4525 Northpark Drive
Colorado Springs, Colorado
December 5, 1970

Mr. Deke Miller
Director of Public Works
Box 1575
Colorado Springs, Colo. 80907

Dear Deke:

This letter is included with the submittal of the Drainage Study of the proposed CHANDELLE Development located adjacent to the south boundary of Peterson Field. The purpose of the letter is to include information which has been developed since the report was first prepared.

The Drainage Board at their meeting of November 12, 1970, reviewed the report and approved that portion of the plan in the Jimmy Camp Basin and set the fees at that for an unstudied basin or the construction of all facilities, whichever amount is greater.

The Drainage Board approved that portion in the Peterson Field Basin with the stipulation that the city be responsible for all drainage facilities. My report shows the estimated cost of these major facilities to be $372,000. The minor structures will probably bring the overall cost up to about $400,000, which would bring the drainage cost of the Peterson Field Basin land to about $1000 per acre.

The Drainage Board withheld decision in the Windmill Gulch drainage area pending further study of retention reservoirs downstream, with the possibility of using city-owned property off of the end of Runway 1735.

It is my understanding from our recent conversations that you hope to have a complete study made on Windmill Gulch in 1971, and until that report is complete, no changes would be made in handling the water from that shown in my report.

Using the present design, the cost for the major drainage facilities in the Windmill Gulch Basin would be $145,000 or about $160 per acre. If the overall basin study for Windmill Gulch determines that the two proposed detention reservoirs in this report can be deleted, the cost per acre will be significantly increased due to the larger outfall facilities required.

If you have any questions on this report, I would be happy to discuss them with you.

Sincerely,

G. J. Weiss, P. E. 4124

1815 North Tejon
Colorado Springs, Colorado
November 12, 1970

Mr. Dewitt Miller
Director of Public Works
Box 1575
Colorado Springs, Colorado

Dear Deke:

Enclosed herewith is a Drainage Study of the proposed CHANDELLE Industrial Airpark and Residential Development located adjacent to the south boundary of Peterson Field.

The report includes a study of the runoff generated, the method of routing the flow, the sizing of channels and structures and a cost estimate for the facilities.

I am available to answer any questions you may have on this report.

Sincerely,

G. J. Weiss
Professional Engineer No. 4124

CHANDELLE DRAINAGE STUDY

SCOPE & PURPOSE

It is the intent of this report to furnish the basis for a master drainage plan for the proposed CHANDELLE development. The study is intended to provide an overall determination of the drainage generated in the area and the general method of routing the flow. It is not intended to give the detailed information which will need to be determined as the individual subdivisions are platted.

BASIN DESCRIPTION

The area studied lies south of the existing Peterson Field and is bounded on the west by the extension of the north-south runway, is bounded on the south by Drennan Road and lies westerly of the extension of Marksheffal Road.

The studied area contains about 1450 acres with 385 acres draining into the Peterson Field Drainage Basin, 160 acres draining into Jimmy Camp Creek Basin and the remaining 905 acres into Windmill Gulch Basin. The latter basin contains a number of natural low areas which traps the drainage into retention reservoirs, some being as much as 12 feet deep. In the undeveloped state, this accumulation of water has drained very rapidly into the sandy soil. If these low areas were designed to drain out the lowest area surrounding them, they would drain to the southwest into the drainage ditch referred to as Windmill Gulch, which flows through the east boundary of Security, Colorado.

The area has a rolling topography with some relatively flat areas adjacent to the northeast - southwest runway for Peterson Field. This latter area also is the main channel for the drainage generated in the Peterson Field Basin.

Most of the soil in this area is a silty sand. Clay lenses exist in scattered locations throughout the area which retards infiltration. Although the natural retention reservoirs have drained very rapidly in the past, this method of disposing of the runoff water cannot be depended on in the future when the land is fully developed.

RAINFALL PATTERNS

Average annual rainfall in this area is low, being about 14 inches per year. The major portion of this rainfall is in May, June, July and August from both mountain and plains type storms.

The one hour, two inch, fifty year frequency storm was used as the design storm.

RUNOFF PATTERNS

The synthetic hydrograph method as developed by the Soil Conservation Service and modified by the Bureau of Reclamation was used to determine the flow in this study. Approximately 2300 acres of the Peterson Field Drainage Basin flows into Basin J-1 of this study. Using the runoff factors in this 2300 acre area for the existing and proposed development, a flow of 2,250 c.f.s. is calculated to enter this point in a one hour storm.

Basin J in this report is that area which is a part of the Peterson Field Drainage Basin and is subdivided into five sub-basins.

Sometime in the past years, a canal was constructed at the upstream end of Basin J-1 which would divert the inflow into Basin A-1. Since this would create legal problems by diverting water from one drainage basin into another, this study will assume that the canal will be removed as the land is developed.

Basin K flows into Jimmy Camp Creek and was studied as only one area since it effects only a minor part of this report.

Basin A has a natural low area which should be filled as it is developed. It will then flow into Basin B, which has a very extensive natural retention reservoir. Basin B would flow into Basin C if it were to overflow.

Basin C flows south across Drennan Road into Basin D, which is not a part of the CHANDELLE Development. However, since Basin D in its undeveloped state flows back into Basin F, it was felt that it should be considered in the study.

Basin E also has a natural retention reservoir which would be difficult to fill. It would outfall into Basin F if it were to overflow.

Basin F is another natural retention reservoir which would receive the water from Basins A, B, C, D and E if they were to overflow. The lowest saddle surrounding Basin F is to the southwest and this would drain into Windmill Gulch.

Basins G, H and I will drain directly into Windmill Gulch, although Basin I will need a small amount of fill as it is developed to provide adequate drainage.

RECOMMENDATIONS

This report will recommend that Basin A be designed to drain into Basin B. This can be accomplished by either filling the low area, cutting the outlet lower, or a combination of both. Basin A is primarily U. S. A. F. Lease Property and not a part of the proposed CHANDELLE Development.

