Georgia-Pacific Crossett LLC
Consumer Products

Crossett Paper Operations
100 Mill Supply Road
P.O. Box 3333
Crossett, AR 71635
(870) 567-8000
(870) 364-9076 (fax)
www.gp.com

September 18, 2017

Caleb Osbourne
Associate Director – Water Quality
Arkansas Department of Environmental Quality
5301 Northshore Drive
North Little Rock, AR 72118-5317

Reference: Georgia-Pacific Crossett LLC - Crossett Paper Operations
NPDES Permit No. AR0001210
Supplementary NPDES Permit Application Information

Dear Mr. Osborne:

Georgia-Pacific Crossett LLC, Crossett Paper Operations has prepared this supplementary NPDES permit application package to provide updated information and additional background information to support the NPDES permit application previously submitted for the renewal of NPDES Permit No. AR0001210. This package provides the additional detail requested in ADEQ's August 14, 2017 letter. Specifically, the additional information provided is as follows:

- Updated process description, process flow diagram and hydraulic profile of the wastewater treatment system;
- Certified Surveyor's Statement and supporting materials detailing the separation of Coffee Creek from the permitted NPDES wastewater treatment system;
- Water quality modeling report for flood conditions in the Ouachita River.

Should you need any additional information, please contact Sarah Ross at (870) 567-8670 or by email at sarah.ross@gapac.com.

"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."

Sincerely,

Michael L. Hohnadel
Vice President - Manufacturing
Crossett Paper Operations

Supplementary NPDES Permit Application Information

NPDES Permit No. AR0001210

Georgia-Pacific Crossett LLC
Crossett Paper Operations
Crossett, Arkansas

September 15, 2017

Table of Contents

Introduction

I. Introduction

In response to ADEQ's August 14, 2017 request, Georgia-Pacific Crossett Paper Operations (GP) has developed an additional NPDES permit application package providing updated and supplementary information for the renewal of NPDES Permit No. AR0001210. This information has been developed to provide additional background for the existing record and document recent updates to the wastewater treatment system. Specifically, the additional information provided is as follows:

- Updated process description, process flow diagram and hydraulic profile of the wastewater treatment system;
- Certified Surveyor's Statement and supporting materials detailing the separation of Coffee Creek from the permitted NPDES wastewater treatment system;
- Water quality modeling report for flood conditions in the Ouachita River.

Updated Process Information

Georgia-Pacific Manufacturing Complex

Georgia-Pacific Crossett LLC's manufacturing complex located in Crossett, Arkansas is made up of three distinct operations: a pulp and paper mill, a chemical plant (including a Resins plant and a Tall Oil Fractionation Plant) and a closed plywood plant and stud mill. The pulp and paper mill also includes an associated extrusion plant (located on the south side of US Highway 82) that applies a coating to bleached board. All of the operations (with the exception of the plywood plant and stud mill) have the potential to operate twenty-four (24) hours per day, seven (7) days per week, and fifty-two (52) weeks per year. The plywood plant and stud mill are permanently closed operations.

Pulp and Paper Mill

The pulp and paper mill processes softwood and hardwood logs and wood chips using the Kraft pulping and recovery process. Purchased pulp from different origins may be used to meet product quality specifications as well. Wood chips are digested in batch digesters with cooking chemicals to form an unbleached pulp. The unbleached pulp is then bleached to the necessary product quality in one of the three bleach plants using chlorine dioxide and hydrogen peroxide. Wastewater from each of the bleach plants is monitored according to the internal outfall monitoring requirements (Outfalls 101, 102 and 103) as specified in the NPDES permit AR0001210. These wastewaters discharge primarily into the P3 sewer. Wastewaters are also generated in the woodyard, causticizing area and pulp mill that are discharged primarily into the P2 sewer.

Paper products are currently manufactured on eight paper machines and two paper extruding machines. The paper machines include one fine paper machine, two board paper machines, and five tissue machines. The fine paper machine has been idled since August of 2013. There are currently no plans to resume production on this machine. Wastewater from the paper machines discharges to the P1 and P2 sewers.

Converting includes the operations involved with converting large parent rolls of tissue/towel from the machines into finished products of tissue, towel and other tissue products. This includes rewinding onto smaller sized rolls, folding, printing, cutting, packaging, and shipping. Minimal wastewater is generated by the tissue / towel converting operations.

The two extruding machines (located at the extrusion plant) receive board from the board paper machines by rail and from outside board customers and apply a polymer coating. Rolls of board are loaded onto an unwind stand before passing through a calendar stack, where they are subjected to burners which flame seal the board. An extruded poly sheet is then pressed together with the board. Wastewater from the Extrusion Plant is discharged separately into the City of Crossett sewer system.

The pulp and paper mill utilizes four steam generating units and a recovery furnace to provide steam and power to the pulp and paper manufacturing process. Two of the boilers (9A and 10A) utilize wet scrubbers that discharge to the P3 sewer. The recovery furnace utilizes a wet bottom electrostatic precipitator that recycles to the liquor recovery cycle except when purging is necessary; purged wastewater discharges to the sewer. Other devices such as the smelt dissolving tanks and lime kiln also have wet scrubbers that discharge to the sewer.

Chemical Plant

The Crossett chemical complex consists of two operations: (1) a Resins facility consisting of manufacturing plants for the production of formaldehyde, urea formaldehyde concentrate, liquid resins, and spray dried resins, and (2) a Tall Oil Fractionation Plant (TOFRAC) consisting of a tall oil distillation unit, a rosin size plant, and a rosin derivatives and pastilles plant. At the Resins facility, these streams flow from the point of generation through a variety of conveyances to the P3 sewer for treatment in the adjacent paper mill's wastewater treatment system. At the TOFRAC facility, process streams and wastewater/storm water collected in various collection sumps flow through an oil-water separator and odor control system before discharging to the P3 sewer for treatment in the paper mill's wastewater treatment system. A pending sale of the TOFRAC facility may put that section of the Chemical complex under other company ownership.

Source Water Treatment

Approximately 45 million gallons of water is used daily to operate the mill. Most of this water comes from the Saline River via GP Lake. Water is pumped from the Saline River into GP Lake. GP Lake provides a ready reservoir of fresh water for the mill as needed. Water is then pumped several miles from the lake to the water treatment plant for solids removal, and can also be fed to an on-site pond at the mill site that can be used for mill water supply in cases of emergency. Polyaluminum chloride, polymer, and a disinfectant (chlorine dioxide or sodium hypochlorite) are used to treat the water, and the pH of the water is also adjusted. Water filter backwash and sludge is either recycled to the head of the water treatment plant or sewered. Treated water is then used in the various mill operations.

A portion of the water used by mill operations is also supplied from several groundwater wells. The water is treated with polyphosphate and chlorine dioxide or sodium hypochlorite for disinfection and used within the Paper Mill for potable water uses and cooling water.

Source Reduction Practices and Pretreatment on the Mill Site

Ash from the 9A and 10A boilers is wet sluiced to an ash removal pond situated on the south side of the 10A boiler. The overflow from this pond is routed to the P3 sewer. Ash removed from this operation is taken to the North Landfill on the northern side of the mill property.

Odor control chemicals are added at the oil water separator at the Tall Oil Fractionation Plant located in the Chemical Plant Complex; at the lime kiln area in the P2 sewer; and at the P2 sewer Parshall Flume. These odor control chemicals presently use a system of hydrogen peroxide with an organic iron catalyst for treatment of reduced sulfur compounds.

The mill is also capable of adding sodium hydroxide to the P3 sewer to adjust the pH upwards. This pH adjustment is sometimes used to raise the pH to reduce the potential for hydrogen sulfide emissions from the wastewater treatment system and to assure that the wastewater entering the aerated stabilization basin (ASB) is near neutral (pH of 7) to ensure efficient biological treatment.

Sanitary Wastewater

Sanitary wastewater at the mill site is pretreated by several septic tanks or aerobic treatment units. The pretreated wastewater from these systems discharge eventually to one of the three main mill sewers for further treatment.

Wastewater Collection and Treatment System

The process flow diagram for the wastewater collection and treatment system is shown in Attachment A. The hydraulic profile for the system is shown in Attachment B.

Sewer Routing from mill

Wastewater from the Crossett Complex is collected within the mill in three sewers: the P1, P2 and P3 sewers. Parshall flumes with ultrasonic level transducers measure and record flow continuously in each sewer. These flumes are located along the western side of the mill site prior to the sewers leaving the mill site and continuing toward the primary clarifier area. The width of each of the flumes and the average flow for the last two years for each of the sewers is:

Sewer	Parshall Flume Throat Width, feet	Average Flow, MGD
P1	7	15.2
P2	5	8.4
P3	6	19.8

The P2 sewer discharges to the P1 sewer after the Parshall flumes of both sewers and prior to leaving the mill site. After this junction, the combined sewer (still called the P1 sewer) transitions to a 72-inch buried pipe as it heads west then turns southwest to the area immediately upstream of the primary clarifier. The length of this enclosed line from the mill site to the primary clarifier area is approximately 5,700 feet.

