DESIGN REPORT
for
GROVERS AVENUE
STORM DRAIN LATERAL
FCD No.: 93-21

FINAL SUBMITTAL

Morrison Maierle/CSSA INC.
ENGINEERS
PLANNERS
SURVEYORS

A026.602

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SUBMITTED TO:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, AZ 85009

SUBMITTED BY:

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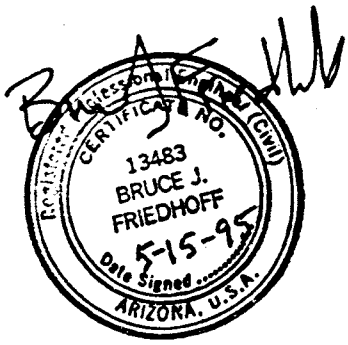

MAY 15, 1995

MM/CSSA Project No.: 8156.001

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A. INTRODUCTION

Grovers Avenue Storm Drain Lateral is located in Phoenix Arizona in the northern part of the City between Bell Road, Union Hills Drive, Cave Creek Road, and 32nd Street. The proposed storm drain lateral is part of a regional flood control project designed to intercept and convey the 100-year storm water runoff to the outfall in the Greenway Parkway Channel. Previous studies have determined the general size, location, and interaction of facility components such as interceptor drains and channels, detention basins, and outfall drains and channels. The project will be constructed by the Flood Control District of Maricopa County (FCDMC) and will be operated and maintained by the City of Phoenix (COP).

It is the purpose of this report to document project concepts, alternatives, and design requirements used in preparing Final Design documents for the Grovers Avenue Storm Drain Lateral. These documents have been reviewed and considered by the FCDMC, COP, utility companies, and other affected agencies. Agency comments have been incorporated into the Final Design submittal.

In preparing this report, three previous studies by the FCDMC affecting the Grovers Avenue Storm Drain Lateral were reviewed to determine the concepts, design criteria, and system requirements pertaining to Grovers Avenue. We collected utility maps and investigated the site and drainage area to identify drainage patterns, existing facilities, and design constraints (ie. utility conflicts, available right-of-way, and access requirements). We performed a topographic engineering survey and the FCD's consultant, Speedy and Associates, Inc., performed a geotechnical investigation in order to determine the site conditions pertaining to the construction of physical improvements.

We prepared a drainage map for the delineation of 22 subareas and performed a hydrologic analysis to determine the storm water runoff to be used in Final Design. We evaluated several alternative storm drain alignments and computed the hydraulic profiles for three (3) different types of conduits (Reinforced Concrete Pipe, RCP; Concrete Box Conduit, CBC; and Cast-in-Place Concrete Pipe, CIPP) in order to determine the preferred optimum design solution and bidding options. Concrete-lined corrugated metal pipe (CMP) is the least desirable conduit option because of corrosive soil conditions (Speedie and Associates, 1994). We also located inlets needed to intercept the design flows and computed optimal inlet sizes and configuration.

We contacted the COP and acquired the design, construction, and bid tabulation documents for recently completed storm drain projects in the area (ie. 20th Street and 9th Street). Both the 9th Street and

20th Street storm drains were constructed in residential areas similar to Grovers Avenue. Pulice Construction Company built the 20th Street storm drain with RCP supplied by Hydro Conduit. The 9th Street storm drain (CIPP) was constructed by Blu-Cor Construction Company. We also contacted pipe manufactures, Hydro Conduit Corporation (RCP & CBC), and KIPP (CIPP) to obtain the most current pricing for these products. We then contacted Blu-Cor Construction Company to find out if there were any special considerations concerning phasing or access control that could have been used to reduce project costs on their last job. The information we obtained from both projects was then used to help us formulate an opinion concerning the probable construction cost, construction phasing, and degree of difficulty.

We researched the federal, state, and local regulations to determine any special requirements for the Grovers Avenue Storm Drain Lateral Project. And finally, we incorporated the Design Concept review comments received from the FCD and the City of Phoenix.

B. PREVIOUS STUDIES

There have been three (3) studies prepared that are applicable to the Grovers Avenue Storm Drain Lateral Project.

1. Upper East Fork Cave Creek Area Drainage Master Study (Executive Summary), Maricopa County Highway Department, NBS/Lowry, October 12, 1987. The purpose of the study was to determine the status of existing storm water runoff and resulting flooding conditions for a 16 square mile drainage area; identify and evaluate alternative improvements to provide protection for the 100-year storm; and determine preliminary engineering design and project cost estimates. The study used the TR-20 computer code and a two-dimensional flow model to help in delineating overland flow paths on alluvial fans for the 100, 50, and 10-year storms. The study concluded the following:

   a. The drainage area northeast of Union Hills Drive and 32nd Street does not contribute flow to the Grovers Avenue Storm Drain Lateral.

   b. The flow north of Union Hills Drive between 26th and 32nd Streets is concentrated at the 26th Street and Grovers Avenue intersection.

   c. The existing peak flow at 30th Way and Union Hills Drive for the 100-year storm is Q = 402 cfs.

d. The existing peak flows for Grovers Avenue are Q_{100} = 142, 282, and 376 cfs for 30th Way, 28th Street, and 26th Street, respectively.

e. Flows closely approximate those developed by FEMA.

f. Use a 77" x 121" elliptical RCP for 1,450 feet from Detention Basin #3 to 26th Street to convey a design flow of 483 cfs for an estimated construction cost of $580,000.

g. Use a 63"x 98" elliptical RCP for 2,000 feet from 26th Street to 29th Street to convey a design flow of 282 cfs for an estimated construction cost of $680,000.

h. The total estimated construction cost is $ 1,260,000.

2. Upper East Fork Cave Creek Detention Area Sizing Study, Flood Control District of Maricopa County and City of Phoenix, NBS/Lowry, February 27, 1989. The purpose of the study was to determine the detention basin area sizing criteria for six (6) detention basins for the storm water runoff from the 100-year storm. The objective was to size the basins so that the maximum outflow from the detention basins would not exceed the capacity of the COP storm drainage system (usually the 2-year storm). The study used the TR-20 computer code (SCS Method) with a modified attenuated kinematic wave routing method, the COP S-Curve. The time of concentration was computed as a function of the gutter velocity for an assumed flow of 3 cfs not to be less than 10 minutes. The storm water runoff was computed using a rainfall depth of $P_{100,24}$ = 4.04", a time increment of t = 0.08 hours, a storm duration of 24 hours, an antecedent moisture condition of AMC = 2, and a weighted ultimate build-out SCS curve number of CN = 87. The study concluded the following:

a. The drainage area northeast of Union Hills Drive and 32nd Street does not contribute flow to the Grovers Avenue Storm Drain Lateral.

b. The drainage area north of Utopia Road between Cave Creek Road and 32nd Street is diverted to the Upper East Fork Cave Creek Channel and does not contribute storm water runoff to the Grovers Avenue Storm Drain Lateral.

c. The drainage area east of 32nd Street and north of Grovers Avenue is diverted to Basin No. 4 located at the northeast corner of 32nd Street and Grovers Avenue.

d. TR-20 routing for Grovers Avenue from 30th Way to 28th Street is Q_{100} = 282 cfs.

e. Pipe flow for Grovers Avenue from 28th Street to Cave Creek Road is Q_{100} = 483 cfs.

f. The flow at Union Hills Drive and 30th Way is Q_{100} = 149 cfs and is routed to 26th Street and Grovers Avenue, not 28th Street.

3. Cave Creek Watershed, Volume 1.7, Arizona Canal Diversion Channel Area Drainage Master Study, ACDC/ADMS Phase 1; Flood Control District of Maricopa County; Kaminski Hubbard Engineering, Inc.; May 26, 1993. This study uses the new FCDMC methods for computing storm water runoff. The S-Graph was converted into a unit hydrograph using MCUHP2. The SCS curve number was replaced with the Green-Ampt method for computing infiltration losses. Basin lag was computed using the FCDMC equation and K_n. Channel routing was approximated using the Muskingum-Cunge method. The study concluded the following:

a. The drainage area at Grovers Avenue and Cave Creek Road is DA = 0.60 sq mi.

b. The peak flow for future conditions at Grovers Avenue and Cave Creek Road for the 6 hour storm is $Q_{100,6}$ = 492 cfs at 4.4 hours.

c. The peak flow for future conditions at Grovers Avenue and Cave Creek Road for the 24 hour storm is $Q_{100,24}$ = 656 cfs at 12.27 hours.

This study also included a comprehensive list of references related to this project. These have been incorporated with the references contained herein.

C. SITE CONDITIONS

1. **DRAINAGE AREA**. The drainage area upstream from the project site and downstream from the Central Arizona Project Canal is approximately 1.83 square miles. Approximately 1.12 square miles will be controlled by the regional flood control project. This leaves approximately 0.71 square miles that will contribute storm water runoff to the Grovers Avenue Storm Drain Lateral (See the Drainage Map in Appendix A).

2. **TOPOGRAPHY**. The drainage area is located on alluvial fill with natural land sloping from 12 to 44 feet per mile in a southwesterly direction. There is a major wash, Upper East Fork Cave Creek Channel, on the western edge and outside of the project drainage area. The major portion of the

contributing drainage area is single family residential on 1/4-acre lots. The remaining portion of the area is commercial. Previous studies have used an average SCS runoff curve number of CN = 83. This compares well with the guidelines in TR-55 and, therefore, will be used for this study.

