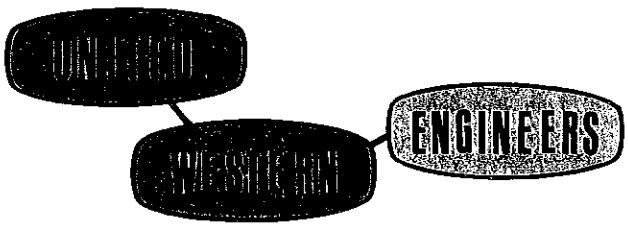


planners · consultants · engineers

REVISED

MASTER DRAINAGE REPORT

DEERFIELD HILLS

UNITED WESTERN ENGINEERS

planners consultants engineers

Suite 200
4525 Northpark Drive
Colorado Springs, Colo. 80907

(303) 598-3222

March 8, 1973

DeWitt Miller
Director of Public Works
P.O. Box 1575
City Hall
Colorado Springs, Colorado

Subject: Revised Master Drainage Plan
Deerfield Hills

Dear Deke:

Transmitted herewith is subject drainage plan for your review and approval.

As you are aware, a master plan for most of this area was approved by Keith Martin, City Engineer, on January 14, 1970. This plan was based on the Peterson Field Master Drainage plan by Karcich & Weber, Inc., dated November, 1965. The revision to this master plan, dated January 22, 1971, requires a new master drainage plan for this area.

The accompanying letter by the developer presents his recommendations for proration of drainage facility costs.

This report covers the unplatted areas of the total development and revisions required through previously platted areas.

Please call me if I may answer any questions you might have.

Respectfully submitted,

UNITED WESTERN ENGINEERS

O. E. Watts
Engineering Director

/dst
Enclosure

DEERFIELD HILLS MASTER DRAINAGE PLAN

INDEX

DEERFIELD HILLS

REVISED MASTER DRAINAGE PLAN

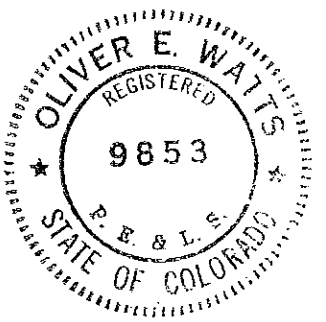
Certifications and Approvals

Registered Engineer

I, Oliver E. Watts, a registered engineer in the State of Colorado, hereby certify that the attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. I further certify that said drainage report is in accordance with all City of Colorado Springs Ordinances and specifications and criteria.

Oliver E. Watts

Colorado PE - LS No. 9853



Owner or developer of the site

"The developer has read and will comply with all of the requirements specified in this drainage report as approved by the City Engineer, and as set forth in the accompanying letter of proposal."

By _____

Title Executive Vice-President
Real Estate Management Corp.

Approved:

City of Colorado Springs, Department of Public Works

_____ _____

Acting City Engineer Date

1. Description of Location

a. The Deerfield Hills development is located South of the Hancock Expressway, West of Hancock Boulevard, adjacent to Academy Boulevard and North of Drennan Road, as shown on the enclosed drawing. It occupies portions of Sections 34 and 35, Township 14 South, Range 66 West of the 6th P.M., in the City of Colorado Springs.

b. Previously approved subdivisions have been platted within the total development as tabulated below. This report concerns itself with the unplatted areas only, except to the extent revisions to the primary greenbelt are required within the Deerfield Meadows Subdivision.

Date Recorded	Filing	Area Acres	Pete Field	Sand Creek	Misc.
9-8-70	Deerfield Hills Sub. No. 1 (includes one refiling)	34.837	6.307	-0-	28.530
6-22-70	Deerfield Meadows Sub (replat of Colony Hills)	(16.990)	(6.073)	-0-	(10.917)
12-12-70	Colony Hills Sub.	28.451	11.128	-0-	17.323
2-2-71	Colony Hills Sub.2	3.420	3.420	-0-	-0-
1-70	Pinehurst Mobile Home Park	32.636	32.636	-0-	-0-
	Unplatted area	277.183	200.743	3.631	72.809
	TOTAL	376.527	254.234	3.631	118.662

c. As shown above and on the enclosed plan, a portion of the development lies within the Peterson Field Drainage, a portion lies within an unstudied basin, and a minor portion is in the Sand Creek Basin. The revised Master Plan for the Peterson Field Basin and the plan for the Sand Creek Basin have been carefully consulted and this drainage plan is in full compliance therewith.

d. The natural drainage is defined by the topography shown on the enclosed plan. Generally the unstudied portion drains to the South to Drennan Road and then Westerly along Drennan Road. The Peterson Field portion generally drains along an alignment corresponding to that of the greenbelt. The Sand Creek portion drains Westerly.

2. Method of Computations:

a. Method: The SCS synthetic hydrograph method was utilized for all internal hydrologic computations, using the prescribed 50 year storm of 2 inches per hour intensity, duration of one hour. Greenbelt design homes were taken from the revised Peterson Field Master Report, (50 year

criteria) except that inflows from the North were taken from the Master Drainage Report for the Southborough Area, as prepared by R. Keith Hook & Associates.

b. Soils: The soil types within the development were obtained from mapping by the local SCS office. These soil types are delineated on the enclosed plan, summarized as follows:

R7-BD Unit: Blakeland Series of deep, dark textured soils, loamy darker sands near the surface turning to lighter colored sandy loams and sands below 16 to 30 inches. Falls in Hydrologic Group "A".

R2-CE Unit: Stapleton Unit of moderately coarse soils becoming gravelly with depth. Sandy loams at the surface to gravelly sandy loams or loamy sands at depths below 10 to 18 inches. Falls in Hydrologic Group "B".

3. External Water Entering the Development

24.9 CFS from the East side of Hancock Boulevard concentrates into a natural depression near the Southeast corner of the development. This is considered an inflow to the facilities described herein to drain that area.

3900 CFS enters the development in the primary Peterson Field Greenbelt at Hancock Boulevard (along Line "A").

733 CFS enters the development from the Southborough area in a proposed 8 feet by 8 feet RCB culvert across the Hancock Expressway. The location shown on the enclosed plan has been mutually agreed upon between United Western Engineers and R. Keith Hook & Associates.

670 CFS enters the development in an existing 20.5 feet by 5 feet RCB culvert across the Hancock Expressway adjacent to Pinehurst Road.

Several minor inflows to the area studied in this report are shown on the enclosed plan, and are the same as previously approved outflows in previous subdivision plattings.

4. Description of Flow Routing

All runoff is routed along streets, supplemented by storm sewer when required by current criteria.

The unstudied basin portion of the development runoff is routed to Drennan Road in accordance with the topography. The natural depression is drained by this storm sewer system. A second storm sewer is provided to route the flow to the existing system on Academy Boulevard, which is insufficiently sized.

The Peterson Field runoffs are routed to the major greenbelt systems, and through the development as shown on the enclosed plan. This routing must pass through a 30 foot wide right-of-way previously approved in the Colony Hills Subdivision. This right-of-way was originally

platted at 60 feet and decreased in size to 30 feet when replatted as the Deerfield Meadows Subdivision on the basis of the Master Drainage Report of January 14, 1970. As later described, the existing double 10 foot by 5 foot culvert on Colony Hills Circle is insufficient to contain the predicted flow. Also, the existing five cell 9 foot by 5 foot culvert on Academy Boulevard is insufficiently sized. In addition, the existing storm sewer along Academy Boulevard from Lakehurst Drive is insufficiently sized.

5. Outfall Points

a. Unstudied Basin: The Easterly portion will outfall into a temporary unlined ditch running Southerly from Drennan Road into the County. This ditch will be built by the developer upon approval of the landowner and no credit for the cost will be sought.

The central portion will outfall into the shown facilities constructed by the State Highway Department along Academy Boulevard. These structures are shown as detail on an enclosed drawing and are insufficiently sized as follows:

Size & Type	Slope	Capacity	Runoff
24" x 68.5' CMP	1.45%	13.8 CFS	13.8 CFS
24" x 114' CMP	0.3%	16.0 CFS	74.0 CFS
24" x 702' RCP	2.56%	36.2 CFS	74.0 CFS
24" x 436' RCP	4.93%	50.2 CFS	Unk
24" x 460' RCP	4.83%	49.7 CFS	Unk

The Westerly portion will outfall into Drennan Road at well below the 30 CFS maximum permissable surface flow.

b. Peterson Field Basin: The main greenbelt will require temporary extension for relief at the Westerly limit. Box culverts along this greenbelt are insufficiently sized as follows:

Size	Location	Capacity	Runoff
2-10' x 5'	Colony Hills Cir.	1560 CFS*	5170 CFS
5-9' x 5'	Academy	3996 CFS**	5170 CFS

* Previous design flow
** Without standing water on the inlet parapet and resulting flooding.

The existing facilities near Lakehurst Drive are insufficiently sized as follows:

Size & Type	Slope	Capacity	Runoff
2-30" x 78' RCP	0.436%	50.0 CFS*	109.1 CFS
42" x 312' RCP	2.282%	151.9 CFS**	109.1 CFS

* With inundation of the inlet to the top of the curbs on Lakehurst Drive.
** The 50.0 CFS reasonable limit will flow at a depth of 1.38 feet.

An additional 53.0 CFS will outfall onto undeveloped ground just North of the existing Pinehurst Mobile Home Park.

c. Sand Creek: 8.9 CFS will outfall as cross-lot flow onto undeveloped land West of the development. Curb protection or equivalent is specified to protect the fill slope of the Trailer Park.