The P3 sewer parallels the P1 sewer as they flow off the mill site and is routed to the east side of primary clarifier in a buried 72-inch pipe. The P3 sewer eventually combines with the primary clarifier effluent from the P1 sewer downstream of the primary clarifier. The length of this enclosed line from the mill site to the primary clarifier area is approximately 5,900 feet. At times, maintenance activities in the mill may necessitate routing the P3 sewer to the P1 sewer: however, this is treated adequately in the primary clarifier.

Both enclosed sewers pass under US Highway 82. Both sewers reduce to a 60-inch pipe size as they pass under the highway, but return to 72-inch pipe after the highway crossing.

Storm water collected on the mill site in the process and adjacent areas enters one of the three sewers and is transported to the wastewater treatment system. Additionally, two storm water collection and diversion ditches begin at Highway 82 – one on the east of the P3 sewer and the other on the west side of the P1 sewers - and collect non-industrial storm water (e.g., storm water runoff from surrounding residential areas and forested areas). These storm water collection ditches prevent further inflow of non-industrial storm water from the adjoining drainage areas into the wastewater treatment system, which would reduce treatment efficiency. The west storm water ditch combines with the treated effluent channel south of the aeration basin final outfall (Outfall 001) and the east side combines with Coffee Creek drainage on the south side of the ASB. The storm water channel on the east side of the P3 sewer at Highway 82 was installed in two parts: the lower part in 1982, and the upper part in 1990. The storm water channel on the west side of the P1 sewer was installed in 1990.

Primary Treatment

In the primary clarifier area, the two piped sewers open into open channels: above the bar screen, the P1 sewer opens into a channel approximately 20 feet wide by 120 feet long prior to flowing through the bar screen and into the primary clarifier. The enclosed P3 sewer flows around the clarifier and combines with the effluent from the primary clarifier to form an open channel sewer that leads to the ash basins or aeration basin (depending on the mode of operation).

Prior to entering the primary clarifier, the P1 sewer is screened using an in-channel catenary screen. Screened solids are conveyed and discharged into a dumpster for eventual disposal into the North Landfill at the mill site. Polymer and/or odor control chemicals may be added to the primary clarifier influent and used to control compounds that could potentially produce odorous emissions from the primary clarifier area. These systems include but may not be limited to a peroxide/organic iron catalyst system and/or oxygen injected into the wastewater as it enters the clarifier. The intent of the odor control systems is to oxidize reduced sulfur compounds.

The 300-foot diameter Eimco primary clarifier was installed in 1968, and the drive was recently replaced in 2014. Typical design parameters are listed below for the primary clarifier:

Parameter	Value
Diameter	300 feet
Average Influent Flow	23.6 MGD
Surface Overflow rate	334 gallons per day per square foot
Solids Loading rate	9.1 pounds per day per square foot (current)
Hydraulic Retention Time	6.3 hours

Sludge from the clarifier is pumped to contract dewatering operations adjacent to the clarifier, and the sludge is currently dewatered on screw presses at an estimated rate of approximately 75 dry tons per day. Dewatering systems and technology can change as contractor operations are changed. Filtrate from the dewatering operation is returned to the influent or center well of the clarifier along with any underflow return not processed by the dewatering operation. Additionally, underflow may be diverted to the effluent channel downstream of the primary clarifier during periods of heavy loading or maintenance conditions. This alternate operating scenario is used on a periodic basis for limited periods of time to protect the function of the primary clarifier. The diversion of these solids downstream does not impact the overall performance of the treatment system as the solids are captured in the downstream units and dredged on a periodic basis. This alternate operating scenario is not considered a "Bypass" under Section III.B.4 of the existing NPDES permit.

Dewatered sludge is loaded onto trucks and taken to the sludge pond reclamation area for closure of a former sludge pond. This is located west of the primary clarifier. Once the closure is complete, sludge will be disposed in the mill's North landfill or utilized in an approved beneficial reuse manner. In the event of a maintenance outage, high solids loading or high storm water flow to the primary clarifier, wastewater may be routed around the primary clarifier.

Clarified water from the primary clarifier combines with the P3 sewer and then flows by gravity via a manmade channel to: (1) the surge basin and then to the aeration basin, or (2) one of the two ash settling basins. The wastewater in the P3 sewer includes boiler scrubber water from the Complex power boilers. However, recent improvements in the pretreatment ash settling basins at the mill may eliminate the need for solids removal in the ash basins at the wastewater treatment area. When the ash basins are in use, one ash basin is in service at a time while the other ash basin is being dredged for solids removal. Each ash basin is approximately 9.5 million gallons in volume with an estimated hydraulic retention time of 5.1 hours at a design average flow rate of 45 MGD. These ash basins were installed in approximately 1957. In the ash basins, ash is settled and mechanically removed to the side of the basin. Ash is allowed to dewater and then trucked to the sludge pond reclamation area for closure. Once the sludge pond reclamation area closure is complete, ash will be disposed in the mill's North landfill or utilized in an approved beneficial reuse manner.

Flow Equalization

The surge basin can be used to control hydraulic and organic loads to increase the efficiency of biological treatment in the aerated stabilization basin. When filled to capacity, the total volume of the surge basin is approximately 220 million gallons, or 4.9 days of retention at a design average flow rate of 45 MGD. The surge basin was installed in 1994. However, the surge basin is typically operated in a flow-through mode in which the flow traverses the pond in channels that stretch from the inlet to the outlet. In this mode, the time spent in the basin is less than 1 hour. Downward closing gates on the discharge structure from the surge basin control the outlet flow. After the surge basin, flow is measured in an 8-foot Parshall flume. This measuring point is designated internally as E1, and several parameters are monitored at this point. The average influent five-day biochemical oxygen demand (BOD_5) at this point over the last two years and just before biological treatment in the aeration basin is approximately 50,900 pounds per day. At the E1 flume, a nutrient solution containing nitrogen and phosphorus may be added to provide sufficient nutrients for proper degradation of organic wastes. Acid may also be added before and after the surge basin to adjust pH prior to biological treatment during periods of high pH above 9.0 that may not be conducive to good biological treatment. Additionally, at this point, sodium hydroxide may also be added to adjust the pH upwards to near neutral (pH of 7) to control hydrogen sulfide emissions from the first part of the aeration basin.

City of Crossett Wastewater

The treated wastewater from the City of Crossett's facultative wastewater ponds discharges into the manmade channel just downstream of the surge basin Parshall flume and before the ASB at an annual average flow rate of approximately 1 MGD. The City of Crossett provides wastewater treatment for the citizens of Crossett (approximately 5,500) and West Crossett (approximately 1,250), for several commercial establishments, and for several smaller industries such as Hood Industries, the GP Extrusion plant, etc. The combined wastewater then flows via the manmade open channel into the aerated stabilization basin.

Biological Treatment

Wastewater entering the aerated stabilization basin is treated by aerating the wastewater with surface aerators (78 fifty horsepower aerators are installed) to supply adequate oxygen for proper aerobic biological degradation of wastes, providing ample time for biological degradation to occur and then settling out the biological and other suspended solids in the final quiescent zone of the aeration basin. The aeration basin provides a theoretical 11.6 days of retention time at a design average flow rate of 45 MGD. Additional aeration capacity is in place beyond what is typically needed: for a typical average influent BOD_5 of 50,900 pounds per day, approximately 34 aerators fully satisfy the BOD_5 influent loading at a required oxygen to BOD_5 ratio of 1.2. Thus, it is not necessary to operate all the aerators at all times in order to supply sufficient oxygen for adequate treatment. Packaged bacteria may be fed to the influent area of the ASB as needed to supplement biological treatment efficiency.

