GREENWAY ROAD
LOCATION STUDY

FROM 19TH AVENUE TO 32ND STREET

CITY OF PHOENIX PROJECT NO.P-82035.00

FMS INDEX NO.P-820357

Registered Professional Engineer (Civil)
CERTIFICATE NO.
6974
RONALD L. LEWING
DATE SIGNED 8-19-82
Arizona U. S. A.

AUGUST 19, 1982

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
PHOENIX, ARIZONA

GREENWAY ROAD
LOCATION STUDY

FROM 19TH AVENUE TO 32ND STREET

CITY OF PHOENIX PROJECT NO.P-82035.00

FMS INDEX NO.P-820357

AUGUST 19, 1982

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
PHOENIX, ARIZONA

I N D E X

A. RECOMMENDATION

Roadway

It is recommended that the location of Greenway Road commencing at the intersection of 19th Avenue generally proceed easterly to the east side of Cave Creek Wash, then paralleling the wash proceed northeasterly to the extended alignment of Paradise Lane near 7th Avenue, then proceed easterly to Aire Libre Avenue near 7th Street where several southeasterly curves bring the alignment south, back to the existing alignment of Greenway Road near 32nd Street. The recommended alignment is generally shown on Plate No. 1, refer to Appendices I - III for graphic layout and preliminary design for interim and future configurations. Plan and profile sheets establish right-of-way requirements, roadway alignment with geometrics and grades.

Channel

A new channel is recommended adjacent to the south right-of-way line of the roadway commencing near Central Avenue extended and terminating at 24th Street (Cave Creek Road). The proposed channel is a broad bottom, unlined channel to 12th Street and a narrow bottom, lined channel from 12th Street to 24th Street to conserve right-of-way requirements and reclaim a maximum amount of flood prone land for potential improvement.

CENTRAL AVE. TO 12TH ST.
UNLINED CHANNEL
295' R.O.W.

12TH ST. TO 24TH ST.
LINED CHANNEL
80' TO 90' R.O.W.

7TH AVE.

24TH ST.

16TH ST.

BELL ROAD

AIRE LIBRE AVENUE

LANE

TURF PARADISE

WASH

ALIGNMENT A

PARADISE

NEW CHANNEL

BEGIN STUDY

END STUDY

GREENWAY ROAD

EAST FORK

LOOKOUT MTN.

GREENWAY ROAD
ALIGNMENT B
110' R.O.W.

HWY.

BLACK CANYON

CAVE CREEK

19TH AVENUE

CENTRAL AVENUE

7TH STREET

12TH STREET

CAVE CREEK ROAD

32ND STREET

40TH STREET

THUNDERBIRD ROAD

CACTUS ROAD

N

0 1/2 MI. 1 MILE

SCALE - 1" = 1200'

LEGEND

- ROADWAY ALIGNMENT
- UNLINED CHANNEL
- LINED CHANNEL

PLATE NO. 1

CITY OF PHOENIX, ARIZONA
ENGINEERING DEPARTMENT

GREENWAY ROAD LOCATION STUDY
19TH AVENUE TO 32ND STREET
PROJECT NO. P-82035.00
VICINITY MAP

DIBBLE & ASSOCIATES, CONSULTING ENGINEERS

DES DATE	DR DATE	CK DATE	SHEET NO	TOTAL SHEETS	AS BUILT
SCALE 1"= HORIZONTAL / VERTICAL					

B. INTRODUCTION

Location

Greenway Road between 19th Avenue and 24th Street (Cave Creek Road) is not developed due to its location along the section line over the north slope of Lookout Mountain. The limits of this study include a five mile reach between Greenway Road extended and Bell Road from 19th Avenue to 32nd Street around the north slope of Lookout Mountain.

Purpose

The purpose of the study is to establish the required right-of-way corridor for the roadway and drainageway; to prepare sufficient preliminary engineering design of the roadway and channel to insure feasibility and to define the facilities throughout the five mile corridor and to provide for an interim improvement of a minimum roadway facility and drainageway.

Scope

The Greenway Road facility is proposed as an ultimate 6 lane major street with 24-foot median designed to minimum 50 mile per hour design speed with maximum 4 percent superelevated roadway within a 110-foot right-of-way width. Between 7th Street and 24th Street (Cave Creek Road) the proposed route lies at the bottom of the north slope of Lookout Mountain and adjacent to a drainageway receiving runoff from a 3.26 square mile (2086 acres) drainage basin from the south. Three-fourths of a mile of right-of-way has been dedicated as part of subdivisions on the slope of the mountain for a channel designated as Indian Bend Floodway from 18th Street to 24th Street (Cave Creek Road). Also the east fork of Cave Creek Wash flows to the northern slope of the mountain between 7th Street and 16th Street. The location of the proposed Greenway Road around the

north slope of the mountain places it in the low land in the existing drainageway described above; therefore this study defines and establishes a channel adjacent to the Greenway Road alignment from approximately Central Avenue (extended) to 24th Street (Cave Creek Road). The type of channel conforms to the recommendations of a recent report for development of Cave Creek Wash and the East Fork (Wirth Report). The Wirth Report suggests preserving the natural growth of the East Fork of Cave Creek and providing new required channelization in a natural earthen channel which can be landscaped with native flora. The earthen channel can accommodate a horse trail system, and the drainage structures under 7th Street and near 12th Street can serve as horse underpasses. This type channel should maintain flow velocities of approximately 5 feet per second. Channel facilities to convey 100-year runoff flow is to be provided. The above criteria requires 295-foot right-of-way width. Therefore, the channel from 7th Street to 12th Street is to be the most easterly one-half mile reach of channel utilizing natural earthen channel. From 12th Street to 24th Street the channel is to be lined in a manner to accept velocities approaching 10-feet per second consistent with Cella Bar Associates, "1981 North Central Area - Master Storm Drainage Study".