6. Internal Design Computations

Because of the complexity of the greenbelt designs, additional explanatory information is presented in this section.

a. Streets: (unplatted ares only)

Filing	Name	Width -ft-	Slope %	Curb Type	Max. Runoff -CFS-	Capacity -CFS-
DH#2	Deerfield Cir.	36'	0.7	Vert	31.0	54.4
DH#3	Rd "A"	36'	2.5	Ramp	9.3	25.9
	Rd "B"	36'	4.6	Ramp	10.9	35.2
	Rd "F"	36'	4.6	Ramp	5.8	35.2
	Rd "H"	36'	4.0	Ramp	12.0	32.8
	Rd "H"	36'	1.8	Ramp	16.1	22.0
	Rd "H"	36'	1.7	Ramp	7.7	21.4
	Rd "H"	36'	0.7	Vert	14.2	34.9
Future	Lakehurst Dr.	36'	1.0	Ramp	1.0	16.4
	Lakehurst Dr.	36'	1.0	Ramp	0.5	16.4
	Lakehurst Dr.	36'	1.0	Ramp	0.9	16.4
	Pinehurst Way	36'	1.7*	Ramp	20.0	21.4
	Pinehurst Dr.E.	36'	1.2*	Vert.	39.8	45.7
	Pinehurst Dr.E.	36'	1.0*	Vert	35.2	41.7
Future	Drennan Rd.E.	60'	2.7	Vert	26.5	30.0
	Drennan Rd. W.	60'	1.3	Vert	13.0	30.0
	Drennan Rd. W.	60'	2.5	Vert	14.4	30.0
Future	Pinehurst Dr.W.	46'	0.7	Ramp	12.0	13.7

* Subject to realignment upon platting

b. Trapezoidal Concrete Channels: n-0.015. Sections are enclosed, showing channel shape, maintenance roads, etc. All slopes are 1:1.

Section	Slope %	Size B & D	Runoff -CFS-	Capacity -CFS-	Freeboard -FT-	Velocity fps
A-A	1.30	16 x 7	3900	4948	1	28.7
B-B	1.18	20 x 7	4517	5746	1	28.4
D-D	0.65	28 x 7.5	5170	6560	1	22.9
EE*	1.89	16 x 7.5	5170	6765	1	35.6
FF*	1.34	5 x 5	733	1086	1	19.6
GG	0.40	8 x 5.5	670	999	1	12.1
HH	0.80	8 x 4.5	670	968	1	15.6
Minor*	0.64	2.5x3.25	88.4	202	1	6.5

*Subject to final design

c. Reinforced Concrete Channel, n=0.013

CC	0.75	28 x 8	5170	6561	1.2	27.2

d. Reinforced Concrete Box Culverts were sized and checked in accordance with the Corps of Engineers Hydraulic Design Manual and the LA County Flood Control District Hydraulic Criteria, summarized as follows:

Location	Size of Box cells-B x D	Class of Flow	Inlet Depth -FT-	Depth in Piers -FT-
Colony Hills	3-10 x 7	C	6.23	6.86*
Academy	5-9 x 5	C	4.67	5.86**
'B' Line	1-8 x 6	N/A	5.70	5.70

* Obviously the existing double 10 x 5 must come out and a triple 10 x 5 will not work.
** It may be seen that the existing culvert is too small, however, it has a parapet wall on the inlet, adding head to the flow. For this reason additional freeboard must be provided near the lower end of trapezoidal channel transition section.

d. Transition Design was based on computing the required length to provide a stable water level in accordance with Bureau of Reclamation criteria, which may be summarized as follows:

Control Line	Transition From	To	Computed Length -FT-	Length Provided -FT-
A	3-5x4.5 Box	Sec A-A	94.75	95.00*
A	Sec A-A	Sec B-B	12.21	15.00
A	Sec B-B	Sec C-C	23.20	25.00
A	Sec C-C	3-10x7 Box	8.40	10.00
A	Sec C-C	Sec D-D	16.77	16.00
A	Sec D-D	5-9x5 Box	56.30	60.00
A	5-9x5 Box	Sec E-E	132.42	140.00*
C	8x8 Box	Sec F-F	2.82	10.00*
B	2-10x5 Box	Sec G-G	29.50	30.00
B	Sec G-G	8x6 Box	7.03	15.00
B	Sec H-H	8x6 Box	7.24	15.00

* Subject to final design

f. Superelevations will be provided upon final design based on one of two alternatives. Either the channel bottom may be superelevated about the inside radius invert (shown as d_2-d_1) or the outside wall may be lifted to the shown d_2 depth plus freeboard as follows. Transition lengths must be provided in accordance with USACE criteria. Spiral curves are not considered practical.

Section	Curve Radius -Feet-	d_2-d_1 Feet	d_2 Feet	Transition -FT-
A-A	200	3.63	7.94	110

	250	2.90	7.58	
	300	2.42	7.34	
	500	1.45	6.85	
B-B	300	2.68	7.44	120
	1380.6	0.58	6.39	
C-C	100	6.45	10.00	100
	400	1.61	7.60	
D-D	150	4.47	8.76	120
	1253	0.54	6.80	
EE	No curves			
FF	200	0.79	4.50	45
	100	1.58	4.89	
GG	No Curves			
HH	358.75	0.32	3.84	40
	463.79	0.25	3.80	
	188.69	0.61	3.99	

g. Concrete Pipe(n-0.013) shall be class II with one foot minimum cover. These designs are summarized as follows.

Location	Size -in-	Slope %	Runoff -CFS-	Capacity -CFS-
Hancock Xpwy	24	1.0	21.5	22.6
Basin III R & S	36	1.0	50.0	66.7
Drennan Rd.E.	36	2.67	79.1	108.9
Drennan Rd.E.	48	0.45Min	94.6	96.3
Drennan Rd.E.	48	1.0	142.0	143.6
Drennan Rd.W.	30	1.3min	46.7	46.7
Drennan Rd.W.	36	1.0	62.0	66.7
Lakehurst Dr.	18	1.0	9.2	10.5

h. CMP Pipe (n-0.024) shall be galvanized of standard corrugations and bands and shall have one foot minimum cover under traffic. Gage shall be determined by resistivity tests and shown on detailed plan and profile sheets. Minimum head will be obtained by earth berm cover.

Location	Size -in-	Slope %	Head -ft-	Runoff -CFS-	Capacity -CFS-
A-Line	18	2.0	0.43	7.8	8.0
A-Line	30	2.0	0.47	22.6	31.4
A-Line	30	2.0	0.43	21.8	31.4
A-Line	21	2.0	0.48	11.3	12.1
A-Line	30	2.0	0.18	14.2	31.4
A-Line	21	2.0	0.48	11.3	12.1
A-Line	21	2.0	0.48	11.3	12.1
A-Line	21	2.0	0.38	10.0	12.1
A-Line	18	2.0	0.09	3.6	8.0
A-Line	21	2.0	0.27	8.5	12.1
A-Line	18	2.0	0.04	2.3	8.0
A-Line	36	2.0	0.25	23.9	51.0

7. Cost Estimate:

a. Unit Prices: The following are the unit prices utilized

in computing the lineal footage costs in the major items, current prices:

Channel Excavation-Major	$2.00/CY
Channel Excavation-Minor	$2.00/CY
Structural Excavation-Major	$2.50/CY
Structural Backfill	$3.00/CY
4" Concrete Lining-Major Ditches	$7.00/SY
4" Concrete Lining-Minor Ditches	$8.00/SY
Structural Concrete	$75.00/CY
Reinforcing Steel	$0.20/LB
Existing fence Removal*	$0.50/LF
Required R/W in Platted Areas*	$1.50/SF
6-foot Chain Link Fencing*	$3.50/LF
Pipe Handrail	$1.50/LF
Replacement of Sod & Landscaping*	$0.15/SF
Asphaltic Pavement & base replacement	$1.50/SY
8" Vertical curb & gutter replacement*	$2.50/LF

* Items unique to previous plattings of Deerfield Meadows and Colony Hills.

Other specific items are as shown in the estimate schedule. It is emphasized that this estimate is based on preliminary quantities and must be revised at the time of bid lettings.

b. Peterson Field Drainage Basin (Listed in order by station)

Item	Quantity	Unit Price	Cost
'A' Line:			
5 cell 10'x4.5' RCB culvert	75 LF	$ 537.86	$ 40339.50
Culvert to Channel transition	95 LF	211.93	20133.35
16 foot by 7 foot concrete channel	1827.5LF	42.66	77961.15
Channel Transition	15 LF	45.30	679.50
20 foot by 7 foot concrete channel	2663 LF	47.94	127664.22
Channel Transition	25 LF	201.22	5030.50
28 foot by 8 foot RC channel	930.4LF	234.74	218402.10
RC Channel to RC Box Transition	20 LF	246.96	4939.20
Remove Existing RC Box & install 3 cell 10'x7' RCB	45 LF	392.34	17655.30
RC Channel to Concrete Channel Transition	16 LF	211.86	3389.76

28 foot by 7.5 foot concrete channel	416.6 LF	$ 61.34	$ 25554.24
Channel to Box Transition	60 LF	289.93	17395.80
Extend 4 cell 9'x5' RCB	60 LF	560.66	33639.60
RCB to channel transition	140 LF	268.31	37563.40
16 foot x 7.5 foot concrete channel	1020 LF	44.95	45849.00
Remove and Replace sewer manhole	1 ea	500.00	500.00
Remove and Replace 8" VCP sewer	305 LF	10.00	3050.00
Sub totals 'A' Line			$ 679746.62

'B' Line:

1/2 Cost of Existing culvert @ Hancock	1/2 of billing	(25168.00	$ 12584.00
Culvert to channel transition	30 LF	104.45	3133.50
8foot by 4.5 foot concrete channel	442.3LF	23.73	10495.78
8 foot by 5.5 foot concrete channel	728.2LF	27.31	19887.14
Channel to RCB transitions	60 LF	79.13	4747.80
8 foot by 6 foot RCB culverts	76 LF	115.75	8797.00
Sub totals 'B' Line			$ 59645.22

