Catfishes)	30.4
Centrarchidae (Sunfishes)	26.2
Atherinopsidae (Silversides)	24.95
Clupeidae (Shad)	20.6
Catostomidae (Suckers)	15.2
Moronidae (Temperate Basses)	13.9
Percidae (Perches)	11.35
Cyprinidae (Minnows and Carps)	10.5
Sciaenidae (Drums)	5.3
Hiodontidae (Mooneyes)	2

Table 18. Typical spawning periods for fish species found upstream and downstream of PDW CWIS in Pickwick Reservoir

Family	Species	Common name	January	February	March	April	May	June	July	August	September	October	November	December
Ambidae	<i>Ambloplites</i>	Bowfin												
Atherinopidae	<i>Labidesthes sicculus</i>	Brook Silverside												
Atherinopidae	<i>Menidia audens</i>	Mississippi silverside												
Atherinopidae	<i>Menidia beryllina</i>	Inland Silverside												
Catostomidae	<i>Hypentelium nigricans</i>	Northern Hog Sucker												
Catostomidae	<i>Ictalurus bubalus</i>	Smallmouth buffalo												
Catostomidae	<i>Minytrema melanops</i>	Spotted Sucker												
Catostomidae	<i>Moxostoma valenciennianum</i>	Silver redbreast												
Catostomidae	<i>Moxostoma valenciennianum</i>	Smallmouth redbreast												
Catostomidae	<i>Moxostoma valenciennianum</i>	River redbreast												
Catostomidae	<i>Moxostoma valenciennianum</i>	Black redbreast												
Catostomidae	<i>Moxostoma valenciennianum</i>	Golden Redbreast												
Centrarchidae	<i>Ambloplites rupestris</i>	Rock bass												
Centrarchidae	<i>Hybrid leucostictus</i>	Hybrid sunfish												
Centrarchidae	<i>Lepomis auratus</i>	Redbreast sunfish												
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish												
Centrarchidae	<i>Lepomis gibbosus</i>	Warmouth												
Centrarchidae	<i>Lepomis humilis</i>	Orangespotted Sunfish												
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill												
Centrarchidae	<i>Lepomis megalotus</i>	Longear sunfish												
Centrarchidae	<i>Lepomis microlophus</i>	Readear Sunfish												
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass												
Centrarchidae	<i>Micropterus nuchialatus</i>	Spotted Bass												
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth bass												
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie												
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black crappie												
Clupeidae	<i>Alosa chrysops</i>	Striped Herring												
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard shad												
Clupeidae	<i>Dorosoma petenense</i>	Threadfin Shad												
Cyprinidae	<i>Camptostoma oligolepis</i>	Largescale Stoneroller												
Cyprinidae	<i>Cyprinella spiloptera</i>	Spotfin Shiner												
Cyprinidae	<i>Cyprinus carpio</i>	Common carp												
Cyprinidae	<i>Notemigonus crysoleucas</i>	Golden Shiner												
Cyprinidae	<i>Notropis atherinoides</i>	Emerald Shiner												
Cyprinidae	<i>Notropis texanus</i>	Weed Shiner												
Cyprinidae	<i>Notropis volucellus</i>	Mimic Shiner												
Cyprinidae	<i>Pimephales notatus</i>	Bluntnose minnow												

Table 18. Continued.

