DOMINION ENERGY

PERIODIC INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

BREMO STATION INACTIVE CCR SURFACE IMPOUNDMENT: EAST POND

APRIL 2023

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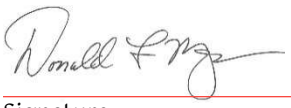
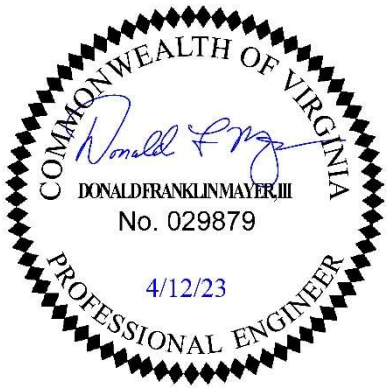
1 CERTIFICATION

This periodic Inflow Design Flood Control System Plan for the Bremo Station's East Pond was prepared by WSP USA Inc. (WSP; formerly d/b/a Golder Associates USA Inc.). The document and Certification/Statement of Professional Opinion are based on and limited to information that WSP has relied on from Dominion Energy and others, but not independently verified, as well as work products previously produced by Golder.

On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the Commonwealth of Virginia that this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), under similar circumstances, at the same time, and in the same locale. It is my professional opinion that the document was prepared consistent with the requirements in §257.82 of the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," published in the Federal Register on April 17, 2015, with an effective date of October 19, 2015 (40 CFR §257.82), as well as with the requirements in §257.100 resulting from the EPA's "Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Extension of Compliance Deadlines for Certain Inactive Surface Impoundments; Response to Partial Vacatur" published in the Federal Register on August 5, 2016, with an effective date of October 4, 2016 (40 CFR §257.100).

The use of the word "Certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

Donald Mayer, PE	Vice President
Print Name	Title
	4/12/2023
Signature	Date



2 INTRODUCTION

This periodic Inflow Design Flood Control System (PIDFCS) Plan was prepared for the Bremo Station's (Station) existing Coal Combustion Residuals (CCR) inactive surface impoundment known as the East Pond. This PIDFCS Plan was prepared in accordance with 40 CFR Part §257, Subpart D and is consistent with the requirements of 40 CFR §257.82. The East Pond had all its CCR removed as well as an over excavation of additional soil in 2019 and currently serves as a stormwater management pond for the Station.

The Station, owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion), is in Fluvanna County at 1038 Bremo Road, east of Route 15 (James Madison Highway) and north of the James River. The Station includes an existing, inactive CCR surface impoundment, the East Pond, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule and Direct Final Rule (40 CFR §257; the CCR Rule). The East Pond is also regulated as an impounding structure by the Virginia Department of Conservation and Recreation (DCR), with Inventory Number 065019. Discharge from the East Pond is currently regulated by Virginia Department of Environmental Quality (DEQ) Virginia Pollutant Discharge Elimination System Permit No. VA0004138 (VPDES Permit).

Dominion Energy performed closure by removal activities in the East Pond by removing the stored CCR and over-excavating soil pursuant to its solid waste permit closure plan (SWP 618). The Virginia Department of Environmental Quality (DEQ) verified removal activities in October 2019. The East Pond remains subject to the CCR Rule requirements due to observed groundwater impacts that prevent full closure of the unit under the rule even though the Pond no longer impounds CCR materials.

3 PURPOSE

This PIDFCS plan is prepared pursuant to 40 CFR §257.82(c) of the CCR Rule [40 CFR §257.82(c)]. The initial IDFCS plan was completed in April 2018 and is required to be reviewed every five (5) years pursuant to 40 CFR §257.82(c)(4). The East Pond remains subject to the CCR rule requirements, including this PIDFCS plan update, even though all CCR materials have been removed.

4 PERIODIC INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

As required by §257.82(c)(1), this PIDFCS plan includes documentation of how the inflow design flood control system for the East Pond has been designed, constructed, operated, and maintained to:

- Adequately manage flow into the East Pond during and following the peak discharge of the inflow design flood [40 CFR §257.82(a)(1)];
- Adequately manage flow from the East Pond to collect and control the peak discharge resulting from the inflow design flood [40 CFR §257.82(a)(2)]; and
- Adequately handle discharge from the East Pond in accordance with the surface water requirements under 40 CFR §257.3-3 [40 CFR §257.82(b)].

