

#### **HYDROLOGY**

#### Climate

The mean annual temperature in the Big Scrubgrass Creek Watershed is about 49° F. The average January temperature is about 28°F and the average July temperature is about 71°F. The mean minimum January temperature is 18°F and the mean maximum July temperature is 85°F. Figure C1 shows the average number of days without killing frost in Pennsylvania. There are about 140 days between killing frosts in the watershed.

On the average, 140 days during the year have some measurable precipitation. During the driest 25 percent of the years, the watershed received between 35 and 40 inches of rainfall and during the wettest years the watershed received between 40 and 50 inches of rainfall indicating very uniform annual precipitation. Figure C2 shows the average annual precipitation for Pennsylvania which shows the 40 inch line going through the southwestern part of the watershed. The amount of rain which falls during the growing season is of importance in the establishment of vegetation on strip mine spoils and in this respect the watershed is well favored. Figure C3 shows the average growing season precipitation for Pennsylvania with 22 inches indicated for the watershed area.

Less winter kill of vegetation will occur when a snow cover persists during cold weather.

This is also important for the success of a winter recreation industry. Here the

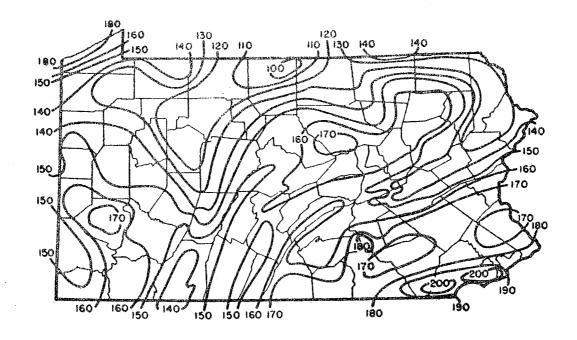


Figure Cl. Average number of days without a killing frost in Pennsylvania.

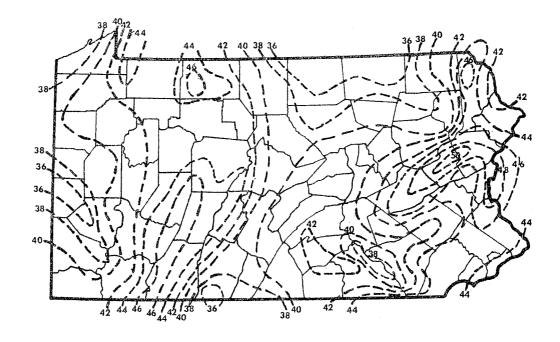


Figure C2. Average growing season (April through September) precipitation for Pennsylvania (inches).

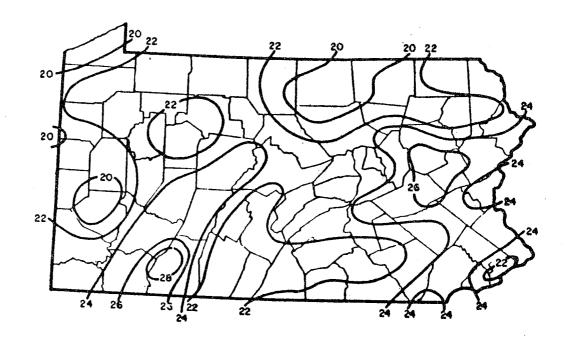


Figure C3. Average Growing Season (April through September) precipitation for Pennsylvania (inches).

watershed is particularly favored with an average annual snowfall of 50 inches and one inch or more on the ground during an average of 90 days per year.

The prevailing winds are from the northwest during the winter and from the west during the summer except for some erractic storms from the southeast during the summer.

#### Precipitation

The location of the three U.S. Weather Bureau rain gaging stations nearest the Big Scrubgrass Creek Watershed are shown in Figure 15 in the main part of this report. Daily records for these stations during the project period are included in table C4 at the end of this appendix. To estimate the average rainfall depth on the watershed from these station records, the Thiessen method was used. This method assigns a weighting factor to each station which is equal to the percentage of the watershed area closest to that station, and these factors are used to determine a weighted average value of the rainfall measured at the stations. Daily totals during the project period, monthly totals during the project period, and long term monthly mean values were computed for the watershed by this method. The monthly and long term values are shown in table C1 and are compared graphically in Figure 16. Two rain gages were maintained within the watershed during the first twelve months of the project period. Daily average from these two gages are shown in table C4 at the end of this appendix and monthly

