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City of Scottsdale, Arizona

PRELIMINARY
DRAINAGE DESIGN REPORT

for

64th Street Improvements
McDowell Road to Thomas Road

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City of Scottsdale Project No. S-4703
AGK Engineers, Inc. Project No. 410.32

City of Scottsdale, Arizona

PRELIMINARY DRAINAGE DESIGN REPORT

for

64th Street Improvements McDowell Road to Thomas Road

City of Scottsdale Project No. S-4703
AGK Engineers, Inc. Project No. 410.32

January 1996

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CITY OF SCOTTSDALE
PRELIMINARY DRAINAGE DESIGN REPORT

1.0 INTRODUCTION

1.1 Background

The 64th street project corridor receives a significant amount of runoff and does not currently have a complete and adequate storm drainage system. Historically, on-site runoff from 64th Street and off-site runoff from Barnes Butte of the McDowell Mountains drains to the east across 64th Street. The overwhelming majority of the runoff is from off-site. Just north of McDowell Road and 64th Street, there are two sets of culverts allowing a portion of the off-site runoff from the west to drain under 64th Street to the east. The intersection of Thomas Road and 64th Street also contains several storm drain inlets which drain runoff from the City of Phoenix water tanks property and the Genetrix property north into the Scottsdale Executive Villas dry well system. There are also a series of grader ditches on the west side of 64th Street. Where roadways are widened and intersections improved by this project, these systems will be improved or modified to comply with City of Scottsdale standards.

1.2 Purpose

The purpose of this study is to identify a storm drain system, meeting City of Scottsdale design criteria, which will safely convey on-site storm runoff within the project to an outfall system. It also considers the off-site runoff and identifies the necessitated modifications to the on-site drainage system in order to convey the off-site runoff. This study forms the basis for design of a storm drain system along the new roadway alignment.

The design presented in this study is not a preliminary or final design, but a concept from which the final storm drain system will be designed concurrently with the design of the new roadway. The design concept is shown on roadway plan and profile sheets. Elements of the storm drain system are quantified and an initial cost estimate is included.

2.0 PREVIOUS STUDIES

A review of previous studies and plans found several sources of information for this project. They were used in developing the concept design of the storm drain system. They will be studied further for preliminary and final design of the 64th Street improvements. The previous studies and reports are listed below:

1. *Final Drainage Study, 64th Street / Indian School Road*, City of Scottsdale, June 1994, PBQ&D

2. *Storm Water Master Plan and Management Program, Basin Reports*, City of Scottsdale, October 1993, Boyle Engineering

3. *Final Drainage Study for Papago Park*, Engineering & Architectural Services Department, City of Phoenix, February 1993, DLE

3.0 CONCURRENT STUDIES

The Flood Control District of Maricopa County (FCDMC) is conducting a concurrent Area Drainage Master Study (ADMS) which includes the 64th Street corridor. The outcome and recommendations from the ADMS would impact storm drain design for this project. Design of the storm drain system for this project will be coordinated with the FCDMC ADMS to ensure proper integration of this project with future storm drain outfall design.

4.0 ON-SITE DESIGN

The design methodology used for this project conforms to the latest Floodplain and Drainage Ordinance adopted by the City of Scottsdale, as modified herein. It also conforms to Sections 2 and 3 of the *City of Scottsdale Design Procedures and Criteria Manual (DPCM, 1985)* and to Chapter 2, Section 2.2 Hydrology, of the *City of Scottsdale Design Standards and Policies Manual (DSPM, 1995)*. Calculations for inlet design and storm drain sizing are contained in **Appendix A**.

4.1 Drainage Area

4.1.1 Existing Conditions

64th Street is a two lane road with curb and gutter on the east side of street and no storm drain system. Runoff drains easterly through the streets of the Hy-View neighborhood. Off-site runoff from the west (Barnes Butte and City of Phoenix baseball facility) contributes a substantial amount of runoff that either crosses or is intercepted at 64th Street. The majority of the off-site runoff crosses at Hubbell Street, and has historically caused flooding in the Hy-View neighborhood. A small portion of the Thomas Road right-of-way drains east to 64th Street. Off-site runoff from the Hy-View neighborhood flows to the east, and therefore is not a tributary to the 64th Street on-site runoff.

Existing drainage facilities along 64th Street include the following: 3-36" and 4-36" CMP's north of McDowell Road (as part of the McDowell Road improvements); roadside ditches on the west side of 64th Street intercepting portions of off-site flow; a dip at the intersection of 64th Street and Hubbell Street (runoff crosses here after the ditch capacity has been exceeded); a 15" culvert crossing Thomas Road which drains the City of Phoenix water tank and Genetrix properties into the Scottsdale Executive Villas dry well system.

4.1.2 Future Conditions

The future drainage area for the on-site runoff estimation is bounded by the right-of-way on the west side of 64th Street and the buffer wall on the east (see **PLATE 1**.) The frontage road (east half of existing 64th Street) is assumed to drain to the east through the neighborhood streets as it presently does and therefore is not included in these calculations. Mitigation of flooding problems in the Hy-View neighborhood is beyond the scope of this study. It will be addressed as part of the ADMS being prepared by the Flood Control District of Maricopa County.

4.2 Design Storm

The storm drain inlets were sized for a 10-year storm. The inlets were spaced per the City's requirement to maintain one dry lane for vehicle traffic moving in each direction during the peak flow resulting from a 100-year-frequency storm *(DPCM,*

Section 3-501.02). The storm drain was also sized for a 10-year storm. The hydraulic grade line of the storm drain under a 100-year peak flow condition was checked to ensure that flow will not be higher than 8 inches above gutter flowline.

4.3 Runoff Estimation

Runoff was estimated using the Rational Method as defined in Chapter 2, Section 2.2 Hydrology, of the *DSPM*. The estimated flow is based on the multiplication of the runoff coefficient, the rainfall intensity, the drainage area, and the storm frequency adjustment factor: $Q_{10} = C\ I_{10}\ A\ F$.

Runoff coefficients assigned to the drainage areas are the composite "C" values calculated based on the widths of paved/unpaved areas from the typical road cross-section. Hydrologic Soil Group B as shown in Figure 2.2-17 of *DSPM* was used for "C" values. In specific instances where areas are non-uniform and vary from the typical road section, composite "C" values were weighted by the size of corresponding land use areas. The curve numbers used are as follows:

Description	Curve No.	"C"
Paved Surfaces	98	.95
Desert Landscape	63	.31

The computation of weighted "C" values is included in **Appendix A**.

Rainfall intensity was derived from Figure 2.2-13 of *DSPM*, using the time of concentration. The time of concentration for runoff from sub-areas was based on the travel time from the most distant point in the drainage area to the point of analysis. The velocity was calculated by the equation $V = (1.12/n)\ s^{0.5}\ d^{0.67}$ as shown in Figure 2.2-15 of *DSPM*, where s=longitudinal slope of gutter, d=depth of the maximum allowable flow for one dry lane. Time of concentration was computed by the equation T_c = Length / (Velocity x 60) in minutes. A minimum time of five minutes was used for the time of concentration.

The surface area (in acres) for each drainage sub-basin was scaled from the map. The storm frequency adjustment factor for a 10-year storm is 1.00 (Figure 2.2-18 of *DSPM*).

4.4 Inlet Design

New inlets on the east and west side of 64th Street were sized to intercept the peak runoff from a 10-year storm. The inlets were spaced so that a minimum of one dry lane is maintained on each side of the street during a 100-year event. In addition, the inlets were spaced to maintain a maximum flow depth of 8 inches at the gutter for a 100-year runoff and to keep the flow within the right-of-way *(Section 3-501.02, DPCM)*.

The inlets proposed for this project are Type M-1 curb opening inlets conforming to City of Phoenix Standard Detail P-1569. The inlet capacities were calculated using Figure 3-46 of *DPCM*, Curb Opening Inlets on Continuous Grades and Figure 3-47, Curb Opening Inlets in Sumps.

Appendix A contains the storm drain inlet design calculation worksheets. **Figures B-1** through **B-11** of **Appendix B** show the locations of the catch basins and the storm drain.

4.5 Storm Drain Design

Storm drain for on-site runoff was designed based on reinforced concrete pipe (RCP) with the following criteria:

Manning's n	= .013
minimum velocity	= 2 fps
minimum slope	= .004 ft/ft
design storm	= 10-year.

A key assumption made as part of this study is that an abandoned 36/45" waterline is available to be used as a storm drain. The cost to construct a new storm drain outfall is not included in the project budget. The 45" line runs approximately 5300 feet east on Thomas Road where it could be tied into an existing 90" storm drain which flows south on Scottsdale Road, thence east on Thomas Road. The ultimate feasibility of using the 36/45" abandoned water line as a storm drain will be verified after this report is reviewed by City of Scottsdale staff.

The north section of the proposed storm drain begins at the intersection of 64th Street and Oak Street and runs north to Thomas Road (Sta. 35+10± to Sta. 62+00±)

and ties in to the abandoned City of Phoenix 45" waterline. This segment of storm drain pipe could be up-sized to convey the 100-year discharge from off-site runoff, if necessary (see section 5.5 - Runoff Mitigation.) Computation sheets as well as plan and profile sheets of this proposed storm drain are shown in **Appendices A** and **B**.

The proposed storm drain alignment south of Wilshire Avenue is on the west side of the new roadway centerline in order to minimize utility conflicts. The alignment of the proposed storm drain north of Wilshire Avenue is linear and does not follow the roadway centerline curve. This alignment was chosen in order to avoid crossing an existing 24" waterline, and to maximize the clearance from the existing City of Phoenix water tanks.

The inlets located just south of Hubbell Street (Sta. 24+30±) and at the City of Phoenix baseball facility (Sta. 18+60±) would convey the off-site runoff in a storm drain under 64th Street to the retention basin north of the Autoplex (See Section 5.5 - Runoff Mitigation). The catch basins at the intersection of 64th Street and McDowell Road would tie into the existing storm drains on McDowell Road or tie into the new storm drain flowing into the Autoplex retention basin.

4.6 Initial Cost Estimate

This opinion of probable cost was based on approximate quantities and may not include some of the items needed for construction of the storm drain. A contingency of 15% was added to cover the cost of these unidentified items. An initial cost estimate for on-site drainage facilities is shown in **TABLE 4.1**.

TABLE 4.1
INITIAL COST ESTIMATE FOR ON-SITE STORM DRAIN

ITEM	ON-SITE STORM DRAIN ONLY:	QTY.	UNIT	UNIT	EXTENDED
505113	Inlet Per Phx. Det. M1, L=6	3	EA.	$2,500.00	$7,500
505114	Inlet Per Phx. Det. M1, L=10	10	EA.	$2,500.00	$25,000
505117	Inlet Per Phx. Det. M1, L=17	2	EA.	$3,000.00	$6,000
618115	18" RGRCP Connector Pipe.	440	L.F.	$45.00	$19,800
618124	24" RGRCP SD	3250	L.F.	$50.00	$162,500
618136	36" RGRCP SD	200	L.F.	$65.00	$13,000
628001	4' Storm Sewer Manhole per MAG Dets. 520 and 524	10	EA.	$1,800.00	$18,000
	Renovate 45" waterline in Thomas Road	1	L.S.	$50,000.00	$50,000
	On-Site Storm Drain Sub-Total Cost				$301,800
	15% Contingency				$45,270
	ESTIMATED ON-SITE STORM DRAIN COST				**$347,070**

5.0 OFF-SITE DESIGN

5.1 Drainage Areas

Basin boundaries were determined by carefully reviewing the aerial contour maps, PBQ&D's drainage study, the Papago Park Drainage study and the City of Scottsdale Drainage Master Plan prepared by Boyle Engineering (see **PLATE 2**.) Most of the boundaries correspond closely with Boyle's model except inside the Papago Park area. In this area, the basin boundaries closely match the Papago Park grading plans and drainage report. Area 10-B was added after reviewing the 1-foot contour maps of the area.

5.2 Design Storm

The design storms analyzed for off-site runoff are six-hour storms for three different return periods: 100-Year, 10-Year, and 2-Year.

5.3 Runoff Estimation

Runoff was estimated using the HEC-1 computer program. This was used in lieu of the Rational Method because the sub-basins are fairly large in size and non-uniform in shape. In addition, the HEC-1 computer program provides peak flow reduction when flows are routed through detention basins. The parameter estimation for the HEC-1 modeling is discussed below.

5.3.1 Precipitation and Rainfall Distribution

Rainfall amounts for the 6 and 24-hour storms were obtained from isopluvial charts in *DSPM*. These values were used as input for the Prefre precipitation frequency computer program. The output from this program was used to generate the hypothetical distribution as described in the HEC-1 manual.

5.3.2 Soil and Land Use

Soil information was obtained from the Soil Survey for Eastern Maricopa and Northern Pinal Counties Area, Arizona, SCS, 1974. Land use was determined from aerial photographs.

5.3.3 Soil Losses

Soil losses were calculated using the kinematic wave option of the HEC-1 computer program. The kinematic wave parameters prepared by Boyle Engineering were transferred to the model.

5.3.4 Curve Number and Percent Impervious

Curve numbers and percentage of impervious were transferred from the Boyle Study.

5.3.5 Channel Routing

Normal depth routing was used to route hydrographs between concentration points. Routing lengths and slopes were obtained from the topographic maps provided by the City. A 4 foot wide channel with 3:1 side slopes was assumed for all routing reaches.

5.3.6 Storage Routing

Modified Puls level pool routing option was used to model detention basins. Stage-area relationship for the existing basin at the Ball Park was obtained from as-built grading plans for Papago Park. A stage discharge table was established using the geometry obtained from the grading plans and by assuming critical depth at the outlet. Storage at the Army Reserve (Basin 510) and at the Riding Club (Basin 10) were modeled using the design assumptions as discussed in Section 5.5 - Runoff Mitigation.

5.3.7 HEC-1 Output and Summary

Results of the HEC-1 modeling are summarized in **TABLE 5.1**. Printouts of the input model files, schematic diagrams of the stream network, and runoff summary output tables are included in **Appendix C**.

TABLE 5.1
SUMMARY OF HEC-1 OUTPUT

Concentration Point Description	3-36" Culvert	4-36" Culvert	Hubbell Street	Army Reserve	Ridding Club	Water Tanks
Basin ID	1010	910	810	510	10A,10B	210
Area (acres)	44.2	53.8	37.8	44.8	51.2	34.6
2-Year Flow (cfs)	7	0	4	5	45	46
10-Year Flow (cfs)	42	29	31	38	99	103
100-year Flow (cfs)	126	128	97	120	186	183

5.4 Comparison to Other Studies

The results of this study are very similar to that contained in the Boyle report since most of the parameters were transferred from that report. Differences between the two studies reflect changes in the basin boundaries and the addition of the storage basins at the Ball Park. The PBQ&D Final Drainage Study and the Papago Park drainage study used the Rational Method for peak runoff estimation and the results from these studies are significantly lower than the peaks generated by this study. A tabulated comparison of the results from the four different studies is included in **Appendix C**.

5.5 Runoff Mitigation

The most challenging aspect of this study is to develop and evaluate alternatives for mitigating the impacts of offsite runoff. The reason it is a challenge is that there are no funds budgeted for a storm drain outfall from 64th Street. AGK's approach to mitigation includes breaking down each sub-area as a separate challenge for mitigation. Then, mitigation measures were evaluated by the use of detention basins, existing culverts, and/or storm drains only in 64th Street. A matrix of alternatives and the recommended combination is included as **TABLE 5.2**. As with the onsite storm drain solution, reuse of the 45" waterline in Thomas Road is a key assumption.

Listed below are summaries of the drainage features in each of these basins and the drainage improvement proposed. They are listed from south to north (see **PLATE 2**).

5.5.1 Basins 1010 and 910 - Corner of McDowell Road and 64th Street and Ball Park Outlet

The 100-year flows from Basins 1010 and 910 are 126-cfs and 128-cfs, respectively. At the intersection of 64th Street and McDowell Road (concentration point for Basin 1010), there is an existing 3-barrel 36-inch culvert under 64th Street. Also, there is a 4-barrel 36-inch culvert at the Ball Park (Basin 910). These two structures convey the runoff from these two basins to the east side of 64th Street and their hydraulics won't be significantly affected by this project. Therefore, they are proposed to be used as the final drainage solution for basins 1010 and 910.

5.5.2 Basin 810 - Ball Park Outlet and Basin 910 - Hubbell Street

The flow from Basin 810 currently ponds then crosses over 64th Street at Hubbell Street. The proposed road profile at this location is significantly higher than the existing grade. The 100-year drainage solution for this location includes a combination of grading, storm drain and storage. A small portion of the Ball Park would be regraded to direct flows south from Hubbell toward Palm Lane in order to reduce the required length of storm drain. A new 48-inch drain would then convey the flow from this point to the storage basins north of the Autoplex. These basins may need to be increased in size to store the additional flow. The 100-year runoff volume for the upstream area is approximately 5.74 Acre-ft.

5.5.3 Basin 510 - Army Reserve

A combination of storage and up sizing of the proposed onsite storm drain was considered for this location. Several combinations of storage/outflow were analyzed and their performance evaluated. An increase of the proposed storm drain from a 24-inches to a 30-inches and a new 3.4 Acre-ft detention basin was determined to be the optimal solution for this location.

5.5.4 Basins 10A and 10B - Valley Field Riding and Polo Club

The same type of analysis was performed here as for the Army Reserve location. For this location, an up sizing of the proposed storm drain from 24-inch to 36-inch in combination with a 3.9 Acre-ft basin would be able to handle the 100-year flow. These values were calculated assuming the 45" waterline outfall at Thomas Road can convey 60-cfs. The peak flows from Basins 510, 10A, and 10B were assumed to occur concurrently. However, the peak from the on-site runoff was reduced by 50% because the time of concentration for the on-site runoff would be much shorter.

5.5.5 Basin 210 - City of Phoenix Water Tanks

This site has been drastically regraded due to the construction of the four (4) large water storage tanks. It is difficult to determine if flows exit or are retained on site. If no retention is available, the HEC-1 model output shows a 100-year peak flow of 138 cfs. Nevertheless, it was noticed that there are several locations where aerial maps show retention of runoff does or could occur (see **PLATE 2**.) Additionally, construction of the new retaining and noise walls will provide a partial barrier to runoff from the site. For these reasons, this study assumes runoff is retained or could be made to be

retained onsite. Our understanding is that the flooding problem from this area is not only from direct runoff but also from the water tanks overflowing during periods of low irrigation water consumption (rain storms). It is difficult to determine whether runoff from the water tank is due to storm water or tank overflows. Spillage from the water tanks is beyond the scope of this study but it is assumed that the owner will mitigate any problems associated with spillage in a manner that will not affect the storm drain performance during peak flows.

5.5.6 Basin 30 - North of Thomas Road

Flow from this basin (Basin 30) presently floods the parking lot at the northwest corner of Thomas Road and 64th Street. There is an existing storm drain under Thomas Road that takes overflow from the water tanks site as well as runoff from Thomas Road and conveys it to the parking lot. This problem would be reduced by disconnecting the storm drain and grading a berm on the south side of the parking lot. Additional reduction of flooding potential would occur by regrading the parking lot to drain to the north. Since the existing drainage path is towards the north and away from the study area, further analysis is beyond the scope of this project.

TABLE 5.2 shows a matrix of the alternatives analyzed for this project with the proposed alternative shaded. The combined off-site solution calls for three (3) new basins and the possible upgrade of a fourth. It also calls for up-sizing the storm drain north of Oak Street and for a new 48" storm drain to the Autoplex basin. The recommendations contained in **TABLE 5.2** are based on an assumption of an adequate outfall at Thomas Road. If limitations are encountered in the existing 45" water main, flow in the storm drain may have to be further reduced by increasing detention basins storage.

If the existing 45" water main cannot be used as a storm drain, there are two options that can be considered. These two options must, however, be constructed in conjunction with a new major outfall, most likely constructed as part of the FCDMC ADMS. The first option would be to expand the retention basin on the Valley Field Riding & Polo Club property (Basins 10A and 10B). The depth of the basin would be increased to 17 feet to take street flow (at reverse grade) from the north end of 64th Street. A pump station would be needed to drain the basin to a new storm drain running south to Oak Street, east to 66th Street, then south on 66th Street. The second option would be to construct a new storm drain in Thomas Road. The costs for both of these options are considerably higher than the solution proposed herein utilizing the existing 45" waterline.

TABLE 5.2
OFF-SITE DRAINAGE ALTERNATIVES

Concentration Point	Alternatives				
	Culvert under 64th Street	Additional Storage	Storm Drain	Recommended 10-year Alternative	Recommended 100-Year Alternative
64th Street @ McDowell	**Existing 3-36" Culvert**				
64th Street @ Ball Park	**Existing 4-36" Culvert**				
64th Street @ Hubbell St.	New 2-1.5' X 5' Box (100-year flow)			Pipe =30" Additional Storage = 2.58 Acre-ft	Pipe = 48" Additional Storage = 5.74 Acre-ft
		Upgrade Autoplex Detention	**Grade to Palm Lane and Install New 48" Pipe to Autoplex Detention**		
		New Detention Basin (On west side)	Detention Outlet to Autoplex Detention		
64th Street @ Army Reserve Basin 510	New 2-1.5' X 6' Box (100-year flow)			Storage = 1.05 acre-ft Up size 2270 Lf of 24" to 30"	Storage = 3.4 acre-ft Up size 2270 LF of 24" to 30"
		New Detention Basin with Outlet to Storm Drain	**Up Size 64th St. Storm Drain**		
		New Detention with Outlet to Basin 10	Open ditch from basin 510 to basin 10		
64th Street @ Ridding Club Basin 10	New 2-2' X 7' Box (100-year flow)			Storage = 2.79 acre-ft Up size 780 LF of 24" to 30"	Storage = 3.9 acre-ft Up size 780 LF of 24" to 36"
		New Detention Basin With Outlet to Storm Drain	**Up Size 64th St. Storm Drain**		
		New Retention Basin			
64th Street @ Water Tanks	New 2-2' X 7' Box (100-Year Flow)	**On Site Retention**	Connect to 45" abandoned Water Line		

5.6 Initial Cost Estimate

This opinion of probable cost was based on approximate quantities and may not include some of the items needed for construction of the storm drain. A contingency of 15% was added to cover the cost of these unidentified items. An initial cost estimate for off-site drainage facilities for 10-year and 100-year events are shown in **TABLE 5.3** and **TABLE 5.4** respectively.

TABLE 5.3
INITIAL COST ESTIMATE FOR OFF-SITE STORM DRAIN - 10 YEAR FLOW

ITEM NO.	OFF-SITE STORM DRAIN UPSIZING: ITEM DESCRIPTION	QTY.	UNIT	UNIT PRICE	EXTENDED PRICE
	Land Purchase	2.9	ACRE	$25,000.00	$72,500
	Landscaping	40400	SQ.FT.	$1.50	$60,600
	Earthwork	9600	CU.YD.	$3.00	$28,800
	Outlet at Autoplex Basin	1	EA.	$5,000.00	$5,000
	Inlet Per MAG Std. Det. 535	2	EA.	$5,000.00	$10,000
	Headwall Inlet	1	EA.	$3,000.00	$3,000
618124	24" RGRCP Connector Pipe.	120	L.F.	$50.00	$6,000
618130	30" RGRCP SD	670	L.F.	$60.00	$40,200
618130	Up size from 24" to 30" RGRCP SD	3050	L.F.	$8.00	$24,400
	Off-Site 10-Year Storm Drain Sub-Total Cost				$250,500
	15% Contingency				$37,575
	ESTIMATED COST FOR 10-YR OFF-SITE STORM DRAIN				**$288,075**

TABLE 5.4
INITIAL COST ESTIMATE FOR OFF-SITE STORM DRAIN - 100 YEAR FLOW

ITEM NO.	OFF-SITE STORM DRAIN UPSIZING: ITEM DESCRIPTION	QTY.	UNIT	UNIT PRICE	EXTENDED PRICE
	Land Purchase	3.2	ACRE	$25,000.00	$80,000
	Landscaping	46,000	SQ.FT.	$1.50	$69,000
	Earthwork	24,000	CU.YD.	$3.00	$72,000
	Outlet at Autoplex Basin	1	EA.	$5,000.00	$5,000
	Inlet Per MAG Std. Det. 535	2	EA.	$5,000.00	$10,000
	Headwall Inlet	1	EA.	$3,000.00	$3,000
618130	30" RGRCP Connector pipe	60	L.F.	$60.00	$3,600
618124	24" RGRCP Connector Pipe.	60	L.F.	$50.00	$3,000
618148	48" RGRCP SD	670	L.F.	$100.00	$67,000
618136	Up size from 24" to 36" RGRCP SD	780	L.F.	$15.00	$11,700
618130	Up size from 24" to 30" RGRCP SD	2,270	L.F.	$10.00	$22,700
	Off-Site 10-Year Storm Drain Sub-Total Cost				$347,000
	15% Contingency				$52,050
	ESTIMATED COST FOR 100-YR OFF-SITE STORM DRAIN				**$399,050**

6.0 CONCLUSION

This study presents a conceptual plan for drainage improvements for this project. Refinement of these improvements will be part of the preliminary and final design construction plans and specifications. **PLATE 2** and **Appendix B, Figures B-1** through **B-11** show the proposed storm drain system developed for the improved 64th Street. This storm drain system will meet the needs of vehicular travel along 64th Street, Hy-View residents, and the City of Scottsdale.

Outfall improvements must come from City of Scottsdale capital improvement plan for storm drain facilities. Overall cost for the on-site storm drain system presented in this study is approximately $296,000. It is recommended that this study be used in the development of 64th Street construction plans and specifications. **TABLE 6.0** shows an updated comprehensive project cost estimate.

TABLE 6.0
UPDATED TOTAL PROJECT COST ESTIMATE

ITEM NO.	DESCRIPTION	QTY.	UNIT	UNIT PRICE	EXTENDED PRICE
104250	Project Hotline	1	L.S.	$3,000.00	$3,000
105801	Construction Stakes, Lines and Grades	1	L.S.	$15,000.00	$15,000
107001	Permits and Fees	1	L.S.	$2,500.00	$2,500
201002	Remove Existing Business Sign	3	EACH	$300.00	$900
301201	Subgrade Preparation	42000	S.Y.	$2.50	$105,000
310106	6" Select Base material	42000	S.Y.	$2.50	$105,000
310110	10" Compacted A.B.C.	42000	S.Y.	$4.25	$178,500
321106	6.5" A.C. (A-1-1/2)	42000	S.Y.	$7.50	$315,000
321101	1.5" A.C. (D-1/2)	51333	S.Y.	$2.00	$102,667
340001	6" Vertical Curb and Gutter per MAG Detail 220, Type A	26500	L.F.	$7.50	$198,750
340061	Single Curb/Curb Termination per MAG Detail 222, Type A	682	L.F.	$9.10	$6,206
340201	Concrete Sidewalk per MAG Detail 230	2000	S.F.	$1.70	$3,400.00
340262	Sidewalk Ramp, MAG Det. 232	4	EACH	$250.00	$1,000.00
340264	Sidewalk Ramp, MAG Det. 234	4	EACH	$350.00	$1,400.00
340302	Concrete Valley Gutter, C O S Det. 2240	1864	S.F.	$4.00	$7,456.00
340406	Concrete driveway, MAG Det. 250	1800	S.F.	$2.70	$4,860.00
342001	Decorative Paver Crosswalk, Det. 2238	2200	S.F.	$10.00	$22,000.00
343002	Exposed Aggregate Concrete Pavement per Detail on Sht. 4	6600	S.F.	$5.00	$33,000.00
345001	Manhole Frame and Cover Adjustment per COS Detail 2270	8	EA.	$275.00	$2,200.00
350040	Remove Concrete Curb	500	L.F.	$2.50	$1,250.00
350041	Remove Concrete Curb and Gutter	5450	L.F.	$2.85	$20,000.00
350061	Remove Concrete Sidewalk, Valley Gutter, or Driveway	1500	S.F.	$1.00	$1,500.00
350201	Remove Irrigation Pipes	100	L.F.	$10.00	$1,000.00
350301	Remove Irrigation Structure	1	EA.	$300.00	$300.00

ITEM NO.	DESCRIPTION	QTY.	UNIT	UNIT PRICE	EXTENDED PRICE
350341	Remove Existing Catch Basin and Connector Pipe	4	EA.	$250.00	$1,000.00
350801	Miscellaneous Removals and Other Work	1	L.S.	$100,000.00	$100,000.00
401001	Traffic Control	1	L.S.	$100,000.00	$100,000.00
401101	Off Duty Police Officer	300	HRS.	$25.00	$7,500.00
402101	Striping and Signage	1	L.S.	$20,000.00	$20,000.00
403002	2" Conduit/Sleeve with Pull Wire	600	L.F.	$7.00	$4,200.00
403101	Traffic Signal Equipment, per Intersection	3	L.S.	$50,000.00	$150,000.00
404001	Signal Detector Loops (6'X40')	12	EA.	$700.00	$8,400.00
404002	Signal Detector Loops (6'X6')	15	EA.	$700.00	$10,500.00
405001	Survey Monument, MAG Detail 120-1 Type A	3	EA.	$280.00	$840.00
405101	Survey Monument, MAG Detail 120-1 Type B	2	EA.	$280.00	$560.00
430811	Landscaping and Planting (Medians)	1	L. S.	$129,000.00	$129,000.00
430831	Landscape Restoration (Private Property)	8000	S. F.	$1.50	$12,000.00
440811	Irrigation System (Medians)	1	L. S.	$107,500.00	$107,500.00
440831	Irrigation System (Private Property)	8000	S. F.	$1.25	$10,000.00
505113	Inlet Per Phx. Det. M1, L=6	3	EA.	$2,500.00	$7,500.00
505114	Inlet Per Phx. Det. M1, L=10	10	EA.	$2,500.00	$22,500.00
505117	Inlet Per Phx. Det. M1, L=17	2	EA.	$3,000.00	$3,000.00
505914	Double 14' Gate	2	L. S.	$2,800.00	$5,600.00
510008	8' Masonry Noise Wall	5200	L. F.	$80.00	$416,000.00
	Integrated Art Features	1	L. S.	$40,000.00	$40,000.00
	15' Retaining Wall	740	L. F.	$315.00	$233,100.00
	3' Concrete Jersey Barrier	1200	L. F.	$100.00	$120,000.00
615108	8" Sanitary Sewer	140	L.F.	$35.00	$4,900.00
615808	8" Sanitary Sewer Cleanout	2	EA.	$500.00	$1,000.00
618115	18" RGRCP Connector Pipe.	440	L.F.	$45.00	$15,975.00
618124	24" RGRCP SD	3250	L.F.	$50.00	$162,500.00
618136	36" RGRCP SD	200	L.F.	$65.00	$13,000.00
	Renovate 45" waterline in Thomas Road	1	L.S.	$50,000.00	$50,000.00
625001	4' Sanitary Sewer Manhole per MAG Dets. 420 and 424	2	EA.	$1,800.00	$3,600.00
625013	4' Sanitary Sewer Drop Manhole per MAG Dets. 420, 424, and 425	1	EA.	$2,500.00	$2,500.00
625014	5' Sanitary Sewer Drop Manhole per MAG Dets. 420, 424, and 425	2	EA.	$1,800.00	$3,600.00
628001	4' Storm Sewer Manhole per MAG Dets. 520 and 524	10	EA.	$1,800.00	$18,000.00
640301	No. 5 Pull Box	48	EA.	$125.00	$6,000.00
640324	Relocate Existing SRP Street Light	12	EA.	$500.00	$6,000.00
640311	1" Conduit, Pull Box to Pole	80	L.F.	$4.50	$360.00
640312	2" Conduit/Sleeve, with Pull Wire	10000	L.F.	$2.50	$25,000.00
	SUBTOTAL COST OF IMPROVEMENTS				$2,953,524
	15% CONTINGENCY				$443,029
	TOTAL ESTIMATED 1996 CONSTRUCTION COST				**$3,396,553**

NOTE: THIS COST ESTIMATE DOES NOT INCLUDE SRP COSTS FOR NEW STREET LIGHTS AND LUMINAIRES, RIGHT-OF-WAY ACQUISITION, OFF-SITE DRAINAGE FACILITIES, ENGINEERING DESIGN, UTILITY COMPANY CHARGES, OR CONSTRUCTION INSPECTION AND TESTING

ITEM NO.	DESCRIPTION	QTY.	UNIT	UNIT PRICE	EXTENDED PRICE
	Roadway construction cost	1	L.S.	$2,953,524	$2,953,524
	Offsite Drainage 10-year	1	L.S.	$250,500	$250,500
	SUBTOTAL COST OF IMPROVEMENTS				$3,204,024
	15% CONTINGENCY				$480,604
	TOTAL ESTIMATED 1996 CONSTRUCTION COST INCLUDING 10-YEAR OFF-SITE DRAINAGE				**$3,684,628**

ITEM NO.	DESCRIPTION	QTY.	UNIT	UNIT PRICE	EXTENDED PRICE
	Roadway construction cost	1	L.S.	$2,953,524	$2,953,524
	Offsite Drainage 100-year	1	L.S.	$347,000	$347,000
	SUBTOTAL COST OF IMPROVEMENTS				$3,300,524
	15% CONTINGENCY				$495,079
	TOTAL ESTIMATED 1996 CONSTRUCTION COST INCLUDING 100-YEAR OFF-SITE DRAINAGE				**$3,795,603**

APPENDIX A

ON-SITE STORM DRAIN CALCULATIONS

STORM DRAIN INLET

DESIGN CALCULATIONS

SHEET 1A OF
BY GS DATE 12/14/95
CHECK DATE
JOB NO. 410.32

CLIENT C.O.S.
JOB NAME 64th St.