4.1 HAZARD POTENTIAL CLASSIFICATION

As indicated in WSP's Periodic Hazard Potential Classification Assessment (WSP, 2023), the East Pond is assigned a "Low" hazard potential rating per 40 CFR §257.73.

4.2 INFLOW DESIGN FLOOD

In accordance with 40 CFR §257.82(a)(3)(ii), a CCR impoundment with a low hazard potential must collect and control the peak discharge resulting from a 100-year flood. Per National Oceanic and Atmospheric Administration (NOAA) Atlas-14, the 100-year, 24-hour precipitation depth is 7.91 inches in Bremo Bluff, Virginia. Evaluation of the East Pond 's inflow design flood control system during the 100-year, 24-hour storm event is provided in Appendix A.

4.3 INFLOW CONTROL

As required by §257.82(a)(1), a control system must be in place for the East Pond that is designed, constructed, operated, and maintained to adequately manage flow into the East Pond during and following the peak discharge of the inflow design flood.

Inflow to the East Pond consists of stormwater runoff from approximately 23 acres of the pond proper and additional 59 acres of run-on from north of the pond. Run-on enters the East Pond via sheet flow and through a structure in the Frog Pond, which is a stormwater management pond located directly north of the East Pond. The contributing drainage areas are mainly undeveloped wooded areas with good cover conditions. The natural and constructed conveyance systems adequately manage run-on into the East Pond during the inflow design flood.

4.4 OUTFLOW CONTROL

As required by §257.82(a)(2), an inflow design flood control system must be in place for the East Pond that is designed, constructed, operated, and maintained to adequately manage flow from the East Pond to collect and control the peak discharge resulting from the inflow design flood.

The East Pond's primary outlet for stormwater is through an existing outlet structure in the southeast corner of the pond. The outlet structure is a square concrete intake tower, 5-feet-6-inches in width with a weir opening at an elevation of approximately 214.0 feet above mean sea level (ft amsl). The outlet pipe is a 24-inch diameter reinforced concrete pipe with an inlet invert elevation of 206.9 ft amsl. An emergency spillway is located in the west side of the East Pond at an elevation of 230.0 ft amsl.

The East Pond stormwater system was modeled in the U.S. Army Corps of Engineers Hydrologic Engineering Center's Hydraulic Modeling System (HEC-HMS), and the analysis is included in Appendix A. The East Pond inflow design flood control system is capable of adequately managing the inflow from the design flood event without overtopping the embankment.

4.5 SURFACE WATER REQUIREMENTS

As required by §257.82(b), a control system must be in place for the East Pond that is designed, constructed, operated, and maintained to meet the requirements of §257.3-3.

The East Pond is operated under VPDES No. VA0004138, a Local Land Disturbance Permit, Stormwater Management Plan, and Stormwater Pollution Prevention Plan (SWPPP). The site is routinely inspected and monitored by Dominion personnel in accordance with the before mentioned plans to minimize potential surface water impacts.

5 CONCLUSIONS

The East Pond is subject to a PIDFCS plan update (due every 5 years from the original assessment performed in April 2018). The pond remains subject to the CCR Rule requirements, even though it no longer impounds CCR materials, due to observed groundwater impacts that prevent full closure of the unit under the CCR Rule.

Based on known site conditions, information in this PIDFCS plan, as well as work performed by WSP, it is WSP's opinion that the existing East Pond inflow design flood control system complies with the requirements of 40 CFR §257.82 of the CCR Rule for a low hazard potential impoundment.

REFERENCES

- Golder Associates. Inflow Design Flood Control System Plan, Bremo Power Station Inactive CCR Surface Impoundment: East Ash Pond. April 2018.
- National Oceanic and Atmospheric Administration's National Weather Service. NOAA Atlas 14 Point Precipitation Frequency Estimates: VA. Accessed February 3, 2023. Available online: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=va
- Virginia Department of Environmental Quality (VDEQ), Valley Regional Office. Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0004138.
- WSP USA Inc. (WSP). 2023. Periodic Hazard Potential Classification Assessment, Bremo Power Station Inactive CCR Surface Impoundment: East Pond. March 2023.

