

ISSUE SUMMARY
Form SOP-0405, Revision 15

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TITLE:	Periodic Run-On and Run-Off Control Plan		
EQUIPMENT NO.:	N/A		
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APPROVER:		DATE:	



CERTIFICATION

I certify that

- This run-on and run-off control plan was prepared by me or under my supervision.
- This run-on and run-off control plan meets the requirements of 40 CFR 257.81.
- I am a registered professional engineer under the laws of the State of Ohio.

Certified by: David Nielson

A handwritten signature in black ink that reads 'D. E. Nielson'.

David E. Nielson, P.E.
2026.08.20 11:40:40 -05'00

Date: 8/20/2026





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1.0 PURPOSE AND SCOPE

This report fulfills the periodic update to Cardinal's run-on and run-off control plan in accordance with the Federal Coal Combustion Residual Rules, 40 CFR 257.81 (c)(4) (Reference 9.1). As required by the rule, Cardinal's landfill continues to manage run-on and run-off peak flows resulting from a 24-hour, 25-year storm event. The initial run-on and run-off control plan was prepared by AEP (October 2016) and was updated by TRC (October 2021).

In addition to meeting the periodic update requirements associated with 40 CFR 257.81, this plan also documents the future changes to landfill run-off conditions associated with the recently installed landfill contact stormwater pond and pump station which have yet to be put into service.

2.0 DESIGN INPUT

- 2.1 Rainfall data for the site was obtained from the NOAA Precipitation Frequency Data Server for the 25-year precipitation event. Rainfall depth for various durations is presented in Table 1 (Attachment 1). The system is designed to account for the peak discharge from the 24-hour, 25-year storm event.

Table 1: Rainfall Data

Duration (minutes)	25-Year
5	0.60
10	0.92
30	1.61
60	2.08
120	2.41
720	3.49
1,440	4.00

- 2.2 Runoff Curve numbers are used per Technical Release No. 55 (TR55) (Reference 9.2).
- 2.3 The total area that is analyzed is roughly 44.5 acres (Attachment 4).
- 2.4 The hydrologic soil group will be type "D" as noted from NRCS Soil Survey (Reference 9.3 & Attachment 2).
- 2.5 The project site is located within the Type II rainfall distribution (Attachment 3) according to the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Technical Release 55 (TR55) "Urban Hydrology for Small Watersheds" (Reference 9.2).



- 2.6 Stormwater runoff will be conveyed by a system of culverts from the existing ponds. All existing structures, pipes, and culverts will remain in-place (Attachment 6, Reference 9.4). This includes the pond discharge system that uses a lift station to pump runoff from the pond into Blockhouse Run. The flow for the east and west interceptor ditches will be directed first to the forebay and then the stormwater pond to the south. The flow for the existing drainage ditches north of cell 1 and 3 is directed to outlet structures in the north and east which also will discharge into Blockhouse Run as well as to the forebay and primary pond to the south.
- 2.7 An overall summary of the drainage areas and their respective CN values can be found in Table 2. The drainage area exhibit and flow path can be found in Attachment 4. The CN value of 89 is estimated based on the existing site conditions for Cells 1 and 3 and the corresponding CN value of ash.

Table 2: Drainage Areas

Drainage Area ID	Area (acre)	Composite CN Value
AREA 1	5.25	89
AREA 2	4.25	89
AREA 3	35.00	89

3.0 Existing Conditions

- 3.1 The east interceptor gravel ditch has a bottom width of 6 ft with side slopes ranging from 3:1 to 4:1. It has a watershed contributing flow of 40 acres. The ditch is 617.00 ft in length. The ditch has an allowable flow depth of 3 ft (with an additional 1 ft freeboard). The design depth of flow is 2.60 ft. For the 25-year, 24-hour storm event, the peak discharge into the ditch is 141.27 cfs. See section 7.0.
- 3.2 The west interceptor gravel ditch has a bottom width of 4 ft with a side slope of 3:1. The ditch was designed using a conservative estimate of 30% of the east ditch flow. The ditch is 166 ft in length. The ditch has an allowable flow depth of 3 ft (with an additional 1 ft freeboard). The design depth of flow is 1.25 ft. For the 25-year, 24-hour storm event, the peak discharge into the ditch is 42.38 cfs. See section 7.0.
- 3.3 The highwall has a watershed area of 12.93 acres. The high wall area is made of rock. Existing highwall design drawings can be found in Attachment 5 (Reference 9.4). Portions of the highwall drain to the existing stormwater pond by means of an 18" culvert. The remaining highwall runoff goes to a drainage layer which is connected to the subsurface drainage layer of the landfill and then transmitted to the leachate collection system.
- 3.4 There is an existing stormwater runoff pond and a stormwater runoff forebay (Attachment 6, Reference 9.4). This pond will receive runoff from the landfill to the north. The existing pond will



collect runoff from the landfill, gypsum reclaim areas, and parts of the western highwall. The east and west interceptor ditches flow into the forebay prior to discharging into the stormwater pond. Any stormwater that does not runoff to the existing stormwater pond then percolates through the waste and is finally treated in the leachate collection system.

The stormwater pond was designed for the 100-year, 24-hour storm event with 1 foot of freeboard. The full volume of the stormwater pond is 24.25 acre-ft. The pond has two pumps that operate at different elevations. It takes approximately 71 hours to draw the pond down to elevation 1001 feet from the maximum water level for the 100-year, 24-hour storm event. The forebay was sized to provide a minimum volume of 3,600 cf/acre of tributary area. The full volume of the forebay pond is 6.03 acre-ft. The primary pond and forebay are designed to accommodate the runoff flow from the 100-year, 24-hour storm event. The east and west interceptor ditches that lead to the forebay and pond are sized to accommodate the 25-year, 24-hour storm event. The run-on and run-off of the landfill is managed through Cardinal's NPDES Permit (01B00009) in accordance with the Clean Water Act and 40 CFR 257.3-3.

- 3.5 There is an existing leachate collection and treatment system. This features two 500,000-gallon settling tanks. Prior to being transported to the outfall, the leachate is decanted from the two settling tanks on site. Runoff from the active area is conveyed to the leachate collection system via vertical chimney drains and a system of transmission pipes. The holding capacity of the leachate storage pond is designed for a 30-day period of leachate volume. This system is monitored on a regular basis by the on-site landfill operator for Cardinal.

4.0 ASSUMPTIONS

- The n value for a gravel ditch is 0.03.
- It is assumed that the maximum length of any sheet flow segment is 300 ft.

