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SALT-GILA INTERIM FLOOD CONTROL WORKS

HOLLY ACRES AREA

DRAFT ADDENDUM AND APPENDIX

Camp Dresser & McKee

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SALT-GILA INTERIM FLOOD CONTROL WORKS

HOLLY ACRES AREA

DRAFT ADDENDUM AND APPENDIX

For

Flood Control District
of Maricopa County, Arizona

By

Camp Dresser & Mckee, Inc.
Walnut Creek, CA

June 12, 1981

DRAFT ADDENDUM

Alternative 6 - Southern Avenue - El Mirage Road Improvements

Figure 3 shows an area northwest of the intersection of Southern Avenue and El Mirage Road that is being flooded during the February 1980 flood. Waters enter this area via a culvert along El Mirage Road and over the Southern Avenue-El Mirage Road intersection, which is lower in elevation than the St. John's Canal bank (the Canal siphons under El Mirage Road). Once the floodwaters cross Southern Avenue, they enter irrigation and drainage ditches and can cause local flooding before the waters can be drained to the west. At sufficiently high discharges, the area would be flooded by overtopping and/or upstream bypassing of the St. John's Canal.

The flooding that occurs prior to overtopping and/or upstream bypassing could be eliminated by raising the intersection of Southern Avenue and El Mirage Road to the height of the St. John's Canal banks and installing a gate on the drainage culvert along El Mirage Road that passes under Southern Avenue. The location and details of the gate depend on whether the Holly Acres subdivision ring levee is built and the normal operation of the culvert. This alternative is included as part of the ring levee plan and is shown on Figures 8 and 9. The costs and benefits have been separated from the ring levee plan.

Alternative 7 - Bank Stabilization, 91st Avenue to 95th Avenue

As shown in Figure 3, the north bank just downstream from the 91st Avenue Treatment Plant is attacked by floodwaters, resulting in loss of land and washout of the St. John's Canal. The present alignment of the low-flow channel along the north bank continues to threaten irrigated farmland and the St. John's Canal, which delivers irrigation water to 2,000 acres.

A solution to this problem is presented in Figure 10. It consists of a new rip-rapped bank to gradually turn the flow along the north bank and a new excavated unlined low-flow channel to prevent effluent and flood flows from attacking the bank at an acute angle or ponding against it. The new bank would tie into the existing banks on either end and would not reduce the

frequency of overbank flooding. However, the bank in this area is high and will not be overtopped by discharges under 200,000 cfs (100-year flood). The purposes of this project are to prevent further loss of land through erosion and to protect the St. John's Canal. Furthermore, the land between the existing bank and the new bank could be filled and utilized.

Alternative 8 - Bank Stabilization, 101st Avenue to 109th Avenue

Figure 3 shows how floodwaters overtop the bank and flow across irrigated farmland and several homes starting at 103rd Avenue. The hydraulic analysis indicates that this breakout will occur at discharges over 100,000 cfs if channel clearing is implemented.

On Figure 11, a bank stabilization plan addressing this problem is shown. The project involves raising the bank slightly to protect against a discharge of about 250,000 cfs with no freeboard. The bank would be rip-rapped and would tie into the existing banks at both ends. Some of the land currently exposed to overland flow would still be subject to backwater ponding from downstream at high flows, but the damages would be reduced substantially at all discharegs. Channel clearing and debris removal that has been performed in this area will help to prevent an increase in water surface elevation.

Alternative 9 - Bank Stabilization, 113th Avenue to 119th Avenue

A major north bank breakout of flow occurs in the vicinity of 113th Avenue. On Figure 3, it can be seen that the overbank flow crosses the Holly Acres Subdivision and that dense phreatophytes restrict the return of flow to the river. Some of the flow continues all the way to the Agua Fria River.

Figure 12 shows a bank stabilization project that could reduce damages in this area. The project would tie into the existing upstream bank near 113th Avenue and direct flows to the southwest and into the cleared channel strip. The project would block off a secondary low-flow channel that presently passes just south of the Holly Acres Subdivision. Minor channel

excavation would help in directing the flow away from the new bank. The channel clearing is important in that it will provide effective flow area removed by the blocked-off channel. Discharges under about 130,000 cfs would be contained, but at larger discharges some flow would overtop the levee and flow into the blocked off low-flow channel. Even at high flows, however, the project would reduce damages along the north overbank.

Alternative 6 - Southern Avenue-El Mirage Road Improvements

This alternative was designed as part of the ring levee plan. The costs are broken out in Table VII-2. The total first cost is $72,000. The annual cost excludes any O&M costs, which are assumed to be negligible. For 25-year amortization, the cost is $4,100 per year.

Alternative 7 - Bank Stabilization, 91st Avenue to 95th Avenue

The alternative was designed and a fairly detailed cost estimate was developed. Table VII-3 presents the cost estimate item by item. The Appendix contains the back-up for this estimate, including design considerations and quantity calculations. The total first cost is $1,137,000. The annual cost, including 1 percent for O&M, is $77,000 for 25-year amortization.

Alternative 8 - Bank Stabilization, 101st Avenue to 109th Avenue

Table VII-4 presents the cost estimate for this alternative. Back-up calculations are in the Appendix. The total first cost is $1,487,000. The annual cost, including 1 percent for O&M is $100,000 for 25-year amortization.

Alternative 9 - Bank Stabilization, 113th Avenue to 119th Avenue

The cost estimate is presented in Table VII-5. The back-up calculations are in the Appendix. The total first cost is $1,178,000. The annual cost, including 1 percent for O&M, is $79,000 for 25-year amortization.discharges under 200,000 cfs (100-year flood)

Table VII-3 presents a summary of the estimated project costs.

- Entire Holly Acres area with no channel clearing
- entire Holly Acres area with 1,000 ft. wide channel clearing
- areas north of Southern Avenue
- areas protected by the Holly Acres subdivision ring levee
- areas protected by the Southern Avenue-El Mirage Road improvements

The computations and results are found in the Appendix.

6. Bank stabilization measures such as Alternatives 7, 8 and 9 are generally not evaluated from a benefit/cost standpoint, since flood damages prevented are difficult to predict accurately. The benefits for Alternatives 7, 8 and 9 were nevertheless estimated based on one possible scenario. These benefits include reduction of land erosion, prevention of canal breaks, and partial reductions in inundated areas and velocity of overbank flow. The calculations and assumptions are documented in the Appendix. The estimated annual benefits are :

Alternative 7:	$ 9,500
Alternative 8:	$ 1,800
Alternative 9:	$157,800

The loss of income associated with reduced crop yields caused by interruption of irrigation supply by breaks in the St. Johns Canal was considered, as well. However, no benefits were assumed for this condition. Past experience has shown that canals that are damaged by floodwaters can be repaired sufficiently quickly to avoid significant impacts to crops, although this may involve a temporary fix before the canal itself is properly repaired or a temporary increase in dependence on alternate sources that are still available, such as wells.

This can be done because the flood period of December through April corresponds to a period of low water use. During the peak irrigation months of July and August, an interruption in supply would be very damaging, but the chances of a flood during or within a couple of months before this time is essentially nil. It was therefore assumed that in the event of a canal break, the supply would be restored or obtained for other sources in time to prevent crop losses.

It should be noted that estimation of benefits associated with the bank stabilization alternatives requires a considerable amount of subjective evaluation and the resulting benefits should be regarded as rough approximations. A more detailed study could not remove most of the uncertainty and subjectivity in these estimates.

7. Based on the annual expected flood damages in selected areas and under certain project construction assumptions, average annual direct benefits of several of the alternative flood control measures were computed. Channel clearing was assumed to be completed in evaluating other alternatives. Indirect benefits were assumed to be 15 percent of direct benefits. Table VIII-1 summarizes the results.

The primary evaluation criteria considered in evaluating the alternatives at this stage were effectiveness and efficiency (as measured by the benefit/cost (B/C) ratio). Table IX-1 presents a summary of the annual benefits and costs for each alternative. Data for this table comes from Tables VII-3 and VIII-1. An evaluation of each alternative follows:

TABLE IX-1

SUMMARY OF ANNUAL BENEFITS
AND COSTS OF ALTERNATIVE FLOOD CONTROL MEASURES

Alternative	Total Annual Average Annual Benefits	Cost 25 yrs. @ 3%	Benefit/Cost Ratio
1. Channel Clearing	$ 28,000	$ 150,000	0.19
2. Channel Excavation	----------Not Computed----------		
3. North Bank Levee	$595,800	$2,956,000	0.20*
4. Southern Avenue Levee	$129,400	$1,180,000	0.11
5. Ring Levee	$216,700	$ 101,000	2.2
6. Road Improvements	$ 28,600	$ 4,100	7.0
7. 91st Avenue to 95th Avenue Bank	$ 9,500	$ 77,000	.12
8. 101st Avenue to 109th Avenue Bank	$ 1,800	$ 100,000	.02
9. 113th Avenue to 119th Avenue Bank	$157,800	$ 79,000	2.0

*0.33 for 100-year amortization

Alternative 1 - Channel Clearing

Channel clearing appears to be an inefficient flood control measure in this reach. The reasons for the low benefits and the limitations on the hydraulic analysis were previously discussed. The major environmental consideration is the destruction of wildlife habitat. The Draft Environmental Assessment Report by Benham-Blair & Affiliates contains more information on the potential impacts of this measure.