'C' Line:

1/2 Cost of 8x8 RCB culvert	75 LF	134.06	10054.50
RCB to channel transition	10 LF	85.16	851.60
5 foot x 5 foot concrete channel	536 LF	20.92	11213.12
Sub totals 'C' LIne			$ 22119.22

Approved Subdivision Drainage Facilities:

Colony Hills Sub, see letter of 12-3-69			-0-
Colony Hills Filing #2, see letter of 1-6-70			-0-
Deerfield Hills Sub #1, see letter of 6-16-70			-0-
Replat of Deerfield Hills, see letter of 4-30-71			-0-
Deerfield Meadows: see letter of 5-20-70			$260.00
Pinehurst Mobile Home Park (see plan for as-built)			
Grated Inlet	1 ea	500.00	500.00
30-inch CMP	90 LF	11.25	1012.50
Sub total-previously approved plattings			$1772.50

Unplatted Areas:

Deerfield Hills, Filing #2		Sub total	
10 foot catch basin	1 ea	$1346.00	$1346.00
27 inch RCP	100 LF	12.00	1200.00
Deerfield Hills, Filing #3			
8 foot catch basin	2 ea	1144.00	2288.00
21 inch RCP	100 LF	11.53	1153.00
24 inch RCP	140 LF	12.26	1716.40
4 foot curb outlet	2 ea	200.00	400.00
4 foot curb inlet	2 ea	200.00	400.00
Other future plattings			
18 inch CMP	40 LF	10.80	432.00
21 inch CMP	100 LF	11.53	1153.00
30 inch CMP	40 LF	13.75	550.00
36 inch CMP	20 LF	15.10	302.00
4 foot catch basin	1 ea	1144.00	1144.00
18 inch RCP	70 LF	8.50	595.00
4 foot curb outlet	1 ea	200.00	200.00
2.5'x3.25' concrete ditch	780 LF	13.73	10709.40
Sub total-unplatted areas			$ 23588.80
Sub total-Peterson Field			786872.36
10% Engr. & Cont.			78687.24
Total-Peterson Field Facilities			$865559.60
Equivalent cost per acre			3404.58

c. Unstudied Basin Facilities
Previously Approved Plattings:

Deerfield Hills Sub No. 1			-0-
Deerfield Meadows Sub			-0-
Colony Hills Sub			-0-

Unplatted Areas:

21 inch RCP	20 LF	9.00	$ 180.00
24 inch RCP	310 LF	10.50	3255.00
27 inch RCP	20 LF	12.00	240.00
30 inch RCP	350 LF	13.50	4725.00
36 inch RCP	1960 LF	19.00	37240.00
48 inch RCP	240 LF	30.50	7320.00
6 foot catch basin	2 ea	829.00	1658.00
8 foot catch basin	1 ea	1144.00	1144.00
10 foot catch basin	2 ea	1346.00	2692.00
16 foot catch basin	1 ea	1692.00	1692.00
Sub total			$60146.00
10% Engr. & Cont.			6014.60
Total-Unplatted Areas			$66160.60
Equivalent per acre cost			238.69

d. Sand Creek Basin Facilities: -none-

8. Drainage Fees & Credits

a. Peterson Field Basin:

Subdivision	Acres	Year	Unit Fees	Fees
Deerfield Hills Sub #1	6.307	1970	$ 986.00	$ 6218.70
Colony Hills Sub	11.128	1970	986.00	10,972.21
Colony Hills Sub #2	3.420	1971	986.00	3372.12
Pinehurst MHP	32.636	1970	986.00	32179.10
Unplatted Areas	200.743	1973	1193.00	239486.40
Total	254.234			$292228.53
Total Cost of structures				$865559.60
Overrun				$573331.07

b. Unstudied Basin

Deerfield Hills Sub #1	28.530	1970	$ 674.00	$ 19229.22
Colony Hills Sub	17.323	1970	674.00	11675.70
Unplatted Areas	72.809	1973	816.00	59412.14
Total	118.662			$ 90317.07
Total Cost of structures				66160.60
Underrun				24156.47

c. Sand Creek Basin

Unplatted Area 3.631 Acres @ $827.20* = $3,003.56*
A cash fee will be appropriate on Platting this area.
* Subject to a restudy

1" = 100' 50 Yr. Storm 2" / 1 Hr. Soils RZ-CE B, RZ-BD A

MAJOR BASIN	SUB BASIN	AREA Planim. Read	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	LAND USE %	LAND USE CURVE	COMP. CURVE	TPO	FLOW Q	FLOW qp	Tb
I	A	10.70	.00384	530	5	.095	0.69 0.31	92 97	94	.557	1.40	4.67	1.49
	B	30.16	.01082	700	21	.075	0.10 0.90	92 95	95	.545	1.48	14.22	1.46
	C	8.62	.00309	640	14	.080	1.0	—	92	.548	1.24	3.38	1.46
	D	9.97	.00358	510	11	.068	1.0	—	92	.541	1.24	3.97	1.44
	E	3.52	.00126	240	5	.042	1.0	—	92	.525	1.24	1.44	1.40
	F	8.81	.00316	480	9	.070	1.0	—	92	.542	1.24	3.50	1.45
	G	3.43	.00123	120	6	.020	1.0	—	92	.512	1.24	1.44	1.37
	H	74.39	.02668	1220	31	.125	0.64 0.36	19 78	40	.575	0.02	0.45	1.54
	I	10.28	.00369	630	14	.080	1.0	—	92	.548	1.24	4.04	1.46
	J	6.03	.00216	310	8	.044	1.0	—	92	.526	1.24	2.46	1.41
	K	9.91	.00355	470	9	.065	1.0	—	92	.539	1.24	3.95	1.44
	L	13.20	.00473	570	10	.080	1.0	—	92	.548	1.24	5.18	1.46
	M	14.02	.00503	740	9	.110	1.0	—	92	.566	1.24	5.33	1.51
	N	4.24	.00152	310	5	.050	1.0	—	92	.530	1.24	1.72	1.42
	O	65.97	.02366	1200	30	.120	1.0	—	95	.572	1.48	29.63	1.53
I	P	140.54	.05041	2280	35	.230	1.0	—	95	.638	1.48	56.60	1.70

HYDROLOGIC COMPUTATION – BASIC DATA

PROJ: DEER FIELD HILLS MASTER DRAIN

By: B EJ

Date: 2-23-73

UNITED WESTERN ENGINEERS
planners · consultants · engineers
Suite 200
4525 Northpark Drive
Colorado Springs, Colo. 80907

MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	V	TPO	FLOW Q	FLOW qp	Tb
I	Q	47.14	.01691	2150	23	.260	1.0	-	95	.656	1.48	18.46	1.75
	R		.02197	2050	24	.240	0.39 0.61	19 95	65	.644	0.14	2.31	1.72
	S	49.87	.01789	1550	17	.200	0.61	95	95	.620	1.48	20.67	1.66
	T1	83.04	.02979	1400	19	.175	B .32 A .68	97 97	97	.605	1.67	39.80	1.61
	T2	71.54	.02566	1200	18	.150	1.0	97	97	.590	1.67	35.15	1.58
	T3	29.26	.01050	1140	6	.220	1.0	97	97	.632	1.67	13.43	1.69
I	T4 T5	12.61 9.92	.00452 .00356	810 530	10 5	.125 .100	1.0 1.0	97 97	97 97	.575 .560	1.67 1.67	6.35 5.14	1.54 1.50
II	A	15.11	.00542	810	24	.086	1.0	-	92	.552	1.24	5.89	1.47
	B	18.46	.00662	710	23	.075	1.0	-	92	.545	1.24	7.29	1.46
	C	14.23	.00510	400	15	.047	1.0	-	92	.528	1.24	5.80	1.41
	D	11.48	.00412	720	22	.080	1.0	-	92	.548	1.24	4.51	1.46
	E	4.78	.00171	440	9	.063	1.0	-	92	.538	1.24	1.91	1.44
	F	2.92	.00105	120	5	.020	1.0	-	92	.512	1.24	1.23	1.37
	G	7.35	.00264	300	9	.040	1.0	-	92	.524	1.24	3.02	1.40
	H	1.40	.00050	170	8	.025	1.0	-	92	.515	1.24	0.58	1.38
II	I	5.57	.00200	550	16	.063	1.0	-	19	.538	0.01	0.02	1.44

HYDROLOGIC COMPUTATION – BASIC DATA

PROJ: DEERFIELD HILLS MASTER DRAIN

By: BES

Date: 2-23-73

UNITED WESTERN ENGINEERS
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Colorado Springs, Colo. 80907

MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	LAND USE %	LAND USE CURVE	COMP. CURVE	TPO	FLOW Q	FLOW qp	Tb
III	A	5.45	.00195	350	9	.048	1.0	-	97	.529	1.67	2.98	1.41
	B	16.34	.00586	900	25	.095	1.0	-	92	.557	1.24	6.31	1.49
	C	9.35	.00335	480	18	.053	1.0	-	92	.532	1.24	3.78	1.42
	D	2.03	.00073	240	5	.040	1.0	-	92	.524	1.24	0.84	1.40
	E	7.87	.00282	440	15	.050	1.0	-	92	.530	1.24	3.19	1.42
	F	4.38	.00157	350	11	.045	1.0	-	19	.527	0.01	0.02	1.41
	G	17.07	.00612	580	22	.062	1.0	-	92	.537	1.24	6.84	1.43
	H	6.10	.00219	360	17	.038	1.0	-	92	.523	1.24	2.51	1.40
	I	10.35	.00371	470	15	.054	1.0	-	19	.532	0.01	0.03	1.42
	J	5.91	.00212	430	8	.064	1.0	-	92	.538	1.24	2.36	1.44
	K	7.62	.00273	360	9	.049	1.0	-	92	.529	1.24	3.10	1.41
	L	2.14	.00077	200	5	.034	1.0	-	92	.520	1.24	0.89	1.39
	M	7.08	.00254	980	19	.120	1.0	-	92	.572	1.24	2.67	1.53
	N	16.48	.00591	660	18	.075	1.0	-	92	.545	1.24	6.51	1.46
	O	7.77	.00279	350	13	.041	1.0	-	92	.525	1.24	3.19	1.40
III	P	14.40	.00517	670	24	.068	1.0	-	92	.541	1.24	5.74	1.44

