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Figure 6-1

PLAN OF STORM DRAINAGE SYSTEM - EXAMPLE PROBLEM

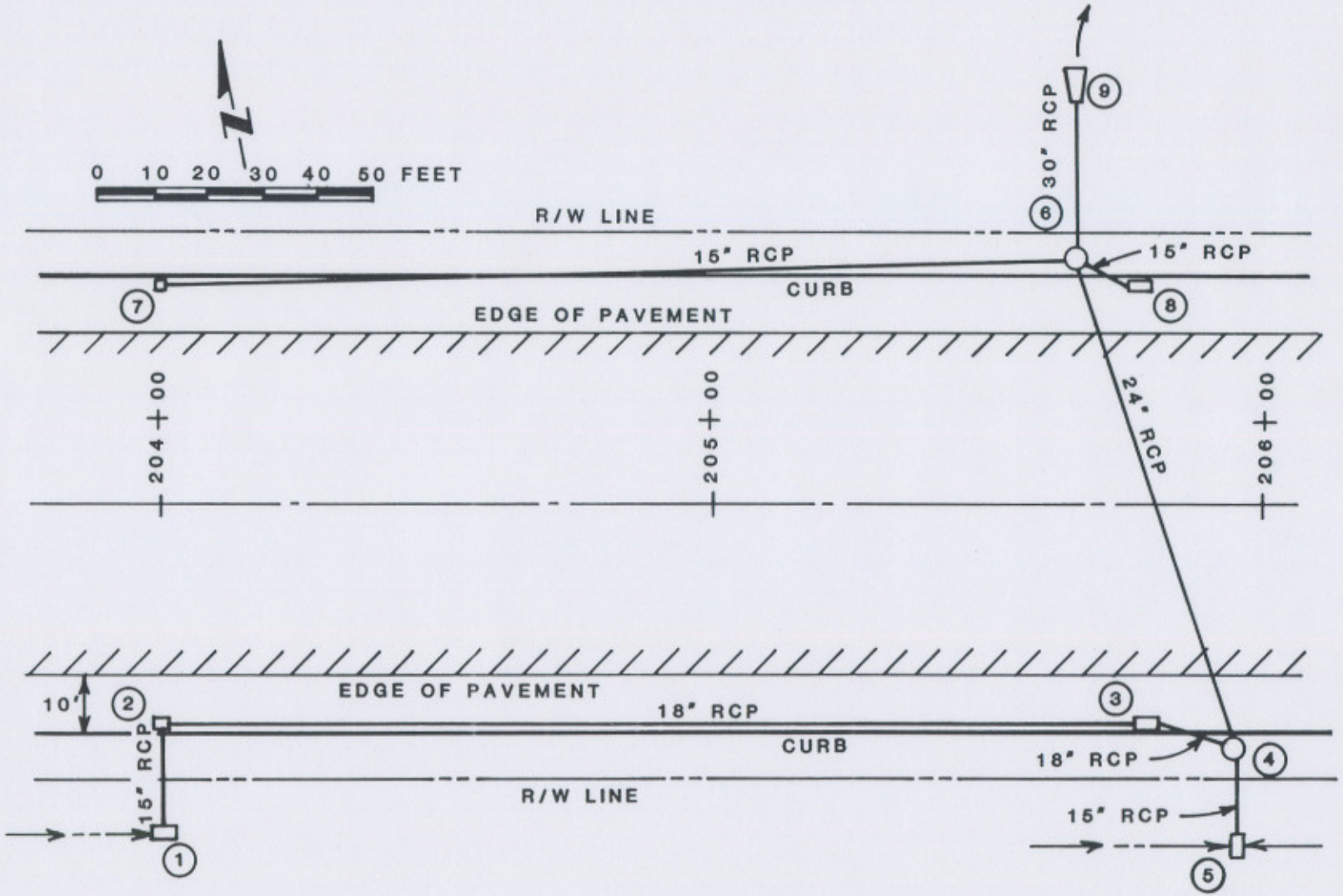
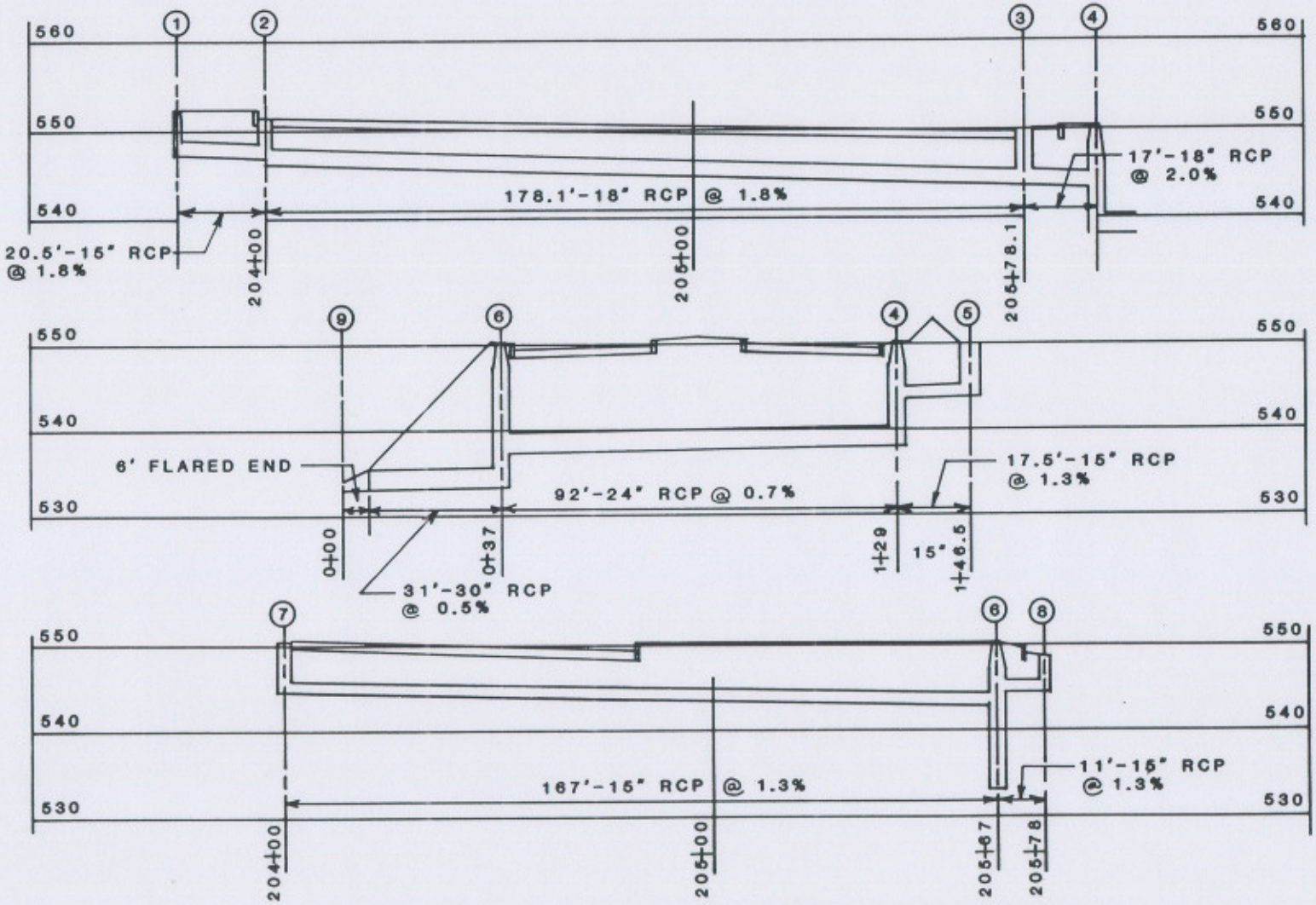