Alternative 2 - Channel Excavation

Channel excavation was considered as a concept only and no plans were developed. The concept was rejected for lack of both effectiveness and efficiency. The effectiveness of channel excavation is considered poor because the natural forces of the river could easily lead to shifts in alignment and sedimentation that would greatly reduce the effectiveness of the excavation over time. Furthermore, channel clearing alone will tend to concentrate the flow and scour out the river in that area. Any more than a small pilot channel through a cleared area would likely be wasted effort.

Despite the above argument, a sufficient amount of excavation in the river could reduce flood depths, at least until the sediment carried by the river could replace the excavated material. However, the rough cost calculations performed indicated that an excavation of only 1 foot in depth would cost as much as clearing and maintaining the same surface area free of phreatophytes. Clearing must be performed as part of any excavation as well. Simple hydraulic calculations show that clearing a strip of the river that is covered with phreatophytes would lower the water surface much more than excavating a 1 foot deep channel in a cleared area, yet would cost about the same. Excavation is less efficient than clearing, yet clearing is not efficient in the Holly Acres area. Channel excavation was therefore not considered further.

Alternative 3 - Levee Along North Bank

This alternative would be very effective in preventing flood damages over the entire Holly Acres area. However, as can be seen, its efficiency is very low. Even if significant cost reductions were identified by further study and a 100-year amortization period were used, the project would not be cost-effective. The possibility of incorporating other objectives into this plan has been mentioned, but the benefits derived from these other uses would have to be much larger than the flood control benefits to justify the project.

Alternative 4 - Levee Along Southern Avenue

This project would cost roughly 40 percent as much as the north bank levee, yet it would produce only 20 percent of the benefits. Its efficiency is thus only half that of the north bank levee. The benefit/cost ratio is so low that even if interior drainage costs were reduced to almost nothing, this alternative would still not be cost effective. For this reason, this alternative was not considered further.

Alternative 5 - Ring Levee Around Holly Acres Subdivision

The benefits of this project are considerably greater than its costs - this appears to be a cost-effective solution to some of the flood problems in the Holly Acres area. The cost and benefit calculations must now be reviewed in more detail to insure that the damage values, unit costs, and design assumptions and criteria are appropriate.

The possibility of local financing appears good since the project has a moderate cost. Federal involvement may be a possibility if the cost estimate of $1.5 million is reasonably accurate (this is less than the Corps of Engineers' $3 million limit for the Small Projects Authority). Environmental impacts should be minor.

Local support for the project should be reasonably good. In the June 1980 survey of the Holly Acres Flood Control Association membership, only 5 percent picked levees as their first choice, but only 8 percent picked levees as their least preferred choice for flood relief. Channelization was by far the most popular choice and relocation was by far the least popular. The ring levee, however, will likely be acceptable to many residents, if the only alternative for flood relief is relocation. The major objection will likely be the limited scope of this project that fails to protect many of the area's residents.

Alternative 6 - Southern Avenue-El Mirage Road Improvements

This project is cost-effective, but extremely limited in scope. The hydraulic analysis for this project was highly approximate since the available topographic data was not very detailed and the flooding of this area is a rather complex dynamic phenomenon. More data collection and analysis needs to be performed on this alternative before it can be recommended, although it appears at this time that the project is a good one. Adverse environmental impacts should be negligible. Public support may be lacking due to the very limited scope of the project.

Alternative 7 - Bank Stabilization, 91st Avenue to 95th Avenue

This project has a low benefit-cost ratio. The benefits are low primarily because there is no overbank flooding problem in this area, the effects of bank erosion are projected to be limited to a relatively small agricultural area with no residences, and it was assumed that a canal break could be repaired with no serious consequences to crop yields.

Alternative 8 - Bank Stabilization, 101st Avenue to 109th Avenue

This project has an extremely low B/C ratio. The low benefits result because damages do not occur at discharges below about 100,000 cfs and the benefits are limited to the short 1 mile reach from 103rd Avenue to 111th Avenue. Also, there are very few homes in this area.

Alternative 9 - Bank Stabilization, 113th Avenue to 119th Avenue

This project has a favorable B/C ratio of 2.0. The benefits were based on the assumption that the project would have significant benefits from 115th Avenue to the Agua Fria River, a distance of 3 miles. This 3 mile reach is the most densely populated residential area along the Gila River. Furthermore, the project would be beneficial at flows as low as 50,000 cfs and as high as 200,000 cfs.

The methods used to compute the benefits of this project are based on the effects of flow velocity on flood damages. As such, it is not in accordance with general practice for flood control planning on the Federal or State levels. A conventional analysis would show no benefits at all for this project. This is a significant fact to consider if funding would be needed from Federal or State sources.

The environmental impacts of the project are probably not of major concern to implementation. Public support may be lacking unless all three bank stabilization projects are constructed as a single project.

Compared to the Ring Levee (Alternative 5) this project is somewhat less costly, affects a larger area, but does not reduce damages as completely. The B/C ratios are comparable. They are redundant so that only one or the other should be built, not both. One major factor in choosing between the two alternatives would be whether outside funding (Federal or State) is needed. The ring levee benefits can almost surely be supported using whatever procedures are required by the funding agency. The bank stabilization benefits probably cannot. Finally, the probability of a successful, long lasting project is greater for the ring levee plan than for the bank stabilization plan.

ADDENDUM APPENDIX

APPENDIX

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Section 2. 101st to 109th Avenues

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SECTION 1. 91ST TO 95TH AVENUES

Cost Calculations

Benefit Calculations

COST CALCULATIONS

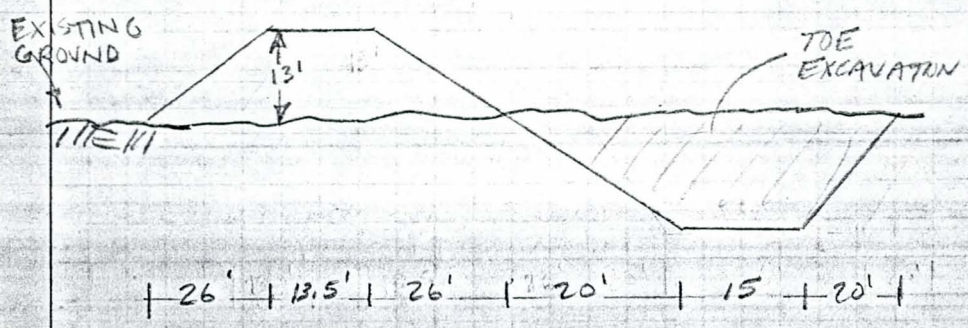
TABLE VII-3

BANK STABILIZATION, 91st TO 95th AVENUE
COST ESTIMATE

QUANTITY TAKE-OFF				_____ ESTIMATE	
MARICOPA COUNTY FLOOD CONTROL DISTRICT				JOB NO.	
SALT-GILA INTERIM FLOOD CONTROL WORKS		COMPUTED BY		PREPARED BY	
HOLLY ACRES AREA BANK STABILIZATION		CHECKED BY		CHECKED BY	
91st TO 95th AVENUES		DATE		DATE	
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	FIRST COST				
1	Diversion and Control of Water	--	JOB	L.S.	--
2	Clear Site and Remove Obstructions	12	ACRE	300	3,600
3	Excavation				
	A. For Channel	27,400	CY	1.50	41,100
	B. For Levee Fill	18,400	CY	1.50	27,600
	C. Toe	118,000	CY	2.50	295,000
4	Compacted Fill				
	A. Levees	16,000	CY	1.00	16,000
	B. Toe	118,000	CY	1.30	153,400
5	Vegetation Erosion Protection		JOB	L.S.	500
6	Filter Material	2,840	CY	18.00	51,100
7	Rock Rip-Rap	11,300	CY	18.00	203,400
8	Flap Gates	--	EA	2000	--
9	Interior Drainage				
	A. Collection	--	JOB	L.S.	--
	B. Pump Station	--	JOB	L.S.	--
10	Road Work				
	A. Excavation and Fill	--	CY	2.50	--
	B. Remove Pavement	--	SF	0.60	--
	C. Aggregate Base	--	CY	18.00	--
	D. Asphalt/Concrete Pavement	9,300	SF	1.00	9,300
	Total Construction Costs				801,000
	Contingencies, 15%				120,200
	Engineering and Design, 10%				80,100
	Supervision and Administration, 10%				80,100
11	Land Acquisition	7	ACRE	8000	56,000
	TOTAL FIRST COST				1,137,000

91ST TO 95TH	2. CLEAR SITE AND REMOVE OBSTRUCTIONS	MARICOPA CO.	COM SWJ

LEVEE:



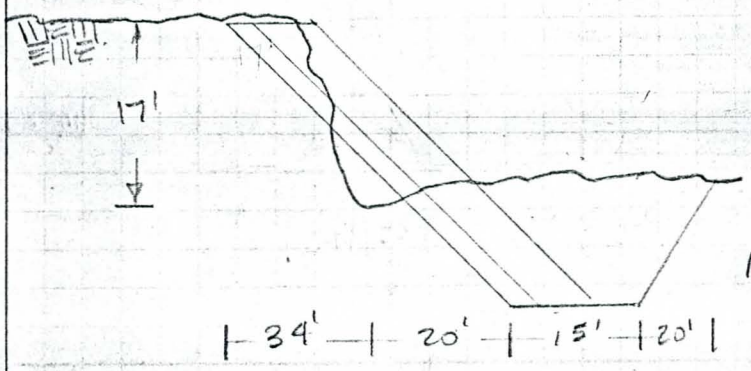
WIDTH OF CLEAR SITE = 120.5 FT

LENGTH = 1140 FT

AREA = (120.5')(1140') = 137400 FT^2

= 3.1 ACRES

BANK:



WIDTH OF CLEAR SITE = 89 FT

LENGTH = 1470 FT

AREA = (89')(1470') = 130,930 FT^2

= 3 ACRES

LOW FLOW CHANNEL:

LENGTH = 2500 FT

WIDTH = 100 FT

AREA = (100')(2500') = 250000 FT^2

= 5.7 ACRES

TOTAL = 3.1 + 3 + 5.7

= 11.8 ACRES

EXCAVATION

MARICOPA COUNTY INTERIM FLOOD CONTROL STUDY

REACH: LEVEE QUANTITIES, 91st TO 95th AVE
SIDE SLOPES: 2.0:1, 2.0:1
TOP WIDTH 8.0
COMPACTION FACTOR: 1.15
RUN DATE: 14-APR-81

STATION #	LENGTH ft	HEIGHT ft	AREA sqft	VOLUME cuyd	CUMM. VOLUME cuyd
996.40		0.0	0.0		
	140.0			1215.9	1215.9
997.80		16.0	640.0		
	260.0			5822.7	7038.6
1000.40		15.0	570.0		
	60.0			810.3	7848.9
1001.00		8.0	192.0		
	300.0			2363.0	10211.9
1004.00		9.0	234.0		
	250.0			3610.9	13822.8
1006.50		15.0	570.0		
	100.0			1869.1	15691.9
1007.50		13.0	442.0		
	50.0			304.7	15996.6
1008.00		0.0	0.0		
	========				==========

LENGTH = 1160.0 REQUIRED EXCAVATION = 18396.1

3.B EXCAVATION FOR LEVEE FILL

4.A COMPACTED LEVEE FILL

LOW FLOW CHANNEL EXCAVATION:

AVERAGE DEPTH OF CHANNEL = 6'
AVERAGE WIDTH = 112'
LENGTH OF EXCAVATION = 1100'

VOLUME OF EXCAVATION = (112')(6')(1100')
= 739,200 FT^3

3.A EXCAVATION for CHANNEL = 27,400 YD^3

TOE EXCAVATION

MARICOPA COUNTY INTERIM FLOOD CONTROL STUDY

REACH: TOE CUT QUANTITIES, 91st TO 95th AVE
SIDE SLOPES: 2.0:1, 2.0:1
BOT WIDTH 15.0
COMPACTION FACTOR: 1.00
RUN DATE: 14-APR-81

STATION #	LENGTH ft	HEIGHT ft	AREA sqft	VOLUME cuyd	CUMM. VOLUME cuyd
996.70		26.0	1742.0		
	110.0			4071.4	4071.4
997.80		11.0	407.0		
	260.0			4209.7	8281.2
1000.40		12.0	468.0		
	160.0			3583.1	11864.3
1002.00		16.0	752.0		
	70.0			1848.9	13713.3
1002.70		15.0	675.0		
	130.0			3250.0	16963.3
1004.00		15.0	675.0		
	250.0			4668.1	21631.3
1006.50		10.0	350.0		
	70.0			1056.9	22688.2
1007.20		12.0	468.0		
	80.0			2386.5	25074.7
1008.00		21.0	1197.0		
	100.0			5206.1	30280.9
1009.00		25.0	1625.0		
	600.0			36111.1	66392.0
1015.00		25.0	1625.0		
	200.0			12467.9	78859.9
1017.00		26.0	1742.0		
	100.0			6674.7	85534.6
1018.00		27.0	1863.0		
	470.0			32430.0	117964.6
1022.70		27.0	1863.0		
	========				==========

LENGTH = 2600.0 REQUIRED EXCAVATION = 117964.6

3.C TOE EXCAVATION

4.B. ASSUME TOE FILL EQUALS TOE EXCAVATION. EXTRA MATERIAL IS NOT REQUIRED FOR TOE FILL EVEN THOUGH THE FILL WILL BE COMPACTED. IT IS ASSUMED THAT ANY LOSS IN VOLUME THROUGH COMPACTION WILL BE BALANCED BY ADDITIONAL RIPRAP AND FILTER VOLUMES.

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

ADOT RAINBOW

91ST TO 95TH AVENUE

STATION	REACH LENGTH (FT)	RIP-RAP VERT. HT. (FT)	RIP-RAP AVE. VERT. HEIGHT (FT)	RIP-RAP AREA (2.24)(H)(L) (FT^2)	RIP-RAP VOLUME (FT^3)	RIP-RAP VOLUME (YD^3)	FILTER MATERIAL VOLUME (YD^3)
996+70	110	27	27	6650	13300	490	120
997+80	420	27	27	25400	50800	1880	470
1002+00	200	27	26.5	11870	23750	880	220
1004+00	250	26	26	14560	29120	1080	270
1006+50	250	26	25.5	14280	28560	1060	265
1009+00	600	25	25.5	34270	68540	2540	635
1015+00	200	26	26	11650	23300	860	215
1017+00	170	26	26.5	10090	20180	750	190
1018+70	400	27	27.0	24190	48380	1790	450
1022+70		27					

$\Sigma = 11300\ YD^3$ 7. ROCK RIPRAP

$\Sigma = 2840\ YD^3$ 6. FILTER MATERIAL

91ST TO 95TH

6. FILTER MATERIAL
7. ROCK RIPRAP

MARICOPA CO.

COM SWT

LENGTH OF LEVEE = 1160 FT

AVERAGE HEIGHT OF LEVEE = 12 FT

AREA = (1160')(12')(2.24) = 31200 FT^2

= 0.7 ACRES

ASSUME START-UP COSTS AND INSTALLATION = $500.00

10. ROAD WORK

ASPHALT CONCRETE PAVEMENT

LENGTH OF LEVEE = 1160 FT

AREA OF A.C. = (1160')(8')

= 9280 FT^2

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

ASSUME ACQUISITION OF 10' OF LAND ON EACH SIDE OF THE LEVEE AND BANK STABILIZATION.

FROM ITEM 2, SITE CLEARING, THE WIDTH OF CLEARING FOR THE LEVEE = 120.5 FT AND THE WIDTH OF CLEARING FOR THE BANK STABILIZATION = 89 FT. LEVEE LENGTH = 1140 FT. STABILIZATION = 1470 FT.

LAND ACQUISITION AREA $= (120.5' + 20')(1140') + (89' + 20')(1470')$

$= 320{,}400\ FT^2$

$= 7.3$ ACRES

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

BENEFIT CALCULATIONS

DAMAGES ASSUMED TO OCCUR FOR ANY FLOOD OVER 50,000 cfs

DAMAGES INCLUDE:
1. EROSION OF LAND ALONG BANK @ $8000/ACRE
2. DAMAGE TO ST. JOHNS CANAL @ 160,000/MILE
   BASED ON 1980 REPAIR COST OF $48,000 FOR 1600 FT.
   ON SOI EXTENSION OF BUCKEYE CANAL

EXTENT OF DAMAGE BASED ON ONE POSSIBLE SCENARIO:

1. EROSION OF 2 ACRES OF LAND = $16,000
2. CANAL BREACH OF 1000 FT. = $30,000

$46,000

PROBABILITY OF A FLOOD GREATER THAN 50,000 cfs IN ANY ONE YEAR = .18

ANNUAL DIRECT BENEFIT: $46,000 (.18) = $8,300/yr.

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

SECTION 2. 101ST TO 109TH AVENUES

Cost Calculations

Benefit Calculations

COST CALCULATIONS

TABLE VII-4

BANK STABILIZATION, 101st TO 109th AVENUES
COST ESTIMATE

QUANTITY TAKE-OFF				_____ ESTIMATE	
MARICOPA COUNTY FLOOD CONTROL DISTRICT				JOB NO.	
SALT-GILA INTERIM FLOOD CONTROL WORKS		COMPUTED BY		PREPARED BY	
HOLLY ACRES AREA BANK STABILIZATION		CHECKED BY		CHECKED BY	
101st TO 109th AVENUE		DATE		DATE	
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	FIRST COST				
1	Diversion and Control of Water		JOB	L.S.	3,700
2	Clear Site and Remove Obstructions	14	ACRE	300	4,200
3	Excavation				
	A. For Channel	--	CY	1.50	--
	B. For Levee Fill	4,530	CY	1.50	6,800
	C. Toe	147,500	CY	2.50	368,800
4	Compacted Fill				
	A. Levees	3,940	CY	1.00	3,900
	B. Toe	147,500	CY	1.30	191,800
5	Vegetation Erosion Protection		JOB	L.S.	500
6	Filter Material	4,190	CY	18.00	75,400
7	Rock Rip-Rap	16,700	CY	18.00	300,600
8	Flap Gates	3	EA	2000	6,000
9	Interior Drainage				
	A. Collection		JOB	L.S.	9,000
	B. Pump Station	--	JOB	L.S.	--
10	Road Work				
	A. Excavation and Fill	--	CY	2.50	--
	B. Remove Pavement	--	SF	0.60	--
	C. Aggregate Base	--	CY	18.00	--
	D. Asphalt/Concrete Pavement	36,200	SF	1.00	36,200
	Total Construction Costs				1,006,900
	Contingencies, 15%				151,000
	Engineering and Design, 10%				100,700
	Supervision and Administration, 10%				100,700
11	Land Acquisition	16	ACRE	8000	128,000
	TOTAL FIRST COST				1,487,000