5.0 METHODOLOGY

The landfill is divided into 3 drainage areas as shown in Attachment 4. Region 1 is located on the northwest side of the landfill. It accounts for 5.25 acres of the drainage area. This area features sections with permanent and temporary coverage that drains north partly to outlet 2 and partly sheet flowing to the north low point which later drains to outlet 3 as well as Blockhouse Run.

Region 2 is located on the south side of the landfill. It accounts for 4.25 acres of the drainage area. Region 2 includes a small portion of the highwall, the area directly west of this area of highwall, a section of the landfill, and part of an existing ditch on site. The majority of this



area drains to the east interceptor ditch. A conservative estimate of 30% of the flow from the landfill is expected to flow to the west interceptor ditch.

Region 3 is located on the middle and east side of the landfill. It accounts for 35.00 acres of the drainage area. Region 3 includes an existing low point on site, a section of the landfill, part of the highwall, and part of an existing ditch on site. This area drains to the existing low point on site which drains to Blockhouse Run.

Each region's time of concentration is calculated based on sheet flow, shallow concentrated flow, and channel flow. The time of concentration path can be found in Attachment 4.

6.0 ACCEPTANCE CRITERIA

The hydrologic and hydraulic components of the Cardinal Power Plant will be considered acceptable if the existing drainage conveyance systems can handle the stormwater runoff for the 25-year, 24-hour storm event without overtopping the discharge locations while maintaining at least 1.00 ft of freeboard.

7.0 CALCULATIONS AND RESULTS

Time of Concentration Calculations

The PondPack program was used to analyze the current stormwater system (Reference 9.5). The inputs for PondPack are the runoff curve number, drainage areas, time of concentration, rainfall depth, and rainfall distribution. The PondPack program outputs can be found in Attachment 7. For region 1,2, and 3, the first 300 feet of the flow path is analyzed as sheet flow. The sheet flow equation can be found in Equation 1.

Equation 1:

$$T_{sf} = \frac{(0.007)(nL)^{0.8}}{P_2^{0.5} S_{sf}^{0.4}} \text{ hr}$$

Region 1:

$$T_{sf} = \frac{(0.007)(0.03*300)^{0.8}}{2.41^{0.5} 0.01^{0.4}} \text{ hr} = 0.16 \text{ hr} = 9.60 \text{ min}$$

Region 2:

$$T_{sf} = \frac{(0.007)(0.03*300)^{0.8}}{2.41^{0.5} 0.013^{0.4}} \text{ hr} = 0.15 \text{ hr} = 9.00 \text{ min}$$



Region 3:

$$T_{sf} = \frac{(0.007)(0.03 \times 300)^{0.8}}{2.41^{0.5} 0.22^{0.4}} \text{ hr} = 0.05 \text{ hr} = 3.00 \text{ min}$$

Where:

n = the roughness coefficient

L = length of sheet flow in ft = 300 ft

P = is the 2-year 24-hour rainfall in inches

S = slope in ft/ft

The shallow concentrated flow can be found in Equation 2. The equations for shallow concentrated flow and open channel flow are from the Ohio Department of Transportation (Reference 9.6).

Equation 2:

$$T_{sf} = \frac{L_{scf}}{60 (V_{scf})} \text{ min}$$

Where:

L = length of shallow concentrated flow in ft

$$V = K\sqrt{S}$$

K = Surface cover coefficient = 20.32 for mostly impervious areas

S = Slope

Region 1:

$$S = 20/280 = 0.07$$

$$V = 20.32\sqrt{0.07} = 5.37$$

$$T_{sf} = \frac{302}{60 (5.37)} = 1.00 \text{ min}$$

Region 2:

$$S = 2/100 = 0.02$$

$$V = 20.32\sqrt{0.02} = 2.87$$

$$T_{sf} = \frac{150}{60 (2.87)} = 0.87 \text{ min}$$



Region 3:

$$S = 33/2260 = 0.015$$

$$V = 20.32\sqrt{0.01} = 2.50$$

$$T_{sf} = \frac{2260}{60 (2.50)} = 15.06 \text{ min}$$

The remaining area for Region 2 is modeled as channel flow. The channel flow equation according to the Ohio Department of Transportation (Reference 9.6) is the same as Equation 2.

Equation 2:

$$T_{sf} = \frac{L_{scf}}{60 (V_{scf})} \text{min}$$

Where:

L = length of shallow concentrated flow in ft

$$V = K\sqrt{S}$$

K = Surface cover coefficient = 20.32 for mostly impervious areas

S = Slope

Region 2:

$$S = 9/350 = 0.03$$

$$V = 20.32\sqrt{0.03} = 3.52$$

$$T_{sf} = \frac{50}{60 (3.52)} = 0.16 \text{ min}$$

The time of concentration for each region can be found below in Table 3.



Table 3: Time of Concentrations

Region	Time of Concentration (min)
Region 1	10.60 (rounded to 10)
Region 2	12.03 (rounded to 10)
Region 3	18.06 (rounded to 15)

The Pondpack results can be found in Table 4 for the 24-hour, 25-year storm event (Attachment 7).

Table 4: Pondpack Results

Region	Flow (cfs)
Region 1	19.68
Region 2	15.93
Region 3	116.76

East Interceptor Ditch

The Landfill primarily consists of areas of gypsum excavation and ash piles stockpiled filling in the excavated areas. The excavation and movement of ash activities will be an ongoing process until the Landfill area is eventually closed. A CN value for ash will be used in the calculations.

A = 40.00 AC (This area is based on the largest possible contributing watershed to the interceptor ditches from the landfill area.)

CN =89 (This value is based on Cells 1 and 3 being primarily ash.)



T_c is calculated in Table 5.

Table 5: Landfill Time of Concentration

Landfill TOC								
Segment	EL1 (ft)	EL2 (ft)	Length (ft)	Slope	n	V (fps)	T_c (min)	T_c (hr)
A	1115	1055	300	0.20	0.011	-	1.34	0.022
B	1055	1051	40	0.10	-	6.43	0.10	0.002
C	1051	1044	310	0.023	-	3.08	1.68	0.028
D	1044	1038	290	0.021	-	2.95	1.64	0.027
E	1038	1013	1330	0.019	-	2.81	7.91	0.132

Time of Concentration

$$T_c = T_{\text{sheet}} + T_1 + T_2 + T_3 + T_4 = 1.34 + 0.1 + 1.68 + 1.64 + 7.91 = 12.67 \text{ min}$$

Bottom width = 6.00 ft

East Interceptor Ditch slopes range from 3:1 to 4:1 in some areas on the northern slope. We will conservatively assume that both north and south slopes are a 3:1 slope.