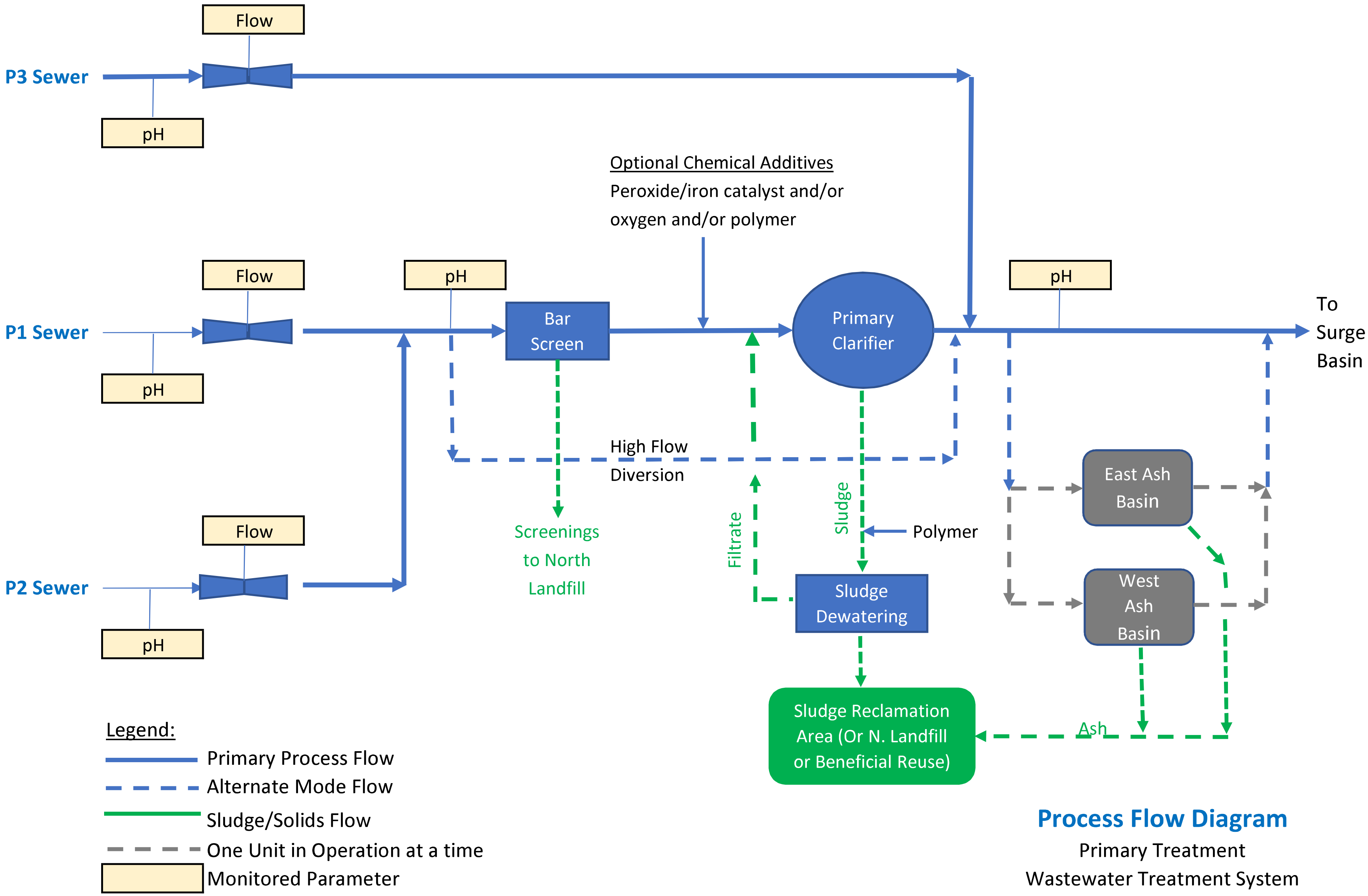
After aerated biological treatment, biological solids settle in a quiescent zone. Polymer or iron salts may be added to assist with settling. Settled solids in the ASB system are dredged periodically to a contiguous section of the aeration basin (the dredged spoils area) for solids dewatering and eventual trucking to the sludge pond reclamation area for closure of that area. Once the sludge reclamation area is closed, the dewatered dredged solids will be disposed in the mill's North landfill or utilized in an approved beneficial reuse manner.

Treated Effluent Flow Measurement and Sampling

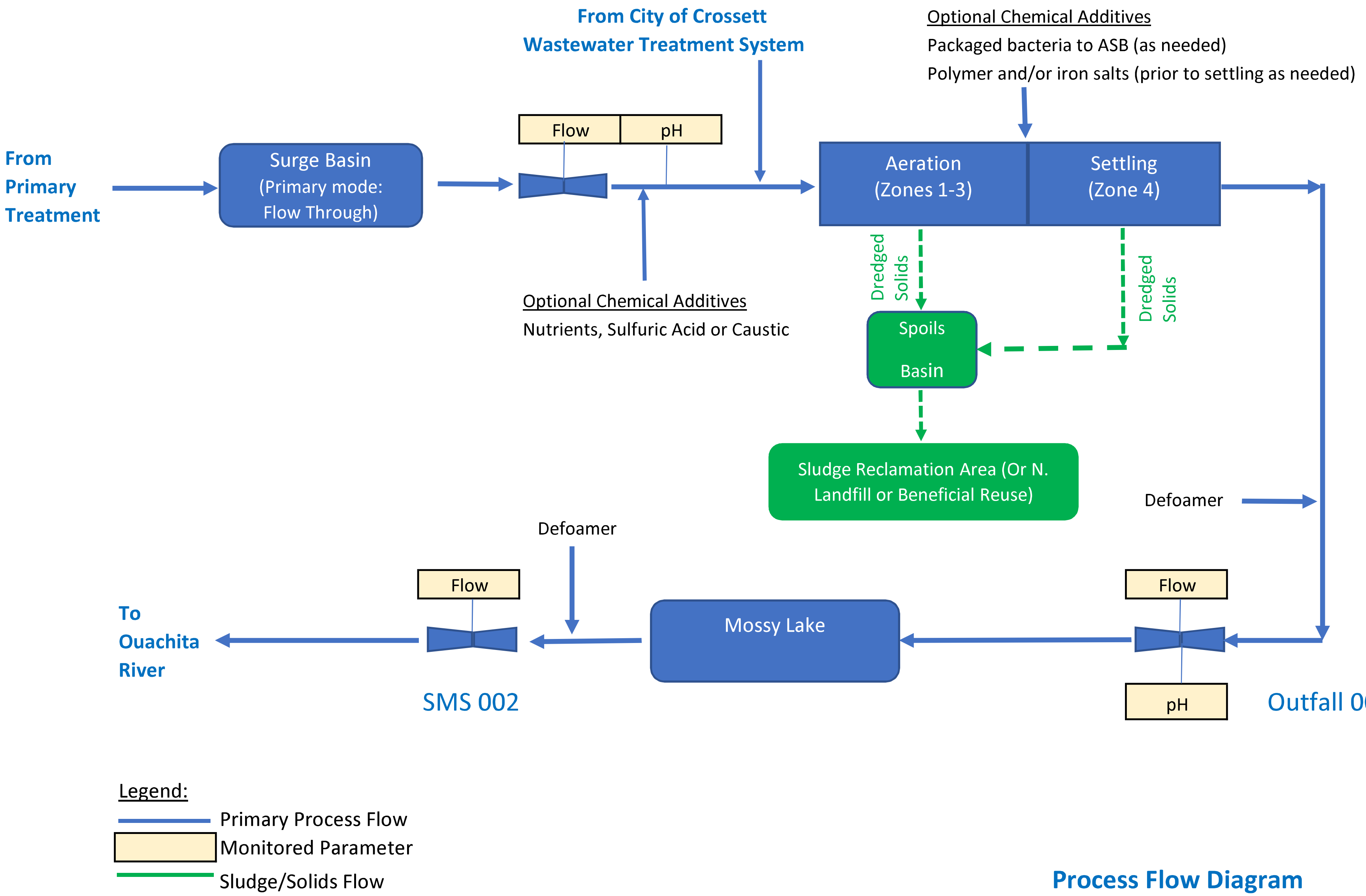
Wastewater exiting the aeration stabilization basin is treated with a non-oil based defoamer to reduce foam downstream of the Parshall flume in the effluent channel. The Parshall Flume represents Outfall 001 as identified in NPDES permit AR0001210. Flow is continuously measured in the Parshall flume and recorded. A flow-proportional sampler collects samples as required at the flume by the NPDES permit. Treated wastewater from the flume enters an earthen manmade channel, which was installed in 1970. The channel flows southward for approximately 4,700 feet, then turns westward for approximately 4,500 feet while running parallel to Cremer Trail. The channel then turns southward again for approximately 13,400 feet and eventually flows into the upper reaches of Mossy Lake.

Mossy Lake and Discharge to the Ouachita River

At the exit of Mossy Lake, flow is regulated by a downward opening weir flow control structure. During unflooded periods as described in the permit, this point (SMS 002) is sampled for the parameters specified in the permit. Due to turbulent conditions from the discharge of Mossy Lake into the channel downstream, a small amount of non-oil based defoamer may be added to prevent foam formation in Coffee Creek and the Ouachita River.