3. **SOILS.**

a. Route Conditions - The alignment of the proposed storm drain lateral is within the right-of-way of Grovers Avenue. The roadway is paved with asphaltic concrete for the entire length of the proposed route with the exception of approximately 300 feet east of Cave Creek Road which is currently a vacant parcel of land covered with a moderate growth of low lying weeds and grasses. Surrounding land usage is generally residential in nature.

b. General Subsurface Conditions - Subsoil conditions along the route are somewhat variable. The subsoils consist of strata varying from stiff to hard silty clays and sandy clays with weak to moderate calcareous cementation to clayey sands and gravelly sands with occasional cobbles (Speedie and Associates, 1994). In-place dry densities are on the order of 116 pcf with moisture contents on the order of 5 percent. Plasticity indices range from 12 to 17 percent. Field and laboratory resistivity tests conducted indicate resistivity values range from 766 to 2298 ohms-cm with pH values on the order of 8.3 to 8.9 (see Design Calculations Report).

The subsoils generally exhibit Standard Penetration Resistance (SPT) values of 15 to 50-plus blows per foot in the upper 6 feet, and from 38 to 50-plus blows per foot from 6 to 20 feet. All borings were dry upon completion and groundwater is reported by ADWR to be on the order of 230 feet deep in the general vicinity (Speedie and Associates, 1994). Therefore, groundwater should not be a factor in the design or construction of the storm drain lateral.

c. Analysis - Due to the nature of the coarser grained soils generally encountered around 13 feet deep along the route, significant disturbances from gravel and occasional cobbles may make neat trenches difficult to achieve. Therefore, cast-in-place pipe may not be feasible. Trench excavations for utilities can be accomplished by conventional trenching equipment. Trench walls may experience

some sloughing in the coarser grained soils. No special recommendations are made if pre-cast RCP is used except that pipe bedding will be required to prevent point loads due to the presence of cobbles. Based on the resistivity tests conducted, the soils are classified by American Iron and Steel Institute as moderate to severely corrosive. Therefore, we recommend that aluminum alloy or bituminous coated CMP be used in conjunction with a low corrosive bedding material if CMP is desired.

d. Utilities Installation - Trench excavation, backfilling and compaction should be carried out under City of Phoenix Supplement to MAG Section 601. Backfill of trenches may be carried out with native excavated material, provided that oversized material is removed in the bedding zone. This material should be moisture-conditioned, placed in 8 inch lifts and mechanically compacted. Water settling is not recommended. Compaction requirements as set forth in Section 601 of MAG Specification should be followed (Speedie and Associates, 1994).

e. Asphalt Pavement - If earthwork in paved areas is carried out to finish subgrade elevation as set forth herein, the subgrade will provide adequate support for pavements.

The existing pavement is currently 2.0 inches of asphalt over 4.0 inches of aggregate base course (ABC). Based on the City of Phoenix minimum pavement design for residential streets and the results of the geotechnical investigation (Speedie and Associates, 1994), a minimum replacement pavement section of 2.0 inches of asphalt over 6.0 inches of ABC is recommended. If pavement subgrade preparation is not carried out immediately prior to paving, the entire area should be proof-rolled at that time with a heavy pneumatic-tired roller to identify locally unstable areas for repair.

Pavement base course material should be ABC per MAG Section 702 Specifications. Asphalt concrete materials and mix design should conform to MAG 710. It is recommended that mix designation D-1/2 or C-3/4 be used for the pavements. While the C-3/4 mix has a somewhat rougher texture, it offers more stability (Speedie and Associates, 1994). Pavement installation should be carried out under applicable portions of MAG Section 321.

4. **UTILITY CONFLICTS**. There is one major utility conflict located at the beginning of the project near Cave Creek Road. Approximately 200 feet of existing 8 inch sanitary sewer line will need to be relocated. There are two water lines and one sewer line located in Grovers Avenue that will effect where the storm drain can be located. There is a 36 inch water transmission main located 15 feet south of the monument line, an 8 inch water line located 6 feet north of the monument line, and an 8 inch sewer line located 16 feet north of the monument line. There are no sewer lines crossing Grovers Avenue. See the typical sections in Figure 1. The two water lines are connected in several places along the alignment but are shallow enough to cross over the proposed storm drain. They have been identified in the construction documents for the contractor to protect during installation of the storm drain pipe. All existing asbestos cement waterline crossings must be replaced with ductile iron pipe by the contractor. The most controlling utility will be the sewer lines in 26th Street, 28th Street, 29th Street, and 30th Way. The proposed inlet connector pipes must cross these existing lines. The storm drain line must be located so that catch basins can be connected without conflicting with these existing sewer lines. Construction of the large diameter storm drain pipe may cause instability for the existing parallel water lines. Construction plans and specifications warn the contractor of the potential problems and require him to include appropriate shoring/protection during construction.

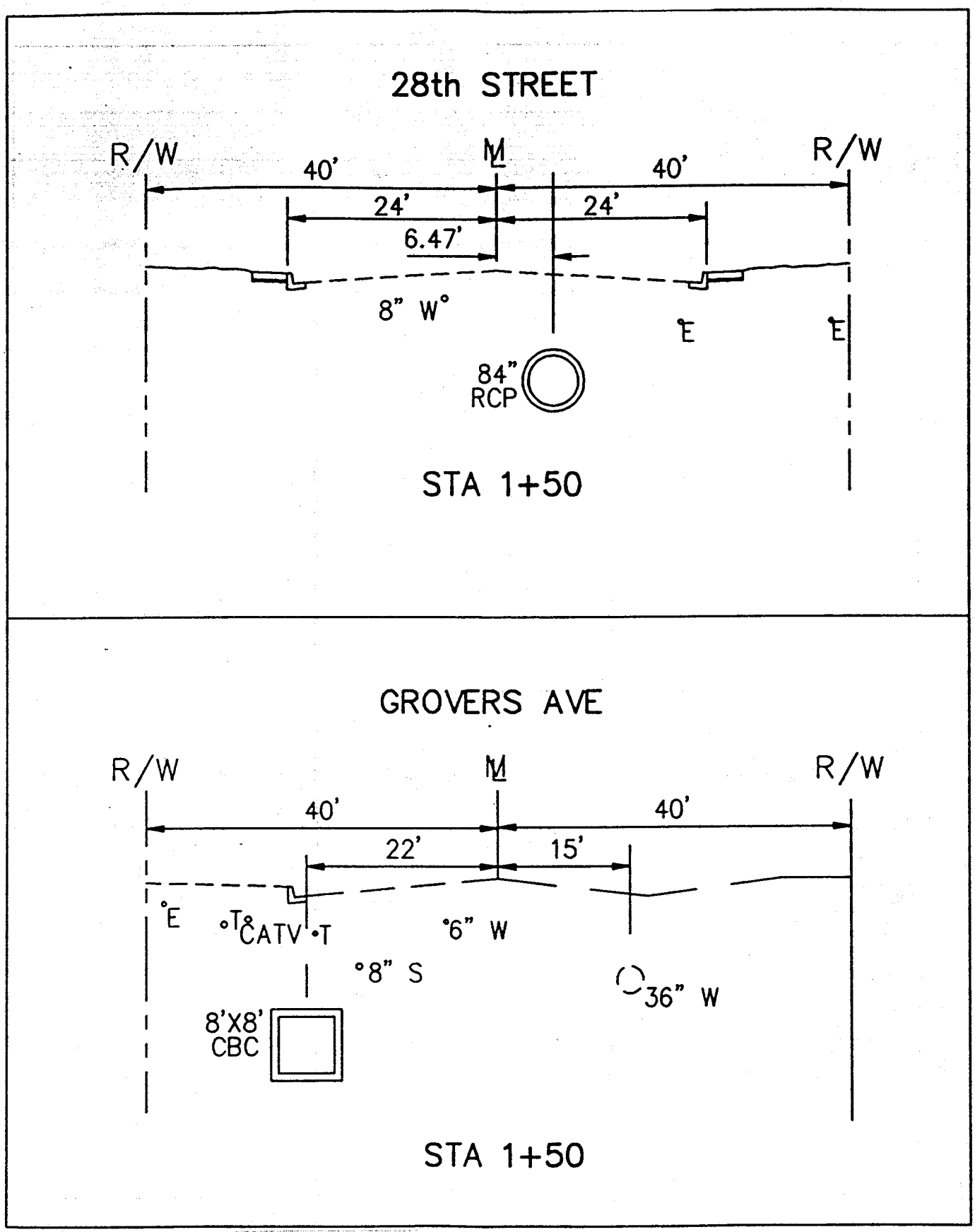

28th STREET
R/W
40'
M
40'
R/W
24'
24'
6.47'
8" W°
E
E
84"
RCP
STA 1+50
GROVERS AVE
R/W
M
R/W
40'
40'
22'
15'
E
T&
CATV
T
6" W
8" S
36" W
8'X8'
CBC
STA 1+50

Figure 1

5. **RIGHT OF WAY AND EASEMENTS**. There is adequate right-of-way throughout the alignment except on the north side of Grovers Avenue between Station 3 + 26.39 and Station 6+30.30 (See the Right-of-Way Map in Appendix B). In this segment there is private property with two residential units located on the north side of the monument line and a 25 foot water line easement on private property on the south side of the monument line. Even though the storm drain line will begin its alignment 23 feet north of the monument line at Cave Creek Road it will need to be on the south side of the monument line between 26th Street and 30th Way in order to avoid a conflict with the existing sewer line in Grovers Avenue. Two alternative alignments are possible. The first alignment would require a 25 foot right-of-way strip on the north side of the street through the Contention Mining Claim parcel. The second alignment would require a joint drainage and water line easement on the south side of the street and a 500 foot x 25 foot temporary construction easement (TCE) on the north side of the street. Following our recommendations the FCDMC purchased additional easement rights for the storm drain as required. A 25 foot TCE will also be required from the Contention Mining Claim Parcel.