The establishment of the right-of-way and preliminary design of the facilities is provided on plan and profile drawings at a scale of 1-inch equals 50-feet in order to provide developers along the corridor well defined requirements for the roadway and channel which may lie within their proposed development. See separate Appendices I, II and III.

C. DISCUSSION

Parameters

The following parameters are used in development of this study:

Ultimate Roadway:

1. Ultimate 6-lane major street
2. 24-foot median
3. 60 mile per hour minimum design speed from 19th Avenue to 24th Street (Cave Creek Road)
4. 50 mile per hour minimum design speed from 24th Street (Cave Creek Road) to 32nd Street
5. 4 percent maximum superelevated pavement
6. 110-foot right-of-way

Interim Roadway:

1. Minimum 2-lane, 28-foot strip pavement
2. Ultimate right-of-way acquisition
3. Minimum interim drainage facilities

Channeling:

1. Convey 100-year flow runoff without increasing high-water elevation in excess of 1-foot
2. Conform to Wirth Report
3. Use flows established in the Cella Barr & Associates 1981 Master Storm Drainage Study
4. Maintain velocities approaching 5-feet per second in earthen channel and 10-feet per second in lined channel

Roadway Locations

Greenway Road extends east of 19th Avenue as a local street for approximately one-half mile where it meets the confluence of Cave Creek Wash flowing from the north and the East Fork of Cave Creek Wash flowing from the east. A special study of the roadway location designated Alignment A and Alignment B is made to determine whether the roadway should turn northerly on the west side of Cave Creek Wash and then turn easterly at the mid-section line (Paradise Lane) Alignment A, or cross Cave Creek Wash on the southerly alignment and then turn northerly along the east side of Cave Creek Wash (Alignment B). See Plate No. 1.

Cost comparisons of the alignments are presented on page 14. The advantages and disadvantages of each alignment are as follows:

Alignment A

Advantages -

1. Frequent access points to existing development
2. Good access frontage to undeveloped parcels both sides of wash
3. Better channel crossing
4. Less fill to be constructed
5. Least costly alternative

Disadvantages -

1. Congested side street access
2. More improved lots need to be acquired for right-of-way
3. More individual lot owners have to be dealt with
4. Trash areas need to be excavated and replaced

Alignment B

Advantages -

1. Better controlled access for traffic
2. Least amount of improved lots need to be acquired
3. Fewer lot owners are affected
4. Trash areas south of Turf Paradise avoided

Disadvantages -

1. Undeveloped parcels on west side of wash have no access
2. Channel crossing is at confluence of other washes
3. More costly alternative
4. Lining protection of roadway embankment east of 15th Avenue
5. Isolating depressed gravel pit east of alignment

Alignment B is selected as the recommended alternative.

The roadway alignment along the midsection line (Paradise Lane extended) from approximately 7th Avenue to Central Avenue lies on land not adjacent to existing defined drainageways. Near Central Avenue the roadway meets the East Fork of Cave Creek Wash flowing from the northeast; therefore the roadway turns northeasterly and then easterly on Aire Libre Avenue (extended) near 7th Street with a proposed improved earthen channel adjacent to the south right-of-way line. The channel right-of-way requirement is 295 feet. An additional 55 feet of street right-of-way establishes the construction centerline of the major street at 250 feet north of the quarter-mile line (Aire Libre Avenue extended) to 12th Street. Additional slope and drainage easements beyond those described above will be required at various locations throughout the route depending on adjacent development and final design considerations.

From 12th Street to 16th Street the alignment remains sufficiently

north of the quarter mile line to not require land acquisition south of the quarter mile line.

From 16th Street to 18th Street the alignment turns southeasterly to connect to existing drainage right-of-way established by subdivisions lying on the north slope of Lookout Mountain, and follows the drainage right-of-way alignment to 24th Street (Cave Creek Road). This reach of right-of-way lies within unimproved low lying drainageways. No defined channel is proposed adjacent to the Greenway Road alignment east of 24th Street (Cave Creek Road).

The road alignment turns southeasterly near 26th Street and easterly in existing Greenway Road near 28th Street passing through older subdivisions consisting of mobile home lots. Right-of-way location in this area is established to maintain the number of required lot acquisitions to a minimum.

Hydraulic Analysis

The channel is discussed in half mile reaches downstream beginning at 24th Street (Cave Creek Road) as follows:

24th Street to 20th Street - The proposed new channel will lie in the existing 80-foot right-of-way from 24th Street to 20th Street by utilizing a lined channel permitting flow velocities in excess of 7 feet per second. Flow rates of 1500 to 2500 cubic feet per second are used to establish this reach of channel.

The main channel is established south of the roadway since peak discharges from the north slope of Lookout Mountain are greater than the peak discharges from the larger but flatter sloped drainage area to the north. A summary of peak flows from the various drainage basins is presented in Appendix VI.

A culvert on the east side of 24th Street (Cave Creek Road) is proposed to convey water under Greenway Road and under 24th Street to establish the new open channel lying south and adjacent to Greenway Road to the west.

A culvert at 20th Street is proposed to convey water from the north under Greenway Road into the new channel.

20th Street to 16th Street - The proposed channel is lined and on the south side of the roadway through presently undeveloped land in which the 100-year runoff spreads to approximately 700 feet wide. The required right-of-way is 90 foot width.

A culvert at 16th Street is proposed to convey water under Greenway Road into the new channel.

16th Street to 12th Street - The proposed channel is lined and on the south side of the roadway through land developed as 2.5 acre homesites with horse priviledges over the east half and unimproved land over the west half. The required right-of-way is 90 foot width.

A major culvert west of 12th Street is proposed under Greenway Road into the new channel, providing a confluence for the East Fork of Cave Creek Wash and the Indian Bend Floodway at this location. The proposed channel downstream is an unlined earthen channel.