Basin B contains the largest and deepest natural retention reservoir. It is recommended that the developer leave 6.8 acres of space in the proposed Park and School development for a Detention Reservoir with 37 acre-feet of storage space. A 48 inch outfall storm sewer is designed to be used in conjunction with the storage reservoir to reduce the peak flow into Windmill Gulch.

The drainage from Basins C and D will flow directly to Basin F. A concrete ditch is designed to pick up the 48 inch outfall line from Basin B and will also pick up the flow generated from Basins C and D.

Basin E contains a natural retention reservoir. This report recommends that a Detention Reservoir of 3.2 acres of land be left in the proposed park area. A 24 inch outfall storm sewer system draining into area F will reduce the peak flow going to Windmill Gulch.

The drainage generated in Basin F will flow to the existing natural retention reservoir. It does not appear feasible to maintain a detention reservoir in this basin and this report will recommend that the low area be filled and the saddle to the southwest be cut sufficiently to permit this basin and the outfall from Basins A, B, C, D and E to flow directly out of the basin by means of a concrete ditch.

Approximately 1200 c.f.s. of flow is generated in Basins A, B, C, D, E and F, but the detention reservoirs will reduce the peak flow going into Windmill Gulch at this point to 450 c.f.s.

The drainage from Basins G, H and I can be handled by the street systems and they outfall directly into the Windmill Gulch Basin. Basin I will require some cutting and filling to get rid of the small natural depression.

Basin K flows into Jimmy Camp Creek Basin and the small portion that is part of this development can be handled by the street system.

Basin J will require a large channel to handle the 2250 c.f.s. of flow generated upstream from this area as well as that generated within the basin.

A channel 125 feet wide by 3 feet deep with a grassed bottom and riprapped sides would handle the flow on the one percent grade. A 5' x 25' concrete ditch could also be used and this report will recommend its use. The grassed ditch would require a 150 foot wide right of way while the concrete ditch will require only 50 feet. The concrete ditch will require less maintenance and the runway structures can be considerably smaller. In comparing costs for the two methods, the grassed ditch method is cheaper, but if the land saved by using the concrete ditch has a value of $5000.00 per acre or more, the two methods will cost about the same.

Basin J will also require construction of box culverts under two runways and two taxi crossings into the Industrial Area.

CONCLUSIONS

This report is intended to serve as a Master Preliminary Drainage Plan for the proposed CHANDELLE Development.

It should be used as a general guide for design of the individual subdivisions within the area. The cost estimates cover the major drainage facilities only and miscellaneous smaller facilities may be required in some areas depending upon the final design of the development.