6. **PRIVATE AND PUBLIC ACCESS**. There are individual residential properties fronting on Grovers Avenue along the north side of the street from 25th Street to 28th Street and on the south side of the street from 28th Street to 32nd Street. There are two schools along the alignment. Campo Bello School is located on the south side of the street from 26th Street to 27th Street. Val Vista School is located on the north side of the street from 28th Street to 29th Street. Access will be provided for all properties during construction. Special provisions will be made to allow access for the two schools. The existing bus stop area for both schools are close to the proposed work site. The contractor will need to provide an adequate area for the school buses to turn around in these two areas. It is recommended that special provisions include adequate barricades, fencing, and warning signs in all work area. The length of open trench may need to be restricted to 300 or 400 feet in order to minimize the construction hazard and maximize local access.

D. HYDROLOGY

1. **DRAINAGE MAP**. A drainage map was prepared and the water shed drainage boundary delineated (See the Drainage Map in Appendix A). According to the results of previous studies, the area north of Utopia and east of 32nd Street will be controlled and will not contribute runoff to the Grovers

Avenue Storm Drain. Union Hills Drive will intercept the upstream area and convey the flow west to the Upper East Fork Cave Creek Channel. Intersecting streets at 30th Way, 29th Street, 28th Street, and 26th Street are higher in elevation than Union Hills Drive. It is possible that water from the 100-year event may spill into these intersecting streets and contribute to the runoff to Grovers Avenue. Field data was collected and discharge rating curves were developed for concentration points 1 thru 5 in order to estimate the split flow (diversion) at these points. Results indicate that a small amount of water will spill into 28th Street (12 cfs) and 29th Street (2cfs) and contribute runoff to Grovers Avenue. No water will spill into 26th Street or 30th Way. Split flows were also approximated at points 12a, 12b, 13 and 14.

There are two existing retention basins located at points 9 and 10 on Michigan Drive. The elevation-storage-discharge curves were developed for these two basins and included in the analysis. The results indicate that these two basins have no effect on reducing the peak flow runoff to Grovers Avenue.

While there is a small amount of retention around the Val Vista School buildings at 28th Street, there is no retention in the field area. Therefore the affects of these retention basins were assumed negligible and were not included in the analysis. Storm water runoff is concentrated on the east side of the school and conveyed by concrete lined rectangular channel to below-ground dual pipe drain system to the west side of the school. Water flows out of the pipes towards the drop-off area at 28th Street where it is combined with flows from north of 28th Street north of Grovers Avenue. Water then travels to the 28th Street and Grovers Avenue intersection and then south to Bell Road. Approximately 46 percent of the drainage area runoff is concentrated at the 28th Street and Grovers Avenue intersection and not at the 26th Street and Grovers Avenue intersection as stated in the NBS/Lowry study.

2. **STORM FREQUENCY AND DISTRIBUTION**. The storm distribution used for this study was the 100-year, 24-hour storm input directly from the TR-20 program data used in the Upper East Fork Cave Creek Detention Area Sizing Study; Flood Control District of Maricopa County and City of Phoenix; NBS/Lowry; February 27, 1989. The reason for using the NBS/Lowry study as opposed to using the Kaminski-Hubbard study is to ensure the facility components (ie., outlets, basins and drains) remain consistent with the overall system design criteria used to design other existing components. The original TR-20 model used a 30 minute time interval to describe the distribution for a point rainfall of $P_{100} = 4.04$ inches and a 5 minute computation interval. The HEC-1 model developed for this study used a computation interval of 1 minute.

3. **LAG TIME**. The lag time was estimated using the procedure specified in Chapter 5 of the Hydrology Manual, Volume I; Flood Control District of Maricopa County; June 1, 1992. The total cumulative runoff of 2.32 inches was computed and the peak rainfall excess was identified between the time interval of 11.755 and 13.714 hours. The incremental excess was then rank ordered in decreasing average excess rainfall intensity and a curve of intensity vs. time of concentration prepared for use in determining the lag time for each basin. Average velocities ranged from 0.9 to 3.8 feet per second and times of concentration ranged from 0.151 to 0.420 hours (9 to 25 minutes). (See Appendix A for calculations.) These velocities are greater and the lag times shorter than those used in the original TR-20 model. Thus, the HEC-1 model developed for this study is expected to give higher peak flows than the previous study.

4. **RUNOFF**. The HEC-1, Version 4.0, U.S. Army Corps of Engineers, May 1991, was used to compute the peak flow storm water runoff to the Grovers Avenue Storm Drain. The computer input and output data are located in the Design Calculation Report. Reach routing between sub-basins was modeled using the kinematic wave method for a rectangular section having a bottom width equal to the street right-of-way width (usually 50 feet). The results indicate that in all cases the travel time is much shorter than the computation interval. This renders the kinematic wave and other reach routing methods (such as the Muskingum-Cunge method) unnecessary. Deleting the reach routing from the network logic will not affect the peak flow. Table 1 below summarizes the peak design flows to be used in design of the Grovers Avenue Storm Drain Lateral and compares them with those computed from previous studies. The design flows recommended in this report were estimated using a more detailed hydrologic analysis of drainage patterns and subareas and, therefore, should be used in place of those values estimated in previous reports.

Table 1. Peak Design Flows (cfs)

Concentration Point	Location	Drainage Structure	MM/CSSA Design	NBS/ Lowry ADMS	NBS/ Lowry DASS	K-H ACDC ADMS
15	30th Way	Inlet	82	142	na	na
12	28th Street	Inlet	255	282	282	na
16	26th Street	Inlet	157	376	na	na
22	Basin #3	Outlet	525	483	483	656

E. LATERAL DESIGN

1. **DESIGN CRITERIA**. The design criteria recommended in Table 2 for use on the Grovers Avenue Storm Drain Lateral is appropriate for a large diameter pipe designed to intercept and convey the runoff from the 100-year storm to Detention Basin #3. Criteria for maximum spread and dry traffic lane criteria is not applicable. It is recommended that inlets be designed to intercept all runoff from the 100-year storm. Design criteria has been adopted from the City of Phoenix Major Street Storm Drain Design Manual; City of Phoenix; the Hydraulic Design Manual, Volume II; Flood Control District of Maricopa County, September 1, 1992; and Drainage of Highway Pavements, HEC-12; Federal Highway Administration, March 1984.

Table 2. Design Criteria

Description	Value	Unit
Maximum Manhole Spacing, 33" to 45" Dia.	440	feet
Maximum Manhole Spacing ≥ 48" Dia.	660	feet
Minimum Ground Cover on Pipe	5	feet
Minimum Ground Cover on HGL	3	feet
HGL - Crown	Positive	
Minimum Pipe Slope	0.001	ft/ft
Minimum Pipe Diameter	24	inch
Minimum Pipe Velocity	2.5	fps
Minimum Clearance Between Utilities	2	feet
Minimum Freeboard Depth in Inlets	0.5	feet
Clogging Factor for Inlets on Grade	0.8	
Clogging Factor for Inlets in Sump	0.5	
N-Values:		
Reinforced Concrete Pipe	0.012	
Corrugated Metal Pipe (Connector Pipes Only)	0.024	
Cast in Place Concrete Pipe	0.015	
Concrete Box Conduit	0.012	
Expansion (Exit) Loss Coefficient	1.0	
Contraction (Entrance) Loss Coefficient	0.5	

2. **CONSTRAINTS**. There are five physical constraints that affect the alignment of Grovers Avenue Storm Drain Lateral:

a. The Grovers Avenue Storm Drain Lateral must connect to the existing 103 inch x 71 inch bituminous coated, arch corrugated steel pipe (n = 0.024) located 65 feet east of Cave Creek Road, 23 feet north of Grovers Avenue, and 20 feet below ground.

b. Construction of the Grovers Avenue Storm Drain Lateral cannot disturb in any way the 36 inch water transmission line located 16 feet south of Grovers Avenue.

c. Construction of the Grovers Avenue Storm Drain Lateral should not disturb, if possible, the 6 to 8 inch (varies) water distribution line located 6 feet north of Grovers Avenue.

d. Construction of the Grovers Avenue Storm Drain Lateral should not disturb, if possible, the 8 inch sanitary sewer line located 16 feet north of Grovers Avenue between 26th Street and 30th Way.

e. The storm drain must be located at an appropriate depth so that the connector pipes for the inlets proposed at 26th Street, 28th Street, 29th Street, and 30th Way can be installed without conflict with the existing 8 inch sewer lines in those respective streets.