A DIVERSION LEVEE IS NEEDED UPSTREAM OF THE PROJECT TO DIVERT FLOW AWAY FROM THE LOW FLOW CHANNEL WHICH IS LOCATED ADJACENT TO THE NORTH BANK. A LARGER LOW FLOW CHANNEL IS LOCATED TO THE SOUTH. ASSUME A MAXIMUM HEIGHT OF 10', AN AVERAGE WIDTH OF 10' AND A LENGTH OF 400 FT

$$\text{VOLUME} = (10')(10')(400')$$
$$= 40\,000\ FT^3$$
$$= \underline{\underline{1480\ YD^3}}$$

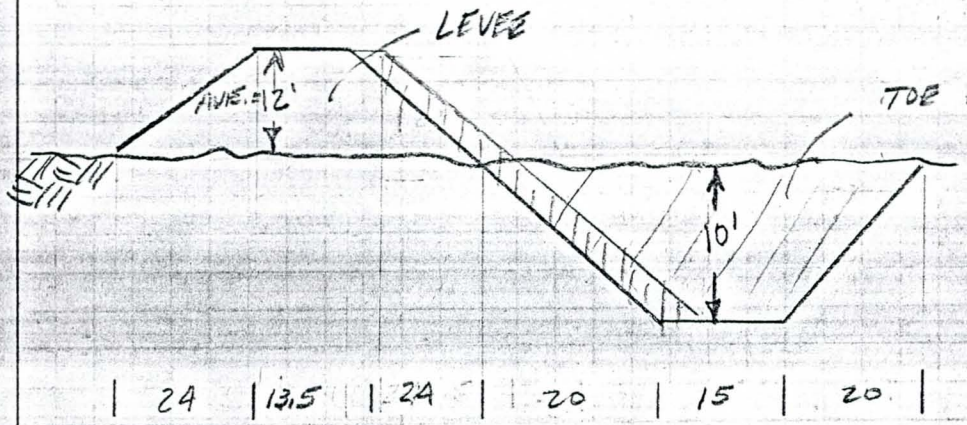
$$\text{COST} = (1480\ YD^3)(\$2.50\ /YD^3)$$
$$= \underline{\underline{\$3700.00}}$$

INCLUDES COST OF EXCAVATION AND PLACEMENT

42-381 50 SHEETS 5 SQUARE
42-382 100 SHEETS 5 SQUARE
42-389 200 SHEETS 5 SQUARE
NATIONAL

101ST TO 109TH	2. CLEAR SITE AND REMOVE OBSTRUCTIONS	MARICOPA CO.	SWT COM

LEVEE :



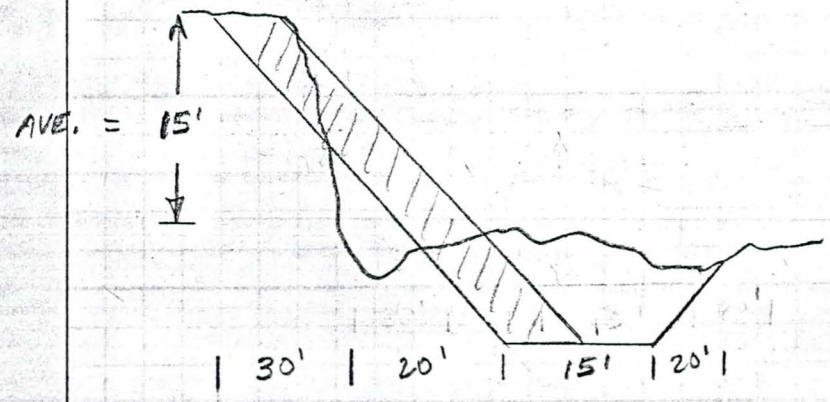
LENGTH OF LEVEE
= 4600 FT

| 24 | 13.5 | 24 | 20 | 15 | 20 |

WIDTH OF SITE CLEARING = 24' + 13.5' + 24' + 20' + 15' + 20'
= 116.5'

AREA = (116.5')(4600') = 535900 FT²
= 12 ACRES

BANK PROTECTION



LENGTH OF BANK PROTECTION
= 740 FT

| 30' | 20' | 15' | 20' |

WIDTH OF SITE CLEARING = 30' + 20' + 15' + 20'
= 85'

AREA = (85')(740') = 62900
= 1.5 ACRES

TOTAL = 12 + 1.5 = 13.5 ACRES

LEVEE EXCAVATION

MARICOPA COUNTY INTERIM FLOOD CONTROL STUDY

REACH: LEVEE QUANTITIES, 101st TO 109th AVE
SIDE SLOPES: 2.0:1, 2.0:1
TOP WIDTH 8.0
COMPACTION FACTOR: 1.15
RUN DATE: 14-APR-81

STATION #	LENGTH ft	HEIGHT ft	AREA sqft	VOLUME cuyd	CUMM. VOLUME cuyd
986.70		0.0	0.0		
	680.0			268.6	268.6
993.50		2.0	24.0		
	1060.0			942.2	1210.8
1004.10		2.0	24.0		
	1190.0			1439.7	2650.5
1016.00		3.0	42.0		
	400.0			622.2	3272.7
1020.00		3.0	42.0		
	1000.0			666.4	3939.2
1030.00		0.0	0.0		
	========				==========
LENGTH =	4330.0	REQUIRED EXCAVATION =			4530.1

3.B EXCAVATION FOR LEVEE FILL

4.A COMPACTED FILL FOR LEVEE

TOE EXCAVATION

MARICOPA COUNTY INTERIM FLOOD CONTROL STUDY

REACH: TOE CUT QUANTITIES, 101st TO 109th AVE
SIDE SLOPES: 2.0:1, 2.0:1
BOT WIDTH 15.0
COMPACTION FACTOR: 1.00
RUN DATE: 14-APR-81

STATION #	LENGTH ft	HEIGHT ft	AREA sqft	VOLUME cuyd	CUMM. VOLUME cuyd
986.70		10.0	350.0		
	680.0			8814.8	8814.8
993.50		10.0	350.0		
	1060.0			13740.7	22555.6
1004.10		10.0	350.0		
	1190.0			15425.9	37981.5
1016.00		10.0	350.0		
	0.0			0.0	37981.5
1016.00		19.0	1007.0		
	400.0			14918.5	52900.0
1020.00		19.0	1007.0		
	1000.0			42573.9	95473.9
1030.00		22.0	1298.0		
	1000.0			51987.6	147461.4
1040.00		24.0	1512.0		
	========				==========

LENGTH = 5330.0 REQUIRED EXCAVATION = 147461.4

3.C TOE EXCAVATION

4.B. ASSUME TOE FILL EQUALS TOE EXCAVATION. EXTRA MATERIAL IS NOT REQUIRED FOR TOE FILL EVEN THOUGH THE FILL WILL BE COMPACTED. IT IS ASSUMED THAT ANY LOSS IN VOLUME THROUGH COMPACTION WILL BE BALANCED BY ADDITIONAL RIPRAP AND FILTER VOLUMES.

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

101ST TO 109TH AVE

STATION	REACH LENGTH (FT)	RIP-RAP VERT. HT (FT)	RIP-RAP AVE. VERT. HEIGHT (FT)	RIP-RAP AREA (2.24)(H)(L) FT2	RIP-RAP VOLUME FT3	RIP-RAP VOLUME YD3	FILTER MATERIAL VOLUME YD3
987+00		27					
	650		25	36400	72800	2700	680
993+50		24					
	60		24.5	3290	6590	240	60
1004+10		25					
	1190		23	61310	122600	4540	1140
1016+00		22					
	400		22	19710	39400	1460	370
1020+00		22					
	1000		23	51520	103040	3820	960
1030+00		23					
	1000		23.5	52640	105300	3900	980
1040+00		24					

$\Sigma = 16660$ $\Sigma = 4190$

7. ROCK RIPRAP 6. FILTER MATERIAL

6. FILTER MATERIAL
7. ROCK RIPRAP

MARICOPA CO. COM
SWT

AVERAGE HEIGHT OF LEVEE = 2.5 FT

LENGTH OF LEVEE = 4530 FT

AREA = (4530')(2.5')(2.24) = 25400 FT^2

= 0.6 ACRES

THE UNIT COST IS \$ 200.00 /ACRE.

BECAUSE 0.6 ACRES IS A SMALL AREA, ASSUME START-UP COSTS INCREASE COST BY \$300.00.

(0.6 ACRES) (\$200/ACRE) + \$300.00

= ~~\$ 420.00~~ USE \$500.00

8. FLAP GATES

ASSUME FLAP GATES ARE NEEDED AT 103RD, 105TH, AND 107TH STREETS FOR LOCAL DRAINAGE. ASSUME DRAINGE WILL BE HANDLED THROUGH EXISTING DRAINAGE SYSTEMS ALONG WITH A SMALL EARTH DITCH TO BE CONSTRUCTED ADJACENT TO THE PROPOSED LEVEE.

9. INTERIOR DRAINAGE

3 INLETS FOR FLAP GATES @ \$3000 EA

(3)(\$ 3000.00) = \$9000.00

A.C. PAVEMENT :

LENGTH OF LEVEE = 4530'

AREA OF A.C. = (4530')(8')

= 36240 FT²

11. LAND ACQUISITION

ASSUME ACQUISITION OF 10' OF LAND ON EACH SIDE OF THE LEVEE AND BANK STABILIZATION.