HYDROLOGIC COMPUTATION – BASIC DATA

PROJ: DEERFIELD HILLS MASTER DRAIN

By: BEJ

Date: 2-23-73

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MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	LAND USE %	LAND USE CURVE	COMP. CURVE	TPO	FLOW Q	FLOW qp	Tb
III	Q	7.53	.00270	360	13	.044	1.0	–	92	.526	1.24	3.08	1.41
III	R	62.50	.02242	850	17	.105	1.0	–	95	.563	1.48	28.53	1.50
III	S	62.77	.02252	700	14	.090	1.0	–	95	.554	1.48	29.12	1.48
IV	A Portion of Deerfield Meadows Subdivision –												
	Drainage Plan Approved 6-2-70,												
	A Portion of Colony Hills Subdivision												
	And Colony Hills Subdivision No. 2												
V	Deerfield Hills Subdivision No. 1 – Drainage Plan												
	Approved 6-22-70, Remaining Portion of												
	Deerfield Meadows Subdivision – Approved 6-2-70,												
	And Remaining Portion of Colony Hills Subdivision												

HYDROLOGIC COMPUTATION – BASIC DATA

PROJ: DEERFIELD HILLS MASTER DRAIN

By: BEJ

Date: 2-23-73

UNITED WESTERN ENGINEERS
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Colorado Springs, Colo 80907

1" = 100'

MAJOR BASIN	SUB BASIN	AREA Planim. Read	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	CURVE	TPO	FLOW Q	FLOW qp	Tb
VI	A1	17.88	.00641	780	8	.130			97	.578	1.67	8.96	1.54
	A2	48.28	.01732	1020	13	.145			97	.587	1.67	23.85	1.57
VI	A3	40.24	.01443	1070	18	.135			97	.581	1.67	20.07	1.55
	B	13.72	.00492	590	6	.100			97	.560	1.67	7.10	1.50
	C	8.26	.00296	530	7	.084			97	.550	1.67	4.35	1.47
	D	14.25	.00511	580	9	.085			97	.551	1.67	7.50	1.47
	E	10.23	.00367	465	6	.078			97	.547	1.67	5.42	1.46
	F	5.28	.00189	290	5	.048			97	.529	1.67	2.89	1.41
	G	8.02	.00288	480	7	.075			97	.545	1.67	4.27	1.46
	H	11.36	.00407	620	9	.090			97	.554	1.67	5.94	1.48
	I	9.34	.00335	570	8	.088			97	.553	1.67	4.90	1.48
	J	6.54	.00235	650	6	.115			97	.569	1.67	3.34	1.52
	K	10.08	.00362	550	6	.092			97	.555	1.67	5.27	1.48
	L	9.40	.00337	510	6	.086			97	.552	1.67	4.93	1.47
	M	12.45	.00447	555	6	.095			97	.557	1.67	6.49	1.49
VI	N	6.96	.00250	260	5	.040			97	.524	1.67	3.86	1.40
Sand Creek	—	17.00	.00610	660	10	.095			97	.557	1.67	8.85	1.49

HYDROLOGIC COMPUTATION — BASIC DATA

PROJ: [redacted] Pinehurst M.H.P.

By: BEJ

Date: 2-23-73

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Page 5 of 6 Pages

MAJOR BASIN	SUB BASIN	AREA Planim. Read	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	CURVE	TPO	FLOW Q	FLOW qp	Tb
VI	O	10.93	.00392	555	5	.100			97	.560	1.67	5.66	1.50
VI	P	10.95	.00393	605	6	.105			97	.563	1.67	5.64	1.50
VI	Q	48.07	.01724	1280	28	.140			97	.584	1.67	23.86	1.56
Unstud. Basin									[redacted]		[redacted]		
W - Academy		29.92	.01073	1500	26	.170			97	.602	1.67	14.41	1.61

HYDROLOGIC COMPUTATION — BASIC DATA

PROJ: [redacted] Pinehurst M. H. P.

By: BEJ

Date: 2-23-73

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Page [redacted]6 of 6 Pages

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Project DEERFIELD HILLS
Calc. by OEWatts date 3-7-73
Checked by _____ date _____

For Capacity of 5 cell 9x5 Box
@ Academy Blvd

Criteria: Max ws inside piers = 5.00 FT

See previous hydraulic calc's (p 23)

Class C inlet flow

d (@ inlet) from interpolation → below $A_1 = 48.33 d_1$ $V_1 = Q/A_1$

$d_c = \sqrt[3]{q^2/g}$ where $q = Q/48.33$

$x = 45/48.33 = 0.9311$

Trial & Error

Q	d_1	A_1	V_1	$V_1^2/2g$	$d_1 / V_1^2/2g$	Chart DB-9.3 $d_2/d_1 = Y$	$d_2 = Yd_1$
4060	4.00	193.32	21.00	6.85	0.584	1.263	5.053 ~~5.064~~
3901	3.90	188.487	20.696	6.65	0.586	1.263	4.926
Try Q = 3901 + 159 $\frac{5-4.926}{5.052-4.926}$ = 3994 cfs, say 3996 (below)							
3996	3.96	191.387	20.880	6.769	0.585	1.263	5.00 ← Q=3996

check: $\alpha = 0.068901$ (p 23 of Hydraulics)

$q = 82.68$

$d_c = 5.97'$ $\lambda = \frac{3.96}{5.97} = 0.6638$

chart 010-6/1 C of E Flow is Class C OK

$Q = \frac{1.486}{0.013} A R^{2/3} (0.00652)^{1/2} = 9.829948 A R^{2/3}$

d_1	A	WP	R	$R^{2/3}$	$A R^{2/3}$	Q
4.00	193.32	56.33	3.432	2.275	439.85	4060
3.90	188.487	56.13	3.358	2.242	422.67	3901
3.96	191.387	56.25	3.402	2.262	432.95	3996
4.30						
4.40						
4.50						
4.60						

JOINT DEPARTMENTAL REPORT
ON
PERFORMANCE OF CULVERTS AND CULVERT PRACTICE
CALIFORNIA DIVISION OF HIGHWAYS

CHART B
FOR DESIGN OF CULVERTS RUNNING FULL UNDER HEAD

ROWE, JUNE 1943

FORMULAE [Flow of Water thru Culverts, - Bulletin 1, Univ. of Iowa]:

Corrugated Pipe, $Q = \frac{A\sqrt{2gh}}{\sqrt{1+0.160^{0.6}+\frac{0.106L}{D^{1.2}}}}$

R.C. Pipe, beveled lip, $Q = \frac{A\sqrt{2gh}}{\sqrt{1.1+\frac{0.026L}{D^{1.2}}}}$

[Adapted to spun pipe by using 0.021L instead of 0.026L.]

Concrete monolith, rounded lip, $Q = \frac{A\sqrt{2gh}}{\sqrt{1.05+\frac{0.0045L}{R^{1.25}}}}$

EXAMPLE

To compile alternative sections to carry 2.0 second-feet for 180 feet, assuming outlet submerged to a stage 1.55 feet below allowable headwater.

For a single conduit, the lowest isopleth is drawn from H = 1.55 through Q = 2.0 to the focus line. From this intersection, a horizontal intersects L = 180 in each of the six fields, giving alternatives

A 84" C.M.P. C 69" Spun R.C.P. E 27.6 sq.ft. Arch
B 72" Cast R.C.P. D 7'x4' R.C. Box F 6'-ft. Arch

For multiple conduits, take Q as the share of each barrel, giving wide variety, such as:

G. Dbl. 5'x3' Box; H. Trpl. 54" C.M.P.

The head at entrance (h_i) must exceed velocity head plus entrance loss.
Compute $V = \frac{Q}{A}$; increase section if necessary, until
$h_i > 0.022\,V^2$ for C.M.P.
$h_i > 0.017\,V^2$ for others