3. **ALIGNMENT**. The recommended storm drain alignment is illustrated on the Hydraulic Profile Maps in Appendix B. The drain line begins at the existing pipe outlet 65 feet east of Cave Creek Road and 23 feet north of Grovers Avenue. There is a short segment of 8 inch sanitary sewer line (approximately 200 feet) that presents a horizontal conflict with the storm drain. The sewer line will need to be relocated south of Grovers Avenue to eliminate this conflict. East of 24th Street, the alignment will transition to 2 feet south of the monument line. This will enable the storm drain to be constructed within the limits of the existing 25 foot water easement after acquiring appropriate storm drain right-of-way from the Contention Mining Claim. East of 28th Street the storm drain will transition to 4 feet south of the monument line, placing it in the COP standard location for storm drain lines. The storm drain will remain on this alignment for the remaining distance to 30th Way. Typical sections have been prepared showing the proximity of the storm drain to existing utilities and the trench excavation limits. These are illustrated in Figure 1.

4. **CONFIGURATION.** The storm drain has been configured to allow reinforced concrete pipe to be installed at the minimum depth and pipe diameter necessary to meet the constraints and design criteria specified in this report.

5. **JUNCTION STRUCTURE.** A special cast in place concrete junction box , 12x12x16 feet, will be needed in order to make the connection/transition from the elliptical pipe to round pipe at the beginning of the project (Figure 2). A second junction box, 10x10x10 feet will also be needed at 28th Street for the 84" x 84" RCP Tee connection.

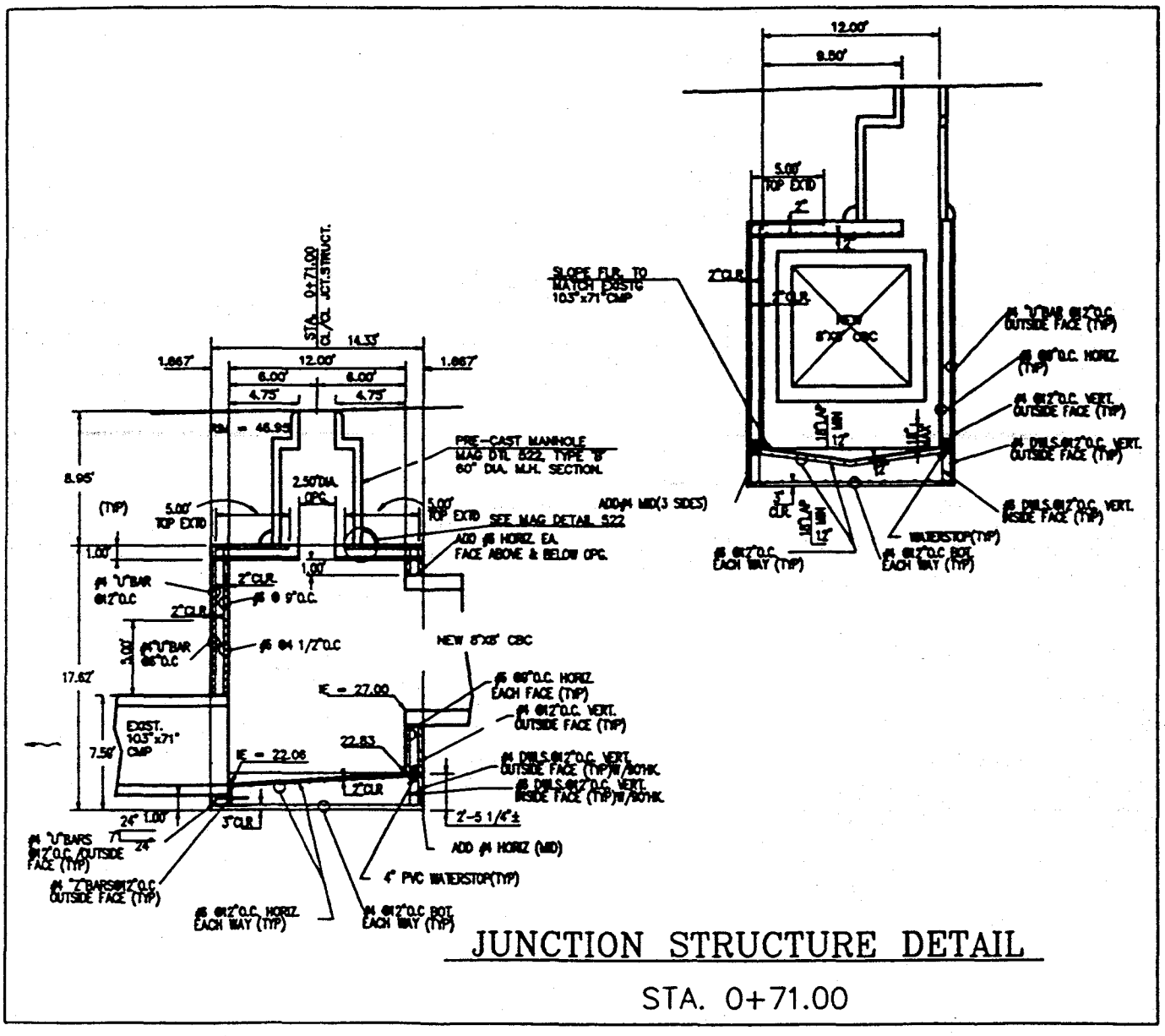


Figure 2

6. **INLET LOCATIONS**. Inlets were located to intercept all of the storm water flow from the 100-year storm before it entered Grovers Avenue. This required locating inlets on both sides of the intersecting streets; 26th Street, 28th Street, 29th Street, and 30th Way. Curb inlets were located starting at the curb return and were extended upstream (Figure 3). The curb inlets function hydraulically as side flow spillways for orifice and weir flow depending on the depth of flow in the street. Water interception and flow profiles were computed using the direct step method for a steady-state, gradually varied flow condition. Table 3 below summarizes the results. Preliminary hydraulic calculations for inlets and connector pipes indicate that the maximum allowable flow per inlet is 55 cfs when a 36 inch connector pipe is used. The standard size P-1569 inlets are:

M-2, L = 17 Total L = 37 ft.

M-2, L = 10 Total L = 23 ft.

The M-2, L = 17 is larger than needed and the L = 10 is too small. It is, therefore, recommended that the P-1569 inlet be modified to accommodate a 36 inch connector pipe, 33 foot curb opening and a 4 foot pre-fab Tee offset. This results in one wing being 13 feet in length and the other 17 feet. Detailed calculations for inlet flow capacities are provided in the Design Calculation Report.

7. **MAINTENANCE**. The City of Phoenix, under provisions in an Intergovernmental Agreement, will assume maintenance of the storm drain after the project construction has been accepted by the FCD and the City of Phoenix.

Maintenance of the storm drain will require periodic inspection of the system. Manholes have been provided at approximately 660 foot intervals or less for this purpose. Access is also available through catch basin lids and grate inlets so that the entire system is made available.

Inspections will identify items to be addressed through maintenance procedures. This may include cleaning debris from grates, sediment from pipes, removing unwanted trash from catch basins and patching concrete.

This system will minimize maintenance needs through the use of materials with known performance records, and by using appropriate design engineering to reduce clogging and deposition of sediment.

TABLE 3

Grovers Avenue Storm Drain Lateral
Inlet/Connector Pipe Configuration Summary - CBC (Primary Design)

Inlet No.	Qty	Description	Location	Design Flow (cfs)	Inlet Flow Capacity (cfs)	Flow By (cfs)
1	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	30th Way ES - RT	40.0	26.0	14.0
2	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	30th Way WS - LT	40.0	26.0	14.0
3	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	30th Way ES - RT	14.0	11.0	3.0
4	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	30th Way WS - LT	14.0	11.0	3.0
5	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	30th Way ES - RT	4.0	4.0	None
6	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	30th Way WS - LT	4.0	4.0	None
			Subtotals		82.0	None
7	1	Catch Basin Type M-1, L = 6 (P-1569)	29th Street ES - RT	8.0	4.0	4.0
8	1	Catch Basin Type M-1, L = 6 (P-1569)	29th Street WS - LT	8.0	4.0	4.0
			Subtotals		8.0	8.0
9	1 (gr)	Catch Basin & Apron, Type N , Single (P-1570)	SE Cor. 28th St./Grov - R	5.0	5.0	None
			Subtotals		5.0	None
10	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street ES - RT	122.0	52.5	69.5
11	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street ES - RT	69.5	30.0	39.5
12	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street WS - LT	122.0	52.5	69.5
13	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street WS - LT	69.5	30.0	39.5
14	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street WS - LT	39.5	20.5	19.0
15	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street ES - RT	39.5	20.5	19.0
16	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street WS - LT	19.0	12.5	6.5
17	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street ES - RT	19.0	12.5	6.5
18	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street WS - LT	12.0	12.0	None
19	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	28th Street ES - RT	12.0	12.0	None
			Subtotals		255.0	None
20	1	Catch Basin Type M-1, L = 10 (P-1569)	SE Cor. 26th St./Grov - R	3.0	3.0	None
			Subtotals		3.0	None
21	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	26th Street WS - LT	71.0	40.0	31.0
22	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	26th Street ES - RT	71.0	40.0	31.0
23	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	26th Street WS - LT	31.0	19.5	11.5
24	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	26th Street ES - RT	31.0	19.5	11.5
25	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	26th Street WS - LT	18.5	18.5	None
26	1	Catch Basin Type M-2, L = 13,17 (P-1569 Mod.)	26th Street ES - RT	18.5	18.5	None
			Subtotals		156.0	None
27	1	Catch Basin Type M-1, L = 10 (P-1569)	Grovers Ave SS - RT	6.0	10.0	None
			Subtotals		6.0	None
28	1	Catch Basin Type M-1, L = 17 (P-1569)	NE Corner Grov/C.C. - L	7.0	10.0	None
			Subtotals		7.0	None
29	1 (gr)	Catch Basin & Apron,Type N,Single (P-1570)	SE Corner Grov/C.C. - R	3.0	5.0	None
			Subtotals		3.0	None
			TOTALS		525	None
ADDITIONAL CATCH BASINS						
30	1 (gr)	Catch Basin & Apron,Type N,Single (P-1570)	Grovers Ave SS - RT			
31	1	Catch Basin Type M-1, L = 6 (P-1569)	Grovers Ave NS - LT			
32	1 (gr)	Catch Basin & Apron,Type N,Single (P-1570)	Grovers Ave SS - RT			
33	1 (gr)	Catch Basin & Apron,Type N,Single (P-1570)	28th St Det Bas Drain - RT			
34	1	Catch Basin Type M-1, L = 6 (P-1569)	Grovers Ave NS - LT			
35	1	Catch Basin Type M-1, L = 6 (P-1569)	Grovers Ave SS - RT			
36	1	Catch Basin Type M-1, L = 6 (P-1569)	Grovers Ave NS - LT			