Side slope (ss) = 3:1

Upstream invert = 1013.00 ft

Downstream invert = 1010.00 ft (Entrance to Forebay Pond)

There is free outfall from the ditch to the pond therefore there is no tailwater condition.

Length of ditch (L) = 617.00 ft

Ditch slope $1013 - 1010 = 3/617 = 0.005$

Manning's roughness coefficient (n) = 0.03 (Used for gravel ditch)

Peak discharge into ditch = 141.27 cfs (25-year, 24-hour storm)



Sizing the East Interceptor Ditch

Open Channel Flow:

Check allowable flow at an arbitrary depth in the ditch

d=2.60 ft (Chosen depth to confirm capacity check)

L = 617.00 ft

b=6.00 ft (bottom width)

ss=0.33 (side slope)

n= 0.03

$P = b + 2 \cdot d \cdot \sqrt{1 + (1/ss)^2}$ wetted perimeter

P=22.40 ft

$A = (b + (1/ss) \cdot d) \cdot d$ area

A= 35.90 sf

R= A/P hydraulic radius

R=1.60 ft

EL change 1013 ft-1010 ft = 3.00 ft

Channel Slope (S) $3/617 = 0.005$ ft/ft

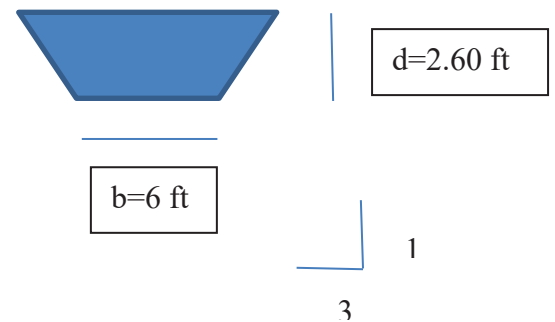
$V = (1.49/n) \cdot R^{2/3} \cdot S^{1/2}$

V=4.80 ft/sec

$Q_1 = A \cdot V = 35.90 \text{ sf} \cdot 4.80 \text{ ft/sec} = 172.28 \text{ cfs}$

Allowable Flow $Q_1 = 172.28 \text{ cfs}$ (Flow in ditch at the assumed 2.60 foot depth check)

Max depth allow = 3.00 feet (plus one foot freeboard for a total 4 feet)





$d = 2.60$ (Design height of ditch flow, is less than max depth allow)

$Q_{1\text{design}} = 141.27$ cfs (25 year, 24-hour Design flow is less than allowable flow)

West Interceptor Ditch Capacity

To account for the worst case scenario, the West Ditch is assumed to receive 30% flow from the landfill area. Therefore, this is taken into consideration below for the flow calculation.

Open Channel Flow:

Check allowable flow at an arbitrary depth in the ditch

$d = 1.22$ ft (Chosen depth to confirm capacity check)

$L = 166.00$ ft

$b = 4.00$ ft (bottom width)

$ss = 0.33$ (side slope)

$n = 0.03$

$P = b + 2 \cdot d \cdot \sqrt{1 + (1/ss)^2}$ wetted perimeter

$P = 12.00$ ft

$A = (b + (1/ss) \cdot d) \cdot d$ area

$A = 9.73$ sf

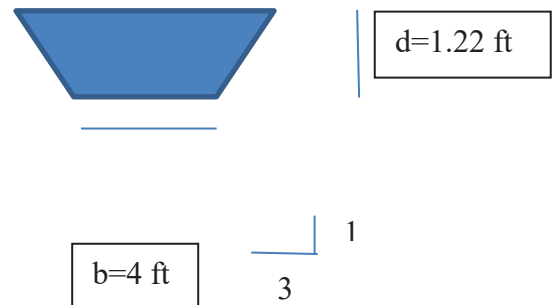
$R = A/P$ hydraulic radius

$R = .81$ ft

EL change $1025.4 - 1020.9 = 4.50$

Channel Slope (S) $4.5/166 = 0.027$ ft/ft

$V = (1.49/n) \cdot R^{2/3} \cdot S^{1/2}$





$$V=7.09 \text{ ft/sec}$$

$$Q1= A*V=9.73 \text{ sf} *7.09 \text{ ft/sec} =59.55 \text{ cfs}$$

$$\text{Allowable Flow } Q1=69.00 \text{ cfs}$$

$$\text{Flow (Q2) from West Interceptor Ditch} = 30\% (141.27) \text{ cfs} = 42.38 \text{ cfs}$$

The downstream stormwater pipe discharging from the downstream end of the West has head water elevation of 1024.61 which can be used as the tailwater for the ditch. This value is used to calculate the upstream headwater elevation of the West Interceptor Ditch which is calculated as elevation 1026.96. The average slope, water level, and length of ditch are used to determine the water level upstream of the ditch. This calculation can be found in Attachment 8.0.

8.0 CONCLUSION

The calculations shown above demonstrate that the expected flow does not exceed the allowable flow for the west and east interceptor ditches for the 25-year, 24-hour storm event which meets CCR Rule Operating Criteria 257.81.

9.0 REFERENCES

9.1 CCR Rule Operating Criteria §257.81 Hydrologic and Hydraulic Capacity, Run-on and Run-off Controls for CCR Landfills, United States Environmental Protection Agency.

9.2. Technical Release No. 55 (TR 55), "Urban Hydrology for Small Watersheds" by U.S. Department of Agriculture, Washington, D.C. 1986.

9.3 Natural Resources Conservation Service (NRCS), Custom Web Soil Survey Map.

9.4 Site Design Drawing:
Landfill Stormwater Runoff Pond Discharge Piping Route, 301033, Rev. 3

9.5 PondPack Connect Edition Computer Program, S&L Verified and Validated (V&Ved) Program PONDPACK 8I (S&L Program No. 03.7.712-10.02.00.01), Status, N

9.6 1100 – Drainage Design Procedures, Ohio Department of Transportation, January 16, 2026.



