BENEFIT/COST ANALYSIS
PARADISE VALLEY-SCOTTSDALE-PHOENIX
DRAINAGE STUDY

prepared for the

Maricopa County Flood Control District

August 1981

THE NATELSON COMPANY, INC.

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BENEFIT/COST ANALYSIS

on the

Paradise Valley-Scottsdale-Phoenix

Drainage Study Project

prepared for the

Maricopa County Flood Control District

by

The Natelson Company, Inc., Phoenix, Arizona

with

Collar, Williams & White Engineering, Inc., Scottsdale, Arizona

August 28, 1981

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BENEFIT/COST ANALYSIS FOR THE PVSP PROJECT

INTRODUCTION

The flood control project which is the subject of this economic analysis consists of a number of combinations of detention basins, channels, culverts and other elements to provide flood protection for an area which includes portions of the Town of Paradise Valley, the City of Scottsdale, and the City of Phoenix. The project area extends from 56th Street to Pima Road, and from the Granite Reef Aqueduct to Indian Bend Wash. Hydrology and hydraulics studies for the project area and preliminary design of flood protection elements were carried out over the past several years, culminating in the PVSP Drainage Studies, Phase III, prepared for the above communities and the Flood Control District of Maricopa County by Collar, Williams & White Engineering, Inc. and Water Resources Associated, Inc., dated July 15, 1978.

For a number of reasons, the project area was divided into three units for purposes of the Phase III analysis, designated Projects A, B, and C. Project A, to the west, follows the main alignment of 56th Street. Project B, in the center area, follows the main alignment of 64th Street. Project C, to the east, follows the main alignment of Scottsdale Road. At other locations within the entire project area, flood protection systems were analyzed individually. The economic analysis contained herein presents costs and benefits for the same project areas outlined above.

In keeping with the previous work cited above, this economic analysis considers project design conditions as they existed at the

time of the original studies. The analysis thus seeks to document the economic justification of the project as it was originally designed based largely on conditions which existed through 1977.* Although it is recognized that some changes have occurred in the area which would have some effect on the flood control systems originally developed, these changes were not incorporated into the analysis presented herein.** Statutes requiring the elevations of structures above the 100 year flood plain are assumed for purposes of this analysis to have been in effect for all structures having a 1974 or later construction date; therefore, no damages were computed for such structures.

The economic benefits of a project are measured by the difference between damages from flooding which would occur without a project and damages which occur with a project, with respect to the same geographic area. The data and methodology utilized to determine the damages are set forth in the following section.

METHODOLOGY

Although some data on hydrology and hydraulics conditions within the study area were available from the previous reports cited above, additional hydrology and hydraulics studies were required in order to provide the following data:

- o two year, fifty year, and one hundred year peak discharges for both project and no project conditions at selected concentration points within the study area;

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* Collar, Williams and White did assume that for purposes of hydrology the entire developable portion of the study area was urbanized.

** With the exception of modifications to the design and location of the proposed Hearn Basin. Further explanation of The Hearn Basin component is provided in subsequent sections of this Report.

- the depth and aerial extent of flows for both project and no project peaks in all sub-areas.

The elevations of drainageways and the floor elevations of affected residences were obtained by on-sight field surveys. The hydrologic, hydraulic and survey data were all compiled on prints of aerial photographs having a scale of 1" equals 100 feet. These sheets then became the work sheets for calculating depths of flooding on a unit-by-unit basis.

The estimated construction cost of the projects was updated by applying appropriate cost indexes to original estimates prepared as part of the PVSP Drainage Study. For purposes of this report, hydrology, hydraulic, and other engineering data are not reported herein; although the relevant materials, either those prepared for this analysis or those prepared as part of the Drainage Study, are available as backup to this document.

In the course of reviewing the initial draft of this Report the question of the limits of flow for engineering purposes was addressed by the consulting engineer. More specific information on this topic is contained in Appendix B, "Determination of the Limits of Flow in the PVSP Cost Benefit Study".

Damages were calculated for residential, landscaping, roads and streets, and, for the few relevant cases, commercial and institutional structures. The relationship between depth of flooding and the amount and cost of damages incurred was investigated for certain of the residential areas included in the analysis. These data were of limited use, and depth-damage relationships established and commonly utilized by the

Arizona Department of Water Resources were applied to this analysis. The depth-damage functions reflect damage to both structures and contents, and were extrapolated for depths above three feet from the data provided. Damage factors by depth of flooding and type of structure are shown in Table 9, "Depth-Damage Relationship". Each residential unit was examined individually in terms of the depth of flooding experienced under each of the discharge rates for which data were prepared. The replacement value of each residence was calculated based on an update of the County Assessor's Improvement Full Cash Value. Damages to landscaping were estimated based on a percent of total residential value. Damages to swimming pools were added as a separate component where applicable. Total flood damage and cleanup costs for public streets were estimated for each event based on historic flood damage data. Additional detail on damage calculations is contained in Appendix A. For the few cases of commercial and public school damages, the same system used for residential areas was applied.

Business losses are incurred for a few small commercial operations along Scottsdale Road, including four office buildings, one retail business building, and one restaurant/bar.

When this report was prepared in its initial draft form, a review of original project conditions indicated that construction of a detention basin near the intersection of Hearn Road and 64th Street could worsen the flooding conditions in some reaches of 64th Street downstream of the planned Hearn Basin. The City of Phoenix subsequently modified the design and location of the Hearn Basin site to allow the basin to operate in a manner that would not increase the flooding potential downstream, but would, in fact, reduce the downstream flood hazard.*

This reduction in flood damage potential downstream of the Hearn Basin was not analyzed for purposes of this report. Instead, the flood damage downstream of the basin was analyzed as being equivalent to the "without project" condition even though it was known that the "with project" conditions would provide a definite reduction in the flood damage potential. This simplifying assumption was made in order to eliminate the need to re-evaluate the project economics in this particular area.

THE PVSP AREA

Most of the study area is characterized by single family homes of relatively high value on sizable lots. A total of 708 residential properties are potentially affected by flood control projects.** In a

*As per the 16 July 1981 letter from D.B. Burris, P.E., City of Phoenix Engineering Department to F. Barrios, State of Arizona Department of Water Resources.

