COUNTY OF MADERA
CALIFORNIA

MASTER DRAINAGE PLAN
FOR
MADERA RANCHOS
BONADELLE RANCHOS
ROOT CREEK

GILL & PULVER ENGINEERS INC.
1300 ETHAN WAY, SUITE 675
SACRAMENTO, CALIFORNIA 95825

JUNE 1984
FINAL

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F I N A L

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RECOMMENDATIONS

It is recommended that:

a. The drainage plan be implemented as shown in Appendix D, sheets 1 through 12, of this report.

b. A benefit district be formed to finance the capital cost of the improvements.

c. A countywide drainage fee ordinance be adopted requiring fees for new land development projects or building permits to finance maintenance costs.

d. An agreement with the Madera Irrigation District be established to allow for the transport of storm drainage water from the area to groundwater recharge basins or to the San Joaquin River.

e. Additional studies be undertaken to define areas of ground water recharge that would be compatible with the drainage plan.

f. Additional studies be undertaken to establish the Cottonwood Creek drainage channel.

INTRODUCTION

The preparation of this master plan for drainage, authorized by the Board of Supervisors in Resolution 83-438, includes the study area shown in Figure 1. The study area includes the drainage basin of Root Creek and the drainage basins for the waterways called Madera Ranchos North and South and Bonadelle Ranchos. The study area extends from the upper limits of the drainage basins of the creeks to the terminal points of the creeks near AT & SF Railroad. Gill & Pulver Engineers Incorporated performed this work under Contract 3565C83 with the County of Madera. Ground surveys for the mapping portion of the work were performed by Greenwood & Associates, aerial mapping was completed by Cartwright Aerial Surveys.

This report describes the study criteria, procedures and results. The recommended improvements are shown on Sheets 1 through 12. Sheets 1 through 12 along with the index sheet presents detailed mapping of the area as well as presenting the recommended improvements.

Acknowledgements

We would like to acknowledge the support of Norman Hanson and Ralph Devina of the County Engineers office and Bill King of the County Roads Department for their assistance in gathering data