FROM ITEM 2, CLEAR SITE, THE WIDTH OF CLEARING FOR THE LEVEE = 116.5 FT AND FOR THE BANK STABILIZATION = 95' THE LEVEE LENGTH = 4600 FT, THE STABILIZATION = 740 FT.

LAND ACQUISITION = (116.5' + 20')(4600') + (95' + 20')(740')

= 705,600 FT²

= 16 ACRES

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

BENEFIT CALCULATIONS

DAMAGES ARE NOT SIGNIFICANT BELOW 100,000 cfs IN THIS AREA (ASSUMING CHANNEL CLEARING IS PERFORMED)

BETWEEN 100,000 cfs AND 250,000 cfs, LEVEED BANK WILL PREVENT FLOW FROM DIRECTLY FLOODING NORTH OVERBANK. BACKWATER MAY STILL POND IN SOME AREAS. ABOVE 250,000 cfs, ASSUME NO BENEFITS.

DISCHARGE (cfs)	101st-111th FLOODED AREA W/o PROJECT (AC)	PONDED AREA W/ PROJECT (AC)	PROTECTED AREA W/ PROJECT (AC)	DEPTH OF PONDING (ft)	HOMES W/o PROJECT	HOMES PONDED W/ PROJECT
150,000	144	110	34	1	0	0
200,000	200	166	34	2	6	6
250,000	234	220	14	3	8	8

UNIT DAMAGE VALUES

RE-GRADING *

$250/ac. IF FLOW RUNS THROUGH
$150/ac. FOR PONDING
$0/ac IF PROTECTED
} APPLIES TO ALL FLOWS

CROPS **

$140/ac FOR ALL AREA THAT GETS WET - 200,000, 250,000 cfs
$100/ac " " " " " " - 150,000

STRUCTURES ***

150,000 - $16/ac
200,000 - $34/ac
250,000 - $68/ac
} THESE VALUE APPLY TO AVERAGE FLOODING (MOSTLY PONDING) FOR FLOWING AREAS, ASSUME DOUBLE VALUES SHOWN

HOMES ****

	FLOWING WATER	PONDED WATER
150,000 -	NO HOMES FLOODED	
200,000 -	$20,000	$8,000
250,000 -	$25,000	$10,000

* BASED ON GRAM WESTERN RESEARCH, BUCKEYE IRRIGATION CO. AND CAWCS VALUES.

** CROP LOSSES BASED ON CAWCS (DEPTH DEPENDENT)

*** STRUCTURES INCLUDE HOMES, DITCHES, ROADS, WELLS, ETC. VALUES FROM CAWCS

**** HOMES CONSIDERED IN ADDITION TO STRUCTURES DUE TO THE GREATER THAN NORMAL NUMBER OF HOMES IN THIS AREA. HOMES ASSUMED TO BE 1' ABOVE GROUND

BENEFIT COMPUTATIONS

* 150,000 cfs:

RE-GRADING:

AREA CHANGED FROM FLOWING TO PONDING
110 ac @ $100/ac = 11,000
AREA CHANGED FROM FLOWING TO DRY
34 ac @ 250/ac = 8,500

CROPS:

AREA PROTECTED
34 ac @ 100/ac = 3,400
AREAS STILL PONDED: NO BENEFIT

STRUCTURES:

AREA CHANGED FROM FLOWING TO PONDING
110 ac @ $16/ac = 1,800
AREA CHANGED FROM FLOWING TO DRY
34 ac @ 32/ac = 1,100

HOMES:
NO BENEFITS

TOTAL BENEFITS = $25,800

* 200,000 cfs:

RE-GRADING:
166 ac @ 100/ac = 16,600
34 ac @ 250/ac = 8,500
CROPS:
34 ac @ 140/ac = 4,800
STRUCTURES:
166 ac @ 34/ac = 5,600
34 ac @ 68/ac = 2,300
HOMES:

6 @ (20,000 − 8,000) = 72,000

TOTAL BENEFITS = 110,000

250,000 cfs:

RE-GRADING:

220 ac @ 100/ac	=	22,000
14 ac @ 250/ac	=	3,500
CROPS:		
14 ac @ 140/ac	=	2,000
STRUCTURES:		
220 ac @ 68/ac	=	15,000
14 ac @ 136/ac	=	1,900
HOMES:		
8 @ (25,000 - 10,000)	=	120,000
TOTAL BENEFITS	=	164,400

ANNUAL BENEFITS

	100 - 150,000 cfs	150 - 200,000 cfs	200 - 250,000 cfs	250,000 cfs UP
AVG. BENEFITS	12,900	68,000	137,000	NONE
FREQUENCY	.025	.01	.0044	
INCREMENTAL DAMAGES	320	680	600	

TOTAL DIRECT BENEFITS: $1600

SECTION 3. 113TH TO 119TH AVENUES

Cost Calculations

Benefit Calculations

COST CALCULATIONS

TABLE VII-5

BANK STABILIZATION, 113th to 119th AVENUES
COST ESTIMATE

QUANTITY TAKE-OFF				_____ ESTIMATE	
MARICOPA COUNTY FLOOD CONTROL DISTRICT				JOB NO.	
SALT-GILA INTERIM FLOOD CONTROL WORKS		COMPUTED BY		PREPARED BY	
HOLLY ACRES AREA BANK STABILIZATION		CHECKED BY		CHECKED BY	
113th TO 119th AVENUES		DATE		DATE	
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	FIRST COST				
1	Diversion and Control of Water		JOB	L.S.	1,480
2	Clear Site and Remove Obstructions	9	ACRE	300	2,700
3	Excavation				
	A. For Channel	17,200	CY	1.50	25,800
	B. For Levee Fill	16,200	CY	1.50	24,300
	C. Toe	106,400	CY	2.50	266,000
4	Compacted Fill				
	A. Levees	14,100	CY	1.00	14,100
	B. Toe	106,400	CY	1.30	138,300
5	Vegetation Erosion Protection		JOB	L.S.	500
6	Filter Material	3,320	CY	18.00	59,800
7	Rock Rip-Rap	13,300	CY	18.00	239,400
8	Flap Gates	2	EA	2000	4,000
9	Interior Drainage				
	A. Collection		JOB	L.S.	6,000
	B. Pump Station	--	JOB	L.S.	--
10	Road Work				
	A. Excavation and Fill	--	CY	2.50	--
	B. Remove Pavement	--	SF	0.60	--
	C. Aggregate Base	--	CY	18.00	--
	D. Asphalt/Concrete Pavement	23,000	SF	1.00	23,000
	Total Construction Costs				805,400
	Contingencies, 15%				120,800
	Engineering and Design, 10%				80,500
	Supervision and Administration, 10%				80,500
11	Land Acquisition	11	ACRE	8000	88,000
	TOTAL FIRST COST				1,175,000

A DIVERSION LEVEE IS NEEDED UPSTREAM OF THE PROJECT TO DIVERT FLOW AWAY FROM THE LOW FLOW CHANNEL WHICH IS LOCATED ADJACENT TO THE NORTH BANK. A LARGER LOW FLOW CHANNEL IS LOCATED TO THE SOUTH. ASSUME A MAXIMUM HEIGHT OF 10', AN AVERAGE WIDTH OF 10' AND A LENGTH OF 400 FT.

$$\text{VOLUME} = (10')(10')(400')$$

$$= 40000\ FT^3$$

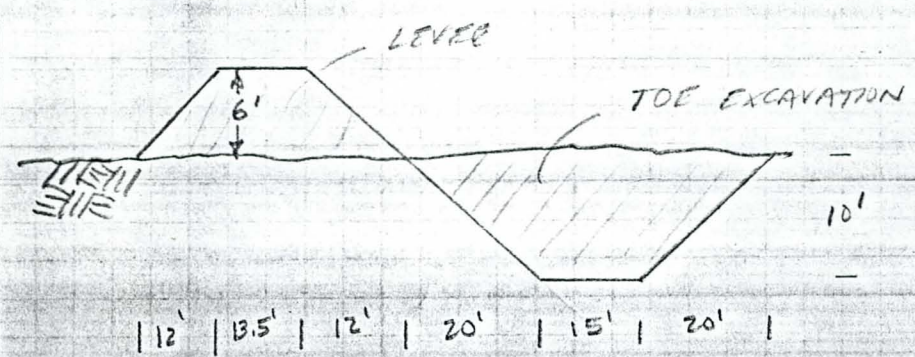
$$= \underline{1480\ YD^3}$$

$$\text{COST} = (1480\ YD^3)(\$1.00/YD^3)$$

$$= \underline{\$1480.00}$$

42-381 50 SHEETS 5 SQUARE
42-382 100 SHEETS 5 SQUARE
42-389 200 SHEETS 5 SQUARE
NATIONAL Made in U.S.A.