12th Street to 7th Street - The proposed channel is unlined and on the south side of the roadway and adjacent to subdivided land south of the channel. This location provides a maximum noise buffer from the proposed roadway to the homes adjacent to the corridor. Drop structures are located throughout the earthen channel reaches to provide

energy dissipation in order to keep velocities from becoming too erosive. Velocities are to be kept in the 5-6 feet per second range for the 100-year flow realizing that some erosion will occur. The required right-of-way is 295 foot width.

7th Street to Central Avenue - The proposed channel is unlined and on the south side of the roadway through presently unimproved land. The required right-of-way is 295 foot width. The channel flowline meets the existing multi-channelled natural wash near Central Avenue. The channel will remain natural on to the west from Central Avenue.

Drainage structures and storm drains are presented to establish flow rates and proportionate size. Adjacent future development may dictate specific locations and sizes. All drainage facilities including roadway catch basins are to be re-analyzed and sized based on final design configuration.

Utility Conflicts

There are numerous utility conflicts due to the development of an improved channel approximately 10-foot deep with existing sewers, watermain and buried telephone cable.

Relocations are required at the following locations:

16th Avenue and Cave Creek Wash
- 24" VCP sanitary sewer
- Telephone
- Waterline

7th Street
- 15" sanitary sewer
- Telephone
- 20" RCP watermain

12th Street
- 21" VCP sanitary sewer
- Telephone

16th Street
8" VCP sanitary sewer
Telephone
20" RCP watermain

18th Street
24" VCP sanitary sewer

19th Street
21" VCP sanitary sewer

20th Street
8" VCP sanitary sewer

22nd Street
8" VCP sanitary sewer

24th Street (Cave Creek Road)
Telephone
16" ACP & 30" RCP watermains

For orderly development of the land adjacent to the channel, a sanitary sewer on each side and parallel to the channel is desirable to avoid excessively deep sewers and multiple crossings of the channel. Recommended sewer alterations of the existing sewers is depicted on Appendix VII. The future location of the Paradise Valley Trunk Sewer is to be relocated within the roadway right-of-way.

Interim Improvements

It is understood that the City desires to establish a minimum interim roadway facility to open the corridor over the 5-mile reach.

The recommended minimum roadway is a two lane strip pavement (28-foot recommended width) following the future alignment of the west bound paved lanes of Greenway Road. (See Appendix II)

Recommendations of minimum initial roadway development in five reaches are as follows:

19th Avenue to Central Avenue

Greenway Road is paved at a 23-foot width to 17th Avenue. Extension of a minimum two lane road crosses Cave Creek Wash and the box culvert should be located at the ultimate location and gradeline. A minimum 40-foot right-of-way is required to establish the roadway from east of Cave Creek Wash to Central Avenue following the future alignment and gradeline of the west bound paved lanes.

Central Avenue to 7th Street

A channel is to be established on the south side of the roadway. A minimum 40-foot right-of-way is required to establish the roadway following the future alignment and gradeline of the west bound paved lanes. A 295-foot channel right-of-way is required. Until the channel is established east and west of 7th Street, the gradeline of 7th Street should not be reaised to ultimate gradeline; therefore Greenway Road gradeline will be depressed over a minimum length to match existing 7th Street gradeline.

Due to well defined channels near Central Avenue and 7th Street, the concrete box culverts under Greenway Road indicated on the Roadway and Channel Plans should be constructed.

The structure near 7th Street should be constructed as soon as a channel to the east can be established. This structure will serve as a horse underpass.

7th Street to 16th Street

Unless the channel is established initially in this reach of roadway and the major concrete box culvert and diking is constructed near 12th Street, the reach of roadway should be constructed lower than ultimate gradeline with a swale to allow sheet flow over a wide area to cross the

roadway. The structure at 12th Street will serve as a horse underpass. Improvement of the entire channel is desirable; however to provide usable channel from 16th to 23rd Streets, a metered outlet in the form of a 36-inch pipe can be established, located at the ultimate channel flowline, between 16th Street and 7th Street utilizing a portion of the channel as retention basin upstream of 16th Street.

A minimum 40-foot right-of-way is required to establish the roadway following the future alignment of the west bound paved lanes. The channel right-of-way is 295-foot wide to 12th Street and 90-foot wide to 16th Street.

16th Street to 24th Street (Cave Creek Road)

A minimum 40-foot right-of-way is required to establish the roadway following the future alignment and gradeline of the west bound paved lanes. A 90-foot channel right-of-way is required to approximately 22nd Street and 80-foot to 24th Street.

If a drain pipe is established from 7th Street to 16th Street, the channel can be developed at any time in this reach of roadway. The channel terminates at the east end of this reach.

24th Street (Cave Creek Road) to 32nd Street

The Greenway Road alignment curves southerly approximately 2000 feet to meet the existing roadway near 28th Street. It is recommended that the 110-foot right-of-way be initially acquired in this reach, and the roadway established following the future alignment and gradeline of the west bound paved lanes. Due to the flat grades the street storm drain should also be established in this reach during the interim roadway development.

It is understood that the City will establish the right-of-way dedication and degree of roadway and channel improvements required of developers adjacent to the roadway corridor.

Each developer must investigate whether retention or full channel improvements will best suit his development and to convey the runoff through the development into the proposed improved channel adjacent to Greenway Road. It is recommended, however, that the ultimate channel and appurtenant drainage facilities be constructed prior to or concurrent with roadway improvement.

Cost Comparisons

The following cost comparison illustrates the selection of alignment investigations for the Cave Creek Wash crossing is not dictated by economic considerations. The cost differential between the two alignments is less than 2%. These cost estimates are presented on the following page.

