

PIKES PEAK PARK EAST

SAND CREEK

DRAINAGE STUDY  
SEPTEMBER 12, 1972

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# COX SURVEYING COMPANY

P.O. BOX 5151 • 3053 DELTA • SECURITY, COLORADO 80931 • PHONE 392-7198

Mr. DeWitt Miller  
Director of Public Works  
City Hall  
Colorado Springs, Colorado

Mr. Miller:

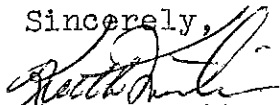
Transmitted herewith is the Drainage Study of Sand Creek Basin within Pikes Peak Park East and a portion of Pikes Peak Park West.

This area is generally bounded by Airport Road on the north, Academy Boulevard and Sand Creek on the west, Hancock Road on the south and the boundary of Sand Creek Basin on the east.

This study pertains to the quantities of surface runoff of each subbasin, together with preliminary designs of drainage facilities, the design of Sand Creek Drainageway and their estimated cost.

Should any questions arise regarding this study, please contact me at your convenience.

Sincerely,



Keith Martin, P.E.

KM/bg

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SCOPE AND PURPOSE OF DRAINAGE ANALYSIS:

This report is intended to furnish the basis for an overall plan for placing drainage ditches, storm sewers, and other drainage appurtenances in an area referred to in this analysis as "Pikes Peak Park East Development".

Included in this report are those subdivisions in which Drainage Reports and Plans have been approved and in some cases construction of the drainage facilities have been accomplished. The City of Colorado Springs has established that portions of three separate drainage basins lie within the boundaries of this development. They are Sand Creek, Spring Creek and Peterson Field Drainage Basins. This report will cover the Sand Creek Drainage Basin only.

Previous studies of this drainage basin as would apply to Pikes Peak Park East have been accomplished. However, during those study periods, master planning for this development had not been completed. Therefore, the drainage

requirements do not reflect the requirements of our now approved Master Plan of the area. Furthermore Drainage Reports and Plans of subdivisions within this development have been accomplished, approved and some drainage structures have been installed. In addition to this, criteria for drainage studies has changed with regards to design and, more particularly, cost of construction. We feel that these changes must and will be reflected in this report. The intent of this analysis is not to establish the precise design of drainage ditches, Greenbelt Channels, or Storm Sewers in any particular area. It should rather establish the general location of required drainage structures and the general required sizes in accordance with the planned development of the area. This will include those drainage structures required to provide proper facilities from existing subdivisions to the major drainage channels. Major channels and quantities for the design of Sand Creek and the East Fork of Sand Creek, as shown in the Sand Creek

Drainage Study dated May 31, 1968, prepared by the Lincoln - De Vore Testing Laboratory, were utilized in the preparation of this report.

Furthermore, this report will outline that portion of the drainage areas as referred to in the document titled "Agreement of Understanding Regarding Park and Drainage Fees", dated 13 October, 1970 by and between Fred C. Sproul Land Company and the City of Colorado Springs.

Sand Creek Drainageway Plans and Profile are included as part of this report (See Appendix 'A', Project No. 5-70-101).

GENERAL DESCRIPTIONS:

Pikes Peak Park East Development is located in Sections 23, 24, 25 and the north  $\frac{1}{2}$  of Section 35, Township 14 South, Range 66 West of the 6th P.M., in the City of Colorado Springs and contains approximately 2724.8 acres. This area lies within portions of three separate drainage basins. Approximately 197 acres are in the Spring Creek Drainage Basin, approximately 901.6 acres are in the Peterson Field Drainage Basin and the remaining 1620.2 acres are in the Sand Creek Drainage Basin. This report will cover the 1620.2 acres within the Sand Creek Drainage Basin and 88.0 acres of unplatted land within Pikes Peak Park West, being that land northwest of the intersection of Hancock Road and Academy Boulevard.

RAINFALL AND RUNOFF PATTERNS:

The annual average rainfall in this Pikes Peak Park East Development is relatively low, being about 14.5" per year. However, the major portions of this rainfall occur in May, June, July and August. Both mountain - type storms and plains - type storms fall on this area, due to the proximity



of the mountains. Storms of record in this area fall into two general categories being - short, intense storms lasting up to two hours and rather local in nature, and long term storms lasting six hours or more spread over a large area. Short duration storms produce less total runoff, but being quite intense, create a high flood peak. Previous drainage studies in this area have investigated several storm types. It was determined through these studies that the one hour duration, 2 inch intensity, 50 year frequency storms with a saturated soil condition produced the highest flood peak. Our investigation indicates that this criteria is correct and was confirmed for our design purposes. Therefore, all data and designs contained in this report are based upon this particular type storm.

STUDY CRITERIA:

All of the information contained in this report is based on the assumption that the entire Pikes Peak Park East will be developed in accordance with the attached map.