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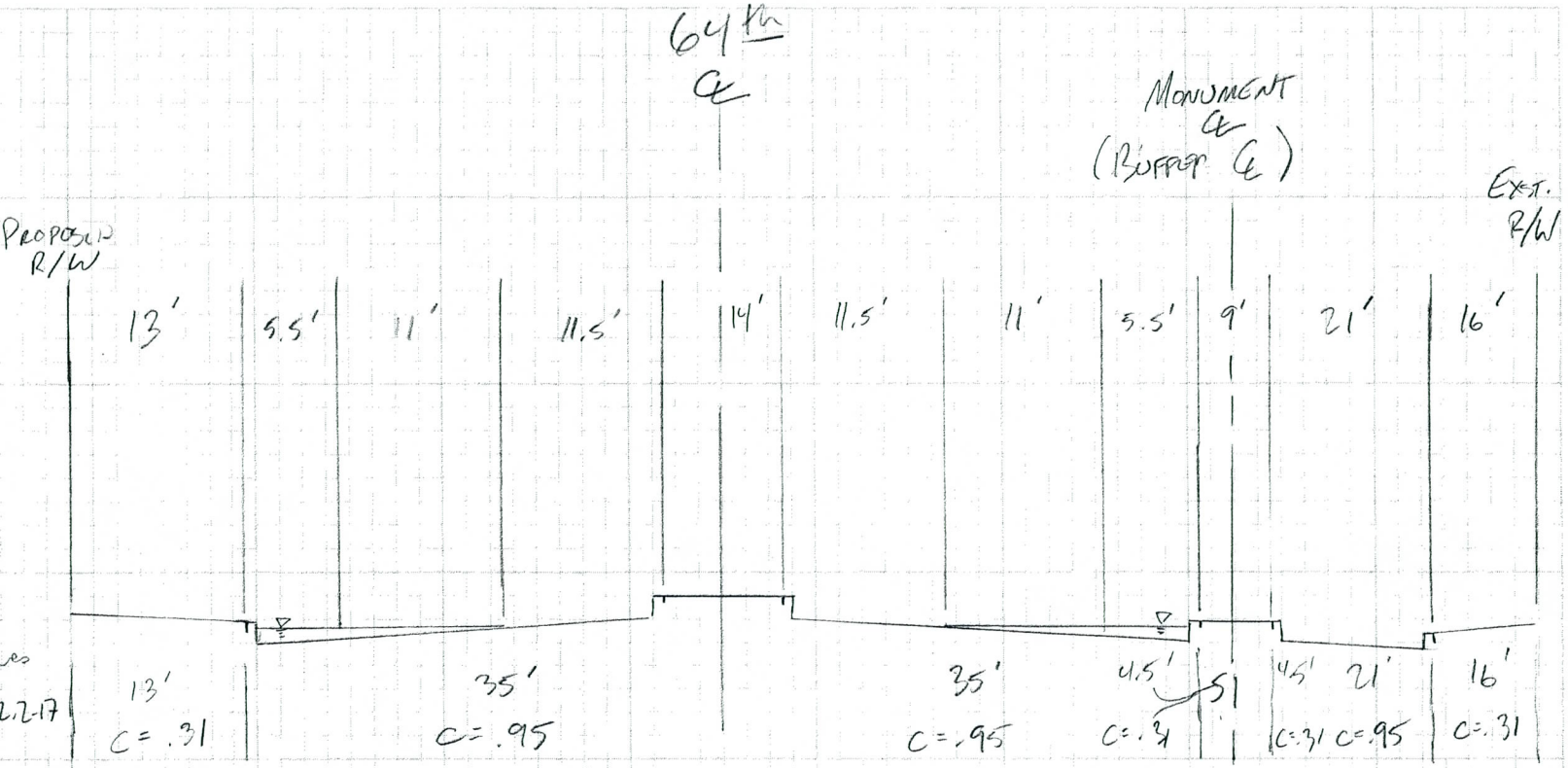

* C-values from Figure 2.2-17

$C = \frac{13}{48}(.31) + \frac{35}{48}(.95)$

$C = .78$ *(.87 when R/W width is 40')

$C = \frac{35}{39.5}(.95) + \frac{4.5}{39.5}(.31)$

$C = .88$

$C = \frac{20.5}{41.5}(.31) + \frac{21}{41.5}(.95)$

$C = .63$

Water Surface:

width = 16' cross slope = 2%

depth = 16' × .02 = .32'

area = 16 × .32 × .5 = 2.56 ft²

WEIGHTED "C" FACTOR

CALCULATION

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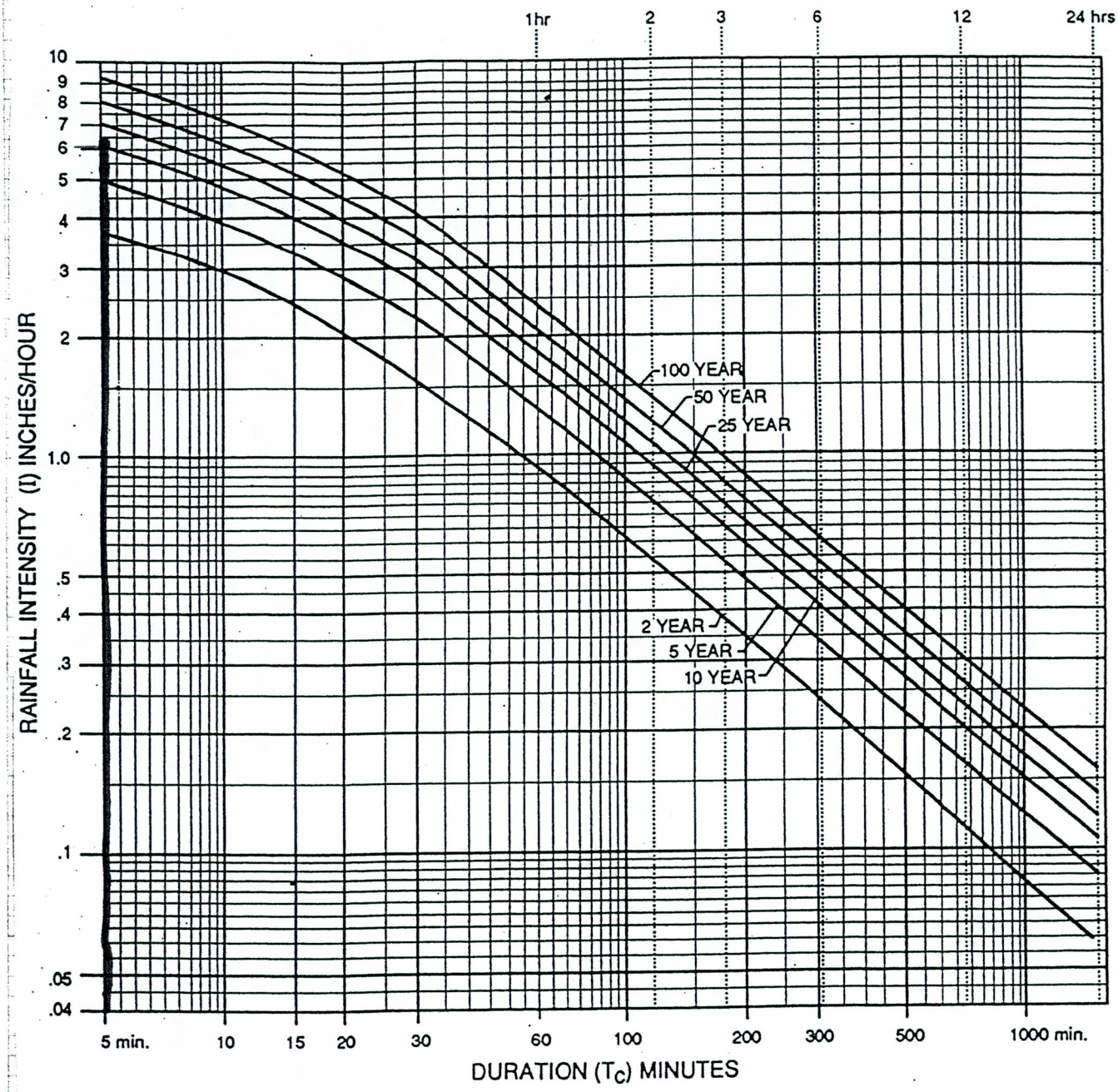

FIGURE 2.2-13

Rainfall Intensity (I) Values for Use in Rational Method

Source: Hydrologic Design Manual for Maricopa County

AREA: (TYPICAL)
T_c: 5.0 min.
I_{10}: 6.1 in/hr.

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AREA 1W

C: $C = .78$

I: Length = 780' $s = .0056$ 1/1

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .0056^{.5} \; 32^{.67}$$

$$= 3.00 \text{ fps}$$

$$T_c = 780' / (3 \times 60) = 4.33 \text{ 5 min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = 780' × 48' = 0.86 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.78)(6.1)(.86)1.00 + 0$$

$$= 4.09 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{4.09(.013)(.02)}{.56(.0056)^{.5}}\right)^{3/8}$$

$= 0.25'$ water surface width $= .25/.02 = 12.5'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = 0.39$ $L = Q/0.39$

$$= 4.09/.39$$

$$= 10.49$$

∴ use C.O.P. Catch Basin Type M-1, L=10'

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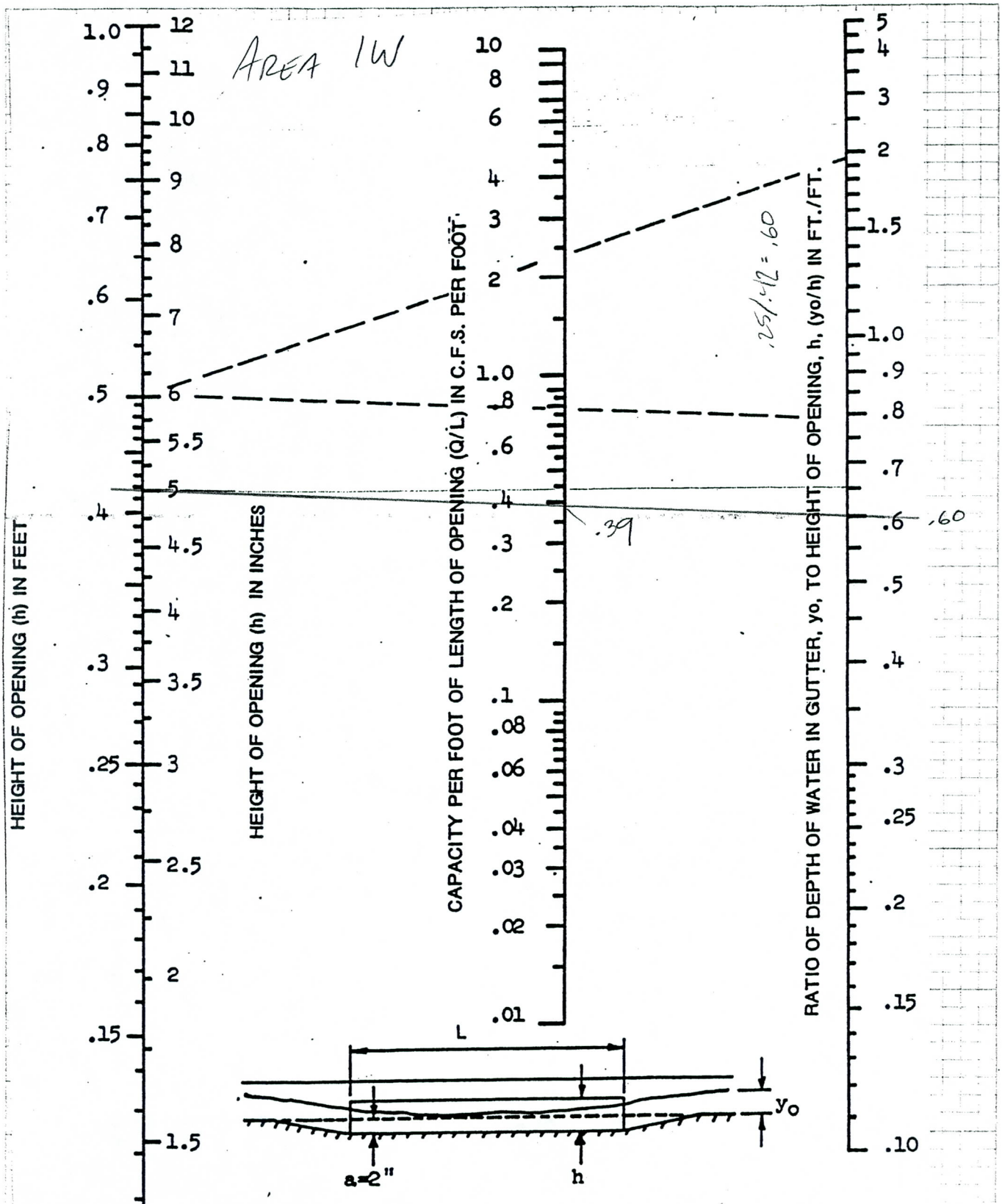

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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JOB NO. 410.32

AREA 2W

C: $C = .78$

I: Length = 1350' $s = .0040\ 1/1$ 1350' .004

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .004^{.5} .32^{.67}$$

$$= 2.54 \text{ fps}$$ 2.54

$$T_c = 1350' / (2.54 \times 60) = 8.86 \text{ min.}$$ 8.86

Fig 2.2-13: Rainfall Intensity $I_{10} = 5.0$ in/hr. 5.0

A: Area = 1350' × 48' = 1.49 acres 1.49

$$Q_{10} = C\, I_{10}\, A\, F_{10} + Q_b$$

$$= (.78)(5.0)(1.49)1.00 + \cancel{0}$$

$$= 5.81 \text{ cfs}$$ 5.81

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{5.81\,(.013)(.02)}{.56(.004)^{.5}}\right)^{3/8}$$

$$= 0.31'$$ water surface width = .31/.02 = 15.5'
< 16' ∴ OK

Fig 3-46 $Q_i = .89(5.81) = 5.17$ cfs

$$Q_b = Q - Q_i = 5.81 - 5.17 = 0.64 \text{ cfs}$$

∴ use C.O.P. Catch Basin Type M-1, L = 17'

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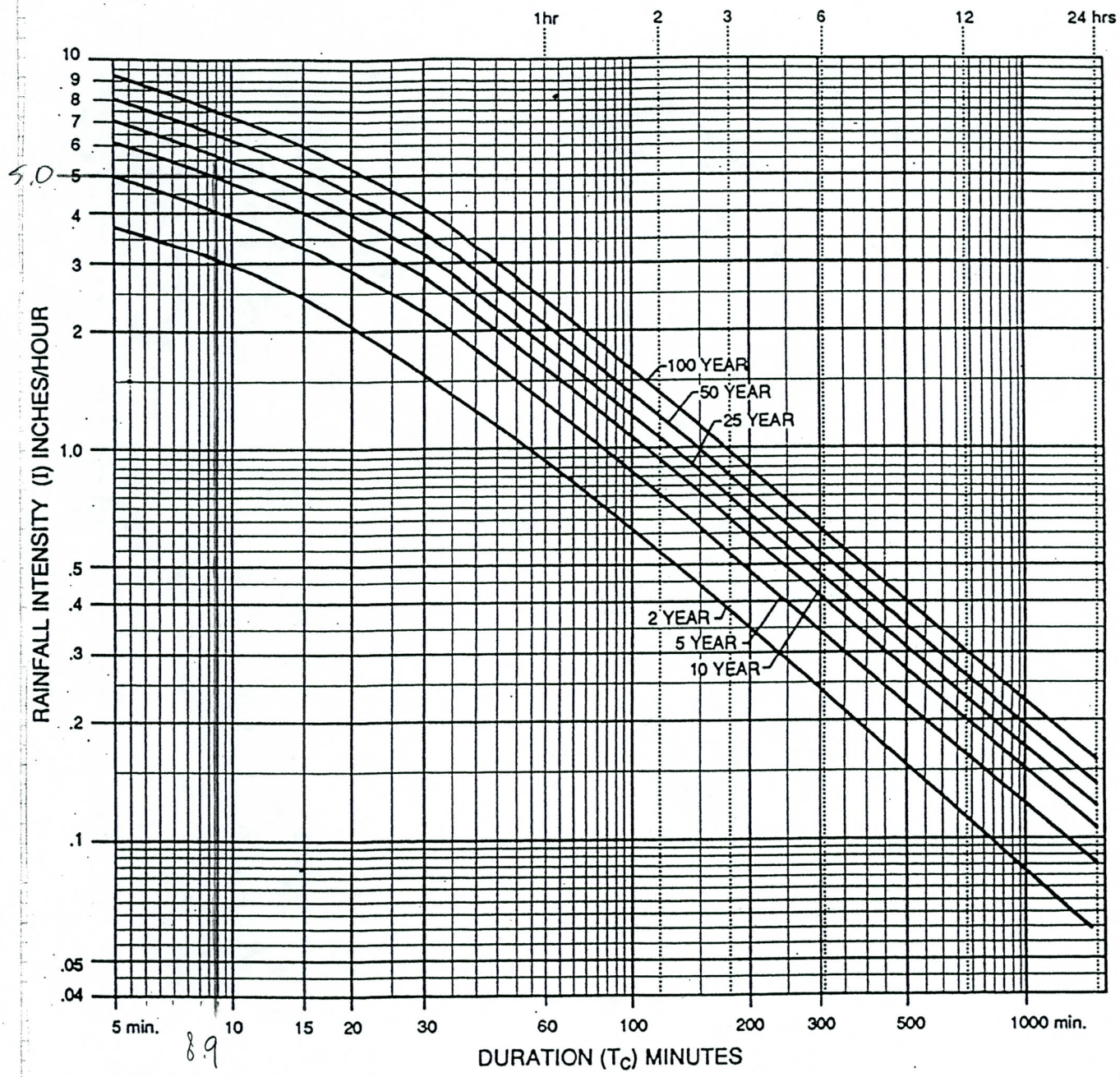

FIGURE 2.2-13

Rainfall Intensity (I) Values for Use in Rational Method

Source: Hydrologic Design Manual for Maricopa County

AREA: 2W

T_C: 8.9 min

I_{10}: 5.0 in/hr

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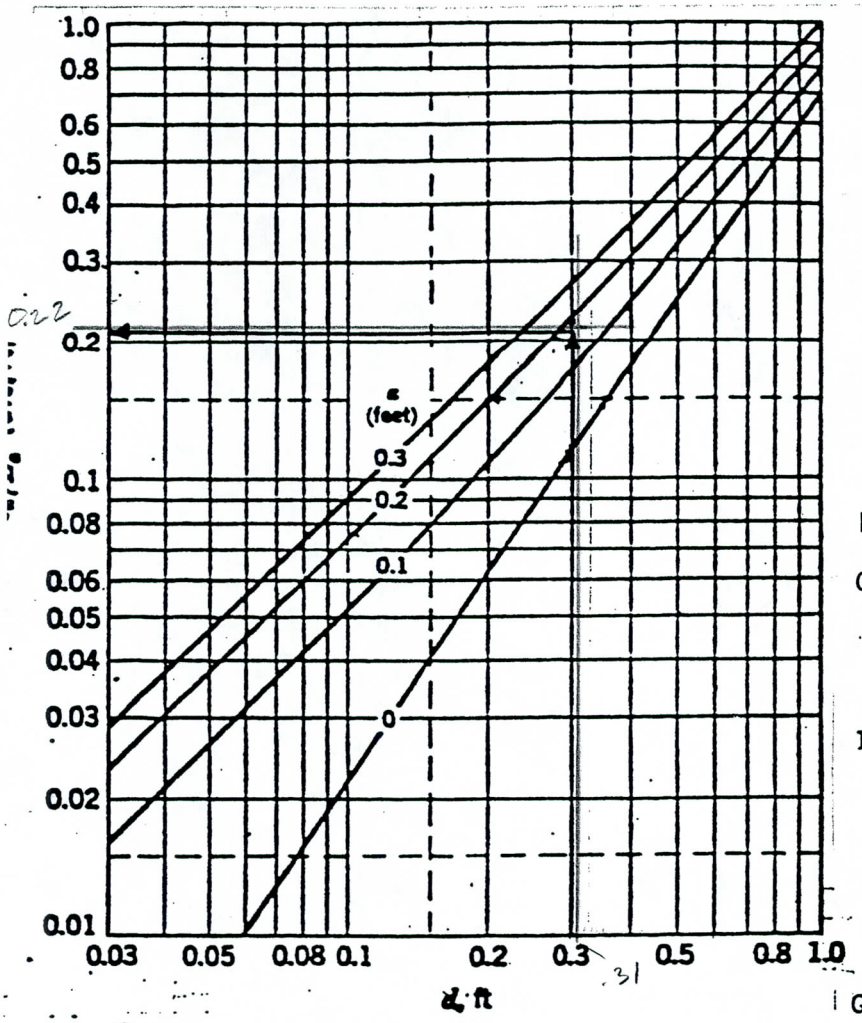
JOB NO. 410.32

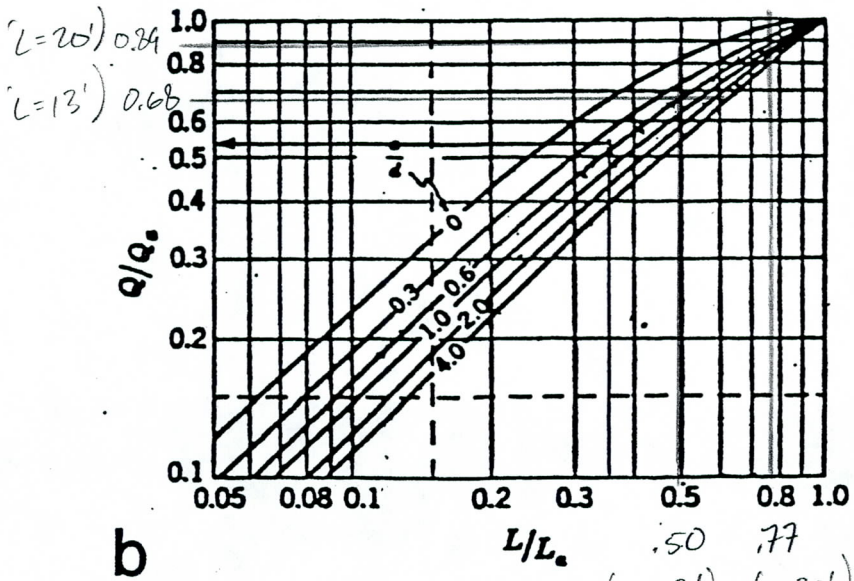


a

FIGURE 3-46

DESIGN CHARTS FOR CURB-OPENING INLETS ON CONTINUOUS GRADES

AREA: 2W



b

EXAMPLE USING FIGURE 3-46a

Given:

$d = 0.3'$ $\quad d = 0.31'$

$a = 0.167'$ (2") $\quad a = 0.167'$

Find:

$\frac{Q_a}{L_a} = 0.21$ cfs/ft. $\quad \frac{Q_a}{L_a} = 0.22$

EXAMPLE USING FIGURE 3-46b

Given:

The above information and

$Q_a = 5.9$ cfs $\quad Q = 5.81$

$L = 10'$ $\quad L = 20'$

Find: Q

$\frac{a}{d} = \frac{0.167}{0.3} = 0.56$ $\quad \frac{a}{d} = 0.54$

$L_a = \frac{5.9}{0.21} = 28'$ $\quad L_a = 26'$

$\frac{L}{L_a} = \frac{10}{28} = 0.36$ $\quad \frac{L}{L_a} = \frac{20}{26} = 0.77$

$\frac{Q}{Q_a} = 0.53$ $\quad \frac{Q}{Q_a} = 0.89$

$Q = (0.53)(5.9) = 3.1$ cfs

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JOB NAME 64th
JOB NO. 410.32

AREA 3W

C: $C = .87$

I: Length = 1150' $s = .00595$ '/'

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .00595^{.5} .32^{.67}$$

$$= 3.10 \text{ fps}$$

$$T_c = 1150 / (3.1 \times 60) = 6.18 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 5.7$ in/hr.

A: Area = 1300' × 40' = 1.19 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.87)(5.7)(1.19)1.00 + 0.64 + 0.62$$

(2W) (8S)

$$= 7.16 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{7.16(.013)(.02)}{.56(.00595)^{.5}}\right)^{3/8}$$

$= .31'$ water surface width = .31/.02 = 15.5' ∴ OK

Fig. 3-47: $Q/L = 0.54$ $L = Q/0.54$

$= 7.16/0.54$

$= 13.26'$

∴ use C.o.P. Catch Basin Type M-1, L = 17'

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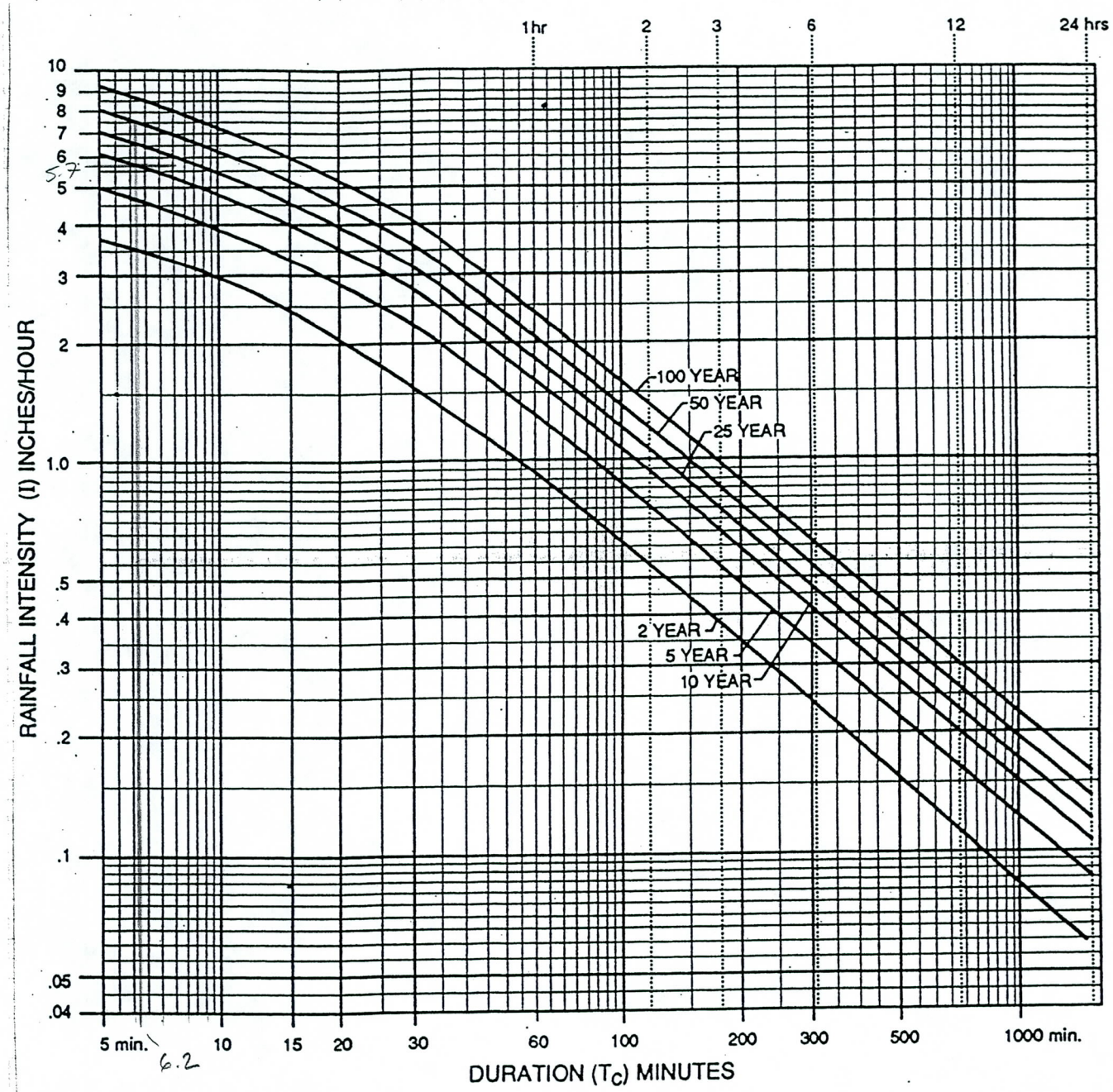

FIGURE 2.2-13

Rainfall Intensity (I) Values for Use in Rational Method

Source: Hydrologic Design Manual for Maricopa County

AREA: 3W
T_c: 6.2 min
I_{10}: 5.7 in/hr.

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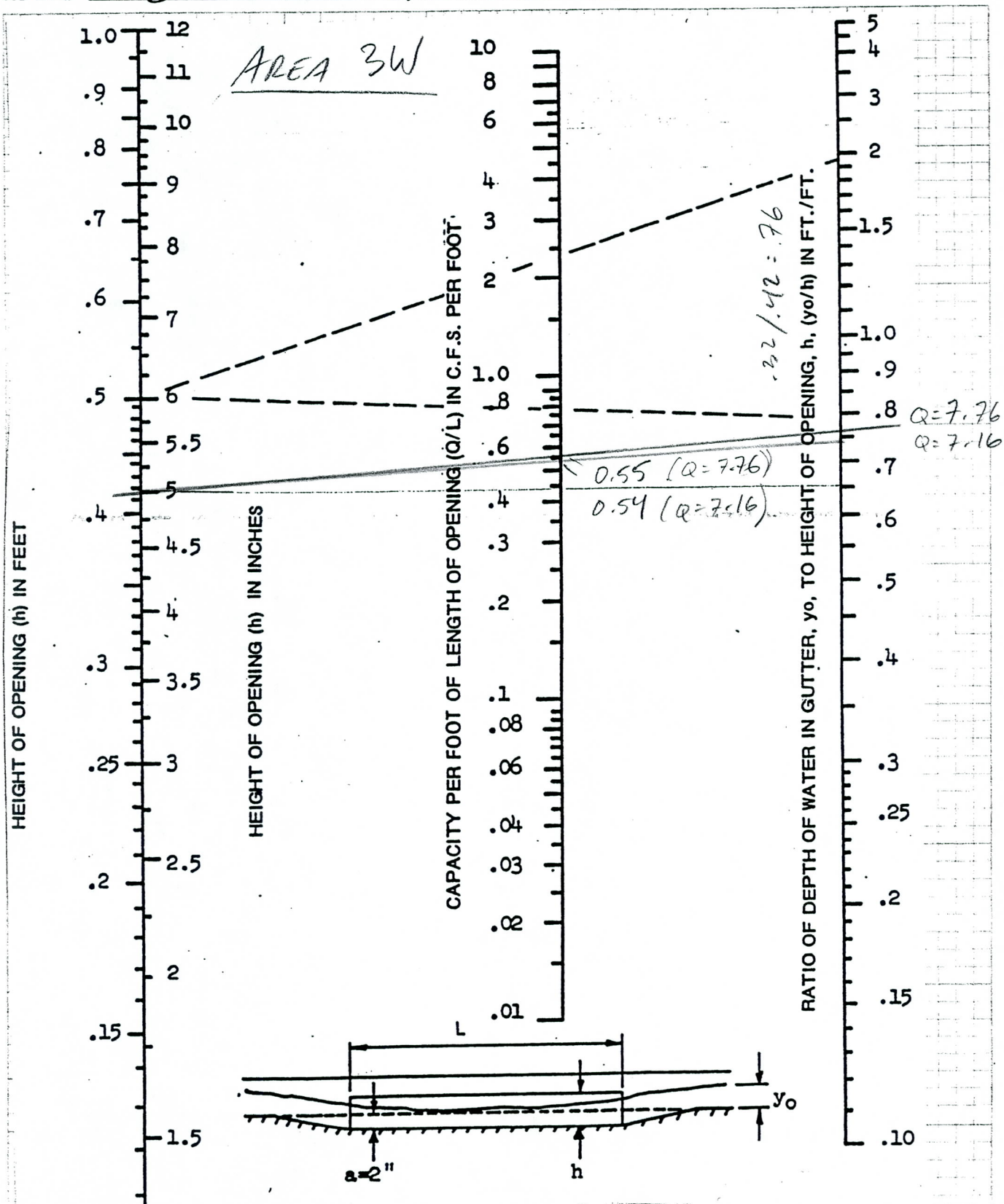

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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JOB NAME 64th
JOB NO. 410.32

AREA 1E

C: $C = .88$

I: Length = 780' $s = .0056$ 1/1

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .0056^{.5} .32^{.67}$$

$$= 3.00 \text{ fps}$$

$$T_c = 780' / (3.0 \times 60) = (4.33) \ 5 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = 780' × 40' = 0.72 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.88)(6.1)(.72)1.00 + \cancel{0}$$

$$= 3.86 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{3.86(.013)(.02)}{.56(.0056)^{.5}}\right)^{3/8}$$

$= 0.25'$ water surface width $= .25/.02 = 12.5'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = 0.39$ $L = Q/0.39$
$= 3.86/0.39$
$= 9.9'$

∴ use C.o.P. Catch Basin Type M-1, L = 10'

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JOB NAME 64th STREET IMPROVEMENTS
JOB NO. 410.32

AREA 1E

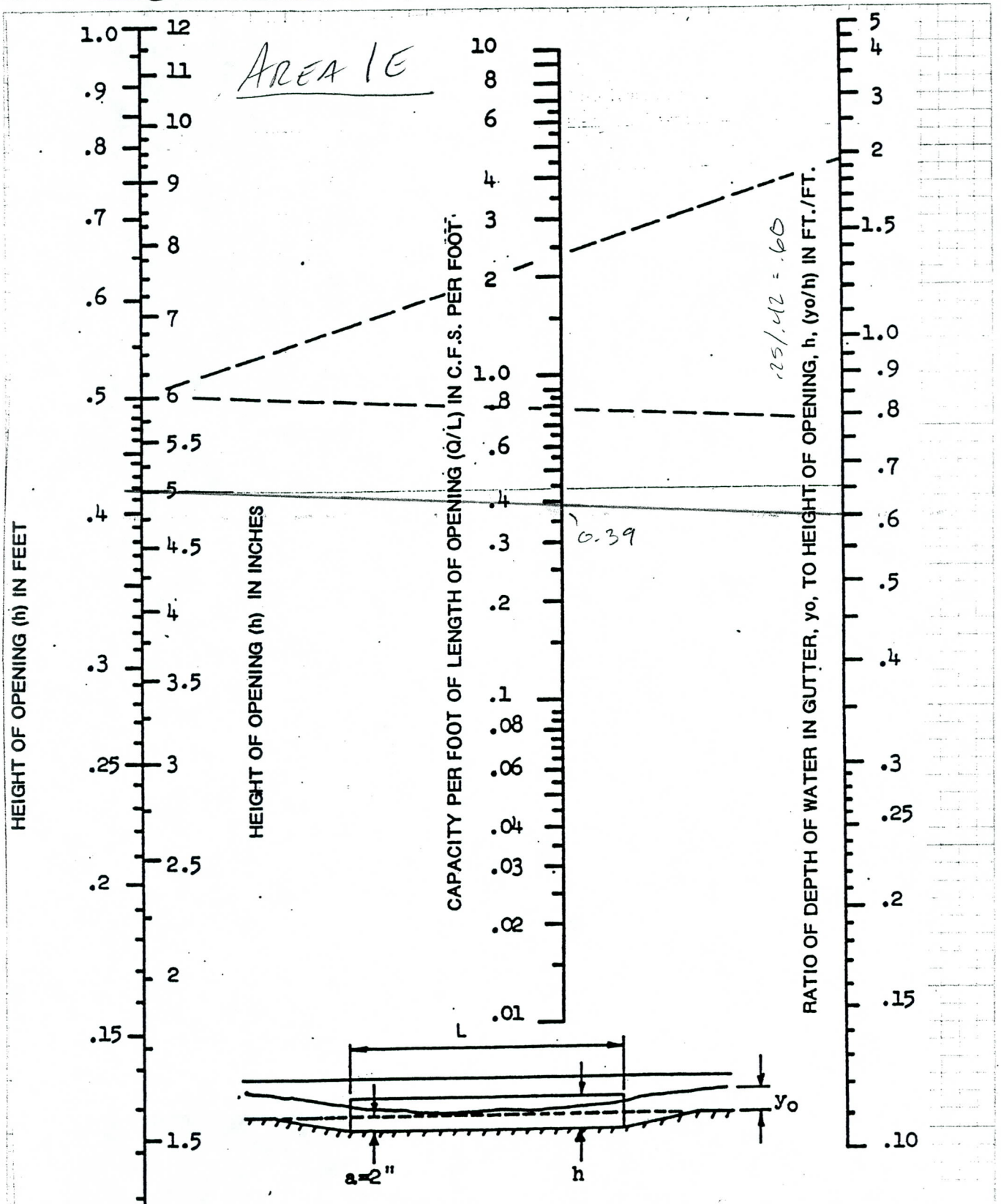

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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JOB NAME 64th
JOB NO. 410.32

AREA 2E

C: $C = .88$

I: Length = 1170' $s = .0040'/'$

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .004^{.5} .32^{.67}$$

$$= 2.54 \text{ fps}$$

$$T_c = 1170 / (2.54 \times 60) = 7.68 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 5.2$ in/hr.