ALIGNMENT "A"
REACHES 9 & 10

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.	Roadway Earthwork	54,000	C.Y.	$ 3.00	$ 162,000
2.	Pavement, Curb, Gutter, Sidewalk & Median	6,350	L.F.	185.00	1,174,750
3.	Storm Drains	1,800	L.F.	60.00	108,000
		3,300	L.F.	25.00	82,500
4.	Excavate & Replace Trash	34,050	C.Y.	4.00	136,200
5.	Culvert @ 14th Avenue	1	Job	L.S.	375,800
6.	Lining	3,580	C.Y.	100.00	358,000
7.	Right-of-Way	10.56	Acres	40,000.00	422,400
		237,500	S.F.	1.50	356,250
			TOTAL		$3,175,900

ALIGNMENT "B"
REACHES 9 & 10

1.	Roadway Earthwork	135,000	C.Y.	$ 3.00	$ 405,000
2.	Pavement, Curb, Gutter, Sidewalk & Median	6,350	L.F.	185.00	1,174,750
3.	Storm Drains	1,800	L.F.	60.00	108,000
		3,300	L.F.	25.00	82,500
4.	Excavate & Replace Trash	13,750	C.Y.	4.00	55,000
5.	Culvert @ 16th Avenue	1	Job	L.S.	375,800
6.	Lining	3,580	C.Y.	100.00	358,000
7.	Right-of-Way	14.42	Acres	40,000.00	576,800
		69,300	S.F.	1.50	103,950
			TOTAL		$3,239,800

Comparisons were also made to evaluate the economics of bridge structures compared to multi-barrel box culverts. A typical comparison is made for the 7th Street crossing:

Bridge Structure

Bridge 105 Ft. x 230 Ft. @ $35/S.F.	=	$845,250

Concrete Box Culvert

(6 - 12' x 10')

Culvert 120 x 9.015 CY/FT @ $350/C.Y.	=	$378,630
Wing Wall 69.7 C.Y. @ $350/C.Y.	=	24,395
Gabion Apron 325 C.Y. @$100/C.Y.	=	32,500
Gabion Outlet Protection		
1968 C.Y. @ $100/C.Y.	=	196,800
		$632,325

Based on the above comparison, reinforced box culvert crossings were used throughout the project.

Project Cost Estimates

Preliminary cost estimates have been made for the entire project. A summary of the breakdown of typical street costs are shown below:

TYPICAL STREET COSTS

PER LINEAR FOOT OF ROADWAY

1.	Pavement	(33.5Ft. x 2)÷ 9 @ $17.00/S.Y.	=	$127.50
2.	Curb & Gutter	2 L.F. @ $ 8.00/L.F.	=	16.00
3.	Sidewalk	5 S.F. x 2 @ $ 1.50/S.F.	=	15.00
4.	Median Curb	2 L.F. @ $ 8.00/L.F.	=	16.00
5.	Median Grading	(24÷9) S.Y. @ $ 3.00/S.Y.	=	8.00
				$182.50
		USE:		$185.00/L.F.

STORM DRAINS PER HALF MILE

Catch Basins	8 @ $2,500.00	=	$20,000
Pipe	125 L.F. x 4 @ $ 50.00	=	25,000
Headwalls	4 @ $1,000.00	=	4,000
Outlet Structures	4 @ $2,000.00	=	8,000
			$62,000

$62,000 ÷ 2,640 L.F. = $23.50/L.F.

USE: $25.00/L.F.

Similar type analyses have been done for culverts, gabion drop structures and gabion channel lining costs.

Cost estimates have been prepared by reach as summarized on the following table. Utility relocation costs are estimated for water and sewer crossings as previously discussed. However, no estimate is made for other utility conflicts such as power, telephone, cable television, etc.

SUMMARY

RIGHT-OF-WAY & CONSTRUCTION COST ESTIMATE
GREENWAY ROAD ALIGNMENT STUDY

	CONSTRUCTION COST		RIGHT-OF-WAY COST		
	STREET	CHANNEL	STREET	CHANNEL	TOTAL
REACH 1 32nd St. to 28th St.	$ 600,000	$ -	$ 200,000	$ -	$ 800,000
REACH 2 28th St. to Cave Creek	1,100,000	-	700,000	-	1,800,000
REACH 3 Cave Creek to 20th St.	700,000	900,000	800,000	-	2,400,000
REACH 4 20th St. to 16th St.	900,000	900,000	300,000	200,000	2,300,000
REACH 5 16th St. to 12th St.	700,000	700,000	300,000	500,000	2,200,000
REACH 6 12th St. to 7th St.	1,200,000	1,700,000	300,000	700,000	3,900,000
REACH 7 7th St. to Central Ave.	900,000	1,300,000	300,000	800,000	3,300,000
REACH 8 Central Ave. to 7th Ave.	700,000	900,000	300,000	200,000	2,100,000
REACHES 9 - 10 7th Ave. to 19th Ave.	2,600,000	-	700,000	-	3,300,000
SUBTOTAL	$9,400,000	$6,400,000	$3,900,000	$2,400,000	
TOTAL					$22,100,000

D. CONCLUSION

The depicted location for a future 6-lane arterial street adjacent to a major drainageway is feasible as discussed herein. The construction of specific reaches of the channel should be established to full designated capacity at such time as it is initiated, while the roadway can be constructed to incremental capacities as traffic demand and funds are developed. Some interim improvements are of a temporary nature such as meeting existing arterial roadways and establishment of an interim drainline between 7th Street and 16th Street.

The southern location for the roadway crossing of Cave Creek Wash disrupts less improved property while the construction cost of either alignment is approximately equal; therefore the southern crossing location is proposed.