As mentioned before, the Pikes Peak Park East Development Plan concerns three drainage basins and approximately 4 zones or subbasins. They are divided as follows:

Spring Creek Basin	3 Subbasins	with numerous subzones
Sand Creek Basin	37 Subbasins	with numerous subzones
Peterson Field Basin	2 Subbasins	with numerous subzones

The outfall points of runoff storm water that enter this development from the north along Airport Road and in the major Greenbelt channels are consistent with those shown in the major drainage basin reports for Sand Creek and Peterson Field. An outfall point was assigned to each subbase and a c.f.s. was constructed for these points. They are as follows:

A. Sand Creek Channel	7240 c.f.s.
B. East Fork Sand Creek	} 4956 C.F.S.
C. 75' Greenbelt at Airport Road	

RECOMMENDATIONS:

The specifications of the City of Colorado Springs indicate that water runoff is not desired in the streets, particularly arterial streets. However, the use of streets as drainage flow structures must be allowed up to a point. It is therefore recommended that all streets be used as

drainageways insofar as possible under city regulations.

There are several streets within the development that will be unable to carry the water required for proper runoff.

At this point storm drainage ditches, greenbelts, and storm sewers have been designed and recommended in this report.

The specific recommendations in this report are shown in the attached tables and maps. The greenbelt Right-of-Ways are specified along with general ditch and storm sewer sizes.

Most drainage channels and ditches follow the natural stream beds and do not interfere with land fit for subdividing.

The recommended bridges and major channels are shown in tables, on the attached maps and on Plan and Profiles of Sand Creek.

It is our recommendation that for economical reasons several ditches, bridges and channels be constructed at one time to sufficiently reduce the overall cost of this project.

## SUBBASIN ZONE DESCRIPTION

### SUBBASIN # 1

Subbasin Zone Number 1 contains 18.9 acres and will drain 31.2 C.F.S. to the south to a proposed drainage ditch, thence easterly to Sand Creek. The proposed street within this area will require drop inlets whereby runoff will be directed to the drainage ditch.

### SUBBASIN # 2

Subbasin Number 2 contains 13.1 acres and will drain 19.8 C.F.S. southwesterly within the future developed roadway systems to a drop inlet; thence in a drainage ditch to Sand Creek.

### SUBBASIN # 3

Subbasin Number 3 contains 15.9 acres and will drain 24.4 C.F.S. southwesterly within the proposed street system to a grated inlet and thence in a drainage ditch to Sand Creek.

### SUBBASIN # 4

Subbasin Number 4 contains 14.8 acres and will drain 22 C.F.S. southeasterly within the proposed roadway systems to a drainage ditch. This drainage ditch will convey this surface runoff and the runoff within Subbasin Number 5 to the east fork of Sand Creek.

SUBBASIN # 5

Subbasin Number 5 contains 21.8 acres and will drain 35.4 C.F.S. southwesterly to that drainage ditch mentioned in Subbasin Number 4. The surface runoff of 35.4 C.F.S. in this area combined with the 22 C.F.S. in Subbasin Number 4 will be conveyed in the one drainage ditch.

SUBBASIN # 6

Subbasin Number 6 contains a total of 37.8 acres and will drain a total of 43.8 C.F.S. southwesterly into the east fork of Sand Creek. 38.1 C.F.S. of this total of ~~37.8~~<sup>43.8</sup> C.F.S. will be conveyed within a drainage ditch (6a) and this remaining 6.7 C.F.S. will be conveyed within a swale.

SUBBASIN # 7

Subbasin Number 7 contains a total of 14.1 acres and will drain a total of 21.3 C.F.S.; 11.3 C.F.S. will be conveyed by a swale to a 75' drainageway, (7a) and the remaining 10.0 C.F.S. will be conveyed by a swale to the east fork of Sand Creek.

SUBBASIN # 8

Subbasin Number 8 contains a total of 18.3 acres and will drain a total of 28.2 C.F.S. southerly to the East fork of Sand Creek. This surface runoff will be conveyed within two swales marked a and b.

SUBBASIN # 9

Subbasin Number 9 contains a total of 10.3 acres and will drain a total of 16.4 C.F.S. southerly within drainage swales marked a and b to the east fork of Sand Creek.

SUBBASIN # 10

Subbasin Number 10 contains 20.6 acres and will drain 32.8 C.F.S. southerly within two or three drainage swales to the east fork of Sand Creek.

SUBBASIN # 11

Subbasin Number 11 contains 13.2 acres and will drain 20.6 C.F.S. southeasterly within the street system to a drainage ditch and thence to Sand Creek.

SUBBASIN # 12 a

Subbasin Number 12 a contains 10.6 acres and will drain 17.2 C.F.S. westerly within a drainage ditch to Sand Creek.

SUBBASIN # 12 b

Subbasin Number 12 b contains a total of 21.1 acres and will drain a total of 37.6 C.F.S. This surface runoff will be conveyed within swales to the three discharge points as noted on the drainage plan.