**This is the number of units in the 100 year flood areas which are afforded some relief with a project. The number does not include units in the area subject to flooding for which protection is not provided by the proposed projects.

portion of Area "A" residential units are interspersed with the Orange Tree Country Club. In Area "B" flood waters affect one public school facility, one small private school, and one church. In Area "C" a few commercial structures are affected by flooding along Scottsdale Road near Shea Boulevard. Most of the main drainageways in the study area are also streets, and these are subject to damage and silt removal costs when floods occur.

Flooding severity varies across the study area, with the most severe flooding in Area "B". Areas "A" and "C" rank second and third, respectively, with regard to severity of flooding, number of units affected and net project benefits. See Tables 3 through 5 for a numerical description of this situation.

PROJECT COSTS

Project installation costs for Projects A, B, and C are summarized on Table 1. More detailed estimates of construction and land acquisition activities and costs are presented in Appendix C.

Estimated average annual operation, maintenance and repair costs are shown on Table 2. Projects A, B, & C each include a combination of channels and detention facilities. For the purpose of this estimate it is assumed that the maintenance provided will only be that necessary to maintain operational efficiency. It is very likely that after the facilities are constructed there may be some landscape features added for the purpose of esthetics. Any additional maintenance costs added due to these features are not considered herein.

Total length of channels considered is approximately 24,600 Lineal Feet. The estimates presented assume cleaning, debris removal, and shap-

ing on a schedule of four (4) times per year utilizing a 3-man crew with one (1) tractor with attachments and one (1) truck capable of production of ½ mile per day, i.e., 108 man days @ $84.00/day plus 36 equipment days @ $400.00/day, or an annual cost of $23,472.00, or $0.95 per Lineal Foot per year.

Total area of detention facilities considered is approximately 80.5 acres. Estimates assume the same schedule as used for channels, with the same crew, capable of production of 5 acres per day, i.e., 192 man days @ $84.00/day plus 64 equipment days @ $400.00/day, or an annual cost of $41,278.00 or $518.00 per acre per year.

The estimated costs were allocated to each of the projects according to detention basin area and extent of channels.

TABLE 1

PROJECT INSTALLATION COSTS

Area	Construction	Contingencies at 15%	Land Rights	Engineering	Total Installation Costs
A*	$1,394,423**	$228,726	$130,416	$140,285	$1,893,850
B*	2,096,901	314,535	-0-	192,914	2,604,350
C	2,732,971	479,935	466,593	294,360	3,973,859
				All Projects	$8,472,059

* For purposes of this analysis, costs associated with the 60th Place project are included in Project A figures, and costs for 66th Street project are included in Project B.

** For Project A with Alternates, construction cost would be $1,331,509, and contingencies and engineering costs would be somewhat lower than those tabulated.

TABLE 2

AVERAGE ANNUAL OPERATION, MAINTENANCE AND REPAIR COSTS

	Channel	Detention	Total
Project A	$ 3,800	$10,412	$14,212
Project B	4,389	11,603	15,992
Project C	15,219	19,684	34,903
		All Projects	$65,107

ECONOMIC EVALUATION

Tables 3, 4 and 5 following show the tabulations of without project damages, damages with a project, and damages prevented, respectively, by types of damages for the flood events being analyzed. Table 5, derived by the subtraction of the values of Table 4 from the values of Table 3, represents the total benefits from flood control projects in each of the three Project areas. Average annual dollar benefits for each of the three project areas and the project as a whole are shown on Table 6. The average annual benefits are computed based on a 3% amortization rate and an effective project life of 50 years.

ECONOMIC JUSTIFICATION

Annual costs for each of the projects were developed for comparison with the average annual benefits described in the Economic Evaluation section of this report. The total average annual cost of the projects consists of the sum of average annual installation cost, extrapolated from the total installation cost, and the average annual operation, maintenance and repair costs associated with each project. Total average annual installation costs and average annual operation maintenance and repair costs for each of the projects are shown on Table 7. The extrapolated annual installation cost values were obtained by applying the amortization rate of 3% (based on an effective project life of 50 years) to the total installation cost for each project. The benefit/cost ratio derived from the comparison of annual costs with annual benefits is shown on Table 8.

TABLE 3

DAMAGES WITHOUT A PROJECT

Types of Damages	Frequency of Flooding, Once In: 2 years	50 years	100 years
Area A			
Land Use	$ 802,043	$1,807,754	$2,366,021
Public	28,649	64,573	84,514
Total	830,692	1,872,327	2,450,535 (266)*
Area B			
Land Use	2,731,563	6,772,541	7,722,275
Public	97,572	241,915	275,840
Total	2,829,135	7,014,456	7,998,115 (355)
Area C			
Land Use	1,193,036	1,926,946	2,131,306
Public	42,615	68,831	76,130
Business Losses	12,647	17,643	20,139
Total	$1,248,298	$2,013,420	$2,227,575 (87)
Grand Total	$4,908,125	$10,900,203	$12,676,225

* Values in parentheses indicate number of parcels potentially affected by the project.

TABLE 4

DAMAGES WITH A PROJECT

Types of Damages	Frequency of Flooding, Once In: 2 years	50 years	100 years
Area A			
Land Use	$ 90,831	249,283	574,720
Public	3,244	8,904	20,529
Total	$ 94,075	258,187	595,249
Area B			
Land Use	1,053,407	2,859,576	3,185,418
Public	37,628	102,144	113,783
Total	1,091,035	2,961,720	3,299,201
Area C			
Land Use	261,076	458,719	510,345
Public	9,326	16,385	18,230
Business Losses	-0-	-0-	-0-
Total	$ 270,402	475,104	528,575
Grand Total	$1,455,512	$3,695,011	$4,423,025

TABLE 5

DAMAGES PREVENTED

Types of Damages	Frequency of Flooding, Once In: 2 years	50 years	100 years
Area A			
Land Use	$ 711,212	$1,558,471	$1,791,301
Public	25,405	55,669	63,985
Total	736,617	1,614,140	1,855,286
Area B			
Land Use	$1,678,155	3,912,966	4,536,857
Public	59,944	139,771	162,057
Total	1,738,099	4,052,737	4,698,914
Area C			
Land Use	931,960	1,468,226	1,620,960
Public	33,289	52,446	57,900
Business Losses	12,647	17,643	20,139
Total	977,896	1,538,315	1,698,999
Grand Total	$3,452,612	$7,205,192	$8,253,199

TABLE 6

AVERAGE ANNUAL DOLLAR BENEFITS

Area	Annualized Benefits *
Area A	$ 600,082
Area B	1,480,548
Area C	637,067
Total	$2,717,697

* Annualized benefits assume zero net benefits for events of less than 2 year frequency.