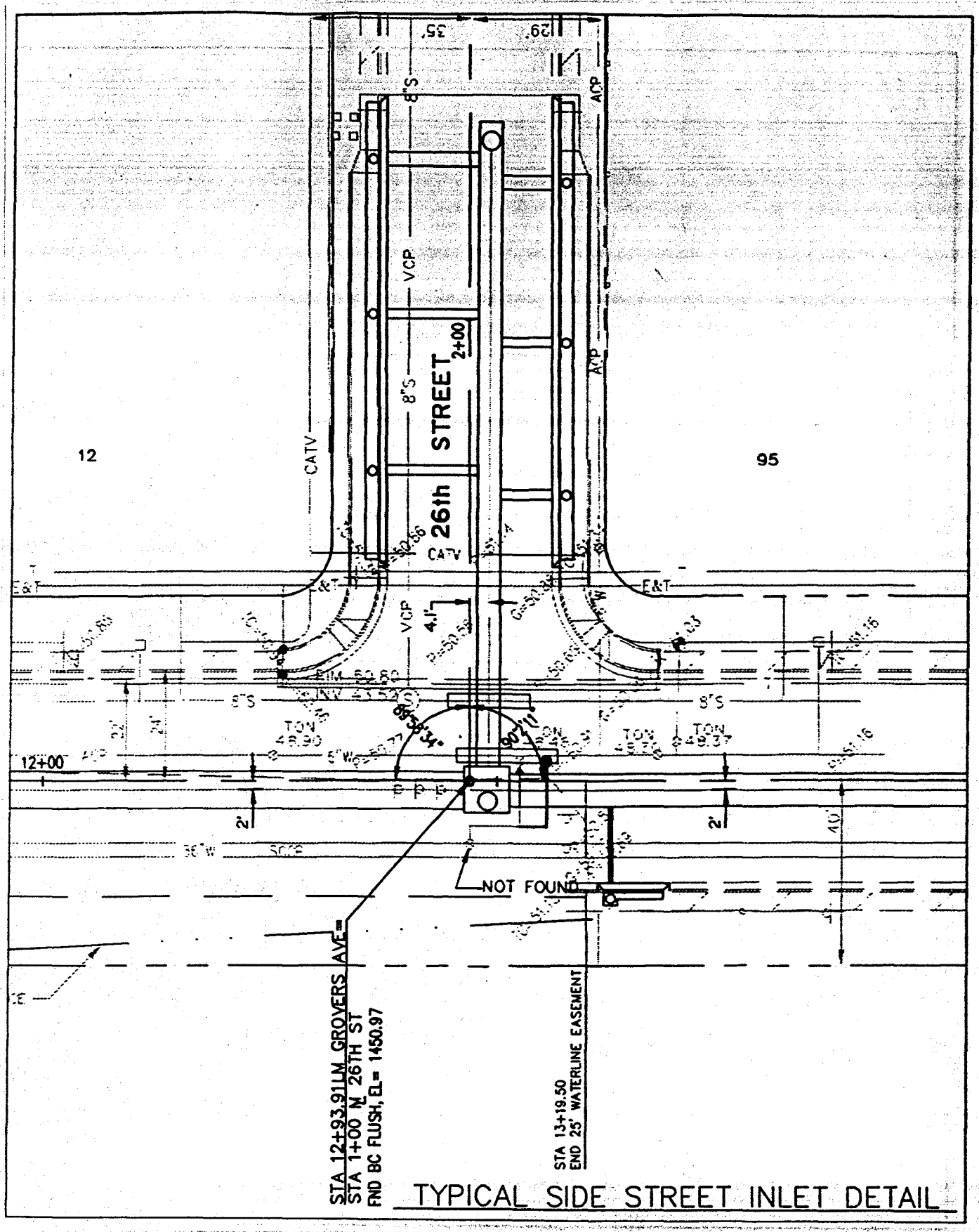

35'
29'
ACP
8"S
VCP
STREET
2+00
26th
CATV
12
95
E&T
4.1'
R=50.00'
8"S
TOW
12+00
2'
NOT FOUND
STA 12+93.91 LM GROVERS AVE
STA 1+00 N 26TH ST
FND BC FLUSH, EL= 1450.97
STA 13+19.50
END 25' WATERLINE EASEMENT
TYPICAL SIDE STREET INLET DETAIL

Figure 3

8. **VALUE ENGINEERING**. Value Engineering has been applied to the storm drain design by investigating the cost of utilizing various materials and configurations, and performing preliminary storm drain designs to size the various hydraulic conduits. Each of these alternatives were estimated for storm drain mainline construction cost, and the low cost alternative recommended for design. Construction costs have been estimated from current City of Phoenix bid tabulations for 9th Street Storm Drain from Bell Road to Union Hills Drive, 20th Street Storm Drain from Bell Road to Grovers Avenue, material cost information from HYDRO CONDUIT, and discussions with contractors (Pulice Construction and Blu-Cor Construction Company). Unit costs considered the results of the soils borings indicating a loose sand-gravel layer and the depth of the trench.

The three configurations investigated are Reinforced Concrete Pipe (RCP), Cast-In-Place Pipe (CIPP), and pre-cast Concrete Box Culverts (CBC). The soils report does not recommend the use of CMP (Speedie and Associates, 1994). The hydraulic calculations and cost estimates are included in the Design Calculation Report. Below is a discussion on each alternative.

a. Reinforced Concrete Pipe (RCP): RCP is the most expensive alternative based on a cost of $1,654,750. The design incudes a junction structure at the beginning of the project and another at the 28th Street lateral connection. RCP pipe sizes range from 108" to 24". Pre-cast manhole sections, tee's and reducers are utilized.

b. Cast-In-Place Pipe (CIPP): CIPP is the second most expensive alternative at a cost of $1,489,982. The design includes a cast-in-place pipe transition at the beginning of the project to tie into the existing 71" x 103" CMP. All other transitions and junctions are also cast-in-place. The cast-in-place pipe ranges from 120" to 48". Due to gravelly sand soil conditions identified in soils borings, trench sloughing may occur, which could affect CIPP construction. CIPP unit costs have been adjusted upward by 50% to account for the difficult trench conditions.

c. Pre-cast Concrete Box Culverts (CBC/RCP): CBC/RCP is the recommended and least expensive alternative at $1,440,817. The design includes a junction structure at the beginning of the project and an 8 ft. x 8 ft. CBC from Cave Creek Road to 26th Street. RCP is utilized for the remainder of the line.

Other factors which have been considered in the Value Engineering recommendation for CBC/RCP are: construction time, safety, access and disruption to traffic. Since CBC/RCP is easily installed and the trench can be immediately backfilled, all of the above factors are positively affected.

F. DESIGN REVIEWS AND PERMITS

1. **CITY OF PHOENIX**. The COP has reviewed all phases of design and construction document preparation. The COP requirements consist of receiving one (1) set of documents at the preliminary phases and two (2) sets of documents upon completion of final design. Final submittals will be directed to:

Ralph Goodall
City of Phoenix
Street Transportation Department
1034 East Madison
Phoenix, AZ 85003

Permits to perform construction within City of Phoenix right-of-way will be required. The Contractor will be required to obtain these permits prior to commencing construction.

2. **UTILITY COMPANIES**. The FCDMC will perform formal utility coordination for this project. Plans have been submitted to the FCDMC at each design phase for utility company review. Final plans for approval will be submitted at design completion.