Family	Species	Common name	January	February	March	April	May	June	July	August	September	October	November	December
Cyprinidae	<i>Pimephales notatus</i>	Bullhead Minnow												
Esocidae	<i>Esox niger</i>	Chain Pickerel												
Fundulidae	<i>Fundulus notatus</i>	Blackstripe Topminnow												
Ictaluridae	<i>Ameiurus natalis</i>	Yellow Bullhead												
Ictaluridae	<i>Ictalurus furcatus</i>	Blue Catfish												
Ictaluridae	<i>Ictalurus punctatus</i>	Channel catfish												
Ictaluridae	<i>Pylodictis olivans</i>	Flathead Catfish												
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted gar												
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose Gar												
Moronidae	<i>Morone chrysops</i>	White bass												
Moronidae	<i>Morone chrysops x saxatilis</i> *	Palmetto Bass*												
Moronidae	<i>Morone mississippiensis</i>	Yellow Bass												
Moronidae	<i>Morone saxatilis</i>	Striped Bass												
Percidae	<i>Etheostoma nigranum</i> *	Blackfin Darter*												
Percidae	<i>Perca flavescens</i>	Yellow Perch												
Percidae	<i>Perca caprodes</i>	Logperch												
Percidae	<i>Sander canadensis</i>	Sauger												
Percidae	<i>Sander vitreus</i>	Walleye												
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater Drum												

*Breeding information was not available.

Sources: Tennessee Valley Authority, 2012; McGregor and O'Neil, 2017; IUCN, 2017 and Etnier and Starnes, 1993.

Table 19. Average seasonal density of fish eggs and larvae in the entrainment samples during 2003 and 2004 at BFN.

	Intake Samples			Reservoir Samples			All Samples
	2003	2004	2003-2004 Combined	2003	2004	2003-2004 Combined	
	# of eggs or larvae/1000m ³ water filtered						
Eggs							
Unspecified	5	T	1	T	T	T	1
Clupeidae	15	56	17	40	4	11	27
Catostomidae	T	T	T	T	T	T	T
Percidae	T	T	T	T	T	T	T
Sciaenidae	76	577	152	376	693	294	447
Totals	96	633	170	416	697	305	475
Larvae							
Lepisosteidae	T	T	T	T	T	T	T
Clupeidae	2,943	8,354	2,671	3,877	9,241	3,656	6,372
Hiodontidae	T	T	T	T	T	T	T
Cyprinidae	8	18	6	11	14	7	13
Catostomidae	43	3	11	34	3	9	19
Ictaluridae	4	6	2	1	1	1	3
Poeciliidae	T	T	T	T	T	T	T
Moronidae	56	90	35	275	72	87	122
Centrarchidae	24	157	42	20	55	21	64
Percidae	8	3	3	6	3	2	5
Sciaenidae	104	8	25	170	19	47	72
Atherinopsidae	16	160	41	6	90	28	69
Totals	3,205	8,800	2,836	4,399	9,497	3,857	6,693

Table 20. Season abundance and spawning of fish in the general vicinity of PDW CWIS.

Family	Species	Common name	Seasonal Occurrence			Abundance
			Spring	Summer	Fall/Winter	
Amiidae	<i>Amia calva</i>	Bowfin	X	X		Rare
Atherinopsidae	<i>Labidesthes sicculus</i>	Brook Silverside		X		Common
Atherinopsidae	<i>Menidia audens</i>	Mississippi silverside	X			Uncommon
Atherinopsidae	<i>Menidia beryllina</i>	Inland Silverside	X	X		Common
Catostomidae	<i>Hypentelium nigricans</i>	Northern Hog Sucker	X			Rare
Catostomidae	<i>Ictiobus bubalus</i>	Smallmouth Buffalo	X			Rare
Catostomidae	<i>Minytrema melanops</i>	Spotted Sucker	X		X	Uncommon
Catostomidae	<i>Moxostoma anisurum</i>	Silver redhorse	X			Rare
Catostomidae	<i>Moxostoma breviceps</i>	Smallmouth redhorse				Rare
Catostomidae	<i>Moxostoma cannatum</i>	River redhorse	X			Rare
Catostomidae	<i>Moxostoma duquesnei</i>	black Redhorse	X			Rare
Catostomidae	<i>Moxostoma erythrurum</i>	Golden Redhorse	X	X		Rare
Centrarchidae	<i>Ambloplites rupestris</i>	Rock Bass	X	X		Rare
Centrarchidae	<i>Lepomis auitus</i>	Redbreast Sunfish		X		Uncommon
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish	X	X		Uncommon
Centrarchidae	<i>Lepomis gulosus</i>	Warmouth	X	X		Rare
Centrarchidae	<i>Lepomis humilis</i>	Orangespotted Sunfish	X	X		Rare
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	X	X		Abundant
Centrarchidae	<i>Lepomis megalotis</i>	Longear Sunfish		X		Common
Centrarchidae	<i>Lepomis microlophus</i>	Redear Sunfish	X	X		Common
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	X			Uncommon
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	X			Uncommon
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	X	X		Abundant
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie	X	X		Rare

Table 20. Continued.