10.0 ATTACHMENTS

- 1.0 PRECIPITATION DATA
- 2.0 WEB SOIL SURVEY
- 3.0 RAINFALL DISTRIBUTION
- 4.0 DRAINAGE AREAS AND FLOW PATH
- 5.0 HIGHWALL DESIGN PLANS
- 6.0 EXISTING GRADING PLANS
- 7.0 PONDPACK OUTPUT
- 8.0 WEST DITCH FLOW



NOAA Atlas 14, Volume 2, Version 3
Location name: Brilliant, Ohio, USA*
Latitude: 40.2528°, Longitude: -80.6523°
Elevation: 727 ft**
* source: ESRI Maps
** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.320 (0.284-0.363)	0.382 (0.339-0.434)	0.463 (0.410-0.524)	0.524 (0.462-0.592)	0.603 (0.531-0.681)	0.663 (0.582-0.747)	0.720 (0.629-0.811)	0.779 (0.679-0.878)	0.858 (0.743-0.965)	0.915 (0.789-1.03)
10-min	0.497 (0.441-0.564)	0.597 (0.529-0.677)	0.719 (0.637-0.814)	0.808 (0.714-0.914)	0.922 (0.812-1.04)	1.00 (0.882-1.13)	1.08 (0.947-1.22)	1.16 (1.01-1.31)	1.26 (1.09-1.42)	1.33 (1.15-1.50)
15-min	0.610 (0.540-0.691)	0.730 (0.647-0.828)	0.883 (0.782-1.00)	0.994 (0.878-1.12)	1.14 (1.00-1.29)	1.24 (1.09-1.40)	1.35 (1.18-1.52)	1.45 (1.26-1.63)	1.57 (1.36-1.77)	1.67 (1.44-1.87)
30-min	0.807 (0.715-0.914)	0.977 (0.866-1.11)	1.21 (1.07-1.37)	1.38 (1.22-1.56)	1.61 (1.42-1.82)	1.78 (1.56-2.00)	1.94 (1.70-2.19)	2.11 (1.84-2.38)	2.33 (2.02-2.62)	2.50 (2.15-2.81)
60-min	0.985 (0.873-1.12)	1.20 (1.06-1.36)	1.52 (1.34-1.72)	1.76 (1.55-1.99)	2.08 (1.84-2.36)	2.34 (2.06-2.64)	2.60 (2.27-2.93)	2.86 (2.50-3.23)	3.23 (2.79-3.63)	3.51 (3.02-3.94)
2-hr	1.13 (0.995-1.30)	1.37 (1.21-1.58)	1.74 (1.52-1.99)	2.02 (1.77-2.31)	2.41 (2.10-2.75)	2.72 (2.37-3.10)	3.05 (2.64-3.46)	3.38 (2.92-3.84)	3.84 (3.29-4.36)	4.21 (3.58-4.78)
3-hr	1.20 (1.07-1.40)	1.46 (1.29-1.69)	1.84 (1.63-2.13)	2.14 (1.88-2.47)	2.56 (2.25-2.95)	2.90 (2.54-3.33)	3.25 (2.83-3.73)	3.62 (3.13-4.15)	4.14 (3.55-4.74)	4.55 (3.88-5.21)
6-hr	1.44 (1.28-1.64)	1.73 (1.54-1.97)	2.16 (1.93-2.46)	2.52 (2.24-2.86)	3.02 (2.67-3.42)	3.42 (3.01-3.87)	3.85 (3.37-4.34)	4.31 (3.75-4.85)	4.95 (4.26-5.56)	5.47 (4.67-6.13)
12-hr	1.70 (1.53-1.90)	2.03 (1.83-2.27)	2.52 (2.26-2.81)	2.91 (2.61-3.24)	3.49 (3.11-3.86)	3.96 (3.52-4.37)	4.46 (3.94-4.91)	5.00 (4.38-5.49)	5.77 (5.01-6.32)	6.40 (5.51-6.97)
24-hr	2.01 (1.88-2.18)	2.41 (2.24-2.60)	2.94 (2.74-3.18)	3.38 (3.14-3.64)	4.00 (3.70-4.30)	4.50 (4.15-4.83)	5.03 (4.62-5.39)	5.58 (5.10-5.97)	6.36 (5.77-6.79)	6.98 (6.30-7.44)
2-day	2.36 (2.21-2.54)	2.82 (2.63-3.03)	3.41 (3.19-3.67)	3.90 (3.63-4.18)	4.56 (4.24-4.89)	5.10 (4.73-5.46)	5.66 (5.22-6.05)	6.24 (5.73-6.65)	7.03 (6.42-7.49)	7.65 (6.95-8.15)
3-day	2.53 (2.38-2.71)	3.01 (2.83-3.22)	3.62 (3.40-3.87)	4.12 (3.86-4.40)	4.80 (4.49-5.12)	5.35 (4.98-5.70)	5.92 (5.49-6.30)	6.49 (6.00-6.90)	7.29 (6.69-7.74)	7.91 (7.22-8.40)
4-day	2.70 (2.55-2.87)	3.20 (3.02-3.41)	3.84 (3.61-4.08)	4.35 (4.09-4.62)	5.05 (4.73-5.36)	5.60 (5.24-5.95)	6.17 (5.75-6.55)	6.75 (6.27-7.16)	7.54 (6.96-7.99)	8.16 (7.49-8.66)
7-day	3.24 (3.07-3.43)	3.84 (3.63-4.06)	4.55 (4.30-4.82)	5.11 (4.83-5.40)	5.88 (5.54-6.21)	6.47 (6.08-6.84)	7.08 (6.64-7.48)	7.69 (7.18-8.12)	8.50 (7.90-8.98)	9.12 (8.44-9.64)
10-day	3.74 (3.55-3.94)	4.40 (4.18-4.66)	5.17 (4.91-5.46)	5.77 (5.48-6.09)	6.58 (6.23-6.94)	7.21 (6.81-7.60)	7.83 (7.38-8.26)	8.46 (7.95-8.92)	9.27 (8.67-9.78)	9.89 (9.21-10.4)
20-day	5.24 (4.99-5.50)	6.15 (5.86-6.48)	7.12 (6.78-7.49)	7.88 (7.50-8.28)	8.88 (8.43-9.32)	9.63 (9.14-10.1)	10.4 (9.81-10.9)	11.1 (10.5-11.6)	12.0 (11.3-12.6)	12.7 (11.9-13.4)
30-day	6.57 (6.26-6.92)	7.69 (7.32-8.11)	8.82 (8.40-9.29)	9.71 (9.23-10.2)	10.9 (10.3-11.4)	11.7 (11.1-12.3)	12.6 (11.9-13.2)	13.4 (12.6-14.1)	14.4 (13.6-15.2)	15.2 (14.2-16.0)
45-day	8.41 (8.03-8.80)	9.80 (9.37-10.3)	11.1 (10.6-11.6)	12.1 (11.6-12.7)	13.4 (12.8-14.0)	14.3 (13.7-15.0)	15.2 (14.5-15.9)	16.1 (15.3-16.8)	17.1 (16.2-18.0)	17.8 (16.9-18.7)
60-day	10.1 (9.72-10.6)	11.8 (11.3-12.3)	13.2 (12.7-13.8)	14.3 (13.7-15.0)	15.7 (15.1-16.4)	16.7 (16.0-17.5)	17.7 (16.9-18.4)	18.5 (17.7-19.3)	19.6 (18.6-20.4)	20.3 (19.3-21.2)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