TABLE 7

AVERAGE ANNUAL COSTS

Area	Total Installation Costs		3% Amortization Rate Factor		Average Annual Installation Costs		Average Annual O & M Costs		Total Average Annual Costs
A	$1,893,850	x	.0389	=	$73,671	+	$ 14,212	=	$ 87,883
B	2,604,350	x	.0389	=	101,309	+	15,592	=	116,901
C	3,973,859	x	.0389	=	154,583	+	34,903	=	189,486
							ALL PROJECTS		$394,270

TABLE 8

PROJECT JUSTIFICATION - 50 YEAR PROJECT LIFE
AVERAGE ANNUAL COSTS AND BENEFITS

Area/Project	Benefits (Table 6)		Total Project Costs (Table 7)		Benefit / Cost Ratio
A	$ 600,082	÷	$ 87,883	=	6.828
B	1,480,548	÷	116,901	=	12.665
C	637,067	÷	189,486	=	3.362
All Projects	$2,717,697	÷	$ 394,270	=	6.893

TABLE 9

DEPTH-DAMAGE RELATIONSHIP

Depth	Structure/ Content Damage Factor	Landscaping Damage Factor*	Pool Damage Amount	Combined Land-Structure/Content Damage Factor**
-2.0	--	.010	--	.010
-1.5	--	.010	--	.010
-1.0	--	.010	--	.010
-0.5	.025	.020	$300	.045
0.0	.060	.020	300	.080
0.5	.110	.020	300	.130
1.0	.150	.020	300	.170
1.5	.210	.020	300	.230
2.0	.270	.020	300	.290
3.0	.370	.020	300	.390
4.0	.450	.020	300	.470
5.0	.540	.020	300	.560
6.0	.630	.020	300	.650
7.0	.730	.020	300	.750
8.0	.820	.020	300	.850
9.0	.920	.020	300	.940

*Homes built between and including the years 1974 to 1977 are assumed to comply with County floodproofing regulations and therefore incur only landscape damage.

**Homes built prior to 1974 are subject to structure/content damages as well as landscape damages.

APPENDIX A

Land Use Damages

The following text documents the assumptions employed in developing damage estimates for residential, commercial and institutional land use in the study area. The depth-damage function referred to is that which is presented on Table 9, "Depth-Damage Relationship".

(1) If the structure was built in 1978 or later, damages were not calculated as these improvements are assumed to be outside the scope of this analysis.

(2) If the structure was built in 1974 through 1977, then the following assumptions apply regarding structure/content damage.

(a) Structure/content damage equals zero as all improvements built in 1974 or later are assumed to comply with Maricopa County Flood Control District regulations. The regulations state that all structures will be built one foot above 100 year flood water surface elevation. See Table 9 for specific damage factors.

(b) Landscaping damage will occur if the water surface elevation is greater than the first floor elevation minus two feet, ie., LADGE = f (WSE> FFE-2'). Landscaping damages are calculated as a percent of the updated improvement full cash value. See Table 9.

(c) Pool damage will occur if the water surface elevation is greater than the first floor elevation minus .5 feet, i.e., PODGE = f (WSE > FFE - .5'). Damage is equal to $300.00 per occurrence.

(3) If the house was built earlier than 1974 the following assumptions apply regarding the three damage categories.

(a) Structure/content damages are calculated as per the depth-damage function of Table 9.

(b) Landscape damage is calculated as per rule 2(b) above.

(c) Pool damage is calculated as per rule 2(c) above.

Public Damages

This damage category consists of silt and debris removal from streets, flood caused damage to water and sewer systems, and other damage to public owned improvements. Estimates for the 2, 50, and 100 year flood events were prepared from historic damages experienced in 1976. The relative magnitudes of other flood damages were used to allocate total event damages to the sub-areas. These damages are displayed as a separate category on Tables 3 through 5.

Business Losses

The amount of business activity taking place in the PVSP study area is limited to the commercial development along Scottsdale Road at Shea Boulevard. As a result, business losses are minimal when compared to total damages. For purposes of this study, these losses were estimated using a simplified approach as outlined below:

- Amount of business activity affected was assumed to be based on an average annual business volume for all operations of $100

per square foot of net operating space per year, or $.274 per day*.

- The total net area of all affected commercial activity equals:

  (24,647 x .85) = 21,000 square feet for the 100 year event
  18,400 square feet for the 50 year event
  13,000 square feet for the 2 year event

  with corresponding losses of:

  $5,754 per day for the 100 year event
  5,041 per day for the 50 year event
  3,562 per day for the 2 year event

- If flooding (which ranges from about ½ foot to two feet in depth) from any event causes an average of 3.5 days of interrupted business, losses would equal the amount shown under the appropriate heading on Table 3.

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*A 365 day year was used since flooding may interrupt use on non-business days as well as business days.

APPENDIX B

DETERMINATION OF THE LIMITS OF FLOW

IN THE PVSP COST BENEFITS STUDY

The criteria for defining the limits of flow were developed in the Phase III portion of the PVSP study by the committee and the consultant. The definition of the limits of flow is that area capable of conveying flood water, as compared to the limits of flooding whose definition is that area which is subjected to flood water whether they are flowing or ponded.

The limits of flow were first confined to streets, alleys and designated floodways coming under the control of public domain. Areas of private domain were eliminated due to the inability to keep such water courses free from obstructions and closures.