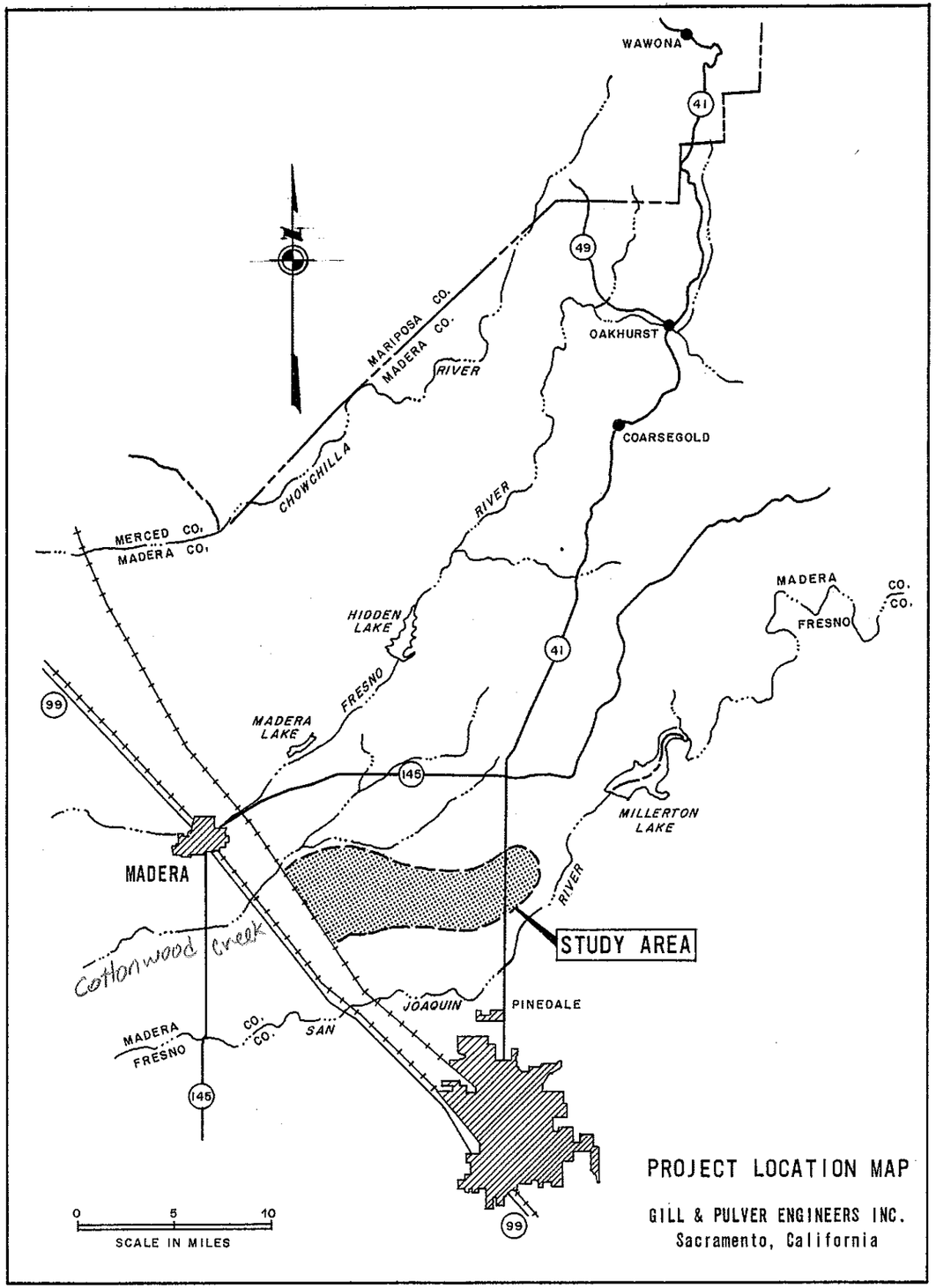
WAWONA
41
49
OAKHURST
COARSEGOLD
MARIPOSA CO.
MADERA CO.
RIVER
CHOWCHILLA
MERCED CO.
MADERA CO.
RIVER
HIDDEN LAKE
FRESNO
MADERA LAKE
99
145
41
MADERA
CO.
CO.
FRESNO
MILLERTON LAKE
RIVER
MADERA
STUDY AREA
Cottonwood Creek
JOAQUIN
PINEDALE
MADERA
FRESNO
CO.
CO.
SAN
145
99
0 5 10
SCALE IN MILES
PROJECT LOCATION MAP
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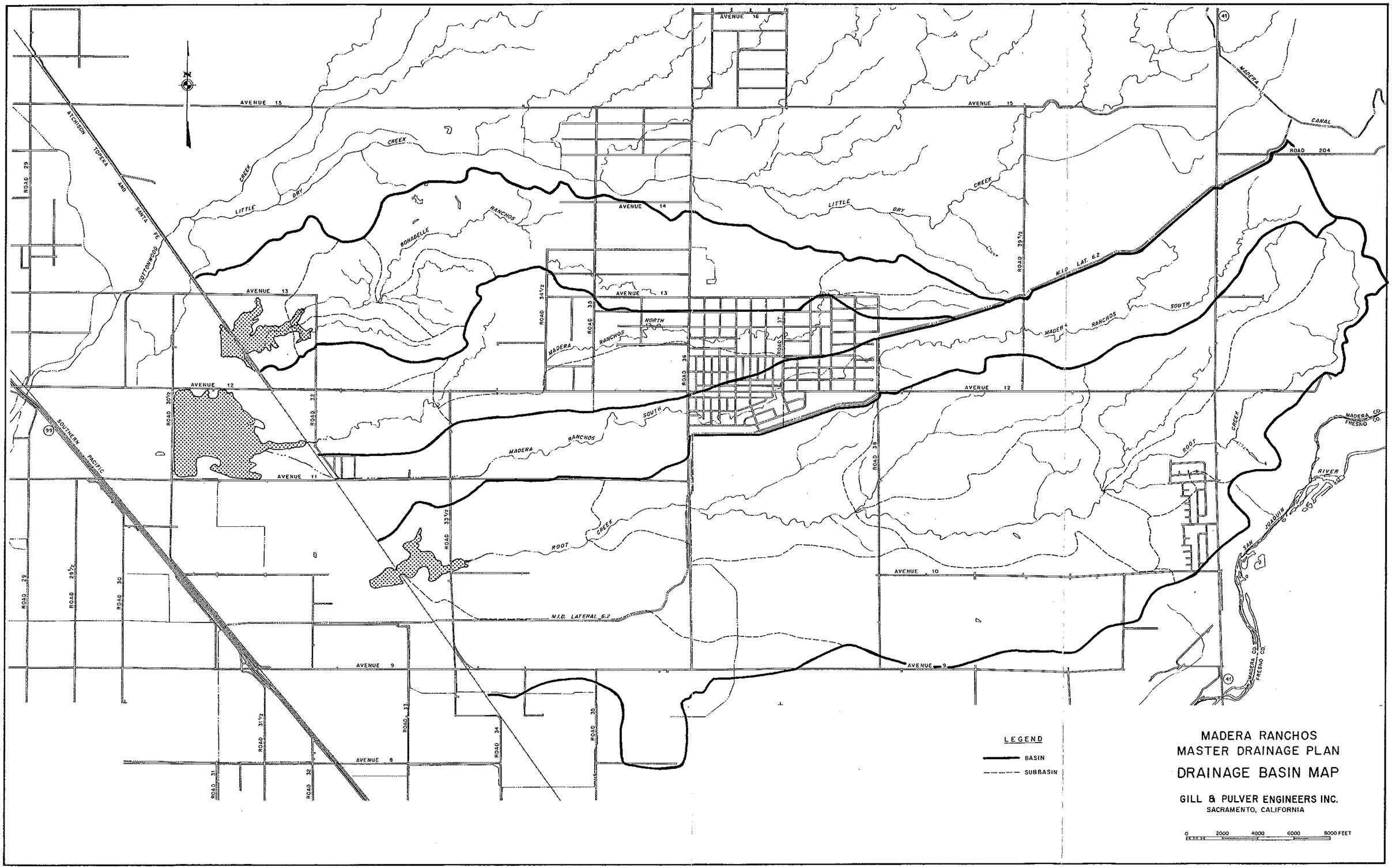
Figure 1

concerning existing conditions. Review comments and suggestions from the Technical Advisory Committee were helpful in establishing the alternatives to be evaluated in this study.

Description of Study Area

There are four waterways included in this study. They are Root Creek and three drainage systems that are designated Madera Ranchos North and South and Bonadelle Ranchos.

The study area is located approximately 10 miles southeast of the City of Madera. Figure 2 shows the drainage basins included in the study. The elevations vary from approximately 380 feet above sea level on the east to approximately 300 feet above sea level on the west side of the study area. The slope is relatively uniform and the area generally drains from the east to the west. The major waterway to the north of the study area is Little Dry Creek and the major waterway in the southern part of the study area is Root Creek. Both of these creeks are major waterways and have well defined water courses. The water courses for Madera Ranchos North and South are not well incised or defined. The channels of Madera Ranchos North and South in the west part of the study area have been leveled and filled in the preparation of the land for agriculture. In the upper basin, ground cover is characterized by orchard crops. In the area from approximate Road 38 to approximate Road 36 the area is characterized by large


AVENUE 16
AVENUE 15
AVENUE 14
AVENUE 13
AVENUE 12
AVENUE 11
AVENUE 10
AVENUE 9
AVENUE 8
ROAD 29
ROAD 29½
ROAD 30
ROAD 30½
ROAD 31
ROAD 31½
ROAD 32
ROAD 33
ROAD 33½
ROAD 34
ROAD 35
ROAD 36
ROAD 37
ROAD 39½
ROAD 204
ATCHISON TOPEKA AND SANTA FE
SOUTHERN PACIFIC
COTTONWOOD CREEK
LITTLE DRY CREEK
BONADELLE RANCHOS
MADERA RANCHOS NORTH
MADERA RANCHOS SOUTH
ROOT CREEK
M.I.D. LATERAL 6.2
MADERA CANAL
SAN JOAQUIN RIVER
MADERA CO.
FRESNO CO.
99
41
LEGEND
BASIN
SUBBASIN
MADERA RANCHOS
MASTER DRAINAGE PLAN
DRAINAGE BASIN MAP
GILL & PULVER ENGINEERS INC.
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0 2000 4000 6000 8000 FEET

Figure 2

lot residential development with the related landscaping features. The remaining area to the west is used intensively for agriculture.