APPENDIX

APPENDIX I

CONSTRUCTION DRAWINGS -FUTURE PLAN AND PROFILE

(27 SHEETS-SEPARATE)

APPENDIX II

CONSTRUCTION DRAWINGS -INTERIM PLAN AND PROFILE

(26 SHEETS-SEPARATE)

APPENDIX III

RIGHT OF WAY MAP

(ROLLS 1-4 SEPARATE)

APPENDIX IV

SOIL LOGS

(SEPARATE)

Geotechnical Report
Preliminary Evaluation
Greenway Road Alignment at Cave Creek Wash
Western Technologies, Inc.
April 30, 1982

APPENDIX V

CHANNEL HYDRAULICS

(COMPUTER OUTPUT-6 SHEETS)

CHANNEL HYDRAULICS SUMMARY*

STATION FROM	TO	DISCHARGE (CFS)	DEPTH (FT)	AVERAGE VELOCITY (FPS)
UNLINED CHANNEL				
98+50	109+00	8400	7.2 - 6.7	5.0
109+00	120+00	8400	7.3	4.9
120+00	129+45	8400	7.5 - 6.7	5.0
129+45	132+50	7500	6.6 - 7.4	4.9
132+50	143+00	7500	6.7 - 6.5	5.4
143+00	156+50	7500	7.6 - 6.3	5.2
LINED CHANNEL				
156+50	168+50	3100	8.6 - 9.6	9.1
168+50	185+50	3100	9.5 - 9.1	8.6
185+50	207+50	3000	9.4 - 9.0	8.4
207+50	215+15	3000	9.6 - 9.4	8.2
215+15	228+50	2500	10.1 - 9.9	7.0
228+50	240+50	1500	7.7 - 8.2	6.1

*Summary of computer HEC2 analysis performed August 5 & 13, 1982.

MANNINGS
OPEN CHANNEL FLOW

Beginning at 24th Street

CHANNEL DESIGN:

Q = 1000.0 C.F.S.
S = 0.0030 FT./FT.
N = 0.035

CHECK 15 FOOT WIDE CHANNEL WITH 2.0:1 AND 2.0:1 SIDES.

CROSS SECTIONAL AREA = 170.68 SQ. FT.
WETTED PERIMETER = 42.82 FEET
WATER SURFACE WIDTH = 39.88 FEET

$R = A/WP$ = 3.99 FT.

$V = (1.49/N)(R^{2/3})(S^{1/2})$ = 5.86 F.P.S.

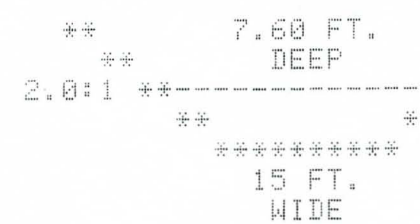
$A = Q/V$ = 170.59 SQ. FT.

24th Street to 22nd Street

CHANNEL DESIGN:

Q = 1500.0 C.F.S.
S = 0.0030 FT./FT.
N = 0.035

CHECK 15 FOOT WIDE CHANNEL WITH 2.0:1 AND 2.0:1 SIDES.



CROSS SECTIONAL AREA = 229.52 SQ. FT.
WETTED PERIMETER = 48.99 FEET
WATER SURFACE WIDTH = 45.40 FEET

$R = A/WP$ = 4.69 FT.

$V = (1.49/N)(R^{2/3})(S^{1/2})$ = 6.53 F.P.S.

$A = Q/V$ = 229.75 SQ. FT.

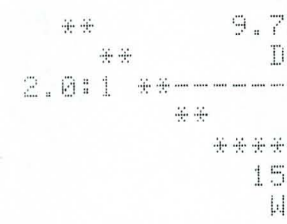
MANNINGS
OPEN CHANNEL FLOW

22nd Street to 20th Street

CHANNEL DESIGN:

Q = 2500.0 C.F.S.
S = 0.0030 FT./FT.
N = 0.035

CHECK 15 FOOT WIDE CHANNEL WITH 2.0:1 AND 2.0:1 SIDES.



CROSS SECTIONAL AREA = 334.76 SQ. FT.
WETTED PERIMETER = 58.47 FEET
WATER SURFACE WIDTH = 53.88 FEET

$R = A/WP$ = 5.73 FT.

$V = (1.49/N)(R^{2/3})(S^{1/2})$ = 7.46 F.P.S.

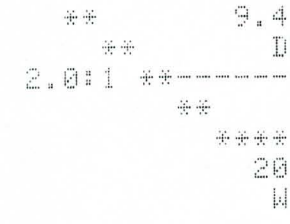
$A = Q/V$ = 335.01 SQ. FT.

20th Street to 16th Street

CHANNEL DESIGN:

Q = 3000.0 C.F.S.
S = 0.0035 FT./FT.
N = 0.035

CHECK 20 FOOT WIDE CHANNEL WITH 2.0:1 AND 2.0:1 SIDES.



CROSS SECTIONAL AREA = 365.30 SQ. FT.
WETTED PERIMETER = 62.08 FEET
WATER SURFACE WIDTH = 57.64 FEET

$R = A/WP$ = 5.88 FT.

$V = (1.49/N)(R^{2/3})(S^{1/2})$ = 8.21 F.P.S.

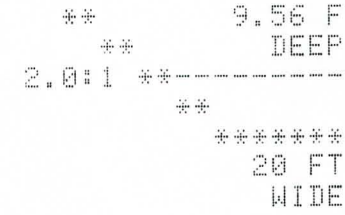
$A = Q/V$ = 365.47 SQ. FT.

MANNINGS
OPEN CHANNEL FLOW
16th Street to 13th Place

CHANNEL DESIGN:

Q = 3100.0 C.F.S.
S = 0.0035 FT./FT.
N = 0.035

CHECK 20 FOOT WIDE CHANNEL WITH 2.0:1 AND 2.0:1 SIDES.



CROSS SECTIONAL AREA = 379.99 SQ. FT.
WETTED PERIMETER = 62.75 FEET
WATER SURFACE WIDTH = 58.24 FEET

$R = A/WP$
$= 5.96$ FT.

