PERIODIC INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN REVISION 1
391-3-4-.10(5) and 40 C.F.R. PART 257.82
PLANT YATES ASH POND 2 (AP-2)
GEORGIA POWER COMPANY

The Federal CCR Rule, and, for Existing Surface Impoundments where applicable, the Georgia CCR Rule (391-3-4-.10) require the owner or operator of a CCR surface impoundment to design, construct, operate and maintain an inflow design flood control system capable of adequately managing flow during and following the peak discharge of the specified inflow design flood. The owner or operator must prepare a written inflow design flood system plan documenting how the inflow design flood control system has been designed and constructed. *See* 40 C.F.R. § 257.82; Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(b). In addition, the Rules require periodic inflow design flood control system plans within 5 years of development of the previous plan. *See* 40 C.F.R. § 257.82(c)(4); Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(b).

The CCR surface impoundment known as Plant Yates AP-2 is located on Plant Yates property, northwest of Newnan, Georgia. A Notification of Intent to Initiate Closure was placed in the Operating Record on 04/17/2019. AP-2 is currently undergoing closure-by-removal. All CCR has been removed from the west portion of the original footprint, and CCR removal is ongoing in the east portion. Following the completion of CCR removal activities a portion of AP-2 will be repurposed for use as a service water pond. As a part of the closure operations and future development for the new service water pond, a new cross-valley dam has been constructed, basically bisecting the original footprint of AP-2. Although closure removal activities are ongoing, the new dam has now been placed into service.

The inflow design flood calculation for the new dam and CCR surface impoundment configuration includes the rainfall that falls within the limits of the surface impoundment and runoff from approximately 1,039 acres of adjoining watershed. The modeling for the inflow includes non-contact runoff from adjoining areas that currently bypass the surface impoundment but will ultimately flow into the future service water pond when all closure construction activities are complete. As such, they represent a “worst-case” inflow design situation for the current CCR surface impoundment.

The inflow design flood has been calculated using the Natural Resources Conservation Service (NRCS) method, also known as the Soil Conservation Service (SCS) method. As mentioned in the previous

paragraph, the inflow design calculation performed as a part of the new dam design was intended to reflect the conditions that will exist when CCR closure is complete, and the new service water pond is operational. The design storm used Engineer of Record for the new dam was the 50% PMP, 6-hr rainfall event. However, both 40 C.F.R. § 257.82 and Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(b) require the use of the 1,000-yr storm event for a significant hazard potential CCR surface impoundment. For AP-2, the 50% PMP, 6-hr rainfall event was determined to be approximately 11.3 inches. Previous inflow design system calculations for AP-2 determined the 1,000-yr storm event to be 11 inches. Therefore, the current inflow design storm meets the requirements of 40 C.F.R. § 257.82 and Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(b). Furthermore, impoundment filling will not begin until CCR removal activities are complete, providing a significant amount of storage capacity below operational normal pool elevations for the new service water pond.

Runoff curve number data and rainfall distribution methodology was determined using information from the Urban Hydrology for Small Watersheds (TR-55). Precipitation values were determined from National Oceanic and Atmospheric Administration (NOAA)'s Precipitation Frequency Data Server (Atlas-14).

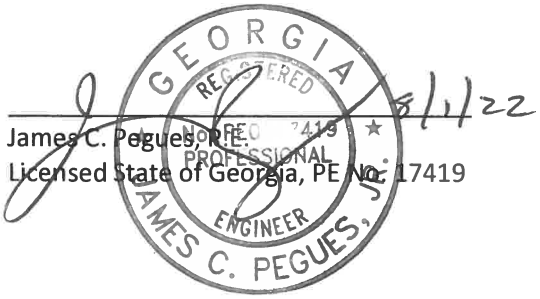
The NRCS provided information on the soil characteristics and hydrologic groups present at the site. It was determined that the hydrological groups "B" and "C" should be used to best reflect the characteristics of the soils on site. This information was placed into Hydrologic Engineering Center - Hydrologic Modeling System and used to generate appropriate precipitation curves, storm basin routing information, and resulting rating curves to evaluate surface impoundment capacity.

The spillways and storage capacity for AP-2 are designed, constructed and maintained to adequately manage flow during and following the peak discharge from a 1,000-year, 24-hour storm.

This assessment is supported by appropriate engineering calculations, a summary of which is attached.

The facility is operated subject to and in accordance with § 257.3-3 of EPA's regulations.

I hereby certify that the inflow design flood control system plan meets the requirements of 40 C.F.R. § 257.82 and Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(b).



8/1/22

James C. Pegues, P.E.
Licensed State of Georgia, PE No. 17419

Schnabel ENGINEERING

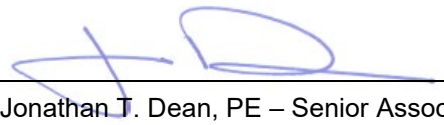
6445 Shiloh Road, Suite A
Alpharetta, GA 30005
T/ 770-781-8008
F/ 770-781-8003

MEMORANDUM

TO:	Patrick Rhodes, PE	**DATE:**	April 22, 2022
COMPANY:	Southern Company	**SUBJECT:**	Plant Yates Service Water Pond Dam
ADDRESS:	10986 Highway 87 Juliette, Georgia 31046	**PROJECT NAME/NO.:**	Plant Yates Service Water Pond Dam 17C17013.00
FROM:	Jonathan T. Dean, PE	**CC:**	

Mr. Rhodes,

As requested, **SCHNABEL ENGINEERING, LLC** (Schnabel) is pleased to provide the attached design calculations associated with the Plant Yates Service Water Pond Dam. Included in the attachment are relevant calculations associated with the hydrologic and hydraulic design, structural design and seepage and slope stability analyses. If you have any questions or comments regarding this memorandum, please do not hesitate to contact the undersigned.

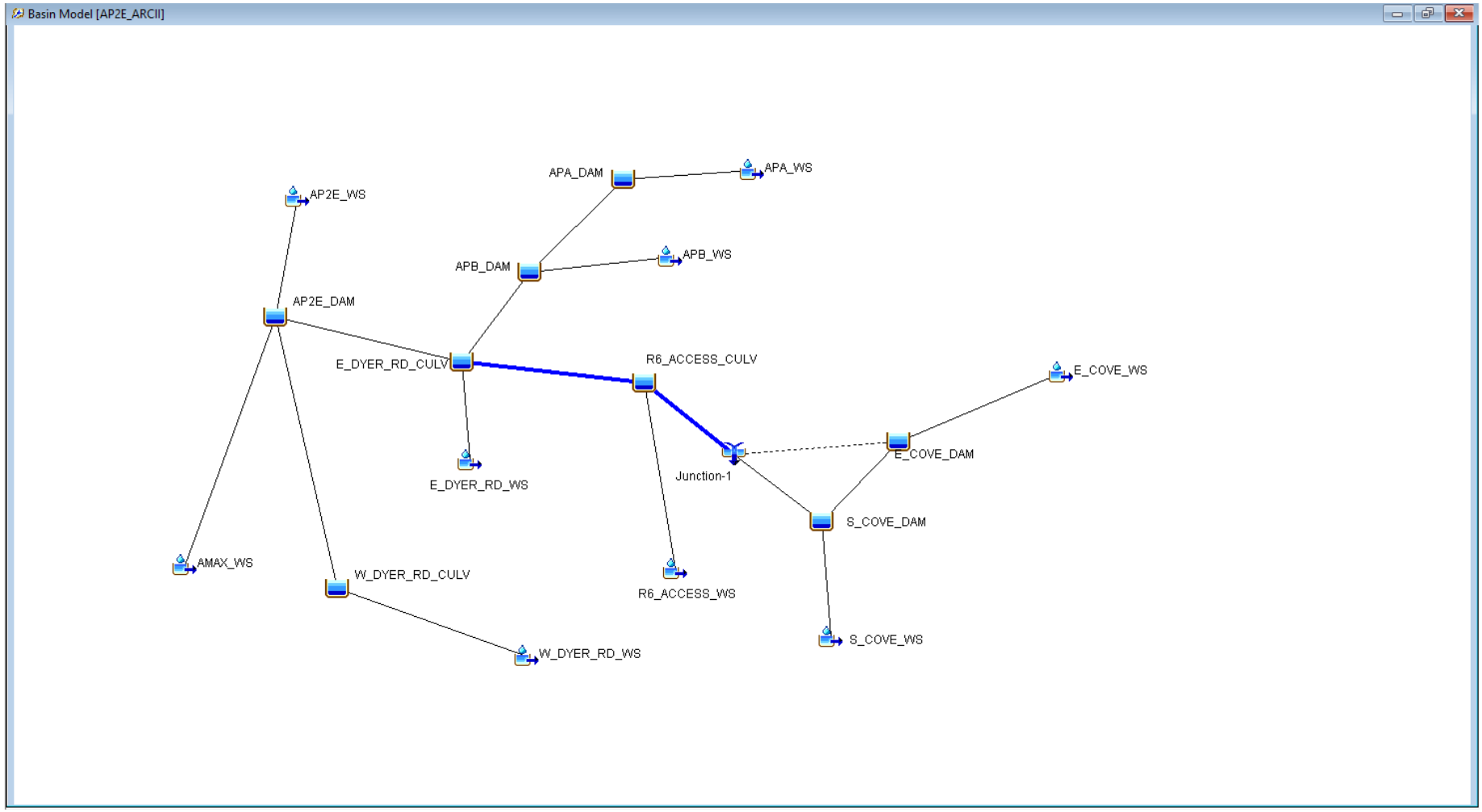
SIGNED: 

Jonathan T. Dean, PE – Senior Associate

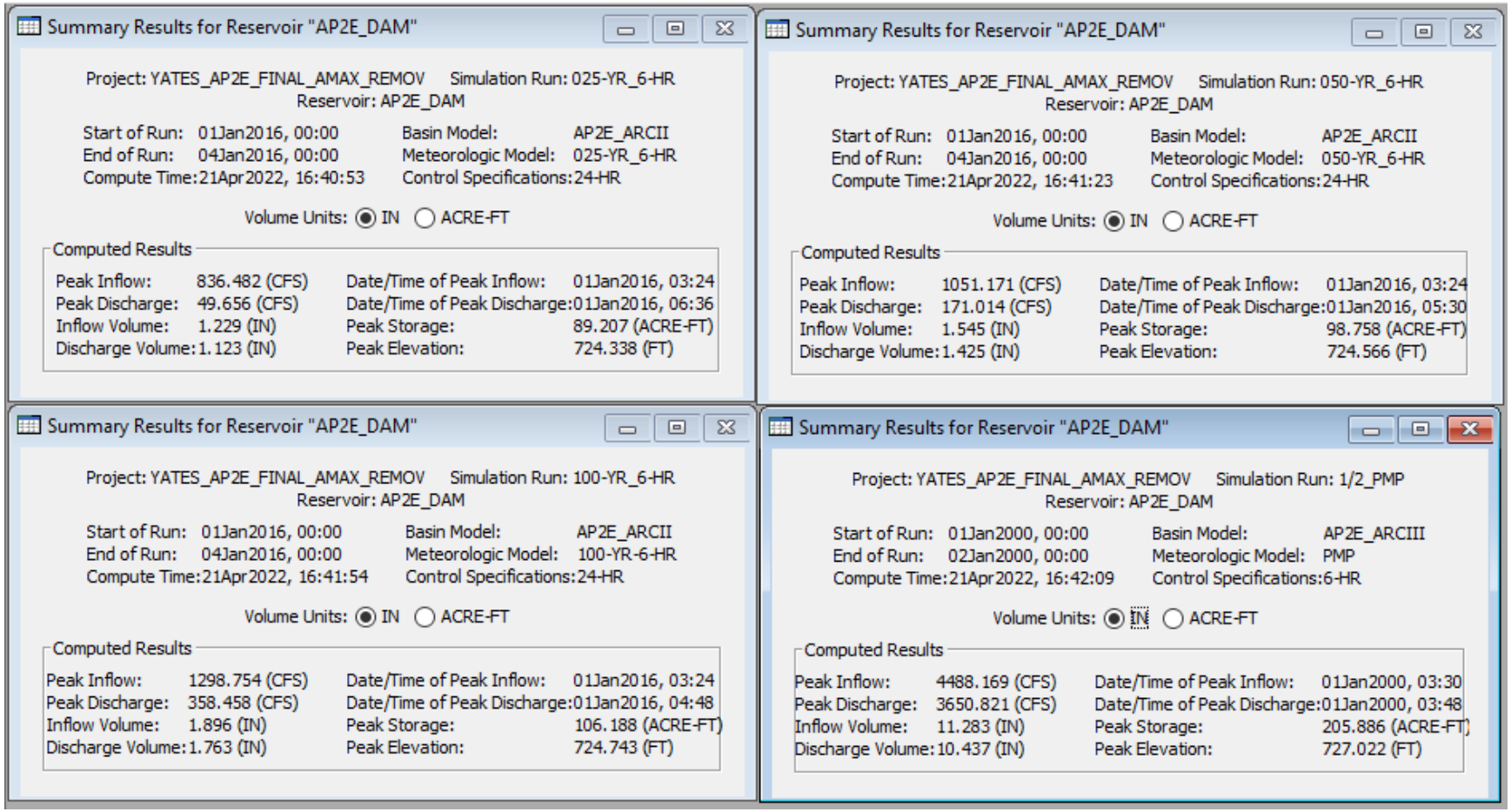
SENT VIA: ☐ First Class Mail ☐ Overnight Service ☒ Email ☐ Other