The climate of the study area is characterized by dry, rainless summers and periods of cool, rainy days and foggy mornings from November to March. Temperatures in the City of Madera range from a January mean of 45 degree F to a mean of 80 degrees F in July.

Madera Ranchos North crosses numerous existing roadways by means of culverts. These are the only obstructions to flow in this creek. Madera Ranchos South passes through a small reservoir upstream or east of Road 38. Madera Ranchos South also passes under Madera Irrigation District Lateral No. 6.2 west and in the reach from Road 38 to Road 36 passes through numerous culverts.

The unique characteristic of all the waterways included in the study is that they terminate in storage areas in the area between State Highway 99 and the AT&SF railroad tracks.

The problem areas that have been identified prior to this study are all near existing culvert facilities. The 100-year flood limits for existing conditions are shown on Appendix D, sheets 1 through 12. All existing drainage facilities and flow paths are also shown on Sheets 1 through 12. The 100-year flood limits indicate the location of existing flooding problems and delineate

the flood hazard areas. In addition to the flood limits shown there are the problems of annoyances to the general public, long term damage to roads culverts and the irrigation canal.

OBJECTIVES AND APPROACH

The objectives of the master plan are to quantify all existing drainage problems, to identify alternatives that will relieve the drainage problems, to establish one alternative as the proposed solution, and to prepare a plan for implementing the recommended alternative along with recommendations for financing the construction and maintenance of the planned facilities.

The approach followed in the analysis included the following steps:

1. Review all existing data and studies for the project area.
2. Analyze the hydrology of the area and determine design discharges at key points along the waterways.
3. Determine flood limits for existing conditions.
4. Define structural and non-structural solutions to the flood problems.
5. Establish a recommended alternative.
6. Recommend methods of financing.
7. Establish a drainage improvement master plan.

HYDROLOGY

An hydrologic analysis was made to determine the quantity of runoff and the peak flow to be expected during major storms. Data describing the land, climate, present and future uses of the land, and historical weather patterns were compiled and used as a basis to compute expected flood hydrographs.

The four stream systems were studied using rainfall-runoff procedures and a computer model to facilitate the volume of computations. The model used was the Corps of Engineers' HEC-1 that utilizes individual basin characteristics, unit hydrographs computed for each sub-basin, rainfall and distribution of rainfall, and losses determined by soils and land uses to compute storm hydrographs.

The study area was divided into sub-basins ranging in size from a square mile to several square miles in area. The sub-basins are shown in Figure 2. Control points, locations where storm hydrographs were calculated, were selected based on the natural mouth of each basin and at locations where hydrologic information was needed for design, usually at County roads.

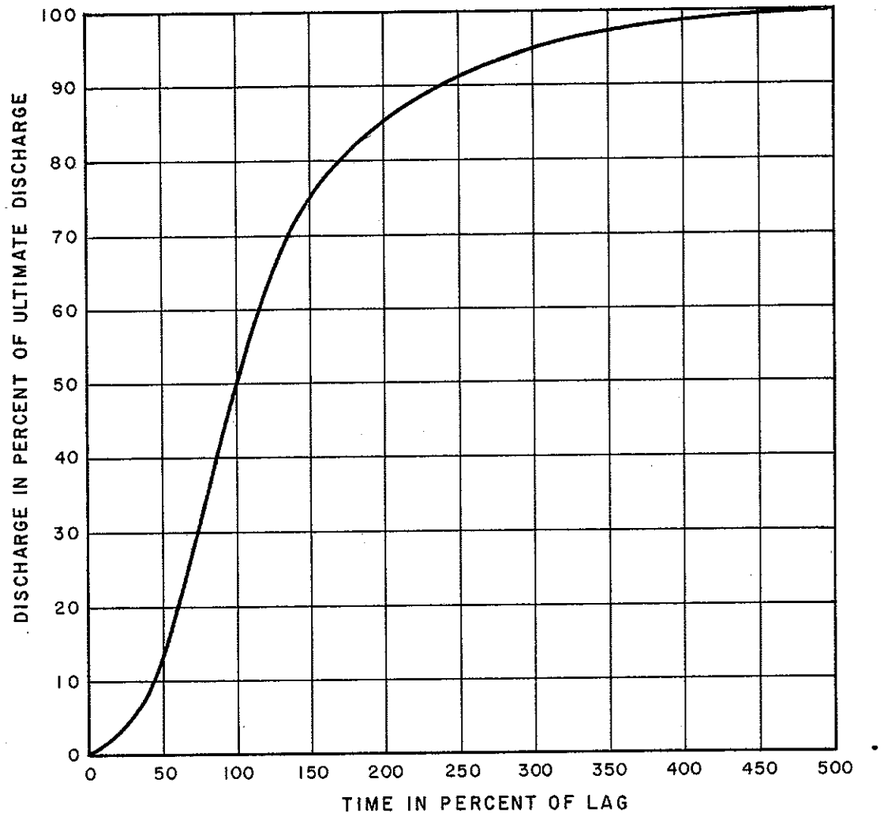
A hydrograph is a plot of streamflow and time. The storm hydrograph as used in this report is a plot of the runoff during the time of the storm.

A unit hydrograph represents a volume of one inch of runoff from a specific basin from a rainstorm of a specified duration. The unit hydrograph can be used to help estimate the runoff from hypothetical storms and to reconstruct the runoff patterns from known historical storms.