$V = (1.49/N)(R^{2/3})(S^{1/2})$
$= 8.28$ F.P.S.

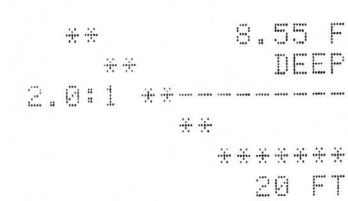
$A = Q/V$
$= 374.45$ SQ. FT.

13th Place to 12th Street

CHANNEL DESIGN:

Q = 3100.0 C.F.S.
S = 0.0055 FT./FT.
N = 0.035

CHECK 20 FOOT WIDE CHANNEL WITH 2.0:1 AND 2.0:1 SIDES.



CROSS SECTIONAL AREA = 317.21 SQ. FT.
WETTED PERIMETER = 58.24 FEET
WATER SURFACE WIDTH = 54.20 FEET

$R = A/WP$
$= 5.45$ FT.

$V = (1.49/N)(R^{2/3})(S^{1/2})$
$= 9.77$ F.P.S.

$A = Q/V$
$= 317.18$ SQ. FT.

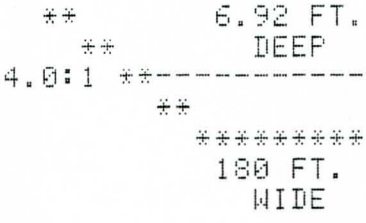
MANNINGS
OPEN CHANNEL FLOW

12th Street to 7th Street

CHANNEL DESIGN:
==========

Q = 7500.0 C.F.S.
S = 0.0010 FT./FT.
N = 0.030

CHECK 180 FOOT WIDE CHANNEL WITH 4.0:1 AND 4.0:1 SIDES.



CROSS SECTIONAL AREA =1437.15 SQ. FT.
WETTED PERIMETER = 237.06 FEET
WATER SURFACE WIDTH = 235.36 FEET

$R = A/WP = 6.06$ FT.

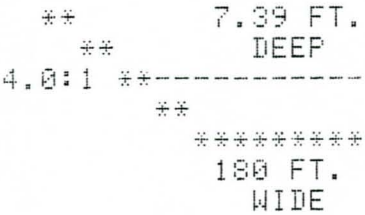
$V = (1.49/N)(R^{2/3})(S^{1/2}) = 5.22$ F.P.S.

$A = Q/V = 1436.28$ SQ. FT.

CHANNEL DESIGN:
==========

Q = 8400.0 C.F.S.
S = 0.0010 FT./FT.
N = 0.030

CHECK 180 FOOT WIDE CHANNEL WITH 4.0:1 AND 4.0:1 SIDES.



CROSS SECTIONAL AREA =1548.65 SQ. FT.
WETTED PERIMETER = 240.94 FEET
WATER SURFACE WIDTH = 239.12 FEET

$R = A/WP = 6.43$ FT.

$V = (1.49/N)(R^{2/3})(S^{1/2}) = 5.43$ F.P.S.

$A = Q/V = 1547.10$ SQ. FT.

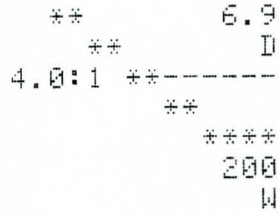
MANNINGS
OPEN CHANNEL FLOW

7th Street to Central Avenue

CHANNEL DESIGN:
==========

Q = 8400.0 C.F.S.
S = 0.0010 FT./FT.
N = 0.030

CHECK 200 FOOT WIDE CHANNEL WITH 4.0:1 AND 4.0:1 SIDES.



CROSS SECTIONAL AREA =1589.86 SQ. FT.
WETTED PERIMETER = 257.53 FEET
WATER SURFACE WIDTH = 255.81 FEET

R = A/WP = 6.17 FT.

$V = (1.49/N)(R^{2/3})(S^{1/2})$ = 5.29 F.P.S.

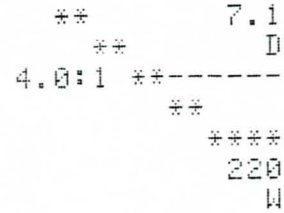
A = Q/V =1589.24 SQ. FT.

Central Avenue to 2nd Avenue

CHANNEL DESIGN:
==========

Q = 9500.0 C.F.S.
S = 0.0010 FT./FT.
N = 0.030

CHECK 220 FOOT WIDE CHANNEL WITH 4.0:1 AND 4.0:1 SIDES.



CROSS SECTIONAL AREA =1765.85 SQ. FT.
WETTED PERIMETER = 278.61 FEET
WATER SURFACE WIDTH = 276.86 FEET

R = A/WP = 6.34 FT.