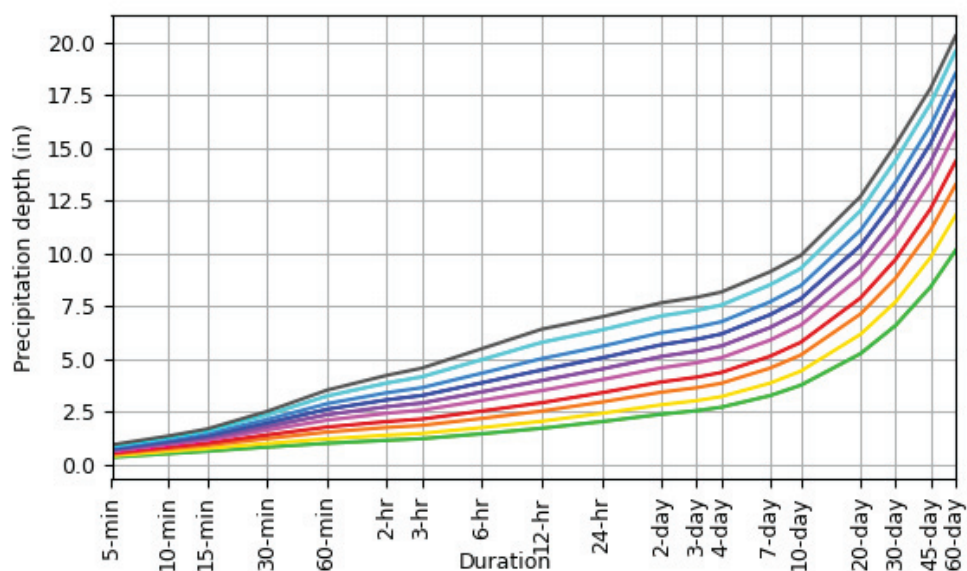
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

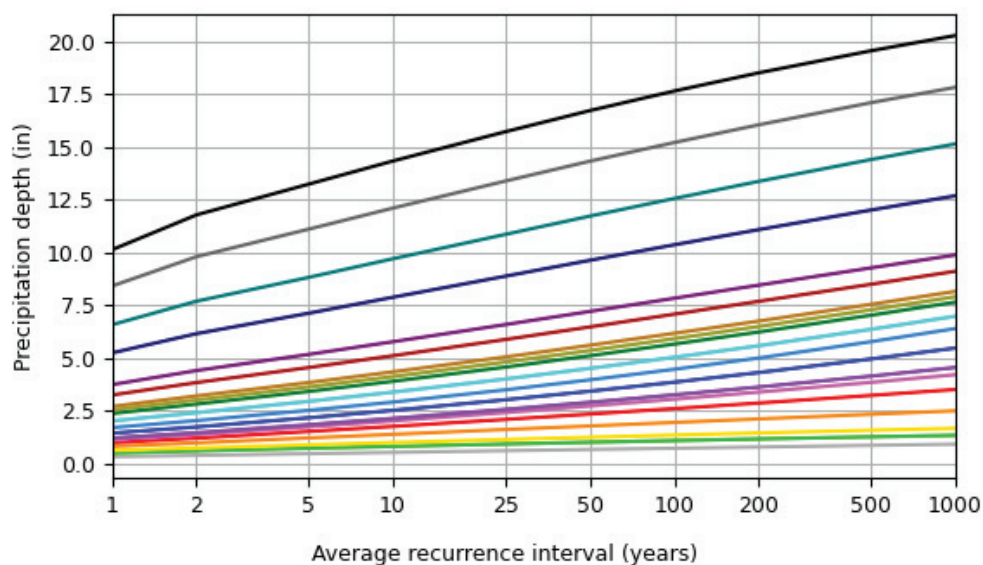
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PF graphical

PDS-based depth-duration-frequency (DDF) curves
 Latitude: 40.2528°, Longitude: -80.6523°



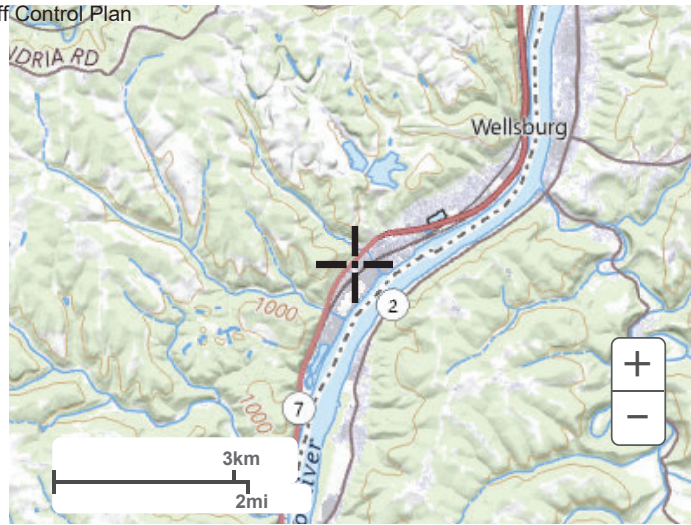
Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



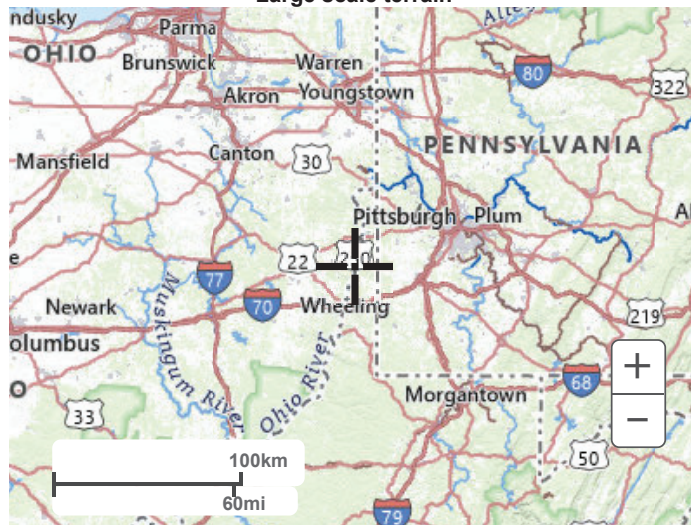
Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