A regional approach was used to develop unit hydrographs based on an s-curve unit hydrograph originally developed for Cottonwood Creek and successfully applied to streams in the area. Figure 3 shows the S-curve.

Rainfall-intensity-duration curves were developed from long term rainfall data, and are shown on Figure 4. A storm duration of three hours was selected for determining peak flow as historically, a storm of this duration, provides the highest peak flow in the Madera region. The adopted three hour depth-area-duration and rainfall distribution is shown in Figure 5.

Storms of four recurrence intervals were selected for study. The recurrence interval is the average interval in years between the occurrence of a specified size of storm and an equal or larger storm. For example, an event having a recurrence interval of 100 years has a probability of 1 percent of occurring in any one year.



MADERA STORM DRAINAGE PLAN
ROOT CREEK AREA

S-CURVE

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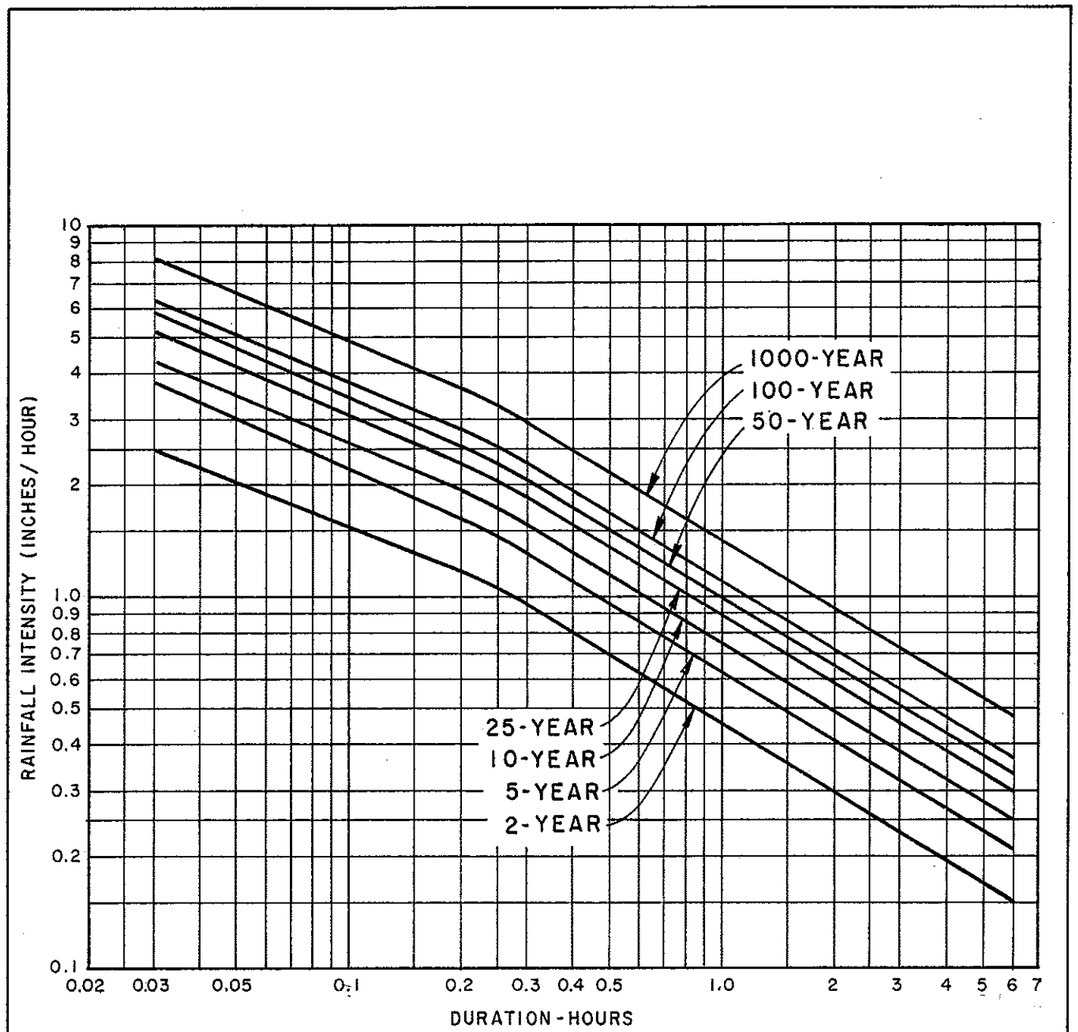
FIGURE 3