Design coordination of water and wastewater relocation plans have been performed during each design phase by MM/CSSA to assure compliance with COP Water Services Department requirements. Plans have been submitted directly to the City of Phoenix Water Services Department for review and approval. The COP has authority for water and wastewater plan review and approval within the City of Phoenix.

3. **MARICOPA COUNTY DEPARTMENT OF ENVIRONMENTAL MANAGEMENT**. A construction permit will be required for dust abatement from the MCDEM. The Contractor will be required to secure this permit prior to construction.

4. **STORM WATER POLLUTION PREVENTION PLAN**. A Storm Water Pollution Prevention Plan for storm water discharge from construction sites is required under the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit. The Contractor and Resident Engineer are required to certify the plan.

The plan is to include project information, hydrologic information and construction information. Specific items to be addressed in the plan are erosion control measures, sediment control measures, hazardous materials spills, project inspections and general construction practices (housekeeping).

The control of sediment from leaving the site is of primary importance. The Storm Water Pollution Prevention Plan needs to address the Contractor's stockpiles of trench excavation materials. Sediment and erosion can be controlled by utilizing silt fences and hay bales along with berms. Sediment from project construction should not be allowed to impact Detention Basin No. 3.

After the plan has been prepared, a Notice of Intent (NOI) needs to be submitted to the EPA. A copy of the plan needs to be kept on site at all times during construction. The Contractor is responsible for compliance with the NPDES.

5. **SCHOOLS**. Two (2) schools are located adjacent to the project. Campo Bello School is located on the south side of Grovers Avenue, west of 27th Street. Val Vista School is located on the north side of Grovers Avenue, east of 28th Street.

Both schools will be impacted during the construction of the storm drain. Several mitigative actions can be taken during design and construction of the storm drain to minimize impacts to the schools. They are as follows:

a. During design, locate major items like manholes away from heavily used areas, such as driveways and drop-off zones, to minimize disruption to access.

b. Contractor shall be required to prepare a traffic control plan meeting specified traffic requirements.

c. Coordinate with the schools prior to construction to discuss concerns and mitigation.

d. City of Phoenix Public Information Services Contact will keep the schools informed of construction schedule.

e. City of Phoenix Public Information Services Contact will hold a safety meeting with the school to discuss the project, associated construction hazards and safety.

f. Throughout the project, require the Contractor to fence off any open trenches or other potential hazards such as vacant equipment when not in use.

g. Post a watchman during off hours.

The cost of these actions are minimal but will help mitigate concerns of the schools and increase project safety. Mitigation should begin during the design phase with notification to the schools of the upcoming storm drain project.

G. CONSTRUCTION

1. **PHASING**. Construction phasing and sequencing is utilized to construct portions of the same project at different times. Justification for phasing can be weather or construction season, cost or fiscal year programming of funds, site conditions, access or traffic requirements, and constructibility. For example, utilities could be relocated prior to installing the storm drain.

There should be no need for special phasing in conjunction with the Grovers Avenue Storm Drain project. On a day-to-day basis, the Contractor will be required to sequence his activities to provide access to adjacent properties and maintain thru-traffic. This will involve stockpiling trench excavation in an off-site location instead of beside the trench in the roadway, and providing temporary access to schools and residences when driveways are blocked by construction. These activities are normally identified by the individual contractor at the pre-construction conference.

Related to phasing is Construction Progression. On a drainage project, the standard progression is to construct the downstream conduit end first and progress upstream. This ensures that if water impacts the trench, the pipe is open to drain the trench. It also allows those portions of the system already constructed to function immediately upon completion.

This project will follow typical practices and should be constructed from the downstream end, progressing upstream.

2. **DURATION AND SCHEDULE**. The project consists of installing storm drains, manholes, catch basin inlets, sanitary sewer relocation, miscellaneous water service relocations, and trench backfill and paving. We estimate 120 calendar days for construction, based on the following schedule:

Mobilization	5 Days	=	1 Week
Sewer Relocation	5 Days	=	1 Week
Junction Structure	10 Days	=	2 Weeks
Install Storm Drain	30 Days	=	6 Weeks
Construct Manholes	10 Days	=	2 Weeks
Construct Catch Basins	20 Days	=	4 Weeks
Punch List	5 Days	=	1 Week
			17 Weeks
		x	7 Days
			119 Days

This schedule is commensurate to the 9th Street Storm Drain Project recently completed by the City of Phoenix under similar conditions.

3. **HAZARDOUS MATERIALS.** During the field review, the project site was observed for evidence of underground storage tanks (UST) and surface waste material. No testing or sampling was performed, all observation was visual. No hazardous material is apparent on the project.

During construction some hazardous materials are utilized or the project. Fuels, solvents, adhesives, paints and ignitable wastes are typical on most construction projects. The Contractor is responsible for those hazardous waste materials he generates. To maintain the site from any accidental contamination, the Contractor will be required to clean up any spilled oil or liquid, maintain a berm around any fuel storage or long-term equipment storage area and comply with EPA and 40 CFR regulations.

4. **COST.** It is recommended that the project be bid using a CBC and RCP storm drain system, with Concrete-Lined CMP as a pipe alternative. The Engineer's opinion of probable construction cost for CBC/RCP is $1,330,975. CIPP is not recommended because of unsuitable soil conditions, but has been shown in the Alternate Pipe Chart at the City's request.

H. CONCLUSION

The results and recommendations of this Final Design Report are based upon several phases of review by concerned agencies. As such, the Final Design Report and Design Calculations have been prepared to document the design decision process used to produce the Final Design Submittal in accordance with FCDMC and COP requirements.

REFERENCES

1. AGK Engineers; Drainage Area Map for Bell Road, 20th Street to 32nd Street; MCDEM Project No. 68544; June 13, 1991.

2. AMWEST Engineering Company, Inc; Hydraulic Report for the Cave Creek Wash from 11th Avenue to Tierra Buena; April, 1988.

3. Burgess and Niple, Inc.; Cave Creek Floodplain Delineation, Cave Buttes Dam to the Arizona Canal Diversion Channel, Final Hydrology Report; FCDMC; Project No. FCD 88-56; January, 1990.

4. Cella Barr Associates; North Central Area Master Storm Drainage Study (East Half); City of Phoenix; Project No. ST-79190-01; April, 1981.

5. Cella Barr Associates; Moon Valley Storm Drainage Study; City of Phoenix; Project No. ST-79190.01; April, 1982.

6. City of Phoenix, Engineering Department; Storm Drainage Design Manual, Subdivision Drainage Design; September, 1985.

7. City of Phoenix, Engineering Department; Storm Drainage Design Manual, Storm Drains with Paving of Major Streets; August, 1975; Revised July, 1987.

8. City of Phoenix Planning Department; General Plan for Phoenix, 1985-2000; October, 1985; Revised July, 1989.

9. Coe and Van Loo Consulting Engineers, Inc.; Hydrology Report, Skunk Creek Between Arizona Canal Diversion Channel & Central Arizona Project; November 9, 1990.

10. CRS Sirrine, Inc.; Revised Concept Drainage Design Hydrology, I-17 to Cave Creek, Outer Loop Highway; November 4, 1988.

11. CRS Sirrine, Inc.; Final Drainage Report, Outer Loop Highway Section 6, (OLH/I-17 Interchange) Phase II; ADOT; Project No. RBM-600-0-306; July, 1989.

12. Deleuw, Cather and Company; Drainage Report, Scatter Wash Hydrology and Outer Loop Highway Interceptor Drain, 39th Avenue to 7th Street; November, 1989.

13. Deleuw, Cather and Company; Interoffice Correspondence, Revised Hydrology and Drainage Concepts for Section 7; October 4, 1990.

14. Entranco Engineers, Inc.; Drainage Map for Bell Road, 19th Avenue to 7th Street; City of Phoenix, Project No. P-860932; August 14, 1989.

15. Federal Emergency Management Agency; Flood Insurance Study for Maricopa County, Arizona and Incorporated Areas; Revised September 20, 1989.

16. Flood Control District of Maricopa County; Uniform Drainage Policies and Standards for Maricopa County, Arizona; February 25, 1987.

17. Flood Control District of Maricopa County; Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology; June, 1992.

18. Floyd M. Whitmore Engineers, Inc.; Catch Basin and Storm Sewer Design, 7th Street - Thunderbird Road to Bell Road; City of Phoenix, Project No.: P-856013; May, 1989.

19. George V. Sabol Consulting Engineer; Flood Control District of Maricopa County, S-Graph Study, FCDMC; Project No. FCD 86-36; November, 1987.

20. Greiner Engineering Sciences, Inc.; Outer Loop Highway, Bell Road to C.A.P. Canal Crossing Section B, Hydrology Report; August, 1986.

21. Greiner Engineering Sciences, Inc.; Bell Road Project Drainage Study, October, 1987.

22. Greiner Engineering Sciences, Inc.; Concept Drainage Design Report from Cave Creek to the CAP Canal, Outer Loop Highway; October, 1987.

23. Greiner Engineering Sciences, Inc.; Scatter Wash Drainage and Storm Drain Study Conceptual Plan, Volumes I and II; September, 1989.

24. John Carollo Engineer; Drainage Area Map for Bell Road, 7th Street to 20th Street; City of Phoenix, Project No. P-860981; March 8, 1991.