SUBBASIN # 13

Subbasin Number 13 contains a total of 19.5 acres and will drain a total of 29.5 C.F.S. southerly within the proposed street systems to the drainage swales as noted on the drainage plan. At this point grated inlets and lined swales may be required to convey the surface runoff to Sand Creek.

SUBBASIN # 14

Subbasin Number 14 contains 10.9 acres and will drain 18.0 C.F.S. westerly in a drainage ditch to east fork of Sand Creek.

SUBBASIN # 15

Subbasin # 15 contains a total of 32.4 acres and will drain 50.9 C.F.S. northwesterly at the six (a thru f) discharge points as indicated on the drainage plan. The number of discharge points and the boundaries of this subbasin may vary or be modified in conjunction with Subbasin Number 18. This may be necessary to provide for an economical grading plan. At all discharge points grated inlets and lined drainage ditches will be required to convey surface runoff to the east fork of Sand Creek.

SUBBASIN # 16

Subbasin Number 16 contains 15.9 acres and will drain 24.8 C.F.S. northwesterly to the east fork of Sand Creek.

SUBBASIN # 17

Subbasin Number 17 contains 59.7 acres and will drain 84.7 C.F.S. southwesterly and under proposed Powers Boulevard within a drainage channel through subbasin Number 18 to the east fork of Sand Creek. Two drop inlets and concrete piping or a culvert will be required at Powers Boulevard crossing.

SUBBASIN # 18

Subbasin Number 18 contains 42.5 acres and will drain

58.4 C.F.S. into a concrete lined drainage ditch which will also convey the 84.7 C.F.S. from Subbasin 17 for a total of 143.1 C.F.S. The subbasin boundaries of this area may vary in order to provide economical drainage facilities and eliminate extensive earthwork. Catch basins will be provided where drainage ditch crosses under the proposed roadway systems.

SUBBASIN # 19

Subbasin Number 19 contains 32.7 C.F.S. and will drain 49.5 C.F.S. easterly within the proposed roadway system. This surface runoff will be conveyed to a drainage ditch along the south boundary of the Subbasin and thence to Sand Creek.

SUBBASIN # 20

Subbasin Number 20 contains 35.0 acres and will drain 32.4 C.F.S. easterly within a drainage ditch to Sand Creek.

SUBBASIN # 21 a

Subbasin Number 21 a contains 111.9 acres and will drain 145.00 C.F.S. westerly within a drainage ditch to Sand Creek. The street system within this area will convey surface runoff to drop catch basins located at the intersection of the drainage ditch and proposed streets. The drainage report for Pikes Peak Panorama Filing Number 2, dated August 14, 1972, covers this subbasin. This drainage report has been approved and drainage fees have been provided.

SUBBASIN # 21 b

Subbasin Number 21b contains 39.0 acres and will drain 53.6 C.F.S. within a drainage system to Sand Creek. The approved drainage report for Pikes Peak Panorama Filing Number 2 dated August 14, 1972 covers this subbasin.



SUBBASIN # 22

Subbasin Number 22 contains 52.8 acres and will drain 78.6 C.F.S. southeasterly in a drainage ditch to Sand Creek. Catch basins should be provided where drainage ditch and roadway intersect.

SUBBASIN # 23

Subbasin Number 23 contains 90.7 acres and will drain 124.7 C.F.S. southeasterly to within a drainage ditch to Sand Creek. Catch basins should be installed along the roadway system within this area to provide adequate drainage and prevent surface runoff from entering Fountain Boulevard.

SUBBASIN # 24

Subbasin Number 24 contains 235.3 acres and will drain 267.0 C.F.S. southwesterly within a drainage channel to Sand Creek. The drainage report and plan for Pikes Peak Panorama Filing Number 1, dated November 2, 1971, pertains <sup>5</sup> to a major portion of this subbasin. Drainage facilities within this subdivision have been installed and drainage fees have been payed.

SUBBASIN # 25

Subbasin Number 25 contains 111.3 acres and will drain 136.5 C.F.S. southerly and easterly within a drainage ditch or underground pipe system. Catch basins and drop inlets should be installed within this area to prevent large accumulation of surface flow. The southerly portion of

this drainage structure will pass through Subbasin Number 26 and a portion of 31.2 C.F.S. of surface runoff within this subbasin will be conveyed in the structure.

#### SUBBASIN # 26

Subbasin Number 26 contains a total of 44.8 acres and will drain 58.1 C.F.S. southeasterly at points a, b, and c as shown on the drainage plan. Swales, sodded or asphalt surfaced will provide adequate drainage at points a, and b.

#### SUBBASIN # 27

Subbasin Number 27 contains a total of 91.3 acres and will drain 121.9 C.F.S. southwesterly within a drainage structure along the north boundary of Chelton Road to Sand Creek. Catch basins and small drainage ditches should be constructed throughout this area to prevent excessive surface runoff within the street system. A Master Drainage Plan of this area is now being prepared.