MADERA STORM DRAINAGE PLAN
ROOT CREEK AREA

INTENSITY–DURATION–FREQUENCY CURVES

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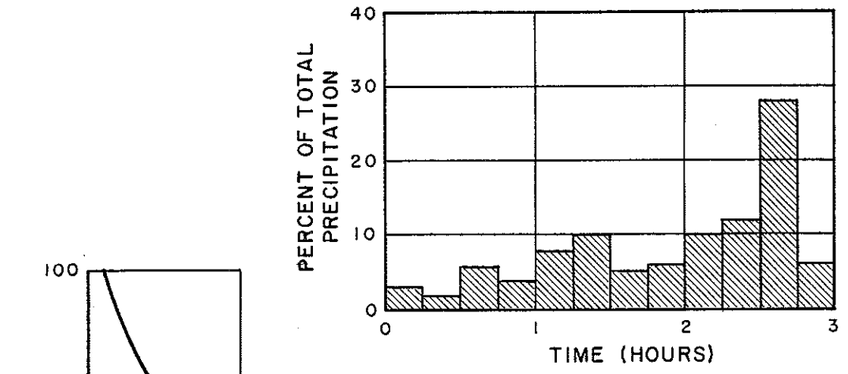
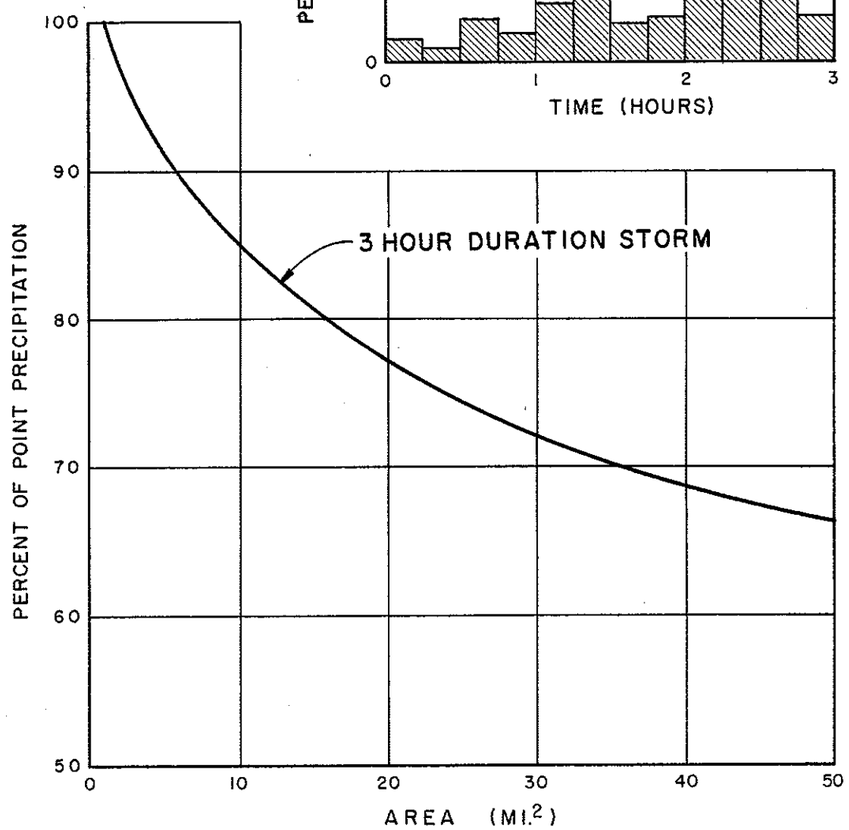
FIGURE 4





MADERA STORM DRAINAGE PLAN
ROOT CREEK AREA

DEPTH-AREA-DURATION AND PRECIPITATION DISTRIBUTION CURVES

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FIGURE 5

Storms with a recurrence interval of 10, 25, 50 and 100 years were selected for analysis. The HEC-1 models of each of the four basins were used to compute the resulting storm runoff hydrographs at each control point.

For smaller areas off-stream from the four primary stream channels, a modified version of the rational method was used. The rational method is based on the premise that the runoff from a specific area will equal the intensity of rainfall over the period of the time of concentration. The time of concentration is the time of flow along the longest flow path in the basin.

The rational method is expressed most simply as:

$Q = C\ i\ A$, where

Q = peak runoff

C = a coefficient of runoff

i = intensity of rainfall

A = area

The coefficient, C, expresses the land use and accounts for the on-land storage and infiltration and the actual runoff. Land use is represented by the percent impervious, a. The coefficient C

is computed by:

$$C = 0.85\ [a + I - 0.25\ (\frac{1.0 - a}{I})],$$ where:

C = runoff coefficient

a = percent impervious

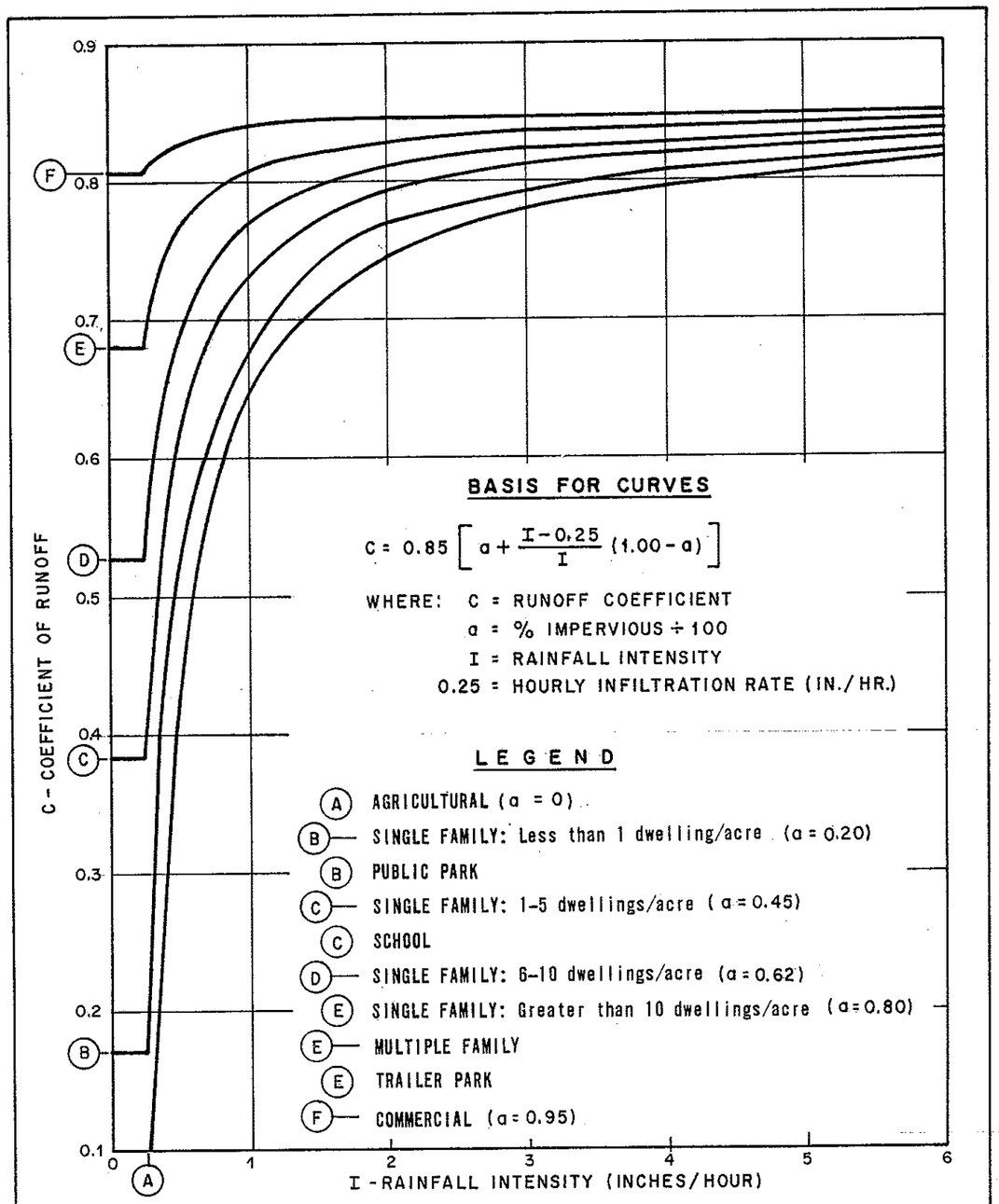
I = rainfall intensity over the time of concentration