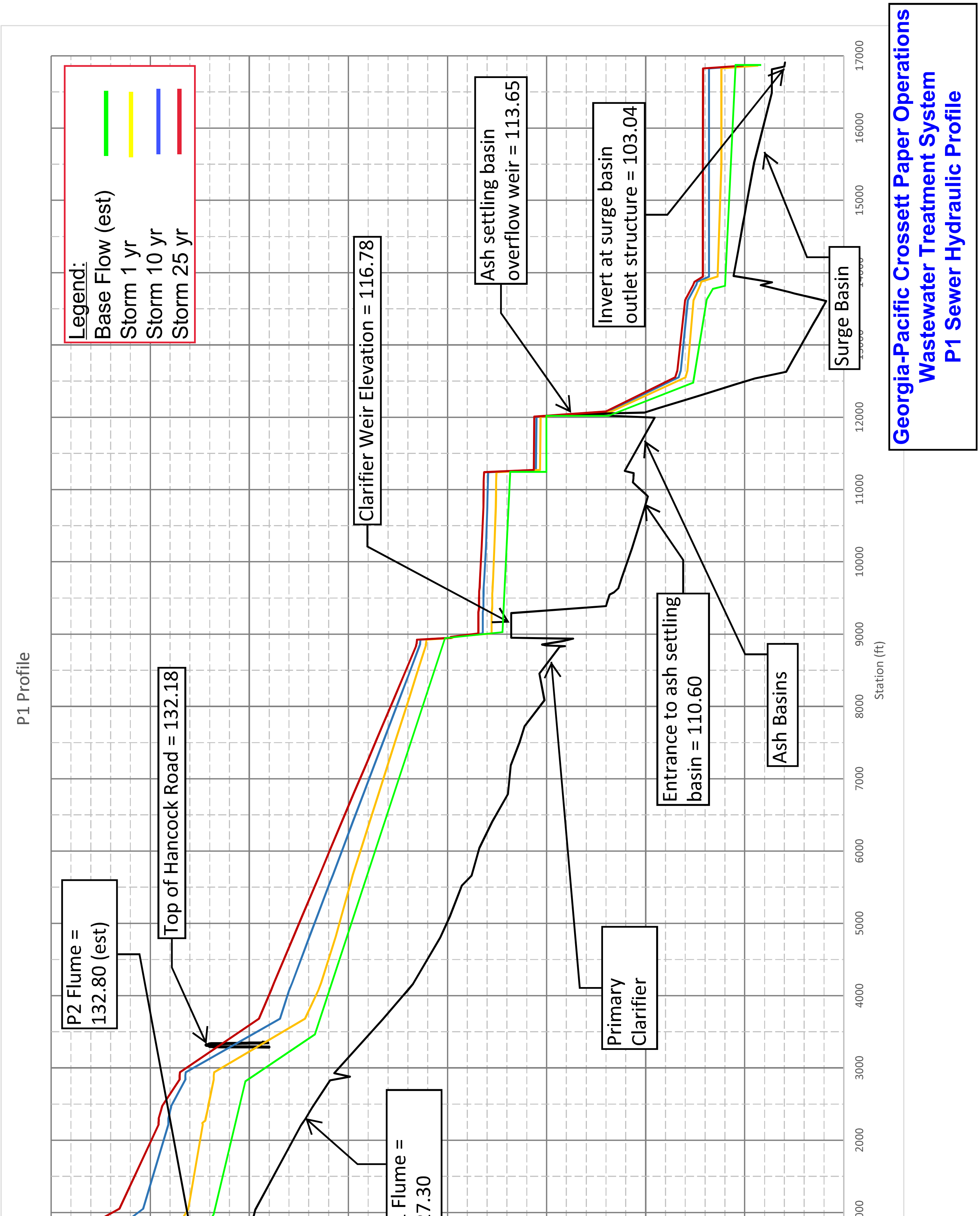


Process Flow Diagram
Primary Treatment
Wastewater Treatment System
Georgia-Pacific Crossett Paper Operations

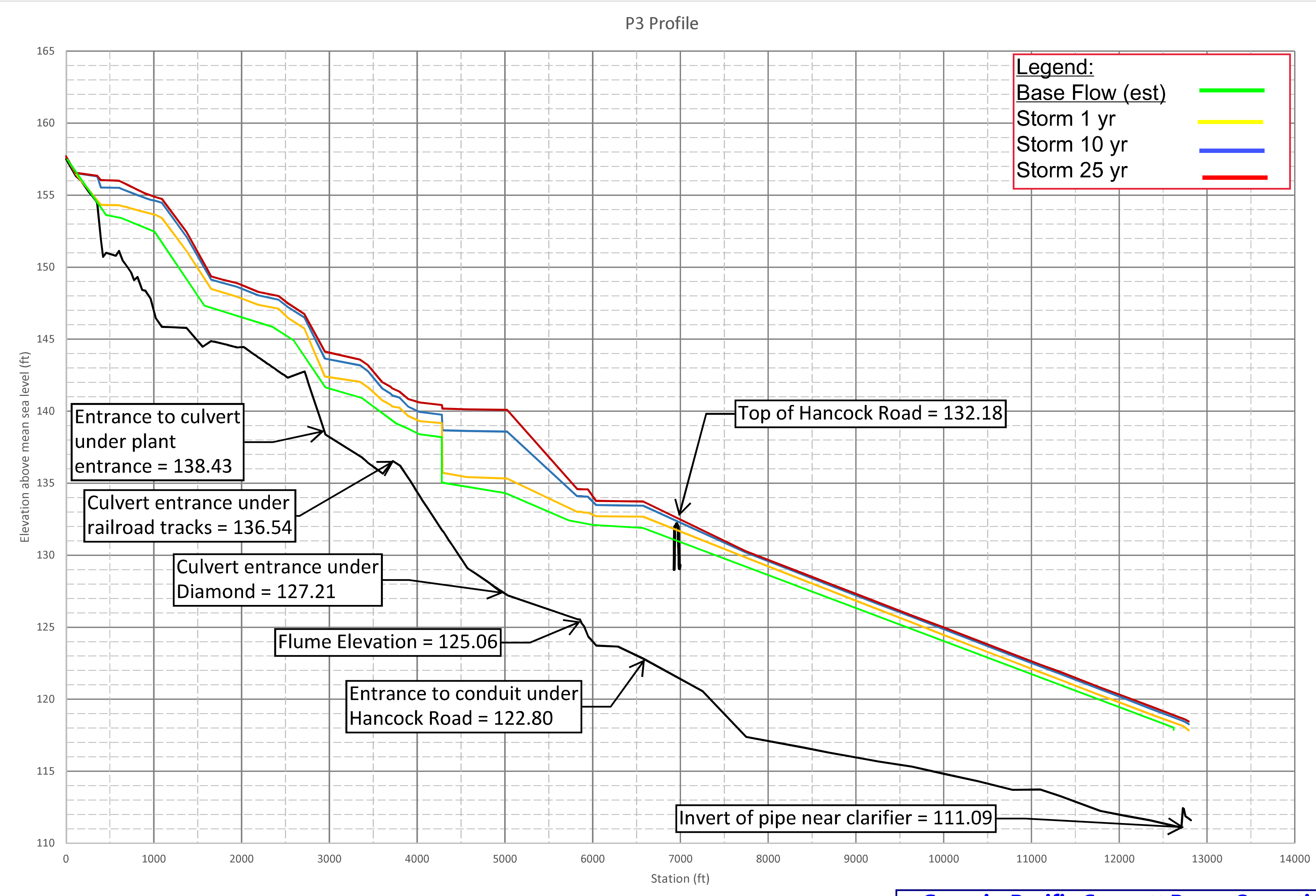


Process Flow Diagram

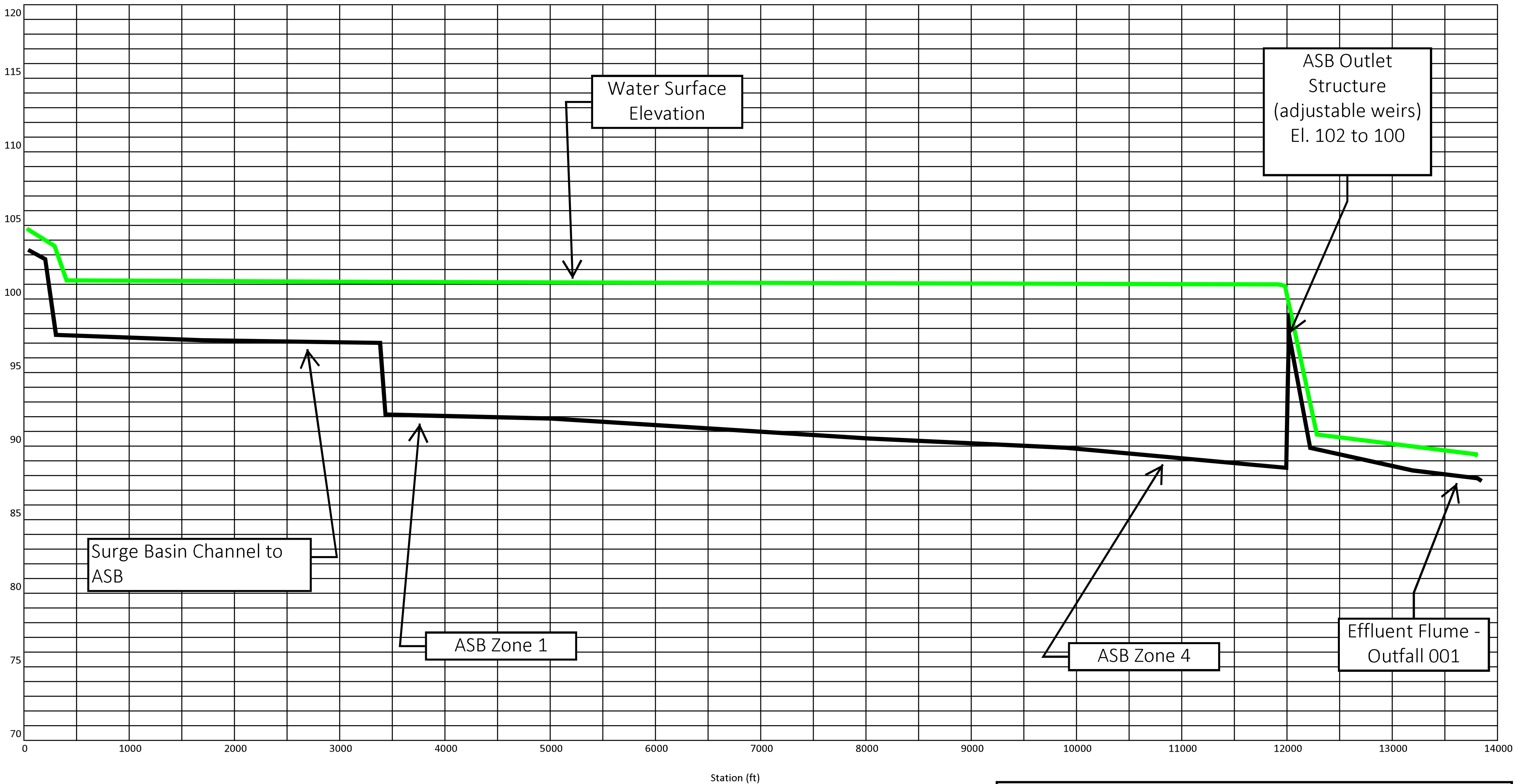
Equalization and Secondary Treatment
Wastewater Treatment System
Georgia-Pacific Crossett Paper Operations