TABLE NO. C1

# MONTHLY PRECIPITATION RECORDS

Project long term Gages Average	4.27 2.93 2.76 2.81	らずらい	37 622 7 7 7 7 7 7	22 22 22 22 22 22 22 22 22 22 22 22 22	3.28 3.29 4.05 4.05
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Franklin	6.22 5.99 3.44	~o.	wa H	2.75 2.75 2.75 2.75 2.75 2.75	4.10 3.80 9.85 9.55 9.55
Slippery Rock	6.62 3.42 8.51 8.51	4,644	က်ထံက်	70105 448 418035	3.3.34 5.3.37 10.36
Parker	6.57 3.88 2.74	2.26 4.19 2.24 0.57	3.02 4.98 3.81	4 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2.22 3.20 3.63 4.40 10.29
	October, 1970 November, 1970 December, 1970	January, 1971 February, 1971 March, 1971 April, 1971	May, 1971 June, 1971 July, 1971	August, 1971 September, 1971 October, 1971 November, 1971 December, 1971	January, 1972 February, 1972 March, 1972 April, 1972 May, 1972 June, 1972

average totals are included in table C1 and Figure 16 for comparison purposes.

The precipitation shows that, while long term monthly averages do not fluctuate greatly throughout the year, the monthly totals measured during the project period had considerable fluctuation. The winters and springs were generally wetter than normal and the first summer and fall periods were generally drier than normal. This would help explain why the measured runoff during the project period was greater than that expected from the long term average runoff for this area.

#### Soils

The rainfall-runoff relationship on a watershed depends on the types of soils in the watershed and their topography. The soils in the Big Scrubgrass Creek Watershed are classifield into four groups or associations.

The Hanover-Gresham soil association covers the largest portion of the area, approximately 40%. This soil association is in the northwestern part of the watershed. These soils are medium textured, moderately well-drained to poorly drained on level to moderately steep slopes. The moderately well drained Hanover soil is the major soil and is on the higher elevations. In older soils reports, this soil was called the Titusville series. The somewhat poorly drained Gresham is on flat hilltops and depressions. A few acres of Shelmadine, the poorly drained soil in this association, are in lower lying depressions. These silt loam soils form in glacial till which is composed primarily of local sandstone and shale.

These soils all have a restrictive horizon which has a permeability ranging between 0.2 and 0.63 inches per hour which is in the slow class. These soils would produce a high percentage of runoff from storm rainfall.

The Cavode, Wharton, and Gilpin Association occupies about 15% of the Watershed in the highest hilltops. This is the area where most of the strip mines are located. The somewhat poorly drained Cavode and moderately well drained Wharton soils are on broad hilltops and gently sloping hillsides. The well drained Gilpin is on the sloping hillsides.

These silt loams are formed from shale, siltstone and some sandstone. Wharton and Cavode have claypans that restrict the movement of air and water through the soil and retard root penetration. The Cavode and Wharton soils have high runoff producing characteristics. The Gilpin soil has moderate permeability but because it generally occurs on the steeper slopes, it also has high runoff producing characteristics.

The Cookport-Hazelton Association occupies about 15% of the watershed. These are course to medium textured, moderately well to somewhat poorly drained sandy loams and loams formed from acid gray sandstone and shale. Cookport has a restrictive horizon with slow permeability and the Hazelton is located on the moderately steep hillsides. Both have high runoff producing characteristics.

The Hazelton-Gilpin Association is on steep and very steep slopes, on valley walls of the major streams. This association covers about 15% of the watershed. In older

soils reports the Hazelton soils was called Dekalb. These soils are foams and sand foams, usually very stony. They are underlain by sandstone, siltstone and shale bedrock. These soils are also high runoff producers.

#### Runoff

Approximately 50 percent of the average annual rainfall on the Big Scrubgrass Creek Watershed shows up as runoff to the streams. Figure C4 is a map showing approximate lines of equal average annual runoff for Pennsylvania, which shows approximately 20 inches per year for the watershed area. No records of runoff are available for the Big Scrubgrass Creek except for those obtained during this project. Table C2 shows annual runoff for six USGS stream gages located near the watershed. These show that for the period covering the first twelve months of the project the runoff in the area ranged from 21 to 26 inches per year which is above the long-term average for these gages. Flow estimates made during the project period at the mouth of the main stream indicate an annual runoff of 24.34 inches per year which agrees closely with the surrounding gages.

The topography and soils on the watershed are a combination which would tend to produce storm runoff hydrographs which would have quick high peaks with rapid rise and fall of the water levels in the streams. On the tributary streams of the watershed this would cause the periodic flow measurements generally to be lower than the mean flow for the period.