HYDROLOGY AND HYDRAULICS

Plant Yates Service Water Pond Dam
HEC-HMS Model



Plant Yates Service Water Pond Dam
HEC-HMS Model Results



N

PROPOSED SERVICE WATER POND DAM

E. DYER ROAD CULVERT

W. DYER ROAD CULVERT

AMAX COVE DAM

AP-A DAM

AP-B DAM

R-6 ACCESS CULVERT

DITCH/ CHANNEL

EAST COVE DAM

SOUTH COVE DAM

SCALE: 1"=1000'

0 1000' 2000'

Schnabel ENGINEERING

SERVICE WATER POND DAM
PLANT YATES
COWETA COUNTY, GEORGIA
PROJECT NO. 17C17013.00

WATERSHED MAP

FIGURE 1

G:\2017 PROJECTS\17C17013.00 PLANT YATES ASH POND 2\03-SE PRODUCTS\08-CAD\DRAWINGS\05-WORKINGYATES_WATERSHED_EXHIBIT.DWG

SCHNABEL ENGINEERING

BY	BWD	**DATE**	08/03/18
CHKD. BY	JCM	**DATE**	09/30/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	Ash Pond 2 East Dam	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Industrial	88	95	137.9	12,135	13,101
B	Open Space (Good cover)	61	78	16.8	1,025	1,310
W	Open Water	100	100	32.1	3,210	3,210
B	Paved; open ditches (including R/W)	89	96	2.9	258	278
B	Woods (Good cover)	55	74	13.5	743	999
C/D	Open Space (Good cover)	80	91	3.2	256	291
			Totals:	**206.4**	**17,627**	**19,190**
			Total (square miles):	**0.323**		

CN_{II}: 85
CN_{III}: 93

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

SCHNABEL ENGINEERING

BY	BWD	**DATE**	08/03/18
CHKD. BY	JCM	**DATE**	09/27/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	Amax Cove Dam	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Commercial	92	97	4.8	442	466
B	Open Space (Good cover)	61	78	70.7	4,313	5,515
W	Open Water	100	100	4.1	410	410
B	Residential, Low Density	60	78	18.1	1,086	1,412
B	Residential, Medium Density	62	79	4.6	285	363
B	Woods (Good cover)	55	74	111.0	6,105	8,214
C/D	Open Space (Good cover)	80	91	0.4	32	36
			Totals:	**213.7**	**12,673**	**16,416**
			Total (square miles):	**0.334**		

CN_{II}: 59
CN_{III}: 77

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

SCHNABEL ENGINEERING

BY	BWD	**DATE**	08/03/18
CHKD. BY	JCM	**DATE**	09/27/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	Ash Pond B Dam	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Industrial	88	95	0.2	18	19
B	Open Space (Good cover)	61	78	33.1	2,019	2,582
B	Paved; open ditches (including R/W)	89	96	2.0	178	192
C/D	Open Space (Good cover)	80	91	0.2	16	18
			Totals:	**35.5**	**2,231**	**2,811**
			Total (square miles):	**0.055**		

CN_{II}: 63
CN_{III}: 79

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

SCHNABEL ENGINEERING

BY	BWD	**DATE**	08/03/18
CHKD. BY	JCM	**DATE**	09/27/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	Ash Pond A Dam	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Industrial	88	95	0.9	79	86
B	Open Space (Good cover)	61	78	25.2	1,537	1,966
B	Paved; open ditches (including R/W)	89	96	7.5	668	720
			Totals:	**33.6**	**2,284**	**2,771**
			Total (square miles):	**0.053**		

CN_{II}: 68
CN_{III}: 82

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

SCHNABEL ENGINEERING

BY	BWD	**DATE**	08/06/18
CHKD. BY	JCM	**DATE**	09/27/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	South Cove Detention Pond	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Open Space (Good cover)	61	78	80.4	4,904	6,271
W	Open Water	100	100	2.1	210	210
B	Residential, Low Density	60	78	4.9	294	382
B	Residential, Medium Density	62	79	44.2	2,740	3,492
B	Woods (Good cover)	55	74	98.7	5,429	7,304
C/D	Open Space (Good cover)	80	91	1.9	152	173
			Totals:	**232.2**	**13,729**	**17,832**
			Total (square miles):	**0.363**		

CN_{II}: 59
CN_{III}: 77

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

SCHNABEL ENGINEERING

BY	BWD	**DATE**	08/06/18
CHKD. BY	JCM	**DATE**	09/27/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	East Cove Detention Pond	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Commercial	92	97	2.6	239	252
B	Open Space (Good cover)	61	78	73.9	4,508	5,764
W	Open Water	100	100	2.1	210	210
B	Residential, Low Density	60	78	15.3	918	1,193
B	Residential, Medium Density	62	79	56.2	3,484	4,440
B	Paved; open ditches (including R/W)	89	96	13.0	1,157	1,248
B	Woods (Good cover)	55	74	162.0	8,910	11,988
C/D	Woods (Good cover)	77	89	0.7	54	62
C/D	Open Space (Good cover)	80	91	3.7	296	337
			Totals:	**329.5**	**19,776**	**25,495**
			Total (square miles):	**0.515**		

CN_{II}: 60
CN_{III}: 77

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

SCHNABEL ENGINEERING

BY	BWD	**DATE**	09/10/18
CHKD. BY	JCM	**DATE**	11/08/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	R-6 Access Road Culvert	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Open Space (Good cover)	61	78	88.4	5,392	6,895
C/D	Open Space (Good cover)	80	91	38.9	3,112	3,540
			Totals:	**127.3**	**8,504**	**10,435**
			Total (square miles):	**0.199**		

CN_{II}: 67
CN_{III}: 82

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

SCHNABEL ENGINEERING

BY	BWD	**DATE**	09/10/18
CHKD. BY	JCM	**DATE**	11/08/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	Dyer Road Culvert	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Industrial	88	95	2.2	194	209
B	Open Space (Good cover)	61	78	15.7	958	1,225
C/D	Open Space (Good cover)	80	91	12.5	1,000	1,138
			Totals:	**30.4**	**2,151**	**2,571**
			Total (square miles):	**0.048**		

CN_{II}: 71
CN_{III}: 85

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

SCHNABEL ENGINEERING

BY	BWD	**DATE**	10/01/18
CHKD. BY	JCM	**DATE**	11/08/19
PROJECT	Plant Yates Ash Pond 2 East Final Design	**PROJ. #**	17C17013.00
WATERSHED	Dyer Road Culvert (West)	**CONDITION**	Proposed

Hydrologic Soil Group	Cover Description (Cover type, treatment, and hydrologic description; % impervious; connected or connected, etc)	CN_{II} (ARC II)	CN_{III} (ARC III)	Area (Ac.)	Product (CN_{II}*Area)	Product (CN_{III}*Area)
B	Open Space (Good cover)	61	78	28.1	1,714	2,192
B	Woods (Good cover)	55	74	4.3	237	318
C/D	Open Space (Good cover)	80	91	4.1	328	373
			Totals:	**36.5**	**2,279**	**2,883**
			Total (square miles):	**0.057**		

CN_{II}: 62
CN_{III}: 79

References:

Soils Information obtained from NRCS Soil Data Map for Coweta County, Georgia
NRCS TR-55, Second Edition, June 1986
NRCS Part 630 Hydrology, NEH, Chapter 9-10, 2004

Schnabel ENGINEERING

Project Plant Yates Page 1 of 1
Project No 17C17013 By JCM Date 11/8/2019
Client Checked RJD Date 11/11/19

Subject Reach Lag times

1) S-Cove to R6 Reach

Length of Reach = 2307 feet

* flowing half full ← Velocity of flow = 1.74 ft/sec (See reach from south cove to APB hydraflow file)

$$\text{Lag time} = \frac{\text{Length}}{\text{Velocity}} = \frac{2307\text{ ft}}{1.74\text{ ft/s}} = 1326 \text{ seconds}$$

or

22.1 mins ✓

2) R-6 to Dyer Road Reach

Length of Reach = 1317 feet

* flowing half full ← Velocity of flow = 2.66 ft/sec (See reach from APB to AP2E hydraflow file)

$$\text{Lag time} = \frac{\text{Length}}{\text{Velocity}} = \frac{1317\text{ ft}}{2.66\text{ ft/s}} = 495 \text{ seconds}$$

or

8.3 minutes ✓

Watershed Lag Method
Plant Yates
17C17013.00
9/30/2019
JCM

Watershed: AP2E

ℓ =	3092	ft
CN =	85	
S =	1.76	in.

Slope:

RISE	RUN	%
24	166	14.5
20	434	4.6
12	259	4.6
14	644	2.2
12	350	3.4
20	194	10.3
	Y =	6.6

Lag:

L = 0.26 hr

16 mins

BWD
10/9/19

Watershed Lag Method
Plant Yates
17C17013.00
9/30/2019
JCM

Watershed: AMAX

ℓ =	4716	ft
CN =	59	
S =	6.95	in.

Slope:

RISE	RUN	%
30	160	18.8
40	261	15.3
20	99	20.2
30	139	21.6
20	146	13.7
	Y =	17.9

Lag:

L = 0.46 hr

28 mins

✓BWD
10/9/19

Watershed Lag Method
Plant Yates
17C17013.00
9/30/2019
JCM

Watershed: APB

ℓ = 2220 ft ✓
CN = 63
S = 5.87 in.

Slope:

RISE	RUN	%
20	230	8.7
30	185	16.2
20	154	13.0
20	141	14.2
	Y =	13.0

Lag:

L = 0.27 hr ✓
16 mins

✓ BWD
10/9/19

Watershed Lag Method
Plant Yates
17C17013.00
9/30/2019
JCM

Watershed: APA

ℓ =	2217	ft
CN =	68	
S =	4.71	in.