Georgia-Pacific Crossett Paper Operations
Wastewater Treatment System
P1 Sewer Hydraulic Profile
P1 Profile
Legend:
Base Flow (est)
Storm 1 yr
Storm 10 yr
Storm 25 yr
P2 Flume = 132.80 (est)
Top of Hancock Road = 132.18
P1 Flume = 127.30
Primary Clarifier
Clarifier Weir Elevation = 116.78
Entrance to ash settling basin = 110.60
Ash Basins
Ash settling basin overflow weir = 113.65
Invert at surge basin outlet structure = 103.04
Surge Basin
Elevation above mean sea level (ft)
Station (ft)



Georgia-Pacific Crossett Paper Operations
Wastewater Treatment System
P3 Sewer Hydraulic Profile



Georgia-Pacific Crossett Paper Operations
Wastewater Treatment System
ASB to Outfall 001 Hydraulic Profile

Survey of Separation between Coffee Creek

and

Wastewater Treatment System

II. Work Description

A local Arkansas-licensed surveyor (Kevin Hicks) was contracted to survey the relationship between the existing GP wastewater treatment system and nearby Coffee Creek. The objective of the survey was to demarcate the physical separation of the two systems and document that there is no co-mingling of the two systems in these areas. The survey began near the existing ash basin where the two systems begin to parallel each other, and continued to a point past the NPDES permitted outfall (Outfall 001). The survey points are shown on Attachment C. Additionally, a written description of the separating elevation profile is included.

A certified surveyor's statement of the separation of the two systems is also included.

SURVEYOR'S CERTIFICATION:

I CERTIFY THAT DURING THE WEEK PRIOR TO THE DATE OF THIS PLAT, I SUPERVISED THIS SURVEY OF THE BANKS AND FLOW LINES OF THE GEORGIA-PACIFIC WASTEWATER TREATMENT SYSTEM AND CHANNEL, AND THE CHANNEL OF COFFEE CREEK. THE TOPOGRAPHY BETWEEN THESE CHANNELS ARE SHOWN AT THE AREAS DEPICTED AND LABELED HEREIN.

I FURTHER STATE, IN MY PROFESSIONAL OPINION AND BASED UPON THE DATA COLLECTED AND SHOWN HERE, THAT THESE CHANNELS ARE COMPLETELY INDEPENDENT OF ONE ANOTHER AND WATER CANNOT FLOW FROM ONE OF THESE CHANNELS TO THE OTHER SAVE FOR FUTURE WORK OF MEN, OR COMPLETE INUNDATION OF THE AREA OF THIS SURVEY.

CHARLES KEVIN HICKS

________________________ 9.14.2017

Date

ARKANSAS PLS NO. 1682

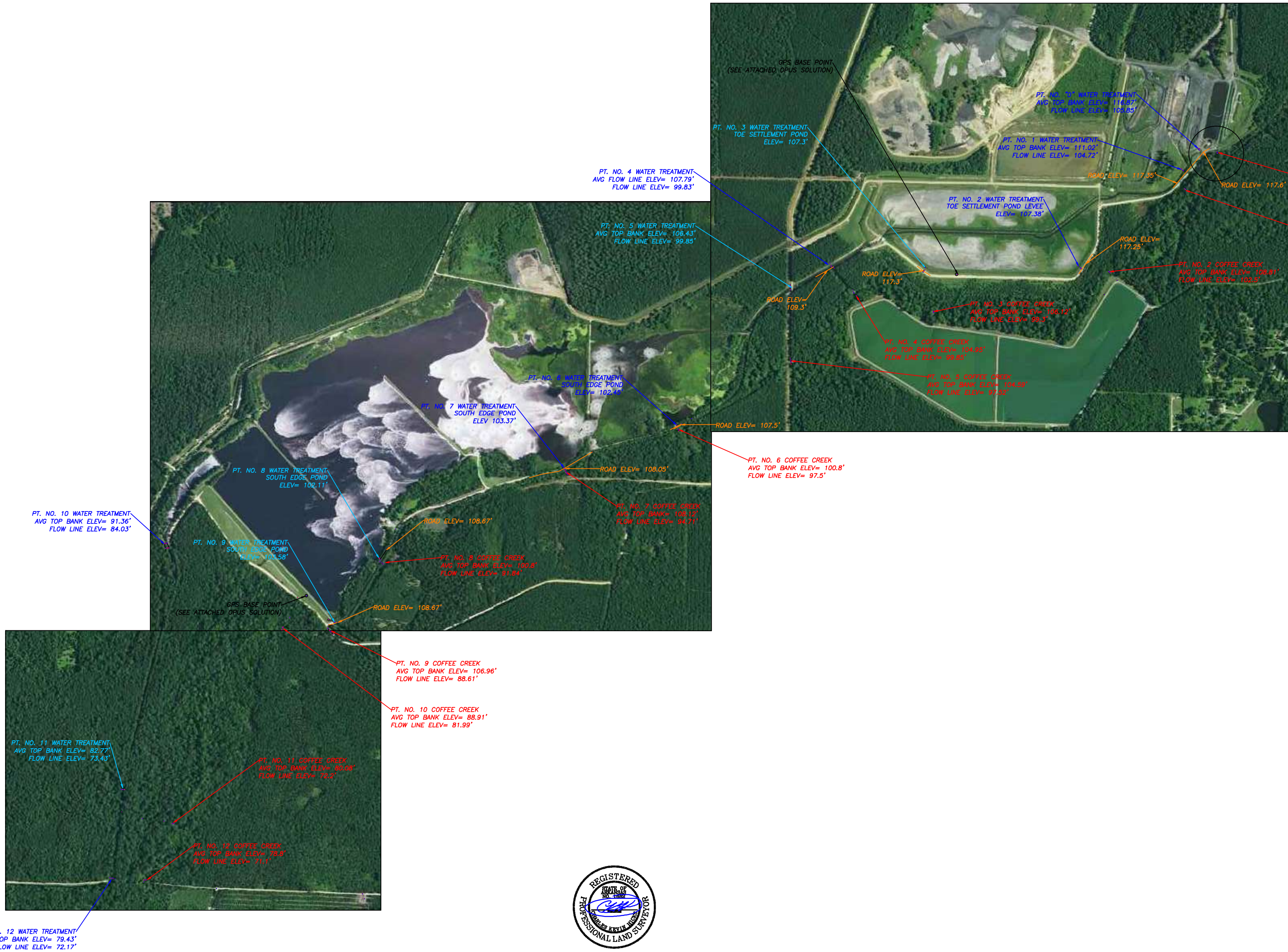
DATA SUMMEARY FOR GEORGIA PACIFIC WASTE WATER AND COFFEE CREEK CHANNELS
MEASURED 8–27 TO 8–31–2017.
REPORTED IN US SURVEY FEET AND ELEVATIONS ABOVE MEAN SEA LEVEL

PT. NO. PT. NO.	DISTANCE APART	AVG FLOW LINE ELEV	AVG TOP BANK ELEV	NOTES
0	245'	101.9'	114.5'	SEPARATED BY ROAD ELEV 117.5'
1	244'	104.1'	110.6'	SEPARATED BY ROAD ELEV 117.8'
2	416'	104.9'	113.2'	SEPARATED BY ROAD ELEV 117.5'
3	577'	103.15'	112.6'	SEPARATED BY ROAD ELEV 117.3'
4	470'	98.84'	106.6'	SEPARATED BY ROAD ELEV 109.3'
5	957'	98.69'	106.66'	SEPARATED BY WOODED TOPOGRAPHY 106'+
6	70'	103.7'	103.7'	SEPARATED BY ROAD ELEV 106.8'
7	66'	99.04'	108.2'	SEPARATED BY ROAD ELEV 108.7'
8	81'	96.9'	107.97'	SEPARATED BY ROAD ELEV 108.6'
9	130'	96.1'	107.1'	SEPARATED BY ROAD ELEV 108.2'
10	1815'	80.47'	89.02'	SEPARATED BY WOODED TOPOGRAPHY 89'+
11	783'	72.83'	78.8'	SEPARATED BY WOODED TOPOGRAPHY 78'+
12	429'	71.6'	79.1'	SEPARATED BY WOODED TOPOGRAPHY 78'+