A: Area = 1170' × 40' = 1.07 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.88)(5.2)(1.07)1.00 + \cancel{0}$$

$$= 4.90 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{4.9\,(.013)(.02)}{.56(.004)^{.5}}\right)^{3/8}$$

$= 0.29'$ water surface width $= .29/.02 = 14.5'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = 0.48$ $L = Q/0.48$
$= 4.9/0.48$
$= 10.21'$

∴ use C.o.P. Catch Basin Type M-1, L=10'

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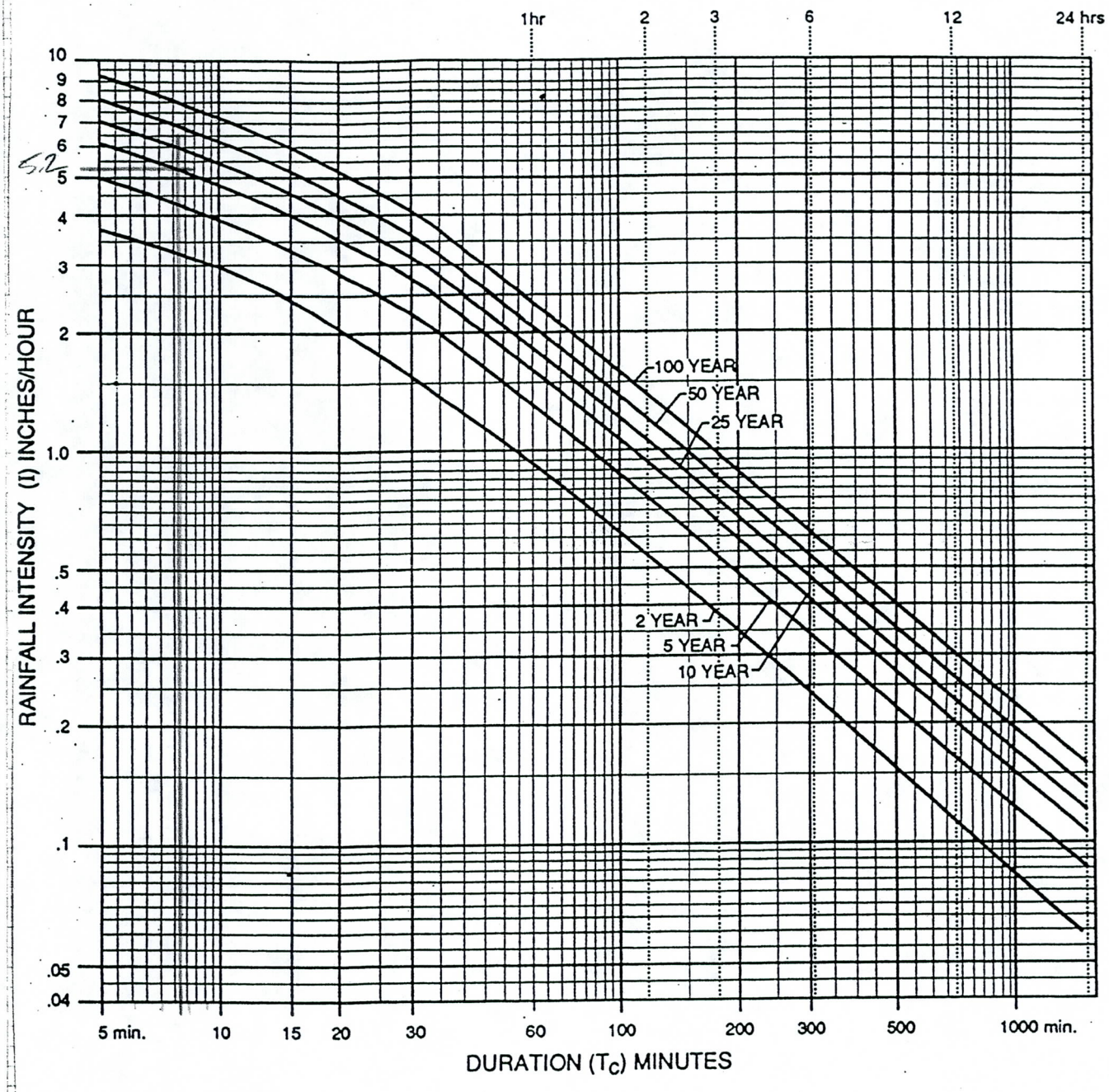

FIGURE 2.2-13

Rainfall Intensity (I) Values for Use in Rational Method

Source: Hydrologic Design Manual for Maricopa County

AREA: 2E
T_C: 7.7 min.
I_{10}: 5.2 in/hr.

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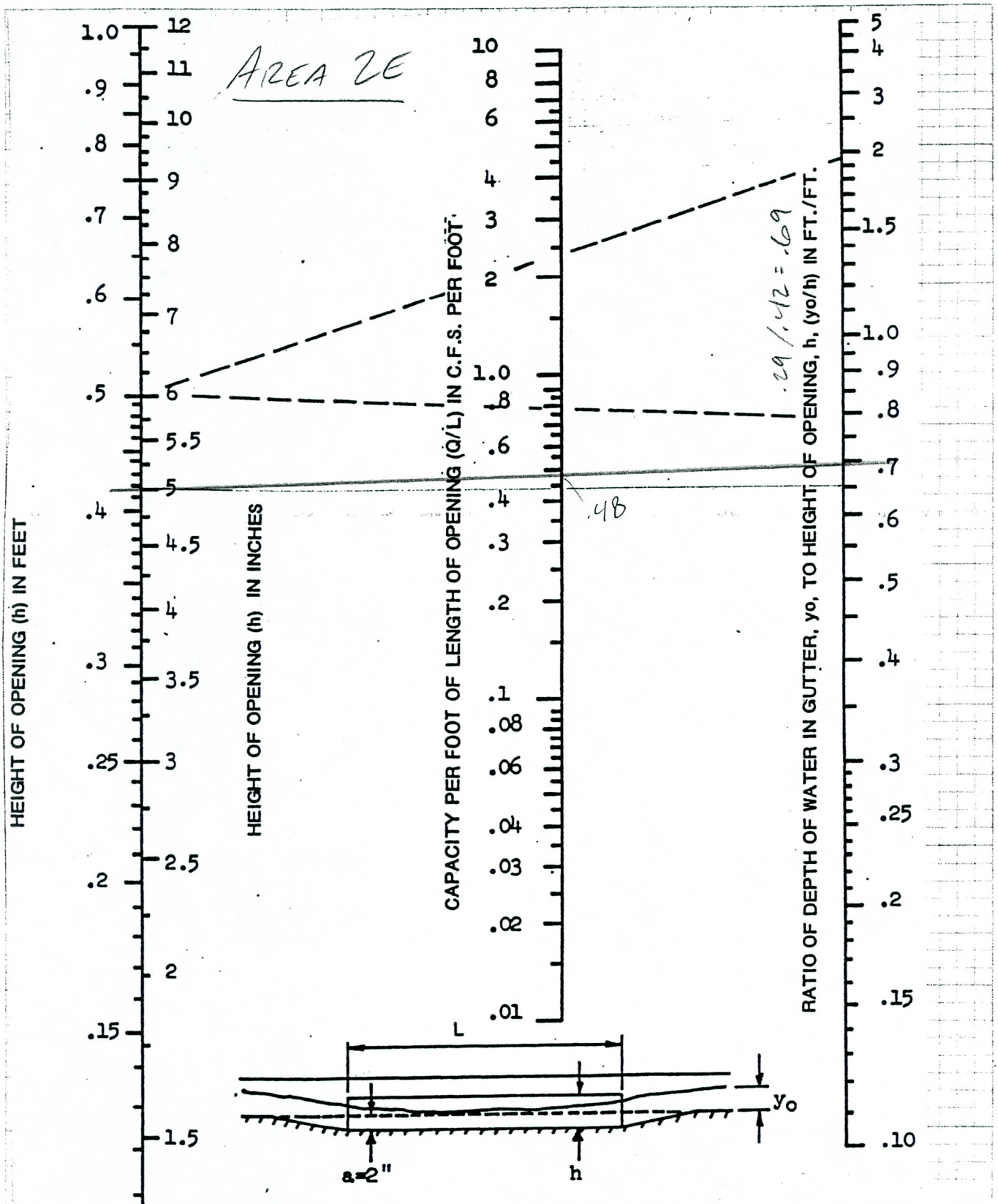

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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AREA 3E

C: $C = .88$

I: Length = 920' $s = .00596$ 1/1

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .00596^{.5} .32^{.67}$$

$$= 3.10 \text{ fps}$$

$$T_c = 920 / (3.10 \times 60) = (4.95)\ 5 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = 920' × 40' = 0.84 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.88)(6.1)(.84)1.00 + 0$$

$$= 4.51 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{4.51(.013)(.02)}{.56(.00596)^{.5}}\right)^{3/8}$$

$= 0.26'$ water surface width $= 26/.02 = 13'$
$< 16'$ ∴ OK

Fig 3-46 $Q_i = 0.64(4.51) = 2.89$ cfs

$$Q_b = Q - Q_i = 4.51 - 2.89 = 1.62 \text{ cfs}$$

∴ use C.o.P. Catch Basin Type M-1, L=10'

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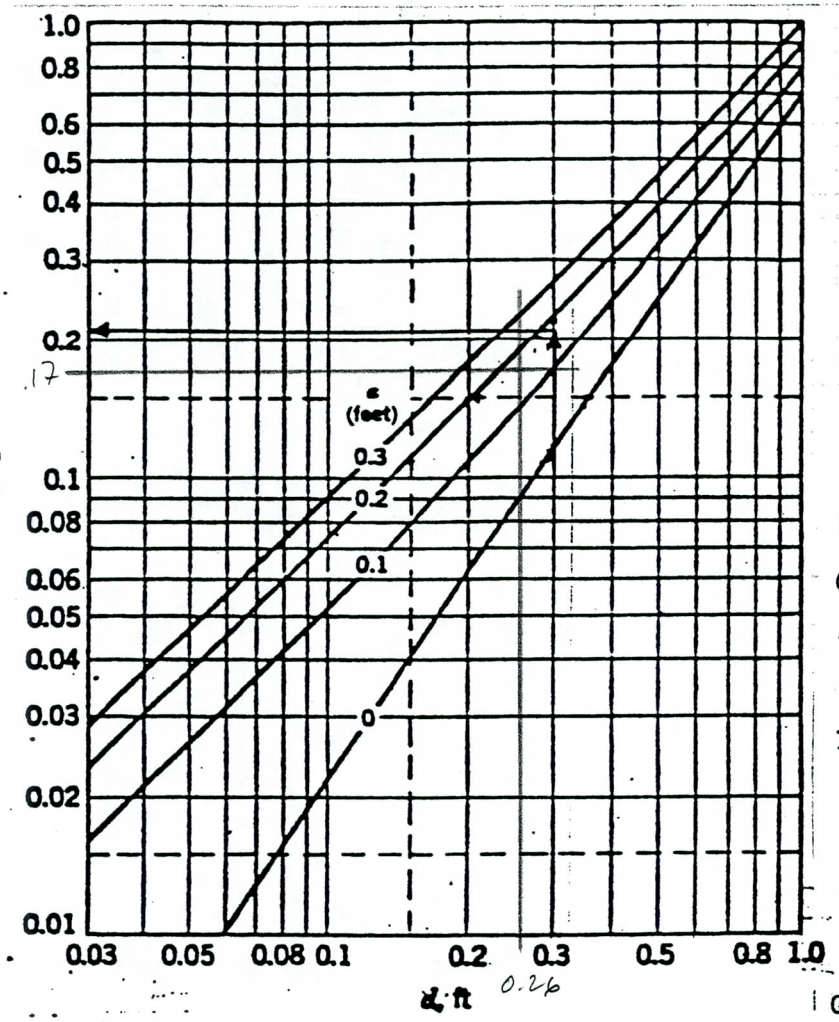


a

FIGURE 3-46

DESIGN CHARTS FOR CURB-OPENING INLETS ON CONTINUOUS GRADES

AREA : 3E

EXAMPLE USING FIGURE 3-46a

Given:

d = 0.3' d = 0.26'

a = 0.167' (2") a = 0.167'

Find:

$\frac{Q_a}{L_a}$ = 0.21 cfs/ft. $\frac{Q_a}{L_a} = 0.17$

EXAMPLE USING FIGURE 3-46b

Given:

The above information and

Q_a = 5.9 cfs $Q_a = 4.51$

L = 10' L = 13'

Find: Q

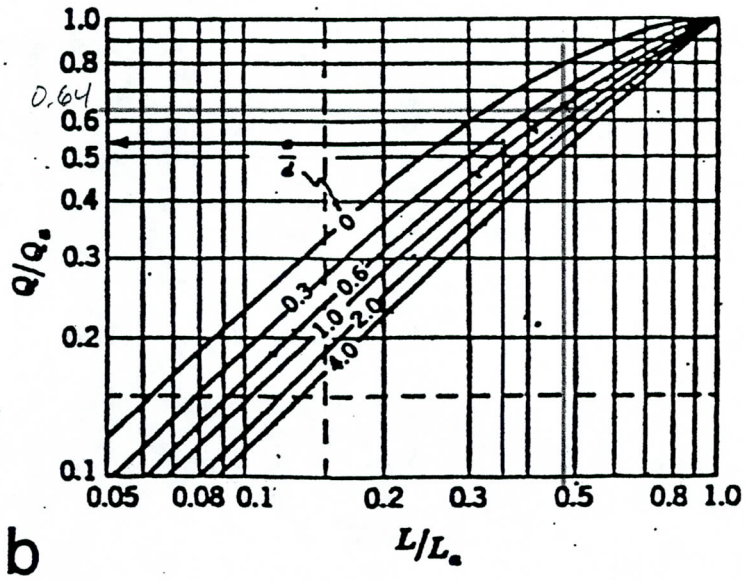
$\frac{a}{d} = \frac{0.167}{0.3} = 0.56$ $\frac{a}{d} = 0.64$

$L_a = \frac{5.9}{0.21} = 28'$ $L_a = 27'$

$\frac{L}{L_a} = \frac{10}{28} = 0.36$ $\frac{L}{L_a} = 0.48$

$\frac{Q}{Q_a} = 0.53$ $\frac{Q}{Q_a} = 0.64$

Q = (0.53)(5.9) = 3.1 cfs



b

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AREA 4E

C: $C = .88$

I: Length = 180' $s = .0125$ 1/1

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .0125^{.5} .32^{.67}$$

$$= 4.49 \text{ fps}$$

$$T_c = 180 / (4.49 \times 60) = (.67) \ 5 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = 300' × 40' = 0.28 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.88)(6.1)(0.28)1.00 + 1.62$$

$$= 3.12 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{3.12(.013)(.02)}{.56(.0125)^{.5}}\right)^{3/8}$$

$= 0.20'$ water surface width $= .20/.02 = 10'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = 0.28$ $L = Q/0.28$

$$= 3.12/0.28$$

$$= 11.14'$$

∴ use C.o.P. Catch Basin Type M-1, L=10'

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AREA 4E

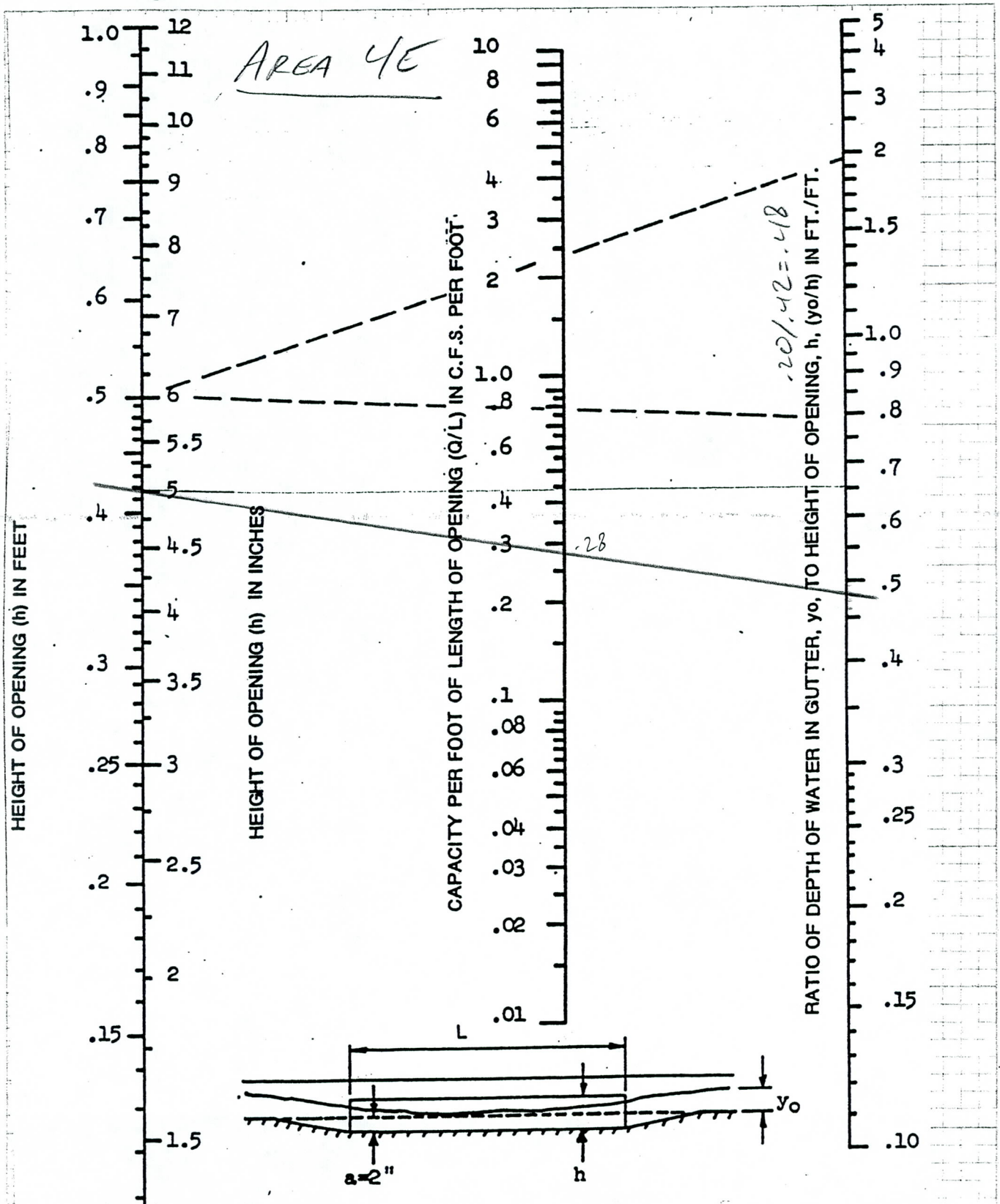

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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AREA SW

C: $C = .78$

I: Length = 480' $s = .0040$ ft/ft

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .0040^{.5} .32^{.67}$$

$$= 2.54 \text{ fps}$$

$$T_c = 480 / (2.54 \times 60) = (2.15)\ 5 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = 480' × 40' = 0.53 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.78)(6.1)(.53)1.00 + 0$$

$$= 2.52 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{2.52(.013)(.02)}{.56(.004)^{.5}}\right)^{3/8}$$

$= 0.22'$ water surface width $= .22/.02 = 11'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = 0.32$ $L = Q/.32$

$$= 2.52/.32$$

$$= 7.88'$$

∴ use C.O.P. Catch Basin Type M-1, L = 6'

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AREA SW

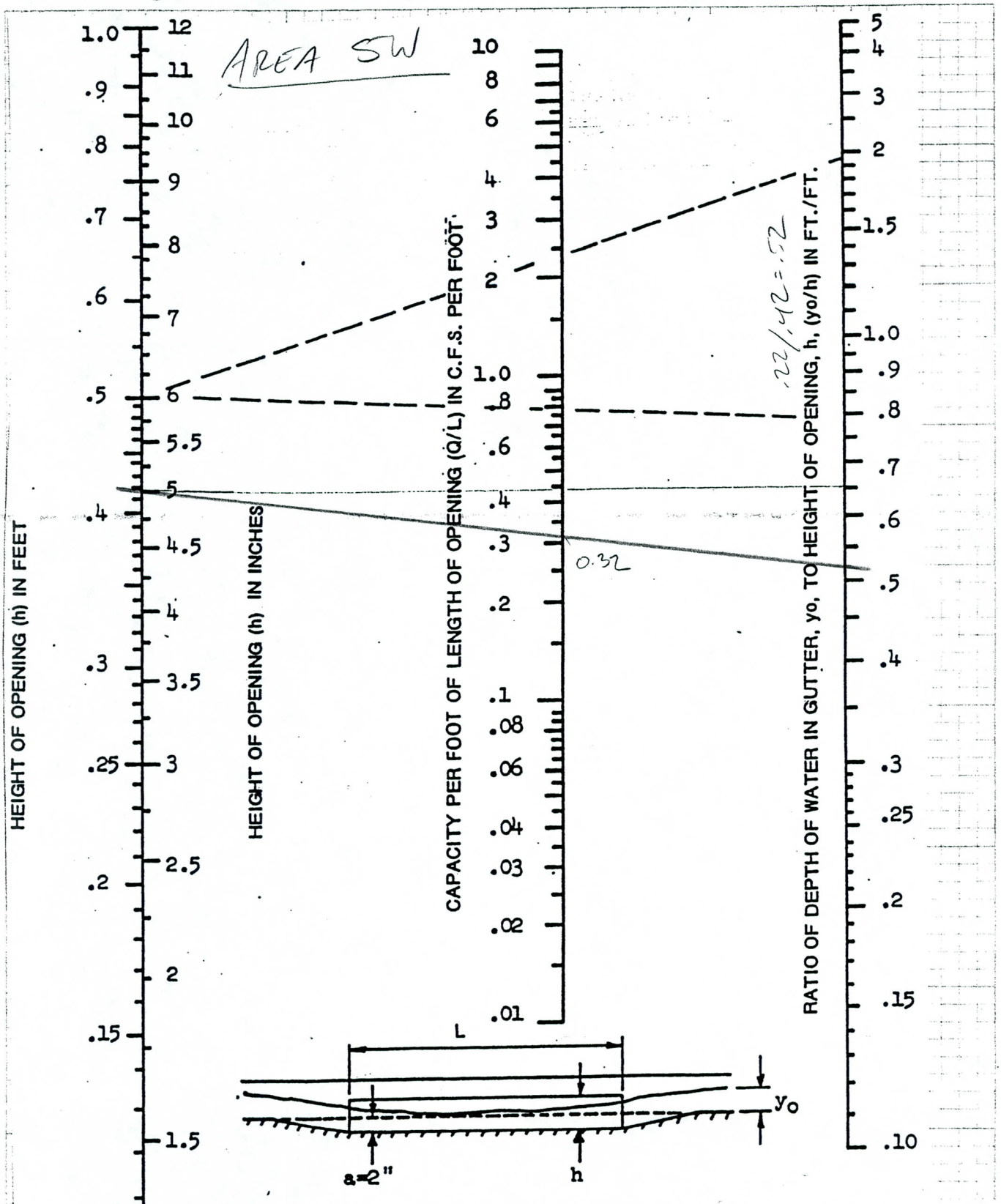

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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AREA 6W

C: $C = .78$

I: Length = 465' $s = .00633$ '/'

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .00633^{.5} .32^{.67}$$

$$= 3.19 \text{ fps}$$

$$T_c = 465 / (3.19 \times 60) = (2.43) \ 5 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = 905' × 40' = 1.00 acres

$$Q_{10} = C I_{10} A F_{10} + Q_b$$

$$= (.78)(6.1)(1.00)1.00 + 0$$

$$= 4.76 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n S_x}{.56 s^{.5}}\right)^{3/8}$$

$$= \left(\frac{4.76(.013)(.02)}{.56(.00633)^{.5}}\right)^{3/8}$$

$= 0.26'$ water surface width $= .26/.02 = 13'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = .41$ $L = Q/.41$

$$= 4.76/.41$$

$$= 11.61'$$

∴ use C.O.P. Catch Basin Type M-1, L=10'

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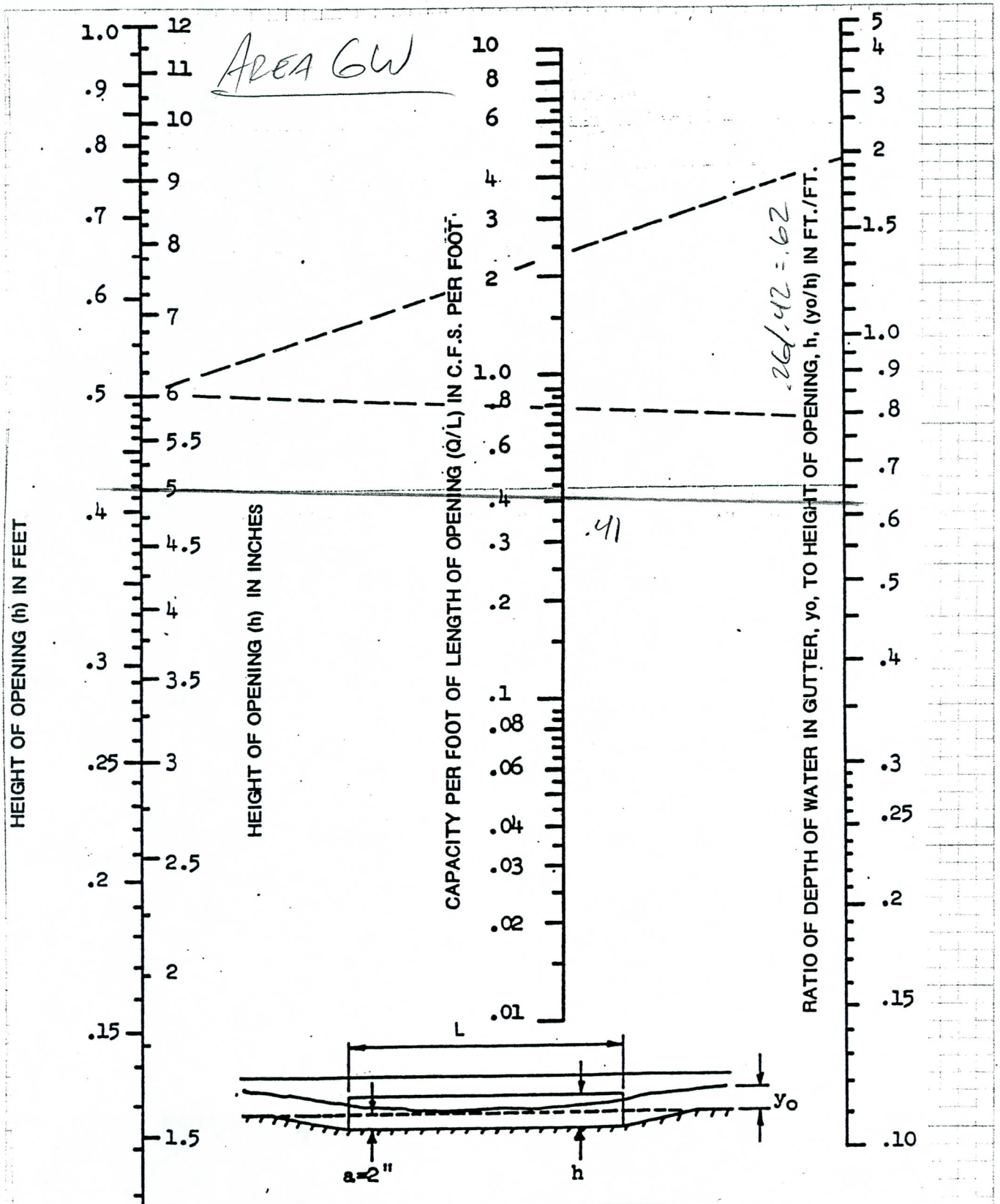

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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AREA 5E

C: $C = .66$

I: Length = 500' $s = .0040$ 1/1

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .0040^{.5} .32^{.67}$$

$$= 2.54 \text{ fps}$$

$$T_c = 500 / (2.54 \times 60) = (2.1) \text{ 5 min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = × = 0.78 acres

$$Q_{10} = C\, I_{10}\, A\, F_{10} + Q_b$$

$$= (.66)(6.1)(.78)1.00 + 0$$

$$= 3.14 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{3.14(.013)(.02)}{.56(.004)^{.5}}\right)^{3/8}$$

$= 0.24'$ water surface width $= .24/.02 = 12'$
$< 16'$ ∴ OK

Fig 3-46 $Q_i = .84(3.14) = 2.64$ cfs

$Q_b = Q - Q_i = 3.14 - 2.64 = 0.50$ cfs

∴ use C.O.P. Catch Basin Type M1, L = 10'

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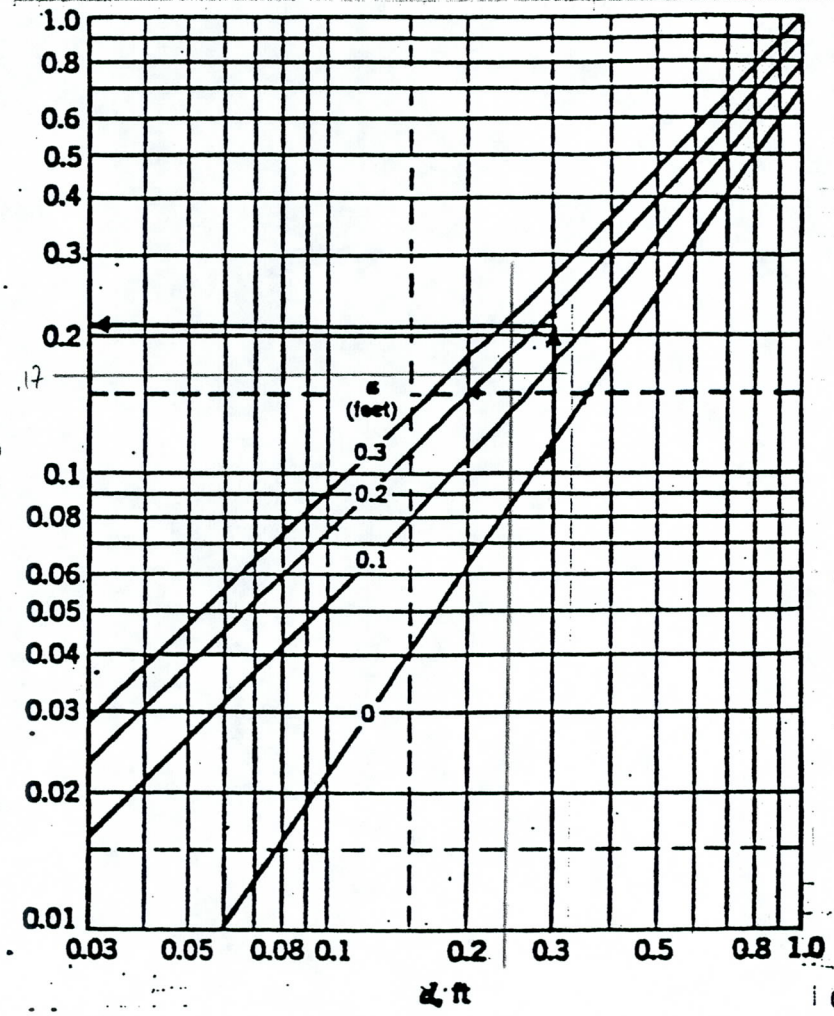
FIGURE 3-46

DESIGN CHARTS FOR CURB-OPENING INLETS ON CONTINUOUS GRADES

AREA :



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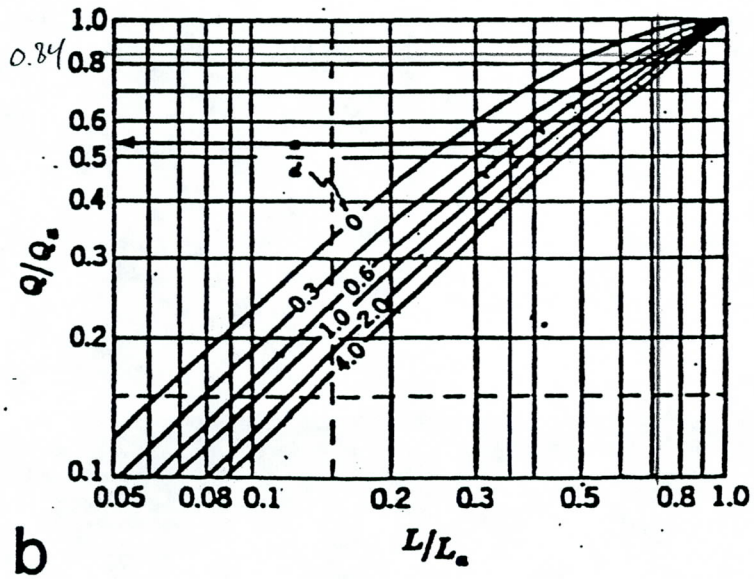

b

EXAMPLE USING FIGURE 3-46a

Given:

d = 0.3' d=0.24'

a = 0.167' (2") a=0.167'

Find:

$\frac{Q_a}{L_a}$ = 0.21 cfs/ft. $\frac{Q_a}{L_a} = 0.17$

EXAMPLE USING FIGURE 3-46b

Given:

The above information and

Q_a = 5.9 cfs Q = 3.14 cfs

L = 10' L = 13'

Find: Q

$\frac{a}{d} = \frac{0.167}{0.3} = 0.56$ $\frac{a}{d} = .70$

$L_a = \frac{5.9}{0.21} = 28'$ $L_a = 18'$

$\frac{L}{L_a} = \frac{10}{28} = 0.36$ $\frac{L}{L_a} = 0.72$

$\frac{Q}{Q_a} = 0.53$ $\frac{Q}{Q_a} = 0.84$

Q = (0.53)(5.9) = 3.1 cfs

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AREA 6E

C: $C = .88$

I: Length = 390' $s = .00633$ 1/1

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .00633^{.5} .32^{.67}$$

$$= 3.19 \text{ fps}$$

$$T_c = 390' / (3.19 \times 60) = (2.01)\ 5 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = 745' × 40' = 0.68 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.88)(6.1)(.68)1.00 + \cancel{0}$$

$$= 3.65 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{3.65(.013)(.02)}{.56(.00633)^{.5}}\right)^{3/8}$$

$= 0.24'$ water surface width $= .24/.02 = 12'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = .36$ $L = Q/.36$

$$= 3.65/.36$$

$$= 10.14'$$

∴ use C.o.P. Catch Basin Type M-1, L = 10'

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AREA 6E

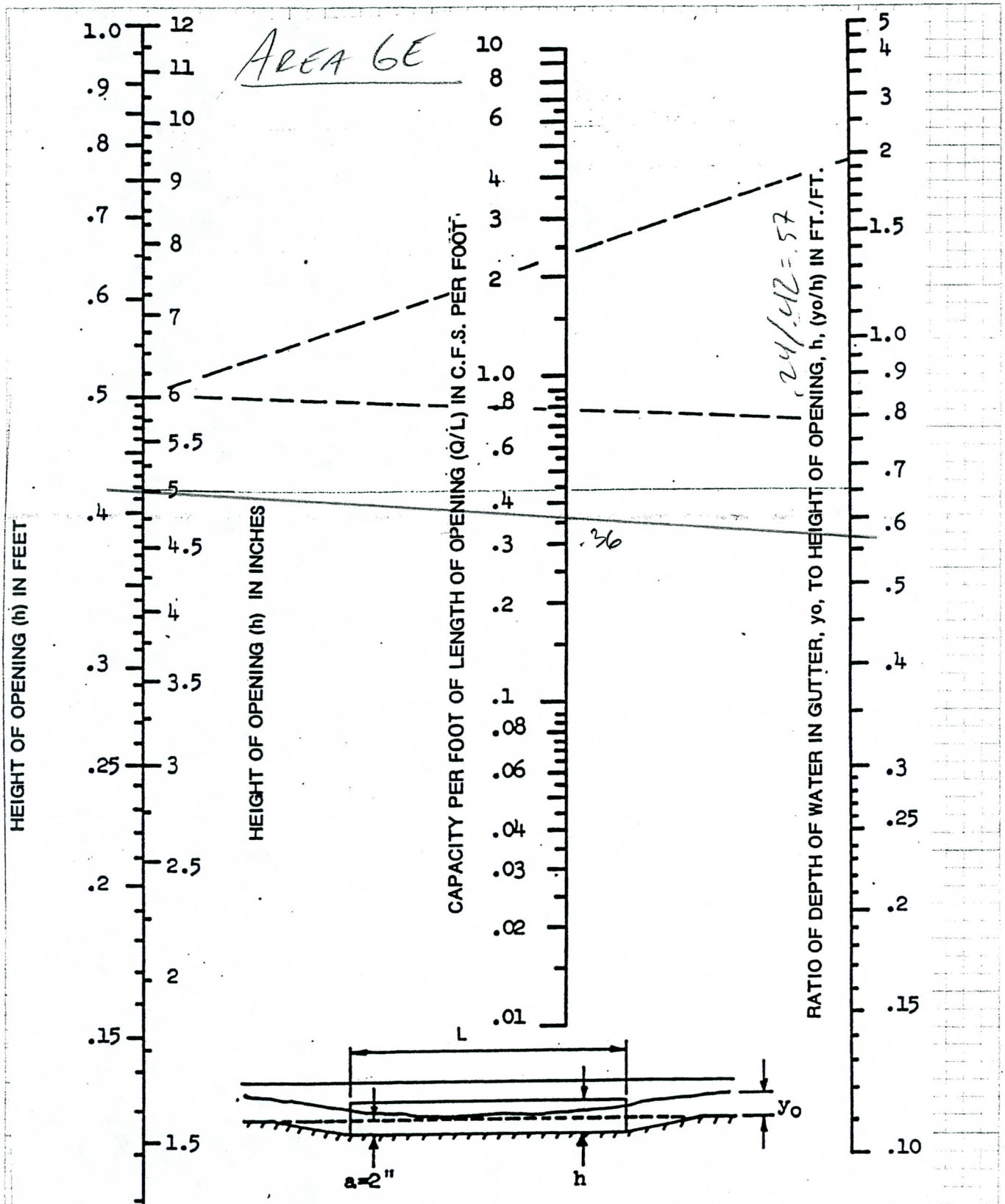

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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AREA 7W

C: $C = .79$

I: Length = 320' $s = .00409$ ft/ft

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .00409^{.5} \, 2.2^{.67}$$

$$= 2.57 \text{ fps}$$

$T_c = 320 / (2.57 \times 60) + 1.08 = 5$ min.