Family	Species	Common name	Seasonal Occurrence			Abundance
			Spring	Summer	Fall/Winter	
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black Crappie	X	X		Rare
Centrarchidae		Hybrid Centrarchid	X	X		Rare
Clupeidae	<i>Alosa chrysochloris</i>	Skipjack herring	X	X		Rare
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	X	X		Abundant
Clupeidae	<i>Dorosoma petenense</i>	Threadfin Shad	X	X		Common
Cyprinidae	<i>Camptostoma oligolepis</i>	Largescale Stoneroller				Uncommon
Cyprinidae	<i>Cyprinella spiloptera</i>	Spotfin Shiner		X		Common
Cyprinidae	<i>Cyprinus carpio</i>	Carp	X	X		Rare
Cyprinidae	<i>Notemigonus crysoleucas</i>	Golden Shiner	X	X		Uncommon
Cyprinidae	<i>Notropis atherinoides</i>	Emerald Shiner	X	X		Uncommon
Cyprinidae	<i>Notropis texanus</i>	Weed Shiner	X	X		Uncommon
Cyprinidae	<i>Notropis volucellus</i>	Mimic Shiner	X	X	X	Uncommon
Cyprinidae	<i>Pimephales notatus</i>	Bluntnose minnow	X	X	X	Rare
Cyprinidae	<i>Pimephales vigilax</i>	Bullhead Minnow	X	X		
Esocidae	<i>Esox niger</i>	Chain Pickerel	X	X		Rare
Fundulidae	<i>Fundulus notatus</i>	Blackstripe Topminnow	X	X		Rare
Ictalundae	<i>Ameiurus natalis</i>	Yellow Bullhead	X	X		Rare
Ictalundae	<i>Ictalurus furcatus</i>	Blue Catfish	X	X		Rare
Ictalundae	<i>Ictalurus punctatus</i>	Channel Catfish	X	X		Uncommon
Ictalundae	<i>Pylodictis olivaris</i>	Flathead Catfish		X		Rare
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted Gar	X			Common
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose Gar	X	X		Rare
Moronidae	<i>Morone chrysops</i>	White Bass	X			Rare
Moronidae	<i>Morone chrysops x saxatilis</i>	Palmetto Bass				Rare
Moronidae	<i>Morone mississippiensis</i>	Yellow Bass	X			Rare
Percidae	<i>Etheostoma nigripinne</i>	Blackfin Darter				Rare

Table 20. Continued.

Family	Species	Common name	Seasonal Occurrence			Abundance
			Spring	Summer	Fall/Winter	
Percidae	<i>Perca flavescens</i>	Yellow Perch	X			Rare
Percidae	<i>Percina caprodes</i>	Logperch	X	X		Uncommon
Percidae	<i>Sander canadense</i>	Sauger	X			Rare
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater Drum	X	X		Rare

*Breeding information was not available.

Sources: Tennessee Valley Authority, 2012, McGregor and O'Neil, 2017, IUCN, 2017 and Etnier and Starnes, 1993

Table 21. U.S. Fish and Wildlife Service (USFWS) Threatened and Endangered Species list for Colbert County, AL. List includes only freshwater species.