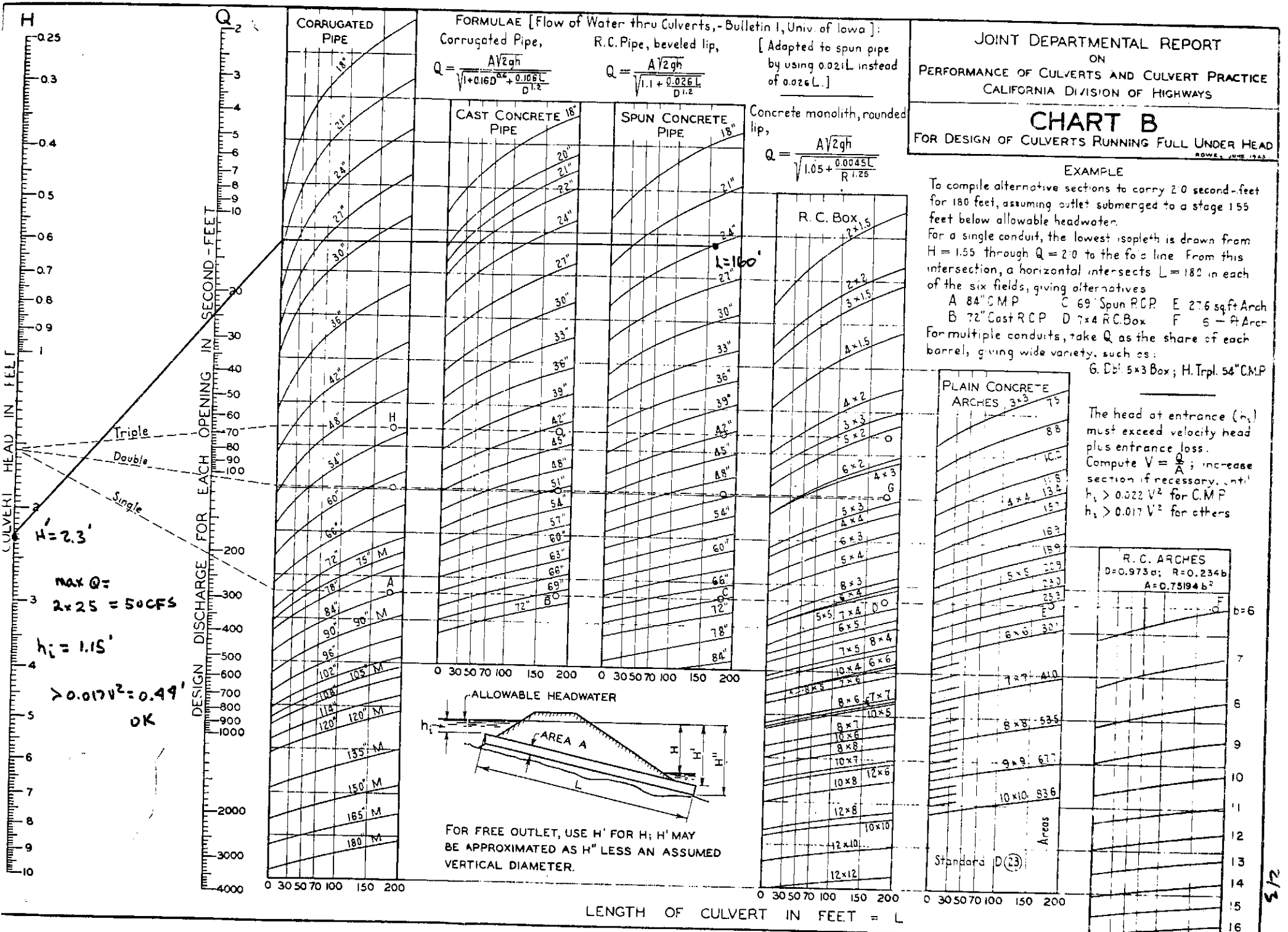
H' = 2.3'

max Q = 2x25 = 50 CFS

h_i = 1.15'

$> 0.017V^2 = 0.49'$

OK



DEERFIELD HILLS - EXIST HWY 24" RCP @ ACADEMY & LAKEHURST DRIVE

2/3

FORMULAE [Flow of Water thru Culverts, - Bulletin 1, Univ of Iowa]:

Corrugated Pipe, $Q = \frac{A\sqrt{2gh}}{\sqrt{1+0.16D^{0.5}+\frac{0.106L}{D^{1.2}}}}$

R.C. Pipe, beveled lip, $Q = \frac{A\sqrt{2gh}}{\sqrt{1.1+\frac{0.026L}{D^{1.2}}}}$

[Adapted to spun pipe by using 0.021L instead of 0.026L.]

Concrete monolith, rounded lip, $Q = \frac{A\sqrt{2gh}}{\sqrt{1.05+\frac{0.0045L}{R^{1.25}}}}$

FOR FREE OUTLET, USE H' FOR H; H' MAY BE APPROXIMATED AS H" LESS AN ASSUMED VERTICAL DIAMETER.

JOINT DEPARTMENTAL REPORT
ON
PERFORMANCE OF CULVERTS AND CULVERT PRACTICE
CALIFORNIA DIVISION OF HIGHWAYS

CHART B

FOR DESIGN OF CULVERTS RUNNING FULL UNDER HEAD

ROWE & JUNE 1943

EXAMPLE

To compile alternative sections to carry 210 second-feet for 180 feet, assuming outlet submerged to a stage 1.55 feet below allowable headwater.

For a single conduit, the lowest isopleth is drawn from H = 1.55 through Q = 210 to the fold line. From this intersection, a horizontal intersects L = 180 in each of the six fields, giving alternatives:

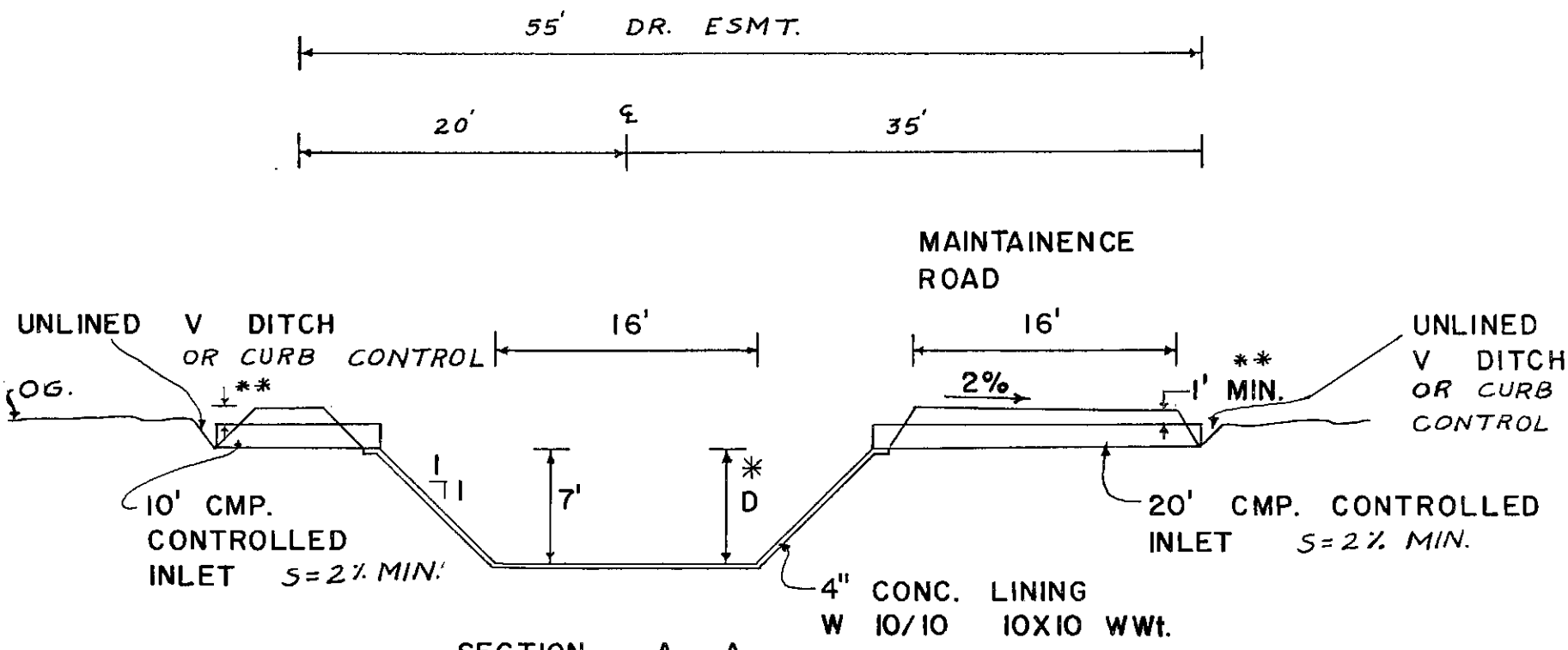
A. 84" C.M.P C. 69" Spun R.C.P. E. 27.6 sq.ft Arch.
B. 72" Cast R.C.P. D. 7×4 R.C. Box F. 6 – ft. Arch

For multiple conduits, take Q as the share of each barrel, giving wide variety, such as:

G. Dbl. 5×3 Box; H. Trpl. 54" C.M.P.

The head at entrance (h_i) must exceed velocity head plus entrance loss. Compute $V = \frac{Q}{A}$, increase section if necessary, until $h_i > 0.022\,V^2$ for C.M.P. $h_i > 0.017\,V^2$ for others.

DEER FIELD HILLS - EXIST HWY SYSTEM @ ACADEMY & DRENNAN



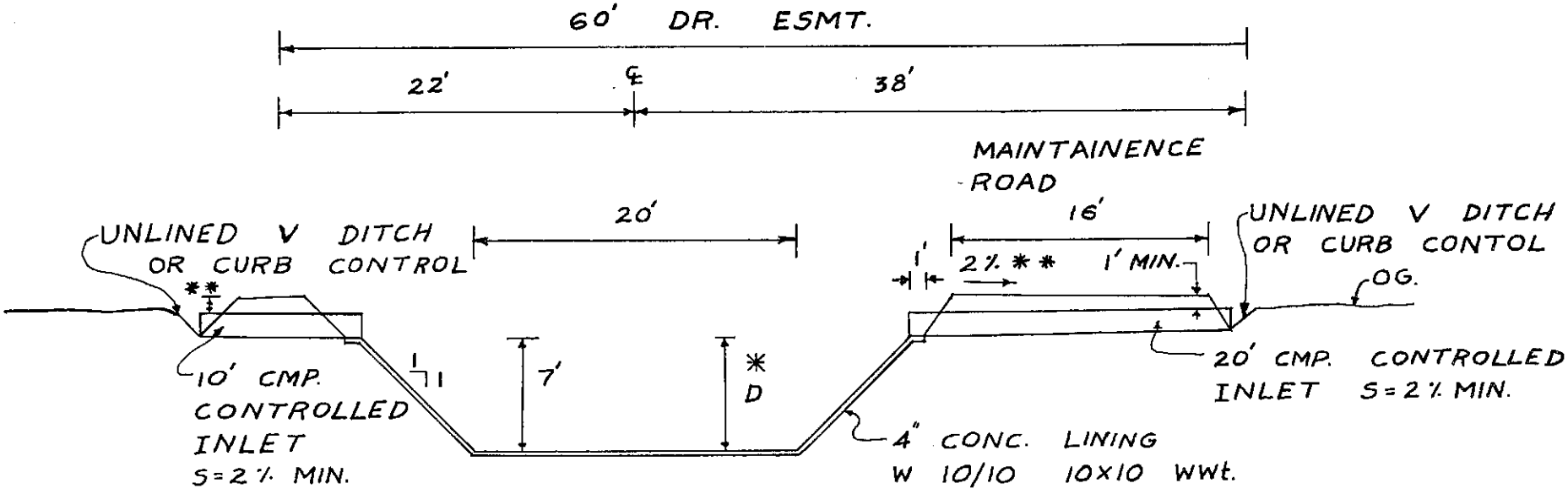
SECTION A – A

STA. 4+81.5 TO 23+09

SCALE 1" = 10'