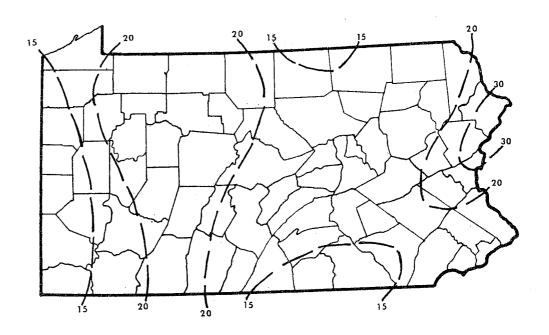


Figure C4. Average Annual Runoff in Pennsylvania (inches)

Source: U. S. Geological Survey

TABLE C2

Annual Runoff Records for USGS Stream Gaging Stations in the Watershed Area

	D <b>A</b>	Average Runoff	1970 Runoff	Fm. Oct., 1970 to Sept., 1971 1971 Runoff
Gaging Station	Sq. Mi.	in./year	in./year	in./year
Sugarcreek at Sugarcreek, Pa.	166	21.35	18.63	24.03
Patchel Run near Franklin, Pa.	5.69	20.17	15.54	21.16
Oil Creek at Rouseville, Pa.	300	23.18	21.19	26.50
Allegheny River at Franklin, Pa.	5982	23.13	22.65	26.15
Slippery Rock Creek at Wurtemburg, Pa.	398	18.83	18.54	21.87
Allegheny River at Parker, Pa.	7671	22.80	22.83	26.17

Fluctuations on the main stream should be less pronounced and periodic measurements there should give good estimates of long term runoff averages.

As part of the sediment and erosion control study of Big Scrubgrass Creek, the Soil Conservation Service performed a hydrologic analysis to estimate runoff and peak discharge rates that can be expected at various points in the Watershed for various frequencies of storms. The watershed was divided into thirty-two subwatersheds from which twenty-three specific locations were selected to calculate discharges. Nineteen of these locations correspond with sampling stations used in the stream quality study for this report. Rainfall for the various frequency storms was taken from United States Weather Bureau Technical Paper 40 for 24-hour storms. Runoff was computed for present land use conditions and sub-hydrographs were routed through the stream channel system by computer.

Table C3 shows a summary of the results of this study on the watershed. The discharges are peak flows in cubic feet per second at the various sampling stations. Sampling station locations are shown in Figure 17. The runoff is the total volume of water expected to flow past the specific location from the specified storm in millions of gallons. Since the peak flows on Big Scrubgrass are associated with net acid water quality these tables would be valuable to estimate the amount of acid which might be discharged from the watershed during the various frequency storms.

TABLE NO. C3

Summary of Storm Runoff Analysis for the Watershed

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SS-12	69.	198	32.5	149	24.5	121	19.8	98	16.0	79	10.3
SS-11	. 52	161	24.5	121	18.4	98	15.0	80	12,2	50	7.6
0 <b>1-88</b>	.25	111	11.8	81,	8,9	29	7.1	55	5.7	35	3.6
SS-1/L	3.70	1341	168.6	7000	126.8	.807	103.0	559	83,7	10	42.7
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		·	STUDY A	AREA II	GILMORE	RUN					
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SS-8	0.43	156	19.7	109	14.6	716	11.8	92	9.6	47	0°0
SS-10	2,96	1020	130.8	761	1.66	80.9	78.3	167	٤*٤9	303	39.2
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ny 8302 ny kaominina			STUDY AH	AREA II	BULLION	RUN					manus (Marie Chica III)
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SS-1	.62	175	27.3	130	20.14	104	16.4	†18	13.2	52	5, 39
SS-1	3.61	879	141.3	1119	103.0	505	81,1	107	0.19	238	37.8
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TABLE NO. C3 (Continued)

Sample Station or Sub-Area	Drainage Area	100	Yr. Inches	25	Years Inches	3.7	Years Inches	3.3	Years Inches	2.6	Years Inches	
		Peak cfs	Peak Q Runoff cfs m-gal	Q cfs	Runoff m-gal	Cfs	Runoff m-gal	C P S	Runoff m-gal	C.f.s	Runoff m-gal	
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			SCRUBGRASS		CREEK AT R	ROUTE 3	308			# Special		
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38-45	0.55	111	25.0	83	18.8	29	15.1	な	12.2	34	7.6	
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TABLE C4

DAILY RAINFALL

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Date	Project Gauges	Franklin	Parker	Slippery Rock	Thiessen Average
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12	.09	.06	.09	.13	.087
13	.235	.26	• 14	.07	.214
14	.085	.12	.06	.08	.099
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#### DAILY RAINFALL