Maps & aerials

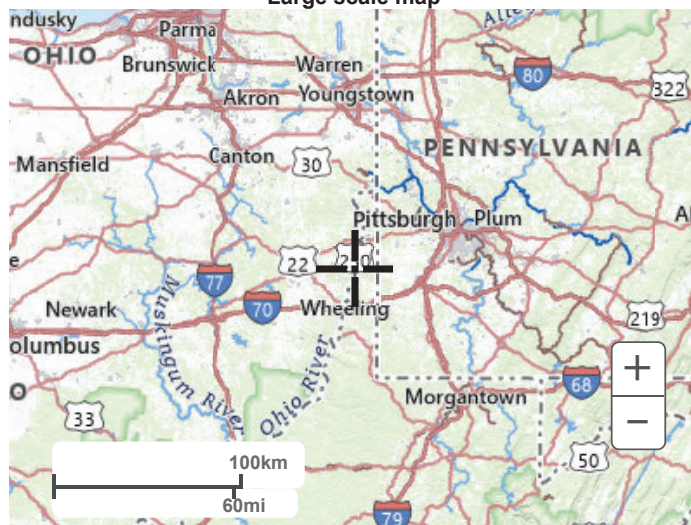
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Jefferson County, Ohio



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

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scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

Legend:

- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jefferson County, Ohio
Survey Area Data: Version 24, Sep 2, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 19, 2021—Sep 19, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
EbD2	Elba silty clay loam, 15 to 25 percent slopes, eroded	0.1	0.1%
LoE	Lowell silty clay loam, 25 to 40 percent slopes	0.1	0.1%
Mwc3D	Morristown silty clay loam, 8 to 25 percent slopes, reclaimed	2.6	1.9%
Mwc3F	Morristown silty clay loam, 25 to 70 percent slopes, reclaimed	4.4	3.3%
Mwf6F	Morristown channery silty clay loam, 25 to 70 percent slopes, unreclaimed	0.1	0.1%
Ub	Udorthents, loamy	126.1	94.6%
Totals for Area of Interest		133.4	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

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was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Jefferson County, Ohio

EbD2—Elba silty clay loam, 15 to 25 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2x9zh
Landscape: Hills
Elevation: 730 to 1,360 feet
Mean annual precipitation: 38 to 42 inches
Mean annual air temperature: 50 to 53 degrees F
Frost-free period: 172 to 193 days
Farmland classification: Farmland of local importance

Map Unit Composition

Elba and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elba

Setting

Landscape: Hills
Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Residuum weathered from limestone and shale

Typical profile

Ap - 0 to 5 inches: silty clay loam
Bt1 - 5 to 18 inches: clay
Bt2 - 18 to 24 inches: clay
Bt3 - 24 to 31 inches: parachannery clay
BC - 31 to 44 inches: silty clay loam
C - 44 to 48 inches: silty clay loam
Cr - 48 to 58 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 40 to 80 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 14 percent
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: F126XY004OH - Side Slope

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Forage suitability group: Unnamed (G126XYF-5OH)
Other vegetative classification: Unnamed (G126XYF-5OH)
Hydric soil rating: No

Minor Components

Westmoreland

Percent of map unit: 5 percent
Landscape: Hills
Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Berks

Percent of map unit: 5 percent
Landscape: Hills
Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

LoE—Lowell silty clay loam, 25 to 40 percent slopes

Map Unit Setting

National map unit symbol: kzvc
Elevation: 670 to 1,340 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Lowell and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lowell

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Residuum

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Typical profile

H1 - 0 to 4 inches: silty clay loam
H2 - 4 to 48 inches: silty clay
H3 - 48 to 55 inches: silty clay
H4 - 55 to 57 inches: unweathered bedrock

Properties and qualities

Slope: 25 to 40 percent
Depth to restrictive feature: 40 to 120 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: F126XY004OH - Side Slope
Hydric soil rating: No

Minor Components

Berks

Percent of map unit: 8 percent
Landform: Hills

Westmoreland

Percent of map unit: 7 percent
Landform: Hills

Low chroma mottles in the lower part of the subsoil

Percent of map unit:

Silty clay surface layer

Percent of map unit:

Mwc3D—Morristown silty clay loam, 8 to 25 percent slopes, reclaimed

Map Unit Setting

National map unit symbol: 2xqvj
Landscape: Hills
Elevation: 860 to 1,360 feet
Mean annual precipitation: 38 to 41 inches
Mean annual air temperature: 51 to 52 degrees F
Frost-free period: 120 to 190 days
Farmland classification: Not prime farmland

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Map Unit Composition

Morristown, reclaimed, unstable fill, and similar soils: 95 percent

Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Morristown, Reclaimed, Unstable Fill

Setting

Landscape: Hills

Landform: Hillslopes

Landform position (two-dimensional): Shoulder, backslope

Landform position (three-dimensional): Side slope

Anthropogenic Feature: Reclaimed lands

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Parent material: Calcareous coal extraction mine spoil derived from limestone, sandstone, and shale

Typical profile

A - 0 to 3 inches: silty clay loam

C - 3 to 80 inches: very channery silt loam

Properties and qualities

Slope: 8 to 25 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.01 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 14 percent

Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: D

Forage suitability group: Unnamed (G126XYB-4OH)

Other vegetative classification: Unnamed (G126XYB-4OH)

Hydric soil rating: No

Minor Components

Fairpoint, reclaimed, unstable fill

Percent of map unit: 5 percent

Landscape: Hills

Landform: Hillslopes

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Side slope

Anthropogenic features: Reclaimed lands

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Hydric soil rating: No

Mwc3F—Morristown silty clay loam, 25 to 70 percent slopes, reclaimed

Map Unit Setting

National map unit symbol: 2xqvl
Landscape: Hills
Elevation: 860 to 1,360 feet
Mean annual precipitation: 38 to 41 inches
Mean annual air temperature: 51 to 52 degrees F
Frost-free period: 120 to 190 days
Farmland classification: Not prime farmland

Map Unit Composition

Morristown, reclaimed, unstable fill, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Morristown, Reclaimed, Unstable Fill