HICKS SURVEYING INC.
617 SOUTH MAIN, HAMBURG, AR 71646

SURVEYED FOR:
GEORGIA PACIFIC
WTR TRTMNT/COFFEE CREEK
ASHLEY COUNTY, ARKANSAS

DATE: 09–01–2017 | SCALE: 1" = 600'



NORTH

0 50 100 150
BEARINGS ARE GRID BASED
SPC ARKANSAS SOUTH ZONE (0302)
NAD '83 (2011), NAVD '88

REGISTERED PROFESSIONAL LAND SURVEYOR — STATE OF ARKANSAS

HICKS SURVEYING INC.
617 SOUTH MAIN, HAMBURG, AR 71646

SURVEYED FOR:
GEORGIA PACIFIC
WTR TRTMNT/COFFEE CREEK
ASHLEY COUNTY, ARKANSAS

DATE: 09-01-2017	SCALE: 1" = 600'

Ouachita River Modeling Report During Flood Conditions

AquAeTer

optimizing
resources | water, air, earth

215 Jamestown Park, Suite 100 ◦ Brentwood, TN 37027 ◦ Phone (615) 373-8532

September 15, 2017 172488

Georgia-Pacific Crossett LLC, Crossett Paper Operations
100 Paper Mill Road
Crossett, Arkansas 71635

Sent via e-mail: Sarah.Ross@gapac.com

RE: Flood-Flow Modeling

Dear Ms. Ross:

AquAeTer, Inc. (**AquAeTer**) is pleased to present our findings of water quality modeling for two flood-flow conditions on the Ouachita River: 1) River stage 65 feet (ft) at Felsenthal Dam; and 2) River stage 75 ft at Felsenthal Dam. The purpose of this modeling is to provide Georgia-Pacific (GP) with the results from a previously calibrated low-flow water quality model and previous water quality data[1] that was modified to estimate potential water quality effects during these two flood scenarios. It is our understanding that the Arkansas Department of Environmental Quality (ADEQ) has requested GP to determine if there are impacts from treated effluent discharged directly from Outfall 001 during these flood conditions.

AquAeTer utilized the existing approved water quality model for the Ouachita River, and modified it for these flood-flow conditions. Inputs expected during the flood-flow situations were used. New data were added to the model to represent water quality conditions that have been measured downstream from Felsenthal during the two critical months selected, i.e., May for 75 ft and June for 65 ft.

SUMMARY

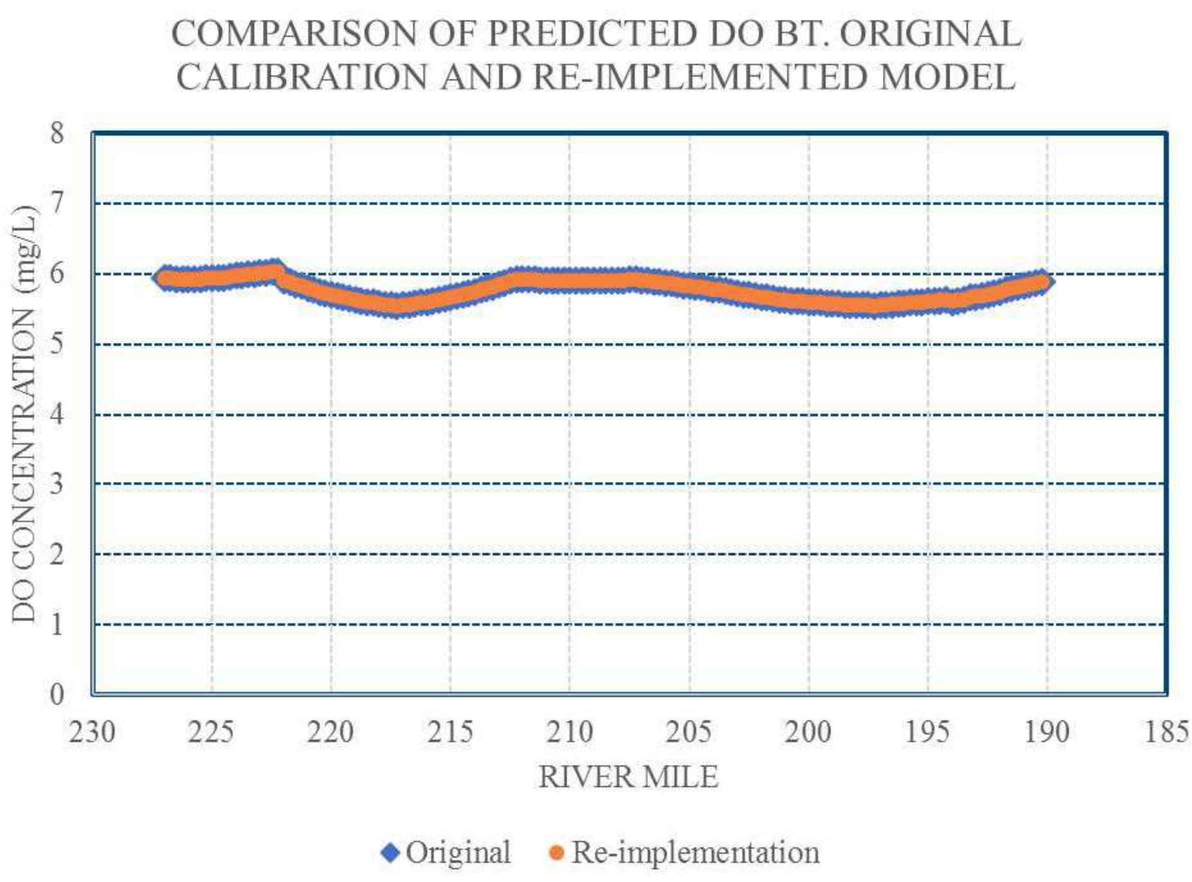
Both flood scenarios show minimal impact to the Ouachita River for a non-conservative pollutant (dissolved oxygen) which resulted in an approximately 0.2 mg/L drop, and a conservative pollutant (copper) which resulted in a less than 0.15 microgram per liter (µg/L) increase in copper concentration.

[1] Taylor, R.D., Borén, J.K., Davis, P.E., G.M., Corn, P.E., M.R. April 1993. "Dissolved Oxygen Use Attainability Analysis: Ouachita River from Felsenthal, AR to Sterlington, LA", AquAeTer, Inc., Brentwood, TN.
Taylor, R.D., Corn, P.E., M.R. 1996. "Dissolved Oxygen Use Attainability Analysis: Ouachita River from Felsenthal, AR to Sterlington, LA", AquAeTer, Inc., Brentwood, TN.
McCormick, S.T., Van Wurm, P.E., W., Smith, P.E., D.S., Corn, P.E., M.R., Bailey, S.K., Gathright, T., Starke, T.M. April 1999. "Total Maximum Daily Load Projections Ouachita River: Felsenthal Lock and Dam, Arkansas to Sterlington, LA", AquAeTer, Inc. and Georgia-Pacific Corporation. Brentwood, TN.

ORIGINAL MODEL

The model originally developed in QUAL2E and submitted to the ADEQ, Louisiana Department of Environmental Quality (LDEQ) and United States Environmental Protection Agency (USEPA) was retrieved from storage. The model was originally developed using WinQual, which ran on a version of Windows that is no longer used. The input deck was converted to work in the DOS-based QUAL-2E. The results were then compared and found to provide very similar results. The dissolved oxygen (DO) concentrations for the original model and the reimplemented model are presented in Figure 1. The maximum difference in the DO concentration between the model results is 0.01 milligram per liter (mg/L), which is less than the accuracy of DO measurements at ±0.1 mg/L.

Figure 1. Comparison of Original Calibrated Model and Re-Implemented Model Results



FLOOD MODEL CONDITIONS

The original model was developed for low-flow conditions, and was calibrated at a flow of 980 cubic feet per second (cfs). The flows for the two flood conditions analyzed are substantially greater. The gage at Felsenthal was analyzed to determine an appropriate flow at the 65' elevation flood condition. However, the gage is not capable of measuring flows when the stage exceeds 65'. Therefore, flow data acquired during flooding periods were used from upstream and downstream gages to estimate the flow at a flood elevation of 75'. The following is a list of the parameters that were changed for each model condition.

Flow

At the 65' Flood, a flow of 17,250 cfs was used. This represents the lower end of the range measured during a flood condition. The lower end of the range represents the highest potential to see an effect from the permitted discharge. At the 75' Flood, a flow of 43,364 cfs was used. As with the 65' flood condition, this represents a flow on the lower end of the range for flows calculated during this flood condition.

Depth and Velocity Coefficients

The digital elevation map (DEM) data were downloaded from the United States Department of Agriculture Geospatial website. These data were used to develop the cross-sectional area of the River during each flood. The average depth at one cross-section for each flood condition was determined. The flow was divided by the cross-sectional area to determine the velocity coefficient. With both conditions, a trendline was developed for the input parameters. These values, along with the original values used in the model are presented in Tables 1 and 2.