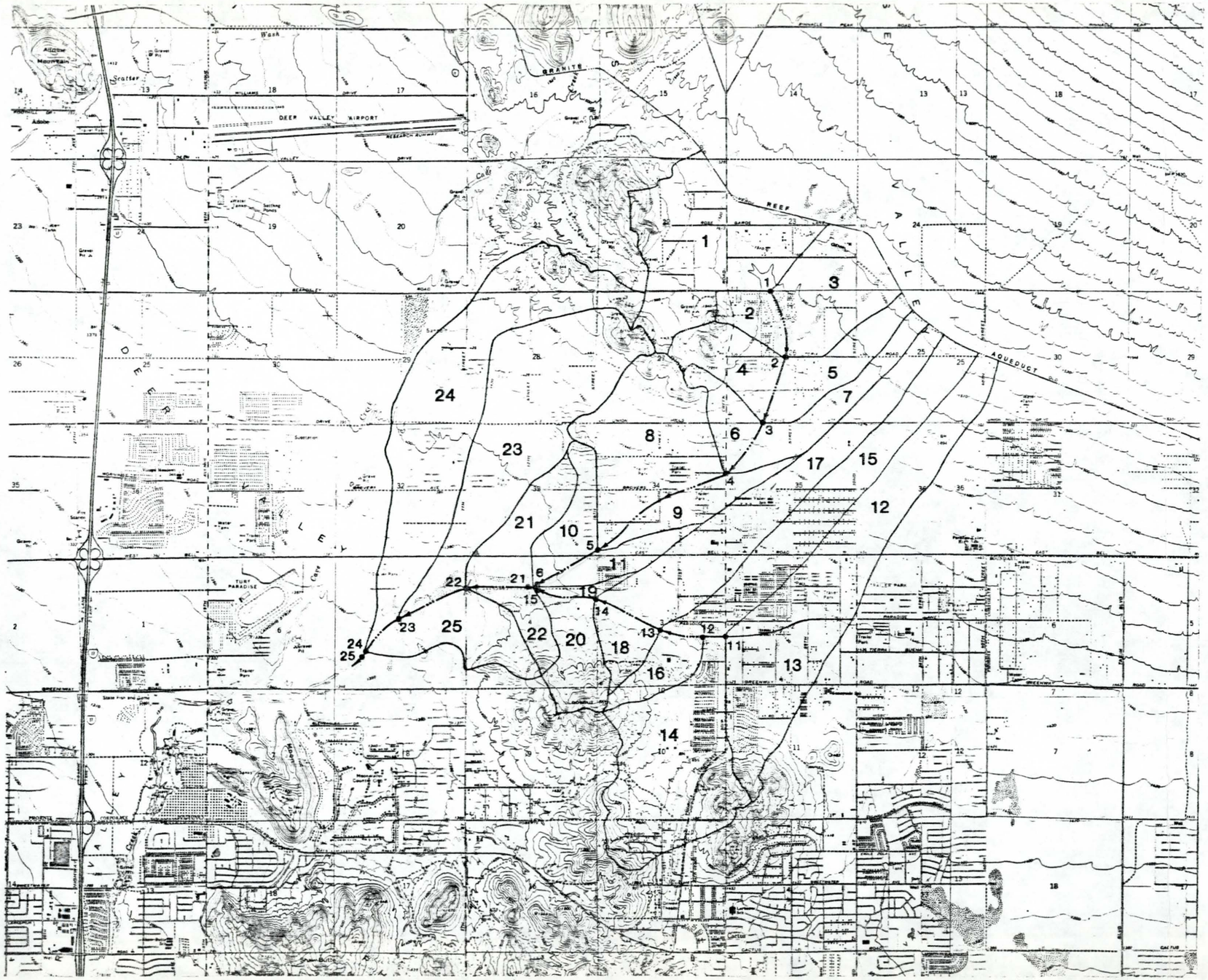
$V = (1.49/N)(R^{2/3})(S^{1/2})$ = 5.38 F.P.S.

A = Q/V =1766.14 SQ. FT.

APPENDIX VI

PEAK FLOW OUTPUT SUMMARY

(2 SHEETS)



ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ———

Medium-duty ——— Unimproved dirt - - - - -

Interstate Route State Route

LEGEND

00 - DRAINAGE AREA NUMBER (COMPUTER STRUCTURE NO.)

00 - COMPUTER CROSS SECTION NO.

- PROPOSED CHANNEL

N

CONTOUR INTERVAL 20 FEET

DOTTED LINES REPRESENT 10-FOOT CONTOURS

NATIONAL GEODETIC VERTICAL DATUM OF 1929

DRAINAGE SCHEMATIC

(ANALYSIS REFLECTS PRORATED FLOW CONDITIONS TO SIMILATE PEAKS PRESENTED IN 1980 FEMA STUDY BY CELLA BARR ASSOC.)

GREENWAY ROAD LOCATION STUDY

PROJECT NO. P-82035.00

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

MAY 1982

APPENDIX VI

(1 OF 2)

SUMMARY TABLE 2 DATA PUNCHED IN SAME FORMAT FOR INSERTION INTO SCS ECONOMICS PROGRAM VERSION 2

DISCHARGE,CFS.