25. Kaminski-Hubbard Engineering, Inc.; Scatter Wash Watershed, Hydrology Report, Arizona Canal Diversion Channel Area; May 4, 1992.

26. NBS/Lowry Engineers and Planners; Upper East Fork Cave Creek Area Drainage Master Study; October, 1987.

27. NBS/Lowry Engineers and Planners; Upper East Fork Cave Creek Detention Area Sizing Study; February, 1989.

28. NBS/Lowry Engineers and Planners; Upper East Fork Cave Creek Detention Area Sizing Study, Engineering Design Descriptions; June, 1989.

29. NBS/Lowry Engineers and Planners; Update of North Central Area master Storm Drainage Study (East Half); City of Phoenix, Project No. ST-893248; September, 1989.

30. NBS/Lowry Engineers and Planners; Upper East Fork Cave Creek Detention Basin #4 Design, 90% Design Submittal; November 2, 1990.

31. NBS/Lowry Engineers and Planners; Construction Plans for Upper East Fork Cave Creek Drainage Channel; FCDMC; Project No. 90-54; June 24, 1991.

32. NBS/Lowry Engineers and Planners; Upper East Fork Cave Creek Detention Basin #3A and 3B Design, Preliminary Design Submittal; City of Phoenix, Project No.'s ST-896829 & P-901801; September 9, 1991.

33. PRC Engineering; I-17 Drainage Design Study Preliminary Design Report; March, 1987.

34. Project Engineering Consultants, Ltd.; Storm Drain Design for Coral Cables Drive, Moon Valley Drive, Carol Ann Way and Country Gables Drive; City of Phoenix, Project No. ST-856500; February, 1989.

35. Robert L. Ward Consulting Engineer; Memorandum, Offsite Drainage Channel,Outer Loop Highway, 7th Street to 1/4 Miles West of 20th Street; December 8, 1989.

36. SCI Consulting Engineers, Inc.; North Central Master Storm Drainage Study (West Half); City of Phoenix, Project No. ST-79185.01; May 15, 1981.

37. Speedie and Associates; Report on Geotechnical Investigation, Grovers Avenue Storm Drain; Flood Control District of Maricopa County, Project No. 930314SA; January 18, 1994.

38. U.S. Army Corps of Engineers, Los Angeles District; Gila River Basin, New River and Phoenix City Streams, Arizona, Design Memorandum No. 2, Hydrology, Part 1; October, 1973.

39. U.S. Army Corps of Engineers, Los Angeles District; Gila River Basin, New River and Phoenix City streams, Arizona, Design Memorandum No. 3, General Design Memorandum - Phase II, Project Design Part 1, Cave Buttes Dam; July, 1976.

40. U.S. Army Corps of Engineers Los Angeles District; Gila River Basin, Phoenix streams, Arizona and Vicinity, Design Memorandum No. 2, Hydrology, Part 2; 1982.

41. U.S. Army Corps of Engineers, The Hydrologic Engineering Center; HEC-1 Flood Hydrograph Package Users Manual; September, 1990.

42. U.S. Department of Agriculture, Soil Conservation Service; Soil Survey of Maricopa County, Arizona, Central Part; April, 1986.

43. U.S. Department of Agriculture, Soil Conservation Service; Soil Survey of Aguila - Carefree Area, Part of Maricopa and Pinal Counties, Arizona; April, 1986.

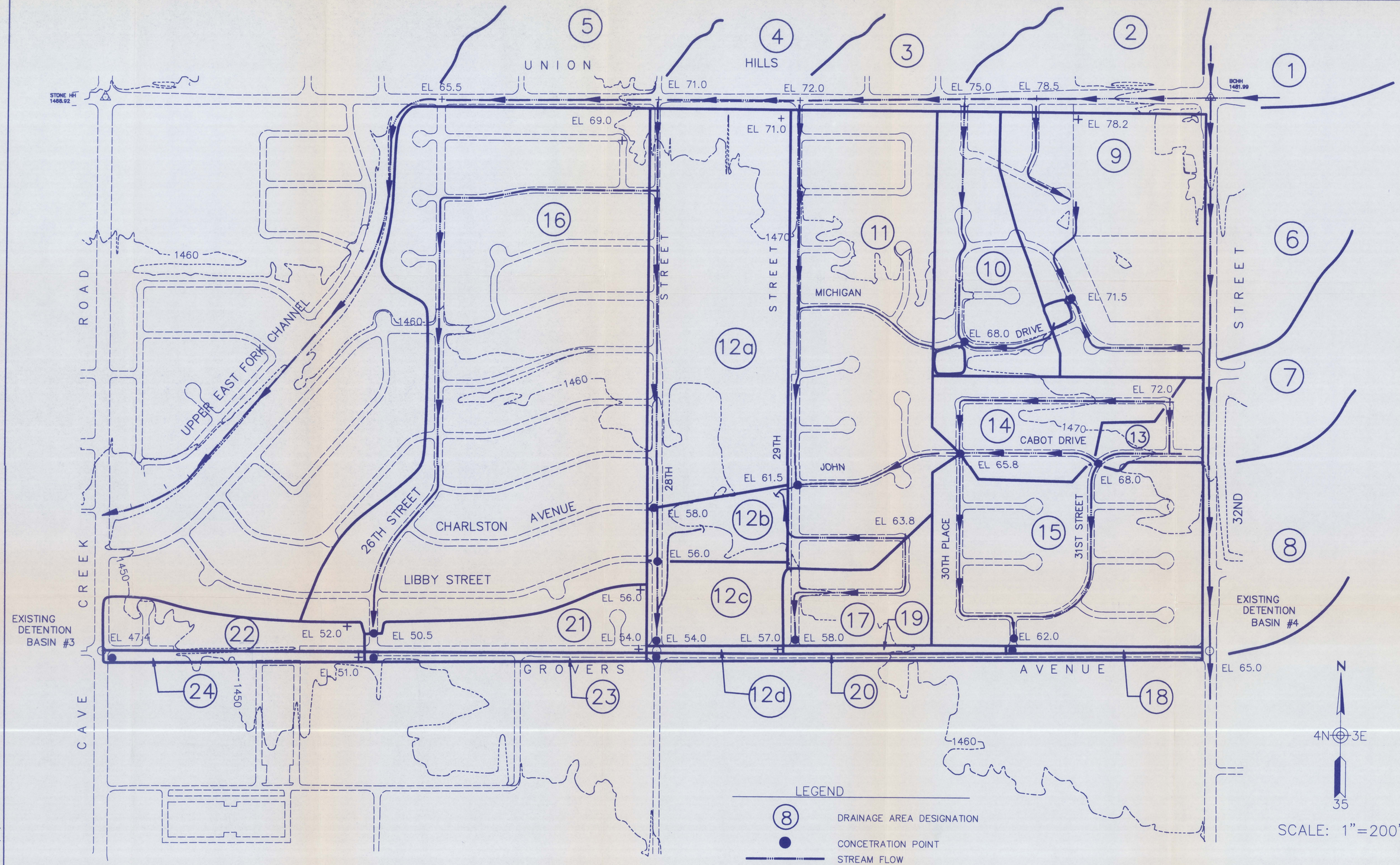
44. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service; NOAA Atlas 2, Precipitation - Frequency Atlas at the Western United States Volume VIII - Arizona; Silver Springs, MD, 1973.

45. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service; NOAA Technical Memorandum NWS HYDRO-40, Depth-Area Ratios in the Semi-Arid Southwest United States; Silver Springs, MD, August, 1984.

46. U.S. Department of Transportation, Federal Highway Administration; Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5; September, 1985.

47. U.S. Geological Survey, Water Resources Division; Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona; April, 1991.

APPENDIX A - DRAINAGE MAP



LEGEND

(8)	DRAINAGE AREA DESIGNATION
●	CONCETRATION POINT
———	STREAM FLOW
———	DRAINAGE BOUNDARY
+ EL 65.5	UPSTREAM ELEVATION
● EL 65.5	DOWNSTREAM ELEVATION

	NAME	DATE
DESIGNED BY	B.J.F.	6/20/94
DRAWN BY	A.G.	6/20/94
CHECKED BY	P.M.	6/20/94

Morrison Maierle / CSSA INC.