Group	Common Name	Scientific Name	Status
Clams	Cumberland bean (pearlymussel)	<i>Villosa trabalis</i>	Experimental Population, Non-Essential
Clams	Tubercled blossom (pearlymussel)	<i>Epioblasma tarulasa tarulasa</i>	Experimental Population, Non-Essential
Clams	Turgid blossom (pearlymussel)	<i>Epioblasma turgidula</i>	Experimental Population, Non-Essential
Clams	Yellow blossom (pearlymussel)	<i>Epioblasma florentina florentin</i>	Experimental Population, Non-Essential
Clams	Alabama lampmussel	<i>Lampsilis virescens</i>	Experimental Population, Non-Essential
Clams	Winged Mapleleaf	<i>Quadrula fragosa</i>	Experimental Population, Non-Essential
Clams	Cumberland monkeyface (pearlymussel)	<i>Quadrula intermedia</i>	Endangered
Clams	Cumberland monkeyface (pearlymussel)	<i>Quadrula intermedia</i>	Experimental Population, Non-Essential
Clams	Pink mucket (pearlymussel)	<i>Lampsilis abrupta</i>	Endangered
Clams	Birdwing pearlymussel	<i>Lemiox rimasus</i>	Experimental Population, Non-Essential
Clams	Dromedary pearlymussel	<i>Dramus dramus</i>	Endangered
Clams	White wartyback (pearlymussel)	<i>Plethobosus cicatricosus</i>	Endangered
Clams	Rough pigtoe	<i>Pleurobema plenum</i>	Endangered
Clams	Shiny pigtoe	<i>Fusconaia cor</i>	Experimental Population, Non-Essential
Clams	Orangefoot pimpleback (pearlymussel)	<i>Plethobosus cooperianus</i>	Endangered
Clams	Ring pink (mussel)	<i>Obovaria retusa</i>	Endangered
Clams	Spectaclecase (mussel)	<i>Cumberlandia manadonta</i>	Endangered
Clams	Clubshell	<i>Pleurobema clava</i>	Experimental Population, Non-Essential
Clams	Oyster mussel	<i>Epioblasma capsaeformis</i>	Endangered
Clams	Oyster mussel	<i>Epioblasma capsaeformis</i>	Experimental Population, Non-Essential
Clams	Slabside Pearlymussel	<i>Pleurobema dolobelloides</i>	Endangered
Clams	Fanshell	<i>Cyprogenia stegaria</i>	Endangered
Clams	Snuffbox mussel	<i>Epioblasma triquetra</i>	Endangered
Clams	Rabbitsfoot	<i>Quadrula cylindrica cylindrica</i>	Threatened
Clams	Sheepnose Mussel	<i>Plethobosus cyphus</i>	Endangered
Fishes	Snail darter	<i>Percina tanasi</i>	Threatened
Fishes	Alabama cavefish	<i>Speoplatyrhinus poulsoni</i>	Endangered
Fishes	Spotfin Chub	<i>Erimonax monachus</i>	Threatened
Snails	Anthony's riversnail	<i>Athearnia anthonyi</i>	Experimental Population, Non-Essential

<https://ecos.fws.gov/ecp0/reports/species-by-current-range-county?fips=01033>
 Accessed 12/22/2108.

Table 22. Total volume of water filtered by sample period during 2003-2004 to estimate entrainment of fish eggs and larvae.

Sample Date	Volume			Sample Date	Volume		
	Intake m ³ day	Reservoir m ³ day	Total m ³ day		Intake m ³ day	Reservoir m ³ day	Total m ³ day
2003				2004			
28-Mar	598	456	1054	25-Mar	1334	1336	2670
3-Apr	1170	1280	2450	1-Apr	1392	1353	2745
10-Apr	1204	1287	2491	7-Apr	1259	1381	2640
17-Apr	1209	1317	2526	15-Apr	1282	1324	2606
24-Apr				22-Apr	555	540	1095
1-May	1185	1291	2476	29-Apr	1222	1275	2497
8-May	1219	1212	2431	6-May	1106	1404	2510
15-May	1262	1294	2556	13-May	974	1266	2240
22-May	1141	1273	2414	20-May	112	1436	1548
29-May	1181	1287	2468	27-May	1074	1261	2335
5-Jun	1205	1284	2489	3-Jun	917	1356	2273
12-Jun	1160	1252	2412	10-Jun	995	1351	2346
19-Jun	1259	1231	2490	17-Jun	1108	1329	2437
26-Jun	933	1310	2243	24-Jun	937	1270	2207
3-Jul	1188	1273	2461	1-Jul	1042	1276	2318
				7-Jul	1048	1282	2330
Total	15914	17047	32961	Total	15309	19158	34467
Average	1137	1218	2354	Average	1021	1277	2298

Table 23. List of fish eggs by Family collected in 2003 and 2004 entrainment samples and lowest level of taxonomic resolution for each Family.