Slope:

RISE	RUN	%
20	155	12.9
20	1047	1.9
20	332	6.0
	Y =	6.9

Lag:

L = 0.32 hr

19 mins

BWD
10/9/19

Watershed Lag Method
Plant Yates
17C17013.00
9/30/2019
JCM

Watershed: S-COVE

ℓ =	3796	ft
CN =	59	
S =	6.95	in.

Slope:

RISE	RUN	%
36	178	20.2
24	155	15.5
18	170	10.6
20	227	8.8
18	186	9.7
28	184	15.2
	Y =	13.3

Lag:

L = 0.45 hr

27 mins

✓BWD
10/9/19

Watershed Lag Method
Plant Yates
17C17013.00
9/30/2019
JCM

Watershed: E-COVE

ℓ =	5050	ft
CN =	60	
S =	6.67	in.

Slope:

RISE	RUN	%
40	471	8.5
16	189	8.5
26	149	17.4
24	166	14.5
22	237	9.3
20	144	13.9
18	125	14.4
	Y =	12.3

Lag:

L = 0.57 hr

34 mins

✓ BWD
10/9/19

Worksheet: Time of Concentration (Tc)*

Project:	**Plant Yates Ash Pond 2 East Design**	By:	BWD	Date:	9/11/18
Proj. #	**17C17013.00**	Checked:	JTD	Date:	9/13/18
Subbasin:	**R-6 Access Road Culvert**	Revised:		Date:	
Dev. Condition:	**Proposed**				

Sheet Flow		Segment	A-B		
1	Surface Description (Table 3-1)		Short grass prarie		
2	Manning's n (Table 3-1)		0.15		
3	Flow Length L (L<= 300 ft)	ft	100		
4	Two Yr Rainfall, P2	in	3.89		
5	Land Slope, s	ft/ft	0.03		
6	Tt=.007(nL)^.8/(P2^0.5*s^0.4)	hr	0.13		
Shallow Concentrated Flow		Segment	B-C		
7	Surface Description (paved/unpaved)		Grassed Waterways		
8	Flow Length L	ft	467		
9	Watercourse Slope, s	ft/ft	0.11		
10	Average Velocity, V (Fig 3-1)	fps	5.35		
11	Tt=L/(3600V)	hr	0.02		
Pipe Flow		Segment	E-F		
12a	Pipe Diameter, d	in	48		
12b	Depth of Flow, y	in	24		
12c	Chord Length	in	48.0		
12d	Central Angle	deg	180.0		
12c	Cross Sectional Flow Area, A	sf	6.28		
13	Wetted Perimeter, P		6.3		
14	Hydraulic Radius, R=A/P		1.00		
15	Channel Slope, S	ft/ft	0.014		
16	Manning's n		0.01		
17	V=1.49*R^.667*S^.5/n	fps	17.63		
18	Flow Length L	ft	115		
19	Tt=L/(3600V)	hr	0.002		
Channel Flow		Segment	C-D	F-G	
20a	Channel Bottom Width, B	ft	8	20	
20b	Channel Side Slope z, where zH:1V		3	3	
20c	Full Bank Flow Depth, d	ft	4	5	
20d	Cross Sectional Flow Area, A	sf	80	175	
21	Wetted Perimeter, P		33.30	51.62	
22	Hydraulic Radius, R=A/P		2.40	3.39	
23	Channel Slope, S	ft/ft	0.003	0.003	
24	Manning's n		0.08	0.08	
25	V=1.49*R^.667*S^.5/n	fps	1.83	2.30	
26	Flow Length L	ft	4423	1365	
27	Tt=L/(3600V)	hr	0.67	0.16	
Flow through Reservoir		Segment			
28	Average Reservoir Depth	ft			
29	Velocity	fps			
30	Flow Length	ft			
31	Tt=L/(3600V)	hr			
32	**Total Tt or Tc**	**hr**	**0.99**		
		LAG (hr)	**0.59**	35.6	min

*Ref: Procedure from Part 630 Hydrology National Engineering Handbook, Chapter 15 - Time of Concentration (May 2010)

Worksheet: Time of Concentration (Tc)*

Project:	**Plant Yates Ash Pond 2 East Design**	By:	BWD	Date:	9/11/18
Proj. #	**17C17013.00**	Checked:	JTD	Date:	9/13/18
Subbasin:	**Dyer Road Culvert (East)**	Revised:		Date:	
Dev. Condition:	**Proposed**				

Sheet Flow		Segment	A-B	
1	Surface Description (Table 3-1)		Short grass prarie	
2	Manning's n (Table 3-1)		0.15	
3	Flow Length L (L<= 300 ft)	ft	100	
4	Two Yr Rainfall, P2	in	3.89	
5	Land Slope, s	ft/ft	0.01	
6	Tt=.007(nL)^.8/(P2^0.5*s^0.4)	hr	0.20	
Shallow Concentrated Flow		Segment	B-C	
7	Surface Description (paved/unpaved)		Grassed Waterways	
8	Flow Length L	ft	1588	
9	Watercourse Slope, s	ft/ft	0.15	
10	Average Velocity, V (Fig 3-1)	fps	6.25	
11	Tt=L/(3600V)	hr	0.07	
Pipe Flow		Segment		
12a	Pipe Diameter, d	in		
12b	Depth of Flow, y	in		
12c	Chord Length	in		
12d	Central Angle	deg		
12c	Cross Sectional Flow Area, A	sf		
13	Wetted Perimeter, P			
14	Hydraulic Radius, R=A/P			
15	Channel Slope, S	ft/ft		
16	Manning's n			
17	V=1.49*R^.667*S^.5/n	fps		
18	Flow Length L	ft		
19	Tt=L/(3600V)	hr		
Channel Flow		Segment	C-D	
20a	Channel Bottom Width, B	ft	20	
20b	Channel Side Slope z, where zH:1V		3	
20c	Full Bank Flow Depth, d	ft	5	
20d	Cross Sectional Flow Area, A	sf	175	
21	Wetted Perimeter, P		51.62	
22	Hydraulic Radius, R=A/P		3.39	
23	Channel Slope, S	ft/ft	0.007	
24	Manning's n		0.2	
25	V=1.49*R^.667*S^.5/n	fps	1.41	
26	Flow Length L	ft	663	
27	Tt=L/(3600V)	hr	0.13	
Flow through Reservoir		Segment		
28	Average Reservoir Depth	ft		
29	Velocity	fps		
30	Flow Length	ft		
31	Tt=L/(3600V)	hr		
32	**Total Tt or Tc**	**hr**	**0.40**	
		LAG (hr)	**0.24**	14.3 min

*Ref: Procedure from Part 630 Hydrology National Engineering Handbook, Chapter 15 - Time of Concentration (May 2010)

Worksheet: Time of Concentration (Tc)*

Project:	**Plant Yates Ash Pond 2 East Design**	By:	BWD	Date:	10/3/18
Proj. #	**17C17013.00**	Checked:		Date:	
Subbasin:	**Dyer Road Culvert (West)**	Revised:		Date:	
Dev. Condition:	**Proposed**				

Sheet Flow		Segment	A-B	
1	Surface Description (Table 3-1)		Short grass prarie	
2	Manning's n (Table 3-1)		0.15	
3	Flow Length L (L<= 300 ft)	ft	100	
4	Two Yr Rainfall, P2	in	3.89	
5	Land Slope, s	ft/ft	0.14	
6	Tt=.007(nL)^.8/(P2^0.5*s^0.4)	hr	0.07	
Shallow Concentrated Flow		Segment	B-C	
7	Surface Description (paved/unpaved)		Grassed Waterways	
8	Flow Length L	ft	479	
9	Watercourse Slope, s	ft/ft	0.19	
10	Average Velocity, V (Fig 3-1)	fps	7.03	
11	Tt=L/(3600V)	hr	0.02	
Pipe Flow		Segment		
12a	Pipe Diameter, d	in		
12b	Depth of Flow, y	in		
12c	Chord Length	in		
12d	Central Angle	deg		
12c	Cross Sectional Flow Area, A	sf		
13	Wetted Perimeter, P			
14	Hydraulic Radius, R=A/P			
15	Channel Slope, S	ft/ft		
16	Manning's n			
17	V=1.49*R^.667*S^.5/n	fps		
18	Flow Length L	ft		
19	Tt=L/(3600V)	hr		
Channel Flow		Segment	C-D	
20a	Channel Bottom Width, B	ft	5	
20b	Channel Side Slope z, where zH:1V		3	
20c	Full Bank Flow Depth, d	ft	2	
20d	Cross Sectional Flow Area, A	sf	22	
21	Wetted Perimeter, P		17.65	
22	Hydraulic Radius, R=A/P		1.25	
23	Channel Slope, S	ft/ft	0.04	
24	Manning's n		0.2	
25	V=1.49*R^.667*S^.5/n	fps	1.73	
26	Flow Length L	ft	2313	
27	Tt=L/(3600V)	hr	0.37	
Flow through Reservoir		Segment		
28	Average Reservoir Depth	ft		
29	Velocity	fps		
30	Flow Length	ft		
31	Tt=L/(3600V)	hr		
32	**Total Tt or Tc**	**hr**	**0.46**	
		LAG (hr)	**0.28**	16.5 min

*Ref: Procedure from Part 630 Hydrology National Engineering Handbook, Chapter 15 - Time of Concentration (May 2010)

PLANT YATES ASH POND B STAGE STORAGE
17C17013.00
8/6/18
AVERAGE END AREA METHOD

EL (ft)	Area (ft^2)	Area (ac)	Inc. Volume (ac-ft)	Cum. Volume (ac-ft)	
718	0	0.0	0.0	0.0	
720	5996	0.1	0.1	0.1	
722	25001	0.6	0.7	0.8	
724	46083	1.1	1.6	2.4	
726	71858	1.6	2.7	5.1	
728	93141	2.1	3.8	8.9	*
730	114676	2.6	4.8	13.7	*
732	137831	3.2	5.8	19.5	*
734	179717	4.1	7.3	26.8	
736	212318	4.9	9.0	35.8	
738	247693	5.7	10.6	46.4	
740	289409	6.6	12.3	58.7	
742	332665	7.6	14.3	73.0	
744	374339	8.6	16.2	89.2	
746	408130	9.4	18.0	107.2	
748	441372	10.1	19.5	126.7	
750	475429	10.9	21.0	147.7	

* Additonal contour areas located towards left side of reservoir ignored.