#### SUBBASIN # 28

Subbasin Number 28 contains 39.0 acres and will drain 53.6 C.F.S. westerly within a drainage system through Subbasin Number 27 to Sand Creek. A Master Drainage Plan of this area is now being prepared.

#### SUBBASIN # 29

Subbasin Number 29 contains 36.2 acres and will drain 51.4 C.F.S. southwesterly within a drainage ditch to Sand Creek. This drainage ditch will also convey the surface runoff from Subbasin Number 30. Catch basins should be

installed at the intersection of the drainage ditch and Jet Wing Drive.

SUBBASIN # 30

Subbasin Number 30 contains 32.7 acres and will drain 47.1 C.F.S. westerly within a drainage ditch through Subbasin Number 29 to Sand Creek. The Drainage Report for Pikes Peak Park Subdivision Number 30 covers this subbasin.

SUBBASIN # 31

Subbasin Number 31 will drain 27.0 C.F.S. westerly through existing drainage facilities located within Pikes Peak Park Subdivision Number 29. A Master Drainage Plan for this Subbasin is now under study.

SUBBASIN # 32

See the Drainage report for Pikes Peak Park Subdivision Number 29 and Number 30.

SUBBASIN NUMBER 33

Subbasin Number 33 contains 28.1 acres and will drain 46.4 C.F.S. westerly within a drainage structure extending from Pikes Peak Park Subdivision Number 29 and Number 30. Catch Basins should be installed at the intersection of the drainage structure and Jet Wing Drive.

SUBBASIN # 34

Subbasin Number 34 contains 35.0 acres and will drain 48.9 C.F.S. westerly within the drainage ditch extending from Pikes Peak Park Subdivisions Number 29 and Number 30.

SUBBASIN # 35

Subbasin Number 35 contains 24.1 acres and will drain 33.2 C.F.S. westerly along the north boundary of Astrozon Boulevard through Subbasin Number 37 and thence through Subbasin Number 38 to Sand Creek. Catch Basins should be installed at the intersection of Jet Wing Drive and Astrozon Boulevard...

SUBBASIN # 36 (Southborough Subdivision # 5 Drainage Report)

Subbasin Number 36 contains 14.3 acres and will drain 21.6 C.F.S. westerly within the street system.

SUBBASIN # 37

Subbasin Number 37 contains 72.3 acres and will drain 78.1 C.F.S. westerly to a drainage ditch along the easterly boundary of Academy Boulevard. This surface runoff will then be conveyed through Subbasin Number 38 to Sand Creek. The drainage aspects of this subbasin are contained in the Drainage Reports on Pikes Peak Park Subdivision Number 28, Southborough Subdivisions Number 1, 2, and 5.

SUBBASIN # 38

Subbasin Number 38 contains 23.8 acres and will drain 33.0 C.F.S. westerly within a drainage ditch to Sand Creek. Catch Basins should be installed at the intersection of Astrozon Boulevard and the drainage ditch.

SUBBASIN # 39

Subbasin Number 39 contains 64.2 acres and will drain 83.4 C.F.S. southerly and northwesterly within a drainage ditch to Sand Creek. Catch basins should be installed at the intersection of Astrozon Boulevard and Hancock Road.

SAND CREEK DRAINAGE BASIN

PIKES PEAK PARK EAST

CALCULATIONS  $Q_p + \frac{(484)(A)(Q)}{T_p}$ ; A = Sq. Mi.;  $T_p = \frac{D}{2} + 0.6 T_c$ ;  $\frac{D}{2} = 0.5$ ;  $Q=1.1$

SUBBASIN	AREA (AC)	SQ.MI.	L (FT)	H(FT)	$T_c$ (HRS)	$T_p$ (HRS)	$Q_p$ (CFS)
1	18.9	.0295	900	42	.08	.55	31.2
2	13.1	.0205	1500	29	.17	.60	19.8
3	15.9	.0248	1200	24	.15	.59	24.4
4	14.8	.0231	1100	12	.18	.61	22.0
5	21.8	.0341	800	16	.10	.56	35.4
6	37.8	.0591	2200	17	.30	.68	38.1
7	14.1	.0220	1100	14	.17	.60	11.3
8	18.3	.0286	1150	22	.15	.59	10.0
9	10.3	.0161	900	16	.12	.57	14.1
10	20.6	.0322	900	18	.12	.57	14.1
11	13.2	.0206	1400	44	.14	.58	8.2
12a	10.6	.0166	700	12	.10	.56	8.2
12b	21.1	.0330	150	10	.02	.51	16.4
13	19.5	.0305	1000	8	.17	.60	32.8
14	10.9	.0170	600	12	.08	.55	20.6

57.4

43.8

21.3

28.2

16.4

18

Sand Creek Drainage Basin  
Pikes Peak Park East

Calculations (con't)