APPENDIX

A East Pond Inflow Design Flood Analysis

CALCULATIONS

Date	April 2023	**Made by:**	HNE
Reference No.	21466315	**Checked by:**	BJP
Site Name	Dominion Energy - Bremo East Pond Bremo Bluff, Virginia	**Approved by:**	ELH

BREMO EAST POND INFLOW DESIGN FLOOD ANALYSIS

1.0 OBJECTIVES

The purpose of this evaluation is to determine the hydraulic performance of the East Stormwater Management Pond (East Pond), formerly the East Ash Pond Coal Combustion Residuals (CCR) impoundment at the Bremo Station, resulting from the 100-year, 24-hour design storm event. This evaluation is in support of the Inflow Design Flood Control System Plan and is based on a "Low" hazard potential classification as defined in §257.53 of the *CCR Rule*. The East Pond has been closed by removal of CCR, and currently is used for surface water management at the site.

2.0 CALCULATIONS

2.1 Pond Storage Volume

The East Pond storage volume was computed based on the topography of the pond following removal of CCR material, surveyed in 2020. The maximum available storage below the emergency spillway at elevation 230.0 feet above mean sea level (ft amsl) is approximately 450 acre-feet. Attachment 1 contains the stage-storage rating table for the East Pond.

2.2 Outlet Design Capacity

Below the emergency spillway, there is a square concrete intake tower located in the southeast corner of the pond. The tower is 5-feet-6-inches in width and has a weir opening at an elevation of approximately 214.0 ft amsl. The outlet pipe is a 24-inch diameter reinforced concrete pipe with an inlet invert elevation of 206.9 ft amsl.

This analysis assumes that the starting water level in the East Pond is at the crest of the weir opening (Elevation 214.0 ft amsl) and is allowed to rise during the design storm event. It is conservatively assumed that no water is discharged through the concrete intake tower during the storm.

2.3 Storm Routing Calculations

The East Pond stormwater system analysis was performed using the US Army Corps of Engineers Hydrologic Engineering Center's Hydraulic Modeling System (HEC-HMS) software package (Ref 1). The drainage area to the pond is 59 acres from north and east of the pond, and 23 acres from direct precipitation into the pond.

Design Storm

Per §257.82(a)(3)(ii), the impoundment is required to adequately manage flow resulting from the 24-hour, 100-year storm event. The 100-year, 24-hour storm event precipitation depth was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Data Server (PFDS, Ref 2) for Bremo Bluff, Virginia, and amounts to 7.9 inches. The design storm is distributed in time as an SCS Type II synthetic distribution.

HMS Model Input

Figure 1 illustrates the connectivity of the stormwater elements and the data inputs as modeled in HEC-HMS. The predominant soil types in the area are Hydrologic Soil Group (HSG) 'B' soils. The acreage, curve number (CN), and lag time for each sub-basin area are provided in the attached worksheet.

The time of concentration for each basin was estimated using the TR-55 time of concentration method (NRCS, Ref 3), which divides the longest hydraulic flow path into sheet flow, shallow concentrated flow, and open channel flow, and considers a minimum time of concentration of 6 minutes. The lag time was estimated as 60% of the time of concentration. The maximum length of sheet flow was assumed to be 100 feet.

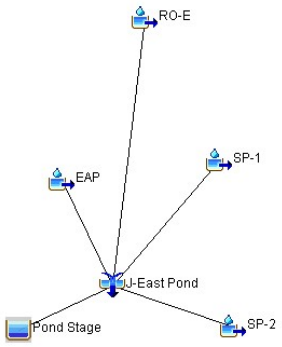


Figure 1: East Pond HEC HMS Model Routing

HMS Model Output

The following table summarizes the results of the HEC-HMS analysis, using a starting water surface elevation of 214.0 ft. Note that the computed high water (Max Hw) elevations are below the level of the emergency spillway (elevation 230.0 ft amsl). The inflow volume and pool elevation are shown in Attachment 1.

Table 1: East Ash Pond HEC-HMS Results

Q_{in} (CFS)	V_{in} (acre-ft)	Max Hw (Ft El*)
355.6	29.1	215.9

3.0 CONCLUSIONS

Based on the calculations presented herein, the East Pond at the Bremo Station can accept and store the 100-year, 24-hour storm event without discharging through the emergency spillway or overtopping the pond berms.