√JTD 8-8-18

PLANT YATES ASH POND A STAGE STORAGE
17C17013.00
8/6/18
AVERAGE END AREA METHOD

EL (ft)	Area (ft^2)	Area (ac)	Inc. Volume (ac-ft)	Cum. Volume (ac-ft)
754	0	0.0	0.0	0.0
756	29148	0.7	0.7	0.7
758	81680	1.9	2.5	3.2
760	145746	3.3	5.2	8.4
762	246071	5.6	9.0	17.4
764	384787	8.8	14.5	31.9

√JTD 8-8-18

PLANT YATES SOUTH COVE STORAGE
17C17013.00
8/7/18
AVERAGE END AREA METHOD

EL (ft)	Area (ft^2)	Area (ac)	Inc. Volume (ac-ft)	Cum. Volume (ac-ft)
744	637008	14.6	0.0	0.0
746	680827	15.6	30.2	30.2
748	730889	16.8	32.4	62.6
750	802960	18.4	35.2	97.8
752	850244	19.5	38.0	135.8
754	908014	20.8	40.4	176.2
756	989092	22.7	43.6	219.8
758	1059857	24.3	47.0	266.8

JHD 8-8-18

PLANT YATES EAST COVE STORAGE
17C17013.00
8/7/18
AVERAGE END AREA METHOD

EL (ft)	Area (ft^2)	Area (ac)	Inc. Volume (ac-ft)	Cum. Volume (ac-ft)
748	280356	6.4	0.0	0.0
750	300323	6.9	13.3	13.3
752	324187	7.4	14.3	27.6
754	350961	8.1	15.5	43.1
756	392348	9.0	17.1	60.2
758	443802	10.2	19.2	79.4
760	498624	11.4	21.6	101.0

JHD 8-8-18

PLANT YATES SOUTH COVE STORAGE
17C17013.00
8/7/18
AVERAGE END AREA METHOD

EL (ft)	Area (ft^2)	Area (ac)	Inc. Volume (ac-ft)	Cum. Volume (ac-ft)
744	637008	14.6	0.0	0.0
746	680827	15.6	30.2	30.2
748	730889	16.8	32.4	62.6
750	802918	18.4	35.2	97.8
752	850128	19.5	37.9	135.7
754	912151	20.9	40.5	176.2
756	994491	22.8	43.8	220.0
758	1069044	24.5	47.4	267.4

√ JJD 8-3-18

PLANT YATES EAST COVE STORAGE
17C17013.00
8/9/18
AVERAGE END AREA METHOD

EL (ft)	Area (ft^2)	Area (ac)	Inc. Volume (ac-ft)	Cum. Volume (ac-ft)
748	280356	6.4	0.0	0.0
750	300315	6.9	13.3	13.3
752	324288	7.4	14.3	27.6
754	353079	8.1	15.6	43.2
756	415189	9.5	17.6	60.8
758	462950	10.6	20.2	81.0
760	529541	12.2	22.8	103.8
762	613956	14.1	26.3	130.1
764	708156	16.3	30.4	160.5

LTD 8-9-18

Plant Yates - Ash Pond 2 Stage-Storage (AMAX Removed)

Elev	Area (sf)	Area (ac)	Vol (ft^3)
722	1514597	34.8	0
724	1754399	40.3	3266060
726	1900835	43.6	3654256
728	2106622	48.4	4005694
		Total Vol (ft^3)	10926011
		(ac-ft)	251

Project	17C17013.00
Done by:	JCM
Checked by:	BWD
Date:	11/4/2020

G:\2017 Projects\17C17013.00 Plant Yates Ash Pond 2\03-SE Products\08-CAD\DRAWINGS\05-WORKING
YATES_HH_AP2E_STAGE STORAGE_REV_11-4-20.dwg

Note: Contours for AMAX Cove area generated by interpolation between 1969 topography and recently aerial topography received from Southern Company.

Schnabel ENGINEERING

Project Plant Yates Ash Pond CCR Page ____ of ____

Project No 176170.3 By SWD Date 8/6/18

Client ____ Checked YD Date 8-8-18

Subject Hydraulics - Rating Curves

Ash Pond A

- Reference: ds_Existing Topo.dwg
- Service Spillway: Earthen channel
  - Crest El. = 754.0 ft (Bottom of pond) ✓
  - Width = 20 ft ✓
  - C = 2.8 ✓

Ash Pond B

- Ref: ds_apB Perimeter.dwg & ds_apB ditch.dwg
- Service Spillway: Earth spillway
  - Crest El. = 744.0 ft ✓
  - width = 180.0 ft ✓
  - C = 2.6 ✓

Schnabel ENGINEERING

Project Plant Yates Ash Pond 2 Page ____ of ____

Project No 177101 By TSM Date 7/12/19

Client ____ Checked SJD Date 9-14-19

Subject Hydraulics - Proposed Detention Pond Upstream of Pond 3

Proposed Design (By others)

- 30-inch perforated riser
- Outlet pipe @ 0.5% slope
- Discharge up to 25-year storm through riser/outlet pipe
- Emergency Spillway for larger storms

Assumptions

- 30-inch dia. riser with crest elev. 2 ft below proposed emergency spillway
- Assume low level orifice instead of perforations

✓

Brett Dodd

From: Jon Dean
Sent: Wednesday, June 07, 2017 11:04 AM
To: Brett Dodd; Randy Bass
Subject: Fwd: Yates - riser pipes in AMA coves

Sent from my iPhone

Begin forwarded message:

> **From:** "Grissom, Ashley O." <AGRISSOM@SOUTHERNCO.COM>
> **Date:** May 1, 2017 at 3:38:02 PM EDT
> **To:** Randy Bass <rbass@schnabel-eng.com>, Jon Dean <jdean@schnabel-eng.com>, "pshull@schnabel-eng.com" <pshull@schnabel-eng.com>
> **Cc:** "Simpson, Stacey Housley" <SHSIMPSO@SOUTHERNCO.COM>
> **Subject: Yates - riser pipes in AMA coves**
>
> I've taken a look at the stormwater ponds/coves at the AMA and will plan to use a 30" perforated riser pipe at each location, one placed in the south cove and a second placed in the east cove. Both will drain at roughly 0.5% slope into the clean ditch. The ponds will contain the 25-year storm and will also include an emergency spillway for larger storms that will direct the water into the clean ditch. The riser pipes will allow the ponds to empty in approximately two days.
>
> Let me know if you have any questions. Thanks!
>
> Ashley Grissom, PE
> Civil Engineer | office: 205-992-5323 | cell: 205-283-7550 | agrissom@southernco.com

Plant Yates - Detention Pond 1 (East)
17C17013.00
7/12/2017
BWD

Proposed Spillway - Rating Curve

Riser - Weir Flow			Riser - Orifice Flow			Low-Level Orifice		
L =	7.85	ft	A =	4.91	ft^2	A =	0.20	ft^2
C =	3.1		C =	0.6		C =	2.8	
Crest El. =	752	ft	Crest El. =	752	ft	Crest El. =	748	ft

Elevation	Riser - Weir		Riser - Orifice		Low-Level Orifice		Pipe Flow	Total
(ft)	Head (ft)	Flow (cfs)	Head (ft)	Flow (cfs)	Head (ft)	Flow (cfs)	(cfs)	Flow (cfs)
748.00	0.00	0.0	0.00	0.0	0.00	0.0	0.0	0.0
749.00	0.00	0.0	0.00	0.0	1.00	4.4	6.7	4.4
750.00	0.00	0.0	0.00	0.0	2.00	6.2	13.1	6.2
751.00	0.00	0.0	0.00	0.0	3.00	7.6	17.3	7.6
752.00	0.00	0.0	0.00	0.0	4.00	8.8	20.7	8.8
753.00	1.00	24.3	1.00	23.6	5.00	9.9	23.6	23.6
754.00	2.00	68.9	2.00	33.4	6.00	10.8	26.2	26.2
755.00	3.00	126.5	3.00	40.9	7.00	11.7	28.5	28.5
756.00	4.00	194.8	4.00	47.3	8.00	12.5	30.7	30.7
757.00	5.00	272.2	5.00	52.9	9.00	13.2	32.7	32.7
758.00	6.00	357.8	6.00	57.9	10.00	14.0	34.6	34.6

JTD 7-14-17

Plant Yates - Detention Pond 1 (East)
17C17013.00
7/12/2017
BWD

Proposed Outlet Conduit - Rating Curve

Pipe Diam. (in)	Pipe Diam. (ft)	Manning's n	Entrance Loss Coeff. Ke	Bend Loss Coeff. Kb	Friction Loss Coeff. Kc	Length of Pipe (ft)	Number of Bends	Leq/D**	Water Surface Elev. (ft)	Outlet Invert Elev. (ft)	Full Pipe Flow (cfs)
24	2	0.024	1	0	0.042326	70	0	0	748.00	747.65	**0.00**
24	2	0.024	1	0	0.042326	70	0	0	749.00	747.65	**6.70**
24	2	0.024	1	0	0.042326	70	0	0	750.00	747.65	**13.15**
24	2	0.024	1	0	0.042326	70	0	0	751.00	747.65	**17.35**
24	2	0.024	1	0	0.042326	70	0	0	752.00	747.65	**20.71**
24	2	0.024	1	0	0.042326	70	0	0	753.00	747.65	**23.60**
24	2	0.024	1	0	0.042326	70	0	0	754.00	747.65	**26.18**
24	2	0.024	1	0	0.042326	70	0	0	755.00	747.65	**28.52**
24	2	0.024	1	0	0.042326	70	0	0	756.00	747.65	**30.68**
24	2	0.024	1	0	0.042326	70	0	0	757.00	747.65	**32.70**
24	2	0.024	1	0	0.042326	70	0	0	758.00	747.65	**34.60**

$Q=a(2gH')^{1/2}/(1+K_e+K_b+K_cL)^{1/2}$
where H'=vertical distance from the upstream water surface to the downstream invert minus 0.6 of the diameter of the pipe.

From: Design Hydrology and Sedimentology for Small Catchments, Haan, C.T., Barfield, and Hayes, 1994. Pg 147-148

** L_{eq}/D is a function of the angle of the bend and gives an equivalent length for each bend. This equivalent length can then be multiplied by Kc to get loss through the bend.

Note that this cannot be used with Kb, the bend loss coefficient. One or the other must be used.

From: Fundamentals of Fluid Mechanics, Second Edition, Gerhart, Philip M., Gross, and Hochstein, 1992, Pg. 519

√ JTD 7-14-17

Plant Yates - Detention Pond 2 (West)
17C17013.00
8/9/2018
BWD

Proposed Spillway - Rating Curve

Riser - Weir Flow			Riser - Orifice Flow			Low-Level Orifice		
L =	7.85	*ft*	A =	4.91	ft^2	A =	0.20	ft^2
C =	3.1		C =	0.6		C =	2.8	
Crest El. =	748	*ft*	Crest El. =	748	*ft*	Crest El. =	744	*ft*

Elevation	Riser - Weir		Riser - Orifice		Low-Level Orifice		Pipe Flow	Total
(ft)	Head (ft)	Flow (cfs)	Head (ft)	Flow (cfs)	Head (ft)	Flow (cfs)	(cfs)	Flow (cfs)
744.00	0.00	0.0	0.00	0.0	0.00	0.0	0.0	0.0
745.00	0.00	0.0	0.00	0.0	1.00	4.4	13.1	4.4
746.00	0.00	0.0	0.00	0.0	2.00	6.2	17.3	6.2
747.00	0.00	0.0	0.00	0.0	3.00	7.6	20.7	7.6
748.00	0.00	0.0	0.00	0.0	4.00	8.8	23.6	8.8
749.00	1.00	24.3	1.00	23.6	5.00	9.9	26.2	26.2
750.00	2.00	68.9	2.00	33.4	6.00	10.8	28.5	28.5
751.00	3.00	126.5	3.00	40.9	7.00	11.7	30.7	30.7
752.00	4.00	194.8	4.00	47.3	8.00	12.5	32.7	32.7
753.00	5.00	272.2	5.00	52.9	9.00	13.2	34.6	34.6
754.00	6.00	357.8	6.00	57.9	10.00	14.0	36.4	36.4
755.00	7.00	450.9	7.00	62.5	11.00	14.6	38.1	38.1