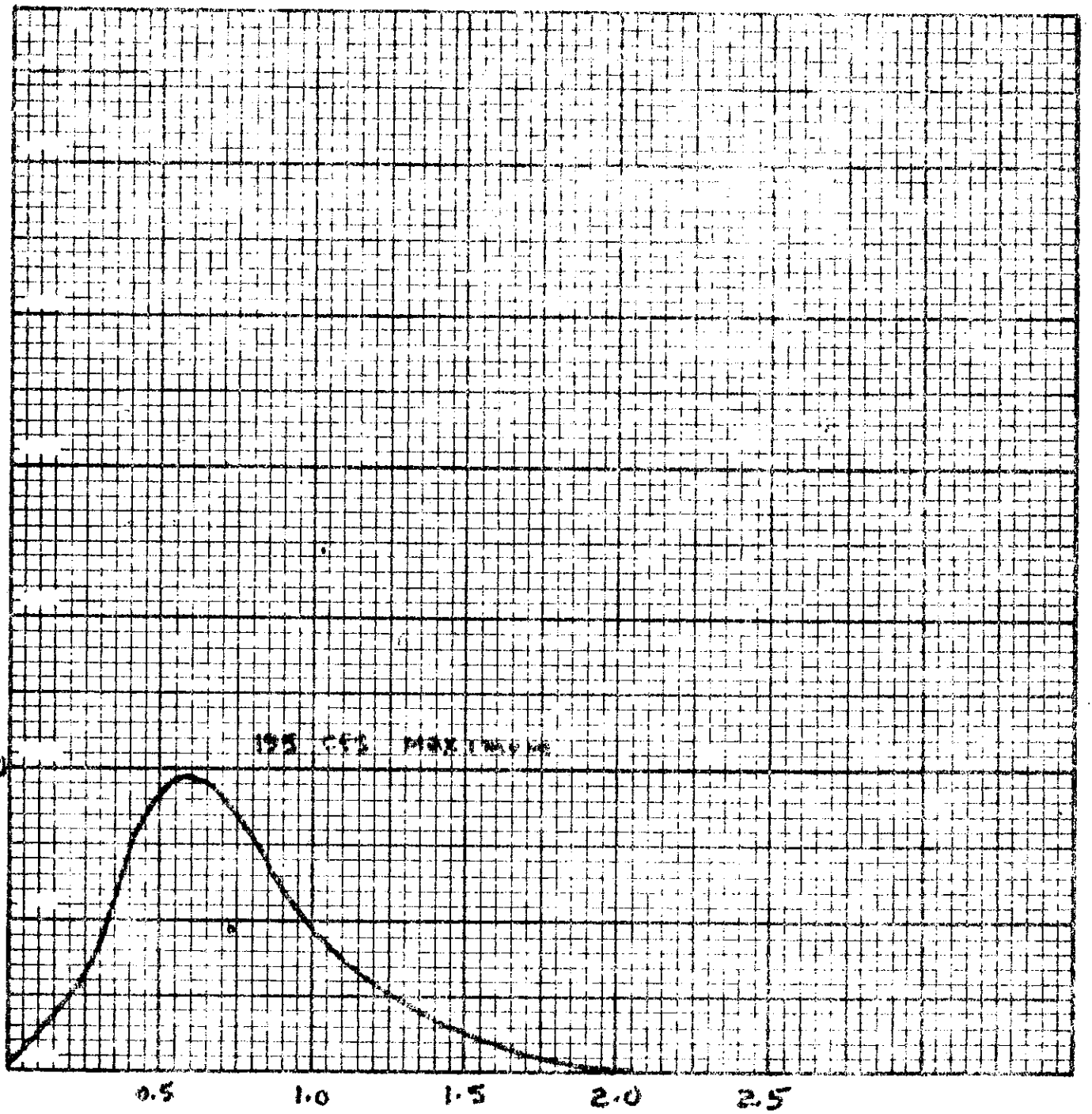
DESIGN CALCULATIONS

$$Qp = \frac{484\ AQ}{Tp} \qquad Tp = \frac{D}{2} + 0.6\ Tc$$

BASIN	AREA (acre)	A (sq. mi.)	L (ft.)	H (ft.)	Tc (hrs.)	Tp (hrs.)	Q (ins.)	Qp (cfs.)
A-1	80.9	0.126	2000	60	0.16	.596	1.2	123
A-2	47.3	0.073	1500	40	0.15	.590	1.2	72
B-1	83.4	0.130	2500	70	0.21	.626	1.2	121
B-2	30.5	0.048	2200	55	0.20	.620	1.2	44
B-3	82.0	0.128	2500	44	0.25	.650	1.2	114
B-4	17.5	0.027	1700	32	0.18	.608	1.2	26
B-5	26.4	0.041	1000	22	0.12	.572	1.0	35
B-6	63.0	0.098	2600	80	0.22	.632	1.3	98
C-1	49.1	0.076	1500	38	0.15	.590	1.2	75
D-1	48.2	0.075	2500	26	0.30	.680	1.2	64
D-2	46.5	0.072	1300	20	0.18	.608	1.2	69
E-1	26.6	0.041	2000	80	0.16	.596	1.2	40
E-2	32.7	0.051	1800	26	0.22	.632	1.0	39
E-3	30.9	0.048	2000	32	0.22	.632	1.3	48
E-4	20.6	0.032	2400	40	0.25	.650	1.2	33
F-1	24.1	0.037	2000	60	0.17	.602	1.3	39
F-2	31.3	0.048	1800	54	0.17	.602	1.3	50
F-3	19.4	0.030	1200	54	0.09	.554	1.2	31
F-4	13.4	0.020	800	16	0.10	.560	1.3	22
F-5	40.9	0.063	1600	54	0.13	.578	1.3	69
G-1	70.6	0.110	2600	44	0.26	.656	1.3	105
H-1	13.5	0.021	400	16	0.05	.530	1.1	21
I-1	52.1	0.081	1300	20	0.18	.608	1.3	84
J-1	93.2	0.145	1500	54	0.12	.572	1.8	220
J-2	131.0	0.204	3600	70	0.32	.692	1.8	256
J-3	65.3	0.102	3400	70	0.30	.680	1.8	130
J-4	61.6	0.096	2800	54	0.26	.656	1.8	128
J-5	31.9	0.049	1400	40	0.15	.590	1.8	57
K-1	159.4	0.249	3200	50	0.32	.692	1.3	226