SUBBASIN	AREA (AC)	SQ. MI.	L (FT)	H (FT)	Tc (HRS)	Tp (HRS)	Qp (CFS)
15a	12.7	.0198	2300	52	.22	.63	18.3
15b	2.9	.0045	400	4	.08	.55	4.8
15c	2.3	.0036	450	6	.08	.55	3.8
15d	3.4	.0053	500	4	.10	.55	5.5
15e	3.6	.0056	400	4	.09	.55	5.9
15f	7.5	.0117	600	14	.07	.54	12.6
16	15.9	.0248	1000	16	.13	.58	24.8
17	59.7	.0933	2000	30	.24	.64	84.7
18	42.5	.0664	2600	42	.27	.66	58.4
19	32.7	.0511	1700	36	.17	.60	49.5
20*	35.0	.0547	1800	40	.19	.61	32.4
21a	111.9	.1748	2300	18	.33	.70	145.0
21b	39.0	.0609	1800	15	.27	.66	53.6
22*	52.8	.0825	2200	62	.18	.61	78.6
23	90.7	.1417	3700	54	.27	.66	124.7
24	235.3	.3677	6000	92	.50	.80	267.0
25	111.3	.1739	3100	28	.40	.74	136.5
26*	44.8	.0700	2800	30	.35	.71	58.1
27	91.3	.1427	3000	48	.30	.68	121.9

14.3

+ 59.6

\* A 19.4 C.F.S.  
 B 10.2  
 C 21.0

## Calculations (con't)

SUBBASIN	AREA (AC)	SQ.MI.	L(FT)	H(FT)	Tc (HRS)	Tp (HRS)	Qp (CFS)	
28	39.0	.0609	2400	36	.26	.66	53.6	
29	36.2	.0566	2300	44	.23	.64	51.4	
30*	32.7	.0511	1800	34	.22	.63	47.1	
31*	29.5	See Pikes Peak Park Subdivision						27.0
32*	52.8	Number 29 & Number 30 Drainage Report						54.3
33*	28.1	.0439	900	32	.09	.55	46.4	
34	35.0	.0547	1400	10	.25	.65	48.9	
35	24.1	.0377	1850	13	.27	.66	33.2	
36	14.3	.0223	1750	28	.17	.60	21.6	
37*	72.3	.1130	4000	48	.45	.77	78.1	
38	23.8	.0372	1400	28	.17	.60	33.0	
39	64.2	.1003	1700	22	.24	.64	83.4	



MAJOR CHANNELS

Sand Creek Drainageway - From Academy Boulevard Right of Way North to Airport Road and the East Fork of Sand Creek to Petersen Field.

LOCATION	LINEAR FEET	COST
1. Ditch Section A-A Sand Creek from Academy Blvd. to intersection of East Fork of Sand Creek. Earthwork Excavation	7,387 L.F. 382,932 Cu.Yds.	\$310254 268818
2. Ditch Section B-B East Fork of Sand Creek to Petersen Field Earthwork Excavation	7,321 L.F. 146,284 Cu.Yds.	\$307482 102692
3. Ditch Section C-C Sand Creek from the intersection of the East Fork of Sand north to Airport Road. Earthwork Excavation	3,368 L.F. 89,189 Cu.Yds.	\$141456 62611
4. Ditch Section D-D North from East Fork of Sand Creek to Airport Road on the East side of M.H.P. Earthwork Excavation	975 L.F. 9,000 Cu.Yds	\$39000 6318
5. Ditch Section E-E Northeasterly from Hancock Road to Academy Boulevard Earthwork Excavation	3333 L.F. 128350 Cu.Yds	139986 90182
6. 23 Drop Structures	@ \$12,253 ea	= 281808
7. 7 Concrete Lined Ditch Section (Heavy scour section)	200 L.F.	51400
COST TOTAL CONSTRUCTION		\$1,831,875

BRIDGES OR CULVERTS

1.	Airport Road - Bridge at the intersection of Sand Creek - Type III Arterial Street - One-Half obligation (\$172,516)	\$86,258
2.	Airport Road - Culvert at the intersection of the 75' Drainageway - Type III Arterial Street - One-half obligation (\$30,316)	\$15,158
3.	Airport Road - Bridge at the intersection of the east fork Sand Creek - Type III Arterial Street - One-Half obligation (\$131,580)	\$65,790
4.	Powers Boulevard - Culvert at the intersection of East Fork of Sand Creek - Type I Arterial Street - \$77,380.00	\$77,380
5.	Fountain Boulevard - Bridge at the intersection of Sand Creek - Type I Arterial Street - \$260,780.00	\$260,780
6.	Chelton Road - Bridge at the intersection of Sand Creek - Standard Minor Arterial Street, 80' R.O.W.	\$140,420
7.	Academy Boulevard - at the intersection of Sand Creek	State of Colorado
8.	Hancock Road - Bridge at the intersection of Sand Creek - Type III Arterial Street	\$172,516
		<hr/>
		\$ 818,302