For the Madera County study area a series of curves was computed to facilitate determination of C. These curves are shown in Figure 6.

The rational method has definite limitations and is not recommended as described for individual areas greater than 200 acres.

A step by step procedure is presented in Appendix C for use in the Madera Ranchos area by the County, landowners, developers and others to estimate storm runoff. A nomograph is provided, on Figure 7, to assist in estimating the time of concentration. A procedure is given for progression downstream combining flows and adding in tributaries and sub-areas.

For more comprehensive analysis, a standard form has been prepared, Figure 8, to logically organize the number procedure for a drainage analysis.



MADERA STORM DRAINAGE PLAN
ROOT CREEK AREA

COEFFICIENT OF RUNOFF CURVES

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FIGURE 6

DESIGN FLOWS

The results of the hydrologic analysis are the design flows. The design flows are the maximum flow rates that occur during the storm which produces the highest peak flow.

Two design flows were developed. The design flows shown in Table 1 are design flows that were developed considering that the peak flows would not be reduced as it passes through the stream system. These are the flood flows that are used to define existing flooding conditions and the design flows that are used in the flood insurance study.

In Table 2 the design flows are presented that would result from attentuation of the peak flow resulting from storage along the waterways. The storage results from the construction of the detention basin and from other inline storage resulting from existing culvert crossings.

TABLE 1
PEAK FLOOD DISCHARGE WITHOUT STORAGE

Location	10 year	25 year	50 year	100 year
MADERA RANCHOS NORTH				
Avenue 13 to Road 35	140	205	265	315
Road 35 to Road 33 1/2	360	540	710	855
Road 33 1/2 to ATSF Railroad	395	590	785	945
MADERA RANCHOS SOUTH				
Highway 41	170	240	290	340
Road 39 1/2	390	570	710	840
Canal	410	600	760	900
Road 37	240	270	380	440
Road 36	250	290	440	520
Road 33 1/2	280	430	610	750
Railroad	300	450	630	770
BONADELLE RANCHOS				
Avenue 13	15	20	20	20
Road 36	255	350	430	480
Road 35	270	385	495	600
West of Road 32	325	485	695	845
ATSF RR	320	475	690	835
ROOT CREEK				
Road 40	353	805	1011	1210
Road 38	620	950	1215	1460
Road 36	630	965	1220	1460
Road 36 - 1 mi W	770	1225	1640	1995
Railroad	870	1375	1860	2265

TABLE 2

DESIGN FLOWS WITH STORAGE
MADERA RANCHOS SOUTH
100-YEAR FLOWS

LOCATION	EXISTING FLOW	FLOW IN	FLOW OUT
3400' west of road 39 1/2	360	360	55
MID canal (0#	900	215	70
Rosemead Avenue	240	40	40
Road 37 3/4	255	65	65
Avenue 12 1/4	270	35	35
Road 37 1/2	290	95	65
Fernwood Drive	310	75	55
Maywood Drive (1# 36"cmp	315	75	35
Berkshire Drive	430	45	45
Road 37	440	60	60
Sparta Drive	440	70	70
Avenue 12	450	75	75
Trieste Road	470	160	110
Road 36 1/2	485	135	120
Haven Road	500	140	140
Road 36	520	180	140

TABLE 2

DESIGN FLOWS WITH STORAGE
MADERA RANCHOS NORTH/BONADELLE RANCHOS
25-YEAR FLOWS

	EXISTING FLOWS	FLOW IN	FLOW OUT
MADERA RANCHOS NORTH			
Road 38 1400' So of Ave 13 (1 12"	30	30	5
Road 37 3/4 (1 12"	20	20	5
Mrytlewood Drive (1 12"	25	25	5
Road 37 1/2	20	20	5
Fernwood Drive	20	20	5
Manon Drive	95	50	10
Marciel Drive	95	65	15
Mesa Drive	95	35	20
Road 37	195	60	10
Gleason Drive	195	45	10
Trieste Drive	200	40	10
Road 36 1/2	200	35	15
Charlton Road	200	80	15
Ardath Road	200	25	25
Road 36	205	55	25
Marciel West of Road 36	210	75	75
Road 35 1/2	220	120	30
Road 35	225	85	10
Road 34 1/2	NA	45	10
Avenue 12 at Road 34 1/2	NA	110	110
Avenue 12 at Railroad to Bonadelle	70	345	300
Road 33 1/2 South of Avenue 12	145	145	145
Road 32 at Trigo North	580	260	260
AT&SF Railroad	590	260	165
BONADELLE RANCHOS			
Road 38 n/o Dublin	50	50	10
Avenue 13 at Road 37 3/4	70	20	15
Avenue 13 e/o Mesa	70	70	25
Road 36 at Avenue 13	350	340	90
Road 35 at Avenue 13 1/4	385	320	125
Road 34 1/2 at Avenue 13 1/2	400	300	150
Railroad	480	480	60
100' west of railroad (pumps	70	60	20

CRITERIA

The following criteria were utilized in the selection and evaluation of drainage alternatives.