Table 1. Depth Coefficient and Exponent

Reach	Original Model Coefficient	Original Model Exponent	Flood Model Coefficient	Flood Model Exponent
1	0.00046	0.897	128.756	-0.643
2	0.00046	0.897	128.756	-0.643
3	0.00046	0.897	128.756	-0.643
4	0.00046	0.897	128.756	-0.643
5	0.00028	0.946	128.756	-0.643
6	0.00028	0.946	128.756	-0.643
7	0.00020	0.930	128.756	-0.643
8	0.00020	0.930	128.756	-0.643

Table 2. Velocity Coefficient and Exponent

Reach	Original Model Coefficient	Original Model Exponent	Flood Model Coefficient	Flood Model Exponent
1	7.17	0.05	$4.994*10^{-6}$	1.37
2	7.17	0.05	$4.994*10^{-6}$	1.37
3	7.17	0.05	$4.994*10^{-6}$	1.37
4	8	0.05	$4.994*10^{-6}$	1.37
5	12	0.018	$4.994*10^{-6}$	1.37
6	12	0.018	$4.994*10^{-6}$	1.37
7	15.03	0.011	$4.994*10^{-6}$	1.37
8	15.03	0.011	$4.994*10^{-6}$	1.37

CBOD Deoxygenation Rate

The ultimate carbonaceous biochemical oxygen demand ($CBOD_u$) deoxygenation rate in the original model increased briefly after the addition of the discharge from Coffee Creek, from 0.05 to 0.075 day^{-1}. For the flooded condition, the effect of the treated effluent is expected to be minimal, based on a mass balance between the receiving stream and the Mill's loading. Therefore, the $CBOD_u$ deoxygenation rate was kept constant for all reaches at 0.05 day^{-1}.

Reaeration Rate

The original model utilized the O'Connor and Dobbins reaeration method. However, the changes to the model depth and velocity to account for the flood conditions did not produce similar predicted reaeration since the effective depth changes for the two flood scenarios. During flood conditions, the aeration is expected to increase due to the increased turbulence. However, the mechanics of the O'Connor-Dobbins equation result in an increase in predicted reaeration for the 65' flood scenario while also calculating a decrease in predicted reaeration for the 75' flood scenario. The Tsivoglou-Neal reaeration rate equation was used with the Sterlington and Felsenthal gage slopes at the same measurement time to check the actual reaeration rate used. The reaeration rate was adjusted for each flood model to project more reasonable rates since the model predicted higher for the 65' flood scenario and lower for the 75' flood scenario using the O'Connor-Dobbins equations.

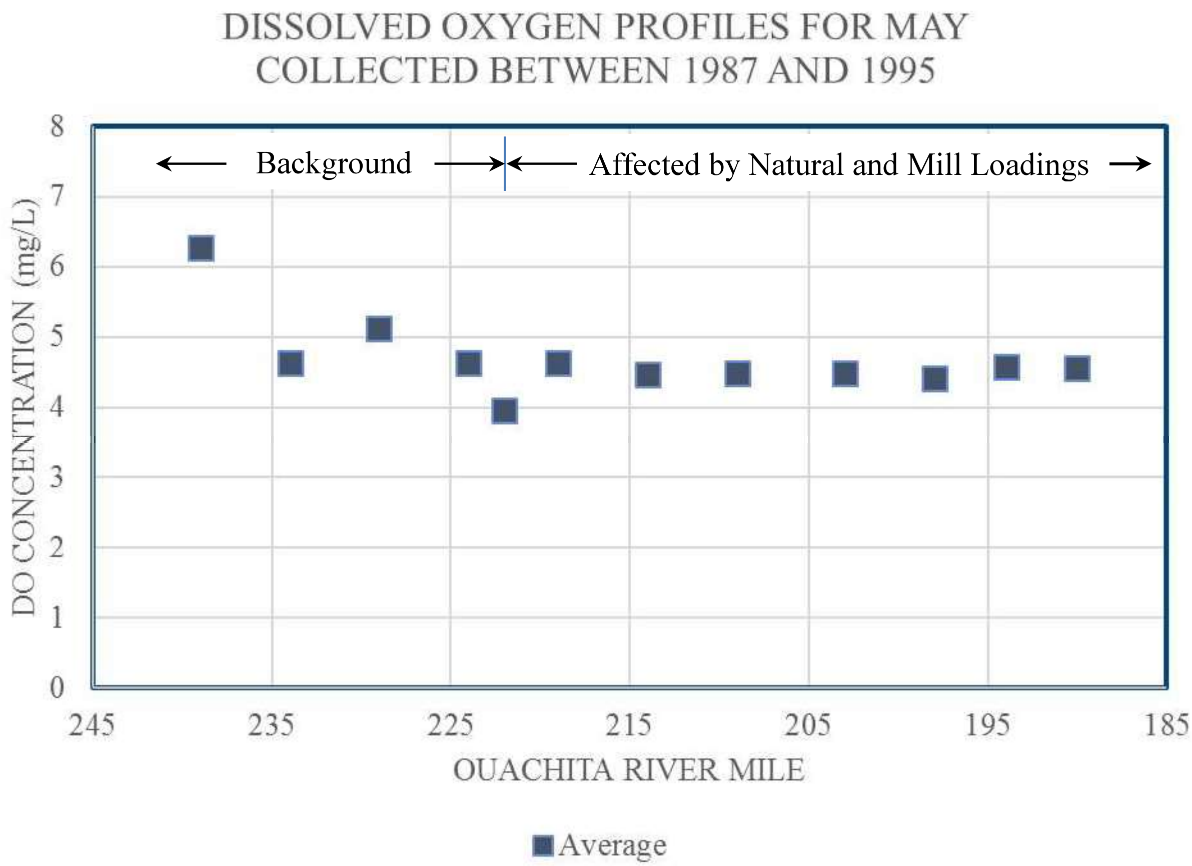
Linear Algal Self-Shading (ft^{-1} per µg/L Chlorophyll a) and Non-Algal Light Extinction

The initial run at the flooded condition failed to converge due to excessive algal growth. The linear algal self-shading parameter was adjusted from 0.0027 to 0.02. The non-algal light extinction coefficient was increased to 4 ft^{-1} for both flood models. These two parameters curtailed the algal population in the model, and allowed future model runs to converge.

Background DO Concentration

Based on the work AquAeTer performed for the Mill in developing a Use Attainability Analysis for the Ouachita River, we utilized a background DO concentration of 3.4 mg/L for the 65' flood scenario and 5.4 mg/L for the 75' flood scenario. These values were based on the data collected for June, representing the 65' flood condition, and May, representing the 75' flood condition. This is intended to represent a worse-case condition when the flooding has expanded into the stagnant water areas within the basin. This phenomenon was previously documented by AquAeTer, as shown in the Figure 2.

Figure 2. DO Data Originally Published in UAA[2]



Temperature

The original calibrated model was developed based on data collected during the field study. The temperature used was 88.7°F for the background river. The flooded conditions were evaluated to determine the most probable months for flooding. A temperature from that month was selected. The 65' flood model was run at a temperature of 87.4°F representing a June condition. For the 75' flood model, a temperature of 81.3°F was used representing a May condition. The initial conditions and background River temperature were adjusted for both models. Other temperature inputs were not adjusted from the original model.

Effluent Data

An effluent flow rate of 45 million gallons per day (mgd) or 69.63 cfs was used for the effluent flowrate. For each flood stage, an average and a maximum loading model run was

[2] Taylor and M.R. Corn. 1996. "Dissolved Oxygen Use Attainability Analysis: Ouachita River from Felsenthal, AR to Sterlington, LA", AquAeTer, Inc., Brentwood, TN.

completed. For parameters that did not have permit conditions, the original model calibration was utilized.

Copper

Copper was included in the model as a conservative mineral. There was not a significant dataset for hardness on the Ouachita River near Felsenthal. The average hardness for the background station was 21.3 mg/L as $CaCO_3$ for June and 22.5 mg/L for May, representing the 65'and 75' flood scenarios, respectively. At a hardness of 21.3 mg/L, the copper water quality standards are 3.96 µg/L and 3.03 µg/L for the CMC and CCC, respectively. At a hardness of 22.5 mg/L, the copper water quality standards are 4.17 µg/L and 3.17 µg/L for the CMC and CCC, respectively.

No Loading Condition

One model run for each flood scenario was completed in which the Mill discharge (Coffee Creek) flowrate was set to 0.

MODEL RESULTS

Both flood scenarios show minimal impact to the Ouachita River. The copper concentration for both flood scenarios also showed slight increases over the background concentration, but within the water quality standard for copper at the background hardness concentrations.