4.0 REFERENCES

1) USACE (United States Army Corps of Engineers). 2020. HEC-HMS Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) [computer software]. Version 4.10. September 2020.

2) Precipitation Frequency Data Server (NOAA Atlas 14). https://hdsc.nws.noaa.gov/hdsc/pfds/

3) NRCS. 2010. National Engineering Handbook. Part 630 Hydrology, Chapter 15 Time of Concentration.

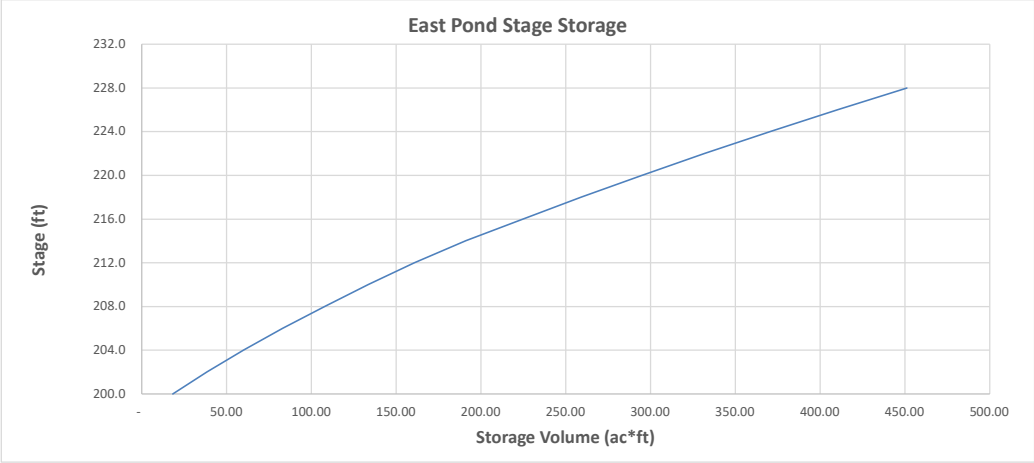
5.0 ATTACHMENTS

1) East Pond H&H Calculations

ATTACHMENT 1

East Pond H&H Calculations

East Pond Stage Storage					
Contour Elevation (ft)	Contour Area (ft^2)	Contour Area (Acre)	Average End Area Volume (ft^3)	Avg End Area Cumulative Volume (ft^3)	Average End Area Cumulative Volume (Acre-ft)
200.0	377,498	8.67			
202.0	420,948	9.66	798,446	798,446	18.33
204.0	452,520	10.39	873,468	1,671,914	38.38
206.0	485,191	11.14	937,711	2,609,625	59.91
208.0	521,003	11.96	1,006,194	3,615,819	83.01
210.0	550,403	12.64	1,071,405	4,687,224	107.60
212.0	579,433	13.30	1,129,836	5,817,060	133.54
214.0	608,301	13.96	1,187,734	7,004,794	160.81
216.0	711,005	16.32	1,319,306	8,324,100	191.10
218.0	740,073	16.99	1,451,078	9,775,178	224.41
220.0	768,315	17.64	1,508,388	11,283,566	259.04
222.0	796,194	18.28	1,564,509	12,848,075	294.95
224.0	823,607	18.91	1,619,801	14,467,876	332.14
226.0	851,193	19.54	1,674,800	16,142,676	370.58
228.0	878,940	20.18	1,730,133	17,872,809	410.30
230.0	900,000	20.66	1,778,940	19,651,749	451.14



Client: Dominion
Project: Bremo East Pond CCR Inflow Design
Project Number: 21466315

Date:	3/9/23
By:	HNE
Chkd:	BJP
Apprvd:	ELH

Design Storm **100 -Year Reccurence Interval**

Storm Duration (hours)	2-Year Depth (inches)	100 -Year Depth (inches)	Storm Distribution
24	3.2	7.9	II

Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 98 Pond Area (acres)	CN = 61 Native Soil (acres)	CN = 55 Wooded Areas (acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
EAP	1,006,477	23.11	0.0361	23.11			CN = 98	0.20	7.67	14.77	643,328
RO-E	531,767	12.21	0.0191		3.50	8.71	CN = 57	7.54	2.94	2.99	130,210
SP-1	1,810,960	41.57	0.0650	1.00		40.57	CN = 56	7.86	2.83	9.81	427,123
SP-2	233,556	5.36	0.0084		5.36		CN = 61	6.39	3.38	1.51	65,711
Total:	3,582,760	82.25	0.13							29.07	1,266,373

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					Flow Segment 1						Flow Segment 2						Flow Segment 3						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Total Lag (0.6*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
EAP	0.0361	98	3.6	6.0																			
RO-E	0.0191	57	5.0	8.3	Sheet	100	0.270	I	Light woods	7.6	Shallow	204	0.390	U	Unpaved	0.3	Channel	189	0.120	G	Grass-lined	0.54	0.3
SP-1	0.0650	56	17.9	29.8	Sheet	100	0.013	I	Light woods	25.6	Shallow	380	0.160	U	Unpaved	1.0	Channel	1420	0.041	G	Grass-lined	0.77	3.3
SP-2	0.0084	61	6.5	10.9	Sheet	100	0.210	G	Bermuda Grass	8.6	Shallow	267	0.300	U	Unpaved	0.5	Channel	424	0.018	G	Grass-lined	0.56	1.8

Notes:
(1) Refer to Attachment A for Roughness Condition descriptions and Tc Coeffiecients.
(2) The minimum lag time for each sub-basin is 3.6 min.

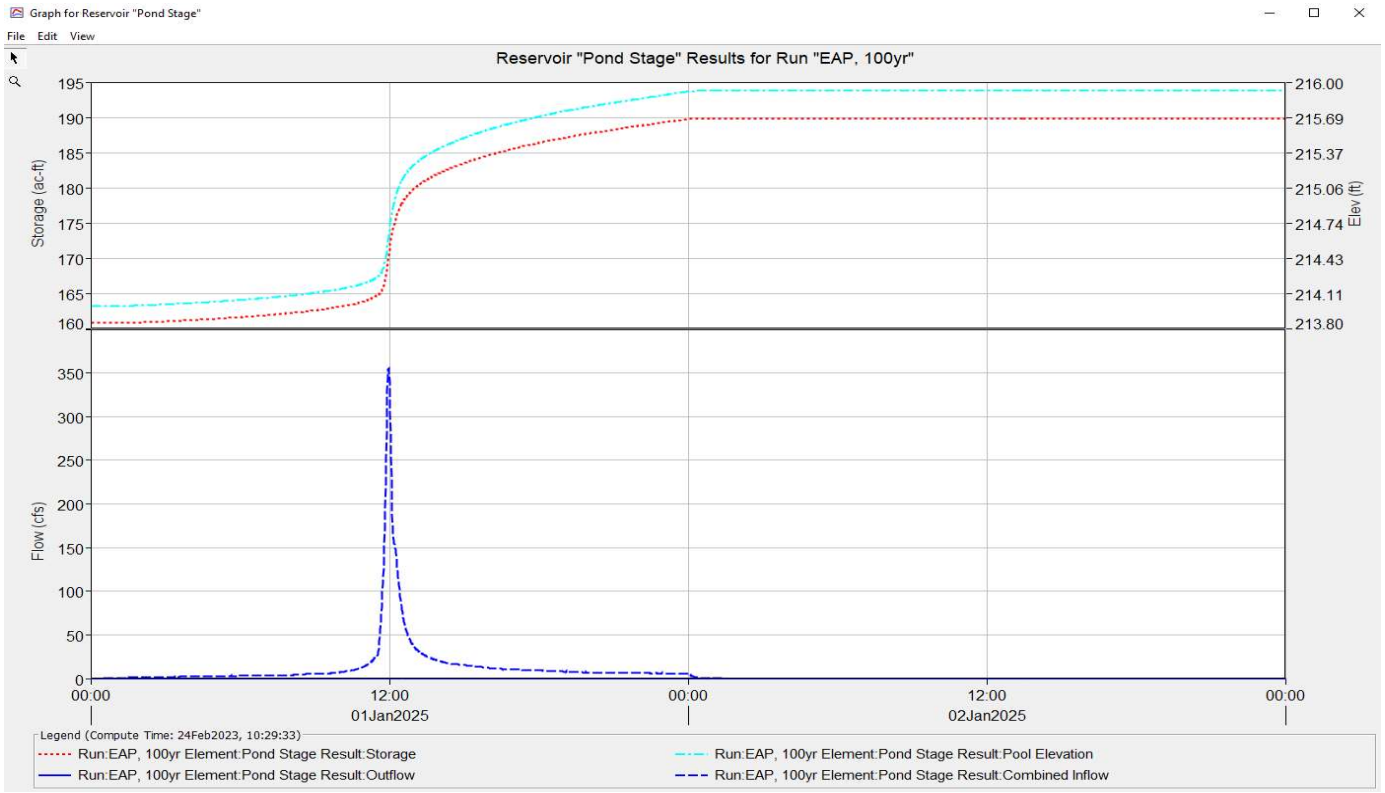
Client: Dominion
Project: Bremo East Pond CCR Inflow Design
Project Number: 21466315