Detention Basins - Detention basins are water storage facilities located along the alignment of a waterway. A detention basin has the capability to store water during a period of high rainfall runoff which will reduce the maximum flow rate in the downstream channel by prolonging flow at a lower flow rate. Detention basin capacity shall be sufficient to contain a volume of storage equal to that produced by the 100-year runoff produced by two three hour 100-year rainfall storms. The detention basins should have the capability to be completely drained in 48 hours.

Roadway Culverts - All roadway culverts shall be designed to pass the 25-year flood without overtopping the roadway.

Channels - All channels shall be capable of passing the 25-year discharge in the banks with velocities less than five feet per second in unimproved channels.

ALTERNATIVES

Alternatives were selected for study that will best satisfy the following objectives:

a. Compatibility of the drainage improvements with the existing culverts channel and land uses.

b. Consideration of costs from both a capitol expenditure and operation and maintenance standpoint.

c. Maximum practical flexibility of operation for future changes in protection, drainage management and groundwater recharge plans.

Alternatives selected for discussion and evaluation for the Madera Ranchos area include, for each waterway, an alternative that includes no structural improvements, an alternative that requires all landowners to maintain all runoff on their own properties and alternatives that provides for structural improvements in accordance with the criteria. The alternatives are discussed in the following paragraphs.

Madera Ranchos South

Alternative I - This alternative includes no structural improvements along the channels. The flood limits for the

existing 100-year flood are delineated on sheets 1 through 12. In order to eliminate all future flood damage using this alternative, all new development would be prohibited within the area delineated as 100-year floodplain. The owners of the existing structures in the area would not be allowed to make substantial structural improvements. The owners of 22 existing structures would be required to flood proof the structures to a level adequate to prevent damage to the contents of the structures from the 100-year flood.

The cost associated with this alternative would result from the repair of flood damages to the Madera Irrigation District canal, the existing channel, culverts roadway and adjacent properties. Damages would be expected to occur after each significant occurrence of runoff.

This alternative would not be consistent with the protection criteria.

Alternative II - This alternative includes an upstream detention basin which is 13 feet in maximum height and will hold 284 acre feet of water. It is proposed that the detention basin will have installed in the embankment a 30 inch diameter outlet culvert. This culvert located at the channel invert will permit a continued release of water to occur during times of flood flow and will pass all non-flood flows. This alternative also includes plugging the culverts at the Madera Irrigation District

canal and diverting a maximum of 70 cfs into the canal by means of a single 36 inch diameter culvert through the canal embankment. Culvert improvements downstream of the MID canal will also be required as shown on the drawings. A more detailed description of the improvements is included in Appendix A.

Alternative III - This alternative is the same as Alternative II except that flood flows are not diverted into the Madera Irrigation Canal. One of the existing culverts under the canal will be blocked. The maximum flow through the remaining existing culvert will be controlled at about 70 cfs by culvert modifications. Improvements in culverts and channels would also be required.

Madera Ranchos North

Alternative I - This alternative includes no structural improvements to the existing system. The flooding limits for the 100-year flood in the existing system is shown on the drawings. Flood proofing of the 33 affected structures will be required along with the same floodplain controls recommended in Alternative I for the Madera Ranchos South.

Alternative II - This alternative includes building a small berm to prevent flooding from water to the north of Avenue 13 and improving all culverts and channels downstream to a capacity

adequate to contain the 25-year flood. The improvements recommended for this alternative are shown on the drawings and discussed in Appendix A.

Madera Ranchos West

Madera Ranchos West is the area between the drainage areas of Madera Ranchos North and South and Road 36. The drainage recommendation for this area are shown on the attached drawings and discussed in Appendix A.

Area West of Road 36

The routing of drainage for the area between Road 36 and the railroad tracks is shown on the attached drawings.

In the area between Road 36 and the railroad tracks stream channels are poorly defined. Due to land preparation for agriculture the historic channels have been eliminated. This results in sheet flow generally parallel to the east-west road system. The improvements shown on the drawings will provide the level of protection specified in the criteria and result in re-directions of the flow. Please note in Appendix A the specific discussion of reducing the flood storage from the termination of Madera Ranchos North, Madera Ranchos South and Root Creek.

On Site Storage Alternative

On site storage involves retaining all stormwater runoff on each individual property within the Madera Ranchos area.

The advantages of this approach is all runoff contributing to the flood flows from the area of on site storage will be eliminated. The remainder of the flows coming into the developed area from the remainder of the watershed will have to be dealt with.

The disadvantages are that each individual property owner would be required to size, design, operate and maintain a storage facility. Uniformity of the required facility, enforcing maintenance and reliability are substantial problems associated with this alternative.

COST ESTIMATES

Cost estimates for each alternative involving structural improvements are shown on the following tables.

For each facility in each alternative a cost estimate of construction costs was prepared for comparison purposes. The cost estimates were based on a generalized analysis of the components of the various facilities and a determination of the quantities of materials and work required for construction.

Unit costs used in preparing the cost estimates were obtained from annual publications which contained unit costs information on a national basis. These costs were adjusted for region. The costs are expected to be good for 1984 estimates. A contingency factor has been added to the total numbers to account for the preliminary nature of the alternative unknown conditions, future price increases, and future design costs. No costs have been included for design construction management, administration, or inspection.

Maintenance costs were determined considering only channel maintenance which basically consists of weed maintenance and cleaning of channels. All maintenance of culverts is expected to be performed as part of normal roadway maintenance.

The total estimated cost of right of way and the construction of the facilities included in the reconstruction plan is $1,157,145. The total cost of operation and maintenance is estimated to be $7,747/year.

Right of way costs were determined based on recent sales price data obtained from local real estate agents and generalized so they could be applied to the areas occupied by the proposed facilities.

No cost estimates were prepared for the non structural or on-site drainage retention alternatives.