Figure 6-2

PROFILE OF STORM DRAINS - EXAMPLE PROBLEM



NOTE: ELEVATIONS ARE SHOWN ON FIGURES 6-5 THROUGH 6-7.

Figure 6-3

STORM DRAINAGE DESIGN

By: NAT Date: _____

Checked by: D. Ho Date: _____ Location DESIGN MANUAL Sheet No. _____ Of _____

Storm Frequency: _____ Contract No. _____

Location From	Location To	Increment Area ΔA Acres	Time: Sum of Time to Inlet T Min.	Time: Flow Time in Pipe T Min.	Rainfall Intensity I In./Hr.	Runoff Coefficient C	ΔC.A. Acres	W ΔC.A. C.A. Acres	Discharge Q C.F.S.	Length of Pipe L FT.	Slope S FT./FT.	Roughness Coefficient N	Pipe Size IN.	Mean Velocity V F.P.S.	Just Full Capacity Q C.F.S.	Invert Upper End FT.	Invert Lower End FT.	~~Remarks~~ Actual Velocities
1	2	2.59	26.5	0.04	3.85	0.755	1.96	1.96	7.53	20.5	0.018	0.013	15	7.07	8.68	47.34	46.97	7.99
2	3	0.48	26.54	0.04	3.85	0.757	0.363	2.32	8.93	178.1	0.018	0.013	18	6.78	11.98	46.72	44.40	7.53
3	4	0.54	26.94	0.03	3.80	0.831	0.449	2.77	10.64	17.0	0.020	0.013	18	8.41	14.86	44.20	43.86	9.25
5	4	0.95	26.0	0.07	3.92	0.645	0.613	0.613	2.40	17.5	0.020	0.013	15	4.40	9.27	44.00	43.65	5.08
4	6	—	26.97	0.21	—	—	—	3.38	13.04	92.0	0.007	0.013	24	6.02	18.92	38.00	37.36	6.50
7	6	0.50	26.0	0.81	3.92	0.950	0.475	0.475	1.86	167.0	0.009	0.013	15	4.82	5.90	44.50	43.00	4.14
8	6	0.46	26.5	0.04	3.85	0.950	0.437	0.437	1.68	11.0	0.020	0.013	15	7.19	8.82	44.74	44.63	5.20
6	9	—	27.18	0.12	—	—	—	—	16.58	31.0	0.005	0.013	30	5.9	29.0	33.16	33.00	6.10

Figure 6-4

HYDRAULIC GRADIENT COMPUTATIONS

Location		Pipe Size	Length of Pipe	Pipe Slope	Hydraulic Slope S_f	H.L. In. Str.	Friction H.L.	Flow Line Elevation (Ft.)		Hydraulic Elevation (Ft.)		Top of Grade
From	To	In.	Ft.	Ft./Ft.	Ft./Ft.	Ft.	Ft.	Upper	Lower	Upper	Lower	Ft.
1	2	15	20.5	0.018	0.014	1.34	0.28	47.34	46.97	50.28	48.66	52.30
2	3	18	178.1	0.018	0.007	0.81	1.25	46.72	44.40	48.66	46.60	51.44
3	4	18	17.0	0.020	0.001	1.07	0.17	44.20	43.86	46.60	45.36	49.66
5	4	15	17.5	0.020	0.001	0.55	0.20	44.00	43.65	45.65	44.90	50.00
4	6	24	92.0	0.007	0.003	0.57	0.31	38.00	37.36	40.24	39.36	50.10
7	6	15	167.0	0.009	0.001	0.38	0.17	44.50	43.00	44.80	44.25	50.52
8	6	15	11.0	0.020	0.001	0.59	0.01	44.74	44.63	46.48	45.88	48.74
6	9	30	31.0	0.005	0.002	0.74	0.06	33.16	33.00	36.30	35.50	50.16

After hydraulic elevation is determined at structures check vs. top of grate elevation to ensure against blow out of drainage structures. It is desirable that the hydraulic gradient not be within 1.5 ft. of the surface.