After reviewing these limits, the committee and the consultant found that use of the entire right of way in streets and alleys was not practical because control necessary to keep the waterway free from obstruction was not available to the local government and the only positive control available was from back of curb to back of curb, or edge of pavement to edge of pavement. Fences, walls, landscaping, etc., are allowed within the right of way and are impediments to the flow of water which cannot reasonably be included in a flow calculation.

These parameters were used in determining the depth of flow for the PVSP Cost Benefit Study. The results of these calculations were then compared to calculations made at several different locations which allowed the flowage area to extend outwardly from the edge of pavement or the back of the curb, to the edge of the buildings on both sides of the roadway. Two

drawings are included that are representative of the comparisons and show the differences between the two methods of calculations.

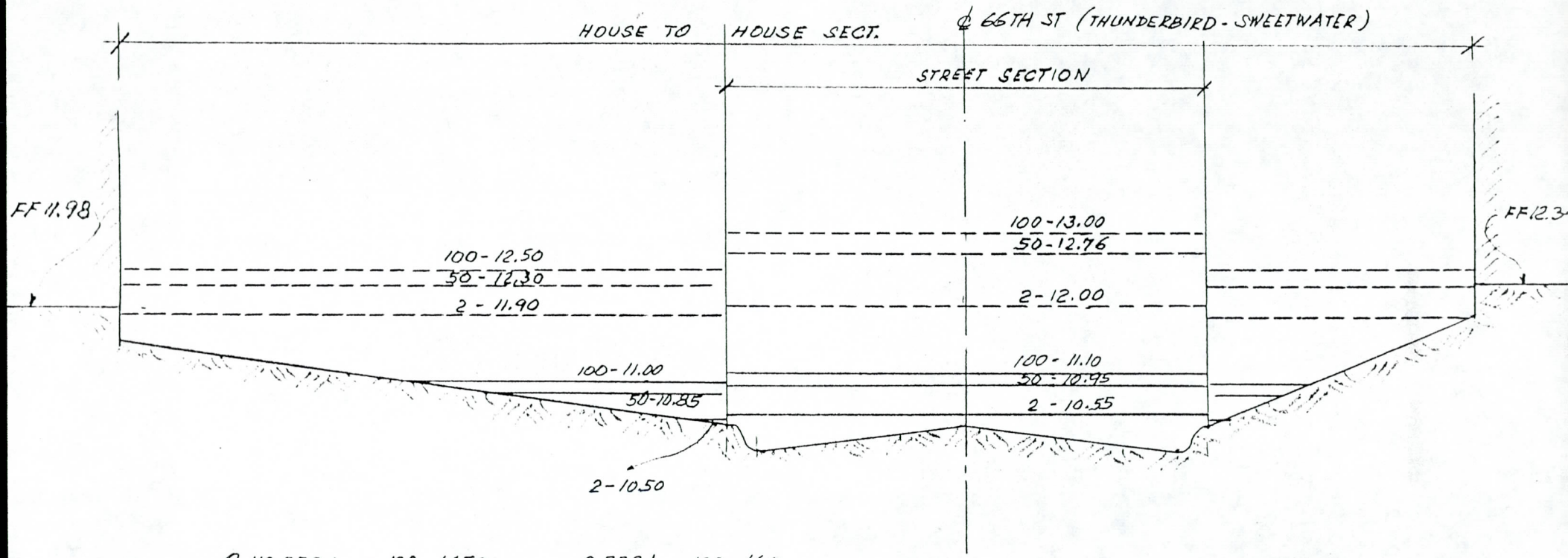
The drawing for 66th Street between Sweetwater and Cactus shows the upper limit of the differences for all of the comparisons. The drawing for 66th Street between Thunderbird and Sweetwater is representative of the average of the comparisons.

The use of the building to building approach will provide somewhat lower water surfaces for approximately half of the project, however, it will also give higher water surfaces if the ground slope is less than 17.5 feet per mile which is the case for the balance of the project. This methodology also assumes that the roughness coefficient will be equivalent to that of a well maintained fully-matured grass waterway and does not anticipate brush or shrub plantings, desert landscaping, hedges, fences or other impediments to the flow between the edge of pavement or curb and the building edge. Any of these imponderables will raise the water surface and in effect confine the flow to the limits of the actual roadway.

Returning to the drawing for the section between Thunderbird and Sweetwater, we find that for "no project conditions" the two approaches produce a difference of one-half foot in the 100-year event. If we add a fence or hedge, this reduces to a difference that is dependent upon the size of the fence or hedge, which is unknown.

Bearing these thoughts in mind, we find the only reasonable practical solution to defining the limits of flow is to describe the water course as being between the back of curb to back of curb or the edge of pavement to edge of pavement.

In the consultants opinion confinement of the flow to the computational limits described does not significantly affect the computed water surface.