√JTD 7-14-17

Plant Yates - Detention Pond 2 (West)
17C17013.00
8/9/2018
BWD

Proposed Outlet Conduit - Rating Curve

Pipe Diam. (in)	Pipe Diam. (ft)	Manning's n	Entrance Loss Coeff. Ke	Bend Loss Coeff. Kb	Friction Loss Coeff. Kc	Length of Pipe (ft)	Number of Bends	Leq/D**	Water Surface Elev. (ft)	Outlet Invert Elev. (ft)	Full Pipe Flow (cfs)
24	2	0.024	1	0	0.042326	70	0	0	744.00	742.65	**0.00**
24	2	0.024	1	0	0.042326	70	0	0	745.00	742.65	**13.15**
24	2	0.024	1	0	0.042326	70	0	0	746.00	742.65	**17.35**
24	2	0.024	1	0	0.042326	70	0	0	747.00	742.65	**20.71**
24	2	0.024	1	0	0.042326	70	0	0	748.00	742.65	**23.60**
24	2	0.024	1	0	0.042326	70	0	0	749.00	742.65	**26.18**
24	2	0.024	1	0	0.042326	70	0	0	750.00	742.65	**28.52**
24	2	0.024	1	0	0.042326	70	0	0	751.00	742.65	**30.68**
24	2	0.024	1	0	0.042326	70	0	0	752.00	742.65	**32.70**
24	2	0.024	1	0	0.042326	70	0	0	753.00	742.65	**34.60**
24	2	0.024	1	0	0.042326	70	0	0	754.00	742.65	**36.41**
24	2	0.024	1	0	0.042326	70	0	0	755.00	742.65	**38.13**
24	2	0.024	1	0	0.042326	70	0	0	756.00	742.65	**39.77**
24	2	0.024	1	0	0.042326	70	0	0	757.00	742.65	**41.35**
24	2	0.024	1	0	0.042326	70	0	0	758.00	742.65	**42.87**
24	2	0.024	1	0	0.042326	70	0	0	759.00	742.65	**44.34**
24	2	0.024	1	0	0.042326	70	0	0	760.00	742.65	**45.76**
24	2	0.024	1	0	0.042326	70	0	0	761.00	742.65	**47.14**
24	2	0.024	1	0	0.042326	70	0	0	762.00	742.65	**48.48**
24	2	0.024	1	0	0.042326	70	0	0	763.00	742.65	**49.78**

$Q=a(2gH')^{1/2}/(1+K_e+K_b+K_cL)^{1/2}$
where H'=vertical distance from the upstream water surface to the downstream invert minus 0.6 of the diameter of the pipe.

From: Design Hydrology and Sedimentology for Small Catchments, Haan, C.T., Barfield, and Hayes, 1994. Pg 147-148

** L_{eq}/D is a function of the angle of the bend and gives an equivalent length for each bend. This equivalent length can then be multiplied by Kc to get loss through the bend.

Note that this cannot be used with Kb, the bend loss coefficient. One or the other must be used.

From: Fundamentals of Fluid Mechanics, Second Edition, Gerhart, Philip M., Gross, and Hochstein, 1992, Pg. 519

NPDES Sump Discharge Rating Curve

Elevation	Discharge (cfs)	Discharge (gpm)
716.5	0	0
717	6	2693
718	20	8977
719	31	13914
720	35	15709
721	40	17953
722	44	19749
723	48.5	21768
724	53	23788
725	56.5	25359
726	60	26930
727	63.5	28501
728	67	30072
729	70.5	31643

Plant Yates Ash Pond 2
17C17013
8/9/2018
JTD

Proposed Riser - Rating Curve Development (Post Construction Phase)

Riser - Weir Flow			Riser - Orifice Flow			Auxiliary Spillway		
L =	12	ft	A =	24	ft^2	L =	0	ft
C =	3.1		C =	0.6		C =	2.8	ft
Crest El. =	722	ft	Crest El. =	722	ft	Crest El. =	724	ft

Elevation	Riser - Weir		Riser - Orifice		Pipe Flow	Auxiliary Spillway		Total
(ft)	Head (ft)	Flow (cfs)	Head (ft)	Flow (cfs)	(cfs)	Head (ft)	Flow (cfs)	Flow (cfs)
722.00	0.00	0.0	0.00	0.0	25.4	0.00	0.0	0.0
722.25	0.25	4.7	0.25	0.0	26.0	0.00	0.0	4.7
722.50	0.50	13.2	0.50	0.0	26.7	0.00	0.0	13.2
722.75	0.75	24.2	0.75	0.0	27.3	0.00	0.0	24.2
723.00	1.00	37.2	1.00	0.0	27.9	0.00	0.0	27.9
723.25	1.25	52.0	1.25	129.2	28.6	0.00	0.0	28.6
723.50	1.50	68.3	1.50	141.5	29.1	0.00	0.0	29.1
723.75	1.75	86.1	1.75	152.9	29.7	0.00	0.0	29.7
724.00	2.00	105.2	2.00	163.4	30.2	0.00	0.0	30.2
724.25	2.25	125.6	2.25	173.3	30.8	0.25	0.0	30.8
724.50	2.50	147.0	2.50	182.7	31.3	0.50	0.0	31.3
724.75	2.75	169.6	2.75	191.6	31.8	0.75	0.0	31.8
725.00	3.00	193.3	3.00	200.2	32.2	1.00	0.0	32.2
725.25	3.25	218.0	3.25	208.3	32.7	1.25	0.0	32.7
725.50	3.50	243.6	3.50	216.2	33.1	1.50	0.0	33.1
725.75	3.75	270.1	3.75	223.8	33.5	1.75	0.0	33.5
726.00	4.00	297.6	4.00	231.1	33.9	2.00	0.0	33.9
726.25	4.25	325.9	4.25	238.2	34.1	2.25	0.0	34.1
726.50	4.50	355.1	4.50	245.1	34.5	2.50	0.0	34.5
726.75	4.75	385.1	4.75	251.9	34.8	2.75	0.0	34.8
727.00	5.00	415.9	5.00	258.4	35.2	3.00	0.0	35.2
727.25	5.25	447.5	5.25	264.8	35.7	3.25	0.0	35.7
727.50	5.50	479.8	5.50	271.0	36.1	3.50	0.0	36.1
727.75	5.75	512.9	5.75	277.1	36.5	3.75	0.0	36.5
728.00	6.00	546.7	6.00	283.1	37.0	4.00	0.0	37.0

Plant Yates Ash Pond 2
17C17013
6/12/2017
BWD

Principal Spillway Conduit - Rating Curve

Pipe Diam. (in)	Pipe Diam. (ft)	Manning's n	Entrance Loss Coeff. Ke	Bend Loss Coeff. Kb	Friction Loss Coeff. Kc	Length of Pipe (ft)	Number of Bends	Leq/D**	Water Surface Elev. (ft)	Sump Water Surface Elev. (ft)	Full Pipe Flow (cfs)	Full Pipe Flow (gpm)
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	722.00	718.40	**25.4**	**11410.8**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	722.25	718.48	**26.0**	**11677.2**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	722.50	718.54	**26.7**	**11967.8**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	722.75	718.60	**27.3**	**12251.5**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	723.00	718.66	**27.9**	**12528.9**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	723.25	718.71	**28.6**	**12814.3**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	723.50	718.79	**29.1**	**13052.0**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	723.75	718.84	**29.7**	**13326.2**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	724.00	718.91	**30.2**	**13568.3**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	724.25	718.95	**30.8**	**13845.4**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	724.50	719.04	**31.3**	**14052.8**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	724.75	719.13	**31.8**	**14257.2**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	725.00	719.21	**32.2**	**14471.2**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	725.25	719.31	**32.7**	**14657.5**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	725.50	719.41	**33.1**	**14841.4**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	725.75	719.50	**33.5**	**15035.1**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	726.00	719.61	**33.9**	**15202.6**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	726.25	719.78	**34.1**	**15297.4**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	726.50	719.87	**34.5**	**15485.4**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	726.75	720.00	**34.8**	**15624.9**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	727.00	720.08	**35.2**	**15820.5**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	727.25	720.15	**35.7**	**16024.9**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	727.50	720.23	**36.1**	**16215.6**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	727.75	720.31	**36.5**	**16404.1**
29.062	2.421833	0.009	1	1	0.004612	1000	2	0	728.00	720.39	**37.0**	**16590.5**

$Q=a(2gH')^{1/2}/(1+K_e+K_b+K_oL)^{1/2}$
where H'=vertical distance from the upstream water surface to the downstream invert minus 0.6 of the diameter of the pipe.

From: Design Hydrology and Sedimentology for Small Catchments, Haan, C.T., Barfield, and Hayes, 1994. Pg 147-148

** L_{eq}/D is a function of the angle of the bend and gives an equivalent length for each bend. This equivalent length can then be multiplied by Kc to get loss through the bend.

Note that this cannot be used with Kb, the bend loss coefficient. One or the other must be used.

From: Fundamentals of Fluid Mechanics, Second Edition, Gerhart, Philip M., Gross, and Hochstein, 1992, Pg. 519

Schnabel ENGINEERING

Project	Plant Yates Ash Pond 2 East Final Design			Page	1
Project No.	17C17013.00	By	JCM	Date	11/4/20
		Checked	JTD	Date	11/13/20

Notes: Auxiliary Spillway

Labyrinth Spillway Design

Data:

Design WS Elevation =		727.00		Number of Cycles	n =	2	Can be whole or half cycles
Crest Elevation =		724.30		Number of Side Walls	=	4	
Design Head	H =	2.70	ft				
				Wall Crest		**HR**	(QR or HR)
Crest Elevation =		724.30					
U/S Slab Elevation =		716.20					
Wall Height	P =	8.10	ft	H/P = 0.333		OK (0.15 to 0.8)	

Planform

Wall Thickness	t =	12.0	in	Use crest width if d/s face slopes	
Cycle Width	W =	20.00	ft	W/P = 2.47	OK (>2.0)
Apex Inside Width	A_D =	24.00	in	~ t	12 in Minimum
Apex Outside Width	A_U =	3.60	ft	$A_U/2*W$ = 0.0900	~(<0.0765)
Cycle Depth	B =	50.00	ft		
Total Spillway Width	n x W	40	ft		
Distance Between Cycles	w=	20.0		w/P= 2.469136	3<w/P<4

Cycle Computations

Cycle Half Width	C =	7.20	ft	$(W - A_U - A_D)/2$	Wall Batte	0	in
Effective Cycle Depth	D =	49.00	ft	$(B - t)$	A_D =	12.000	in
Side Wall Angle	α =	8.359	°	$\tan^{-1}(C/D)$			
Actual Side Wall Length	L_A =	49.53	ft	$D/\cos(\alpha)$	Check:		
Effective Side Wall Length	L_e =	48.66	ft	$L_A - t*\tan(45 - \alpha/2)$	Min A_U =	3.72760	ft
Effective Total Side Wall	L_E =	50.60	ft	$L_e + A_D + (A_u - A_{umin})/2$	A_U =	3.70	ft
Total Side Wall Length	L_T =	51.46	ft	$L_e + A_U/2 + A_D/2$			
	L/W =	5.15		$2*L_T/W$	<6		