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#### DAILY RAINFALL

# January, 1971

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TABLE C4 (Continued)

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22	.20	T	.26	.18	.091
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#### DAILY RAINFALL

May, 1971

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20	aus dess		par 440	an un	top das
21	MA 400	ener villa		***	Marie deser
<b>2</b> 2					udio apin
23	400 100				en en
24	en er				
25	•33	.41	.28	.27	. 347
26	-	${f T}$	T	.01	.003
27	<b></b>	${f T}$	Ţ		Con sep
28	dia sa		<del></del>		ion am
29				com que	ter ter
30	vigus anno		Gas last	***	eco est
31	-	es 105	um till	640b 4200	dises CEA

# TABLE C4 (Continued) DAILY RAINFALL

June, 1971

Date	Project Gauges	Franklin	Parker	Slippery Rock	Thiessen Average
1		interviewe with the control of the c		-	
2	ing com	${f T}$	T		
3	.36	.29	.43	•37	.334
4	4000 5544		- <del>-</del>	ani 440	· Code destr
5	' سمع مدد	direct scale	سنج جيوه	COD COM .	
6	.57	.48	.46	1.72	.888
7	.16	•33	.04	.05	.203
8	• <b>7</b> 75	.87	1.48	.04	.671
9	com tore	<b></b>	***		
10			400 CATO		
11			### 4EP		
12	.185		.45	T	• 55
13	.105	.15	.2		.107
14	• 335	.13	•54	.41	.272
15	.015	${f T}$	.05	***	.006
16	em cas	${f T}$		· day een	
17	çan tol	non libr	. 444 500	100 400	
18	- CARA-	SNA GIO	200 (40)		witer peak
19		GAST GASS		Acce case	and the
20	-	400 200		Circ cor	
21	.81	.49	.67	1.19	.743
22	tore film	one make	WW 1884	-	ovin Maro
23	core dan			<b>511 Aur</b>	
24	Clark desire	cumb disab		w =	
25	.025	.07	egne demi		
26	.275		.66		.218
27	uto can			946 450	obside diginals
28	GMA SEP		-	Cabo Mari	Ales vote
29	en: 60		the test	No. 905	<b>-</b> 00+
30		en 400	Como dicer		- ·

# DAILY RAINFALL

July, 1971

Date	Project Gauges	Franklin	Parker	Slippery Rock	Thiessen <b>Average</b>
1	COS GEO		T	risals (SE)	NEST - JUST
2	.285	.15	.31	.42	.259
3	ine (909	death COUTO	esco esso	ates scale	ONE 40H
4	AND- COLD	que em	ndo (510)	ब्राच्य काम	本語 水油
5	~ « « »	ca	AND COM	4350 CHAP	Alast closs
6	.035	. 08	name accord	.01	.047
7	COM GALL	glast stitut	and contr	440 153	set avo
8	tale enu	1000 جنين	<b>****</b>	CESS Appel	നുള് വാ
9	.04	.11	aton tates	acter dest-	.06
10 11	.78	.23	1.05	1.23	.661
12	.305	.11	.25	•53	.266
	.23	.22	.29	.18	.215
13	eso eso	<b>30.</b> 50.	ean aim	east Coar	Ecor com
14	•435	.27	.19	• 75	.419
15	~ ~ ~	T	dem ordin	-	espin kant
16	.085	.06	.12	.08	. 074.
17	and stop	T	émin égyi	. Koosa deer	AND URN
18	.015	-	T	.04	.013
19	.095	.12	.07	.12	.115
20	• 35	.16	.63	.16	.218
21	dda (20)	· ·	aa 03	<b>6</b> 57 keV	dian Ania
22	, , , , , , , , , , , , , , , , , , ,	940 con	<b>⇔</b>	1000 GHD	500 cm
23	dead Wild	viscal dates			digase visida
5/1	.175	.42	T	${f T}$	.23
25	. 14	. 14	.11	.18	.196
26		6000 8000	our den	ama 440	dani dani
27	.225		•47	.19	.121
<b>2</b> 8	desart - State	, das libro		appro estado	agus valle
29	.46	.78	.13	•5	.608
30	.21	• 34	.11	.17	.256
31	.04	T	.08	www decide	.01