Figure 6-5

HYDRAULIC GRADIENT PROFILES
EXAMPLE PROBLEM

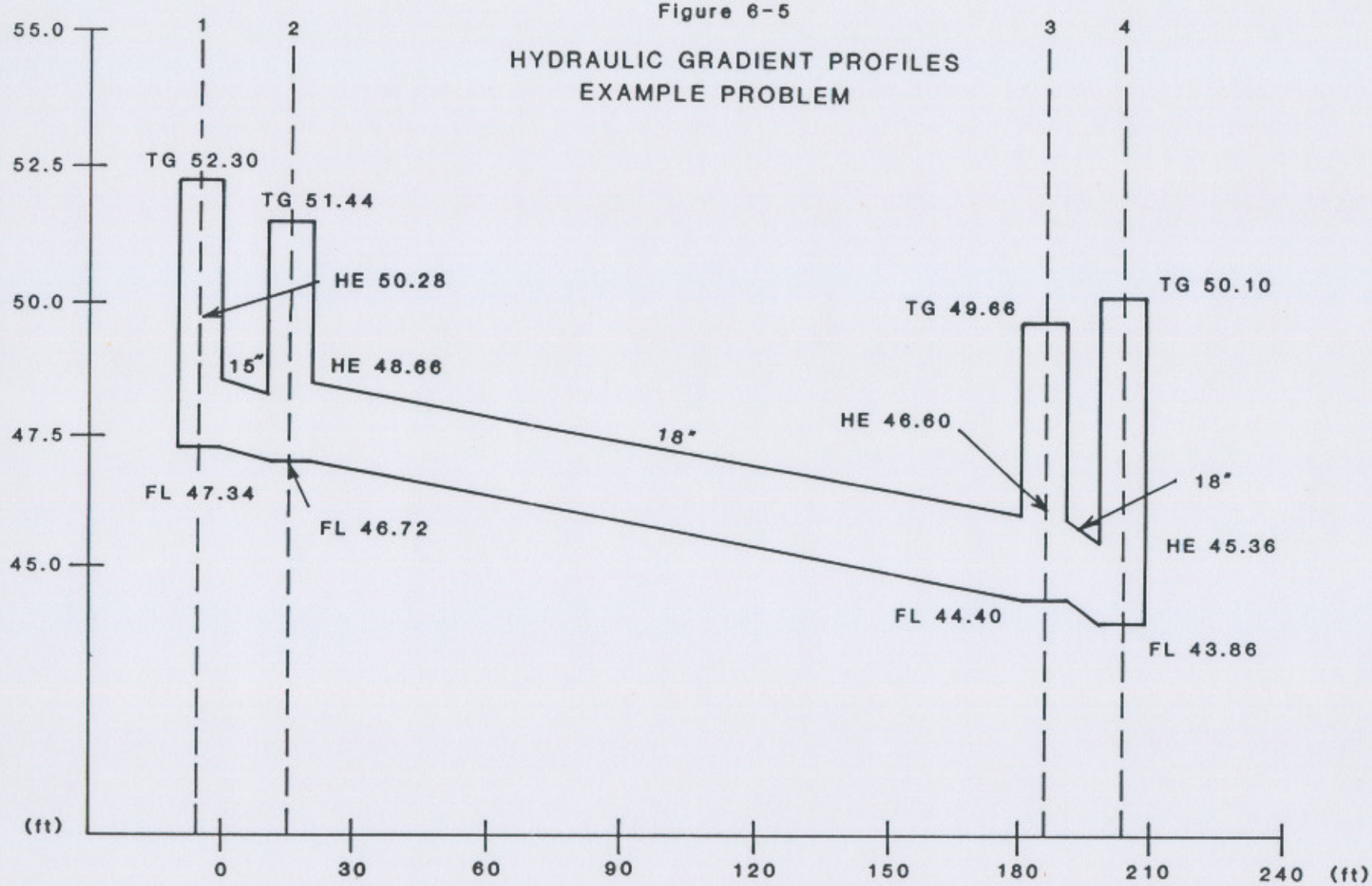


Figure 6-6

HYDRAULIC GRADIENT PROFILES — EXAMPLE PROBLEM

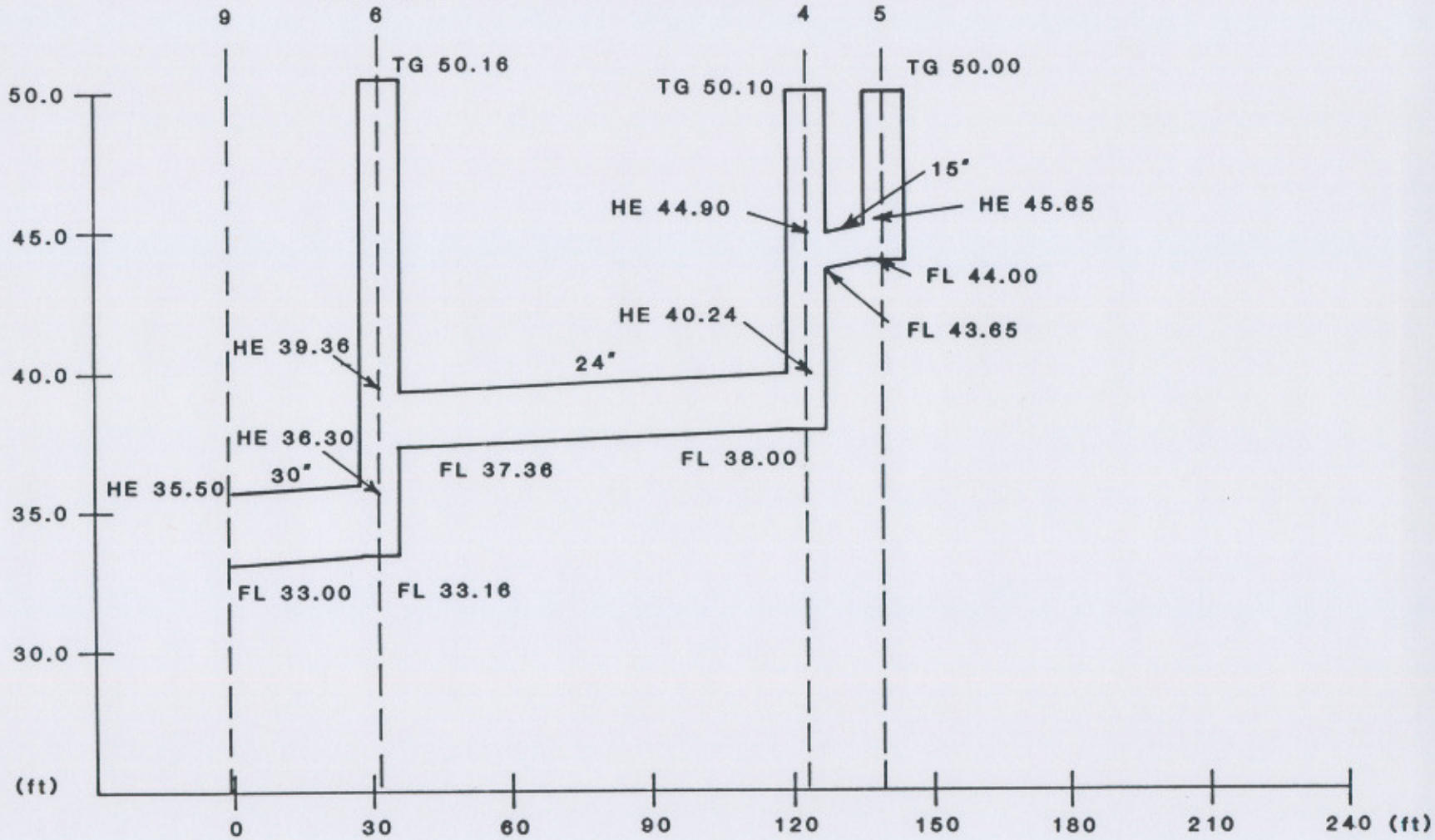


Figure 6-7

HYDRAULIC GRADIENT PROFILES
EXAMPLE PROBLEM

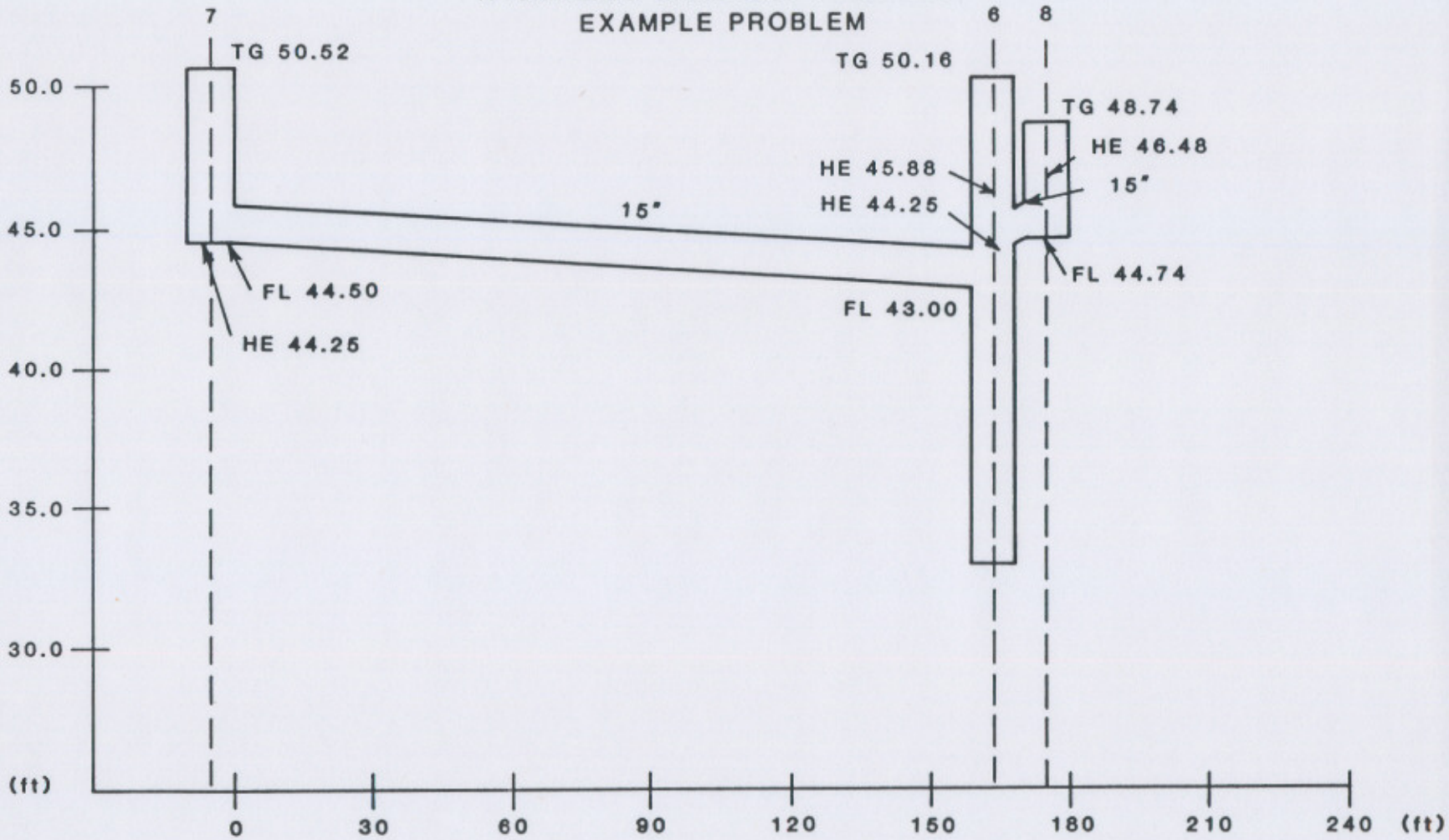


Figure 6-8

CRITERIA FOR STORM DESIGN FREQUENCY

Road Classification			STORM DESIGN YEARS				
			Bridges (Over 20' Span)	Culverts	Storm Drains	Side Ditches	Medians
Rural	Arterials		50	25	10	10	10
	Collectors	Over 2,000 ADT	50	25	10	10	10
		Over 2,000 ADT	25	10	5	5	5
	Local		25	10	5	5	5
Urban	Arterials		50	50	10	10	10
	Collectors		50	25	10	10	10
	Local		50	25	10	5	10

Figure 6-9

Compiled by _____

Date _____

DESIGN RISK ASSESSMENT

(Based upon design engineering data)

1. Identify involvement within the base flood plain _____

_____

_____

2. Traffic Service: ADT _____

Detours Available _____ Length _____

Overtopping flood Q = _____ E.P. _____%

Stage _____

Potential damage to the highway facility _____

_____

3. Applicable Flood Plain Management Criteria _____

_____

_____

4. Note social, economic, ecological and human use of flood plain land _____

_____

_____

_____

5. Drainage Area _____