PROJECT No. 8156.001

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

100 YEAR DRAINAGE MAP

GROVERS AVENUE STORM DRAIN

60% SUBMITTAL NOT FOR CONSTRUCTION

1 OF 1

D:\DWG\GROVERS\DRNDGN.DWG 03/23/94 BJF

APPENDIX B - HYDRAULIC PROFILE/RIGHT-OF-WAY MAP

SHEET 5 | SHEET 6 | SHEET 7 | SHEET 8 | SHEET 9 | SHEET 10

1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00

PEPPER RIDGE

PROPOSED STORM DRAIN

CATCH BASIN NO (TYP)

UNSUBDIVIDED
CONTENTION MINING
CLAIM M S 1180

CONTENTION MINING CLAIM

'CAMPO BELLO SCHOOL'

STEWART'S CORNER

DETENTION BASIN No 3
Q100 = 525 CFS

CAVE CREEK ROAD
STA 0+00.00
NEW SD JCT. BOX/MH #1

24th PLACE
STA 2+11.39

NEW SDMH 12
STA 2+39 26TH ST

26th STREET
STA 12+93.91

27th WAY
STA 24+54.43

TBM #1

TBM #2

BM#1 B C H H M
CAVE CREEK ROAD &
GROVERS AVE
EL 1446.43

START PROJECT
STA 0+65.00
INDEX NO ST-930289

STA 0+70
EXIST HEADWALL

146 L F 8" SEWER
RELOCATION

BORE HOLE B-1
STA 3+00 - 16' RT

BORE HOLE B-2
STA 12+00 - 14' RT

BORE HOLE B-3
STA 22+00 - 2' RT

STA 7+00
NEW S D M H #2

STA 12+98 NEW SD
JCT STRUCTURE/MH #3

27th STREET
STA 19+79.62

STA 20+28
NEW SD MH #4

MATCHLINE STA 25+00 SEE SHT 4

▲TBM #1
STA 2 + 96 - 24' LT
SCRIBED "X" TOP OF CURB
NORTH SIDE OF GROVERS AVE
50' EAST OF NE CURB RETURN, 24th PLACE
ELEV = 1448.10

▲TBM #2
STA 13 + 97 - 24' LT
SCRIBED "X" TOP OF CURB
NORTH SIDE OF GROVERS AVE
63' EAST OF NE CURB RETURN, 26th ST
ELEV = 1451.26

GROVERS AVENUE

MH No.1
STA 0+71 C NEW
12'x12' JCT BOX
RIM = 46.95

MH No. 2
STA 7+00
RIM = 51.13

MH No. 3
STA 12+98
RIM = 50.98

MH No. 4
STA 20+28
RIM = 53.43

EXIST PROFILE @ M.L.

HGL

S=0.163%

S=0.254%

1227 LF 8' x 8' CBC @ 0.480%

60" RCP

1348 LF 84" RCP @ 0.360%

IE = 22.06
IE = 27.00

IE = 30.02

IE = 32.89W
IE = 34.39N
IE = 33.89E

IE = 36.50

MATCHLINE STA 25+00 SEE SHT 4

1455 1450 1445 1440 1435 1430 1425 1420

1455 1350 1445 1440 1435 1430 1425 1420

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00

Q_{100} = 525 CFS | Q_{100} = 509 CFS | Q_{100} = 349 CFS

SCALE: H: 1"= 100'
V: 1"= 5'
100 50 0 100

263-1100
Blue Stake Center
CALL COLLECT

NO	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

GROVERS AVENUE STORM DRAIN LATERAL
CAVE CREEK ROAD TO 30TH WAY
PROJECT NO 93-21

		DATE
DESIGNED	JKM	5/10/95
DRAWN	DLW	5/10/95
CHECKED	BJF	5/10/95

Stanley Consultants CSA

KEY MAP/PROJECT PROFILE SHEET | SHEET OF

SHEET 10 | SHEET 11 | SHEET 12 | SHEET 13

MATCHLINE STA 25+00 SEE SHT 3

PEPPER RIDGE UNIT 2 | PEPPER RIDGE UNIT 7 | PARQUE VISTA ESTATES UNIT 10

VAL VISTA SCHOOL

CAMPO BELLO

CAMPO BELLO

GROVERS AVENUE

CATCH BASIN NO (TYP)

NEW SDMH #11 STA 2+64-28TH ST

TCE 105'x60'

NEW SDMH #10 STA 1+35 29TH ST

NEW SDMH #7 STA 33+00

CATCH BASIN NO (TYP)

NEW SDMH #9 STA 2+35-30TH WAY

28th STREET STA 28+30.53

29th STREET STA 32+86.40

30th WAY STA 43+33.01

32nd STREET STA 52+67.22

SHEET 15 | SHEET 16 | SHEET 17

TBM #3 | TBM #4 | TBM #5

656.95' | 656.95' | 379.70' | 1409.53' | 934.21'

1218.10'

BORE HOLE B-4
STA 32+00 - 10' RT

BORE HOLE B-5
STA 42+00 - 1' RT

STA 28+46 NEW SDMH #5 1ST STRUCTURE/MH

STA 32+93 NEW SDMH #6

STA 38+57.66 30th STREET

STA 43+37 NEW SDMH #8 END PROJECT

BM# 2
BRASS CAP FLUSH-
32ND ST & GROVERS
AVE COP DATUM
EL = 1484.80

N

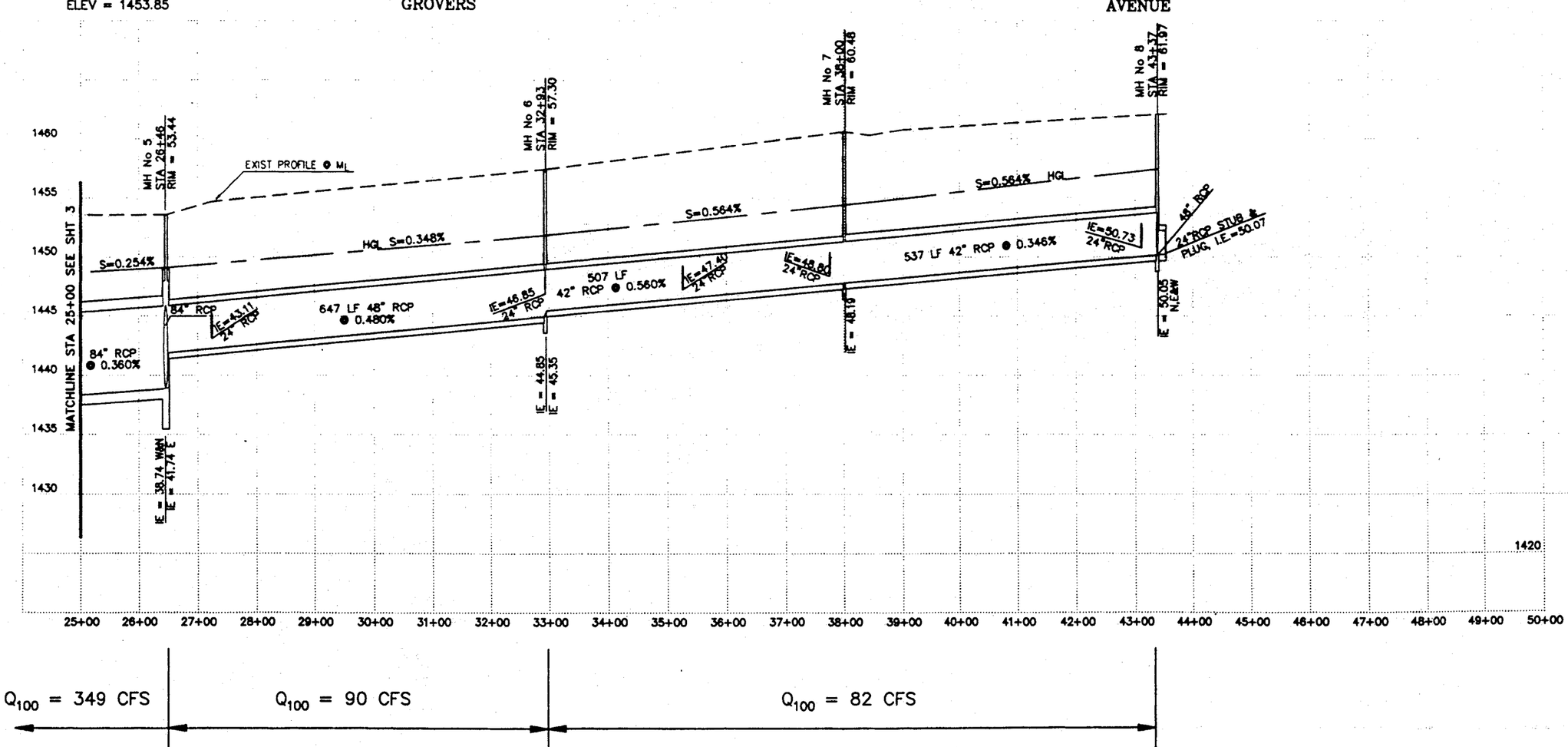
SCALE: 1"= 100'
VERTICAL: 1"= 5'

100 50 0 100

▲TBM #3
STA 25 + 40 - 24' LT
SCRIBED "X" TOP OF CURB
NORTH SIDE OF GROVERS AVE
50' EAST OF NE CURB RETURN, 27th WAY
ELEV = 1453.85

▲TBM #4
STA 33 + 86 - 24' LT
SCRIBED "X" TOP OF CURB NORTH SIDE OF GROVERS AVE
50' EAST OF NE CURB RETURN, 29th STREET
ELEV = 1457.77

▲TBM #5
STA 44 + 19 - 24' LT
SCRIBED "X" TOP OF CURB NORTHSIDE OF GROVERS AVE
50' EAST OF NE CURB RETURN, 30th WAY
ELEV = 1462.46



Q_{100} = 349 CFS | Q_{100} = 90 CFS | Q_{100} = 82 CFS

263-1100
Blue Stake Center
CALL COLLECT

NO	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

GROVERS AVENUE STORM DRAIN LATERAL
CAVE CREEK ROAD TO 30TH WAY
PROJECT NO 93-21

		DATE
DESIGNED	JKM	5/10/95
DRAWN	DLW	5/10/95
CHECKED	BJF	5/10/95

KEY MAP/PROJECT PROFILE SHEET | SHEET OF