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = × = 0.45 acres

$$Q_{10} = C I_{10} A F_{10} + Q_b$$

$$= (.79)(6.1)(.45)1.00 + 0$$

$$= 2.17 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n S_x}{.56 s^{.5}}\right)^{3/8}$$

$$= \left(\frac{2.17(.013)(.02)}{.56(.00409)^{.5}}\right)^{3/8}$$

$= 0.21'$ water surface width $= 21/.02 = 10.5'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = .30$ $L = Q/.30$
$= 2.17/.30$
$= 7.23'$

∴ use C.O.P. Catch Basin Type M-1, L = 6'

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AREA 7W

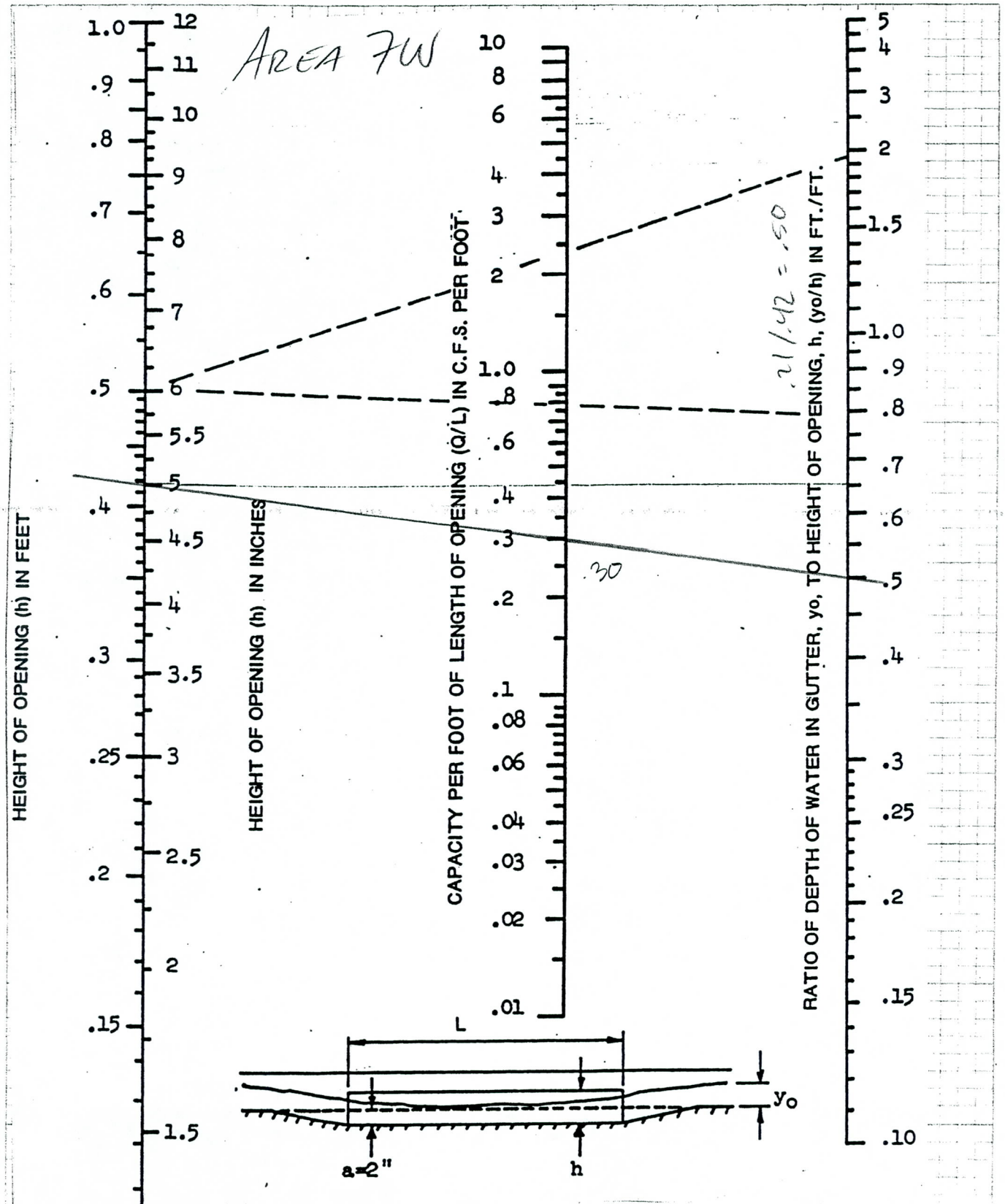

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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AREA 7E

C: $C = .59$

I: Length = 300' $s = .00409'/'$

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .00409^{.5} .32^{.67}$$

$$= 2.57 \text{ fps}$$

$T_c = 300' / (2.57 \times 60) = (1.95)$ 5 min.

Fig 2.2-13: Rainfall Intensity $I_{10} = 6.1$ in/hr.

A: Area = × = 0.50 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.59)(6.1)(.50)1.00 + 0$$

$$= 1.80 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{1.80(.013)(.02)}{.56(.00409)^{.5}}\right)^{3/8}$$

$= 0.20'$ water surface width $= .20/.02 = 10'$
$< 16'$ ∴ OK

Fig. 3-47: $Q/L = 0.28$ $L = Q/.28$

$$= 1.80/.28$$

$$= 6.43'$$

∴ use C.O.P. Catch Basin Type M-1, L = 6'

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AREA 7E

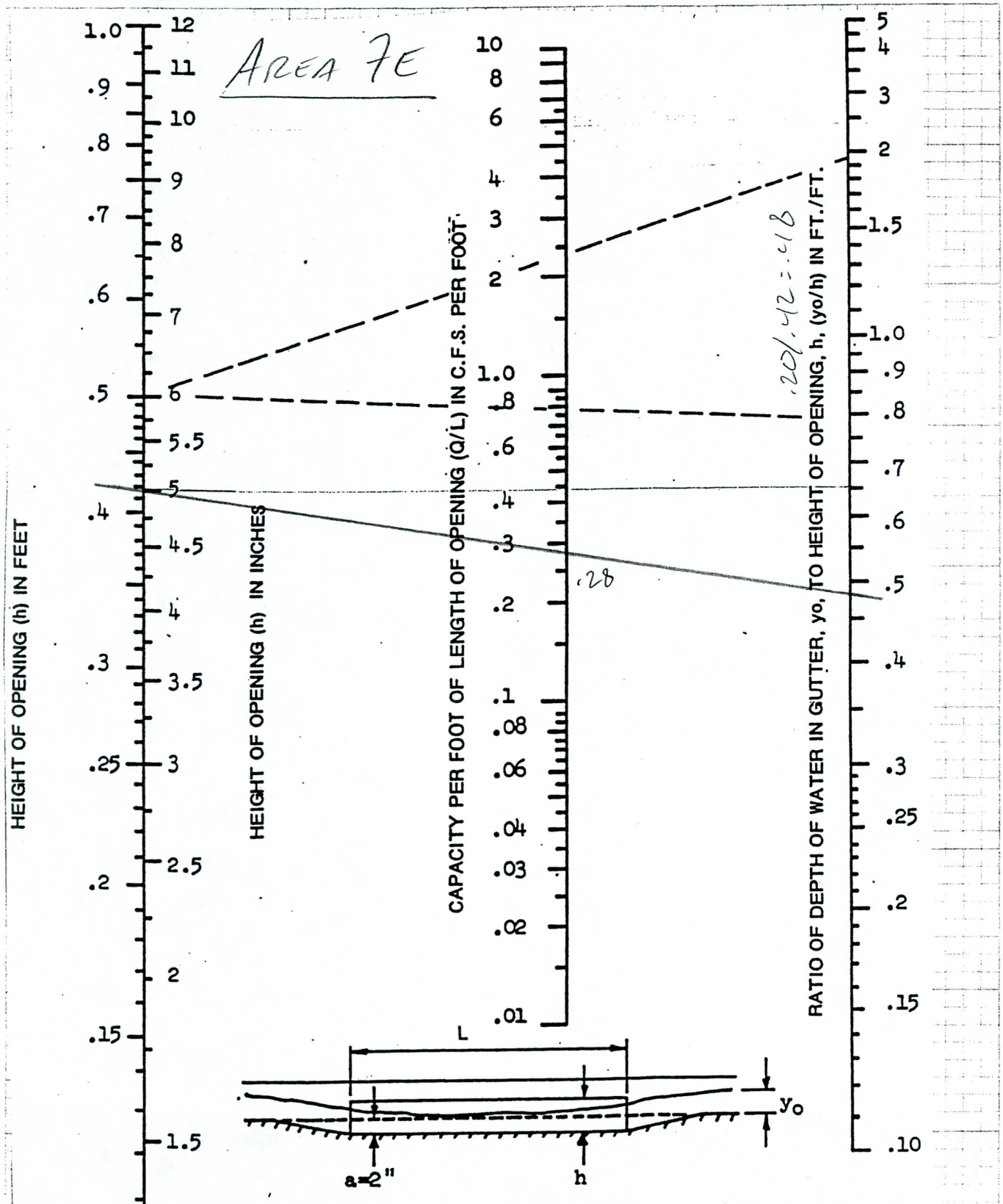

FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

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AREA 8S

C: $C = .91$

I: Length = 1050' $s = 0.0015$ 1/1

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .0015^{.5} .32^{.67}$$

$$= 1.56 \text{ fps}$$

$$T_c = 1050 / (1.56 \times 60) = 11.22 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 4.6$ in/hr.

A: Area = 41' × 1050' = 0.99 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.91)(4.6)(.99)1.00 + 0$$

$$= 4.14 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{4.14\,(.013)(.02)}{.56(.0015)^{.5}}\right)^{3/8}$$

$= 0.32'$ water surface width $= .32/.02 = 16'$

Fig 3-46 $Q_i = .85(4.14) = 3.52$ cfs

$Q_b = Q - Q_i = 4.14 - 3.52 = 0.62$ cfs

∴ use C.O.P. Catch Basin Type M-1, L = 10'

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JOB NAME 64th STREET IMPROVEMENTS
JOB NO. 410.32

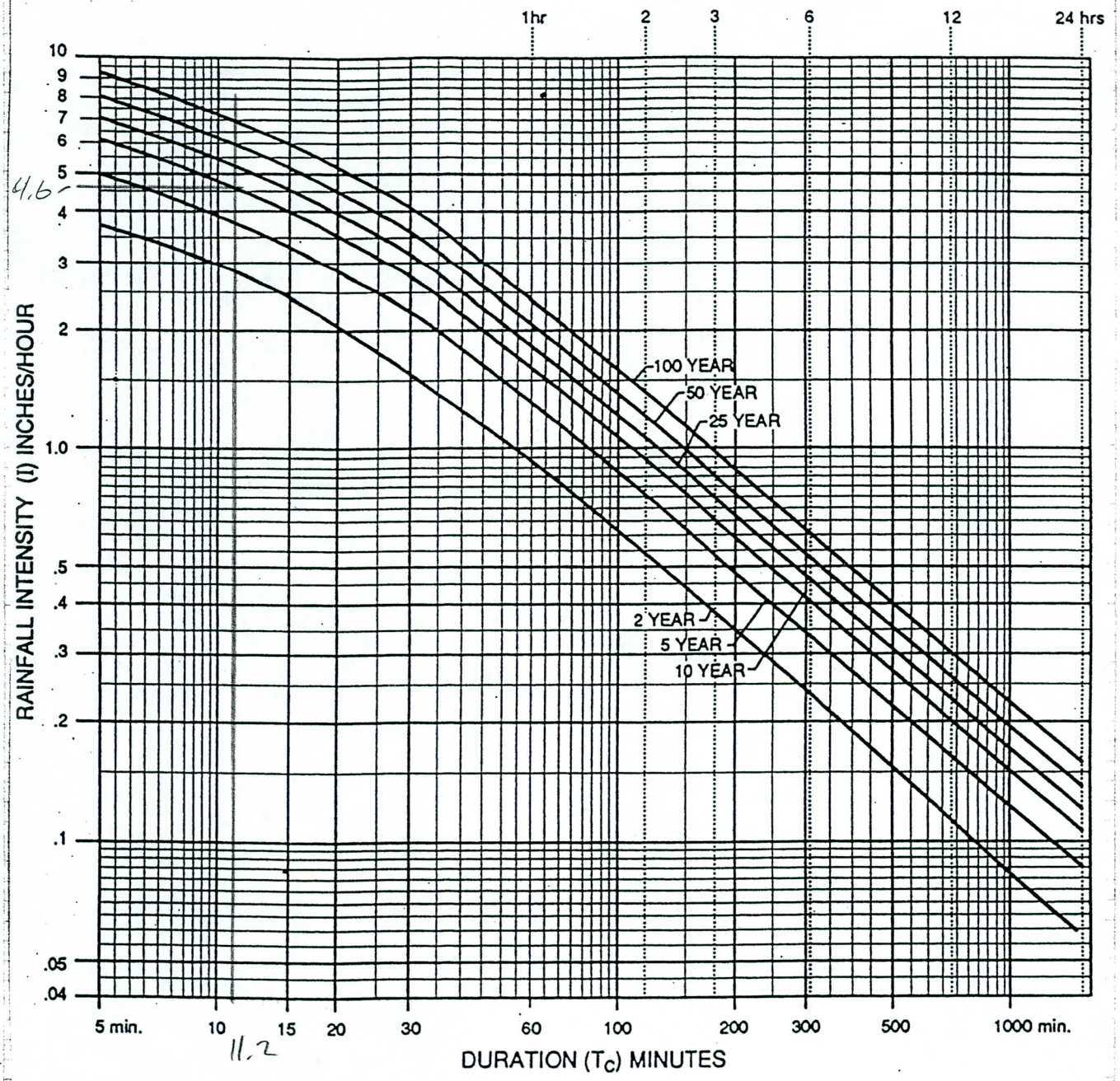

FIGURE 2.2-13

Rainfall Intensity (I) Values for Use in Rational Method

Source: Hydrologic Design Manual for Maricopa County

AREA: 8S
T_C: 11.2 min
I_{10}: 4.6 in/h

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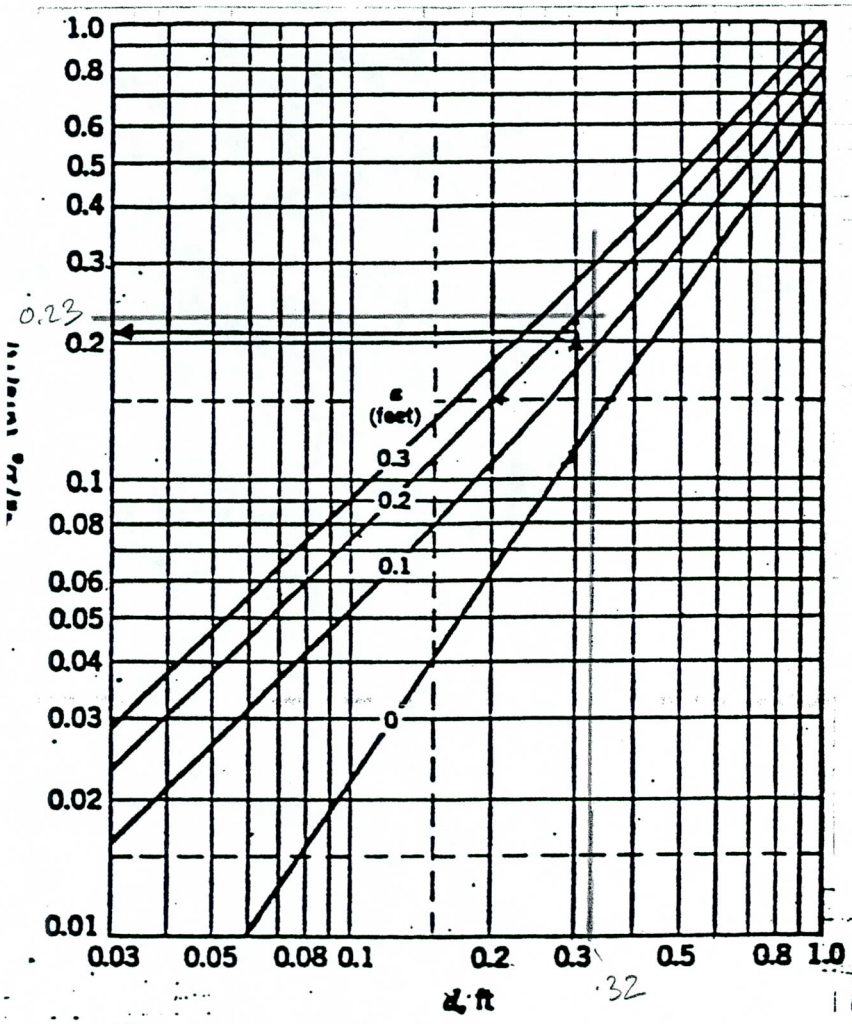
BY ES DATE 01/30/96
CHECK _____ DATE _____

CLIENT CITY OF SCOTTSDALE
JOB NAME 64th STREET IMPROVEMENTS JOB NO. 410.32



a

FIGURE 3-46

DESIGN CHARTS FOR CURB-OPENING INLETS ON CONTINUOUS GRADES

AREA: 8S

EXAMPLE USING FIGURE 3-46a

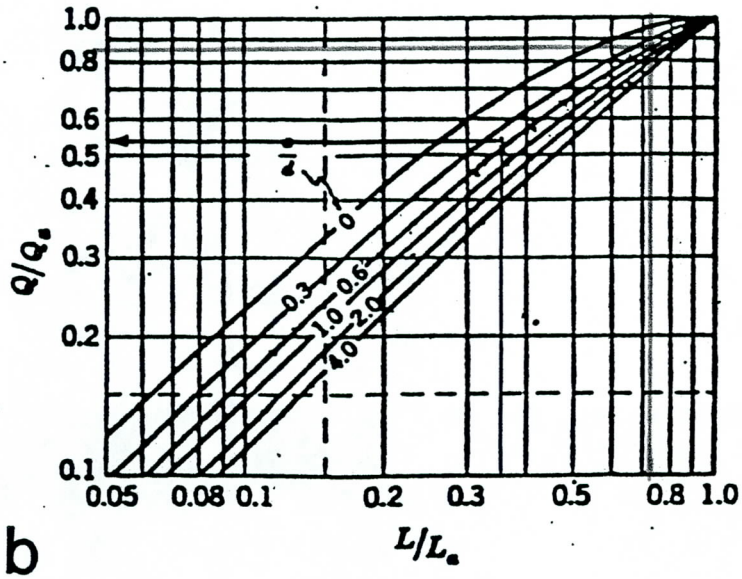
Given:

d = 0.3' $d = .32'$

a = 0.167' (2") $a = .167'$

Find:

$\frac{Q_a}{L_a}$ = 0.21 cfs/ft. $\frac{Q_a}{L_a} = 0.23$



b

EXAMPLE USING FIGURE 3-46b

Given:

The above information and

Q_a = 5.9 cfs $Q_a = 4.14$

L = 10' $L = 13'$

Find: Q

$\frac{a}{d} = \frac{0.167}{0.3} = 0.56$ $\frac{a}{d} = 0.52$

$L_a = \frac{5.9}{0.21} = 28'$ $L_a = \frac{4.14}{.23} = 18'$

$\frac{L}{L_a} = \frac{10}{28} = 0.36$ $\frac{L}{L_a} = \frac{13}{18} = 0.72$

$\frac{Q}{Q_a} = 0.53$ $\frac{Q}{Q_a} = 0.85$

Q = (0.53)(5.9) = 3.1 cfs

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CLIENT C. O. S.
JOB NAME 64th
JOB NO. 410.32

AREA 8N

C: $C = .86$

I: Length = 1050' $s = 0.0014$ ft/ft

$$\text{Velocity} = \left(\frac{1.12}{n}\right) s^{.5} d^{.67}$$

$$= \left(\frac{1.12}{.013}\right) .0014^{.5} \cdot 32^{.67}$$

$$= 1.50 \text{ fps}$$

$$T_c = 1050 / (1.50 \times 60) = 11.67 \text{ min.}$$

Fig 2.2-13: Rainfall Intensity $I_{10} = 4.5$ in/hr.

A: Area = 44' × 1200' = 1.21 acres

$$Q_{10} = C\, I_{10} A F_{10} + Q_b$$

$$= (.86)(4.5)(1.21)1.00 + 0$$

$$= 4.68 \text{ cfs}$$

$$\text{DEPTH} = \left(\frac{Q_{10} n\, S_x}{.56\, s^{.5}}\right)^{3/8}$$

$$= \left(\frac{(\quad)(\quad)}{.56(\quad)^{.5}}\right)^{3/8}$$

$= 0.34'$ water surface width $= .34/.02 = 17'$

Fig. 3-47: $Q/L = 0.62$ $L = Q/0.62$

$= 4.68/.62$

$= 7.55'$

∴ use C.O.P. Catch Basin Type M-1, L = 10'

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JOB NAME 64th STREET IMPROVEMENTS
JOB NO. 410.32

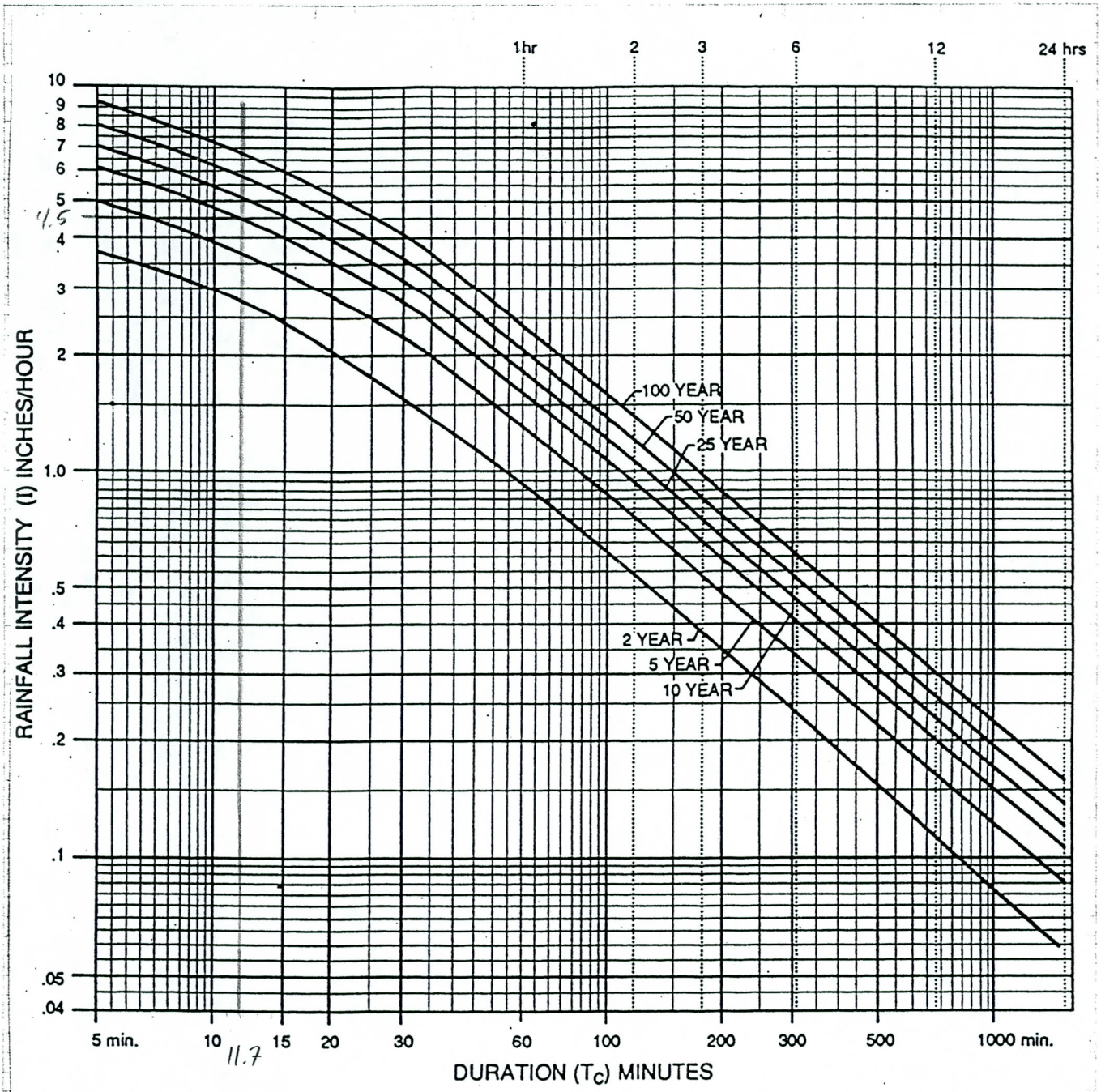

FIGURE 2.2-13

Rainfall Intensity (I) Values for Use in Rational Method

Source: Hydrologic Design Manual for Maricopa County

AREA: 8N
T_C: 11.7 min
I_{10}: 4.5 in/hr

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JOB NAME 64th STREET IMPROVEMENTS
JOB NO. 410.32

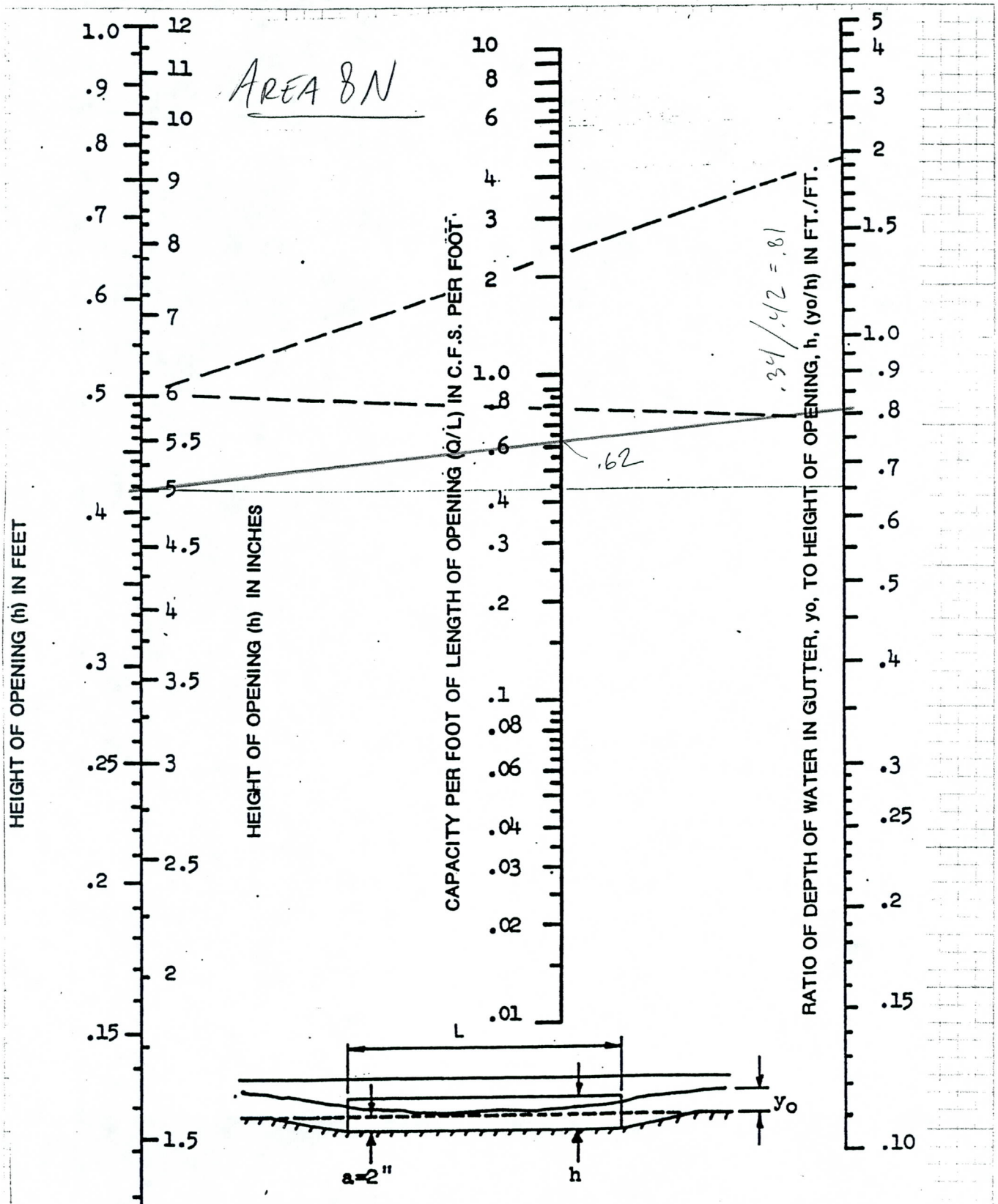


FIGURE 3-47 NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

STORM DRAIN PIPE

SIZING SPREADSHEET

Location		Individual Sub-Areas			Incremental Sub-Area Total					
From Point	To Point	C (coeff)	A (acres)	Length (ft)	C A	Tc (min)	I-10 (in/hr)	I-100 (in/hr)	Q-10 (end) (cfs)	Q-100 (end) (cfs)
G.B.	1W/1E	0.83	1.58	780	1.31	5.00	6.1	9.2	8.00	12.06
1W/1E	2W/2E	0.82	2.56	1360	3.41	13.98	4.1	6.2	13.98	21.15
2W/2E	3E	0.88	0.84	1010	4.15	17.81	3.8	5.5	15.56	22.82
3E	3W/4E	0.87	1.47	170	5.43	18.42	3.7	5.4	20.09	29.31
3W/4E	45" Exst	-	-	-	-	-	-	-	-	-

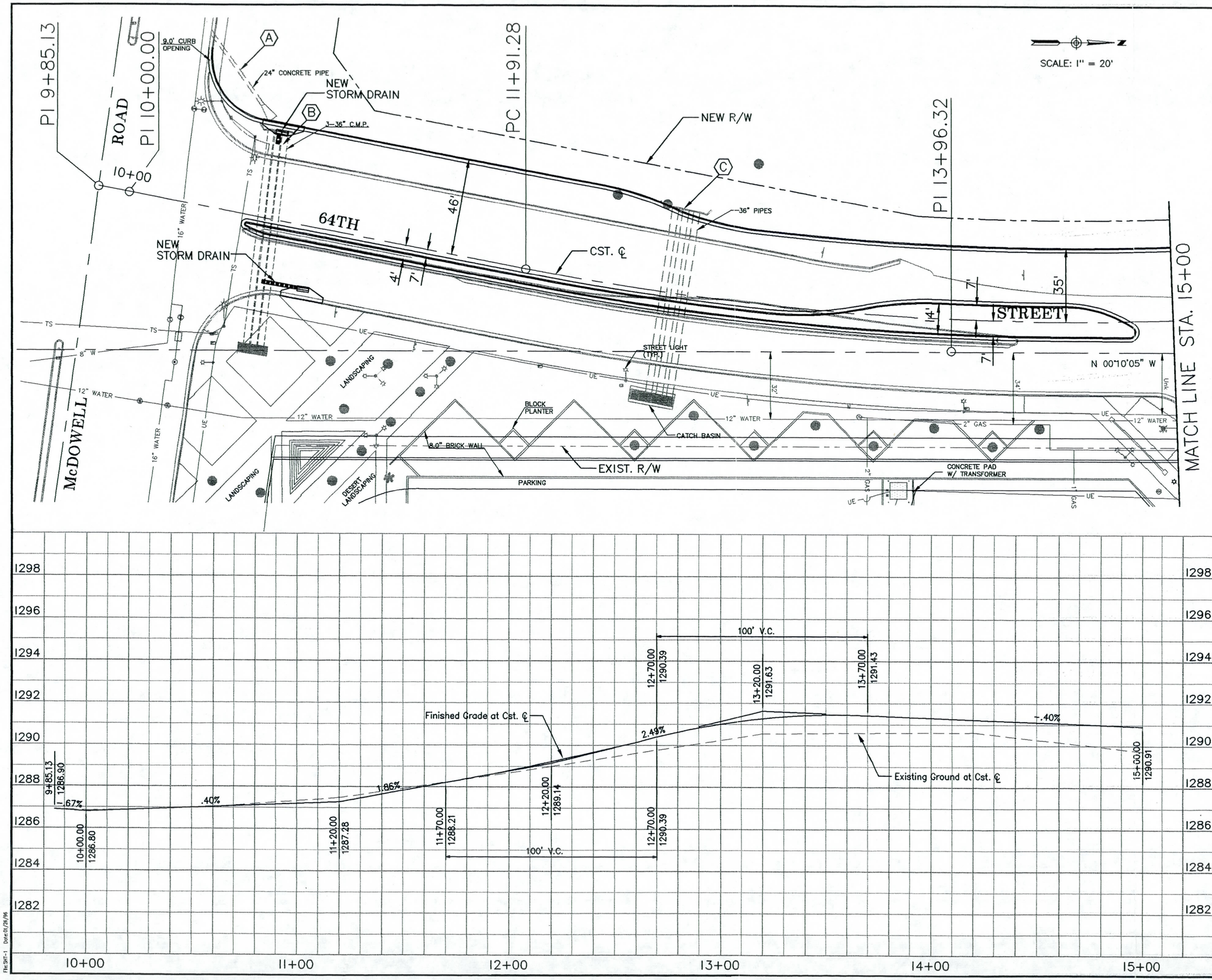
Location		Storm Drain (Q-10)						Cover	Hydraulic Grade Line (Q-100)			
From Point	To Point	Diam. (in)	Velocity (fps)	Length (ft)	Slope (ft/ft)	Invert Elevation	Crown Elevation	Criteria: 5' Min.	Max. Flow Elevation	Sf (ft/ft)	hL (ft)	H.G.L. Elevation
G.B.	1W/1E	-	-	-	-	71.48	73.48	10.57	84.05	-	-	76.14
1W/1E	2W/2E	24	2.5	1360	0.0040	66.04	68.04	8.52	76.56	0.0024	3.30	72.84
2W/2E	3E	24	4.5	1010	0.0040	62.00	64.00	6.84	70.84	0.0074	7.52	65.32
3E	3W/4E	24	5.0	170	0.0040	61.32	64.32	5.36	69.68	0.0087	1.47	63.85
3W/4E	45" Exst	36	2.8	200	0.0040	60.52	63.52	6.98	70.50	0.0016	0.33	63.52