Q = 3900.0 C.F.S.
CAP. = 4947.8 C.F.S.
FREE BOARD = 1'
*SUPERELEVATION R D
(SEE REPORT)
S = 1.30 %
** SEE REPORT FOR hi

DEERFIELD HILLS
'A' LINE
UNITED WESTERN ENGINEERS



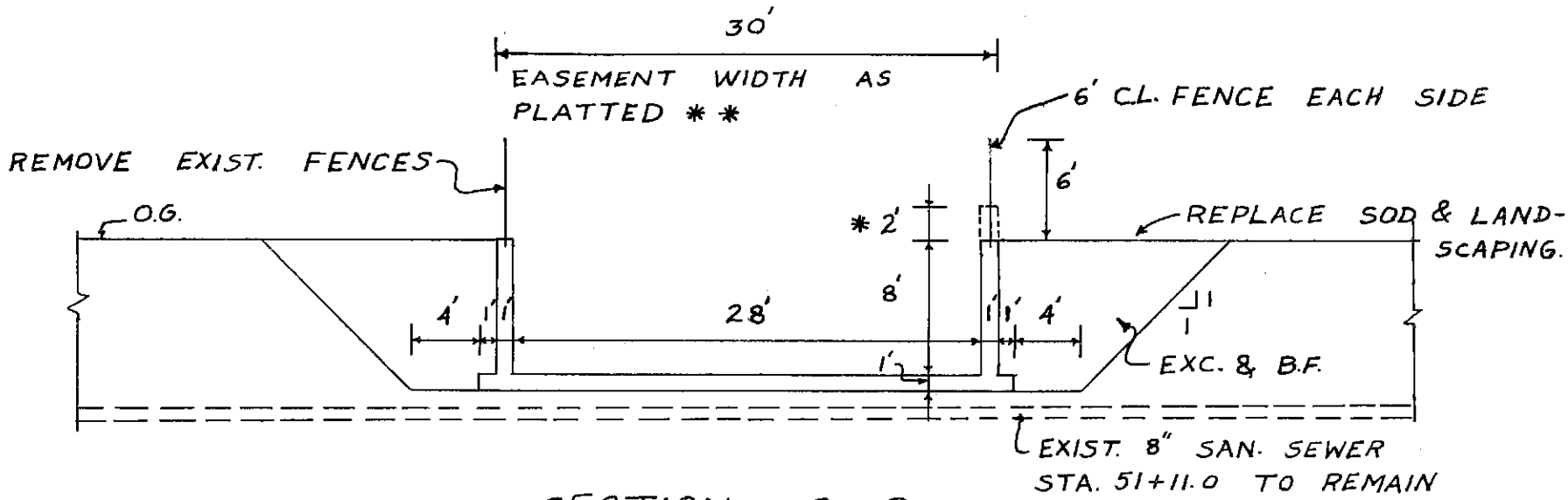
SECTION B-B

STA. 23+24.0 TO 49+87.0

SCALE 1"=10'

Q = 4517.0 C.F.S.
CAP. = 5746 C.F.S.
FREE BOARD = 1'
* SUPERELEVATION: R D
(SEE REPORT)
S = 1.18 %
** SEE REPORT FOR h_i

DEERFIELD HILLS
'A' LINE
UNITED WESTERN ENGINEERS



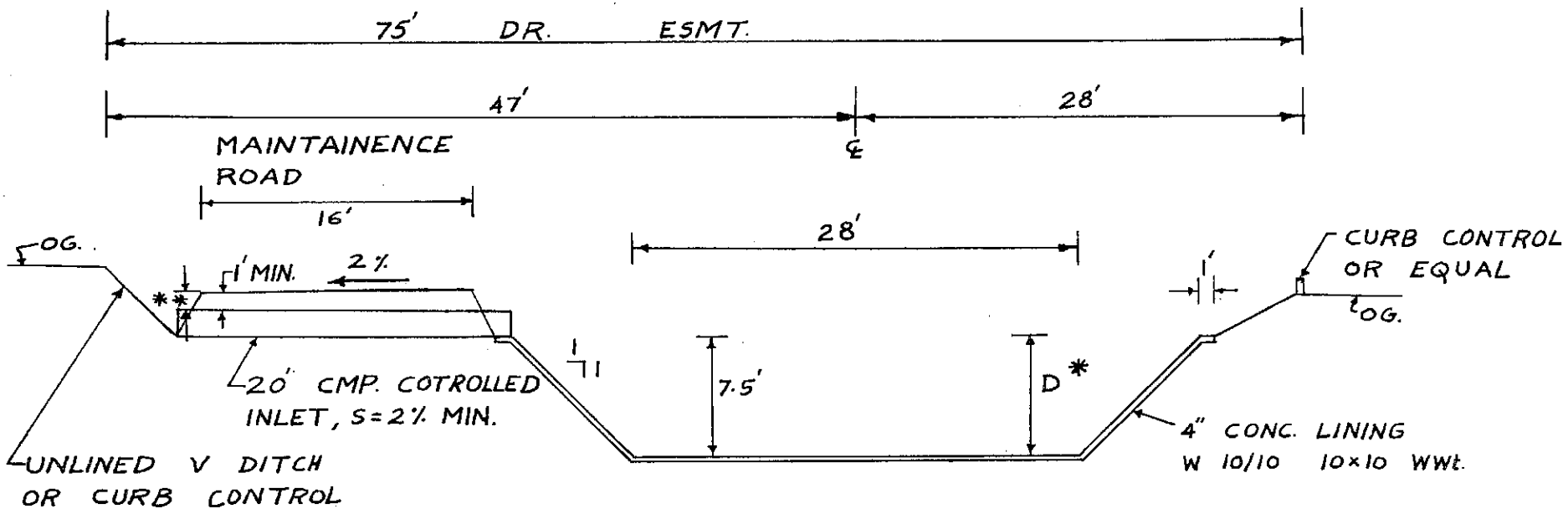
SECTION C - C

STA. 50+12.0 TO 57+48.2 & 58+13.2 TO 60+07.4

SCALE: 1" = 10'

Q = 5170 C.F.S.
CAP. = 6561 C.F.S.
FREE BOARD = 1'
* 100' R CURVES TO BE SUPERELEVATED 2'.
REINFORCEMENT NOT SHOWN.
STRUCTURAL DIMENSIONS MAY VARY UPON SOIL TEST RESULTS.
S = 0.75 %.
** ADDITIONAL R.O.W. REQ'D ON INSIDE OF CURVES.

DEERFIED HILLS
'A' LINE
UNITED WESTERN ENGINEERS



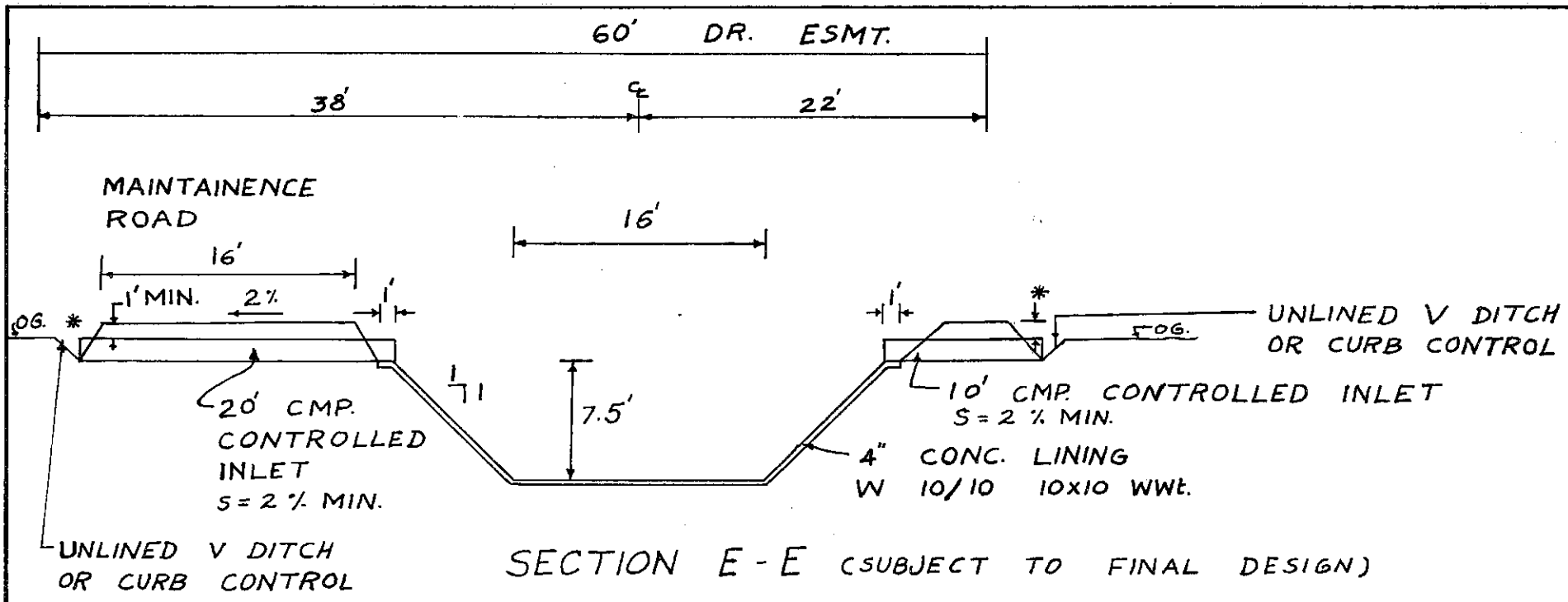
SECTION D - D

STA. 60+23.4 TO 64+40.0

SCALE 1" = 10'