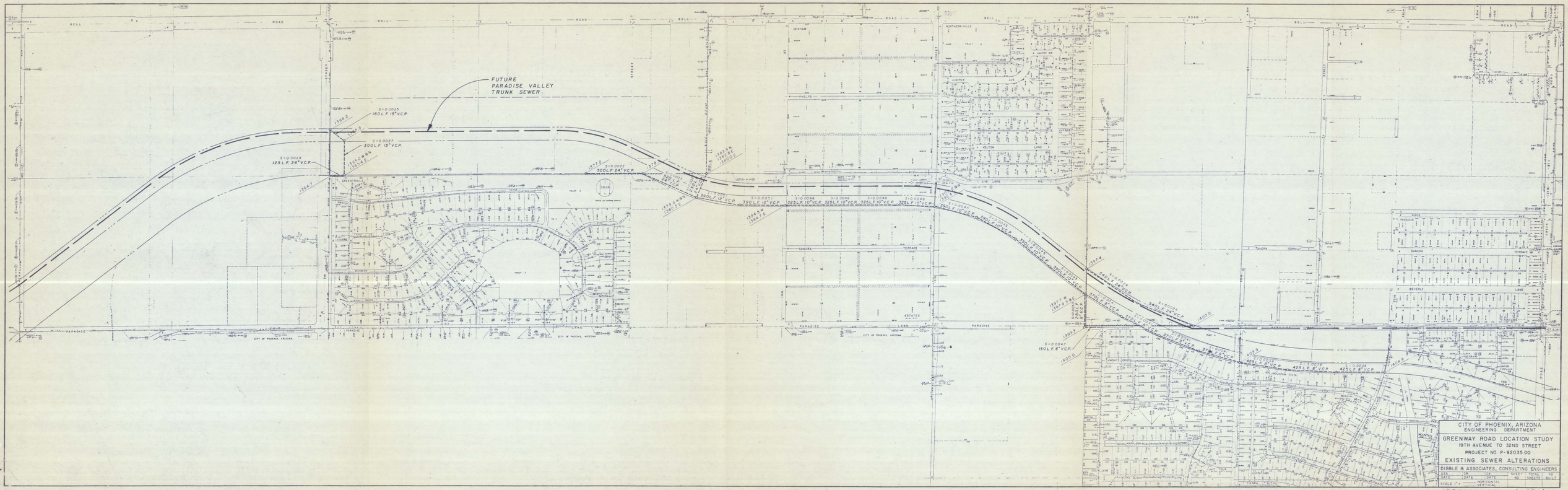
CONTROL WORD	XSEC NAME	1 OR 6	2 OR 7	3 OR 8	4 OR 9	5 OR 10		
ALTERNATE NO. 1								
FLOW-FREQ	-25	571.21	477.20	0.00	0.00	0.00ALT	1	1
FLOW-FREQ	-24	1202.81	913.40	0.00	0.00	0.00ALT	1	2
FLOW-FREQ	-23	1296.99	1001.62	0.00	0.00	0.00ALT	1	3
FLOW-FREQ	-22	265.25	269.86	0.00	0.00	0.00ALT	1	4
FLOW-FREQ	-21	447.62	374.52	0.00	0.00	0.00ALT	1	5
FLOW-FREQ	-20	515.77	517.63	0.00	0.00	0.00ALT	1	6
FLOW-FREQ	-19	65.79	62.00	0.00	0.00	0.00ALT	1	7
FLOW-FREQ	-18	303.88	312.20	0.00	0.00	0.00ALT	1	8
FLOW-FREQ	-17	658.07	509.20	0.00	0.00	0.00ALT	1	9
FLOW-FREQ	-16	335.10	336.31	0.00	0.00	0.00ALT	1	10
FLOW-FREQ	-15	573.87	444.00	0.00	0.00	0.00ALT	1	11
FLOW-FREQ	-14	1347.62	1067.92	0.00	0.00	0.00ALT	1	12
FLOW-FREQ	-13	784.66	653.55	0.00	0.00	0.00ALT	1	13
FLOW-FREQ	-12	667.11	502.52	0.00	0.00	0.00ALT	1	14
FLOW-FREQ	-11	316.60	256.78	0.00	0.00	0.00ALT	1	15
FLOW-FREQ	-10	331.48	279.28	0.00	0.00	0.00ALT	1	16
FLOW-FREQ	-9	260.69	203.30	0.00	0.00	0.00ALT	1	17
FLOW-FREQ	-8	1148.77	947.37	0.00	0.00	0.00ALT	1	18
FLOW-FREQ	-7	310.04	237.16	0.00	0.00	0.00ALT	1	19
FLOW-FREQ	-6	376.99	257.40	0.00	0.00	0.00ALT	1	20
FLOW-FREQ	-5	372.40	299.74	0.00	0.00	0.00ALT	1	21
FLOW-FREQ	-4	466.77	441.36	0.00	0.00	0.00ALT	1	22
FLOW-FREQ	-3	684.82	573.90	0.00	0.00	0.00ALT	1	23
FLOW-FREQ	-2	284.62	227.01	0.00	0.00	0.00ALT	1	24
FLOW-FREQ	-1	1595.63	1417.76	0.00	0.00	0.00ALT	1	25
FLOW-FREQ	1	1595.63	1417.76	0.00	0.00	0.00ALT	1	26
FLOW-FREQ	2	2462.75	2107.94	0.00	0.00	0.00ALT	1	27
FLOW-FREQ	3	3309.63	2672.25	0.00	0.00	0.00ALT	1	28
FLOW-FREQ	4	3862.51	3009.43	0.00	0.00	0.00ALT	1	29
FLOW-FREQ	5	4855.76	3906.38	0.00	0.00	0.00ALT	1	30
FLOW-FREQ	6	5307.38	4237.89	0.00	0.00	0.00ALT	1	31
FLOW-FREQ	11	1305.47	995.47	0.00	0.00	0.00ALT	1	32
FLOW-FREQ	12	2648.77	2052.21	0.00	0.00	0.00ALT	1	33
FLOW-FREQ	13	3255.71	2500.23	0.00	0.00	0.00ALT	1	34
FLOW-FREQ	14	3895.50	3021.00	0.00	0.00	0.00ALT	1	35
FLOW-FREQ	15	3998.35	3128.09	0.00	0.00	0.00ALT	1	36
FLOW-FREQ	21	9299.57	7348.17	0.00	0.00	0.00ALT	1	37
FLOW-FREQ	22	9573.27	7549.77	0.00	0.00	0.00ALT	1	38
FLOW-FREQ	23	10768.30	8441.49	0.00	0.00	0.00ALT	1	39
FLOW-FREQ	24	12167.80	9506.42	0.00	0.00	0.00ALT	1	40
FLOW-FREQ	25	12167.80	9506.42	0.00	0.00	0.00ALT	1	41

PEAK FLOW DATA

APPENDIX VII

EXISTING SEWER ALTERATIONS

(1 FOLDOUT)



CITY OF PHOENIX, ARIZONA
ENGINEERING DEPARTMENT

GREENWAY ROAD LOCATION STUDY
19TH AVENUE TO 32ND STREET
PROJECT NO. P-82035.00

EXISTING SEWER ALTERATIONS

DIBBLE & ASSOCIATES, CONSULTING ENGINEERS

DES.	DR.	CK.	SHEET	OF
DATE	DATE	DATE	NO.	SHEETS BUILT

SCALE 1" = HORIZONTAL
VERTICAL

APPENDIX VII (1 OF 1)