APPENDIX B

ON-SITE STORM DRAIN FIGURES

HEC-1 OUTPUT

100-YEAR



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PRELIMINARY STORM DRAIN DESIGN

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3939 CIVIC CENTER PLAZA
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		1
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

File:SHT-1 Date:01/26/96

Figure B-1

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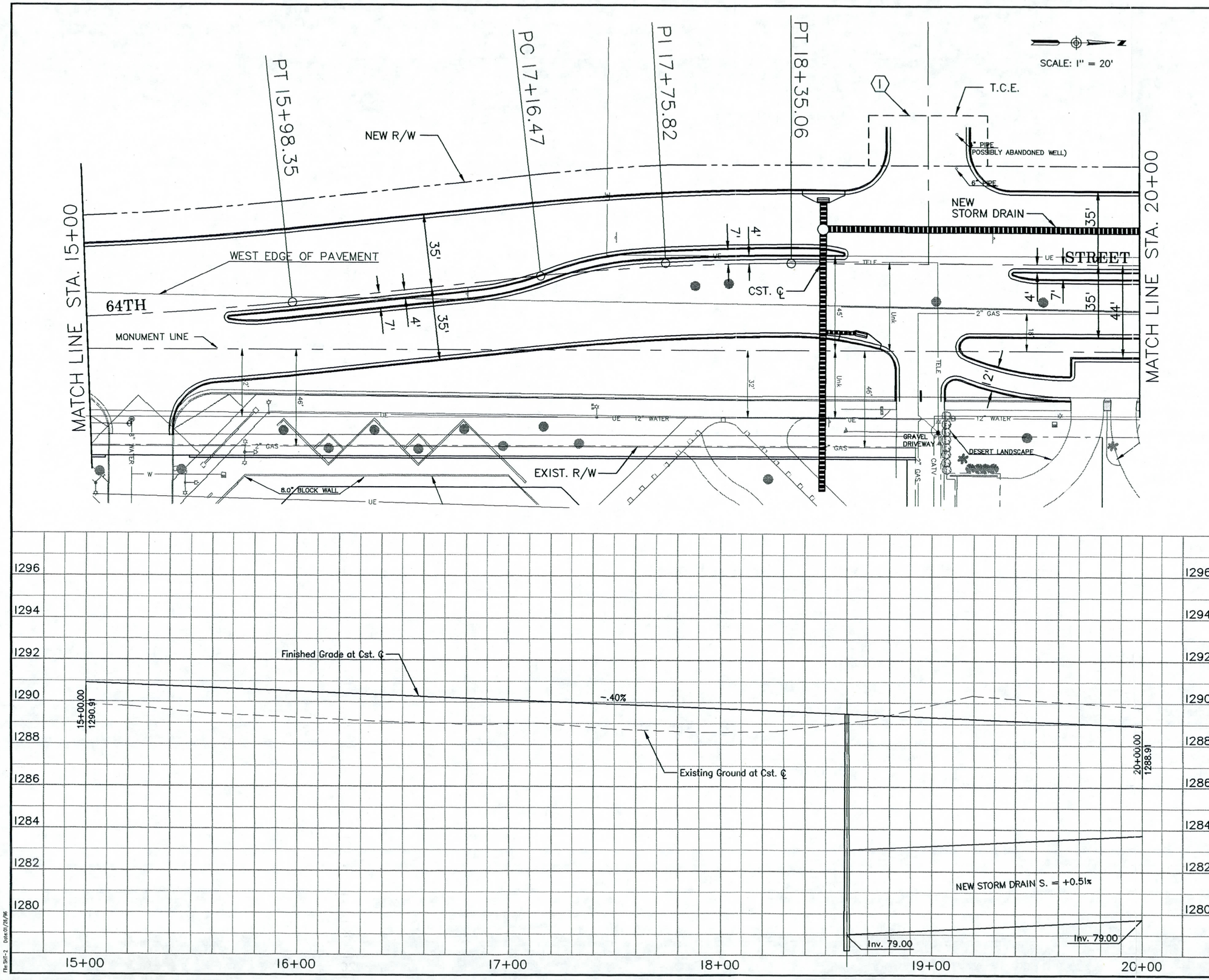

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PROJECT TITLE **64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE**

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		2
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

File: SHT-2 Date: 01/26/96

Figure B-2

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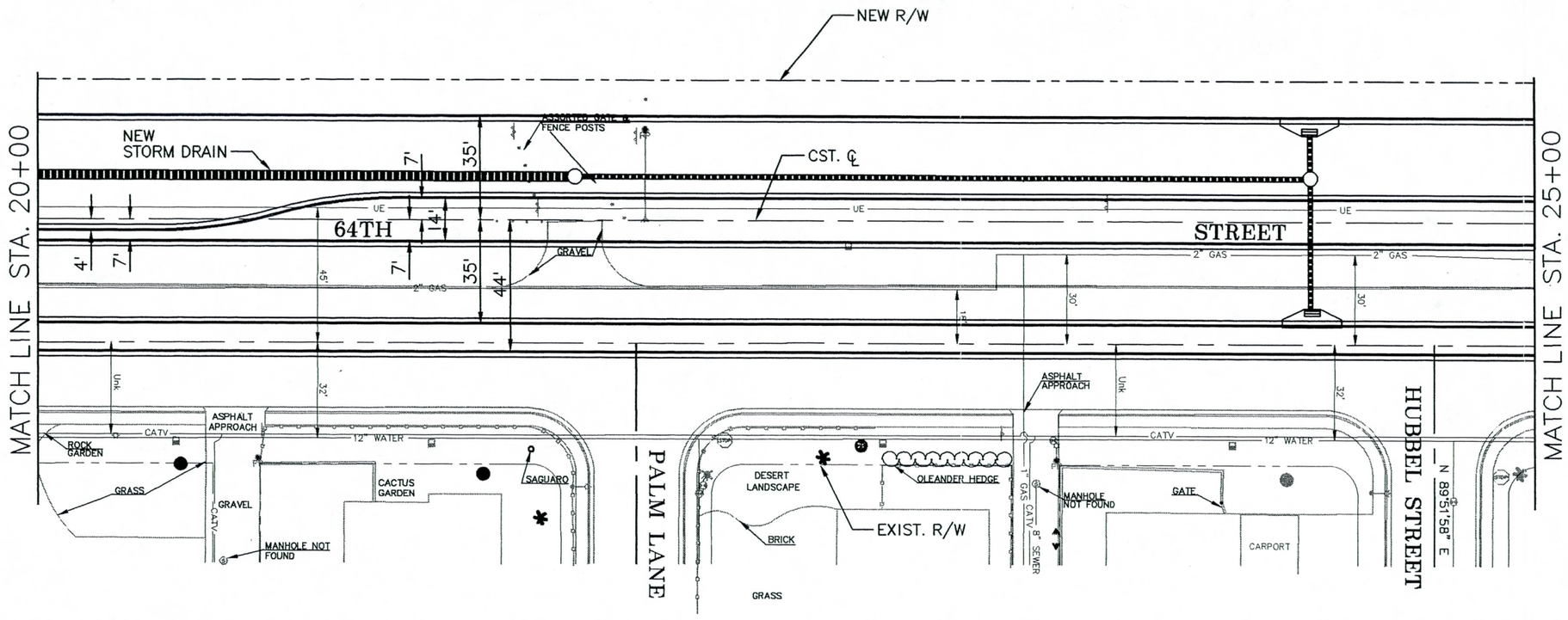
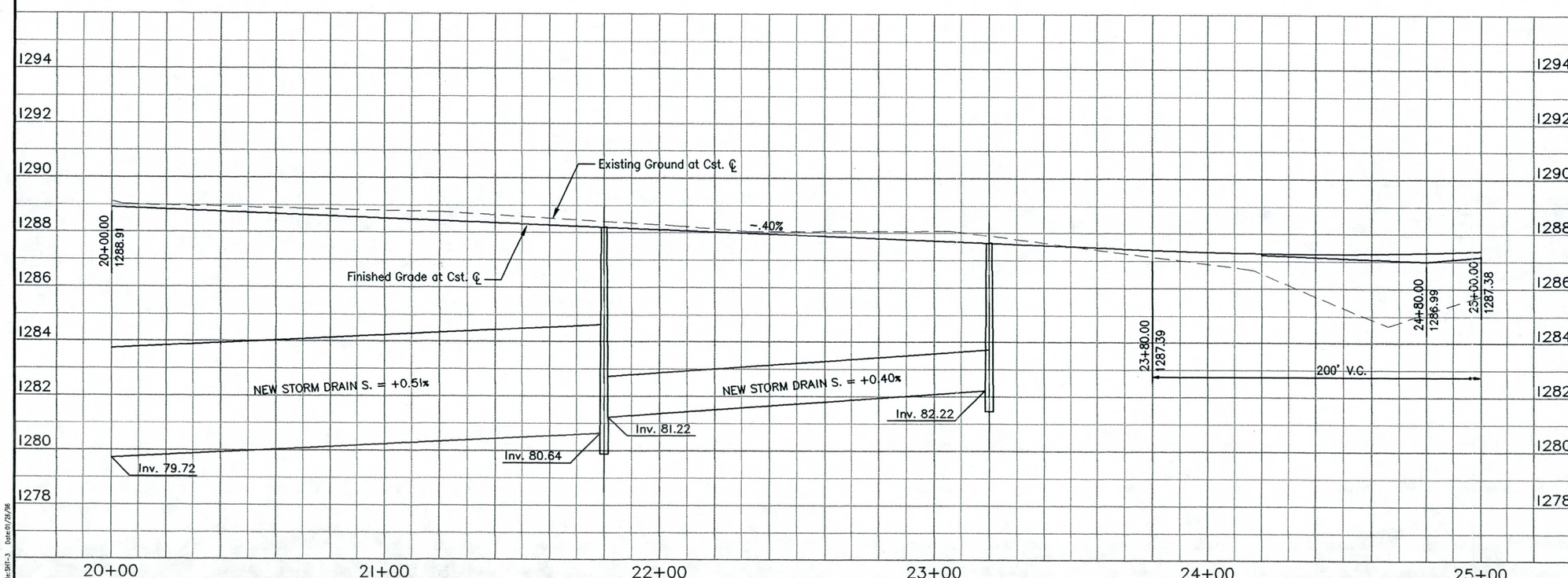
SCALE: 1" = 20'





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PROJECT TITLE **64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE**

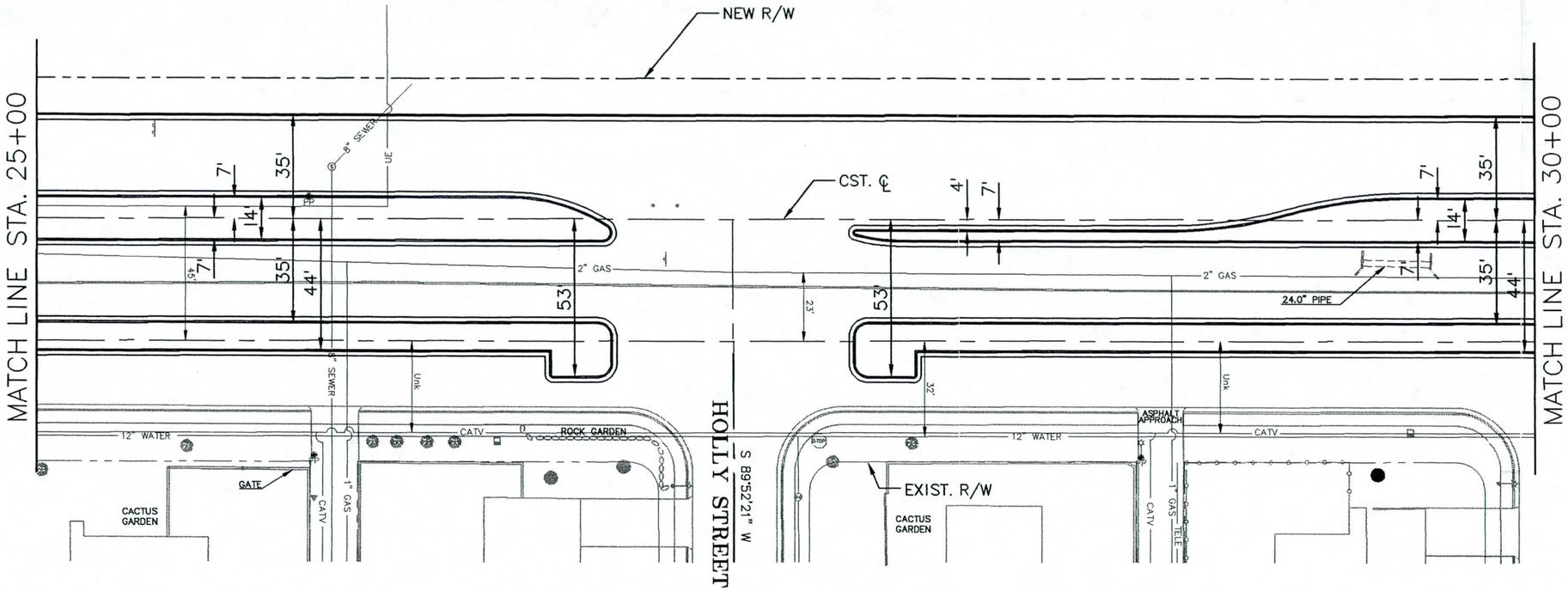
SCALE	DESIGNED BY	DATE	BD NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		3
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

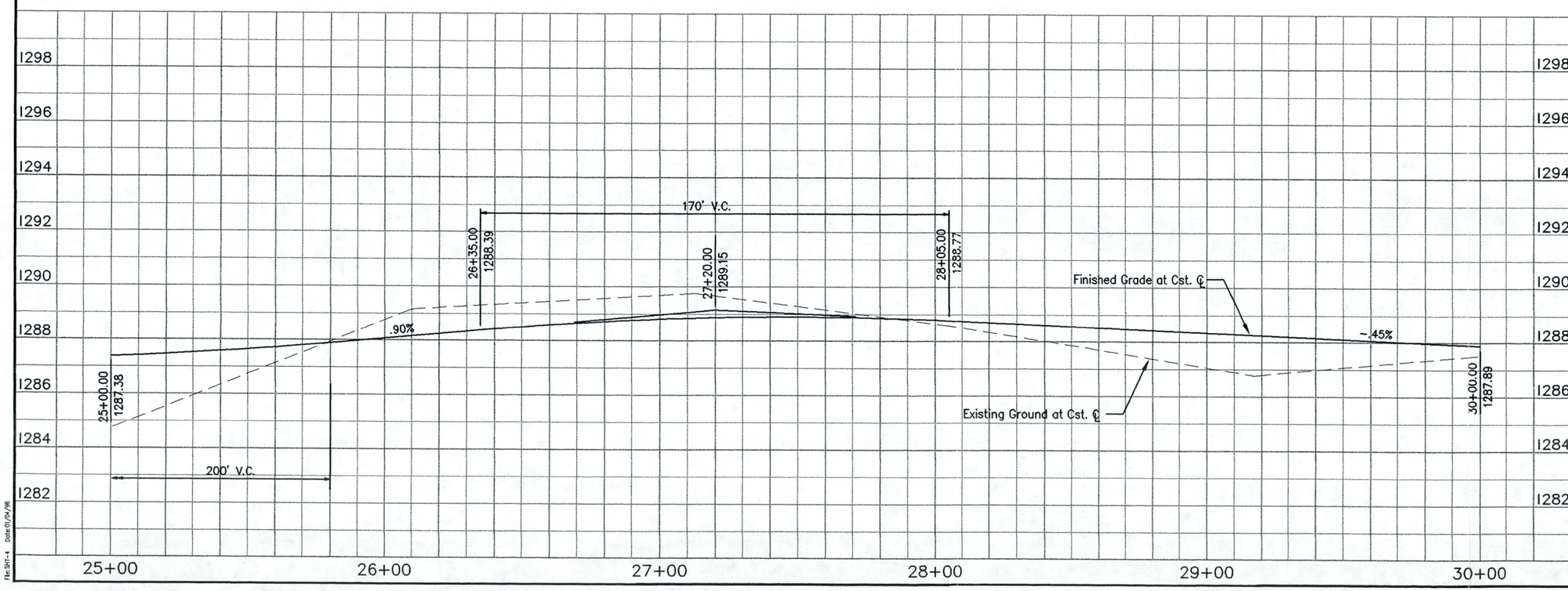
File:SHT-3 Date:01/26/96

Figure B-3

(NO STORM DRAIN IMPROVEMENTS THIS SHEET)

SCALE: 1" = 20'





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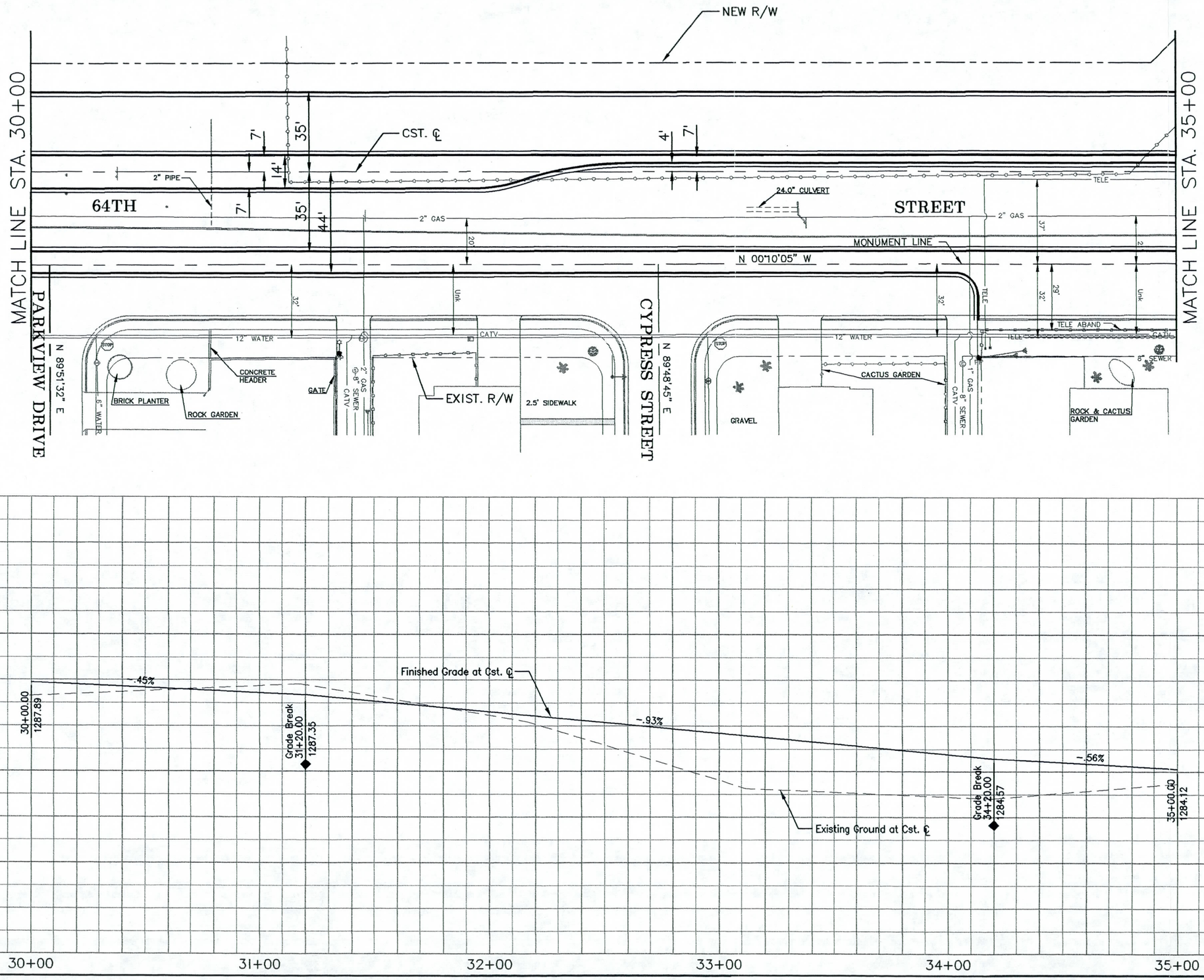
SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		4
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

Figure B-4

File:SHT-4 Date:01/04/96

(NO STORM DRAIN IMPROVEMENTS THIS SHEET)

SCALE: 1" = 20'



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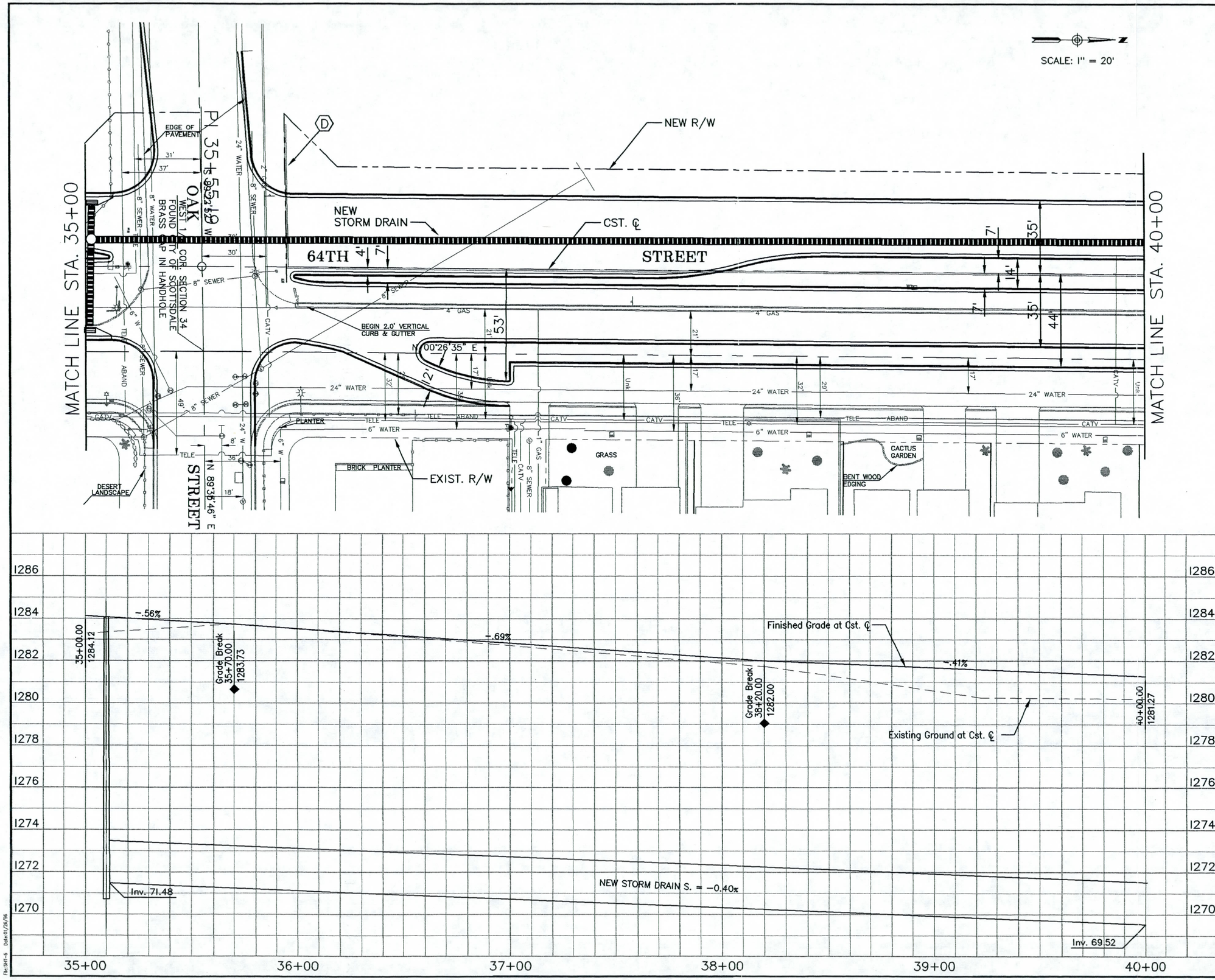
PROJECT TITLE: **64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE**

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20' VERT. 1"=2'	MJB	01/04/96		6
	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

File: SHT-5 Date: 01/05/96

Figure B-5



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PRELIMINARY STORM DRAIN DESIGN

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PROJECT TITLE
64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		6
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

File: SHT-6 Date: 01/26/96

Figure B-6

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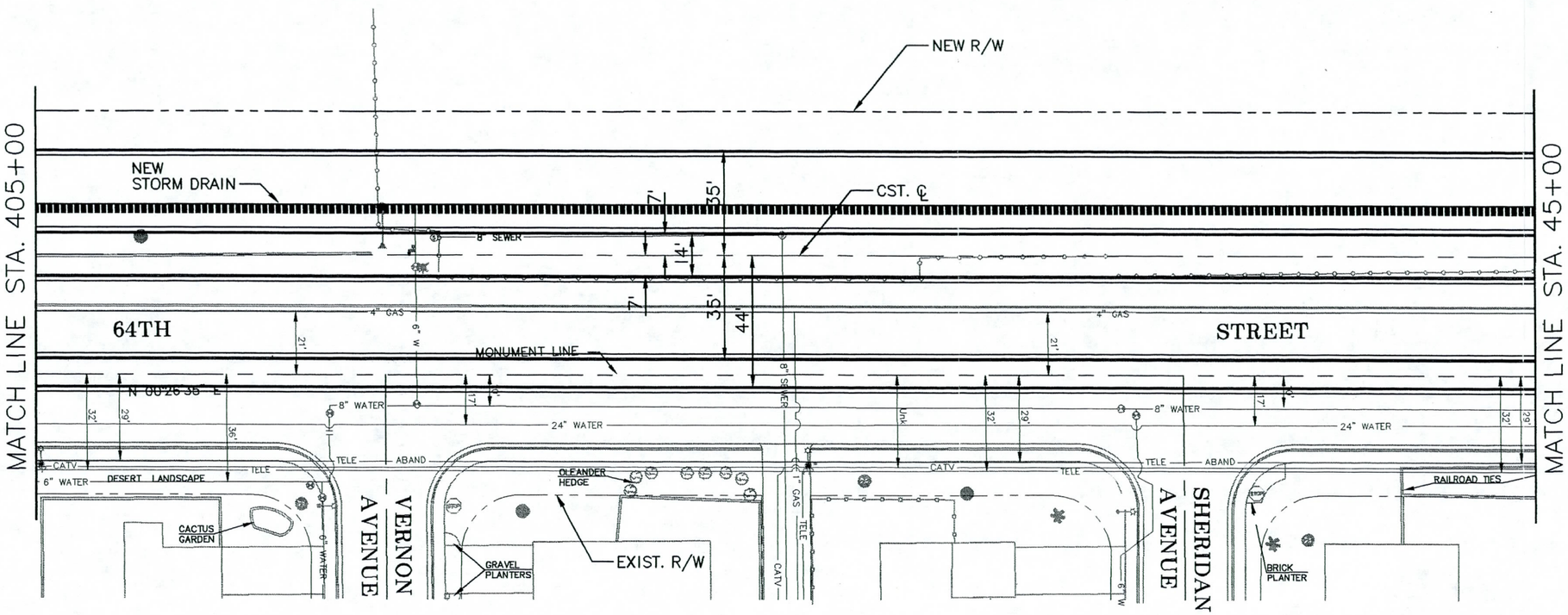
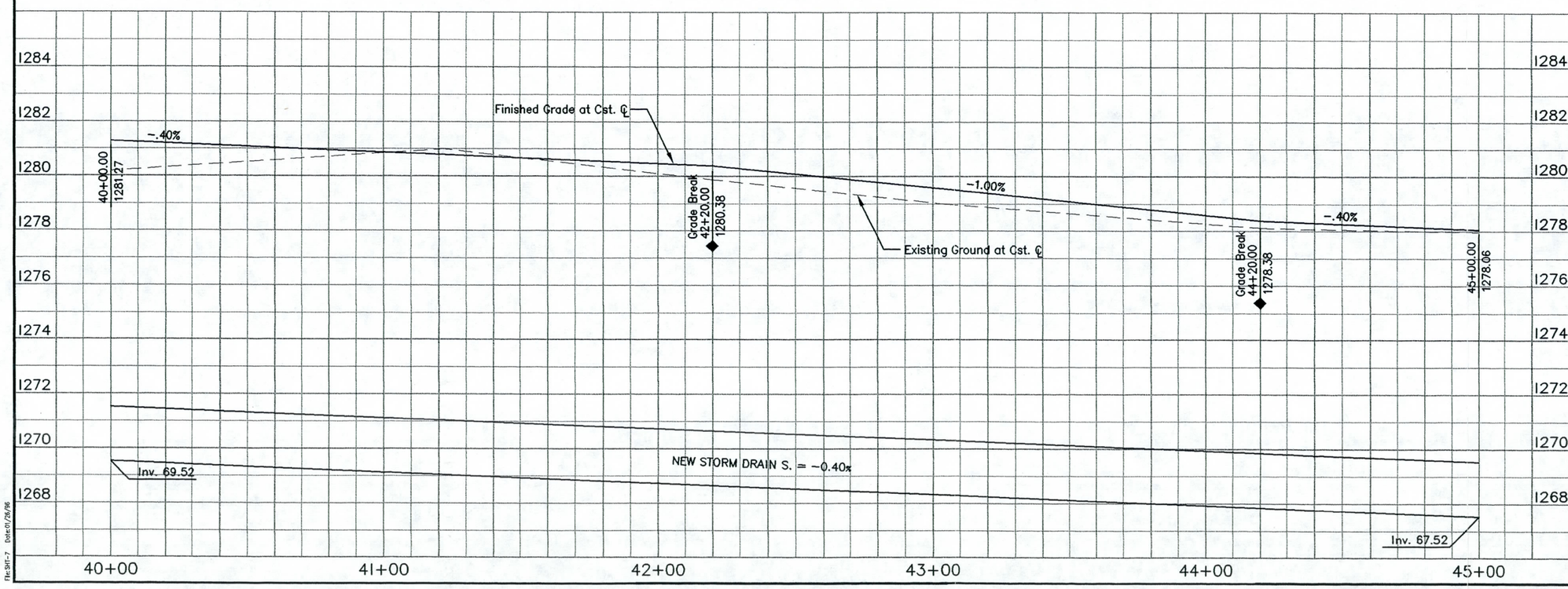
SCALE: 1" = 20'





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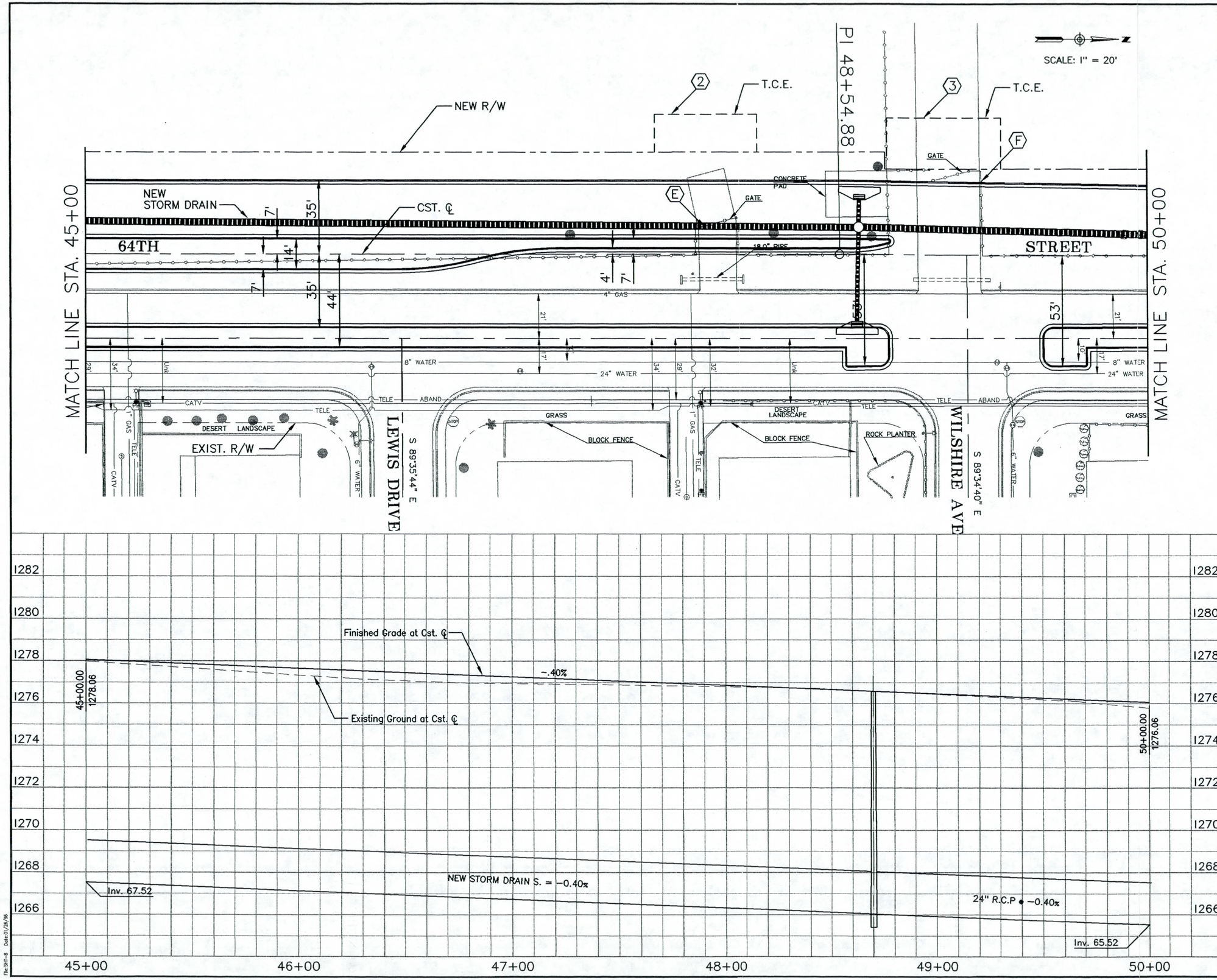
PROJECT TITLE **64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE**

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		7
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