Setting

Landscape: Hills
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Anthropogenic Feature: Reclaimed lands
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Calcareous coal extraction mine spoil derived from limestone, sandstone, and shale

Typical profile

A - 0 to 3 inches: silty clay loam
C - 3 to 80 inches: very channery silt loam

Properties and qualities

Slope: 25 to 70 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 14 percent
Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Forage suitability group: Unnamed (G126XYH-1OH)

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Other vegetative classification: Unnamed (G126XYH-1OH)
Hydric soil rating: No

Minor Components

Fairpoint, reclaimed, unstable fill

Percent of map unit: 5 percent
Landscape: Hills
Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope
Anthropogenic features: Reclaimed lands
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Mwf6F—Morristown channery silty clay loam, 25 to 70 percent slopes, unreclaimed

Map Unit Setting

National map unit symbol: 2xqvs
Landscape: Hills
Elevation: 970 to 1,340 feet
Mean annual precipitation: 40 to 41 inches
Mean annual air temperature: 51 to 51 degrees F
Frost-free period: 120 to 190 days
Farmland classification: Not prime farmland

Map Unit Composition

Morristown, unreclaimed, unstable fill, and similar soils: 94 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Morristown, Unreclaimed, Unstable Fill

Setting

Landscape: Hills
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Anthropogenic Feature: Spoil banks
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Calcareous coal extraction mine spoil derived from limestone, sandstone, and shale

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: channery silty clay loam
C - 3 to 80 inches: very channery silt loam

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Properties and qualities

Slope: 25 to 70 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 14 percent
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Forage suitability group: Unnamed (G126XYH-1OH)
Other vegetative classification: Unnamed (G126XYH-1OH)
Hydric soil rating: No

Minor Components

Fairpoint, unreclaimed, unstable fill

Percent of map unit: 5 percent
Landscape: Hills
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Anthropogenic features: Spoil banks
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Other vegetative classification: Unnamed (G126XYH-1OH), Limy Hills (LH2)
Hydric soil rating: No

Typic epiaquents, unreclaimed, unstable fill

Percent of map unit: 1 percent
Landscape: Hills
Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder, footslope
Landform position (three-dimensional): Side slope
Anthropogenic features: Spoil piles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Ub—Udorthents, loamy

Map Unit Setting

National map unit symbol: kzw3
Elevation: 800 to 2,000 feet

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Mean annual precipitation: 28 to 40 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 170 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Properties and qualities

Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Bedrock escarpments

Percent of map unit: 4 percent

Urban land

Percent of map unit: 3 percent

Natural soils

Percent of map unit: 3 percent

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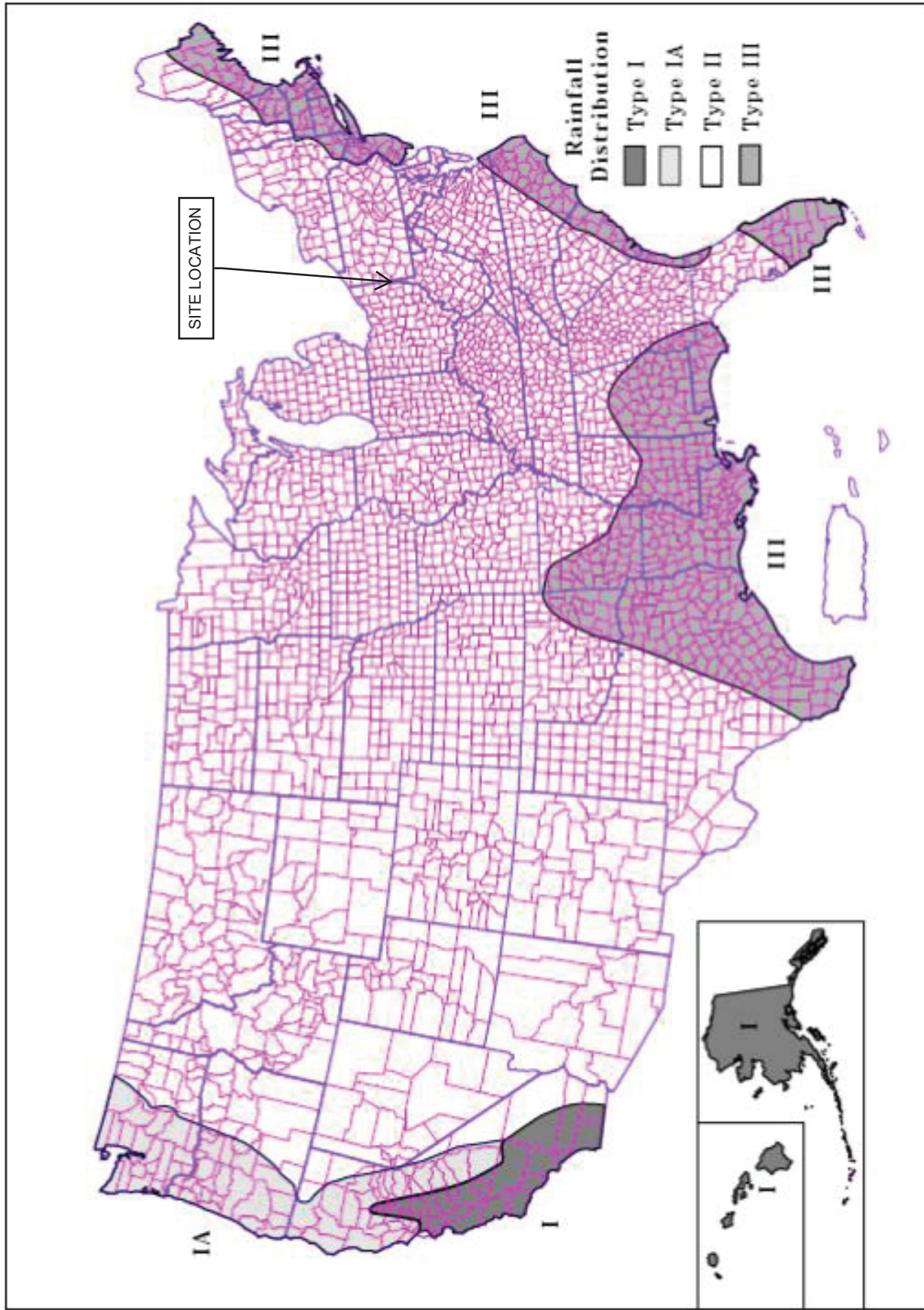
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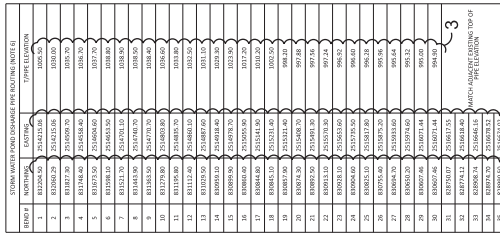
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- | REFERENCE DRAWINGS | |
|--------------------|---|
| 301034 | POND DISCHARGE PIPING ROUTE PROFILE AND DETAILS |
| 518118 | LANDFILL STORMWATER RUNOFF POND LIFT STATION P&ID |
| 540001 | LEACHATE COLLECTION SYSTEM OUTFALL 602 SECTION AND DETAIL |
| 570001 | LIFT STATION PIPE SUPPORTS |
| 570002 | LIFT STATION PIPE SUPPORTS |
| 590002 | PIPING P&ID OUTFALL 602 |