Scientific Name	Common Name	Lowest Level of Taxonomic Identificaiton
	Unspecified	Identificaiton to family was not possible. Limiting Factors were size, stage of development, and season when egg was collected
Clupeidae	Shad	Family
Catostomidae	Sucker	Family
Percidae	Perches	Family
Sciaenidae	Drums	Species, Freshwater Drum

Table 24. List of fish by Family collected in 2003 and 2004 entrainment samples and lowest level of taxonomic resolution for each Family.

Scientific Name	Common Name	Lowest Level of Taxonomic Identificaiton
Lepisosteidae Clupeidae	Gars Shad	Species-Spotted Gar Family-All Larvae<20 mm TL Genus or Species - Larger individuals to Alosa spp.- alewife, skipjack, Dorosoma Spp. Gizzard and Threadfin Shad
Hiodontidae Cyprinidae	Mooneyes Minnows and Carps	Species-Mooneye Family-Most Minnows, shiners, clubs, dace. Genus or Species - common carp, golden shiner, and larger individuals to emerald shiner, mimic shiner, Pimephales spp.
Catostomidae	Sucker	Subfamily-ictiobines (buffalo carpsuckers, and redhorse) Genus-Larger individual to buffalo Species - Spotted Sucker
Ictaluridae	Catfishes	Species-Blue, Channel, and Flathead Catfish
Poeciliidae	Livebearers	Species-Western Mosquitofish
Moronidae	Temperate Basses	Genus- Most Larva life phases Species- yolk-sack larvae ≥ 5 mm TL (Striped bass), larger individuals to white, yellow and striped bass
Centrarchidae	Sunfishes	Genus-Crappie, Lepomids (sunfishes), and black bass. Species- Larger individuals to largemouth and smallmouth bass.
Percidae	Perches	Family-darters (Percina or Etheostoma), no yellow perch or sauger were collected. Genus or Species - Larger individuals to logperch and Percina sp.
Sciaenidae	Drum	Species-Freshwater drum
Atherinopsidae	Silversides	Family-Most Larvae (either brook or inland silverside) Species - Larger individuals to inland silverside

Table 25. Percent composition of fish eggs and larvae by Family in entrainment samples during 2003 and 2004.

	Intake Samples			Reservoir Samples			All Samples
	2003	2004	Combined 2003-2004	2003	2004	Combined 2003-2004	
	%	%	%	%	%	%	
Eggs							
Unspecified	4.7	T	0.6	0.1	T	T	0.2
Clupeidae	16.5	8.2	9.3	9.5	0.3	3.4	5.5
Catostomidae	T	T	T	T	T	T	T
Percidae	T	T	T	T	T	T	T
Sciaenidae	78.7	91.8	90.1	90.3	99.7	96.5	94.3
Larvae							
Lepisosteidae	T	T	T	T	T	T	T
Clupeidae	91.8	95	94.2	88.1	97.3	94.7	94.5
Hiodontidae	T	T	T	T	T	T	T
Cyprinidae	0.2	0.2	0.2	0.3	0.1	0.2	0.2
Catostomidae	1.3	T	0.4	0.8	T	0.2	0.3
Ictaluridae	0.1	0.1	0.1	T	T	T	T
Poeciliidae	T	T	T	T	T	T	T
Moronidae	1.8	1	1.2	6.3	0.7	2.3	1.8
Centrarchidae	0.8	1.7	1.5	0.5	0.6	0.6	1
Percidae	0.2	T	0.1	0.1	T	0.1	0.1
Sciaenidae	3.2	0.1	0.9	3.8	0.2	1.2	1.1
Atherinopsidae	0.5	1.8	1.5	0.1	1	0.7	1

T - Taxon was collected in samples but composition was less than 0.1%

Table 26. Average seasonal density of fish eggs and larvae in entrainment samples during 2003 and 2004.