Q NO PROJ. - 100 - 1450
50 - 1260
2 - 870

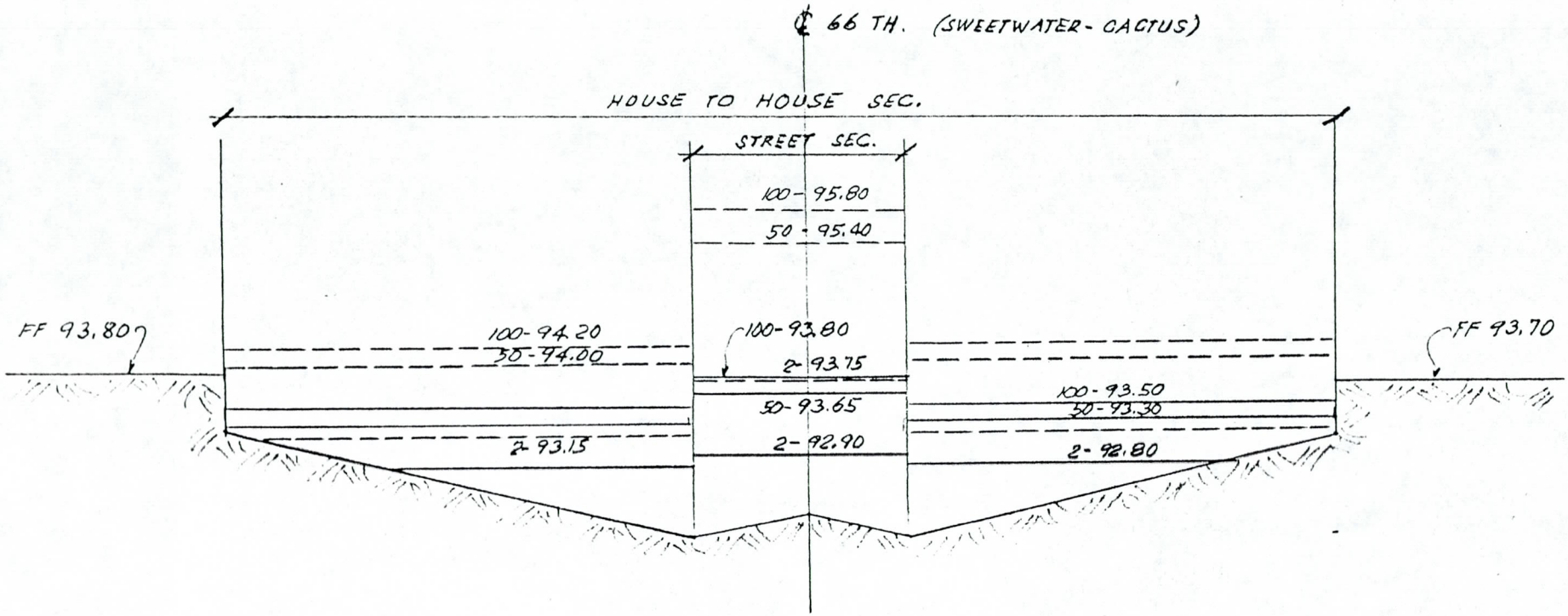
Q PROJ - 100 - 160
50 - 140
2 - 40

STREET SEC. ($n = 0.015$) - NO PROJ. WS EL - 100 - 13.00, 50 - 12.76, 2 - 12.00

PROJ. WS EL - 100 - 11.10, 50 - 10.95, 2 - 10.55

HOUSE TO HOUSE ($n = 0.025$) - NO PROJ WS EL - 100 - 12.50, 50 - 12.30, 2 - 11.90

PROJ WS EL - 100 - 11.00, 50 - 10.85, 2 - 10.50



Q NO PROJ. - 100 - 1500
50 - 1300
2 - 385

Q PROJ - 100 - 445
50 - 385
2 - 115

STREET SECT ($n = 0.015$) - NO PROJ. WS EL - 100 - 95.80, 50 - 95.40, 2 - 93.75
PROJ. WS EL - 100 - 93.80, 50 - 93.65, 2 - 92.90

HOUSE TO HOUSE ($n = 0.025$) - NO PROJ W.S. EL - 100 - 94.20, 50 - 94.00, 2 - 93.15
PROJ. W.S. EL - 100 - 93.50, 50 - 93.30, 2 - 92.80

APPENDIX C

ESTIMATED COSTS

PHASE III

PVSP

The following cost estimates are based on current November 1980 cost data. The original estimates were based on July 1978 data. They include cost of structures, rights of way (where applicable), and all utilities.

Details may be found on the following data sheets. Summary by Project areas is as follows:

	Grand Totals
Project A	$ 1,681,214.00
Project B	2,035,526.00
Project C	3,679,499.00
60th Place	43,010.00
66th Street	375,910.00
TOTAL	$ 7,815,159.00

PVSP PHASE III ESTIMATED COSTS

PROJECT "A"

PLATE 1:

Retention Excavation -

85,579 C.Y. @ $1.50/C.Y. (Cost of clearing, excavation & haul-off only)	$ 128,369.00

PLATE 2:

42 Inch dia. conc. pipe complete in place -

2600 L.F. @ $63.00/L.F.	163,800.00
Headwalls - 2 Ea. @ $3,000.00/Ea.	6,000.00
Transition Channel Ex. 220 C.Y. @ $1.50/C.Y.	330.00
Total Plate 2	$ 170,130.00

(Assume all necessary easements are provided in the Desert Springs Development)

PLATE 3:

Assume that Thunderbird Road will be designed and constructed to provide for storm water overflow to 58th Street.

Cost Assigned to PVSP	0.00

PLATE 4:

Retention Excavation -

64,533 C.Y. @ $1.50/C.Y.	$ 96,800.00
(42" Pipe Outlet) 48 L.F. @ $63.00/L.F.	3,024.00
(Rip-Rap Outlet Channel to the Street) $\frac{20 \times 100 \times 1}{27}$ X $70.00/C.Y.	5,185.00
Total Plate 4	$ 105,009.00

PLATE 5:

Existing Street section adequate

Cost Assigned to PVSP	0.00

Revised 11/80

PVSP PHASE III
PROJECT "A"

PLATE 6:

Remove existing pavement -	16,911 S.Y. @ $2.50/S.Y.	$ 42,278.00
Remove existing C.&G. -	2,500 L.F. @ $2.00/L.F.	3,750.00
Remove existing S.E. -	10,000 S.F. @ $0.75/S.F.	7,500.00
Adjust existing S.S. M.H. -	15 Ea. @ $350.00/Ea.	5,250.00
Reset existing F.H. -	9 Ea. @ $400.00/Ea.	3,600.00
Reset existing water meters -	Lump Sum	1,500.00
Relocate A.P.S. facilities - (Street lights, overhead power - cost may be assumed by Utility Co.)	Lump Sum	15,000.00
Relocate Mountain Bell facilities - (Adjust manholes - cost may be assumed by Utility Co.)	Lump Sum	5,000.00
Right-of-Way acquisition (West side)	2940 X 25 = 1.69 Ac. @ $28,600.00/Ac.	48,334.00
Roadway subgrade preparation	21,985 C.Y. @ $1.50/C.Y.	32,978.00
Construct new pavement (Assume 2"/9")	45,344 S.Y. @ $7.00/S.Y.	317,408.00
Construct new Curb & Gutter (Assume 7")	10,600 L.F. @ $5.50/L.F.	58,300.00
Construct new Sidewalk	42,400 S.F. @ $1.10/S.F.	46,640.00
Reconstruction of driveways & side Street intersections	Lump Sum	9,000.00
	Total Plate 6	$ 596,538.00