Figure B-7

File:SHT-7 Date:01/26/96



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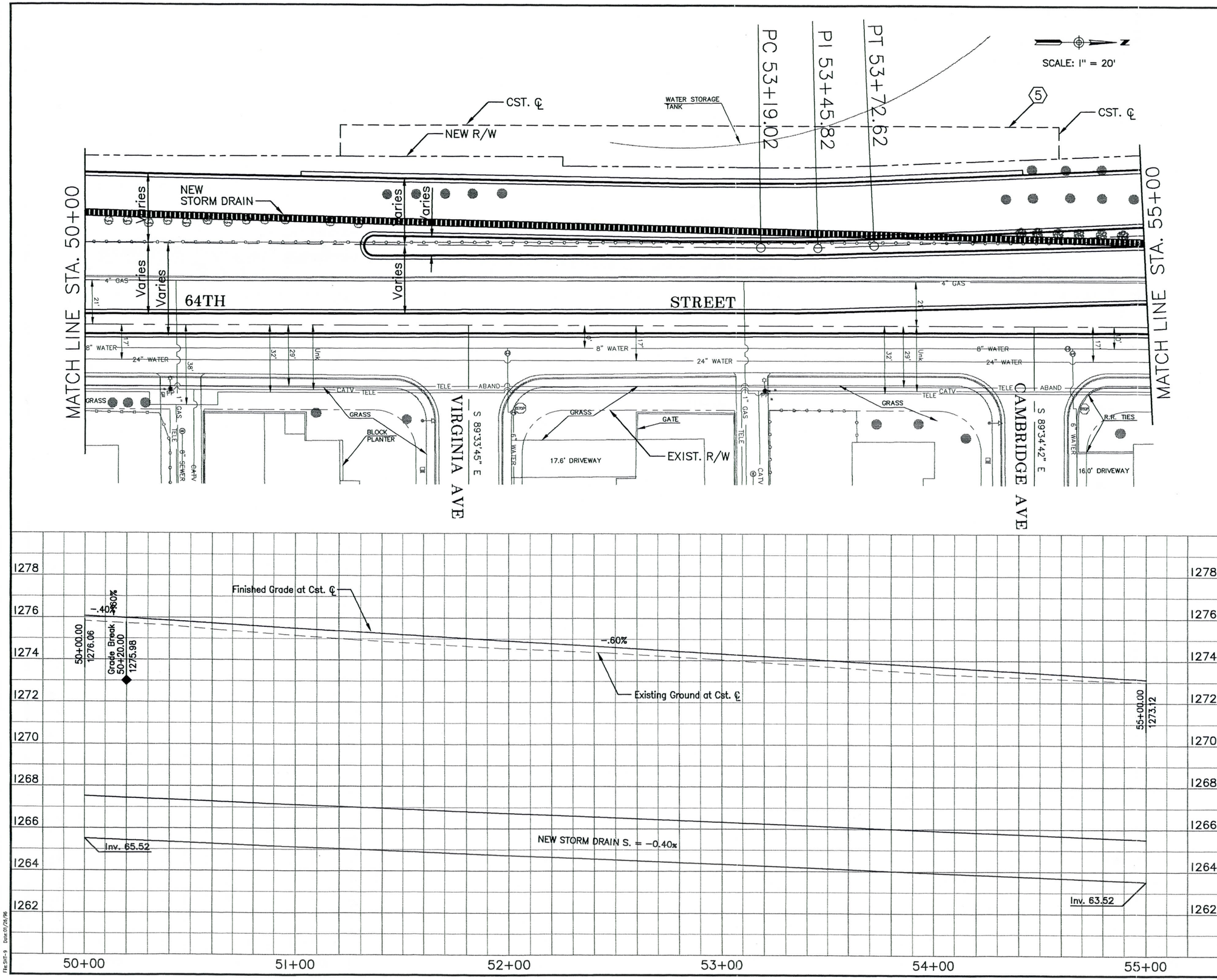
PROJECT TITLE
64TH STREET IMPROVEMENTS
DCR PLAN AND PROFILE

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		8
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

File:SHT-8 Date:01/26/96

Figure B-8



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PROJECT TITLE: **64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE**

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		9
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

File:SHT-9 Date:01/26/96

Figure B-9

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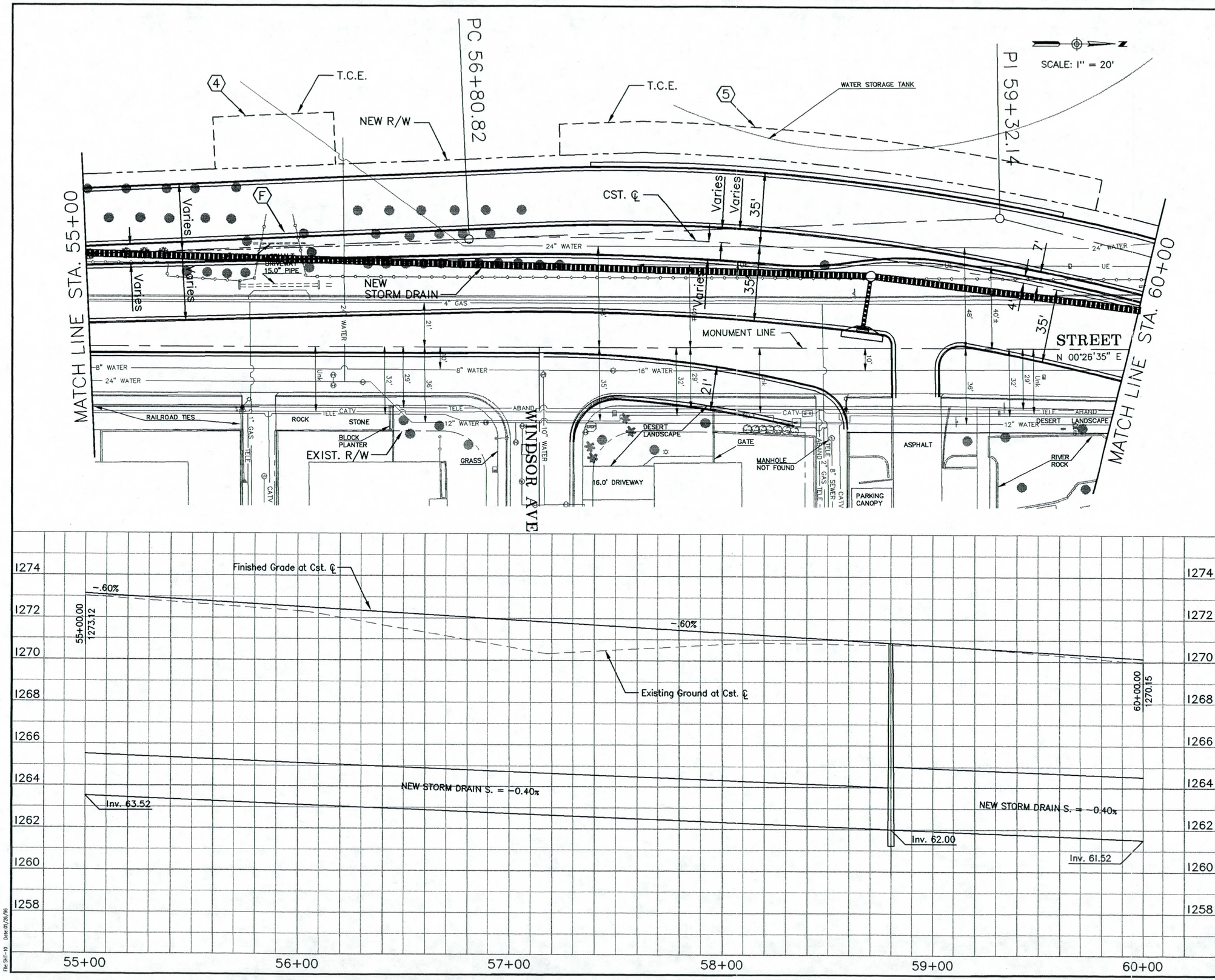

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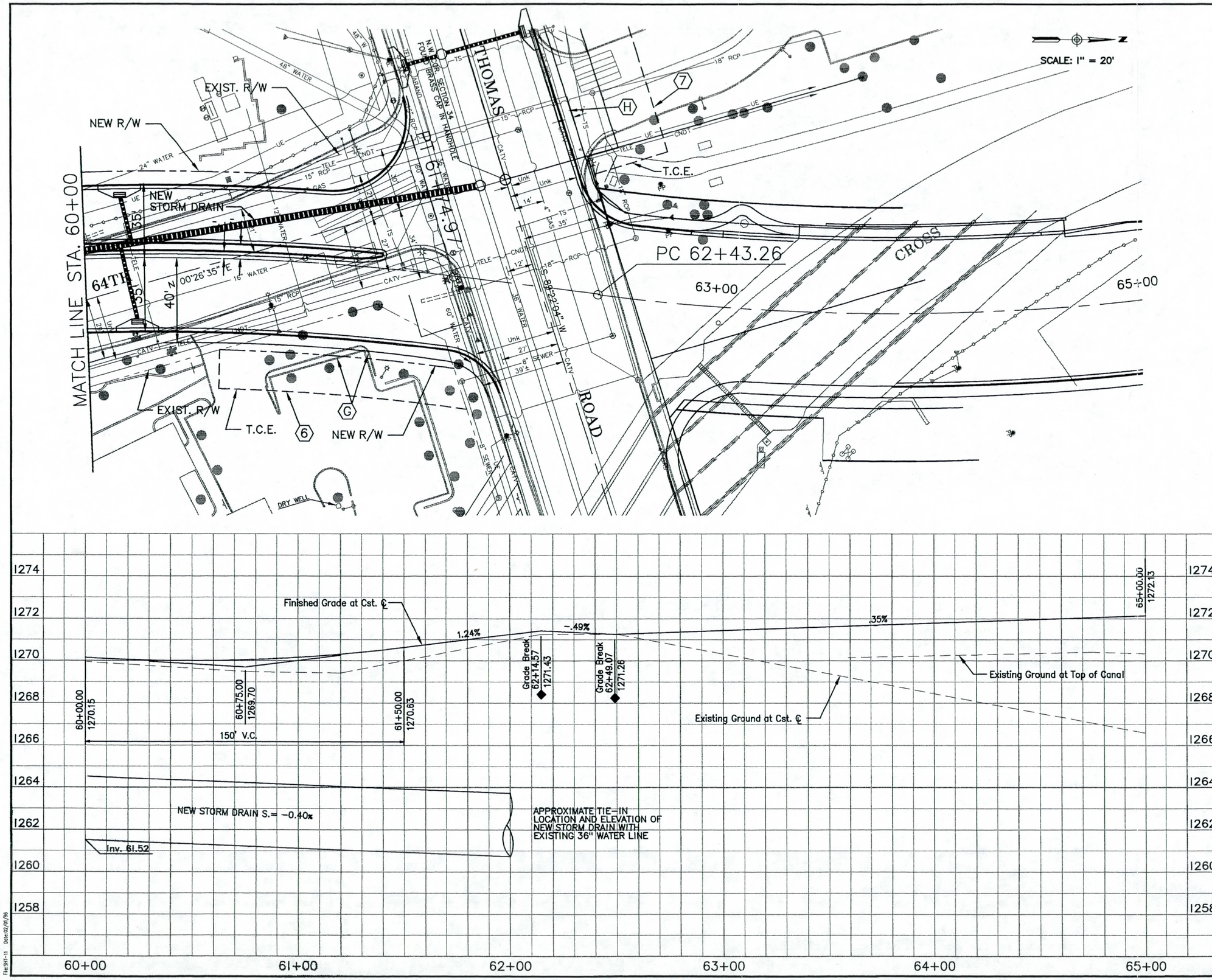
PROJECT TITLE **64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE**

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		10
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

Figure B-10

File:5FT-10 Date:01/26/96



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PRELIMINARY STORM DRAIN DESIGN

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PROJECT TITLE **64TH STREET IMPROVEMENTS DCR PLAN AND PROFILE**

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=20'	MJB	01/04/96		11
VERT. 1"=2'	DRAWN BY JDS	AS-BUILT	PROJECT NO. 410.32	OF 11

File:SHT-11 Date:02/01/96

Figure B-11

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*            VERSION 4.0.1E             *
*     Lahey F77L-EM/32 version 5.01     *
*       Dodson & Associates, Inc.       *
*  RUN DATE  01/18/96  TIME  18:11:13   *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 551-1748              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID   ****************      Off-site drainage for 64th street     *****************
  2           ID   100-Year  6-Hour Storm                                  File:  64-ALT-3.DAT
  3           ID   With retention basins
  4           ID   Alternative No. 3
  5           ID   ******************************************************************************
  6           ID
  7           ID
  8           IT       2                     300
  9           IO       5
              *DIAGRAM

 10           KK  3-1010   BASIN
 11           KM   *** BASIN 03-1010 ** Papago Park and south of McDowell Rd. (3-36"CMP culvert)
 12           BA   0.069
 13           KM   ++++++++++++++++ HYPOTETICAL STORM PRECIPITATION DATA ++++++++++++++++++++++
 14           PH                    0.79    1.55    2.63    2.86    3.01    3.30
 15           KM   ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 16           LS       0      87       0       0      98       0
 17           UK     300  0.0100    0.20      99
 18           UK     100  0.0100    0.10       1
 19           RK    1819  0.0207    0.03            TRAP      60     1.0
 20           RK    3004  0.0207    0.03            TRAP      60     1.0
 21           KM   *** BASIN 03-910 *** Papago Park and West of park (4-36"CMP culvert)

 22           KK  03-910   BASIN
 23           BA   0.084
 24           LS       0      86       0       0      98       0
 25           UK     300  0.0100    0.20      99
 26           UK     100  0.0100    0.10       1
 27           RK     214  0.0034    0.30            TRAP      60     1.0
 28           RK    3794  0.0207    0.03            TRAP      60     1.0

 29           KK  S3-910
 30           KM   **** STORAGE **** Detention basins at ball park ****************************
 31           RS       1     STO       0
 32           SA   0.121   0.336   0.407   0.828   1.035   1.146
 33           SE    1390 1390.68    1391    1392  1392.4    1393
 34           SQ       0     7.2      20      38      58      82     108     200
 35           SE  1392.4  1392.5  1392.6  1392.7  1392.8  1392.9    1393  1393.1
 36           KM   *** BASIN 03-810 *** Papago Park (Hubbell St.)

 37           KK  03-810   BASIN
 38           BA   0.059
 39           LS       0      85       0       0      98       0
 40           UK     300  0.0100    0.20      99
 41           UK     100  0.0100    0.10       1
 42           RK     539  0.0034    0.02            TRAP      60     1.0
 43           RK    3226  0.0207    0.02            TRAP      60     1.0

 44           KK  STR810
 45           KM   **** STORAGE **** VOLUME CALCULATION BASIN 03-810   **************************
 46           KO       3
 47           RS       1     STO       0
 48           SA    1.05    1.11   1.176   1.242    1.31   1.377   1.448
 49           SE       0       1       2       3       4       5       6
```

Why a high 'n' value?

routing through Proposed storm drain to the basin?

Storage is dummy

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  50          SQ       0    .001
  51          SE       3       6
  52          KM   *** BASIN 03-510 *** National Guard and north part of Papago Park (Oak St.)

  53          KK  03-510   BASIN
  54          BA   0.070
  55          LS       0      85       0       0      98       0
  56          UK     300  0.0100    0.20      99
  57          UK     100  0.0100    0.10       1
  58          RK     554  0.0034    0.03            TRAP      30     1.0
  59          RK    1647  0.0207    0.03            TRAP      30     1.0

  60          KK  STR510
  61          KM   **** STORAGE **** VOLUME CALCULATION AT BASIN 03-510 ************************
  62          KM   24" ORIFICE
  63          KO       3
  64          RS       1     STO       0
  65          SA    .698    .740    .784    .828    .873    .918    .965   1.012   1.059
  66          SE       0       1       2       3       4       5       6       7       8
  67          SQ       0      15      21      26      26      26      26      26      26
  68          SE       0       1       2       3       4       5       6       7       8

  69          KK  R03-10
  70          KM   **** ROUTE **** Route basin 03-510 through basin 05-10 to conc. point 05-20
  71          RS       2    FLOW       0
  72          RC   0.040   0.025   0.040    1400 0.00357
  73          RX       0      79      89      98     102     111     121     200
  74          RY  107.95     104     103     100     100     103     104  107.95
  75          KM   *** BASIN 05-10 ***

  76          KK   05-10   BASIN
  77          BA   0.067
  78          LS       0      81       0       0      98       0
  79          UK     144  0.0100    0.30      52
  80          UK      57  0.0100    0.10      48
  81          RK    1189  0.0033    0.02            TRAP      30     1.0
  82          RK    1197  0.0038    0.02            TRAP      60     1.0
  83          KM   *** BASIN 05-10A *** Part of subdivicion
                 05-10B
  84          KK  ~~05-10A~~
  85          BA   0.013
  86          LS       0      81       0       0      98       0
  87          UK     154    0.01    0.30      66
  88          UK      51    0.01    0.10      34
  89          RK     800  0.0156   0.035            TRAP       4       2
  90          RK     400  0.0156   0.020            TRAP       4       2

  91          KK  R5-10B
  92          KM   **** ROUTE **** Route 05-10A through basin 05-10 to conc. point 05-10
  93          RS       2    FLOW       0
  94          RC   0.035   0.300   0.035    1700  0.0082
  95          RX       0      79      89      98     102     111     121     200
  96          RY  107.95     104     103     100     100     103     104  107.95
  97          KM   *** POINT OF CONC. 05-10 *** Combine basins 05-10 and 05-10A
```

Where

Where is the basin?

Route through Pipe to C210

S 10A

Storage route (connected to pipe route to 210?)

S 210

Storage route

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  98          KK   05-10
  99          HC       2

 100          KK   STR10
 101          KM   **** STORAGE **** VOLUME CALCULATION AT BASIN 05-10 ************************
 102          KM   30" ORIFICE
 103          KO       3
 104          RS       1     STO       0
 105          SA    .698    .740    .784    .828    .873    .918    .965   1.012   1.059
 106          SE       0       1       2       3       4       5       6       7       8
 107          SQ       0      23      33      41      45      45      45      45      45
 108          SE       0       1       2       3       4       5       6       7       8

 109          KK  R05-10
 110          KM   **** ROUTE **** Route 05-10 through basin 05-210 to conc. point 05-220
 111          RS       2    FLOW       0
 112          RC   0.040   0.025   0.040    1250    .004
 113          RX       0      79      89      98     102     111     121     200
 114          RY  107.95     104     103     100     100     103     104  107.95
 115          KM   *** BASIN 05-210 *** (Thomas Rd.)

 116          KK  05-210   BASIN
 117          BA   0.054
 118          LS       0      79       0       0      98       0
 119          UK     200  0.0100    0.30      28
 120          UK     200  0.0100    0.10      72
 121          RK     564  0.0038    0.02            TRAP      23     1.0
 122          RK    1199  0.0033    0.02            TRAP      23     1.0

 123          KK  STR210
 124          KM   **** STORAGE **** VOLUME CALCULATION AT BASIN 05-210 ************************
 125          KO       3
 126          RS       1     STO       0
 127          SV       0       2       4       8      12      16      20      24
 128          SE       0       2       4       8      12      16      20      24
 129          SQ       0    .001
 130          SE       3      24
 131          KM   *** POINT OF CONC. 05-220 *** Combine basins 05-10 and 05-210

 132          KK  05-220
 133          HC       2
 134          ZZ
```

Need to hold onto for the property

Storage based on City of Plano, Oklahoma's Nationwide Guarantees that this storage will be provided

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   10      3-1010
                .
                .
   22           .      03-910
                .          V
                .          V
   29           .      S3-910
                .           .
                .           .
   37           .           .     03-810
                .           .         V
                .           .         V
   44           .           .     STR810
                .           .         .
                .           .         .
   53           .           .         .     03-510
                .           .         .         V
                .           .         .         V
   60           .           .         .     STR510
                .           .         .         V
                .           .         .         V
   69           .           .         .     R03-10
                .           .         .         .
                .           .         .         .
   76           .           .         .         .      05-10
                .           .         .         .         .
                .           .         .         .         .
   84           .           .         .         .         .     05-10A
                .           .         .         .         .          V
                .           .         .         .         .          V
   91           .           .         .         .         .     R5-10A
                .           .         .         .         .          .
                .           .         .         .         .          .
   98           .           .         .         .      05-10............
                .           .         .         .         V
                .           .         .         .         V
  100           .           .         .         .      STR10
                .           .         .         .         V
                .           .         .         .         V
  109           .           .         .         .     R05-10
                .           .         .         .         .
                .           .         .         .         .
  116           .           .         .         .         .     05-210
                .           .         .         .         .          V
                .           .         .         .         .          V
  123           .           .         .         .         .     STR210
                .           .         .         .         .          .
                .           .         .         .         .          .
  132           .           .         .         .      05-220............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************                    *****************************************
*                                       *                    *                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
*              MAY   1991               *                    *    HYDROLOGIC ENGINEERING CENTER      *
*           VERSION 4.0.1E              *                    *          609 SECOND STREET            *
*     Lahey F77L-EM/32 version 5.01     *                    *       DAVIS, CALIFORNIA 95616         *
*       Dodson & Associates, Inc.       *                    *           (916) 551-1748              *
*  RUN DATE  01/18/96  TIME  18:11:13   *                    *                                       *
*****************************************                    *****************************************


                    ****************      Off-site drainage for 64th street     *****************
                    100-Year  6-Hour Storm                                  File:  64-ALT-3.DAT
                    With retention basins
                    Alternative No. 3
                    ******************************************************************************


  9 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           2  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1    0  ENDING DATE
                     NDTIME        0958  ENDING TIME
                      ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL    0.03 HOURS
                      TOTAL TIME BASE    9.97 HOURS

         ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 44 KK     *   STR810   *
           *            *
           **************

 46 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                          *** BASIN 03-510 *** National Guard and north part of Papago Park (Oak St.)

             HYDROGRAPH ROUTING DATA

 47 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP         STO  TYPE OF INITIAL CONDITION
                     RSVRIC        0.00  INITIAL CONDITION
                          X        0.00 WORKING R AND D COEFFICIENT
```

```
48 SA            AREA        1.0      1.1      1.2      1.2      1.3      1.4      1.4

49 SE       ELEVATION       0.00     1.00     2.00     3.00     4.00     5.00     6.00

50 SQ       DISCHARGE        0.       0.

51 SE       ELEVATION       3.00     6.00

                                                  ***

                                        COMPUTED STORAGE-ELEVATION DATA

          STORAGE      0.00     1.08     2.22     3.43     4.71     6.05     7.46
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00

                                      COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00     1.08     2.22     3.43     4.71     6.05     7.46
          OUTFLOW      0.00     0.00     0.00     0.00     0.00     0.00     0.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   STR810

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR      24-HR      72-HR     9.97-HR
  (CFS)       (HR)
                           (CFS)
+     0.      0.03                    0.         0.         0.         0.
                         (INCHES)   0.000      0.000      0.000      0.000
                          (AC-FT)     0.         0.         0.         0.

PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR      24-HR      72-HR     9.97-HR
  (AC-FT)     (HR)
     6.       9.93                    5.         3.         3.         3.

PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR      24-HR      72-HR     9.97-HR
  (FEET)      (HR)
   4.77       9.97                   4.50       2.89       2.89       2.89

                         CUMULATIVE AREA =    0.06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
60 KK     *    STR510  *
          *            *
          **************

63 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

64 RS          STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP        STO  TYPE OF INITIAL CONDITION
                    RSVRIC       0.00  INITIAL CONDITION
                         X       0.00 WORKING R AND D COEFFICIENT

65 SA            AREA        0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.0      1.1
```

```
66 SE        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

67 SQ        DISCHARGE       0.      15.      21.      26.      26.      26.      26.      26.      26.

68 SE        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00
                                                      ***

                                   COMPUTED STORAGE-ELEVATION DATA

          STORAGE      0.00     0.72     1.48     2.29     3.14     4.03     4.97     5.96     7.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

                              COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00     0.72     1.48     2.29     3.14     4.03     4.97     5.96     7.00
          OUTFLOW      0.00    15.00    21.00    26.00    26.00    26.00    26.00    26.00    26.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

    ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   STR510

PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR      9.97-HR
+  (CFS)      (HR)
                        (CFS)
    26.      3.43                14.          8.          8.          8.
                      (INCHES)  1.819       1.830       1.830       1.830
                       (AC-FT)     7.          7.          7.          7.

PEAK STORAGE  TIME                       MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR       72-HR      9.97-HR
+  (AC-FT)    (HR)
     3.      3.90                 1.          1.          1.          1.

PEAK STAGE    TIME                       MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR       72-HR      9.97-HR
+  (FEET)     (HR)
    4.33     3.93                1.59        0.96        0.96        0.96

                      CUMULATIVE AREA =    0.07 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
100 KK    *     STR10  *
          *            *
          **************

103 KO       OUTPUT CONTROL VARIABLES
                   IPRNT          3  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

          HYDROGRAPH ROUTING DATA

104 RS       STORAGE ROUTING
                   NSTPS          1  NUMBER OF SUBREACHES
                    ITYP        STO  TYPE OF INITIAL CONDITION
                  RSVRIC       0.00  INITIAL CONDITION
                       X       0.00 WORKING R AND D COEFFICIENT

105 SA            AREA        0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.0      1.1

106 SE       ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00
```

```
107 SQ        DISCHARGE        0.      23.      33.      41.      45.      45.      45.      45.      45.

108 SE        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00
                                                          ***

                                        COMPUTED STORAGE-ELEVATION DATA

          STORAGE      0.00     0.72     1.48     2.29     3.14     4.03     4.97     5.96     7.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

                                     COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00     0.72     1.48     2.29     3.14     4.03     4.97     5.96     7.00
          OUTFLOW      0.00    23.00    33.00    41.00    45.00    45.00    45.00    45.00    45.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION    STR10

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR      9.97-HR
  (CFS)       (HR)
                            (CFS)
     45.      3.33                   19.         12.         12.         12.
                          (INCHES)  2.203       2.227       2.227       2.227
                           (AC-FT)     9.         10.         10.         10.

PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR      9.97-HR
  (AC-FT)     (HR)
      4.      3.67                    1.          1.          1.          1.

PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR      9.97-HR
  (FEET)      (HR)
    4.90      3.67                 1.45        0.88        0.88        0.88

                         CUMULATIVE AREA =    0.08 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
123 KK      *    STR210  *
            *            *
            **************

125 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                        *** POINT OF CONC. 05-220 *** Combine basins 05-10 and 05-210

            HYDROGRAPH ROUTING DATA

126 RS        STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP        STO  TYPE OF INITIAL CONDITION
                   RSVRIC       0.00  INITIAL CONDITION
                        X       0.00 WORKING R AND D COEFFICIENT

127 SV          STORAGE        0.0      2.0      4.0      8.0     12.0     16.0     20.0     24.0

128 SE        ELEVATION      0.00     2.00     4.00     8.00    12.00    16.00    20.00    24.00

129 SQ        DISCHARGE        0.       0.
```

130 SE ELEVATION 3.00 24.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	2.00	3.00	4.00	8.00	12.00	16.00	20.00	24.00
OUTFLOW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ELEVATION	0.00	2.00	3.00	4.00	8.00	12.00	16.00	20.00	24.00

*** *** *** *** ***

HYDROGRAPH AT STATION STR210

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	9.97-HR
+ (CFS)	(HR)					
		(CFS)				
0.	0.03		0.	0.	0.	0.
		(INCHES)	0.000	0.000	0.000	0.000
		(AC-FT)	0.	0.	0.	0.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	9.97-HR
+ (AC-FT)	(HR)				
7.	9.87	7.	5.	5.	5.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	9.97-HR
+ (FEET)	(HR)				
7.47	9.97	7.25	4.84	4.84	4.84

CUMULATIVE AREA = 0.05 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	3-1010	126.	3.37	15.	9.	9.	0.07		
HYDROGRAPH AT	03-910	142.	3.37	17.	10.	10.	0.08		
ROUTED TO	S3-910	128.	3.47	15.	9.	9.	0.08	1393.02	3.47
HYDROGRAPH AT	03-810	97.	3.37	12.	7.	7.	0.06		
ROUTED TO	STR810	0.	0.03	0.	0.	0.	0.06	4.77	9.97
HYDROGRAPH AT	03-510	120.	3.33	14.	8.	8.	0.07		
ROUTED TO	STR510	26.	3.43	14.	8.	8.	0.07	4.33	3.93
ROUTED TO	R03-10	26.	3.97	14.	8.	8.	0.07	101.15	4.03
HYDROGRAPH AT	05-10	185.	3.10	16.	10.	10.	0.07		
HYDROGRAPH AT	05-10A	29.	3.07	3.	2.	2.	0.01		
ROUTED TO	R5-10A	10.	3.73	3.	2.	2.	0.01	101.98	3.73
2 COMBINED AT	05-10	186.	3.10	19.	12.	12.	0.08		
ROUTED TO	STR10	45.	3.33	19.	12.	12.	0.08	4.90	3.67
ROUTED TO	R05-10	45.	3.63	19.	12.	12.	0.08	101.46	3.70
HYDROGRAPH AT	05-210	183.	3.10	15.	9.	9.	0.05		
ROUTED TO	STR210	0.	0.03	0.	0.	0.	0.05	7.47	9.97
2 COMBINED AT	05-220	45.	3.63	19.	12.	12.	0.13		

*** NORMAL END OF HEC-1 ***

APPENDIX C

OFF-SITE DRAINAGE CALCULATIONS

HEC-1 OUTPUT

10-YEAR

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             MAY   1991                *
*           VERSION 4.0.1E              *
*     Lahey F77L-EM/32 version 5.01     *
*       Dodson & Associates, Inc.       *
*  RUN DATE  01/18/96  TIME  18:15:54   *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 551-1748              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID   ****************      Off-site drainage for 64th street     *****************
  2           ID   10-Year  6-Hour Storm                                  File:  64-ALT1X.DAT
  3           ID   With retention basins
  4           ID   ******************************************************************************
  5           ID
  6           ID
  7           IT       2                     300
  8           IO       5
              *DIAGRAM

  9           KK   DB-A1
 10           KM   **** Drainage Basin DB-A1
 11           BA    .028
 12           KM   +++++++++++++++ HYPOTETICAL STORM PRECIPITATION DATA ++++++++++++++++++++++
 13           PH                     .51      .97    1.63    1.77    1.87    2.05
 14           KM   ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 15           LS       0      87       0       0      98       0
 16           UK     300  0.0100    0.20      99
 17           UK     100  0.0100    0.10       1
 18           RK    1819  0.0207    0.03            TRAP      60     1.0
 19           RK    3004  0.0207    0.03            TRAP      60     1.0
 20           KM   *** BASIN 03-910 *** Papago Park and West of park (4-36"CMP culvert)

 21           KK  03-910   BASIN
 22           BA   0.084
 23           LS       0      86       0       0      98       0
 24           UK     300  0.0100    0.20      99
 25           UK     100  0.0100    0.10       1
 26           RK     214  0.0034    0.30            TRAP      60     1.0
 27           RK    3794  0.0207    0.03            TRAP      60     1.0

 28           KK  S3-910
 29           KM   **** STORAGE **** Detention basins at ball park ****************************
 30           RS       1     STO       0
 31           SA   0.121   0.336   0.407   0.828   1.035   1.146
 32           SE    1390 1390.68    1391    1392  1392.4    1393
 33           SQ       0     7.2      20      38      58      82     108     200
 34           SE  1392.4  1392.5  1392.6  1392.7  1392.8  1392.9    1393  1393.1
 35           KM   *** BASIN 03-810 *** Papago Park (Hubbell St.)

 36           KK  03-810   BASIN
 37           BA   0.059
 38           LS       0      85       0       0      98       0
 39           UK     300  0.0100    0.20      99
 40           UK     100  0.0100    0.10       1
 41           RK     539  0.0034    0.02            TRAP      60     1.0
 42           RK    3226  0.0207    0.02            TRAP      60     1.0

 43           KK  STR810
 44           KM   **** STORAGE **** VOLUME CALCULATION BASIN 03-810   *************************
 45           KO       3
 46           RS       1     STO       0
 47           SA    1.05    1.11   1.176   1.242   1.310   1.377   1.448
 48           SE       0       1       2       3       4       5       6
 49           SQ       0    .001
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  50          SE       3       6
  51          KM   *** BASIN 03-510 *** National Guard and north part of Papago Park (Oak St.)

  52          KK  03-510   BASIN
  53          BA   0.070
  54          LS       0      85       0       0      98       0
  55          UK     300  0.0100    0.20      99
  56          UK     100  0.0100    0.10       1
  57          RK     554  0.0034    0.03            TRAP      30     1.0
  58          RK    1647  0.0207    0.03            TRAP      30     1.0

  59          KK  STR510
  60          KM   **** STORAGE **** VOLUME CALCULATION AT BASIN 03-510 ************************
  61          KM   24" ORIFICE
  62          KO       3
  63          RS       1     STO       0
  64          SA    .698    .740    .784    .828    .873    .918    .965   1.012   1.059
  65          SE       0       1       2       3       4       5       6       7       8
  66          SQ       0      15      21      26      26      26      26      26      26
  67          SE       0       1       2       3       4       5       6       7       8

  68          KK  R03-10
  69          KM   **** ROUTE **** Route basin 03-510 through basin 05-10 to conc. point 05-20
  70          RS       2    FLOW       0
  71          RC   0.040   0.025   0.040    1400 0.00357
  72          RX       0      79      89      98     102     111     121     200
  73          RY  107.95     104     103     100     100     103     104  107.95
  74          KM   *** BASIN 05-10 ***

  75          KK   05-10   BASIN
  76          BA   0.067
  77          LS       0      81       0       0      98       0
  78          UK     144  0.0100    0.30      52
  79          UK      57  0.0100    0.10      48
  80          RK    1189  0.0033    0.02            TRAP      30     1.0
  81          RK    1197  0.0038    0.02            TRAP      60     1.0
  82          KM   *** BASIN 05-10A *** Part of subdivicion

  83          KK  05-10A
  84          BA   0.013
  85          LS       0      81       0       0      98       0
  86          UK     154    0.01    0.30      66
  87          UK      51    0.01    0.10      34
  88          RK     800  0.0156   0.035            TRAP       4       2
  89          RK     400  0.0156   0.020            TRAP       4       2

  90          KK  R5-10A
  91          KM   **** ROUTE **** Route 05-10A through basin 05-10 to conc. point 05-10
  92          RS       2    FLOW       0
  93          RC   0.035   0.300   0.035    1700  0.0082
  94          RX       0      79      89      98     102     111     121     200
  95          RY  107.95     104     103     100     100     103     104  107.95
  96          KM   *** POINT OF CONC. 05-10 *** Combine basins 05-10 and 05-10A
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 97           KK   05-10
 98           HC       2

 99           KK   STR10
100           KM   **** STORAGE **** VOLUME CALCULATION AT BASIN 05-10 ************************
101           KM   24" ORIFICE
102           KO       3
103           RS       1     STO       0
104           SA    .698    .740    .784    .828    .873    .918    .965   1.012   1.059
105           SE       0       1       2       3       4       5       6       7       8
106           SQ       0      15      21      26      26      26      26      26      26
107           SE       0       1       2       3       4       5       6       7       8

108           KK  R05-10
109           KM   **** ROUTE **** Route 05-10 through basin 05-210 to conc. point 05-220
110           RS       2    FLOW       0
111           RC   0.040   0.025   0.040    1250    .004
112           RX       0      79      89      98     102     111     121     200
113           RY  107.95     104     103     100     100     103     104  107.95
114           KM   *** BASIN 05-210 *** (Thomas Rd.)