Design Discharge

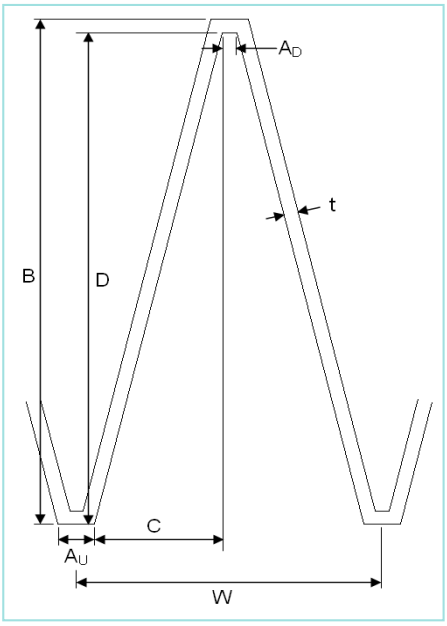
α
8
10

Crookston 2010 Discharge Coefficient Table

Wall Angle (a)	QR Coefficients				HR Coefficients				
	a	b	c	d	a	b	c	d	
6	0.0262	-2.6810	0.3669	0.1572	6	0.009447	-4.039	0.3955	0.187
8	0.0361	-2.5760	0.4104	0.1936	8	0.01709	-3.497	0.4048	0.2286
10	0.0615	-2.1130	0.4210	0.2030	10	0.0299	-2.978	0.4107	0.252
12	0.0930	-1.7110	0.4278	0.2047	12	0.03039	-3.102	0.4393	0.2912
15	0.1089	-1.7230	0.5042	0.2257	15	0.0316	-3.27	0.4849	0.3349
20	0.1113	-1.8890	0.5982	0.2719	20	0.03361	-0.35	0.5536	0.3923
35	0.0357	-3.7600	0.7996	0.4759	35	0.01855	-4.904	0.6697	0.5062
90	-2.3800	6.4760	1.3710	0.5300	90	-8.609	22.65	1.812	0.6375

Labyrinth Discharge Rating Curve							
Head (H)	**H/P**	**$C_{d\text{-lower}}$**	**$C_{d\text{-upper}}$**	**C_d**	**Q (cfs)**	**Res EL (ft)**	
0.00	0.000	0.0000	0.0000	0.0000	0	724.30	*
0.25	0.031	0.5636	0.6099	0.5719	80	724.55	*
0.50	0.062	0.6292	0.6720	0.6369	252	724.80	*
0.75	0.093	0.6379	0.6824	0.6459	470	725.05	*
1.00	0.123	0.6221	0.6703	0.6308	706	725.30	*
1.25	0.154	0.5956	0.6479	0.6050	946	725.55	
1.50	0.185	0.5650	0.6208	0.5750	1182	725.80	
1.75	0.216	0.5336	0.5923	0.5441	1410	726.05	
2.00	0.247	0.5032	0.5640	0.5141	1628	726.30	
2.25	0.278	0.4747	0.5369	0.4858	1835	726.55	
2.50	0.309	0.4484	0.5113	0.4597	2034	726.80	
2.75	0.340	0.4246	0.4876	0.4359	2225	727.05	
3.00	0.370	0.4031	0.4658	0.4144	2410	727.30	
3.25	0.401	0.3839	0.4458	0.3950	2590	727.55	
3.50	0.432	0.3667	0.4276	0.3776	2768	727.80	
3.75	0.463	0.3514	0.4111	0.3621	2943	728.05	
4.00	0.494	0.3378	0.3961	0.3482	3118	728.30	
4.25	0.525	0.3257	0.3825	0.3359	3294	728.55	
4.50	0.556	0.3150	0.3703	0.3249	3472	728.80	
4.75	0.586	0.3055	0.3592	0.3151	3652	729.05	
5.00	0.617	0.2971	0.3492	0.3064	3835	729.30	
5.25	0.648	0.2896	0.3401	0.2987	4021	729.55	
5.50	0.679	0.2830	0.3319	0.2918	4212	729.80	
5.75	0.710	0.2771	0.3246	0.2856	4408	730.05	
6.00	0.741	0.2719	0.3179	0.2801	4609	730.30	
6.25	0.772	0.2673	0.3119	0.2753	4814	730.55	
6.50	0.802	0.2632	0.3064	0.2709	5025	730.80	^
6.75	0.833	0.2595	0.3015	0.2670	5242	731.05	^
7.00	0.864	0.2562	0.2970	0.2636	5464	731.30	^
7.25	0.895	0.2534	0.2930	0.2605	5692	731.55	^
7.5	0.926	0.2508	0.2893	0.2577	5925	731.80	^
7.75	0.957	0.2485	0.2860	0.2552	6164	732.05	^
8.00	0.988	0.2464	0.2830	0.2530	6408	732.30	^
8.25	1.019	0.2446	0.2803	0.2510	6658	732.55	^
8.50	1.049	0.2430	0.2778	0.2492	6914	732.80	^
8.75	1.080	0.2415	0.2756	0.2477	7175	733.05	^
9.00	1.111	0.2402	0.2735	0.2462	7441	733.30	^
9.25	1.142	0.2391	0.2717	0.2449	7713	733.55	^
9.50	1.173	0.2380	0.2700	0.2438	7990	733.80	^
9.75	1.204	0.2371	0.2685	0.2427	8272	734.05	^
10.00	1.235	0.2363	0.2671	0.2418	8559	734.30	^

*H/P below recommended minimum value of 0.15. Crest shape governs discharge.
^H/P above recommended maximum of 0.8 - Outside limits of testing.


A_D
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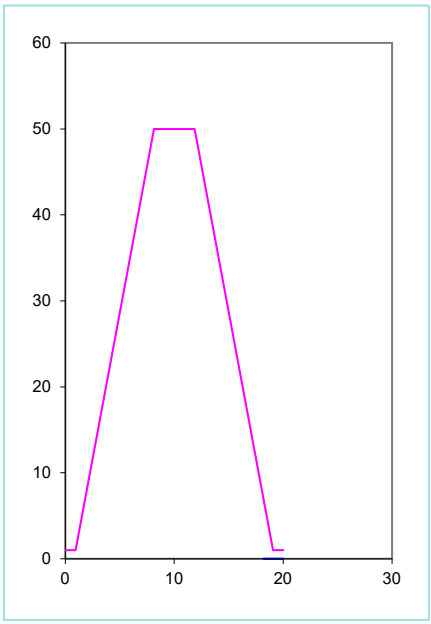
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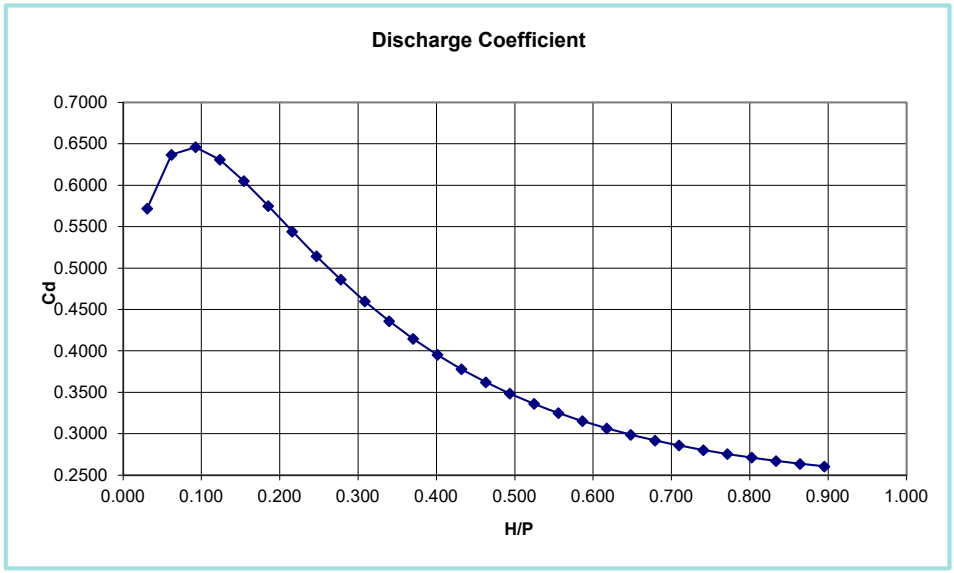
Discharge Coefficient
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0.6500
0.6000
0.5500
0.5000
0.4500
0.4000
0.3500
0.3000
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Cd
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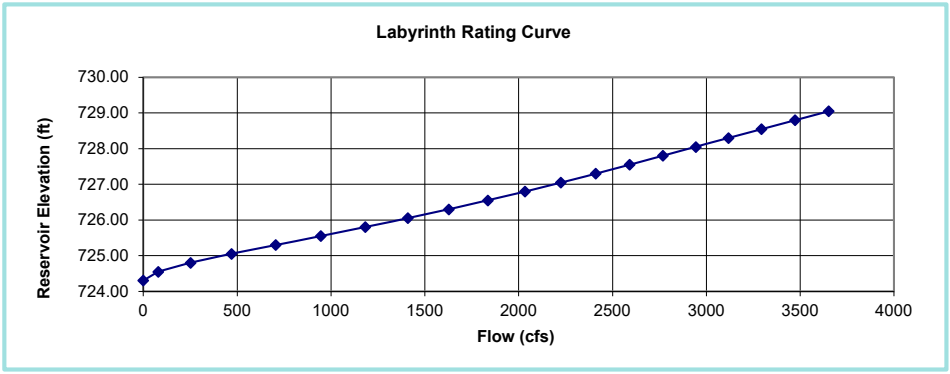
0.600
0.700
0.800
0.900
1.000
H/P


Labyrinth Rating Curve
730.00
729.00
728.00
727.00
726.00
725.00
724.00
Reservoir Elevation (ft)
0
500
1000
1500
2000
2500
3000
3500
4000
Flow (cfs)

Schnabel ENGINEERING

Project	Plant Yates Ash Pond 2 East Final Design			Page	1
Project No.	17C17013.00	By	JCM	Date	11/4/20
		Checked	JTD	Date	11/13/20

Notes: Auxiliary Spillway

Labyrinth Spillway Design

Data:

Design WS Elevation =		727.00		Number of Cycles	n =	1	Can be whole or half cycles
Crest Elevation =		724.30		Number of Side Walls	=	2	
Design Head	H =	2.70	ft				
				Wall Crest		**HR**	(QR or HR)
Crest Elevation =		724.30					
U/S Slab Elevation =		716.20					
Wall Height	P =	8.10	ft	H/P = 0.333		OK (0.15 to 0.8)	

Planform

Wall Thickness	t =	12.0	in	Use crest width if d/s face slopes	
Cycle Width	W =	28.00	ft	W/P = 3.46	OK (>2.0)
Apex Inside Width	A_D =	24.00	in	~ t	12 in Minimum
Apex Outside Width	A_U =	3.60	ft	$A_U/2*W$ = 0.0643	~(<0.0765)
Cycle Depth	B =	50.00	ft		
Total Spillway Width	n x W	28	ft		
Distance Between Cycles	w=	28.0		w/P= 3.45679	3<w/P<4

Cycle Computations

Cycle Half Width	C =	11.20	ft	$(W - A_U - A_D)/2$	Wall Batte	0	in
Effective Cycle Depth	D =	49.00	ft	$(B - t)$	A_D =	12.000	in
Side Wall Angle	α =	12.875	°	$\tan^{-1}(C/D)$			
Actual Side Wall Length	L_A =	50.26	ft	$D/\cos(\alpha)$	Check:		
Effective Side Wall Length	L_e =	49.47	ft	$L_A - t*\tan(45 - \alpha/2)$	Min A_U =	3.59444	ft
Effective Total Side Wall	L_E =	51.47	ft	$L_e + A_D + (A_u - A_{umin})/2$	A_U =	3.70	ft
Total Side Wall Length	L_T =	52.27	ft	$L_e + A_U/2 + A_D/2$			
	L/W =	3.73		$2*L_T/W$	<6		