PVSP PHASE III
PROJECT "A"

PLATE 7:

Remove existing pavement	7,711 S.Y. @ $2.50/S.Y.	$ 19,278.00
Remove existing C. & G.	660 L.F. @ $2.00/L.F.	1,320.00
Remove existing S.W.	2,640 S.F. @ $0.75/S.F.	1,980.00
Adjust existing S.S. M.H.	6 Ea. @ $350.00/Ea.	2,100.00
Reset existing F.H.	2 Ea. @ $400.00/Ea.	800.00
Reset existing water meters	Lump Sum	1,500.00
Relocate A.P.S. facilities (Cost may be assumed by Utility Co.)	Lump Sum	10,000.00
Relocate Mountain Bell facilities (Cost may be assumed by Utility Co.)	Lump Sum	4,000.00
Right-of-Way acquisition	5,000 X 25 = 2.87 Ac. @ $28,600/Ac.	82,082.00
Roadway subgrade preparation	17,422 C.Y. @ $1.50/C.Y.	26,133.00
Construct new pavement (Assume 2"/9")	36,000 S.Y. @ $7.00/S.Y.	252,000.00
Construct new Curb & Gutter (Assume 7")	8,000 L.F. @ $5.50/L.F.	44,000.00
Construct new sidewalk	32,000 S.F. @ $1.10/S.F.	35,200.00
Reconstruction of driveways & side Street intersections	Lump Sum	7,000.00
	Total Plate 7	$ 487,393.00

(Note: In the reconstruction of Shea Boulevard, a dip section will be required at the 56th Street crossing.)

PVSP PHASE III
PROJECT "A"

PLATE 8: (An alternate design for the reach from Shea Blvd. to Indian Bend Wash)

Remove existing pavement (from Plate 7)		$ 19,278.00
Remove existing C. & G. (from Plate 7)		1,320.00
Remove existing S.W. (from Plate 7)		1,980.00
Rebuild existing S.S. M.H. -	4 Ea. @ $1,000.00/Ea.	4,000.00
Reset existing F.H. (from Plate 7)		800.00
Reset existing water meteres (from Plate 7)		1,500.00
Relocate A.P.S. facilities (from Plate 7)		10,000.00
Relocate Mountain Bell facilities (from Plate 7)		4,000.00
Right-of-Way acquisition (from Plate 7)		82,082.00
Roadway subgrade preparation -	7,111 C.Y. @ $1.50/C.Y.	10,666.00
Channel excavation	12,148 C.Y. @ $1.50/C.Y.	18,222.00
Construct concrete culverts @ Shea Blvd., Mountain View Road & 1320 Feet South of Shea Blvd.		
(Assume 3 Single Box 10' X 4')	130 C.Y. Concrete @ $250.00/C.Y.	32,500.00
	Guard Rail etc. - Lump Sum	8,000.00
Construct new pavement (Assume 2"/9")	21,333 S.Y. @ $7.00/S.Y.	149,331.00
Construct New C. & G. (from Plate 7)		44,000.00
Construct new Single Curb	8,000 L.F. @ $5.00/L.F.	40,000.00
Construct new sidewalk (from Plate 7)		35,200.00
Reconstruction of driveways & side Street intersections	Lump Sum	7,000.00
	Total Plate 8	$ 461,879.00

(Note: This alternate will require an adjustment of the design of the profile of Shea Blvd.)

PVSP PHASE III
PROJECT "A"

Estimated Cost Project "A"	$ 1,487,439.00
Contingencies @ 15%	223,116.00
ESTIMATED GRAND TOTAL COST	$ 1,710,555.00

Estimated Cost Project "A" with Alternate	$ 1,461,925.00
Contingencies @ 15%	219,289.00
ESTIMATED GRAND TOTAL COST WITH ALTERNATE	$ 1,681,214.00

PVSP PHASE III COST ESTIMATE

PROJECT "B"

PLATE 1:

Excavation of detention basin No. 1

104,085 C.Y. @ $1.50/C.Y. $ 156,128.00 *

(Cost of clearing, excavation & haul-off only)

PLATE 2:

36 Inch dia. conc. pipe complete in place

800 L.F. @ $54.00/L.F.	43,200.00
Headwalls-2 Ea. @ $3,000/Ea.	6,000.00
Transition Channel Ex. 220 C.Y. @ $1.50/C.Y.	330.00
Total Plate 2	$ 49,530.00

(Assume all necessary easements are provided in the Desert Springs Development)

PLATE 3:

Existing Street Section adequate — Cost assigned to PVSP — 0.00

PLATE 4 & 5:

Channel - (Box in 64th Street from Thunderbird Rd. to Cactus Rd.)

Sawcut and remove existing pavement 54,000 S.F. @ $0.40/S.F.	$ 21,600.00
Construct concrete box including grates 4,400 C.Y. @ $250.00/C.Y.	1,100,000.00
Structural excavation 9,000 C.Y. @ $7.00/C.Y.	63,000.00
Lower existing water mains (11 crossing) 20 L.F. @ $25.00/L.F.	5,500.00
18 Inch dia. conc. pipe outlet from retention basin at Thunderbird Rd. and 64th Street 140 L.F. @ $27.00/L.F.	3,780.00
Headwall - Lump Sum	1,000.00
Pvmt. Replacement - Lump Sum	450.00
Total Plates 4 & 5	$ 1,195,330.00

* As per the 13 August 1981 letter from N. P. Karan, P.E., Maricopa County Flood Control District to J. E. McClure, The Natelson Company, Inc.