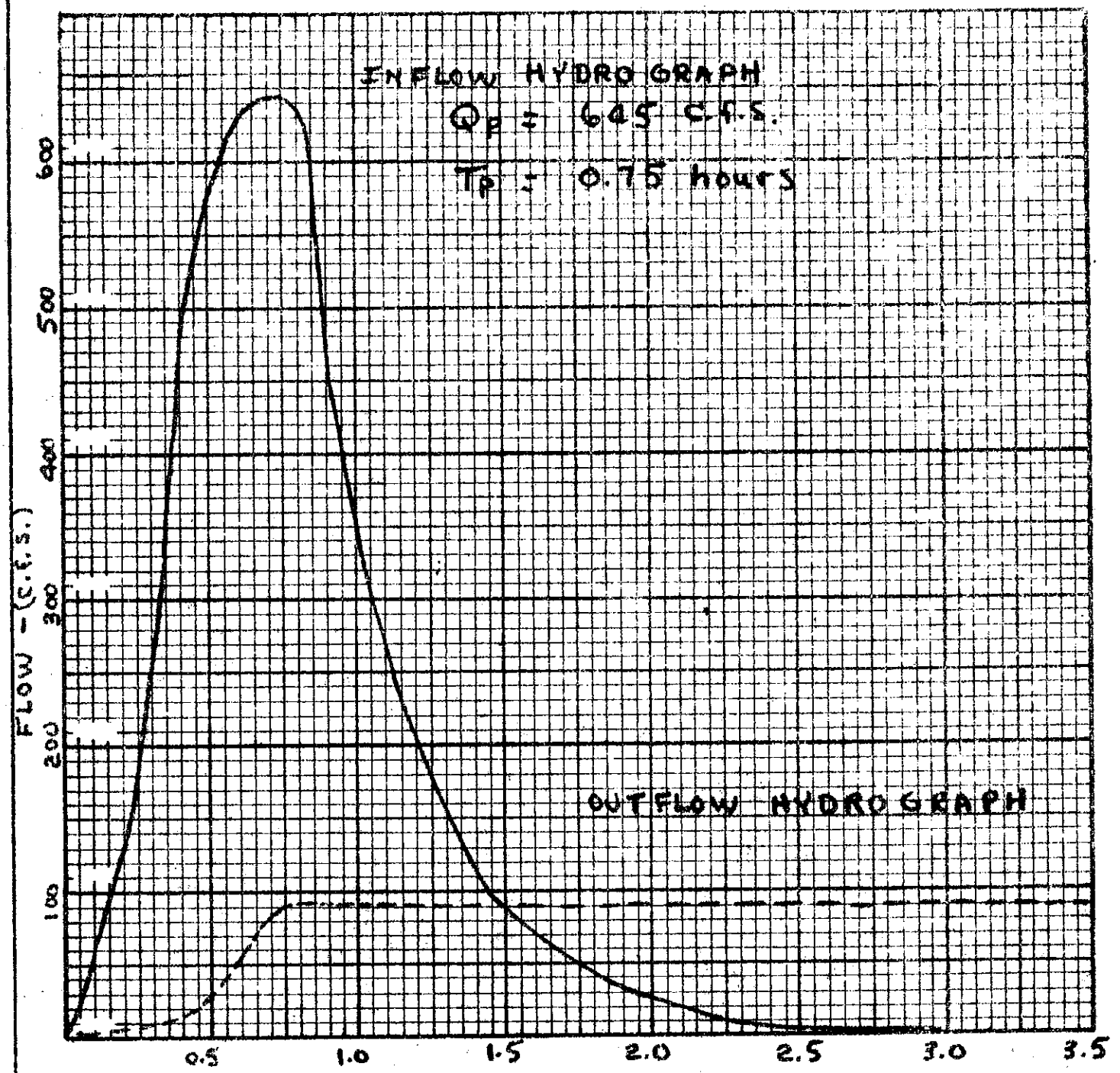
MAJOR STRUCTURES

LOCATION	LENGTH	STRUCTURE	COST
A to IV	2000'	2' x 4' Conc. Ditch	$16,000.
IV to III	3000'	48" R. C. P.	75,000.
III to II	1700'	3' x 5' Conc. Ditch	18,700.
II to I	1200'	4' x 6' Conc. Ditch	16,800.
V to F	900'	24" R. C. P.	10,800.
F to II	700'	3' x 5' Conc. Ditch	7,700.
VI to VII	7400'	5' x 25' Conc. Ditch	222,000.
VI to VII	500'	Triple 5' x 10' box culvert	150,000.
			$372,000.