LEVEE :



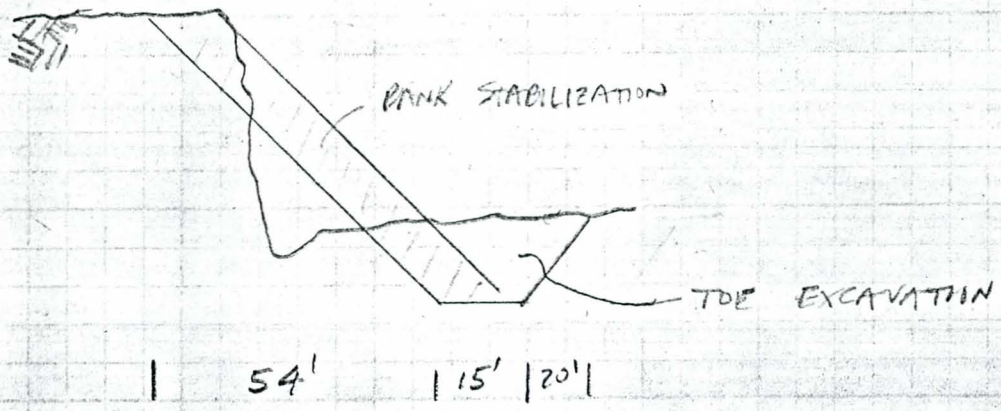
WIDTH OF CLEARING = 92.5 FT

LENGTH OF LEVEE = 3400 FT

AREA = (92.5') (3400') = 314,500 FT^2

= 7.2 ACRES

BANK :



WIDTH OF CLEARING = 89 FT

LENGTH OF BANK PROTECTION = 800 FT

AREA = (800 FT) (89 FT) = 71200 FT^2

= 1.6 ACRES

TOTAL = 1.6 + 7.2 = 8.8 ACRES

LEVEE EXCAVATION

MARICOPA COUNTY INTERIM FLOOD CONTROL

REACH: 113th TO 119th AVENUES
SIDE SLOPES: 2.0:1, 2.0:1
TOP WIDTH 8.0
COMPACTION FACTOR: 1.15
RUN DATE: 24-MAR-81

STATION #	LENGTH ft	HEIGHT ft	AREA sqft	VOLUME cuyd	CUMM. VOLUME cuyd
973.70		0.0	0.0		
	1370.0			5409.0	5409.0
987.40		10.0	280.0		
	220.0			1370.1	6779.0
989.60		4.5	76.5		
	330.0			2584.5	9363.6
992.90		12.0	384.		
	710.0			4486.1	13849.7
1000.00		2.0	14.0		
	100.0			88.9	13938.6
1001.00		2.0	24.0		
	140.0			169.4	14108.0
1002.40		3.0	42.0		
	0.0			0.0	14108.0
1002.40		0.0	0.0		
	=========				==========
LENGTH =	2870.0	REQUIRED EXCAVATION =			16224.2

3.B EXCAVATION FOR LEVEE FILL

4.A COMPACTED FILL FOR LEVEE

LOW FLOW CHANNEL EXCAVATION:

ESTIMATED DEPTH OF EXCAVATION = 8'

LENGTH OF EXCAVATION = 500'

AVERAGE WIDTH OF EXCAVATION = 116'

VOLUME OF EXCAVATION = $(8')(500')(116')$

$= 4.64 \times 10^5 \ FT^3$

3.A. $= \underline{1.72 \times 10^4 \ YD^3}$

TOE EXCAVATION

MARICOPA COUNTY INTERIM FLOOD CONTROL STUDY

REACH: TOE CUT, 113th TO 119th AVE
SIDE SLOPES: 2.0:1, 2.0:1
BOT WIDTH 15.0
COMPACTION FACTOR: 1.00
RUN DATE: 14-APR-81

STATION #	LENGTH ft	HEIGHT ft	AREA sqft	VOLUME cuyd	CUMM. VOLUME cuyd
973.50		22.0	1298.0		
	1390.0			47806.9	47806.9
987.40		14.0	602.0		
	220.0			6487.1	54294.1
989.60		19.0	1007.0		
	330.0			8379.8	62673.9
992.90		11.0	407.0		
	710.0			19102.8	81776.8
1000.00		20.0	1100.0		
	100.0			4074.1	85850.8
1001.00		20.0	1100.0		
	140.0			3586.1	89436.9
1002.40		10.0	350.0		
	610.0			7907.4	97344.3
1008.50		10.0	350.0		
	700.0			9074.1	106418.4
1015.50		10.0	350.0		
	========				==========

LENGTH = 4200.0 REQUIRED EXCAVATION = 106418.4

3.C TOE EXCAVATION

4.B ASSUME TOE FILL EQUALS TOE EXCAVATION. EXTRA MATERIAL IS NOT REQUIRED FOR TOE FILL EVEN THOUGH THE FILL WILL BE COMPACTED. IT IS ASSUMED THAT ANY LOSS IN VOLUME THROUGH COMPACTION WILL BE BALANCED BY ADDITIONAL RIPRAP AND FILTER VOLUMES.

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

113TH TO 119TH AVENUES

STATION	REACH LENGTH (FT)	RIP-RAP VERT. IT. (FT)	RIP-RAP AVE VERT. HEIGHT (FT)	RIP-RAP AREA (2.24)(H)(L) (FT²)	RIP-RAP VOLUME (FT³)	RIP-RAP VOLUME (YD³)	FILTER MATERIAL VOLUME (YD³)
973+50		0					
	1390		11.5	35800	71600	2650	660
987+40		23					
	220		23	11300	22700	840	210
999+60		23					
	330		23	17000	34000	1260	315
992+90		23					
	710		22.5	35800	71600	2650	660
1000+00		22					
	100		22.0	4900	9800	360	90
1001+00		22					
	140		22.0	6900	13800	510	130
1002+40		22					
	1310		23.0	67500	135000	5000	1250
1015+50		24					

Σ = 13300 Σ = 3315

7. ROCK RIPRAP 6. FILTER MATERIAL

6. FILTER MATERIAL
7. ROCK RIPRAP

MARICOPA CO. COM

5. VEGETATION EROSION PROTECTION

AVERAGE LEVEE HEIGHT = 6'

AREA = (6')(2.24)(2870')

= 38570 FT^2

= 0.9 ACRES

UNIT COST IS \$200.00/ACRE. BECAUSE 0.9 ACRES IS A SMALL AREA, ASSUME START-UP COSTS INCREASE COST BY \$300. (1 ACRE)(\$200/ACRE) + \$300 = COST.

= \$500.0

8. FLAP GATES

ASSUME TWO FLAP GATES, ONE AT 113TH AVENUE AND ONE AT 115TH AVENUE FOR LOCAL DRAINAGE. TWO INLETS FOR FLAP GATES @ \$3000.00 EACH.

10. ROAD WORK

ASPHALT CONCRETE PAVEMENT:

LENGTH OF LEVEE = 2870'

AREA OF A.C. = (2870')(8')

= 22960 FT^2

ASSUME ACQUISITION OF 10' OF LAND ON EACH SIDE OF THE LEVEE OR BANK PROTECTION. FROM ITEM 2, SITE CLEARING, LEVEE WIDTH = 92.5' AND BANK STABILIZATION WIDTH = 89'.

AREA FOR ACQUISITION =

$$(92.5' + 20')(3400') + (89' + 20')(800')$$

$$= 469{,}700 \text{ FT}^3$$

$$= \underline{\underline{10.8 \text{ ACRES}}}$$

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.

BENEFIT CALCULATIONS

LEVEE AND BANK STABILIZATION WILL DIRECT FLOWS TO THE SOUTH AND AWAY FROM HOLLY ACRES SUBDIVISION. THE LEVEE WILL BE OVERTOPPED AT 130,000 cfs. OVER 200,000 cfs, ASSUME FEW BENEFITS, SINCE A CONSIDERABLE AMOUNT OF FLOW COULD FLOW OVER AND AROUND THE LEVEE. BELOW 30,000 cfs, THERE ARE NO SIGNIFICANT DAMAGES.

THEREFORE, BENEFITS OCCUR BETWEEN 30,000 cfs AND 200,000 cfs ONLY A SMALL AMOUNT OF THE BENEFITS WOULD BE IN THE FORM OF TOTAL PROTECTION OF THE AREA BEHIND THE LEVEE. MOST OF THE BENEFIT WOULD BE REDUCTION OF FLOW VELOCITIES IN THE NORTH OVERBANK FROM 115TH AVE. TO THE AGUA FRIA RIVER.

ONE WAY TO ROUGHLY ESTIMATE BENEFITS WOULD BE TO RE-CALCULATE THE FLOOD DAMAGES FROM 115TH AVE. TO THE AGUA FRIA BASED ON PONDED RATHER THAN FLOWING WATER. SPECIFICALLY, THE DAMAGES PREVIOUSLY CALCULATED WOULD BE CHANGED AS FOLLOWS:

IN SECTIONS 4N1, 5N1 AND 6N1 ONLY AND FOR 50,000, 100,000 AND 200,000:

* REDUCE DAMAGE TO HOMES FROM:		TO:	BENEFIT
50,000	12,000	NONE*	12,000 ea.
100,000	20,000	8,000	12,000 ea.
200,000	30,000	12,000	18,000 ea.