	Intake Samples			Reservoir Samples			All Samples
	2003	2004	Combined 2003-2004	2003	2004	Combined 2003-2004	
	1000 m ³	1000 m ³	1000 m ³	1000 m ³	1000 m ³	1000 m ³	
Eggs							
Unspecified	5	T	1	T	T	T	1
Clupeidae	15	56	17	40	4	11	27
Catostomidae	T	T	T	T	T	T	T
Percidae	T	T	T	T	T	T	T
Sciaenidae	76	577	152	376	693	294	447
Totals	96	633	170	416	697	305	475
Larvae							
Lepisosteidae	T	T	T	T	T	T	T
Clupeidae	2943	8354	2671	3877	9241	3656	6327
Hiodontidae	T	T	T	T	T	T	T
Cyprinidae	8	18	6	11	14	7	13
Catostomidae	43	3	11	34	3	9	19
Ictaluridae	4	6	2	1	1	1	3
Poeciliidae	T	T	T	T	T	T	T
Moronidae	56	90	35	275	72	87	122
Centrarchidae	24	157	42	20	55	21	64
Percidae	8	3	3	6	3	2	5
Sciaenidae	104	8	25	170	19	47	72
Atherinopsidae	16	160	41	6	90	28	69
Totals	3205	8800	2836	4399	9497	3857	6693
T - Taxon was collected in samples but density averaged less than 1 individual per 1000 m ³							

Table 27. Estimated daily hydraulic entrainment at BFN by sample period during 2003 and 2004.

Volume				Volume			
Sample Date	Intake m ³ day	Reservoir m ³ day	Entrained %	Sample Date	Intake m ³ day	Reservoir m ³ day	Entrained %
2003				2004			
28-Mar	8.00E+06	5.30E+07	15.1%	25-Mar	4.00E+06	5.30E+07	7.5%
3-Apr	8.00E+06	2.90E+07	27.6%	1-Apr	6.90E+06	6.90E+07	10.0%
10-Apr	8.00E+06	8.40E+07	9.5%	7-Apr	8.00E+06	1.90E+07	42.0%
17-Apr	8.00E+06	1.30E+08	6.3%	15-Apr	8.00E+06	3.00E+07	27.0%
24-Apr	8.00E+06	1.20E+08	6.7%	22-Apr	8.00E+06	4.30E+07	18.6%
1-May	8.00E+06	1.00E+08	7.6%	29-Apr	8.00E+06	4.10E+07	19.5%
8-May	7.90E+06	1.90E+08	4.1%	6-May	7.90E+06	4.40E+07	17.9%
15-May	8.00E+06	2.00E+08	4.0%	13-May	8.00E+06	3.50E+07	22.9%
22-May	8.00E+06	2.00E+08	4.1%	20-May	8.00E+06	3.90E+07	20.6%
29-May	8.00E+06	1.10E+08	7.1%	27-May	8.00E+06	3.00E+07	26.6%
5-Jun	8.00E+06	1.20E+08	6.8%	3-Jun	7.90E+06	7.20E+07	33.0%
12-Jun	8.00E+06	1.10E+08	7.4%	10-Jun	8.00E+06	5.30E+07	15.1%
19-Jun	8.00E+06	1.30E+08	6.1%	17-Jun	8.00E+06	7.00E+07	11.4%
26-Jun	5.40E+06	1.30E+08	4.2%	24-Jun	8.00E+06	1.10E+08	7.2%
3-Jul	8.00E+06	1.80E+08	4.4%	1-Jul	8.00E+06	1.40E+08	5.9%
				7-Jul	8.00E+06	1.20E+08	6.7%
Average	7.82E+06	1.26E+08	6.2%	Average	7.67E+06	6.05E+07	12.7%

Table 28. Seasonal entrainment estimates for numerically significant fish taxa collected during 2003 and 2004.