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570001	LIFT STATION PIPE SUPPORTS
570002	LIFT STATION PIPE SUPPORTS
590002	PIPING P&ID OUTFALL 602

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DURING ALL EXCAVATION/FOUNDATION/DEMOLITION WORK,	2022	60	12/22/2024	08/27

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BEILLIANT

LANDFILL STORMWATER
RINOFF POND DISCHARGE

PART COVER AND STORMWATER POND PROJECTS

OHIO

	
PROJECT NUMBER 0	DRAWING NUMBER 301033
SHEET 3	

	SCALE NAME	CIVIL ENGINEERING
	DRAWN BY	
	CHECKED BY	
	DATE	
	PROJECT NO.	


CARDINALS
 OPERATING COMPANY
 306 COUNTY ROAD 7E
 BRILLIANT OH 43953
 DATE: 11-10-2003
 ENC: --
 0000

CROSS REF:

3

Scenario Calculation Summary

Scenario Summary			
ID	1		
Label	Base		
Notes			
Active Topology	Base Active Topology		
Hydrology	Base Hydrology		
Rainfall Runoff	Base Rainfall Runoff		
Physical	Base Physical		
Initial Condition	Base Initial Condition		
Boundary Condition	Base Boundary Condition		
Infiltration and Inflow	Base Infiltration and Inflow		
Output	Base Output		
User Data Extensions	Base User Data Extensions		
PondPack Engine Calculation Options	Base Calculation Options		
Output Summary			
Output Increment	0.050 hours	Duration	24.000 hours
Rainfall Summary			
Return Event Tag	25	Rainfall Type	Time-Depth Curve
Total Depth	4.0 in	Storm Event	25 YEAR 24 HOUR

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
CM-1	Base	25	None	0.470	12.000	7.49	(N/A)	(N/A)
CM-2	Base	25	None	1.057	12.000	16.85	(N/A)	(N/A)
CM-3	Base	25	None	9.031	12.050	128.44	(N/A)	(N/A)
O-1	Base	25	None	0.470	12.000	7.49	(N/A)	(N/A)
O-2	Base	25	None	1.057	12.000	16.85	(N/A)	(N/A)
O-3	Base	25	None	9.031	12.050	128.44	(N/A)	(N/A)

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft ³ /s)	End Point	Node Flow Direction
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Messages

Scenario Calculation Summary

Messages

Message Id	7
Scenario	Base
Element Type	Catchment
Element Id	15
Label	CM-1
Time	(N/A)
Message	The difference between calculated peak flow and interpolated peak flow 1.7 % is greater than 1.5 %. Computed peak flow= 7.62 ft ³ /s Interp. peak flow= 7.49 ft ³ /s. Output increment for this catchment may be too large.
Source	Warning

Message Id	7
Scenario	Base
Element Type	Catchment
Element Id	16
Label	CM-2
Time	(N/A)
Message	The difference between calculated peak flow and interpolated peak flow 1.7 % is greater than 1.5 %. Computed peak flow= 17.15 ft ³ /s Interp. peak flow= 16.85 ft ³ /s. Output increment for this catchment may be too large.
Source	Warning

Water Level Computation

Description	Variable		Unit
		Ditch west	
<u>Weighted runoff coefficient</u>			
Design Discharge Upstream	Qu	46.26	cfs
Design Discharge Downstream	Qd	46.26	cfs
Downstream Control	CD	HW-1	
Downstream Water level	Wd	1024.61	ft
<u>Ditch Computations:</u>			
Bottom width	B	4.00	ft
Side slope	Ss	3.00	ft
Downstream Invert	Ed	1020.90	ft
Upstream Invert	Eu	1025.95	ft
Length	L	166.00	ft
Longitudinal slope S = (Eu-Ed)/L	S	0.03042	ft/ft
Manning's n	n	0.030	
<i>Downstream Computation</i>			
Design discharge downstream	Qd	46.26	cfs
Water Level	Wd	1024.61	ft
Flow depth Dd = Wd - Ed	Dd	3.71	ft
Flow Area A s= (B+Ss x Dd) X Dd	Ad	56.13	ft ²
Flow velocity Vd = Qd/Ad	Vd	0.82	ft/sec
Flow perimeter Pd = B + 2 x (1+Ss ²) ^{0.5} x Dd	Pd	27.46	ft
Hydraulic Radius Rs = Ad/Pd	Rd	2.04	ft
Full flow velocity using bed slope	Vf	13.95	ft/sec
Water surface slope Sd = n ² Vd ² / (Rd ^{4/3} x 1.49 ²)	Sd	0.00011	ft/ft
<i>Upstream Computation</i>			
Design discharge downstream	Qu	46.26	cfs
Assumed Water Level	Wu	1026.96	ft
Flow depth Du = Wu-Eu	Du	1.01	ft
Flow Area A u= (B+Ss x Du) X Du	Au	7.10	ft ²
Flow velocity Vu = Qu/Au	Vu	6.52	ft/sec
Flow perimeter Pu = B + 2 x (1+Ss ²) ^{0.5} x D u	Pu	10.39	ft
Hydraulic Radius Ru = Au/Pu	Ru	0.68	ft
Water surface slope Su = n ² Vu ² / (Ru ^{4/3} x 1.49 ²)	Su	0.028580	ft/ft
Average Slope Sa = (Su +Sd)/2	Sa	0.014343	ft/ft
Computed water level upstream	Wuc	1026.99	ft
Difference ΔD = Wuc - Wu; Revise Wu to get this value close to zero	ΔD	0.03	ft
Travel time (based on avg. velocity)	T	0.75	min
Top of Road at upstream	Tu	NA	ft