115           KK  05-210   BASIN
116           BA   0.054
117           LS       0      79       0       0      98       0
118           UK     200  0.0100    0.30      28
119           UK     200  0.0100    0.10      72
120           RK     564  0.0038    0.02            TRAP      23     1.0
121           RK    1199  0.0033    0.02            TRAP      23     1.0

122           KK  STR210
123           KM   **** STORAGE **** VOLUME CALCULATION AT BASIN 05-210 ************************
124           KO       3
125           RS       1     STO       0
126           SV       0       2       4       8      12      16      20      24
127           SE       0       2       4       8      12      16      20      24
128           SQ       0    .001
129           SE       3      24
130           KM   *** POINT OF CONC. 05-220 *** Combine basins 05-10 and 05-210

131           KK  05-220
132           HC       2
133           ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9       DB-A1
               .
               .
  21           .      03-910
               .          V
               .          V
  28           .      S3-910
               .          .
               .          .
  36           .          .      03-810
               .          .          V
               .          .          V
  43           .          .      STR810
               .          .          .
               .          .          .
  52           .          .          .      03-510
               .          .          .          V
               .          .          .          V
  59           .          .          .      STR510
               .          .          .          V
               .          .          .          V
  68           .          .          .      R03-10
               .          .          .          .
               .          .          .          .
  75           .          .          .          .      05-10
               .          .          .          .          .
               .          .          .          .          .
  83           .          .          .          .          .      05-10A
               .          .          .          .          .          V
               .          .          .          .          .          V
  90           .          .          .          .          .      R5-10A
               .          .          .          .          .          .
               .          .          .          .          .          .
  97           .          .          .          .      05-10...........
               .          .          .          .          V
               .          .          .          .          V
  99           .          .          .          .      STR10
               .          .          .          .          V
               .          .          .          .          V
 108           .          .          .          .      R05-10
               .          .          .          .          .
               .          .          .          .          .
 115           .          .          .          .          .      05-210
               .          .          .          .          .          V
               .          .          .          .          .          V
 122           .          .          .          .          .      STR210
               .          .          .          .          .          .
               .          .          .          .          .          .
 131           .          .          .          .      05-220...........
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************                                    ****************************************
*                                       *                                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
*              MAY   1991               *                                    *    HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.0.1E             *                                    *          609 SECOND STREET           *
*     Lahey F77L-EM/32 version 5.01     *                                    *       DAVIS, CALIFORNIA 95616        *
*        Dodson & Associates, Inc.      *                                    *           (916) 551-1748             *
*  RUN DATE  01/18/96  TIME  18:15:54   *                                    *                                      *
*****************************************                                    ****************************************


                    ****************     Off-site drainage for 64th street     *****************
                    10-Year  6-Hour Storm                                 File:  64-ALT1X.DAT
                    With retention basins
                    ******************************************************************************


  8 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT           HYDROGRAPH TIME DATA
                       NMIN           2  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1    0  ENDING DATE
                     NDTIME        0958  ENDING TIME
                      ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL    0.03 HOURS
                      TOTAL TIME BASE    9.97 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 43 KK      *    STR810  *
            *            *
            **************

 45 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                          *** BASIN 03-510 *** National Guard and north part of Papago Park (Oak St.)

               HYDROGRAPH ROUTING DATA

 46 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP         STO  TYPE OF INITIAL CONDITION
                     RSVRIC        0.00  INITIAL CONDITION
                          X        0.00 WORKING R AND D COEFFICIENT
```

```
47 SA          AREA        1.0      1.1      1.2      1.2      1.3      1.4      1.4

48 SE       ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00

49 SQ       DISCHARGE       0.       0.

50 SE       ELEVATION      3.00     6.00

                                                  ***

                                        COMPUTED STORAGE-ELEVATION DATA

          STORAGE      0.00     1.08     2.22     3.43     4.71     6.05     7.46
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00

                                      COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00     1.08     2.22     3.43     4.71     6.05     7.46
          OUTFLOW      0.00     0.00     0.00     0.00     0.00     0.00     0.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00

    ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   STR810

PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR      9.97-HR
  (CFS)       (HR)
                          (CFS)
+     0.      0.03          0.          0.          0.          0.
                       (INCHES)     0.000       0.000       0.000       0.000
                        (AC-FT)       0.          0.          0.          0.

PEAK STORAGE  TIME                        MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR       72-HR      9.97-HR
  (AC-FT)     (HR)
     3.       9.97                 2.          1.          1.          1.

PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR       72-HR      9.97-HR
  (FEET)      (HR)
   2.29       9.97                2.08        1.30        1.30        1.30

                     CUMULATIVE AREA =    0.06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
59 KK     *    STR510  *
          *            *
          **************

62 KO        OUTPUT CONTROL VARIABLES
                   IPRNT          3  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

           HYDROGRAPH ROUTING DATA

63 RS        STORAGE ROUTING
                   NSTPS          1  NUMBER OF SUBREACHES
                    ITYP        STO  TYPE OF INITIAL CONDITION
                  RSVRIC       0.00  INITIAL CONDITION
                       X       0.00 WORKING R AND D COEFFICIENT

64 SA          AREA        0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.0      1.1
```

```
65 SE        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

66 SQ        DISCHARGE       0.       15.      21.      26.      26.      26.      26.      26.      26.

67 SE        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00
                                                      ***

                                   COMPUTED STORAGE-ELEVATION DATA

          STORAGE      0.00     0.72     1.48     2.29     3.14     4.03     4.97     5.96     7.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

                              COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00     0.72     1.48     2.29     3.14     4.03     4.97     5.96     7.00
          OUTFLOW      0.00    15.00    21.00    26.00    26.00    26.00    26.00    26.00    26.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

   ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   STR510

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR      9.97-HR
  (CFS)       (HR)
                            (CFS)
   18.        3.93                 6.          4.          4.          4.
                         (INCHES)  0.813      0.821       0.821       0.821
                          (AC-FT)  3.         3.          3.          3.

PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR       72-HR      9.97-HR
+ (AC-FT)     (HR)
    1.        3.93                 0.          0.          0.          0.

PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR       72-HR      9.97-HR
+   (FEET)    (HR)
   1.43       3.93                 0.44        0.26        0.26        0.26

                         CUMULATIVE AREA =    0.07 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
99 KK     *     STR10  *
          *            *
          **************

102 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

103 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP        STO  TYPE OF INITIAL CONDITION
                     RSVRIC       0.00  INITIAL CONDITION
                          X       0.00 WORKING R AND D COEFFICIENT

104 SA               AREA        0.7      0.7      0.8      0.8      0.9      0.9      1.0      1.0      1.1

105 SE          ELEVATION       0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00
```

```
106 SQ          DISCHARGE          0.      15.      21.      26.      26.      26.      26.      26.      26.

107 SE          ELEVATION       0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00
                                                                  ***

                                                   COMPUTED STORAGE-ELEVATION DATA

          STORAGE      0.00     0.72     1.48     2.29     3.14     4.03     4.97     5.96     7.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

                                                COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00     0.72     1.48     2.29     3.14     4.03     4.97     5.96     7.00
          OUTFLOW      0.00    15.00    21.00    26.00    26.00    26.00    26.00    26.00    26.00
        ELEVATION      0.00     1.00     2.00     3.00     4.00     5.00     6.00     7.00     8.00

    ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    STR10

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR      9.97-HR
  (CFS)       (HR)
                            (CFS)
+    24.      3.70                   10.         6.          6.          6.
                          (INCHES)  1.148       1.162       1.162       1.162
                           (AC-FT)    5.          5.          5.          5.

PEAK STORAGE  TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR      9.97-HR
  (AC-FT)     (HR)
     2.       3.70                    1.         0.          0.          0.

PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR      9.97-HR
  (FEET)      (HR)
   2.59       3.70                 0.86        0.53        0.53        0.53

                         CUMULATIVE AREA =    0.08 SQ MI


        *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
122 KK    *    STR210  *
          *            *
          **************

124 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                          *** POINT OF CONC. 05-220 *** Combine basins 05-10 and 05-210