Design Discharge

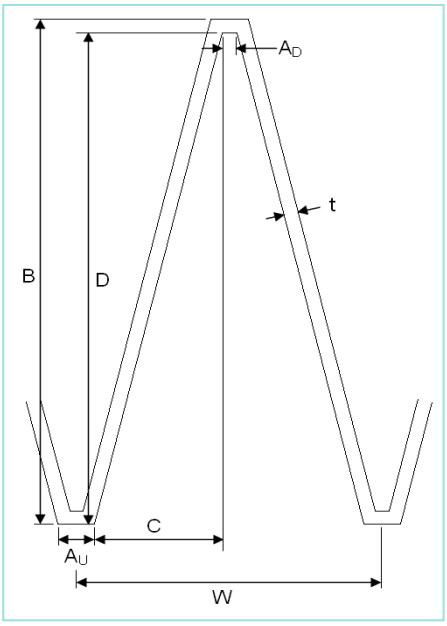
α
12
15

Crookston 2010 Discharge Coefficient Table

Wall Angle (a)	QR Coefficients				HR Coefficients				
	a	b	c	d	a	b	c	d	
6	0.0262	-2.6810	0.3669	0.1572	6	0.009447	-4.039	0.3955	0.187
8	0.0361	-2.5760	0.4104	0.1936	8	0.01709	-3.497	0.4048	0.2286
10	0.0615	-2.1130	0.4210	0.2030	10	0.0299	-2.978	0.4107	0.252
12	0.0930	-1.7110	0.4278	0.2047	12	0.03039	-3.102	0.4393	0.2912
15	0.1089	-1.7230	0.5042	0.2257	15	0.0316	-3.27	0.4849	0.3349
20	0.1113	-1.8890	0.5982	0.2719	20	0.03361	-0.35	0.5536	0.3923
35	0.0357	-3.7600	0.7996	0.4759	35	0.01855	-4.904	0.6697	0.5062
90	-2.3800	6.4760	1.3710	0.5300	90	-8.609	22.65	1.812	0.6375

Labyrinth Discharge Rating Curve							
Head (H)	**H/P**	**$C_{d\text{-lower}}$**	**$C_{d\text{-upper}}$**	**C_d**	**Q (cfs)**	**Res EL (ft)**	
0.00	0.000	0.0000	0.0000	0.0000	0	724.30	*
0.25	0.031	0.6070	0.5945	0.6034	43	724.55	*
0.50	0.062	0.6772	0.6695	0.6750	135	724.80	*
0.75	0.093	0.6984	0.7027	0.6996	258	725.05	*
1.00	0.123	0.6958	0.7125	0.7006	398	725.30	*
1.25	0.154	0.6807	0.7082	0.6887	546	725.55	
1.50	0.185	0.6591	0.6954	0.6697	698	725.80	
1.75	0.216	0.6345	0.6775	0.6471	850	726.05	
2.00	0.247	0.6089	0.6569	0.6229	1000	726.30	
2.25	0.278	0.5835	0.6349	0.5985	1146	726.55	
2.50	0.309	0.5589	0.6127	0.5746	1289	726.80	
2.75	0.340	0.5356	0.5909	0.5518	1428	727.05	
3.00	0.370	0.5139	0.5699	0.5302	1564	727.30	
3.25	0.401	0.4937	0.5500	0.5101	1696	727.55	
3.50	0.432	0.4751	0.5312	0.4915	1826	727.80	
3.75	0.463	0.4581	0.5138	0.4743	1955	728.05	
4.00	0.494	0.4425	0.4976	0.4586	2082	728.30	
4.25	0.525	0.4284	0.4827	0.4442	2209	728.55	
4.50	0.556	0.4155	0.4690	0.4311	2336	728.80	
4.75	0.586	0.4038	0.4565	0.4191	2463	729.05	
5.00	0.617	0.3932	0.4450	0.4083	2591	729.30	
5.25	0.648	0.3836	0.4346	0.3985	2720	729.55	
5.50	0.679	0.3749	0.4251	0.3895	2852	729.80	
5.75	0.710	0.3670	0.4165	0.3815	2985	730.05	
6.00	0.741	0.3599	0.4087	0.3742	3121	730.30	
6.25	0.772	0.3535	0.4016	0.3675	3259	730.55	
6.50	0.802	0.3477	0.3952	0.3615	3400	730.80	^
6.75	0.833	0.3424	0.3894	0.3561	3545	731.05	^
7.00	0.864	0.3377	0.3842	0.3512	3692	731.30	^
7.25	0.895	0.3334	0.3795	0.3468	3842	731.55	^
7.5	0.926	0.3295	0.3752	0.3428	3996	731.80	^
7.75	0.957	0.3260	0.3713	0.3392	4153	732.05	^
8.00	0.988	0.3228	0.3678	0.3359	4314	732.30	^
8.25	1.019	0.3199	0.3646	0.3329	4478	732.55	^
8.50	1.049	0.3173	0.3618	0.3303	4645	732.80	^
8.75	1.080	0.3149	0.3592	0.3278	4816	733.05	^
9.00	1.111	0.3128	0.3569	0.3256	4990	733.30	^
9.25	1.142	0.3108	0.3548	0.3237	5168	733.55	^
9.50	1.173	0.3091	0.3529	0.3219	5349	733.80	^
9.75	1.204	0.3075	0.3512	0.3202	5533	734.05	^
10.00	1.235	0.3060	0.3496	0.3188	5721	734.30	^

*H/P below recommended minimum value of 0.15. Crest shape governs discharge.
^H/P above recommended maximum of 0.8 - Outside limits of testing.


A_D
t
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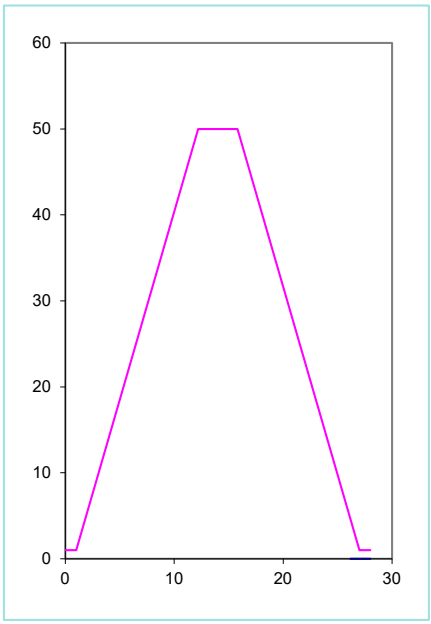
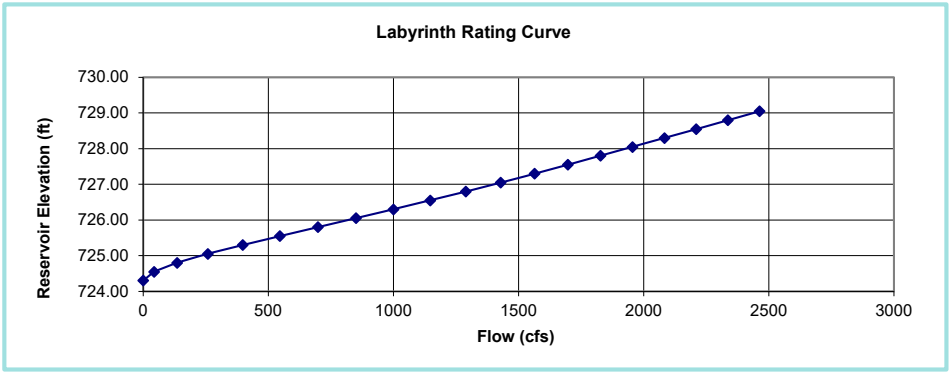
W


60
50
40
30
20
10
0
0
10
20
30


Discharge Coefficient
0.7500
0.7000
0.6500
0.6000
0.5500
0.5000
0.4500
0.4000
0.3500
0.3000
0.2500
Cd
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
H/P


Labyrinth Rating Curve
730.00
729.00
728.00
727.00
726.00
725.00
724.00
Reservoir Elevation (ft)
0
500
1000
1500
2000
2500
3000
Flow (cfs)

Schnabel ENGINEERING

Project	Plant Yates Ash Pond 2			Page	
Project No.	17C17013.00	By	JCM	Date	11/11/20
		Checked	JTD	Date	1/20/21

Notes: Hydraulic Design and Layout of SAF

Hydraulic Design of SAF

Spillway Outflow during 1/2 PMF Design Storm = 3651 cfs

Design SAF Hydraulically for 2/3 of Above Flow through Chute
Design Discharge = 2/3(Design Storm) = 2434 cfs *68 foot wide chute
Unit Discharge, q, for Q = 2434 cfs

q = Q/Spillway Width = 35.8 cfs/ft

Tailwater Elevation , T_w = 703.5 ft

Elevation of Labyrinth Apron = 716.2 ft

See Spreadsheet for Determination of SAF Floor Elevation
From Grading Information Received from Southern Company…
Stream Channel is at Approximate Elev. Of ----------> 700 at Toe of the Dam

Set SAF Floor 4.8 ft Below Stream Channel
Therefore,
SAF Floor Elev. = 695.20

Layout of SAF

Height of Floor and chute blocks = d_1 = 0.90 ft ----> Use 1'-0"

Height of Tranverse End Sill, s = 0.07 * d_2 = 0.63 ft ----> Use 9"

Width of Floor and Chute Blocks = 3/4(d_1) = 0.68 ft ----> Use 1-0"

Space between Wall and Chute Blocks ≥ 0.34 ft ----> Use 6"
Use 33 chute blocks spaced 1' apart ----------> 48.53% Coverage
Use 34 floor blocks spaced 1' apart ----------> 50.00% Coverage
Basin Length, LB = 8.82 ft -------> Use 9'-0"
Floor Block Location = LB/3 ---------> Use 3'-0"
Height of Sidewalls, J = 10.61 ft -------> Use 11'-0" Top of wall Elev 706.20 for Tailwater

Schnabel ENGINEERING

Project: Plant Yates Ash Pond 2 | Page:
Project No.: 17C17013.00 | By: JCM | Date: 11/11/20
Checked: BWD | Date: 4/23/20

Notes: SAF Floor Elevation Calculations (2/3 design storm)

Design Flow (2/3)	2434.0 cfs	**Tailwater Elevation**	703.5 MSL
Spillway Width	68 feet	**Upper Apron Elevation**	716.2 MSL
q	35.8 cfs/ft		

Elevation	Drop	d1	v1	f1	d2	d'2	Rqd. TW Elevation	
700	16.2	0.99	36.2	6.40	8.48	7.37	707.37	not OK
699	17.2	0.97	36.9	6.60	8.59	7.42	706.42	not OK
698	18.2	0.95	37.7	6.81	8.69	7.48	705.48	not OK
697	19.2	0.93	38.5	7.03	8.80	7.53	704.53	not OK
696	20.2	0.92	38.9	7.15	8.85	7.56	703.56	not OK
695.2	21	0.90	39.8	7.39	8.96	7.62	702.82	OK
694	22.2	0.88	40.7	7.64	9.08	7.68	701.68	OK
693	23.2	0.87	41.1	7.77	9.14	7.71	700.71	OK
692	24.2	0.86	41.6	7.91	9.20	7.74	699.74	OK

full design storm tailwater goes up to 704.1

Schnabel ENGINEERING

Project: Plant Yates Ash Pond 2 | Page:

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Notes: Hydraulic Design Criteria for SAF Stilling Basin

HYDRAULIC DESIGN CRITERIA FOR SAF STILLING BASIN

1.	$F_1=V_1/\sqrt{gd_1}$	$F_1=$	54.63	$v_1=$	39.77	ft/sec
2.	$d_2=(d_1/2)(-1+(8F_1+1)^{1/2})$	$d_2=$	8.96 ft.	$d_1=$	0.90	ft
3.	$d'_2=1.4d_1F_1^{0.45}$	$d'_2=$	7.62 ft.	g=	32.17	ft/sec
4.	$L_B=4.5d_2/F1^{0.38}$	$L_B=$	8.82 ft.			
5.	$J=d_2/3+d'_2$	J=	10.61 ft.			
6.	$s=0.07d_2$	s=	0.63 ft.			