# DAILY RAINFALL

August, 1971

Date	Project Gauges	Franklin	Parker	Slippery Rock	Thiessen <b>Average</b>
1					des que
2	design glassia	and some		and and	
3	.01		.03	.01	.007
4	•445	.22	. 38	.7	.398
5	.095		.18	.12	.062
6.	Octupe alarmin	and 983		-	CASP Cope
7	949 <b>4</b> 49	***	atter time		-
8	tipo cas	sale flori			<b>400</b> 400
9	dia ver			um u-	
10			.01		.001
11	.055	.12`		.01	.069
12	.05	.12	· •••	opp 6500	.066
13	Aur 400				No. 484
14	ent/- temp	Anne Marri	name quan		<b>~</b>
15	.185		.01	•45	.15
16	wa 66	··· ··	601 040	***	-
17	gas dan	decis state	-	dger tile	
18	<b>w w</b>	Auro Mills .			
19		and 440	1005 646	as	
20	.17	.17	.13	.22	.19
21	• 745	1.69	.32	.02	•97
22	.12	Т	.21	.21	.182
23	.456	.42	.51	-44	.438
24	may data				
<b>2</b> 5	No. 450	T			<b>-</b>
<b>2</b> 6	.055	.1	.03.	.04	.072
27	.315	• 3	•47	.18	.281
28	.215	.41	.24	.02	.261
29	.135	.22	.21	.03	.156
30	_ ·	apple from			• ± ) ∪
31	man files				

TABLE C4 (Continued)
DAILY RAINFALL

September,	1971
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Date	Project Gauges	Franklin	Parker	Slippery Rock	Thiessen Average
1	cop 428	and the state of t		HELD STEEL STEELS S BALLET STEELS	March 1964 (Application of Application of Application (Application of Application
2	New cool	open open	water trans	other Grace	dos esse
3	CHES GLAN	AUGO N'OS	T	emo que	State CRS-
4	compa facts	gen daya	des em	T	Sales COM
5	isste raine	Wight along	eso eso	main ethan	€/⊅ sasi
6	Petro uppa	etica d'Alla	400 ess	Ann 420	<b>95 84</b>
7	ercan COM	${f T}$	<b>5</b> 700	describin	ential domp
8	Garan Plate	upo una	<b>40 42</b>	quar exas	. dic# d465
9	stin dos	cione strat	pino Cont	state dure	CAS COS
10	qual- anch	ain the	NAME AND	-	MID type
11	gap exa	assi têb	300 date		digit dass
12	.385	.56	.24	.31	.438
13	1.75	.84	1.39	.91	.966
14	.425	.50	.38	• 75	.569
15	atin gay	Date com	${f T}$	.01	.003
16	460 853	quae Gelle	*** ***	dem gast	NOS gine
17	.145	Team spice .	.31	.11	.074
18	eus			\$0.00 ecm-	Mark year
19	.225	.11	.31	.30	.197
20	.645	.21	.43	.17	.224
21	.115	.21	T	.20	.181
22	egn nga-	1000 WWW	1999 4488	po	cos eco
23	. east son		com 400	NATE: 1007	EDA esse
24	·	${f T}$	dim con	aça em	cus cus
25	phile depre	<b>***</b> ****	······································	ECS: - GAMM	Calar poss
26	.205	.23	. 24	.17	.212
27	.045	.08	01.	.02	.056
28	.11	.06	.17	.11	.09
29	.16	.06	.29	.12	.109
30	.075	.17	Side Green	.05	.11

# DAILY RAINFALL

# October, 1971

Date	Project Gauges	Franklin	Parker	Slippery Rock	Thiessen Average
1					ige tim
2	eas law	Annual Grans	MASS. COLD		
3	. buts 4960	-	T		
4		and they			
5	.015	Ţ	.04	T	.005
6	.185	• 3	.17	.09	.214
7	.125	.1	.1	.17	.123
8	.01		.03	.02	.011
9	.15	.21	. 14	.1	.165
10	•375	. 35	.41	. 36	.366
11	.025	.06	ease	.01	.04
12	.08	.19	. 04		.109
13		, max. <del>( - 0</del>	400 BD		مه دين -
14	100 mg	ego cos			one that
15	-	and stell		. turn view	
16		case where	<del></del>		
17				-	
18		· dam dam			apper major
19			<u></u>		
20	···		ene 450		
21	cas ***	w. es		-	Non-drin
22					<b></b>
23	.055	.13	*** ***	.03	.081
24	.13	.23	.16	.03	. 156
25	.41	•37	•54	.30	.367
26	.01		.03	.01	.007
27	<del></del>	· ·	-	T	mar note
28	-	-			tion that
29	-		MES -494	-	
30			, <del>-</del> -		-
31	40a aus		-		