* ASSUME LEVEE SUCCESSFULLY INCREASES CONVEYANCE IN CLEARED CHANNEL SUCH THAT DAMAGES IN HOLLY ACRES ARE ELIMINATED

* REDUCE RE-GRADING FROM $250/ac. TO $150/ac $100/ac BENEFIT

* REDUCE STRUCTURAL DAMAGES 50%
SUM OF ALL OTHER CATEGORIES EXCEPT CROP LOSSES

* NO CHANGE IN CROP LOSSES

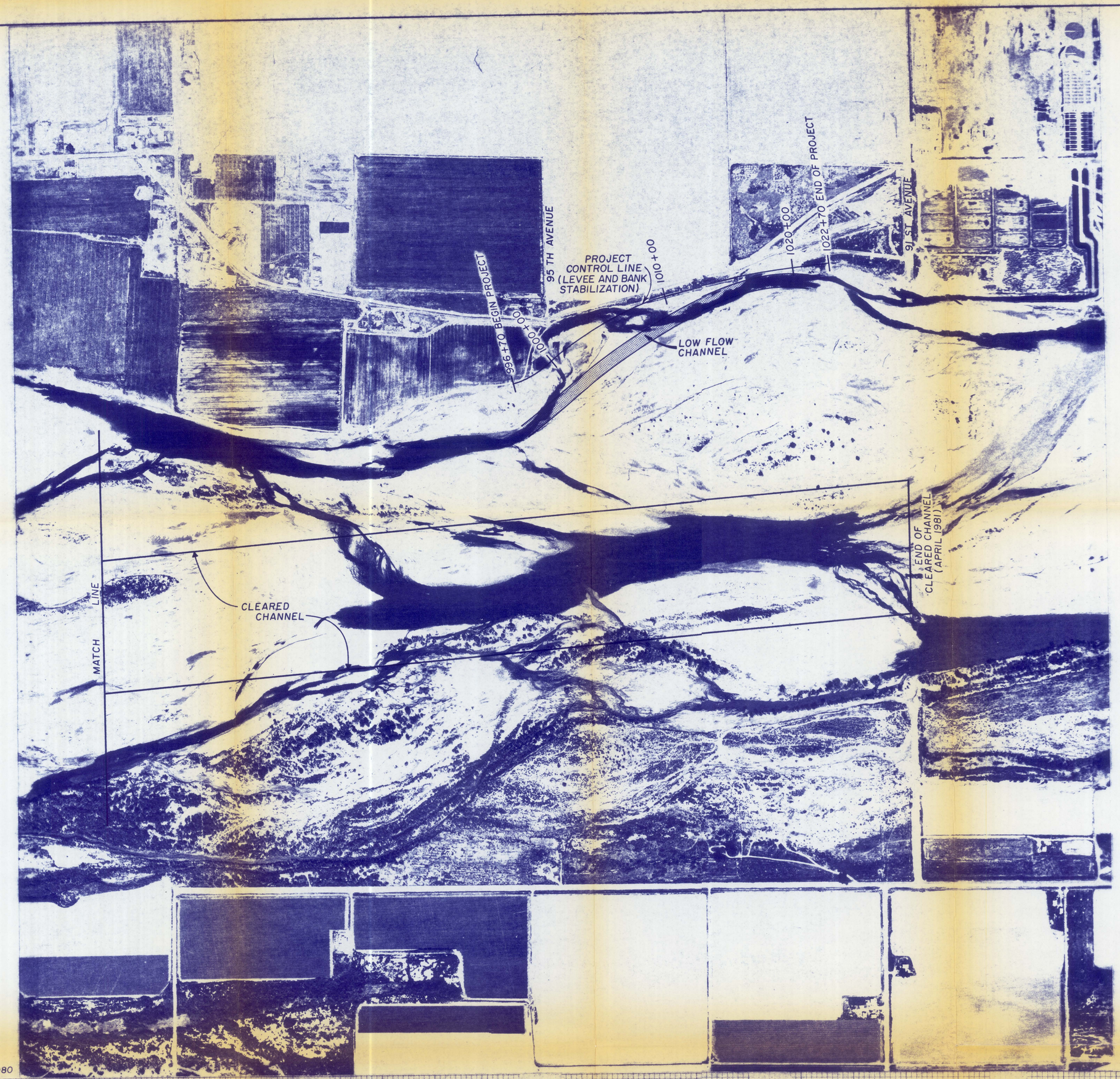
	50,000 cfs			100,000 cfs			200,000 cfs		
CATEGORY	BENEFIT/UNIT	UNITS	BENEFIT	BEN/UNIT	UNITS	BEN.	BEN/UNIT	UNITS	BEN.
1. F. HOMES	12,000	1	12,000	12,000	30	360,000	18,000	30	540,000
2. B. HOMES	12,000	2	24,000	12,000	39	468,000	18,000	39	702,000
3. M. HOMES	2,000	1	2,000	2,000	5	10,000	2,000	5	10,000
4. FARMSTEADS	12,000	1	12,000	12,000	2	24,000	12,000	2	24,000
5. CULT. LAND	100	50	5,000	100	360	36,000	100	360	36,000
6. PASTURELAND	50	—	—	50	75	4,000	50	75	4,000
7. DAIRIES	25,000	—	—	25,000	—	—	25,000	—	—
8. DITCHES	12,000	1	12,000	12,000	7	84,000	12,000	7	84,000
9. CANALS	2500	—	—	2500	—	—	2500	—	—
10. COM. BLDGS	5000	—	—	5000	—	—	5000	—	—
11. PUB. BLDGS	38,000	—	—	38,000	—	—	38,000	—	—
12. PAVED RDS.	9,000	—	—	9,000	1	9,000	9,000	1	9,000
13. DIRT RDS.	3,000	1	3,000	3,000	6	18,000	3,000	6	18,000
TOTAL			70,000			1,013,000			1,427,000

ANNUAL BENEFITS

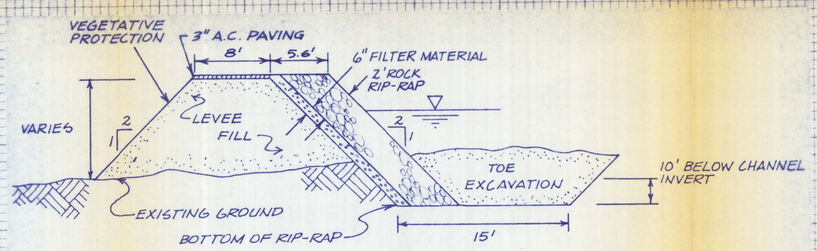
	30,000-50,000	50-100,000	100-200,000	200,000 UP
AVG. BENEFITS	35,000	542,000	1,220,000	—
FREQUENCY	.030	.087	.073	
INCREMENTAL BENEFITS	1,000	47,100	89,100	

TOTAL DIRECT BENEFITS : $137,200

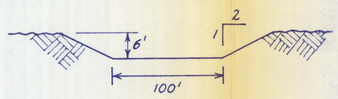
NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE Made in U.S.A.



NOTE: PHOTOGRAPH TAKEN MARCH 1980



TYPICAL LEVEE
NOT TO SCALE



TYPICAL LOW FLOW CHANNEL
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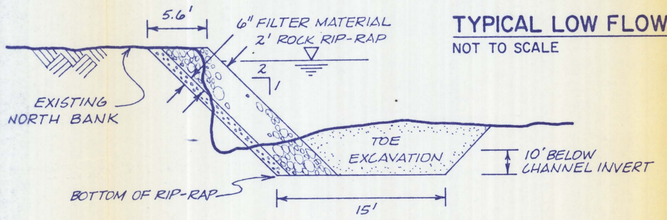

TYPICAL BANK STABILIZATION
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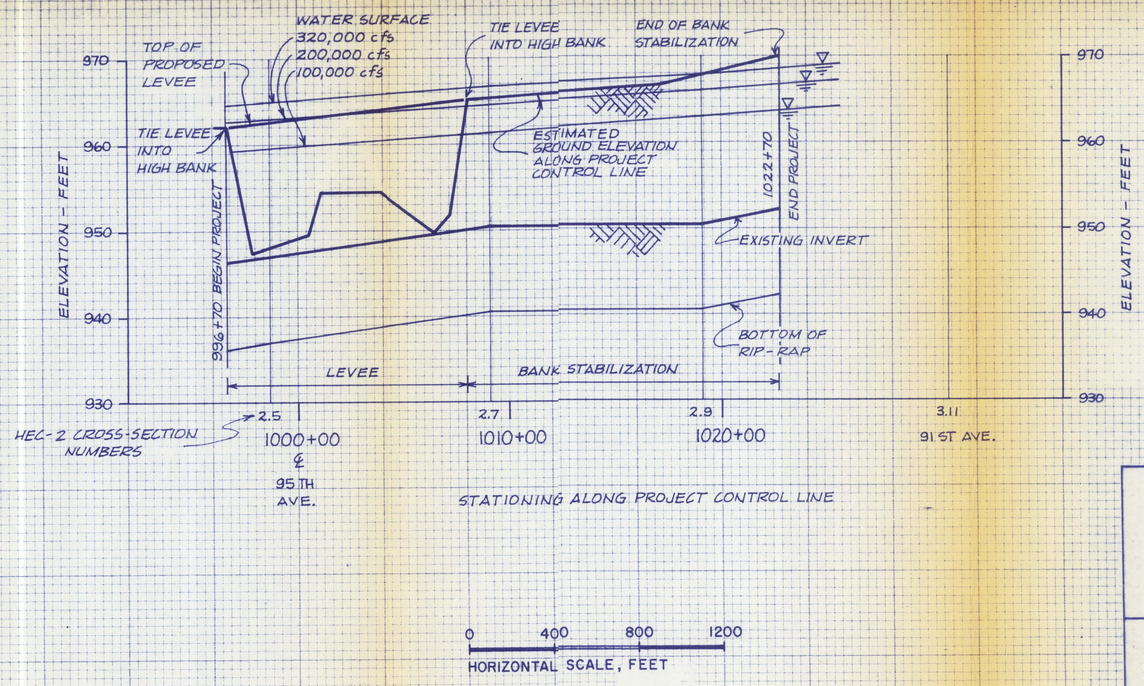