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PVSP PHASE III
PROJECT "B"

PLATE 6:

Channel excavation

12,711 C.Y. @ $1.50/C.Y.	$	19,067.00
Gabion Bank protection		
1156 C.Y. @ $70.00/C.Y.		80,920.00
Box culvert at Sunnyside Dr.		
55 C.Y. @ $250.00/C.Y.		13,750.00
Guard Rail, etc. - Lump Sum		6,000.00
Storm drain in Cactus from 62nd St. to 64th St. and from 66th St. to the 64th St. Channel		
42 Inch Conc. pipe		
2600 L.F. @ $63.00/L.F.		163,800.00
18 Inch conc. pipe		
160 L.F. @ $27.00/L.F.		4,320.00
24 Inch conc. pipe		
80 L.F. @ $36.00/L.F.		2,880.00
Catch basins - 12 Ea. @ $1,000/Ea.		12,000.00
Man Holes - 6 Ea. @ $1,000.00/Ea.		6,000.00
Headwalls - 2 Ea. @ $1,000.00/Ea.		2,000.00
Pvmt Replacement - 1893 S.F. @ $15.00/S.F.		28,395.00
Adjust water services -Lump Sum		1,500.00
Sewer tap encasement - Lump Sum		1,500.00
	$	222,395.00
Total Plate 6	$	342,132.00

PLATE 8:

Improve existing Channel between Turquoise & Mountain View Roads

Channel excavation: 3,422 C.Y. @ $1.50/C.Y.	$	5,133.00
Gabion Bank protection		
311 C.Y. @ $70.00/C.Y.		21,770.00
Total Plate 8	$	26,903.00
ESTIMATED COST PROJECT "B"	$	1,770.023.00
Contingencies @ 15%		265,503.00
ESTIMATED GRAND TOTAL COST	$	2,035,526.00

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PVSP PHASE III COST ESTIMATE

PROJECT "C"

PLATE 1:

Excavation of Detention Basin No. 1		
	60,076 C.Y. @ $1.50/C.Y.	$ 90,114.00
(Cost of clearing, excavation & haul-off only)		

PLATE 2:

60 Inch dia. conc. pipe complete in place		
	500 L.F. @ $90.00/L.F.	45,000.00
	Headwall - Lump Sum	6,000.00
	Right-of-Way acquisition	
	0.17 Ac. @ $45,000.00/Ac.	7,650.00
	Total Plate 2	$ 58,650.00

PLATE 3:

Concrete pipe culvert complete in place		
(5 barrel - 115 Ft. in length, Skew 60^0)		
	Pipe - 115 X 5 = 575 L.F.	
	@ $90.00/L.F.	51,750.00
	Headwalls & Guard Rails	
	Lump Sum	6,000.00
		$ 57,750.00
	Relocate Sewer:	
	8"V.C.P. - 100 L.F. @ $6.00/L.F.	600.00
	1 Drop M.H. - Lump Sum	1,000.00
		$ 1,600.00
	Adjust 8" Water Main	
	8" A.C.P. - 80 L.F. @ $15.00/L.F.	$ 1,200.00
	Total Plate 3	$ 59,350.00

PLATE 4:

Channel Excavation	1,956 C.Y. @ $1.50/C.Y.	$ 2,934.00
	Gabion Bank protection	
	356 C.Y. @ $70.00/C.Y.	$ 24,920.00
	Right-of-Way acquisition	
	0.62 Ac. @ $45,000.00/Ac.	27,900.00
	Total Plate 4	$ 55,754.00

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PVSP PHASE III
PROJECT "C"

PLATE 5:

Channel excavation 16,483 C.Y. @ $1.50/C.Y.		$ 24,725.00
Gabion Bank protection 2,867 C.Y. @ $70.00/C.Y.		200,690.00
Sewer Encasement 75 L.F. @ $6.00/L.F.		450.00
Adjust 6" Water Main 75 L.F. @ $10.00/L.F.		750.00
Relocation of A.P.S. facilities Lump Sum (Natural gas & overhead power) (Cost may be assumed by Utility Co.)		15,000.00
Right-of-way acquisition 3.55 Ac. @ $45,500/Ac.		161,525.00
Total Plate 5		$ 403,140.00

PLATE 6:

Conc. pipe culvert complete in place (5 barrel - 45 Ft. in length)		
Pipe - 45 X 5 = 225 L.F. @ $90,000/L.F.		20,250.00
Headwalls & guard Rails-Lump Sum		6,000.00
Utility relocation-Lump Sum		2,000.00
Pvmt. replacement 147 S.Y. @ $15.00/S.Y.		2,205.00
Total Plate 6		$ 30,455.00

PLATE 7:

Cost to PVSP		0.00

PLATE 8: Cost equal to Plate 6 $ 30,455.00

PLATE 9: Cost equal to Plate 6 $ 30,455.00

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PVSP PHASE III
PROJECT "C"

PLATE 10:

Excavation of detention basin 160,430 C.Y. @ $1.50/C.Y. (Cost of clearing, excavation & Haul-off only)	$ 240,645.00
Storm drain in Larkspur Dr. (60 inchdia. pipe - length 2,900+ Ft.) Located under pavement in Larkspur under the Scottsdale Road Channel, with direct discharge into detention basin at Cactus Road)	
60 Inch dia. conc. pipe- 2,900 L.F. @ $90.00/L.F.	$ 261,000.00
18 Inch dia. conc. pipe - 160 L.F. @ $27.00/L.F.	4,320.00
24 Inch dia. conc. pipe - 40 L.F. @ $36.00/L.F.	1,440.00
Catch basins - 10 Ea. @ $1,000.00/Ea.	10,000.00
Manholes - 5 Ea. @ $900.00/Ea.	4,500.00
Pavement replacement 2,180 S.Y. @ $15.00/S.Y.	32,700.00
Utility adjustments - Lump Sum	2,000.00
Headwall - Lump Sum	2,000.00
	$ 317,960.00
Total Plate 10	$ 558,605.00

PLATE 11:

60 Inch dia. conc. pipe line	
60 Inch pipe - 4,000 L.F. @ $90.00/L.F.	$ 360,000.00
Headwalls - Lump Sum	3,000.00
Manholes - 5 Ea. @ $1,200.00/Ea.	6,000.00
Pavement replacement 152 S.Y. @ $15.00/S.Y.	2,280.00
Adjust Sewer 8" V.C.P. - 20 L.F. @ $6.00/L.F.	120.00
Drop M.H.'s -2 Ea. @ $1,000.00/Ea.	2,000.00
Adjust 6 inch Water Main 50 L.F. @ $10.00/L.F.	500.00
Right-of-Way acquisition 0.21 Ac. @ $26,000.00/Ac.	5,460.00
Total Plate 11	$ 379,360.00