SAND CREEK DRAINAGE BASIN (TYPICAL DETAIL: PAGE 27)

DRAINAGE DITCHES

SUBBASIN ZONE	C.F.S	B.	H.	W.	ROW	SLOPE	LENGTH	COST
1	31.2	2'0"	1'0"	6'0"		2:1	350'	\$ 3912 *
2	19.8	2'0"	1'0"	5'0"		1½:1	110'	1400 *
3	24.4	2'0"	1'0"	8'0"		3:1	150'	1762 *
4 & 5	57.4	2'0"	1'0"	8'0"		3:1	500'	3540
6a.	38.1	3'0"	1'6"	7'6"		1½:1	85'	765
b.	6.7	CONSTRUCT SWALE SEE NOTE						----
7a.	11.3	"	"	"	"			----
b.	10.0	"	"	"	"			----
8a.	14.1	"	"	"	"			----
b.	14.1	"	"	"	"			----
9a.	8.2	"	"	"	"			----
b.	8.2	"	"	"	"			----
10	32.8	"	"	"	"			----
11	20.6	2'0"	1'0"	5'0"		1½:1	200'	\$ 1264

\* Costs includes the price of Drop Inlets and/or Catch Basins

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SUBBASIN ZONE	C.F.S	B.	H.	W.	ROW	SLOPE	LENGTH	COST	
** 12a.	17.2	2'0"	1'0"	5'0"		1½:1	700'	\$ 3792	
b.	CONSTRUCT SWALES AT 3 DISCHARGE POINTS								
13a.	15.5	CONSTRUCT SWALE - SEE NOTE							
b.	14.0	"	"	"	"			-----	
14.	18.0	2'0"	1'0"	5'0"		1½:1	700'	3792	
15a.	18.3	2'0"	1'0"	6'0"		2:1	100'	5040	
b.	4.8	CONSTRUCT SWALE - SEE NOTE							
c.	3.8	"	"	"	"			-----	
d.	5.5	"	"	"	"			-----	
e.	5.9	"	"	"	"			-----	
f.	12.6	"	"	"	"			-----	
16	24.8								
17	84.7	3'0"	2'0"	15'0"		3:1	1100'	18477	
** 18	143.1	4'0"	3'0"	13'0"		1½:1	2800'	50440 *	
19	49.5	3'0"	1'6"	7'6"		1½:1	950'	\$ 9250	

\*\* Drainage Structures as specified in Sand Creek Drainage Study, May 1968.

SUBBASIN ZONE	C.F.S	B.	H.	W.	ROW	SLOPE	LENGTH	COST	
20	32.4		1'0"	14'0"			500'		
21a.	145.0	PIKES PEAK PANORAMA FILING NUMBER 2						\$ 58739	
b.	53.6	"	"	"	"	"			
22	78.6	3'0"	1'6"	12'0"		3:1	2000'	35760	
23	124.7	3'0"	2'0"	15'0"		3:1	1700'	29779	
** 24a.	267.0	4'0"	3'0"	16'0"		2:1	1400'	21000*	
b.	134.6	3'0"	2'0"	15'0"		3:1	1200'	48980*	
c.	48.9	3'0"	1'6"	7'6"		1½:1	1200'	11500*	
** 25	136.5	4'0"	3'0"	13'0"		1½:1	3000'	47800*	
26a.	19.4						400'		
b.	10.2	CONSTRUCT SWALE - SEE NOTE							
** c.	31.2						400'	7400*	
27	121.9	3'0"	2'0"	11'0"		2:1	1800'	26412*	
28	53.6	STORM SEWER SYSTEM						1000'	\$ 32100*

\* Costs includes the price of Drop Inlets and/or Catch Basins

\*\* Drainage Structures as specified in Sand Creek Drainage Study, May 1968.

SUBBASIN ZONE	C.F.S.	B.	H.	W.	ROW	SLOPE	LENGTH	COST
29a.	51.4							
b.	98.5	3'0"	2'0"	15'0"		3:1	1700	\$ 27600*
30	47.1	SURFACE FLOW IN STREETS @ 2% GRADE						
31	27.0	"	"	"	"	"	1.4% GRADE	
** 32a.	59.4	R.C.P. PIPE = 1980 L.F.						
** 32b.	54.3 113.7	P.P.P. #29 Drainage Plan						
		3'0"	2'0"	11'0"	20'	2:1	1000'	28501 12500
** 33.	46.4 160.1	3'0"	2'0"	15'0"		3:1	650	18531*
** 34	48.9 209.0	4'0"	3'0"	13'0"		1½:1	620'	12090*
35	33.2 54.8	R.C.P. PIPE 500 L.F. = W/2 DROP INLETS						
								7400
36	21.6	STREET @ 1.6% GRADE						
** 37	132.9	3'0"	2'0"	11'0"		2:1	1100'	17730 ***
38	165.9	4'0"	3'0"	13'0"		1½:1	1400'	22400*
39	83.4	STORM SEWER SYSTEM						
							2300'	35450*