SALT - GILA INTERIM FLOOD CONTROL WORKS

HOLLY ACRES AREA BANK STABILIZATION

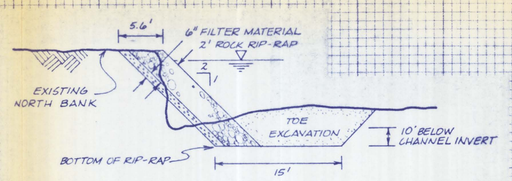
91ST TO 95TH AVENUE
PLAN AND PROFILE

CDM

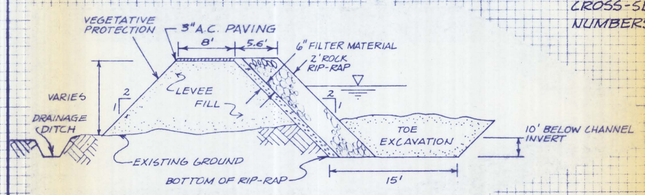
CAMP DRESSER & McKEE INC.
710 South Broadway
Walnut Creek, California 94596

FIGURE 10

NOTE: PHOTOGRAPH TAKEN MARCH 1980



TYPICAL BANK STABILIZATION
NOT TO SCALE



TYPICAL LEVEE
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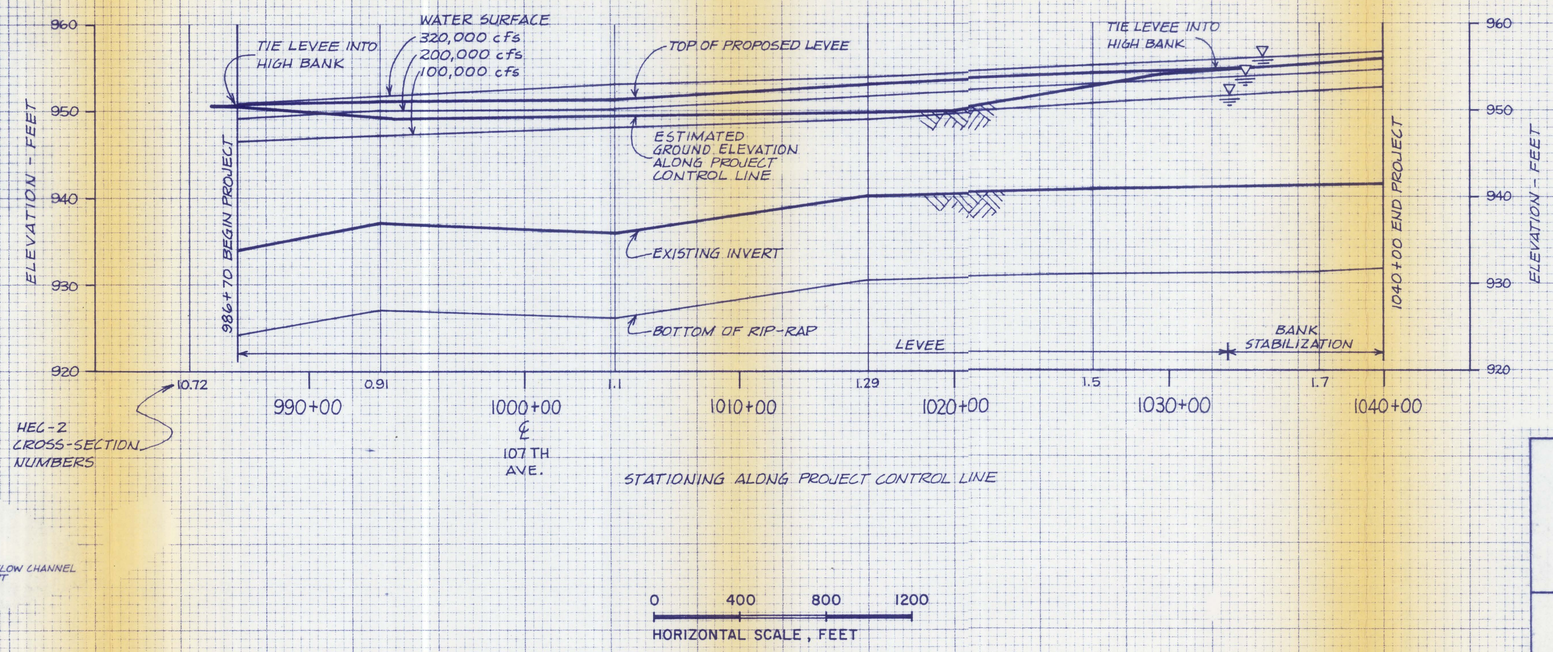


0 400 800 1200
HORIZONTAL SCALE, FEET

SALT - GILA INTERIM FLOOD CONTROL WORKS

HOLLY ACRES AREA BANK STABILIZATION

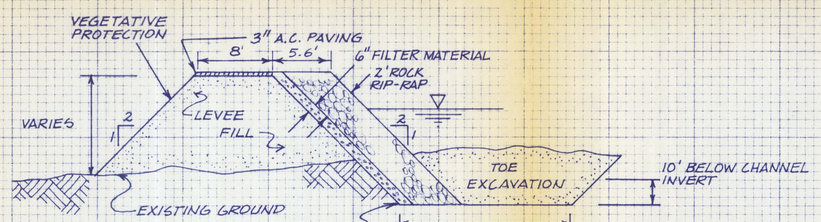
101ST TO 109TH AVENUE
PLAN AND PROFILE

CDM.

CAMP DRESSER & McKEE INC.
710 South Broadway
Walnut Creek, California 94596

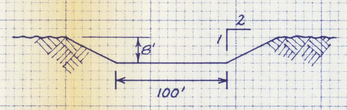
FIGURE 11

NOTE: PHOTOGRAPH TAKEN MARCH 1980



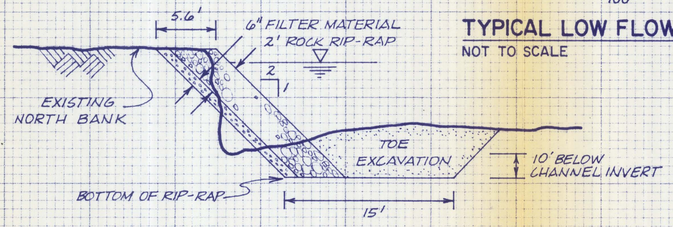
TYPICAL LEVEE

NOT TO SCALE



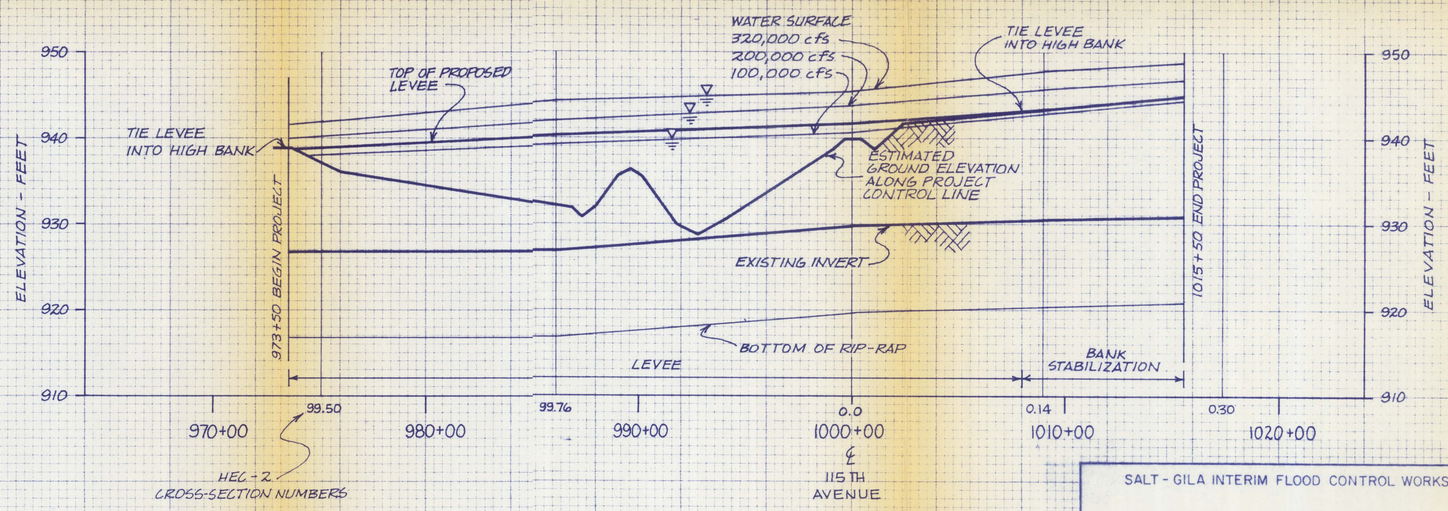
TYPICAL LOW FLOW CHANNEL

NOT TO SCALE



TYPICAL BANK STABILIZATION

NOT TO SCALE



0 400 800 1200

HORIZONTAL SCALE, FEET

SALT - GILA INTERIM FLOOD CONTROL WORKS

HOLLY ACRES AREA BANK STABILIZATION

113TH TO 119TH AVENUE

PLAN AND PROFILE

CDM

CAMP DRESSER & McKEE INC.

710 South Broadway
Walnut Creek, California 94596

FIGURE 12