Date:	3/9/23
By:	HNE
Chkd:	BJP
Apprvd:	ELH

HEC-HMS Basin Model:	East Pond
HEC-HMS Met. Model:	1000yr,24-hr
HEC-HMS Control Specs:	48 hour, 1 min

Hydrologic Element	Drainage Area (sq mile)	Peak Discharge (cfs)	Time of Peak	Total Volume (ac-ft)
EAP	0.036	242.4	01Jan2025, 11:56	14.8
J-East Pond	0.129	355.6	01Jan2025, 11:58	29.1
RO-E	0.019	54.8	01Jan2025, 11:59	3
SP-1	0.065	103.4	01Jan2025, 12:12	9.8
SP-2	0.008	26.1	01Jan2025, 12:00	1.5

East Pond Storage Analysis



Attachment A
Time of Concentration and Mannings Flow Coefficients

TR-55 (1986)

Sheet Flow Travel time (SCS Upland Method)

$$T_t = \frac{0.007\ (n'\ L)^{0.8}}{(P_2)^{0.5}\ S^{0.4}}$$

Where: T_t = travel time (hr); n' = roughness coefficient; L = flow length (ft);
P_2 = 2-yr storm depth (inches); s = slope (ft/ft)
flow velocity = $L/(60T_t)$

Flow Type	Surface Type	roughness n	Surface Description	Short Description
Sheet/Overland Flow	A	0.011	Smooth surfaces (concrete, asphalt, gravel, bare soil)	Smooth
	B	0.05	Fallow (no residue)	Fallow
	C	0.06	Cultivated soils: Residue cover <= 20%	Cover<20%
	D	0.17	Cultivated soils: Residue cover > 20%	Cover>20%
	E	0.15	Grass: Short grass prairie	Short Grass
	F	0.24	Grass: Dense grasses	Dense Grass
	G	0.41	Grass: Bermuda grass	Bermuda Grass
	H	0.13	Range (natural)	Range
	I	0.40	Woods: Light underbrush	Light woods
	J	0.80	Woods: Heavy underbrush	Heavy Woods

Shallow Concentrated Flow Velocity (SCS Upland Method)

$v = mS^{0.5}$ Where: v = velocity (fps); m = roughness coeffient; S = slope (ft/ft)

Flow Type	Surface Type	Roughness m	Surface Description	Short Description
Shallow Conc. Flow	P	20.3282	Paved Surfaces	Paved
	U	16.1345	Unpaved Surfaces	Unpaved

Channel Flow Velocity (Mannings Velocity)

$v = 1.49/n\ Rh^{2/3}S^{1/2}$ Where: v = velocity (fps); n = roughness coeffient; Rh = Hydraulic Radius (ft), S = slope (ft/ft)

Lining Type	Mannings n for Depth	Mannings n for Velocity	Material	Maximum Velocity	Maximum Shear Stress
A	0.026	0.026	ACB	25	
C	0.024	0.022	CSP	50	
E	0.025	0.022	Earth-lined	3	
G	0.035	0.030	Grass-lined	5	
I	0.017	0.013	Ductile Iron	50	
P	0.012	0.009	Plastic	25	
R	0.040	0.035	Riprap	16	
T	0.035	0.030	Turf Reinf.	10	1.5
Z	0.060	0.005	Other	25	