65' Flood Scenario

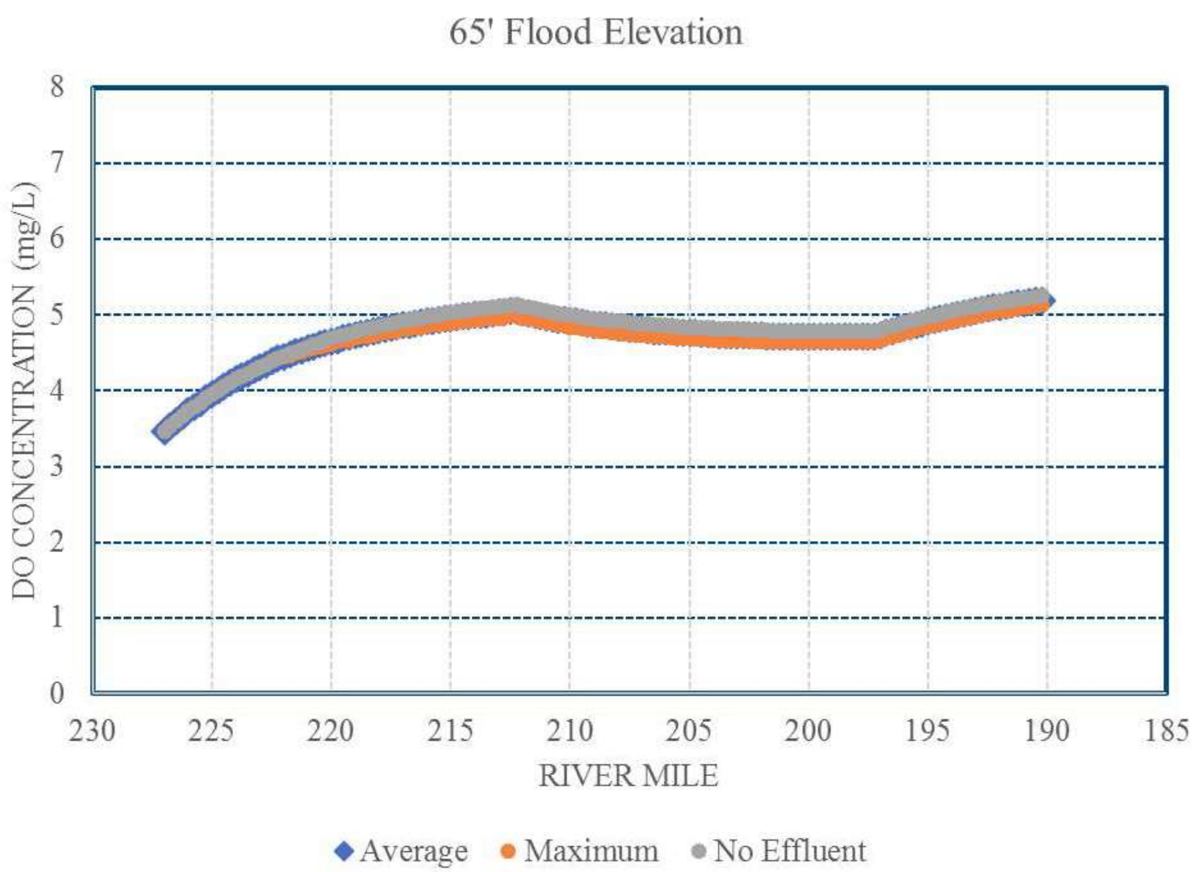
The results of the DO concentration at the 65' Flood Elevation are presented in Figure 3. A summary of the maximum delta DO concentration compared to the model run without the Mill's effluent is provided in Table 3. The difference in the DO concentration is within the accuracy of DO instrumentation, which is ±0.1 mg/L, which gives a potential swing of 0.2 mg/L.

Table 3. Results of 65' Model Scenario

Parameter	Units	At Average Permit Loading	At Maximum Permit Loading
DO, as Maximum Difference from Model Prediction without Mill	mg/L	0.08	0.16
Predicted Copper Increase Downstream from Mill	µg/L	0.07	0.15

The copper results for both permit conditions are also presented in Table 3. When using a river background concentration of 1.24 µg/L, the in the resulting downstream copper concentration would be much less than the water quality standard for both flood scenarios modeled.

Figure 3. 65' Flood Scenario



<u>**75' Flood Scenario**</u>

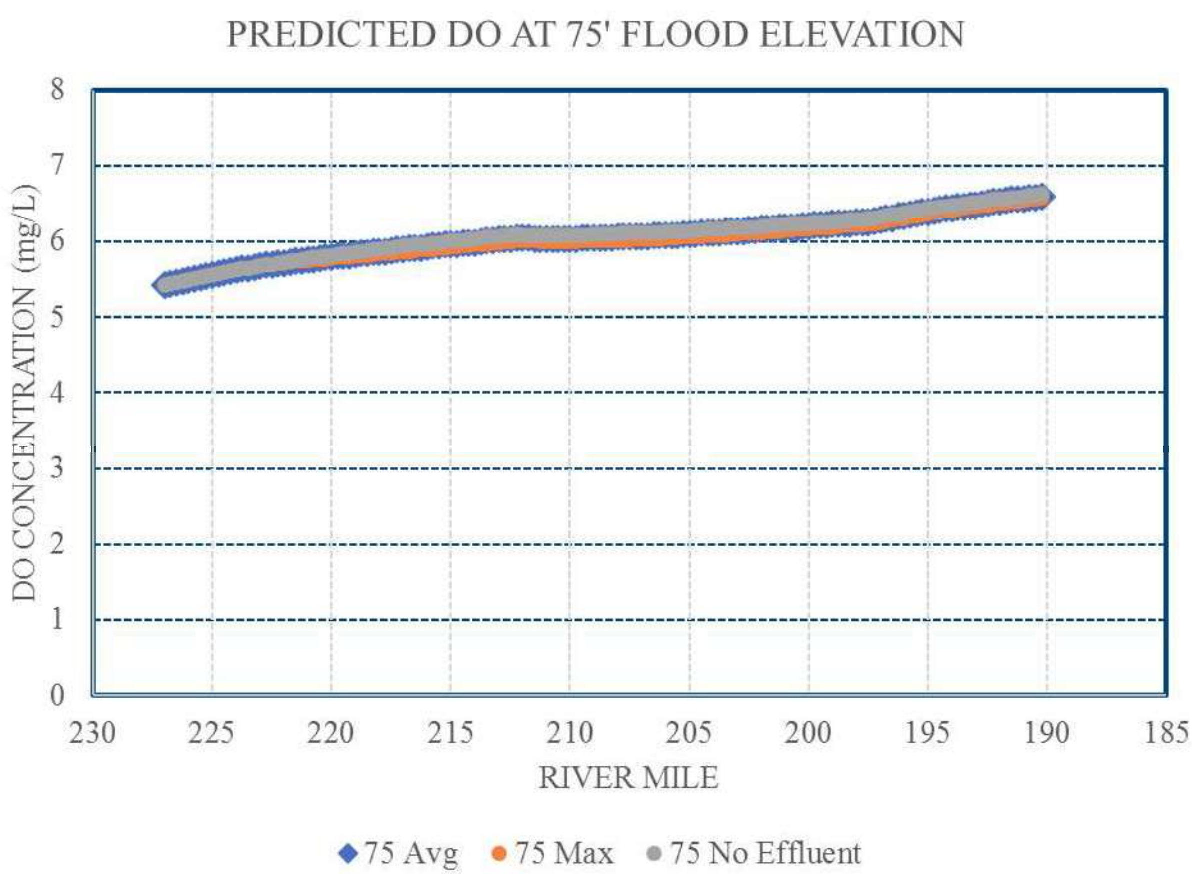
The results of the DO concentration at the 75' Flood Elevation are presented in Figure 3. A summary of the maximum delta DO concentration compared to the model run without the Mill's effluent is provided in Table 4. The difference in the DO concentration is within the accuracy of DO instrumentation, which is ±0.1 mg/L, which gives a potential swing of 0.2 mg/L.

The copper results for both permit conditions are also presented in Table 4. When using a river background concentration of 1.77 µg/L, the in the resulting downstream copper concentration would be much less than the water quality standard for both flood scenarios modeled.

Table 4. Results of 75' Model Scenario

Parameter	Units	At Average Permit Loading	At Maximum Permit Loading
DO, as Maximum Difference from Model Prediction without Mill	mg/L	0.05	0.09
Predicted Copper Increase Downstream from Mill	µg/L	0.03	0.05

Figure 4. 75' Flood Scenario



CLOSING

We appreciate the opportunity to work with you on this matter. If you have questions or comments pertaining to this letter, please contact us by telephone at (615) 373-8532, by FAX at (615) 373-8512, or by e-mail at jmcorn@aquaeter.com or mcorn@aquaeter.com.

Regards,

John Michael Corn, P.E.
Project Manager

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President

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Paul Marotta, Ph.D., P.E. (AR), BCEE

CERTIFICATION

Arkansas
PE Certificate
Number: 12650
September 15, 2017

STATE OF LOUISIANA
MICHAEL R. CORN
REG. No. 26715
REGISTERED
PROFESSIONAL ENGINEER
IN
ENVIRONMENTAL ENGINEERING

September 15, 2017

Paul J. Marotta, Ph.D., P.E. (AR) BCEE

Expires December 31, 2018

Michael R. Corn, P.E. (LA), BCEE

Expires September 30, 2018