\* Costs includes the price of Drop Inlets and/or Catch Basins

TOTAL \$ 609,018

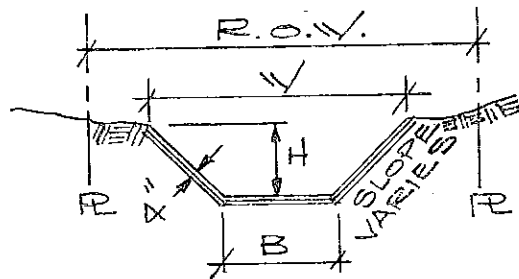
\*\* Drainage Structures as specified in Sand Creek Drainage Study, May, 1968.

\*\*\* Cost includes cost of Box Culvert

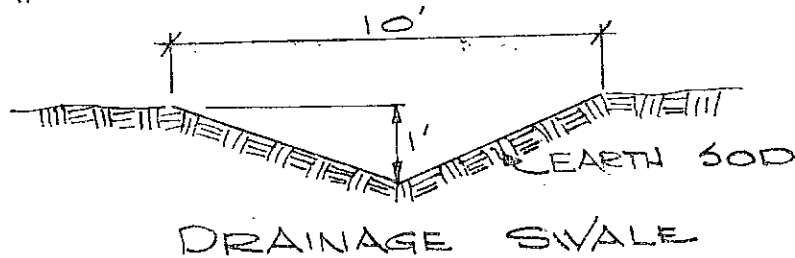
COST OF DRAINAGE STRUCTURES AS SPECIFIED IN SAND CREEK DRAINAGE STUDY DATED MAY 1968...\$168,192.00