Q = 5170 C.F.S.
CAP. = 6560 C.F.S.
F.B. = 1'
* SUPERELEVATION R D
(SEE REPORT)
S = 0.65 %.
** SEE REPORT FOR hi

DEERFIELD HILLS
'A' LINE
UNITED WESTERN ENGINEERS



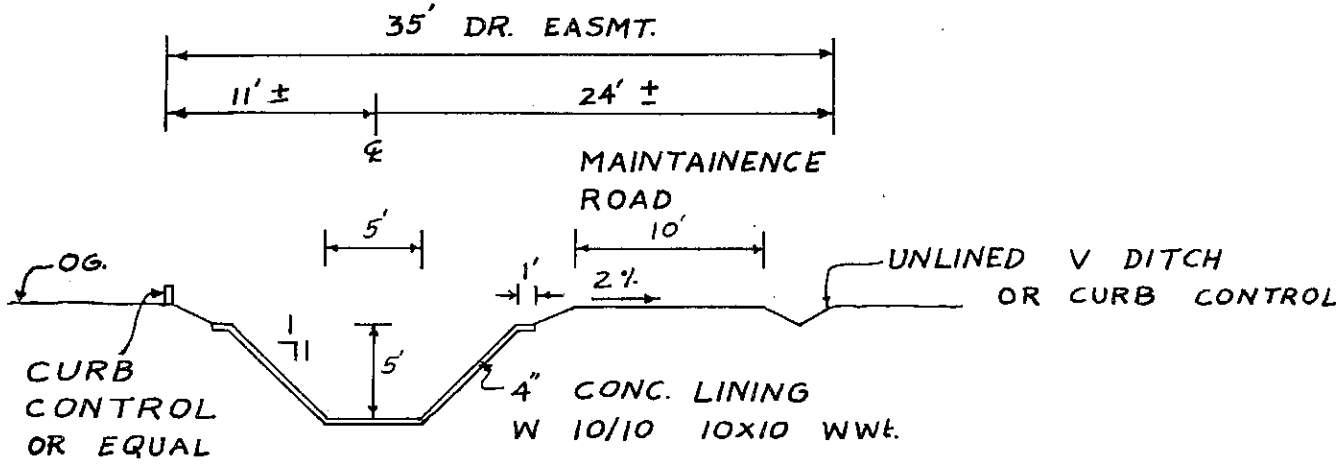
SECTION E - E (SUBJECT TO FINAL DESIGN)

STA. 68+52.0 TO 78+72.0

SCALE: 1" = 10'

Q = 5170 C.F.S.
CAP. = 6765 C.F.S.
FREE BOARD = 1'
S = 1.89 % ±
* SEE REPORT FOR h_i

DEERFIELD HILLS
'A' LINE
UNITED WESTERN ENGINEERS



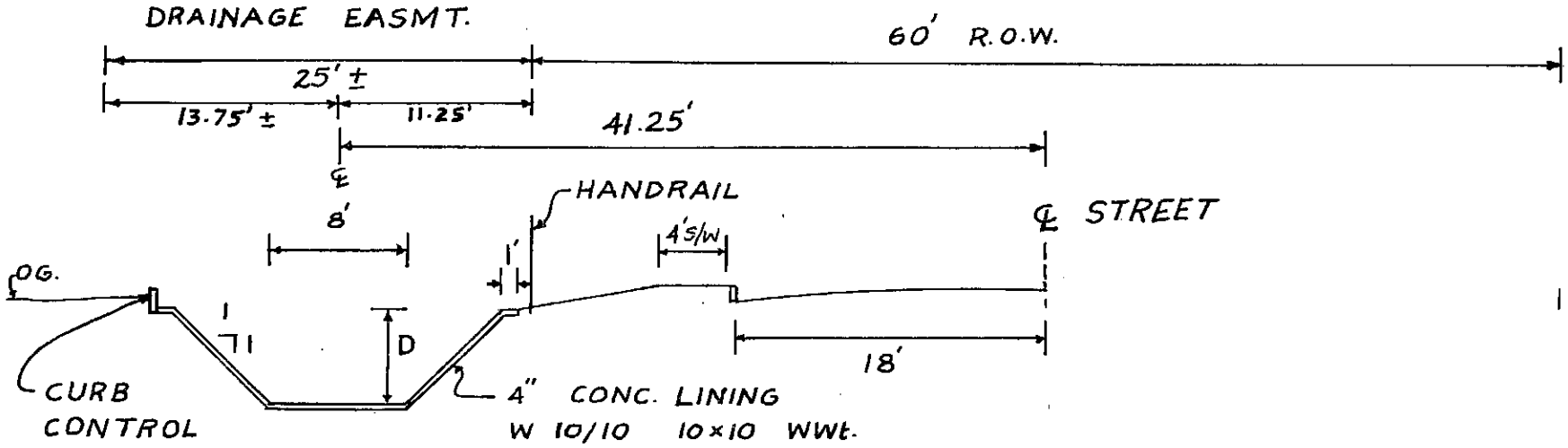
SECTION F-F (SUBJECT TO FINAL DESIGN)

STA. 0+10.0 TO 5+46.0

SCALE 1"=10'

Q = 733 C.F.S.
FREE BOARD = 1'
CAP. = 1086 CFS.
S = 1.34 %

DEERFIELD HILLS
'C' LINE
UNITED WESTERN ENGINEERS



SECTION G-G & H-H

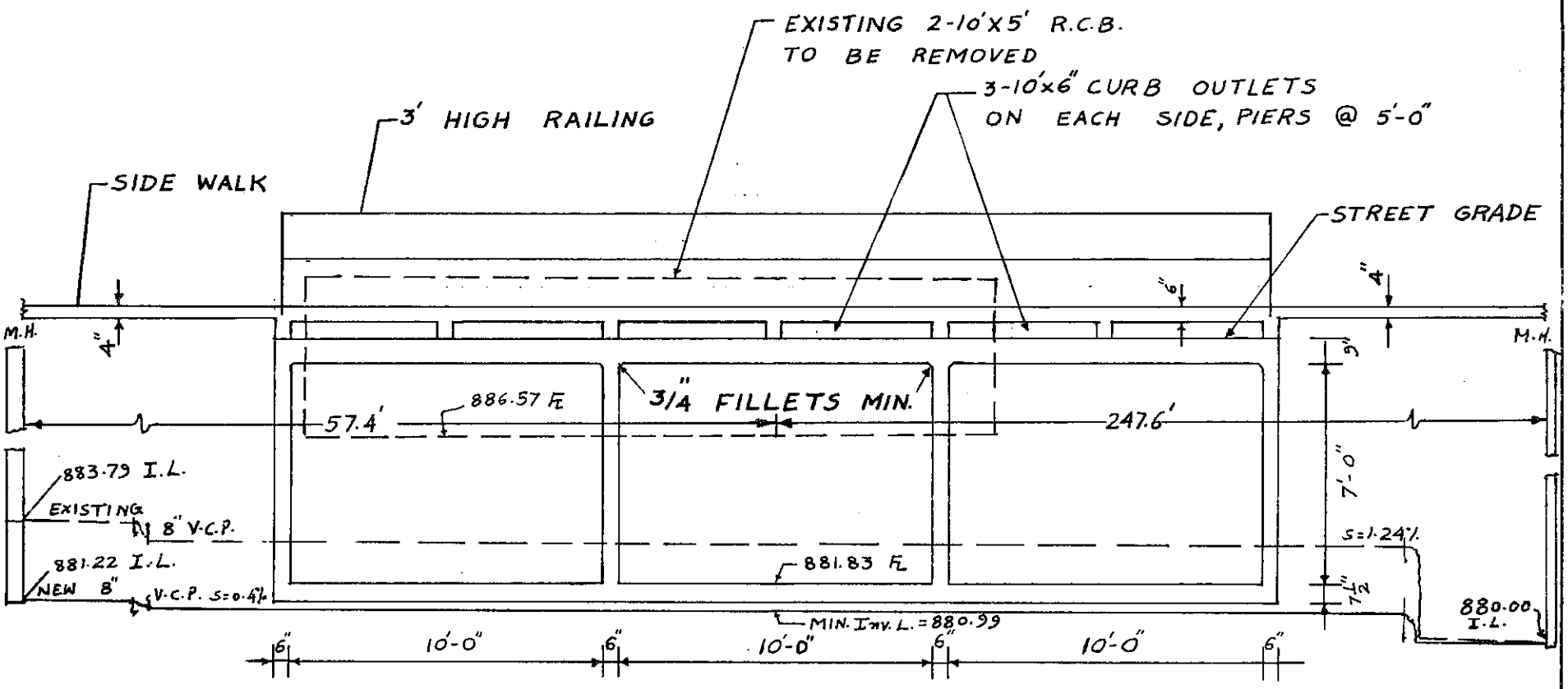
SCALE 1" = 10'