COMBINED A

UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO



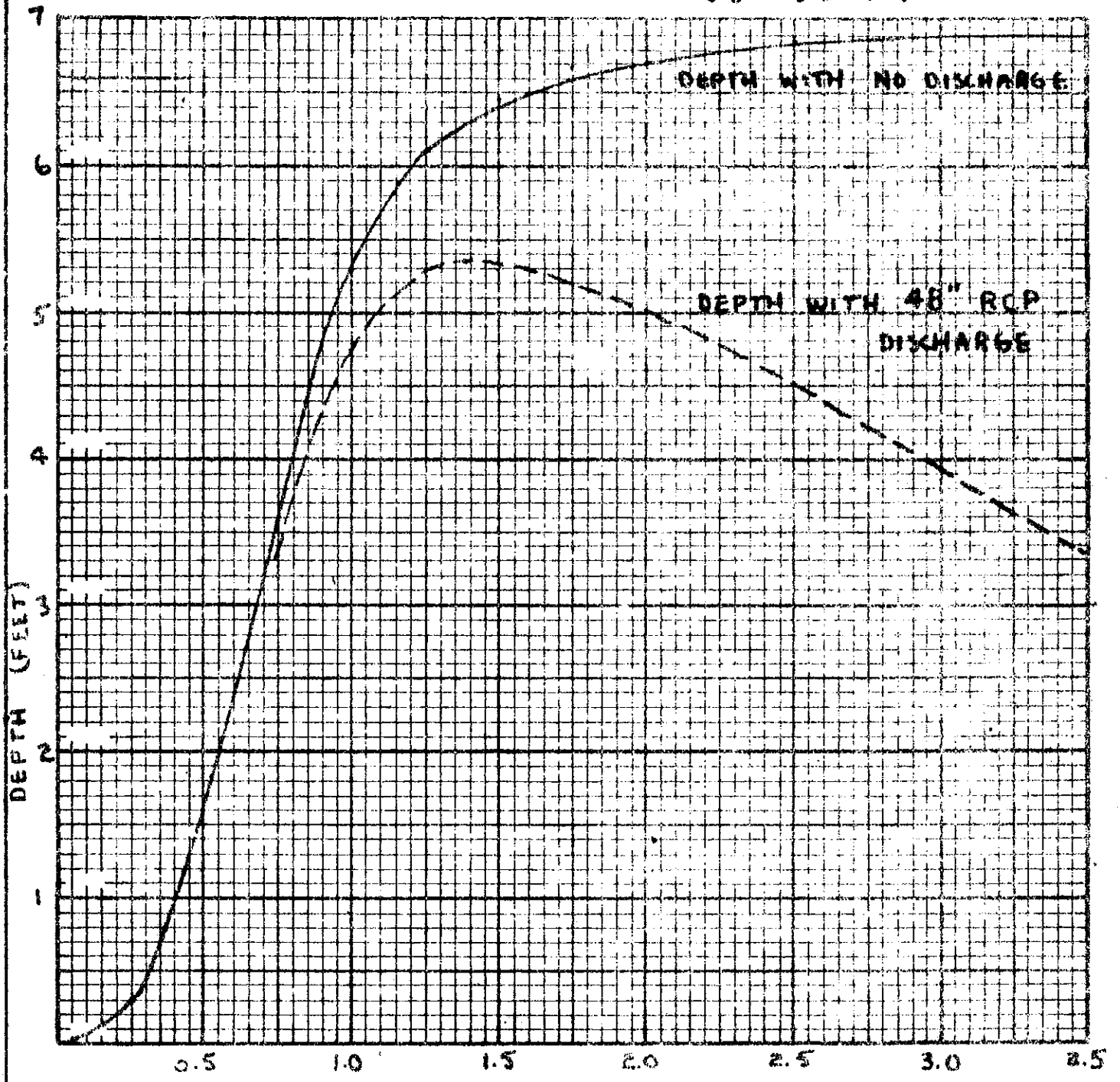
COMBINED A & B

AREA = 43.7 ACRE-FEET

POINT IV	UNITED WESTERN ENGINEERS COLORADO SPRINGS, COLORADO

6.8 ACRES OF LAND REQUIRED 1:4 SIDE SLOPE

6.0' DEPTH

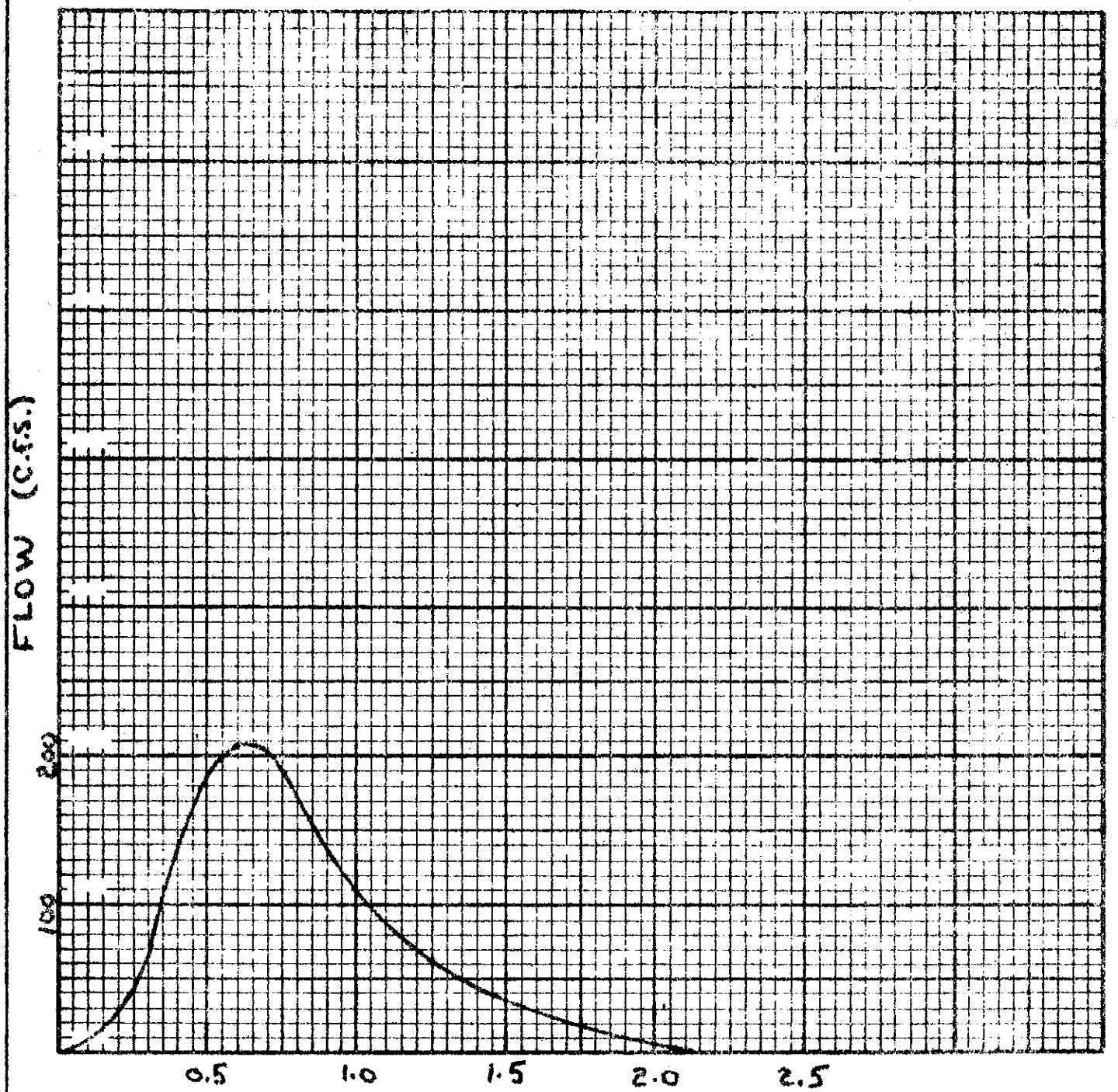


48" RCP @ 0.5 % 3000' LENGTH

0.5 hr.	Q = 24 cfs	V = 6.2 FPS
0.6 hr	Q = 56 cfs	V = 7.1 FPS
0.75 hr	Q = 90 cfs	V = 7.1 FPS
1.0 hr	Q = 90 cfs	V = 7.1 FPS
3.5 hr	Q = 90 cfs	V = 7.1 FPS

RESERVOIR B

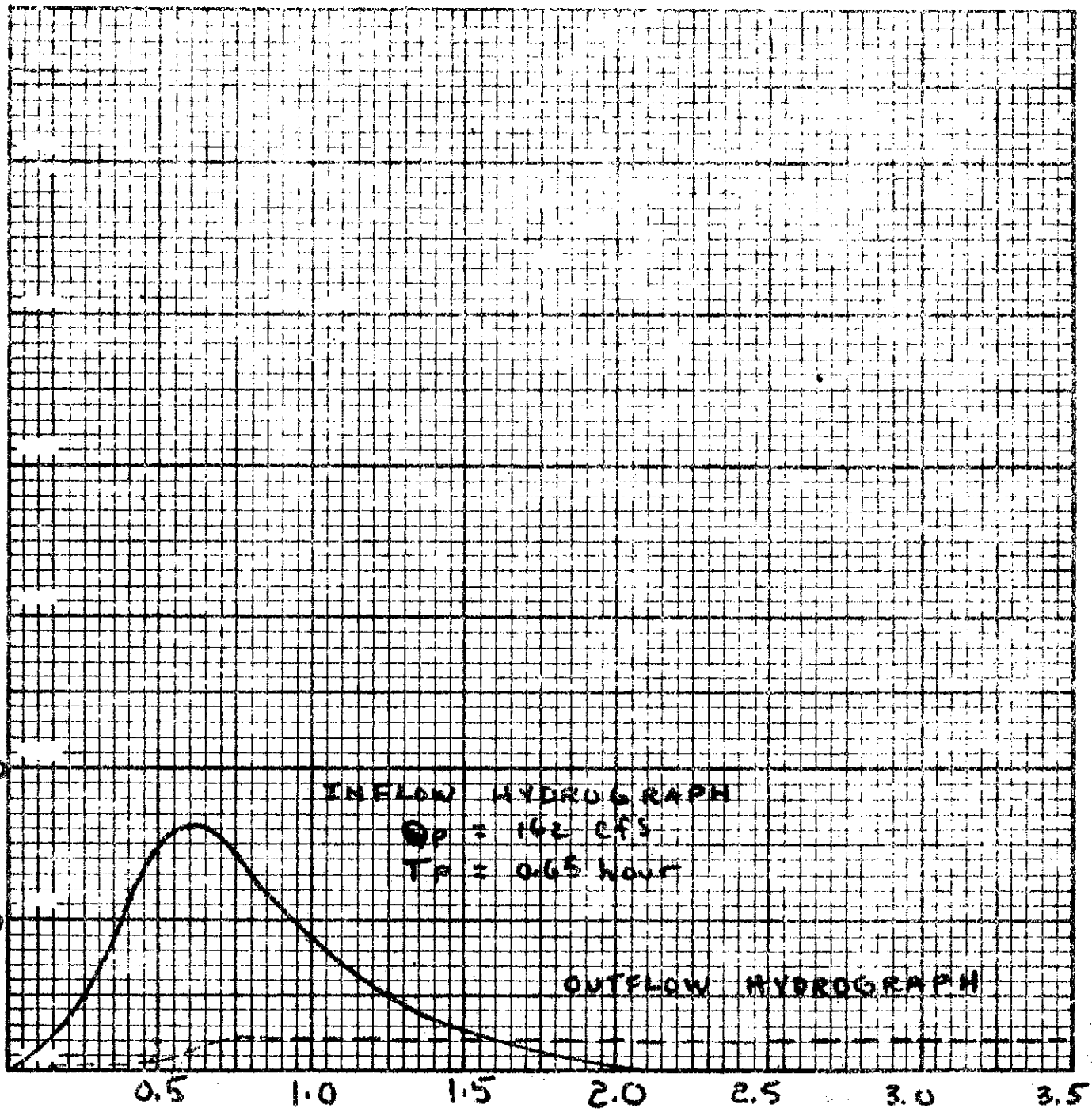
UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO



TIME - HOURS

COMBINED C & D

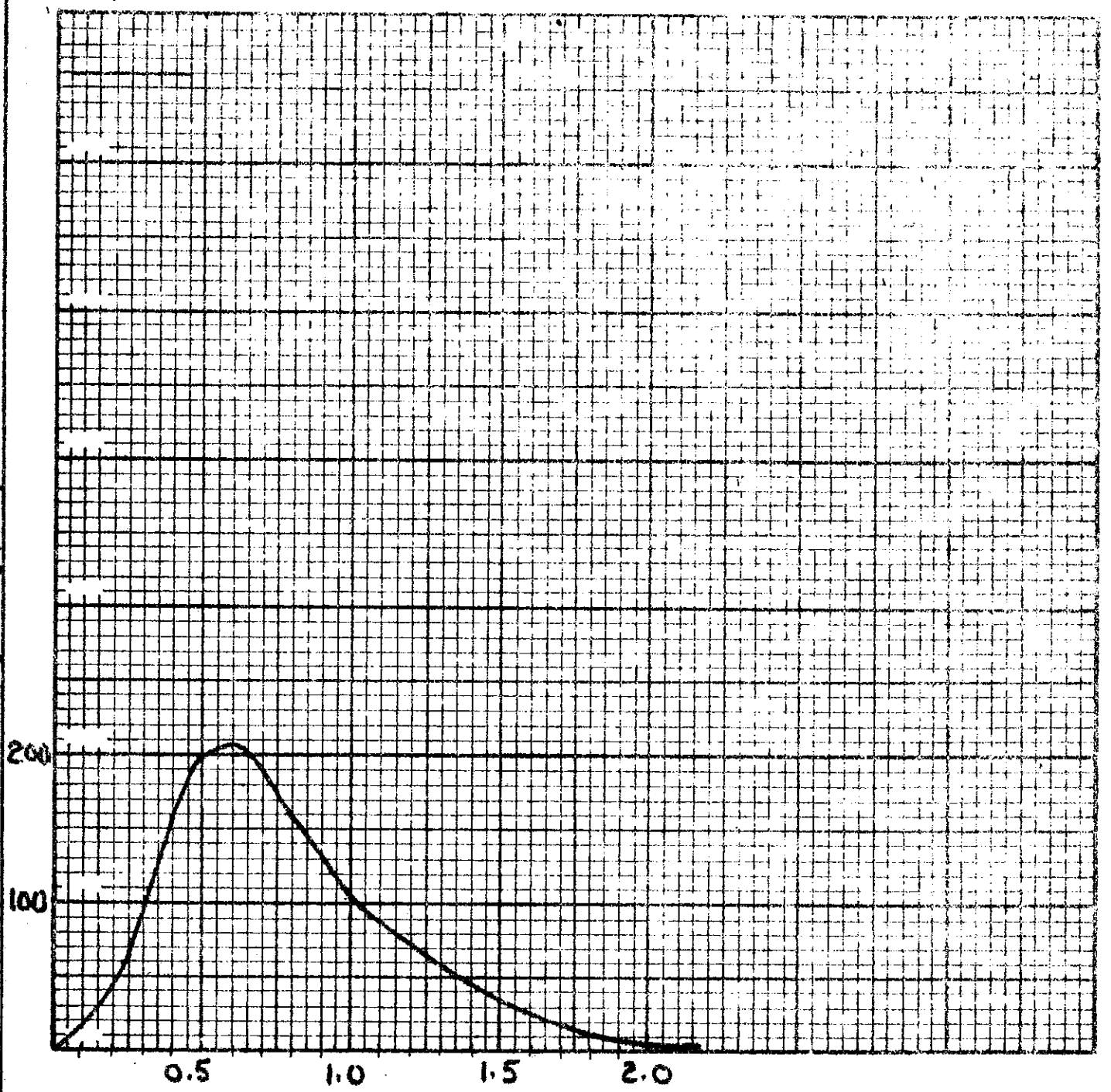
UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO



COMBINED E

AREA = 10.7 ACRE-FEET

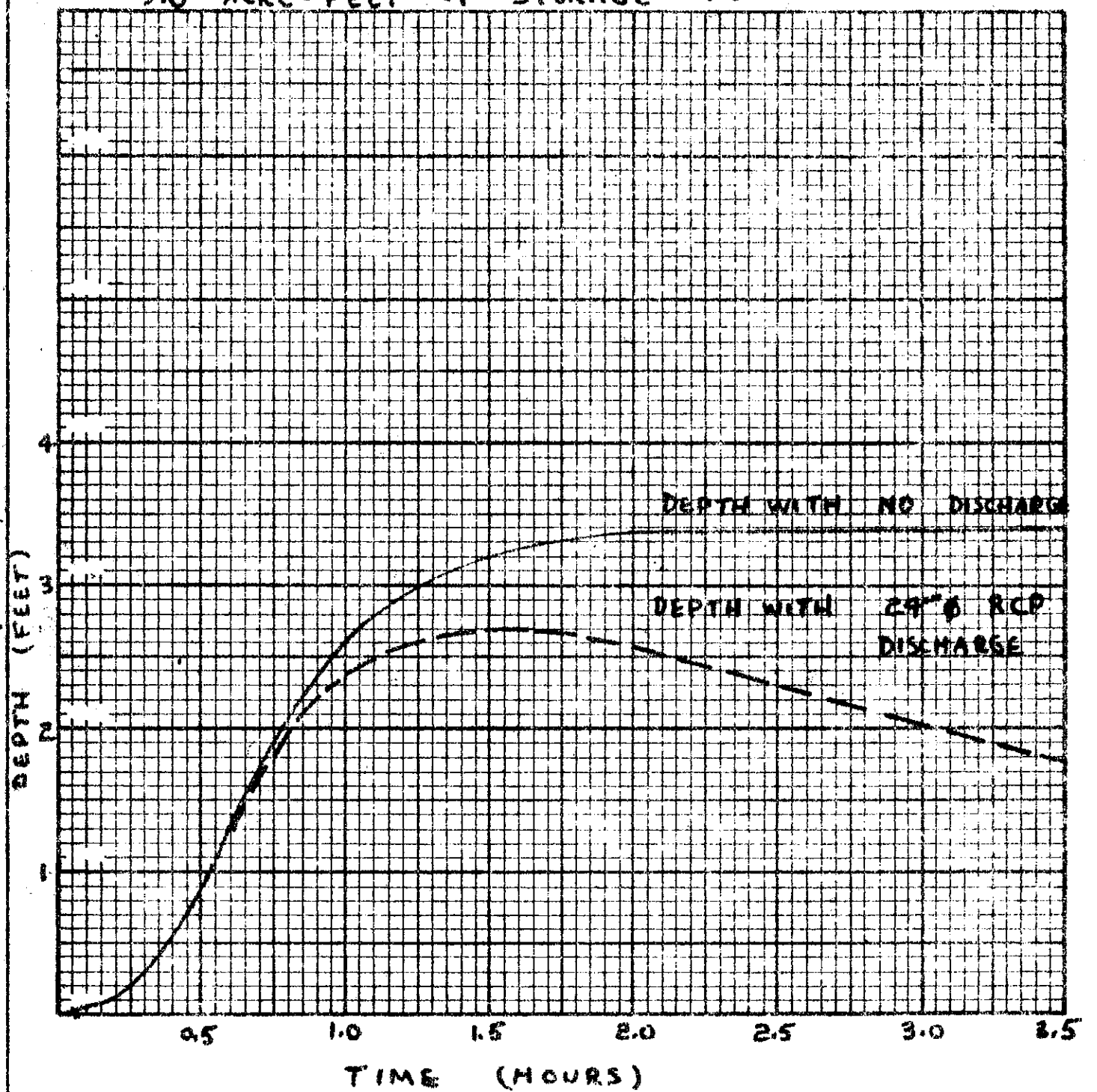
UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO



COMBINED F

UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO

3.2 ACRES OF LAND REQD. 1:4 SIDE SLOPE
9.0 ACRE-FEET OF STORAGE 3.0' DEPTH

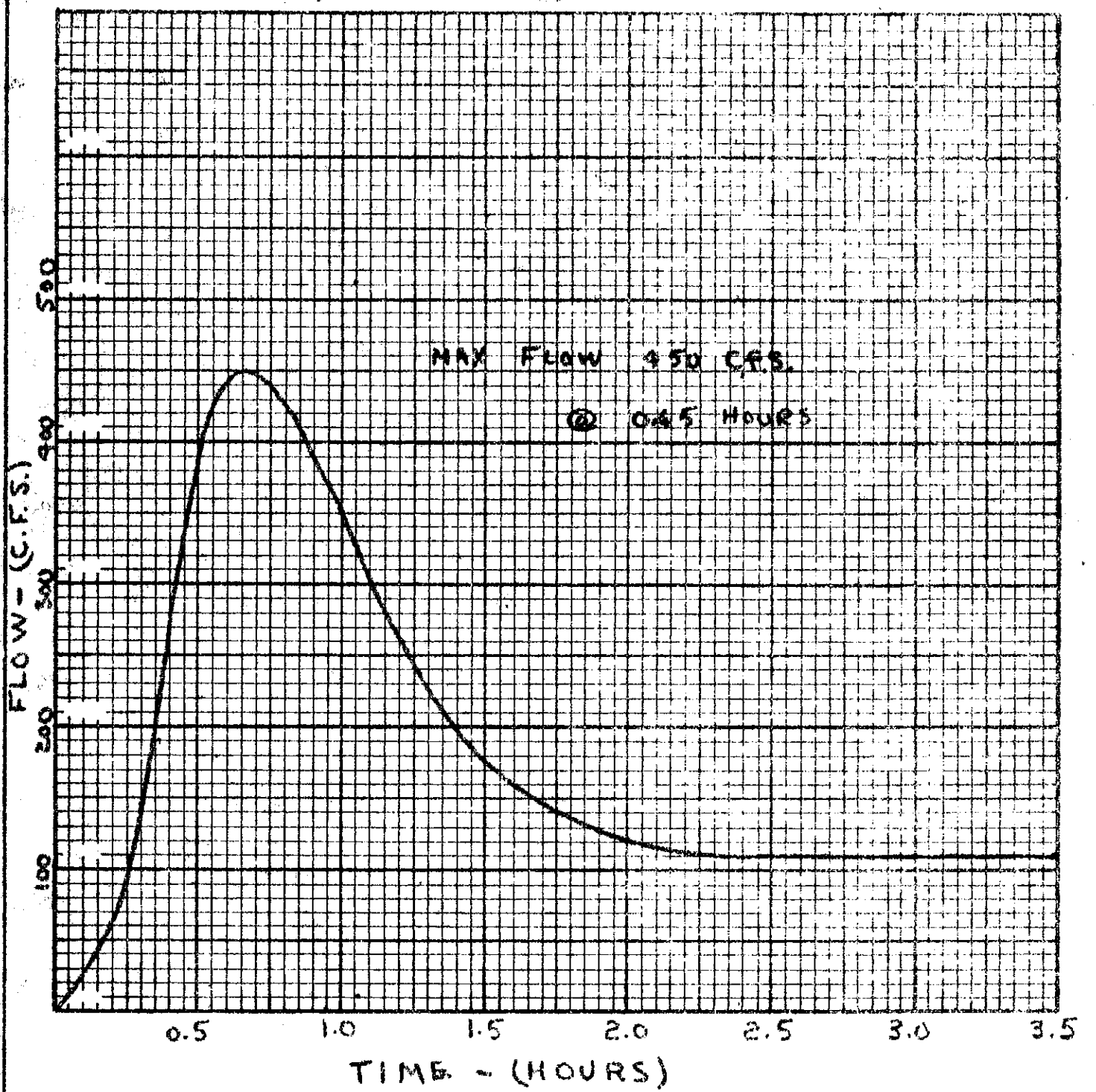


24" RCP @ 1.0 % 900' LENGTH

0.5 hr.	7 cfs	V = 6.0
0.6 hr.	15 cfs	V = 6.2
0.75 hr.	20 cfs	V = 6.2 fps
1.0 hr.	20 cfs	
3.5 hr.	20 cfs	

RESERVOIR E

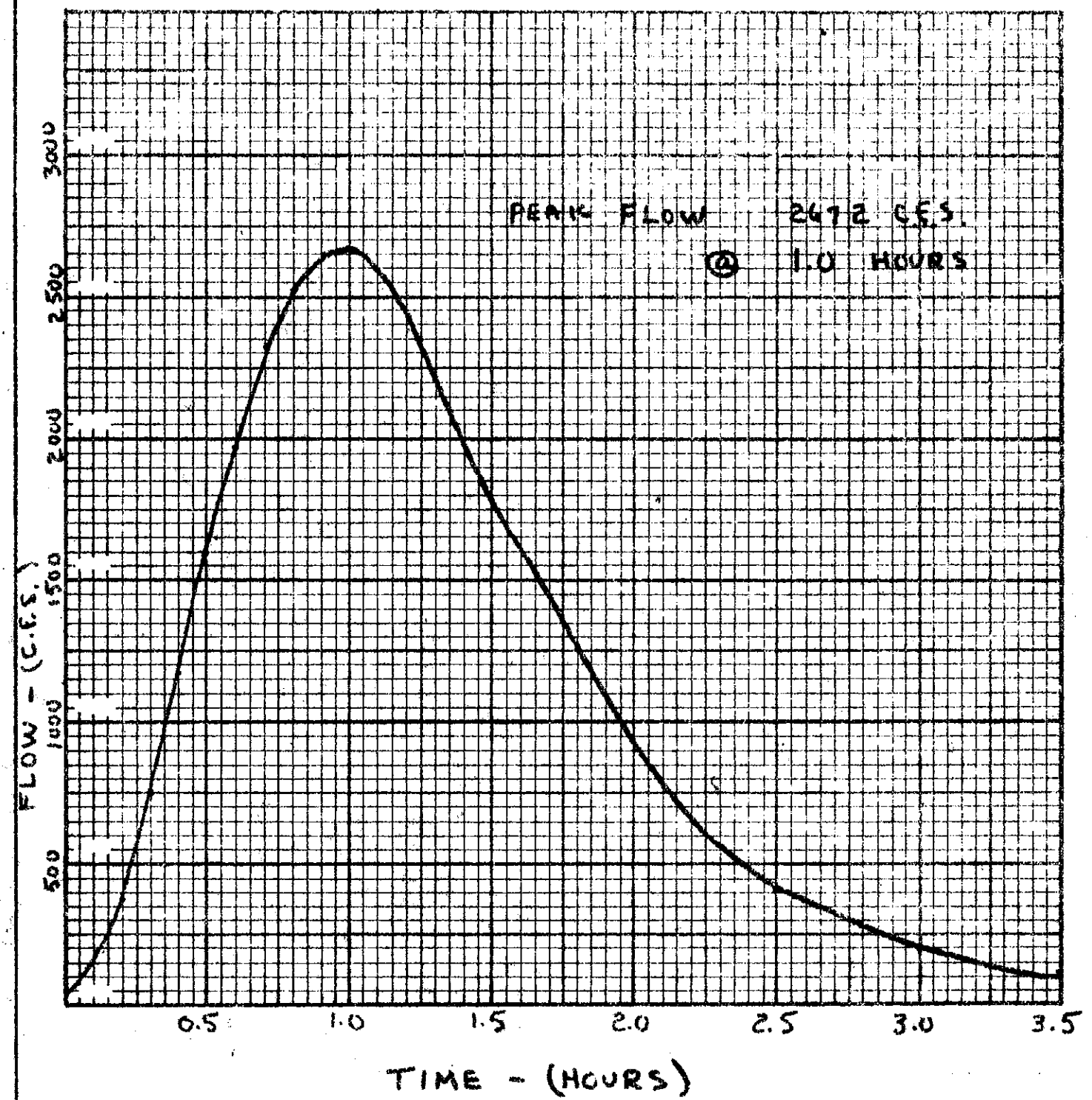
UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO



COMBINED HYDRO GRAPH

POINT II

BASINS A, B, C, D, E & F	UNITED WESTERN ENGINEERS COLORADO SPRINGS, COLORADO



COMBINED OUTFALL - PETE FIELD

POINT VI	UNITED WESTERN ENGINEERS COLORADO SPRINGS, COLORADO