SAND CREEK DRAINAGE BASIN  
TYPICAL DRAINAGE DITCHES

TYPICAL DITCH SECTIONS

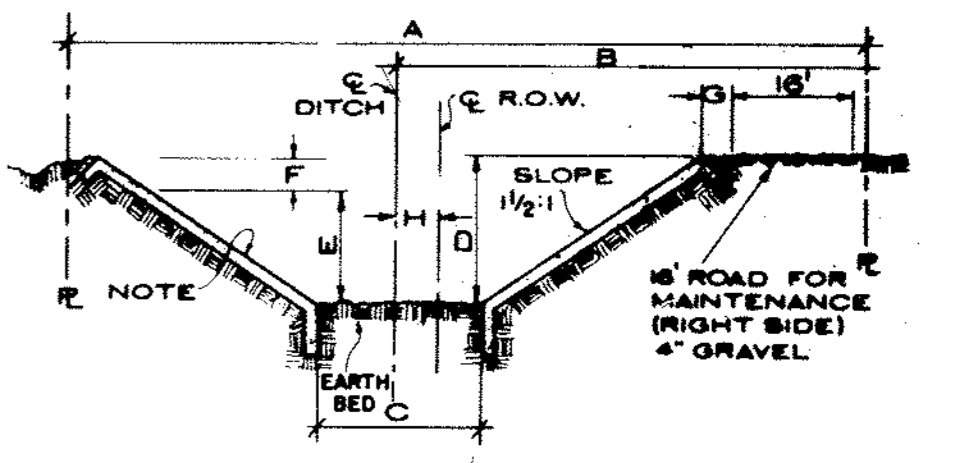
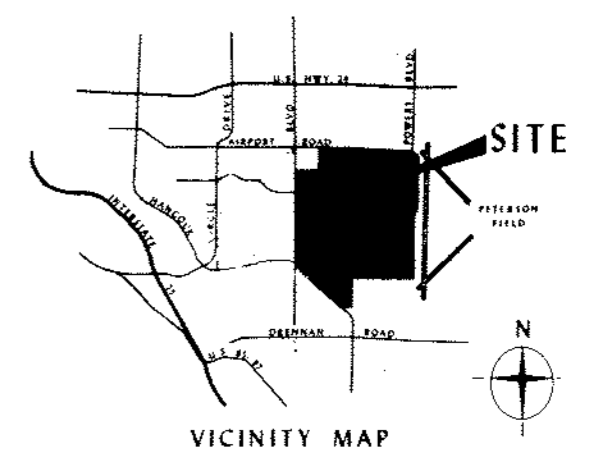
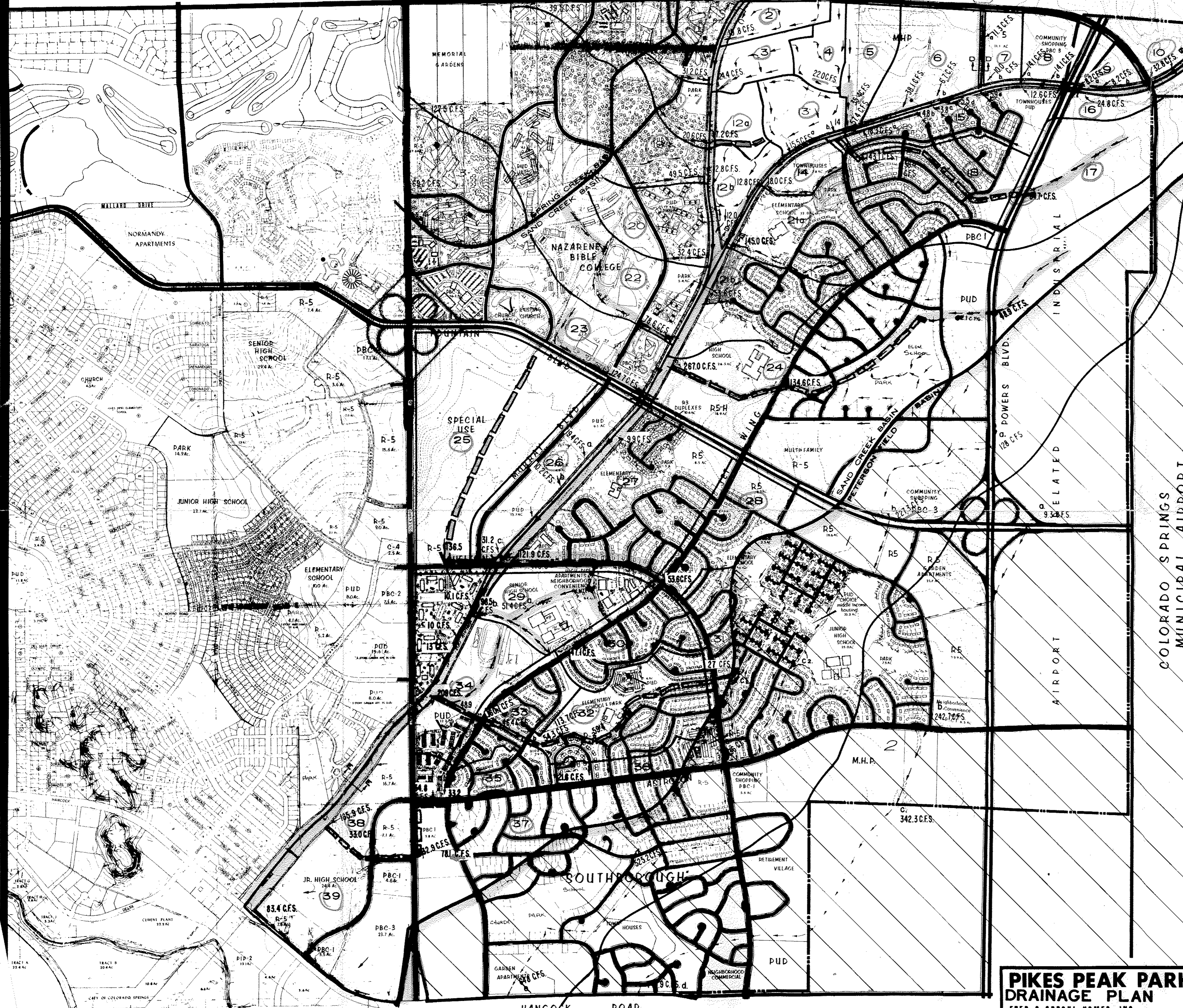


TRAPEZOIDAL DRAINAGE DITCH



AIRPORT ROAD

DUPLICES - R-5 12.5 AC



SAND CREEK DITCH SECTIONS  
NO SCALE

DITCH SECTION	A	B	C	D	E	F	G	H
A-A	200'	112'	155'	6'	4.5'	1.5'	8'	12'
B-B	125'	65.75'	70'	6.5'	4.5'	2'	5'	3.25'
C-C	140'	80'	97'	8.5'	4.5'	2'	5'	10'
D-D	75'	40.50'	44'	5'	3'	2'	-	8'
E-E	250'	125'	155'	6'	5'	1'	5'	-

NOTE: CONCRETE, ASPHALT, RIPRAP OR SUITABLE APPROVED MATERIAL.  
\* SECTION E-E ALSO HAS 220' R.O.W.

- LEGEND**
- BASIN BOUNDARY
  - SUBBASIN BOUNDARY
  - MAJOR DRAINAGE CHANNEL
  - MINOR DRAINAGE CHANNEL
  - DIRECTION OF FLOW AND/OR SWALE
  - NUMBER OF SUBBASIN
  - 71.5 C.F.S. CUBIC FEET OF WATER PER SECOND
  - DRAINAGE DITCHES AS REQUIRED IN SAND CREEK DRAINAGE STUDY
  - SPRING CREEK BASIN  
Scale in feet
  - PETERSON FIELD BASIN

**PIKES PEAK PARK / EAST DRAINAGE PLAN**  
 FRED C. SPROUL HOMES, INC.  
 P.O. BOX 5038 COLORADO SPRINGS, COLORADO