STA.		B	D	Q	F.B.	CAP.	SLOPE
10+24.7 TO	14+60.0	8'	5.5'	670 C.F.S.	1'	999 C.F.S.	0.4 %
15+28.0 TO	23+31.2	8'	4.5'	670 C.F.S.	1'	968 C.F.S.	0.8 %

DEERFIELD HILLS

'B' LINE

UNITED WESTERN ENGINEERS



ELEVATION

STA. 57+58.2 TO 58+03.2

SCALE 1"=5'

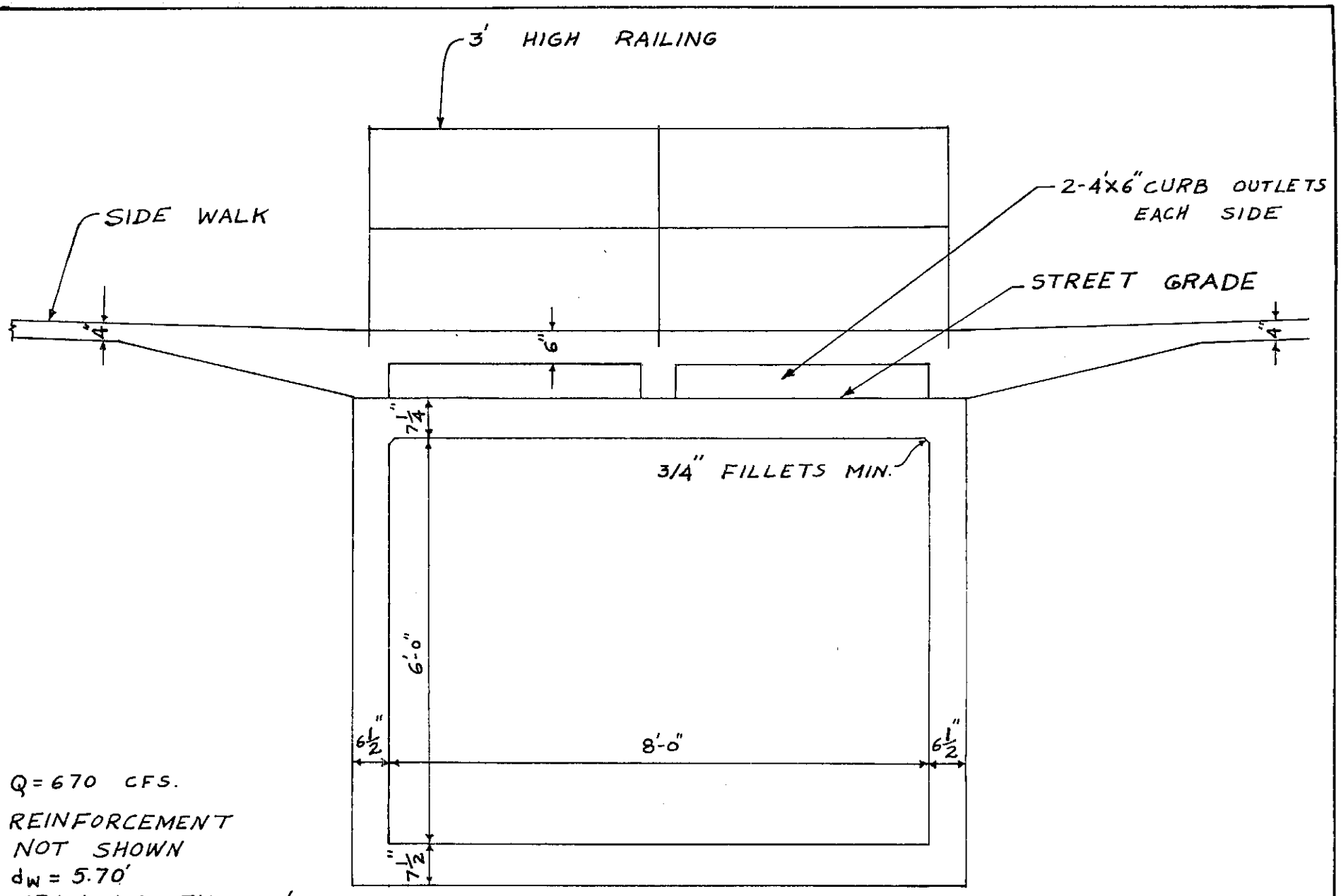
Q = 5170 CFS.
REINFORCEMENT NOT SHOWN
d_w = 6.86' INSIDE PIERS
d_w = 6.23 OUTSIDE PIERS
CLASS 'C' FLOW
TRANS. LENGTH = 10.00'

DEERFIELD HILLS

BOX CULVERT AT COLONY HILLS CIRCLE

'A' LINE

UNITED WESTERN ENGINEERS



Q = 670 CFS.

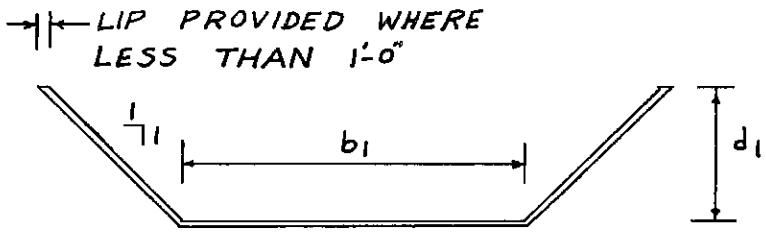
REINFORCEMENT NOT SHOWN

d_W = 5.70'

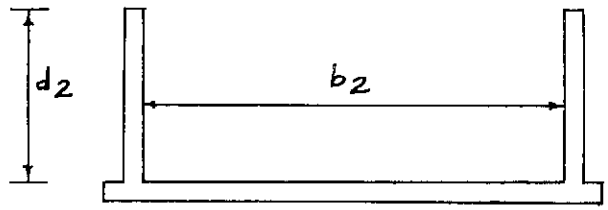
TRANS. LENGTH = 15.00'

TYPICAL ELEVATION
SCALE 1" = 2'

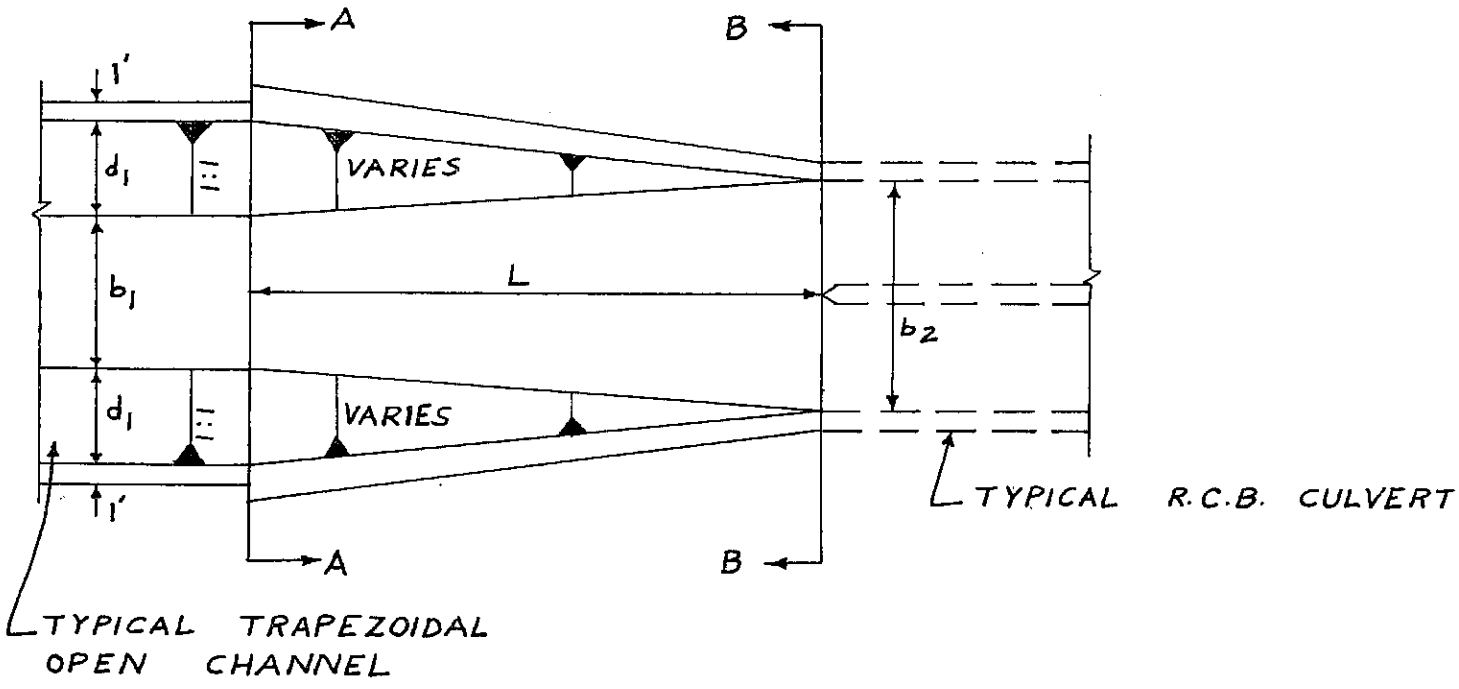
DEERFIELD HILLS
BOX CULVERT ON 'B' LINE
UNITED WESTERN ENGINEERS



SECTION A - A



SECTION B-B



PLAN

STRUCTURAL DIMENSIONS VARY
SEE REPORT FOR DETAILS
NO SCALE

DEERFIELD HILLS
TYPICAL TRANSITION
UNITED WESTERN ENGINEERS