F_1 Froude's number (dimensionless number)

$v_1=$ Entrance velocity of water to SAF stilling basin- Ft/Sec
(from chart ES-78 of chute spillway handbook or water surface profile calculations)

$d_1=$ Entrance depth of water to SAF stilling basin - feet
(from chart ES-78 of chute spillway handbook or water surface profile calculations)

$L_B=$ Length of SAF Basin- feet

J= Height of sidewalls of SAF stilling basin - feet

s= Height of transverse end sill of SAF basin - feet

$d'_2=$ Required height of tailwater over SAF basin - feet

$d_2=$ Sequent depth of flow to depth d_1 - feet

g= Acceleration due to gravity - 32.16 ft/sec^2

SAF basin elevation+d'_2= Tailwater Elev. (If not approximately equal, adjust basin elevation, recalculate v_1 and d_1 and retry)

From Engineering Handbook Section 14 - Chute Spillways

Schnabel ENGINEERING

Project: Plant Yates Ash Pond 2 | Page
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Notes: Labyrinth Chute Vertical Curve Design

Labyrinth Chute Vertical Curve Design

Input Parameters			
Design Storm Outflow =	3651.00	cfs	
Percentage of Design Storm =	1		
Width of Spillway =	68.00	ft	
Spillway Slope =	3.00	:1V	
User input - Point of Interception =	6.00	ft	**Leave Blank for First Trial**

Output			
Design Discharge, Qd =	3651	cfs	
Unit Dischage, q =	53.7	cfs/ft	
Critical Depth, Dc =	4.47	ft	
Depth of Water at "The Brink," yo =	3.20	ft	
Velocity, V =	16.8	fps	
Point of Interception =	-6.58	ft	
"False" Velocity =	16.8	fps	**User Input - Round to Nearest 1/2' Increment For Ease of Construction**

Vertical Curve Coordinates

X	Y	(incremental y)
0	0.00000	
1	-0.02535	-0.02535
2	-0.10141	-0.07606
3	-0.22817	-0.12676
4	-0.40564	-0.17747
5	-0.63382	-0.22817
6	-0.91270	-0.27888

Schnabel ENGINEERING

Project	Plant Yates Ash Pond 2			Page	
Project No.	17C17013.00	By	JCM	Date	11/11/20
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Notes: 1/2 PMF Laby Sidewall Height (Using Full Design Flow)

Design Flow:	3651	cfs			
Spillway Width:	68	feet	**Laby. Apron Elevation:**	716.2	MSL
q:	53.69	cfs/ft			

Elevation	Drop	d	ρ	d_a	w/F.S. =1.25
715	1.2	3.02	1.00	3.02	3.78
714	2.2	2.65	1.00	2.65	3.31
712	4.2	2.25	1.00	2.25	2.81
710	6.2	2.00	1.00	2.00	2.50
708	8.2	1.82	1.07	1.95	2.43
706	10.2	1.68	1.09	1.83	2.29
704	12.2	1.58	1.11	1.75	2.19
702	14.2	1.50	1.13	1.70	2.12
700	16.2	1.44	1.14	1.64	2.05
698	18.2	1.38	1.16	1.60	2.00
695.2	21	1.3	1.18	1.53	1.92

A factor of safety of 1.25 is used to account for splashing.

Depth of water at Upstream End of Vertical Curve, yo = 3.2 feet
(See Laby Chute Vertical Curve Page)

NEW ASH POND 2 DAM

PLANT YATES

NEWNAN, GEORGIA

PRJ. NO. 17C17013.00

Stage/Storage Data for New Ash Pond Dam Drawdown

Notes: Storage Values obtained from 1969 topography

G:\2017 Projects\17C17013.00 Plant Yates Ash Pond 2\03-SE Products\02-Calcs\02-HH\Final Design\NEW ASH POND 2 DAM H&H FINAL\DRAWDOWN CALCULATIONS\Siphon & Gate

Elev. (ft)	Area (ft^2)	Area (ac)	Volume (ac-ft)	
			Incremental	Cumulative
692	31529	0.7	0.0	0.0
700	268169	6.2	27.5	27.5
710	1054113	24.2	151.8	179.3
722	1514597	34.8	353.8	533.1

2/3 Volume =	355.4	ac-ft
Remaining Vol =	177.7	ac-ft
Elevation @ 2/3 =	710	ft

SIPHON SPILLWAY DISCHARGES

Plant Yates - New Ash Pond Dam 2
PROJECT NO.: 17C17013.00
DATE: 4/16/2019

SIZE(in, I.D.) =	15.5	N.P. ELEV =	722.0
LENGTH(ft) =	150	INV. ELEV =	707.3
AREA (SF) =	1.310		
NO. PIPES =	1		
		Kb(45) =	0.4
n =	0.009	Kb(22.5) =	0.2
K_{ent} =	1	# 45'S =	0
		# 22.5'S =	5

RISE FROM NORMAL POOL (FT)	ELEVATION	TOTAL HEAD (FT)	VELOCITY (FT/S)	HEAD LOSS (friction) (FT)	HEAD LOSS (bends) (FT)	HEAD LOSS (entrance) (FT)	VELOCITY HEAD (FT)	HEAD LOSS TOTAL (FT)	DISCHARGE PER PIPE (CFS)	DISCHARGE TOTAL (CFS)	ELEV.
-13	709	1.70	4.88	0.59	0.37	0.37	0.37	1.33	6.40	**6.40**	**709.00**
-12	710	2.70	6.15	0.94	0.59	0.59	0.59	2.11	8.06	**8.06**	**710.00**
-11	711	3.70	7.20	1.29	0.80	0.80	0.80	2.90	9.43	**9.43**	**711.00**
-10	712	4.70	8.11	1.63	1.02	1.02	1.02	3.68	10.63	**10.63**	**712.00**
-9	713	5.70	8.94	1.98	1.24	1.24	1.24	4.46	11.71	**11.71**	**713.00**
-8	714	6.70	9.69	2.33	1.46	1.46	1.46	5.24	12.70	**12.70**	**714.00**
-7	715	7.70	10.39	2.67	1.68	1.68	1.68	6.02	13.61	**13.61**	**715.00**
-6	716	8.70	11.04	3.02	1.89	1.89	1.89	6.81	14.47	**14.47**	**716.00**
-5	717	9.70	11.66	3.37	2.11	2.11	2.11	7.59	15.28	**15.28**	**717.00**
-4	718	10.70	12.24	3.72	2.33	2.33	2.33	8.37	16.04	**16.04**	**718.00**
-3	719	11.70	12.80	4.06	2.55	2.55	2.55	9.15	16.78	**16.78**	**719.00**
-2	720	12.70	13.34	4.41	2.76	2.76	2.76	9.94	17.48	**17.48**	**720.00**
-1	721	13.70	13.85	4.76	2.98	2.98	2.98	10.72	18.15	**18.15**	**721.00**
-0.5	721.5	14.20	14.11	4.93	3.09	3.09	3.09	11.11	18.48	**18.48**	**721.50**
0.00	722	14.70	14.35	5.11	3.20	3.20	3.20	11.50	18.81	**18.81**	**722.00**

SIPHON SPILLWAY AND GATE TOTAL DISCHARGE

Plant Yates - New Ash Pond Dam 2

PROJECT NO: 17c17013.00

DATE 4/16/2019

Discharge through gate (CFS) = $C \times A \times \sqrt{2gh}$

h(ft): Depth of orifice centre below free water surface

Discharge Coefficient (C) =	0.6
Area of gate (A, sq.ft.) =	4
Gravitational acceleration (g, ft/s^2) =	32.2
Elevation of center of gate (ft.) =	718

ELEV. (ft)	Discharge (CFS)		
	Siphon	Gate	Total
722	18.81	38.52	57.33
721.5	18.48	36.03	54.51
721	18.15	33.36	51.51
720	17.48	27.24	44.72
719	16.78	19.26	36.04
718	16.04	6.00	22.04
717	15.28	0.00	15.28
716	14.47	0.00	14.47
715	13.61	0.00	13.61
714	12.70	0.00	12.70
713	11.71	0.00	11.71
712	10.63	0.00	10.63
711	9.43	0.00	9.43
710	8.06	0.00	8.06
709	6.40	0.00	6.40

New Ash Pond 2 Dam, Plant Yates Time-Series for Reservior Drawdown
Newnan, GA

Date	Time	Inflows (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
1-Mar-19	0:00	0	377.3	722	57.3
1-Mar-19	6:00	0	350	721.2	52.8
1-Mar-19	12:00	0	325	720.5	47.9
1-Mar-19	18:00	0	302.5	719.8	42.9
2-Mar-19	0:00	0	282.6	719.2	37.6
2-Mar-19	6:00	0	265.6	718.6	31.1
2-Mar-19	12:00	0	251.7	718.2	24.9
2-Mar-19	18:00	0	240.3	717.8	21
3-Mar-19	0:00	0	230.4	717.5	18.8
3-Mar-19	6:00	0	221.6	717.2	16.9
3-Mar-19	12:00	0	213.6	717	15.3
3-Mar-19	18:00	0	206.1	716.7	15.1
4-Mar-19	0:00	0	198.7	716.5	14.9
4-Mar-19	6:00	0	191.4	716.2	14.7
4-Mar-19	12:00	0	184.2	716	14.5
4-Mar-19	18:00	0	177	715.7	14.3
5-Mar-19	0:00	0	170	715.5	14
5-Mar-19	6:00	0	163.1	715.3	13.8
5-Mar-19	12:00	0	156.3	715	13.6
5-Mar-19	18:00	0	149.6	714.8	13.4
6-Mar-19	0:00	0	143	714.6	13.2
6-Mar-19	6:00	0	136.5	714.3	13
6-Mar-19	12:00	0	130.1	714.1	12.8
6-Mar-19	18:00	0	123.8	713.9	12.6
7-Mar-19	0:00	0	117.6	713.7	12.4
7-Mar-19	6:00	0	111.5	713.4	12.1
7-Mar-19	12:00	0	105.6	713.2	11.9
7-Mar-19	18:00	0	99.7	713	11.7
8-Mar-19	0:00	0	94	712.8	11.5
8-Mar-19	6:00	0	88.3	712.6	11.2
8-Mar-19	12:00	0	82.8	712.4	11
8-Mar-19	18:00	0	77.4	712.2	10.8
9-Mar-19	0:00	0	72.1	711.9	10.6
9-Mar-19	6:00	0	66.9	711.7	10.3
9-Mar-19	12:00	0	61.9	711.5	10.1
9-Mar-19	18:00	0	56.9	711.4	9.9
10-Mar-19	0:00	0	52.1	711.2	9.6
10-Mar-19	6:00	0	47.4	711	9.4
10-Mar-19	12:00	0	42.8	710.8	9.1
10-Mar-19	18:00	0	38.3	710.6	8.9
11-Mar-19	0:00	0	34	710.4	8.7
11-Mar-19	6:00	0	29.7	710.3	8.4
11-Mar-19	12:00	0	25.6	710.1	8.2
11-Mar-19	18:00	0	21.7	709.9	7.5
12-Mar-19	0:00	0	18.3	709.8	6.3

Date:04/16/2019