	2003			2004			2003-2004		
	Intake Number Entrained Per Day	Reservoir Total Nubmer Per Day	Entrainment Estimate %	Intake Number Entrained Per Day	Reservoir Total Nubmer Per Day	Entrainment Estimate %	Intake Number Entrained Per Day	Reservoir Total Nubmer Per Day	Entrainment Estimate %
Eggs									
Clupeidae	1.20E+08	6.20E+09	2.0%	4.50E+08	2.20E+08	225.7%	3.00E+08	3.00E+09	9.9%
Sciaenidae	5.80E+08	4.90E+10	1.2%	4.60E+09	2.70E+10	17.3%	2.70E+09	3.70E+10	7.3%
Total Eggs	7.40E+08	5.50E+10	1.3%	5.00E+09	2.70E+10	18.8%	3.00E+09	4.00E+10	7.6%
Larvae									
Clupeidae	2.30E+10	5.00E+11	4.6%	6.70E+10	3.60E+11	18.3%	4.60E+10	4.30E+11	10.8%
Hiodontidae	4.50E+05	2.20E+07	2.0%	*	*	*	2.10E+05	1.00E+07	2.0%
Cyprinidae	5.90E+07	1.50E+09	3.9%	1.50E+08	8.50E+08	17.1%	1.10E+08	1.20E+09	9.0%
Catostomidae	3.40E+08	2.70E+09	13.0%	2.30E+07	1.30E+08	17.4%	1.70E+08	1.30E+09	13.2%
Ictaluridae	2.80E+07	1.20E+08	23.4%	4.80E+07	1.30E+08	37.1%	3.90E+07	1.30E+08	31.0%
Moronidae	4.40E+08	1.50E+10	3.0%	7.20E+08	2.90E+09	24.8%	5.90E+08	8.40E+09	7.0%
Centrarchidae	1.90E+08	2.90E+09	6.6%	1.20E+09	2.40E+09	51.8%	7.40E+08	3.30E+08	28.5%
Percidae	6.10E+07	5.50E+08	10.9%	1.60E+07	1.40E+08	11.8%	3.70E+07	3.30E+08	11.1%
Sciaenidae	7.70E+08	2.40E+10	3.2%	6.30E+07	8.50E+08	7.4%	3.90E+08	1.20E+10	3.3%
Atherinopsidae	1.30E+08	8.20E+08	15.4%	1.30E+09	3.70E+09	34.5%	7.40E+08	2.30E+09	31.4%
Total Larvae	2.50E+10	5.40E+11	4.5%	7.00E+10	3.80E+11	18.7%	4.90E+10	4.50E+11	10.8%

* Not Collected

Table 29. Historical and current entrainment estimates at BFN.

Year	Hydraulic Rate %	Eggs			Larvae		
		Reservoir	Intake	Rate	Reservoir	Intake	Rate
		Mean Daily Number	Mean Daily Number		Mean Daily Number	Mean Daily Number	
				%			%
Historical Baseline							
1977	12.0%	6.40E+09	1.50E+08	2.3%	3.20E+10	3.70E+09	11.7%
1978	13.3%	1.30E+09	5.00E+07	3.7%	5.40E+10	2.90E+09	5.3%
1979	9.0%	2.30E+09	1.90E+08	8.2%	3.00E+10	1.30E+09	4.5%
Currently Evaluation							
2003	6.2%	5.50E+10	7.40E+08	1.3%	5.40E+11	2.50E+10	4.5%
2004	12.7%	2.70E+10	5.00E+09	18.8%	3.80E+11	7.00E+10	18.7%
2003-2004							
Totals	8.4%	4.00E+10	3.00E+09	7.6%	4.50E+11	4.90E+10	10.8%

Attachment C – EPA Form 1