             HYDROGRAPH ROUTING DATA

125 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP        STO  TYPE OF INITIAL CONDITION
                     RSVRIC       0.00  INITIAL CONDITION
                          X       0.00 WORKING R AND D COEFFICIENT
```

126 SV	STORAGE	0.0	2.0	4.0	8.0	12.0	16.0	20.0	24.0
127 SE	ELEVATION	0.00	2.00	4.00	8.00	12.00	16.00	20.00	24.00
128 SQ	DISCHARGE	0.	0.						
129 SE	ELEVATION	3.00	24.00						

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	2.00	3.00	4.00	8.00	12.00	16.00	20.00	24.00
OUTFLOW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ELEVATION	0.00	2.00	3.00	4.00	8.00	12.00	16.00	20.00	24.00

*** *** *** *** ***

HYDROGRAPH AT STATION STR210

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	9.97-HR
(CFS)	(HR)					
		(CFS)				
+ 0.	0.03		0.	0.	0.	0.
		(INCHES)	0.000	0.000	0.000	0.000
		(AC-FT)	0.	0.	0.	0.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	9.97-HR
(AC-FT)	(HR)				
4.	9.90	4.	3.	3.	3.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	9.97-HR
(FEET)	(HR)				
4.20	9.97	4.05	2.68	2.68	2.68

CUMULATIVE AREA = 0.05 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	DB-A1	16.	3.70	3.	2.	2.	0.03		
HYDROGRAPH AT	03-910	46.	3.60	8.	5.	5.	0.08		
ROUTED TO	S3-910	29.	3.93	5.	3.	3.	0.08	1392.65	3.93
HYDROGRAPH AT	03-810	31.	3.60	5.	3.	3.	0.06		
ROUTED TO	STR810	0.	0.03	0.	0.	0.	0.06	2.29	9.97
HYDROGRAPH AT	03-510	38.	3.57	6.	4.	4.	0.07		
ROUTED TO	STR510	18.	3.93	6.	4.	4.	0.07	1.43	3.93
ROUTED TO	R03-10	18.	4.03	6.	4.	4.	0.07	100.93	4.03
HYDROGRAPH AT	05-10	99.	3.13	9.	5.	5.	0.07		
HYDROGRAPH AT	05-10A	15.	3.07	1.	1.	1.	0.01		
ROUTED TO	R5-10A	4.	3.93	1.	1.	1.	0.01	101.27	3.93
2 COMBINED AT	05-10	99.	3.13	10.	6.	6.	0.08		
ROUTED TO	STR10	24.	3.70	10.	6.	6.	0.08	2.59	3.70
ROUTED TO	R05-10	24.	3.80	10.	6.	6.	0.08	101.06	3.80
HYDROGRAPH AT	05-210	103.	3.13	8.	5.	5.	0.05		
ROUTED TO	STR210	0.	0.03	0.	0.	0.	0.05	4.20	9.97
2 COMBINED AT	05-220	24.	3.80	10.	6.	6.	0.13		

*** NORMAL END OF HEC-1 ***

COMPARISON TABLE

OF HYDROLOGY RESULTS

AGK ENGINEERS, INC.
2255 N. 44th Street, Ste. 330, Phoenix, AZ 85008 Tel. (602) 244-2566

CLIENT City of Scottsdale
JOB NAME 64th Street Off site Drainage

SHEET ___ OF ___
BY HAA DATE 12/08/95
CHECK ___ DATE ___
JOB NO. ___

AGK Engineers					Boyle Engineers					PBQ and B				Desert Land		
Conc. Point	Area (Acres)	2Yr	10Yr	100Yr	Conc. Point	Area Acres	2Yr	10Yr	100Yr	Conc. Point	Area (Acres)	10Yr	100Yr	Conc Point	Area	100Yr
03-1010	44.2	7	42	126	1010	52.4	9	50	145	10	27.1	32	48	10	27.1	48
03-910	53.76	7 * 0	46 * 29	142 * 128	910	36.48	5	30	91	20	53.8	61	90	30	53.8	90
03-810	37.76	4	31	97	810	46	6	38	116	30	35.9	30	44	40	35.9	44
03-510	44.8	5	38	120	510	44.8	6	38	116	50	*82.8	84	127			
05-10	51.2	45	99	186	10	42.9	47	96	174	60	*	184	346			
05-210	34.56	46 * 80	103 180	183 * 335	210	34.56	47	103	178	70	*	252	468			

* Include Basin (hubble street)

Volume							Vol
810 →	0.75	2.58	5.74	1010	52.4	9	
510 →	0.90	3.08	6.85	03910	36.48	6	
				03810	46.00	7	
10 →	2.14	4.98	9.51	03510	44.80	7	
210 →	2.01	4.20	7.47				

2 3 1

HUBBELL STREET DRAINAGE

(BASIN 810)

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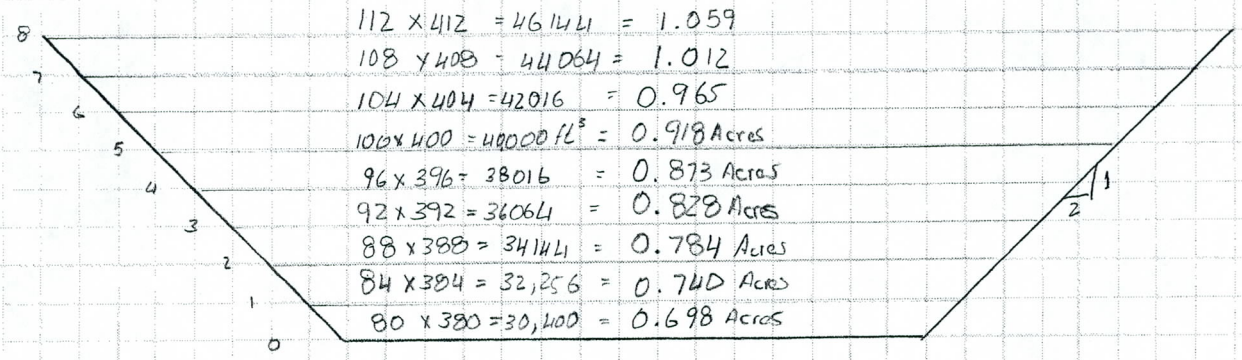
SHEET _____ OF _____
BY _____ DATE _____
CHECK _____ DATE _____

CLIENT _____
JOB NAME _____ JOB NO. _____

Stage / Area

for basins 510 and 10

for basin 810 Areas were increased by a 1.5 factor



Stage / Discharge

Stage - dischare was developed using orifice equation

$Q = CA\sqrt{2gH}$ the orifice coefficient C was assumed C = 0.6

H	$Q_{24''}$	$Q_{30''}$	$Q_{36''}$
1	15	23	34
2	21	33	48
3	26	41	59
4	30	47	68
5	34	53	76

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SHEET 2 OF
BY DATE
CHECK DATE

CLIENT
JOB NAME
JOB NO.

Basin 510
ARMY RESERVE

Basis S510 Outflow

$$Q = CA\sqrt{2gH}$$

assuming C= 0.6

$$H = \left(\frac{Q}{CA}\right)^2 \Big/ 2g$$

assumming a 24" orifice

$$A = \frac{\pi(2)^2}{4} = 3.1416$$

$$H = \left[\frac{50}{(0.6)(3.1416)}\right]^2 \Big/ (2)(32.2) = 10.93'$$

assumming a 30" Orifice

$$A = \frac{\pi(2.5)^2}{4} = 4.91$$

$$H = \left(\frac{50}{(0.6)(4.91)}\right)^2 \Big/ (2)(32.2) = 4.47$$

assumming a 36" Orifice

$$A = \frac{\pi(3)^2}{4} = 7.07$$

$$H = \left(\frac{50}{(0.6)(7.07)}\right)^2 \Big/ (2)(32.2) = 2.15$$

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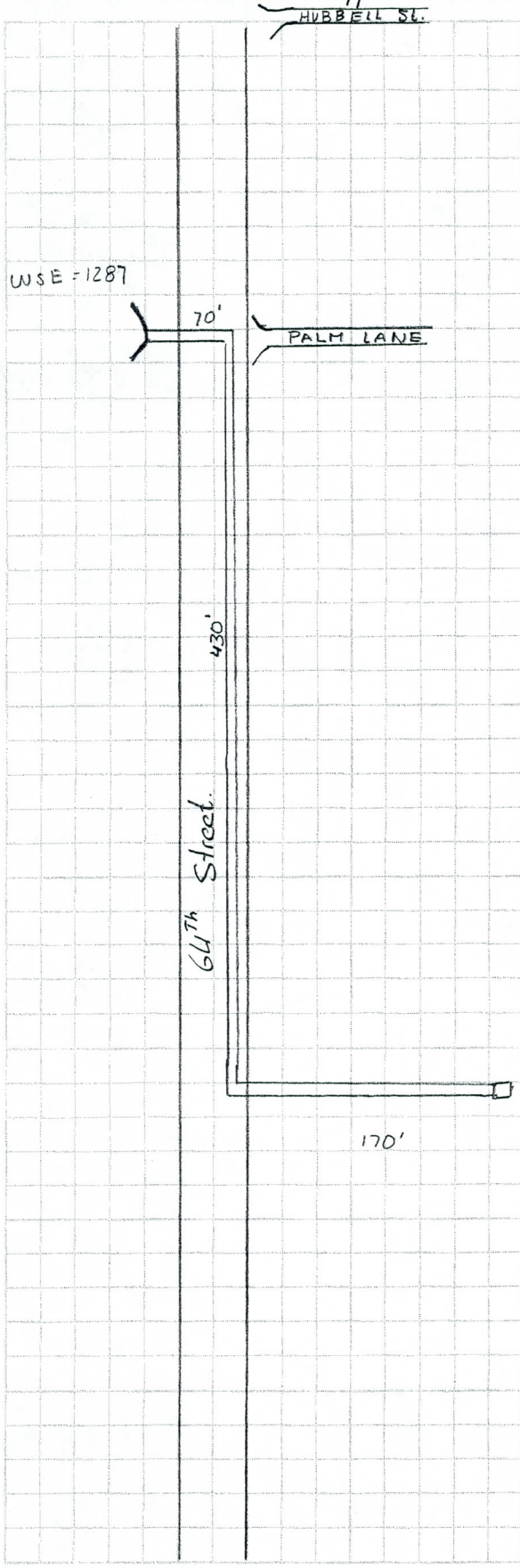
SHEET 1 OF 4
BY HAA DATE 1/4/96
CHECK _____ DATE _____

CLIENT City of Scottsdale
JOB NAME 64th Street Off-site Drainage
JOB NO. _____

Basin 810
HUBBLE ST



Total pipe lenght = 430
70
170
670 ft ← L

Minor Lossen k =

Entrance	0.5
90° Bend	(2) 0.24
Exit	1
	1.98

use k = 2.0 ← K

Inv = 1277.6
WSE = 1282.27

H = 1287 - 1282.27
= 4.73 ft

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BY HAA DATE 1/4/96

CHECK _____ DATE _____

CLIENT City of Scottsdale

JOB NAME 64th Street Off Site Drainage

JOB NO. _____

$$H = \left(\frac{Q \; n}{1.486 \; A \; R^{0.667}} \right)^2 L + k \frac{V^2}{2g}$$

try 48"

$$A = \frac{\pi D^2}{4} = \frac{(3.1416)(4)^2}{4} = 12.57 \text{ ft}^2$$

$$P = \pi D = (3.1416)(4) = 12.57 \text{ ft}$$

$$R = 12.57/12.57 = 1$$

$$V = 100/12.57 = 7.96 \text{ ft/sec}$$

$$H = \left(\frac{100 \; (0.012)}{(1.486)(12.57)(1)^{.667}} \right)^2 670 + 2.0 \frac{7.96^2}{(2)(32.2)}$$

$$= 2.77 \text{ ft} + 1.96$$

$$= 4.73 \text{ ft}$$

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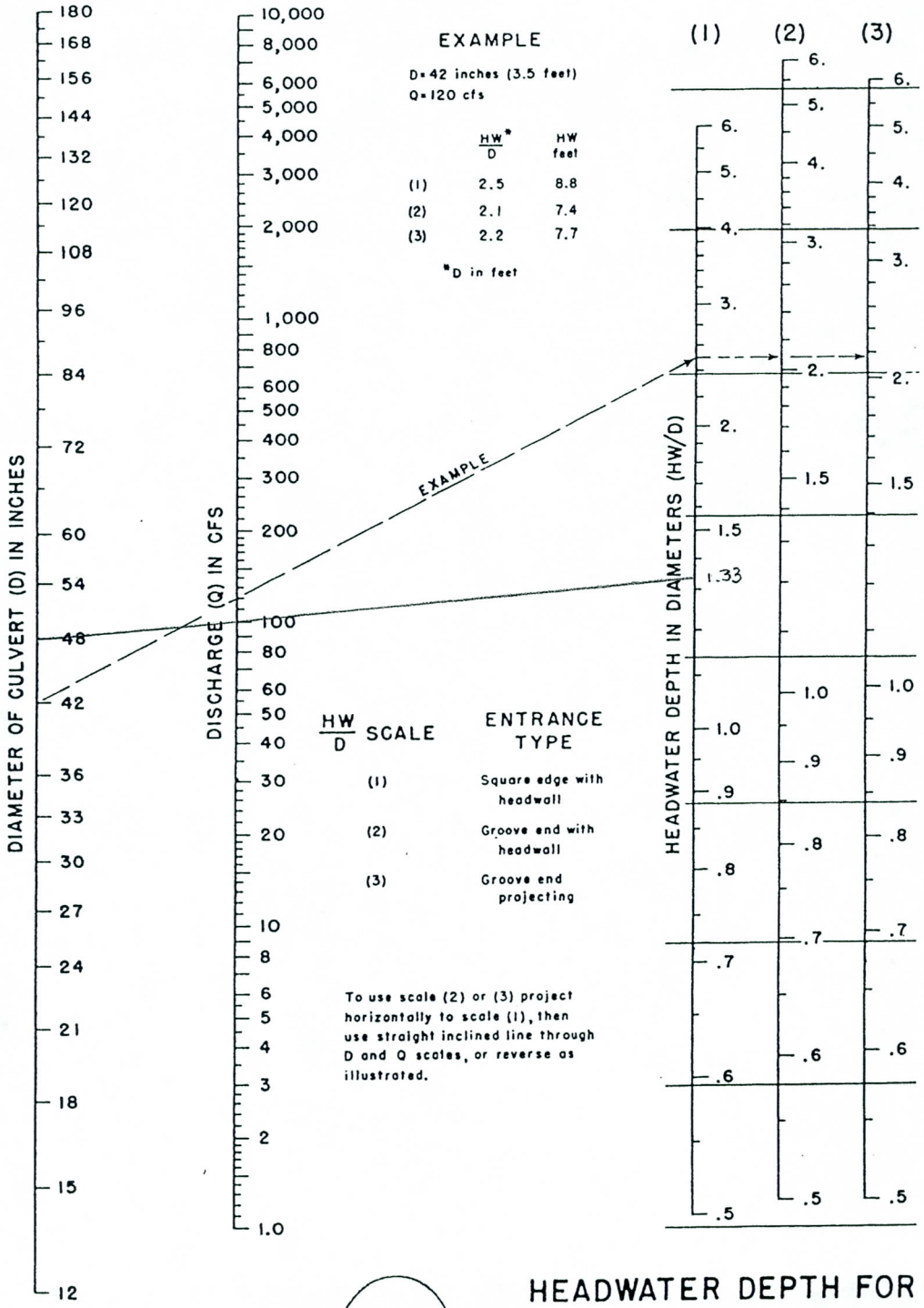
SHEET 3 OF 4
BY HMA DATE 1/4/96
CHECK _____ DATE _____
JOB NO. _____

CLIENT City of Scottsdale
JOB 64th Street Offsite Drainage

CHART 2



HW/D = 1.33
HW = (1.33) 4
= 5.32 ft

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

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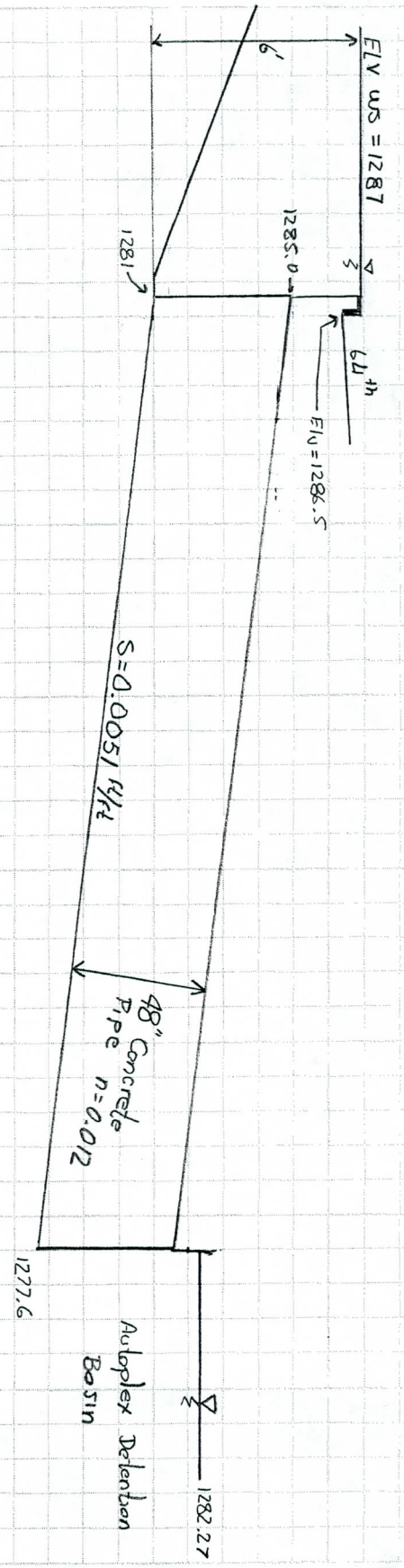
SHEET 4 OF 4
BY HAA DATE 1/4/96
CHECK _____ DATE _____

CLIENT City of Scottsdale
JOB NAME 64th Street Offsite Drainage
JOB NO. _____



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SHEET _____ OF _____

BY HAA DATE 04-Jan-96

PROJEC City of Scottsdale CHECK _____ DATE _____

LOCATIO 64th Street Drainage - Pipe from basin 810 to Autoplex detention basin JOB NO. _____

Normal depth in a circular channel

Flow Q (cfs)	Manning's n	Depth Y (in)	Diameter D (in)	Theta (radians)	Area A (sqft)	Wetted Perimeter P (in)	Hydraulic Radius R	Slope S (ft/ft)	Top Width T (in)	Velocity V (fps)	Froude Number Fr	Critical Depth Yc (in)
100.000	0.012	24.00	24.0	6.283	3.14	6.28	0.50	0.166494	0.00	31.83	0.000	39.858
100.000	0.012	30.00	30.0	6.283	4.91	7.85	0.63	0.050646	0.00	20.37	0.000	39.858
100.000	0.012	36.00	36.0	6.283	7.07	9.42	0.75	0.019153	0.00	14.15	0.000	39.858
100.000	0.012	42.00	42.0	6.283	9.62	11.00	0.88	0.008418	0.00	10.39	0.000	39.858
100.000	0.012	48.00	48.0	6.283	12.57	12.57	1.00	0.004130	0.00	7.96	0.000	39.858
100.000	0.012	52.00	52.0	6.283	14.75	13.61	1.08	0.002695	0.00	6.78	0.000	39.858
100.000	0.012	60.00	60.0	6.283	19.63	15.71	1.25	0.001256	0.00	5.09	0.000	39.858
31.000	0.012	24.00	24.0	6.283	3.14	6.28	0.50	0.016000	0.00	9.87	0.000	39.858
31.000	0.012	30.00	30.0	6.283	4.91	7.85	0.63	0.004867	0.00	6.32	0.000	39.858
31.000	0.012	36.00	36.0	6.283	7.07	9.42	0.75	0.001841	0.00	4.39	0.000	39.858
31.000	0.012	42.00	42.0	6.283	9.62	11.00	0.88	0.000809	0.00	3.22	0.000	39.858
31.000	0.012	48.00	48.0	6.283	12.57	12.57	1.00	0.000397	0.00	2.47	0.000	39.858

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SHEET _____ OF _____
BY _____ DATE _____
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CLIENT _____
JOB NAME _____ JOB NO. _____

Autoplex Aditional storage Requirement

100 yr 5.74 Acre-ft

10 Yr 2.58 Acre ft

lenght 1300 ft
width 100 ft

Area = (1300)(100) / 43560 = 2.98 Acres

Average depth 100 Yr = 5.74/2.98 = 1.96 ft

average depth 10 Yr = 2.58/2.98 = 0.87 ft

ARMY RESERVE

(RIDING CLUB)

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SHEET 1 OF
BY DATE
CHECK DATE

CLIENT
JOB NAME
JOB NO.

BASIN 510
ARMY RESERVE

Storage @ Army Reserve Parking

A Store total Volume

Runoff Volume 10 Yr = 3.08 Acre-ft = 134164.8 cu-ft

100 Yr = 6.85 Acre-ft = 298,386 cu-ft

Available Area 100 ft strip at East end of parking lot

assuming A 100 x 400 Area (No outflow)

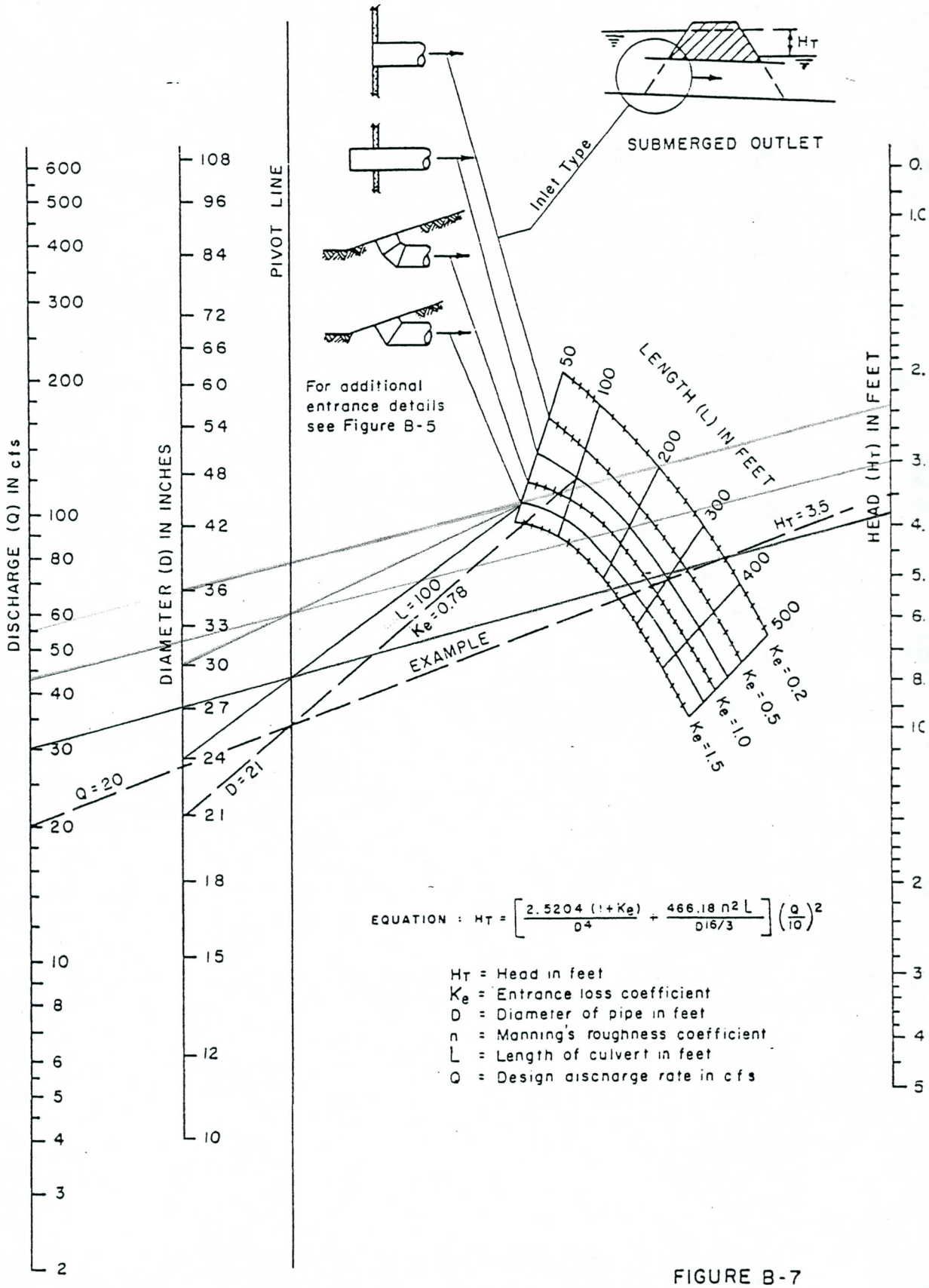
$A = 40,000 \ ft^2$

10 Yr depth = 134164.8/40000

= 3.35 ft ← 10 Yr 100' x 400' x 3.35

100 Yr depth = 298386/40000

= 7.46 ft ← 100 Yr 100' x 400' x 7.46



EQUATION : $H_T = \left[\frac{2.5204\,(1+K_e)}{D^4} + \frac{466.18\,n^2 L}{D^{16/3}}\right]\left(\frac{Q}{10}\right)^2$

H_T = Head in feet
K_e = Entrance loss coefficient
D = Diameter of pipe in feet
n = Manning's roughness coefficient
L = Length of culvert in feet
Q = Design discharge rate in cfs

REFERENCE
After Bureau of Public Roads Charts

FIGURE B-7

DISCHARGE FOR FULL PIPE FLOW n = 0.012

EWP Unit Portland, Oregon

SHEET ____ OF ____
BY ____ DATE ____
CHECK ____ DATE ____

JOB NO. ____

CLIENT ____
JOB NAME ____

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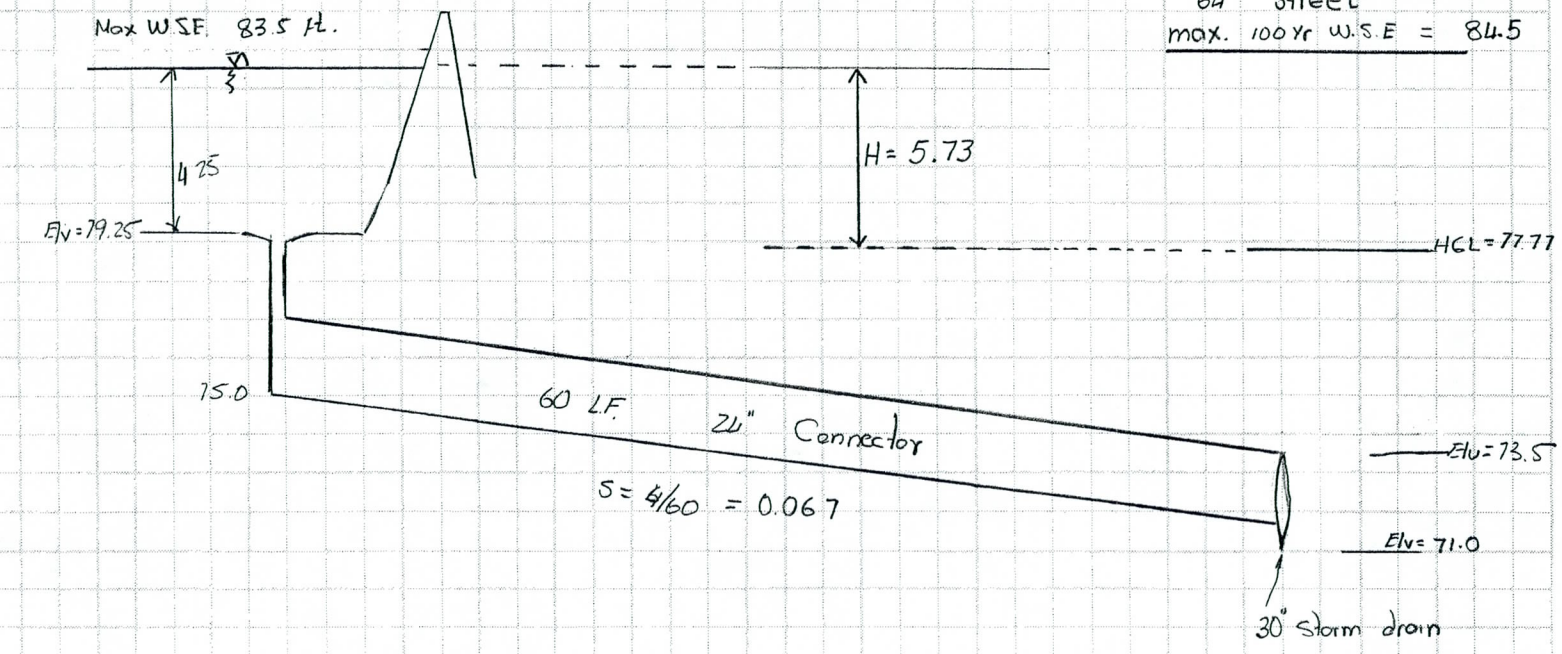
ARMY RESERVE
BASIN OUTLET
UPSIZE to 30"

Q out = 25 cfs
Q_{inside} = (0.5)(12) = 6 cfs



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SHEET _____ OF _____
BY _____ DATE _____
CHECK _____ DATE _____

CLIENT _____
JOB NAME _____ JOB NO. _____

Basin 10 Ridding Club

Runoff Volume 10 Yr = 4.98 Acre-ft
100 Yr = 9.51 Acre-ft

Available Area about 100 x 400
A = 40,000 ft^2
= 0.92 Acres

10 yr depth = 4.98/0.92 = 5.41 ft
100 Yr depth = 9.51/0.92 = 10.34 ft

Assuming the same Storage and outflow as for the army Reserve Basin

	24"	30"	36"
100 Yr	stage = 5.45 Outflow = 36	stage 4.53 Outflow = 50	stage = 3.71 Outflow = 65
10 Yr	stage 2.42 outflow = 23	stage = 1.89 outflow = 32	Stage = 1.48 Outflow = 41

ALTERNATIVES AND COST ESTIMATES

TABLE 3. - OFFSITE DRAINAGE ALTERNATIVES

Concentration Point	Alternatives				
	Culvert under 64th Street	Additional Storage	Storm Drain	Recommended 10-year Alternative	Recommended 100-Year Alternative
64th Street @ McDowell	**Existing 3-36" Culvert**				
54th Street @ Ball Park	**Existing 4-36" Culvert**				
64th Street @ Hubbell St.	New 2-1.5' X 5' Box (100-year flow)			Pipe =30" Additional Storage = 2.58 Acre-ft	Pipe = 48" Additional Storage = 5.74 Acre-ft
		Upgrade Autoplex Detention	**Grade to Palm Lane and Install New 48" Pipe to Autoplex Detention**		
		New Detention Basin (On west side)	Detention Outlet to Autoplex Detention		
64th Street @ Army Reserve Basin 510	New 2-1.5' X 6' Box (100-year flow)			Storage = 1.05 acre-ft Upsize 2270 Lf of 24" to 30"	Storage = 3.4 acre-ft Upsize 2270 LF of 24" to 30"
		New Detention BasinWith Outlet to Storm Drain	**Upsize 64th St. Storm Drain**		
		New Detention with Outlet to Basin 10	Open ditch from basin 510 to basin 10		
64th Street @ Basin 10	New 2-2' X 7' Box (100-year flow)			Storage = 2.79 acre-ft Upsize 780 LF of 24" to 30"	Storage = 3.9 acre-ft Upsize 780 LF of 24" to 36"
		New Detention Basin With Outlet to Storm Drain	**Upsize 64th St. Storm Drain**		
		New Retention Basin			
64th Street @ Water Tanks	New 2-2' X 7' Box (100-Year Flow)	**On Site Retention**	Connect to 45" abandoned Water Line		

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SHEET 1 OF 1
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CLIENT City of Scottsdale
JOB NAME 64th Street Offsite Drainage
JOB NO. _____

45" Abandoned Water line @ Thomas Rd.

assuming slope parallel to Thomas Rd. from 64 to 68 streets

$L = 2260$ ft
$\Delta Elev = 1272 - 1253 = 19$ ft

$S = 19/2260$

$= 0.008$ ft/ft.

$$Q = \frac{1.486}{n} A R^{0.667} S^{0.5}$$

$$A = \frac{\pi D^2}{4} = \frac{3.1416 \, (45/12)^2}{4} = 11.04 \text{ ft}^2$$

$$R = D/4 = 45/12/4 = 0.938$$

$$Q = \frac{1.486}{0.02}(11.04)(0.938)^{0.667}(0.008)^{0.5}$$

$= 70.28$ cfs ← 45" Capacity

$V = 70.28/11.04$

$= 6.37$ ft/sec ← flow velocity - 45"

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SHEET _____ OF _____
BY _____ DATE _____
CHECK _____ DATE _____

CLIENT _____
JOB NAME _____ JOB NO. _____

Alternative	Description	Basin Outflow	Basin Max Stage	Connector Size	
Alt-1	Upsize entire Line to 30"	26 26	4.33 6.11	24" 24"	Basin 510 Basin 10
Alt-2	Upsize entire Line to 36	45 45	3.48 4.90	30" 30"	Basin 510 Basin 10
Alt-3	Upsize part to 30 and part to 36	26 45	4.33 4.90	24" 30"	Basin 510 Basin 10

Location		Total	Storm Drain (Q-10)							Hydraulic Grade Line (Q-100)				
From Point	To Point	Q-Max (cfs)	Diam. (in)	Velocity (fps)	Length (ft)	Slope (ft/ft)	Invert Elevation	Crown Elevation	Cover Criteria	Max. Flow Elevation	Sf (ft/ft)	hL (ft)	H.G.L. Elevation	
G.B.	1W/1E	32.00	-	-	-	-	71.00	73.50	10.55	84.05	-	-	78.20	5.85124
1W/1E	2W/2E	35.50	30	6.5	1350	0.0040	65.60	68.10	8.46	76.56	0.0052	7.00	71.20	5.362541
2W/2E	3E	35.50	30	7.2	920	0.0040	61.92	64.42	6.42	70.84	0.0064	5.87	65.33	5.514589
3E	3W/4E	35.50	30	7.2	180	0.0040	61.20	63.70	5.98	69.68	0.0064	1.15	64.18	5.503468
3W/4E	45" Exst	-	30	7.2	200	0.0040	60.40	62.90	7.60	70.50	0.0064	1.28	62.90	7.6

Location		Total	Storm Drain (Q-10)							Hydraulic Grade Line (Q-100)				
From Point	To Point	Q-Max (cfs)	Diam. (in)	Velocity (fps)	Length (ft)	Slope (ft/ft)	Invert Elevation	Crown Elevation		Max. Flow Elevation	Sf (ft/ft)	hL (ft)	H.G.L. Elevation	
G.B.	1W/1E	51.00	-	-	-	-	71.00	74.00	10.05	84.05	-	-	77.80	6.254954
1W/1E	2W/2E	55.50	36	7.2	1350	0.0040	65.60	68.60	7.96	76.56	0.0050	6.73	71.07	5.49037
2W/2E	3E	55.50	36	7.9	920	0.0040	61.92	64.92	5.92	70.84	0.0059	5.43	65.64	5.198108
3E	3W/4E	55.50	36	7.9	180	0.0040	61.20	64.20	5.48	69.68	0.0059	1.06	64.58	5.100057
3W/4E	45" Exst	-	36	7.9	200	0.0040	60.40	63.40	7.10	70.50	0.0059	1.18	63.40	7.1

Location		Total	Storm Drain (Q-10)							Hydraulic Grade Line (Q-100)			
From Point	To Point	Q-Max (cfs)	Diam. (in)	Velocity (fps)	Length (ft)	Slope (ft/ft)	Invert Elevation	Crown Elevation	Cover Criteria	Max. Flow Elevation	Sf (ft/ft)	hL (ft)	H.G.L. Elevation
G.B.	1W/1E	45.00	-	-	-	-	70.98	74.48	9.57	84.05	-	-	74.64
1W/1E	2W/2E	70.00	42	4.7	1350	0.0040	65.58	69.08	7.48	76.56	0.0040	5.40	69.24
2W/2E	3E	70.00	42	7.3	920	0.0040	61.90	65.40	5.44	70.84	0.0041	3.79	65.45
3E	3W/4E	70.00	42	7.3	180	0.0040	61.18	64.68	5.00	69.68	0.0041	0.74	64.70
3W/4E	45" Exst	-	42	7.3	200	0.0040	60.38	63.88	6.62	70.50	0.0041	0.82	63.88

Location		Total	Storm Drain (Q-10)							Hydraulic Grade Line (Q-100)				Basin loss
From Point	To Point	Q-Max (cfs)	Diam. (in)	Velocity (fps)	Length (ft)	Slope (ft/ft)	Invert Elevation	Crown Elevation	Cover Criteria	Max. Flow Elevation	Sf (ft/ft)	hL (ft)	H.G.L. Elevation	
G.B.	1W/1E	32.00	-	-	-	-	71.00	73.50	10.55	84.05	-	-	78.07	5.979069
1W/1E	2W/2E	55.50	30	6.5	1350	0.0040	65.60	68.60	7.96	76.56	0.0052	7.00	71.07	5.49037
2W/2E	3E	55.50	36	7.9	920	0.0040	61.92	64.92	5.92	70.84	0.0059	5.43	65.64	5.198108
3E	3W/4E	55.50	36	7.9	180	0.0040	61.20	64.20	5.48	69.68	0.0059	1.06	64.58	5.100057
3W/4E	45" Exst	-	36	7.9	200	0.0040	60.40	63.40	7.10	70.50	0.0059	1.18	63.40	7.1

64TH Street Offsite drainage Cost Estimates

Basins Draining to 45" existing water line

Land	25000	($/acre)	
Earthwork	3	($/cu-yard)	
Outlet	5000	($)	
Landscape	1.5	($/SF)	Based on 1/3 of basin area

Alternative	Description of Alternatives	Basin ID	Maximum Outflow (cfs)	Basin Maximum Stage (ft)	Area (acres)	Land cost ($)	Landscape cost ($)	Volume (cu-yr)	Earthwork Cost ($)	Outlet size	Outlet Cost	Connector Size	Connector Length	Connector Cost	Insite Drain Size	Drain Length	Insite Drain Cost	Combined Drain Size	Combined Drain Cost	Incremental Drain Cost	Total offsite drainage cost
Alt 1	Up size from 24" to 30"	510	26	4.33	0.892	$22,301	$19,429	6232	$18,695	24	$5,000	24	60	$3,000	24	780	$39,000	30	$45,240	$6,240	$74,664
	100-yr Storm	10	26	6.11	0.972	$24,295	$21,166	9579	$28,738	24	$5,000	24	60	$3,000	24	2270	$113,500	30	$131,660	$18,160	$100,359
															36	180	$11,700	36	$11,700	$0	$0
																					$175,023
Alt 2	Up size from 24" to 36"	510	45	3.48	0.854	$21,349	$18,599	4794	$14,383	30	$5,000	30	60	$3,480	24	780	$39,000	36	$50,700	$11,700	$74,511
	100-yr Storm	10	45	4.9	0.918	$22,939	$19,985	7254	$21,761	30	$5,000	30	60	$3,480	24	2270	$113,500	36	$147,550	$34,050	$107,216
															36	180	$11,700	36	$11,700	$0	$0
																					$181,726
Alt 3	Up size from 24" to 30"	510	26	4.33	0.892	$22,301	$19,429	6232	$18,695	24	$5,000	24	60	$3,000	24	780	$39,000	36	$50,700	$11,700	$80,124
	and 36"	10	45	4.9	0.918	$22,939	$19,985	7254	$21,761	30	$5,000	30	60	$3,480	24	2270	$113,500	30	$131,660	$18,160	$91,326
	100-yr Storm														36	180	$11,700	36	$11,700	$0	$0
																					$171,449
Alt 4	Up size from 24" to 30"	510	18	1.43	0.762	$19,052	$16,598	1758	$5,275	24	$5,000	24	60	$3,000	24	780	$39,000	36	$50,700	$11,700	$60,625
	and 36"	10	24	2.59	0.814	$20,352	$17,730	3402	$10,205	24	$5,000	24	60	$3,000	24	2270	$113,500	30	$131,660	$18,160	$74,447
	10-yr Storm														36	180	$11,700	36	$11,700	$0	$0
																					$135,071

64TH Street Offsite drainage Cost Estimates

Basin draining to Autoplex drainage basin

Land	25000	($/acre)
Earthwork	3	($/cu-yard)
Outlet	3000	($)
Landscape	1.5	($/SF)

Based on 1/3 of basin

Alternative	Description of Alternatives	Basin Maximum Stage (ft)	Area (acres)	Land cost ($)	Landscape cost ($)	Volume (cu-yr)	Earthwork Cost ($)	Outlet size	Inlet Outlet Cost	Drain Length	Combined Drain Size	Combined Drain Cost	Total offsite drainage cost
Alt 1	100-yr	4.77	1.360	$34,000	$29,621	10466	$31,398	48	$6,000	670	48	$67,000	$168,019
Alt 1	10-yr	2.29	1.195	$29,875	$26,027	4415	$13,245	48	$6,000	670	30	$38,860	$114,007

ACK ENGINEERS, INC.
2255 NORTH 44TH STREET, SUITE 330
PHOENIX, ARIZONA 85008
TELEPHONE (602) 244-2566

LEGEND

- 510 — Drainage Area
- Proposed Drainage
- Existing Drainage Path
- 510 — Analysis Node
- 510 — Existing Storage Basin
- 510 — Proposed Storage Basin
- Basin Boundary
- Proposed Storm Drain
- Flood Zone Boundary

DATE	REVISION	BY

ENGINEER

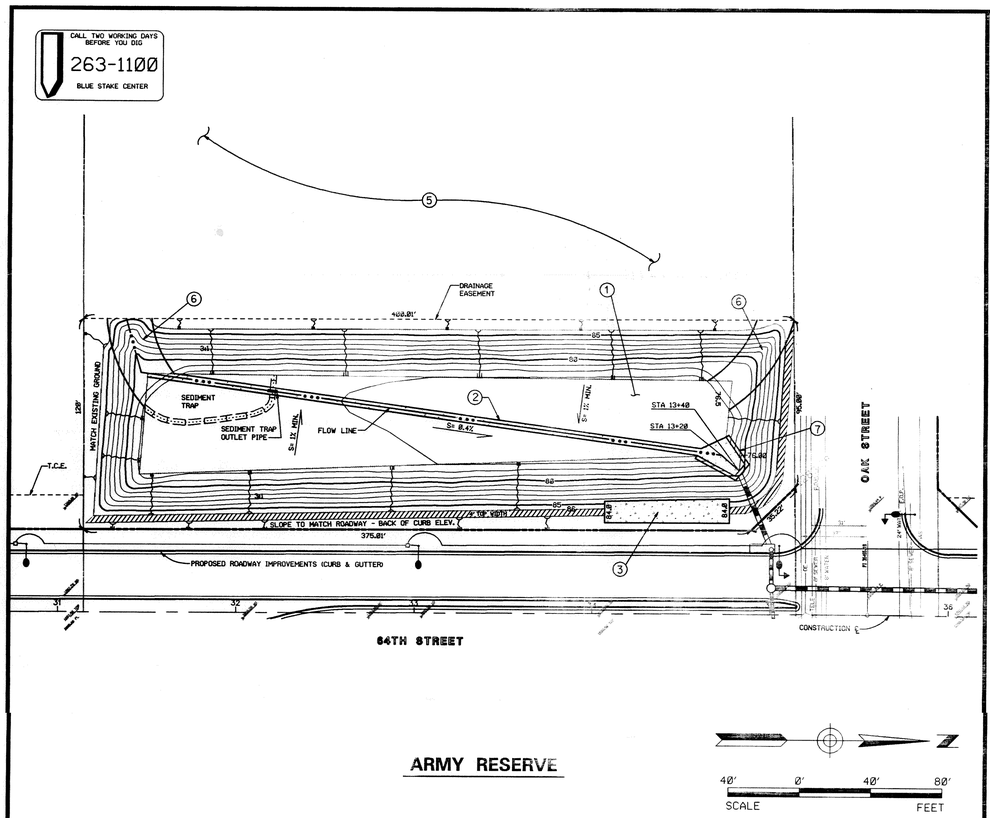
CITY OF SCOTTSDALE ARIZONA
MANAGEMENT SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
3939 CIVIC CENTER PLAZA
SCOTTSDALE, ARIZONA 85251

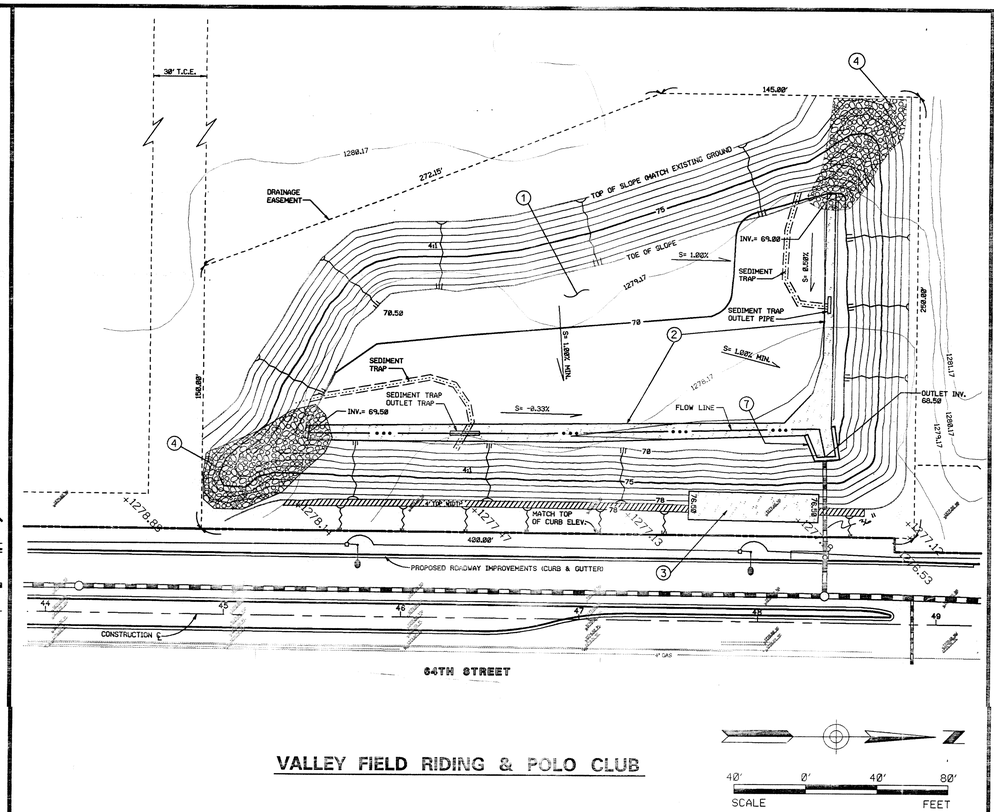
PROJECT TITLE: **64TH STREET IMPROVEMENTS DRAINAGE MAP**

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=400'	MJB/HAA	01/24/96		
VERT. —	DRAWN BY GLT	AS-BUILT	PROJECT NO. 410.32	OF

Preliminary - Not for Construction or Recording

Plate 2



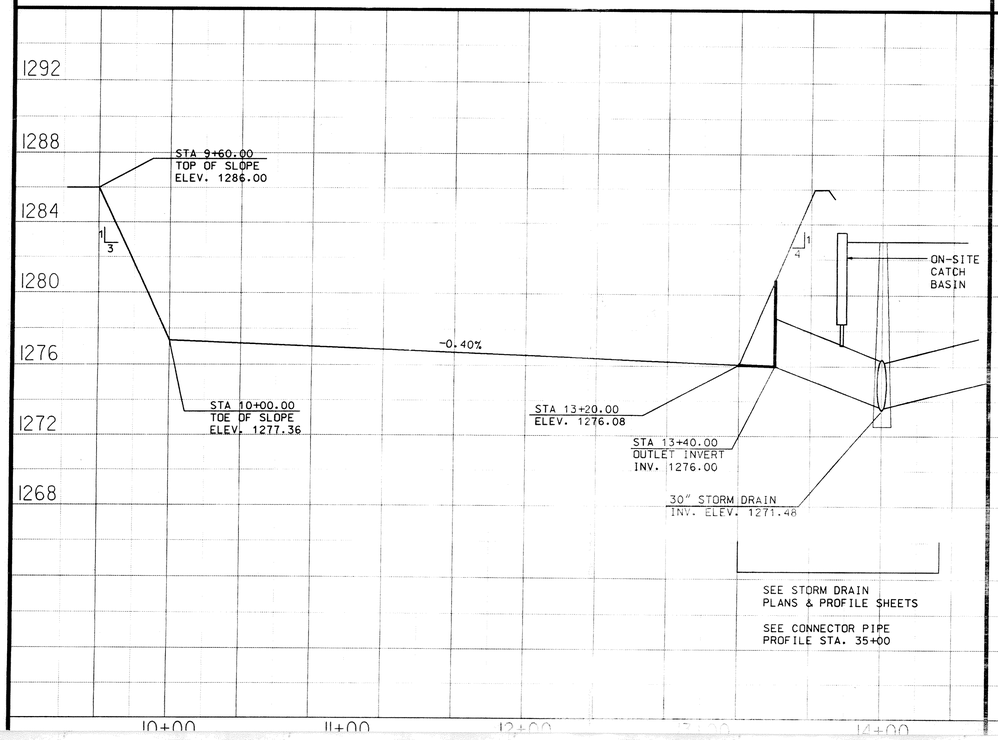


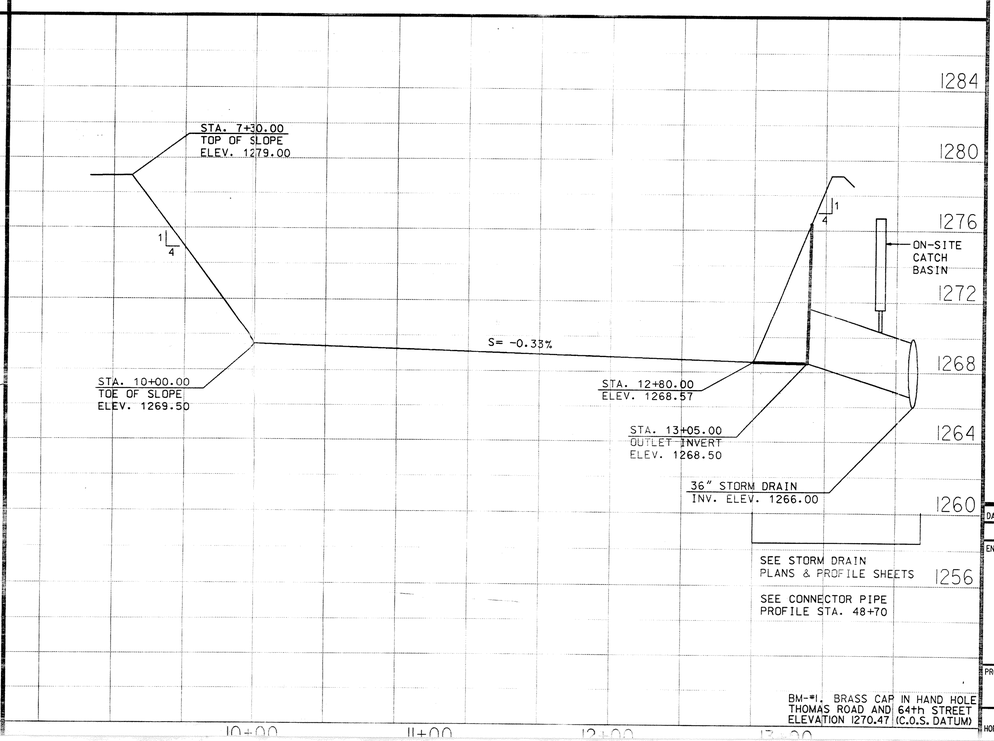
Entellus
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602) 244-2566
Fax (602) 244-8947

410.32

DETENTION BASIN NOTES

1. REMOVE EXISTING SOIL AND GRADE TO CONTOURS SHOWN. PROVIDE MINIMUM CROSS-SLOPE OF 1.00%
2. INSTALL CONCRETE GUTTER AT MAXIMUM CONGITUDINAL SLOPE OF 0.5%
3. INSTALL CONCRETE SPILLWAY (DESIGN FOR 100 YR. PEAK FLOOD) PER.....
4. INSTALL EROSION PROTECTION (NATURAL LOOKING RIP RAP) PER DETAIL __ ON SHEET __
5. PLACE EXCESS MATERIAL AND COMPACT TO 95% OF OPTIMUM DRY DENSITY
6. PROVIDE VEHICLE ACCESS RAMP PER DETAIL __ ON SHEET __
7. INSTALL HEADWALL WITH TRASHRACK PER DETAIL ON SHEET





LEGEND

- PROPOSED CONTOURS
- EXISTING CONTOURS
- TOP OF SLOPE
- TOE OF SLOPE
- DRAINAGE EASEMENT/T.C.E.
- R/W LINE

DETENTION BASIN PLAN & PROFILE

DATE	REVISION	BY

ENGINEER

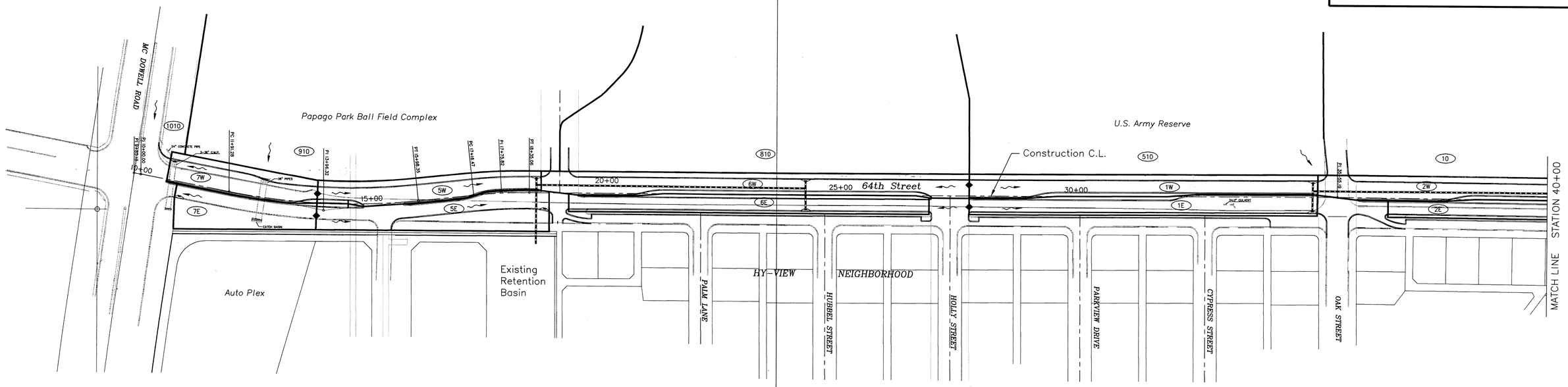
MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
3939 CIVIC CENTER PLAZA
SCOTTSDALE, ARIZONA 85251

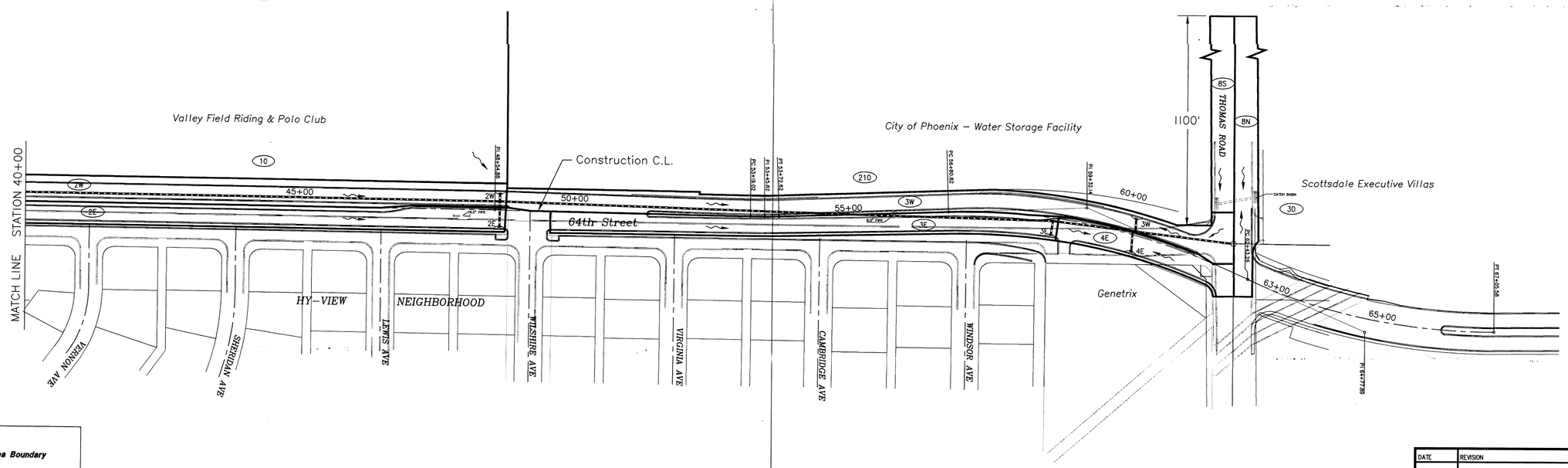
PROJECT TITLE
64th STREET WIDENING McDOWELL TO THOMAS

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=40'	HA/ES/JH	00/00/00		
	DRAWN BY AS-BUILT		PROJECT NO.	

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
AUG 22 1996
AUG 22 1996

ACK ENGINEERS, INC.
2255 NORTH 44TH STREET, SUITE 330
PHOENIX, ARIZONA 85008
TELEPHONE (602) 244-2566





LEGEND

- Drainage Area Boundary
- (2E) Drainage Area (on-site)
- 2E Drainage Area Analysis Point
- Proposed Storm Drain & Inlet
- Existing Inlet
- Existing Storm Drain
- Grade Break
- Direction of Runoff

DATE	REVISION	BY

ENGINEER

CITY OF SCOTTSDALE ARIZONA
MANAGEMENT SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
3939 CIVIC CENTER PLAZA
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE **64TH STREET IMPROVEMENTS DRAINAGE MAP**

SCALE	DESIGNED BY	DATE	BID NO.
HORIZ. 1"=100'	MJB/ES	01/24/96	
VERT. –	DRAWN BY GLT	AS-BUILT	PROJECT NO. 410.32

File:PLATE-1 Date:01/24/96

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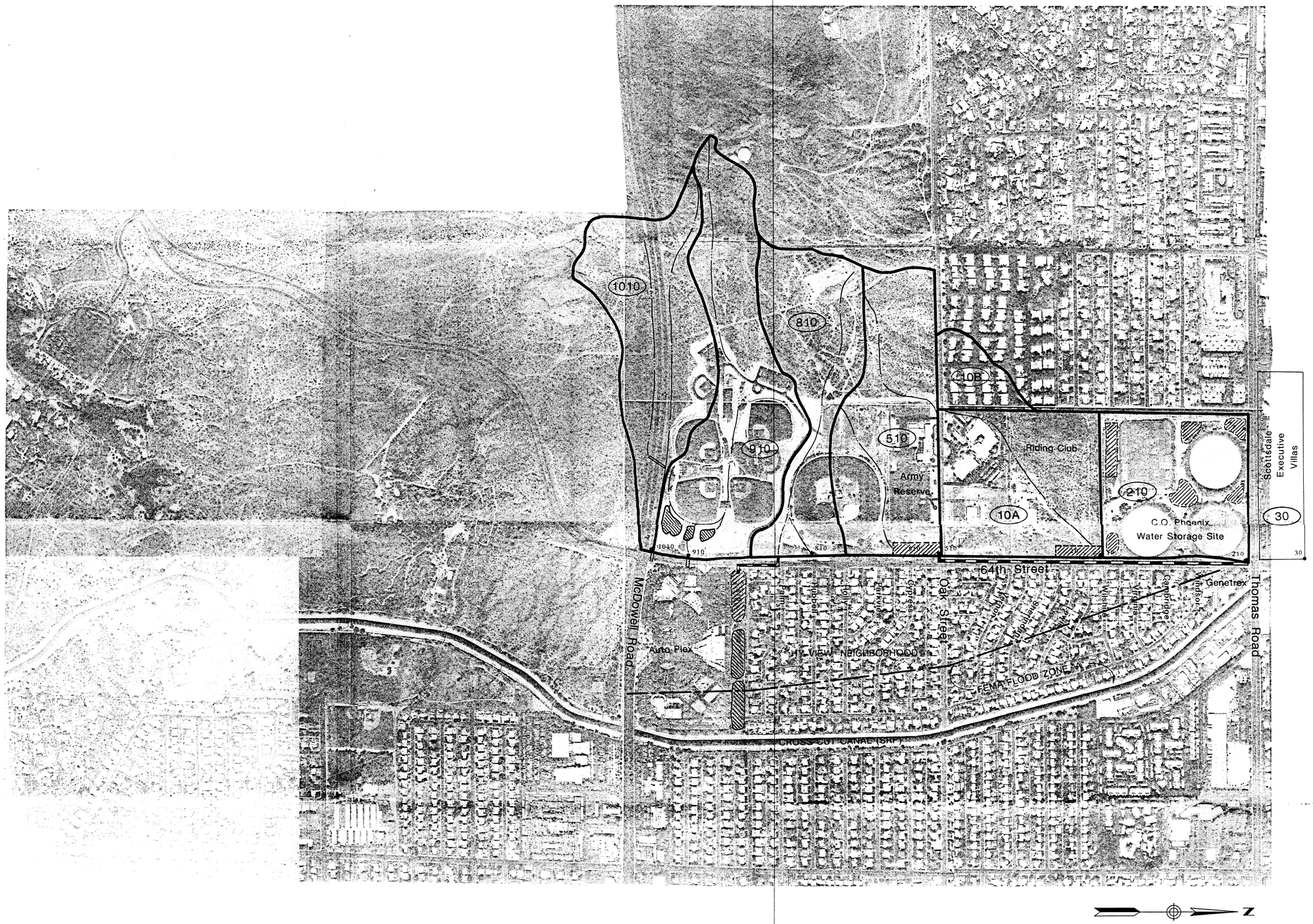
Plate 1



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PHOENIX, ARIZONA 85008
TELEPHONE (602) 244-2566

LEGEND

- 510 — *Drainage Area*
- *Proposed Drainage*
- *Existing Drainage Path*
- 510 — *Analysis Node*
- *Existing Storage Basin*
- *Proposed Storage Basin*
- *Basin Boundary*
- *Proposed Storm Drain*
- *Flood Zone Boundary*

DATE	REVISION	BY

ENGINEER

MANAGEMENT SERVICES DEPARTMENT
CITY OF SCOTTSDALE ARIZONA
CAPITAL PROJECT MANAGEMENT
3939 CIVIC CENTER PLAZA
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: **64TH STREET IMPROVEMENTS DRAINAGE MAP**

SCALE	DESIGNED BY	DATE	BID NO.	SHT.
HORIZ. 1"=400'	MJB/HAA	01/24/96		
VERT. –	DRAWN BY GLT	AS-BUILT	PROJECT NO. 410.32	OF

Preliminary - Not for Construction or Recording

Plate 2