PVSP PHASE III
PROJECT "C"

PLATE 12:

Excavation of detension basin 95,000 C.Y. @ $1.50/C.Y. (Cost of clearing, excavation & haul-off only)	$	142,500.00

PLATE 13:

Excavation Stilling basin 2,222 C.Y. @ $1.50/C.Y.		3,333.00
60 Inch pipe - 800 L.F. @ $90.00/L.F.		72,000.00
Headwalls - Lump Sum		3,000.00
Right-of-Way acquisition 0.5 Ac. @ $26,000.00/Ac.		13,000.00
Total Plate 13	$	91,333.00

PLATE 14:

Clearing, excavation & haul-off 24,704 C.Y. @ $1.50/C.Y.		37,056.00
Gabion Bank protection 3,407 C.Y. @ $60.00/C.Y.		204,420.00
Relocate 4 Inch Water Main 500 L.F. @ $6.00/L.F.		2,000.00
Sewer encasement 40 L.F. @ $6.00/L.F.		240.00
Right-of-Way acquisition 5.3 Ac. @ $32,400.00/Ac.		171,720.00
Total Plate 14	$	415,436.00

PLATE 15:

Concrete pipe culverts-complete in place Shea Blvd. - (8 barrel - 100 Ft. length) 60" dia. pipe - 800 L.F. @ $90.00/L.F.		72,000.00
Headwalls & guard rails-Lump Sum		6,000.00
Pavement replacement 178 S.Y. @ $15.00/S.Y.		2,670.00
Lower 12" water main 60 L.F. @ $30.00/L.F.		1,800.00
	$	82,470.00

PVSP PHASE III
PROJECT "C"

PLATE 15 (con't):

Cochise Road - (8 barrel - 44 Ft. Length)	
60" dia. pipe - 352 L.F. @ $90.00/L.F.	$ 31,680.00
Headwalls - Lump Sum	6,000.00
Pavement replacement	
133 S.Y. @ $15.00/S.Y.	1,995.00
Lower 6" water main	
60 L.F. @ $10.00/L.F.	600.00
	$ 40,275.00
Gold Dust Ave. (8 barrel - 44 Ft. Length)	
(Cost equal to Cochise Rd. Culvert	40,275.00
Total Plate 15	$ 163,020.00

PLATE 17:

Excavation of detension basin	
30,746 C.Y.@ $1.50/C.Y.	46,119.00
(Cost of clearing, excavation & haul-off only)	

PLATE 18:

Concrete pipe drain	
15 Inch dia. pipe - 100 L.F. @ $23.00/L.F	$ 2,300.00
Outlet protection	
Gunite - 150 S.F. @ $1.50/S.F.	225.00
Total Plate 18	$ 2,525.00

PLATE 19:

Channel excavation	
36,000 C.Y. @ $1.50/C.Y.	$ 54,000.00
Bank protection	
Gunite - 324,000 S.F. @ $1.50/S.F.	486,000.00
Extend spillway	
Concrete - 29 C.Y. @ $250.00/C.Y.	7,250.00
Pavement Replacement	
533 S.Y. @ $15.00/S.Y.	7,995.00
Right-of-way acquisition	
3.72 Ac. @ $23,400.00/Ac.	87,048.00
Total Plate 19	$642,293.00

ESTIMATED COST PROJECT "C"	$ 3,199,564.00
Contingencies @ 15%	479,935.00
ESTIMATED GRAND TOTAL COST	$ 3,679,499.00

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PVSP PHASE III COST ESTIMATE

60th PLACE FLOOD PROTECTION SYSTEM

PLATE 2:

Increase capacity of Street by the installation of concrete curbs having an effective height of 1.0 Foot (Length - 1,800 ± Ft.)

Curb - 3,600 L.F. X 0.06 = 216 C.Y.		
216 C.Y. @$150.00/C.Y.	$	32,400.00
Reconstruct driveway entrance		
Lump Sum		5,000.00
ESTIMATED COST	$	37,400.00
Contingencies @ 15%		5,610.00
ESTIMATED GRAND TOTAL COST	$	43,010.00

(Note: In the reconstruction of Shea Blvd., a dip section will be required at 60th Place.)

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PVSP PHASE II ESTIMATED COSTS

66th STREET FLOOD PROTECTION SYSTEM

PLATE 2:

Item 1	Remove existing strip pavement:	
	3,200 S.Y. @ $1.50/S.Y.	$ 4,800.00
	Construct new Street section:	
	(Assume 2"/9"	
	Pavement - 3,867 S.Y. @ $7.00/S.Y.	27,069.00
	Curb & Gutter - 2400 L.F. @ $5.50/L.F.	13,200.00
	Driveway reconstruction - Lump Sum	7,000.00
	SUB TOTAL	$ 52,069.00
Item 3	Box culvert under Shea Blvd.	
	Structural excavation	
	417 C.Y. @ $7.00/C.Y.	$ 2,919.00
	Structural concrete	
	204 C.Y. @ $250.00/C.Y.	51,000.00
	Reconstruct approximately 300 Ft. of Shea Blvd.	
	Pavement removal, import fill, reconstruct roadway, traffic control	
	Lump Sum	25,000.00
	Lower 12 inch dia. water main	
	80 L.F. @ $30.00/L.F.	2,400.00
	SUB TOTAL	$ 81,319.00
Item 4	Concrete box channel:	
	Structural excavation	
	2600 C.Y. @ $7.00/C.Y.	$ 18,200.00
	Structural concrete	
	645 C.Y. @ $250.00/C.Y.	$ 161,250.00
	Right-of-Way acquisition	
	0.6 Ac. @ $23,400.00/Ac.	14,040.00
	SUB TOTAL	$ 193,490.00
	ESTIMATED COST	$ 326,878.00
	Contingencies @ 15%	49,032.00
	ESTIMATED GRAND TOTAL COST	$ 375,910.00

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