COST ESTIMATE

MADERA RANCHOS, SOUTH

ALTERNATIVE II

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
1. Detention Dam - 13'Hx750'	CY	9 400	2 50	23 400
Outlet Works 30"ϕ	LF	80	24 00	2 000
2. MID Canal - Block (E) Culverts	LS	1	500 00	500
Canal Inlet (1) 36" RCP	LF	60	70 00	4 200
Gates & Structure	LS	1	10,000 00	10 000
3. Maywood - Block one 36" CMP	LS	1	500 00	500
4. Rd 33½ - Berm 2'x10'x7000 &				
Ditch 3'x30'x4700	CY	15 700	2 00	31 000
5. Railroad at Avenue 11 -				
Deepen Box Culvert	LS		1,000 00	1 000
Deepen Ditch West of RR	CY	1 700	1 00	1 700
Deepen Ditch RR to Rd 32	CY	1 000	1 50	1 500
IMPROVEMENT TOTAL - MADERA RANCHOS SOUTH				75 800
IMPROVEMENT CONTINGENCIES - 15%				11 370
6. Land Costs				
Detention Basin Item 1	AC	100	2,250 00	225 000
Detention Basin Item 2	AC	25	3,000 00	75 000
Ditch 40'x4700' Item 4	AC	4.2	4,000 00	16 500
Reset Row End Stakes	LS		8,000 00	8 000
TOTAL LAND - MADERA RANCHOS SOUTH				324 500
LAND CONTINGENCY - 10%				32 450
TOTAL - MADERA RANCHOS SOUTH				444 120

COST ESTIMATE

MADERA RANCHOS SOUTH

ALTERNATIVE II

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
Root Creek Diversion Pumping	LS	(324 AF)		878 yr
Canal Diversion Maintenance	LS	(185 AF)		615
Avoided Pumping	LS	(185 AF)		(328)
Trigo Pumping & Maintenance		(43 AF)		199
OPERATIONS & MAINTENANCE TOTAL				1 364 yr

COST ESTIMATE

MADERA RANCHOS NORTH

ALTERNATIVE II ...

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
1. Myrtlewood Drive - (1) 12" cmp	LF	40	10 00	400
Remove & Replace Pavement	SF	100	2 00	200
2. Avenue 13/Mesa - Construct Berm	CY	200	2 00	400
3. Marciel Drive - (1) 18" cmp	LF	40	15 50	620
Remove & Replace Pavement	SF	100	2 00	200
4. Road 36½ - (2) 18" cmp	LF	80	15 50	1 240
Remove & Replace Pavement	SF	144	2 00	300
5. Charlton Road - (2) 18" cmp	LF	80	15 50	1 240
Remove & Replace Pavement	LF	144	2 00	300
6. Road 36 - (1) 24" cmp	LF	50	18 50	930
Remove & Replace Pavement	SF	120	2 00	240
7. Marciel Drive - Grade Ditch	CY	1 900	1 50	2 800
8. Road 34½ - Deepen Ditch	CY	1 200	2 00	2 400
9. Avenue 12 - 2' Berm Road 32				
to 33½	CY	3 500	2 00	7 000
10. Ave 12 @ Railroad-Block 36" cmp				
Grade Ditch to Bonnadelle	CY	1 300	1 50	3 200
11. Road 32 - (4) 54" cmp	LF	200	66 00	13 200
Grade Ditch to railroad	CY	1 830	1 50	2 700
Remove & Replace Pavement	SF	720	2 00	1 440

COST ESTIMATE

MADERA RANCHOS NORTH

ALTERNATIVE II

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
12. Railroad - Bore & Jack (2) 42"	LF	120	550 00	66 000
13. Avenue 12-2800' West of Railroad				
Construct 2-5000 gpm pump	LS		28,000 00	28 000
Construct Ditch to Bonadelle	CY	3 800	2 00	7 600
Construct Culvert Under Ave 12	LS		1,700 00	1 700
IMPROVEMENT SUBTOTAL				142 100
IMPROVEMENT CONTINGENCY - 15%				21 315
14. Land Costs				
Item 2 - Construct Berm on				
Road R/W	AC	0		0
Item 7 - Land for Ditch20'x1300'	AC	0.6	1,500 00	1 000
Item 8 - Land for Ditch20'x1800'	AC	.09	1,500 00	1 300
Item 9 - Land for Berm on Rd R/W	AC	0		0
Item 10-Land for Ditch 80'x1100'	AC	1.0	1,500 00	1 500
Item 13-Land for Ditch 20'x2300'	AC	1.1	4,000 00	4 300
LAND SUBTOTAL				8 100
LAND CONTINGENCY - 10%				810
TOTAL				172 325
Pumping - At Bonadelle				418 yr
- At Trigo				562
Maintenance - At Bonadelle				448
- At Trigo				711
OPERATION & MAINTENANCE TOTAL				2 140

COST ESTIMATE

MADERA RANCHOS SOUTH

ALTERNATE III
FLOW UNDER CANAL

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
1. Detention Dam 13 x 750	CY	9 400	2 50	23 400
30" cmp Outlet	LF	80	24 00	2 000
2. MID Canal - Block One Culvert	LS		500 00	500
Decrease Inlet to 36" ϕ	LS		1,000 00	1 000
3. Rosemead - Excavate Swale	CY	350	2 00	700
4. Road 37 1/2- Add two 36" cmp	LF	80	45 00	3 600
Remove and Replace Pavement	SF	440	2 00	880
5. Fernwood Drive-Add one 36"cmp	LF	40	45 00	1 800
R&R Pavement	SF	280	2 00	560
6. Berkshire-Add one 36" cmp	LF	40	45 00	1 800
R&R Pavement	SF	280	2 00	560
7. Road 37 - Add two 36" cmp	LF	80	45 00	3 600
R&R Pavement	SF	440	2 00	880
8. Sparta - Add one 36" cmp	LF	40	45 00	1 800
R&R Pavement	SF	280	2 00	560
9. Road 33 1/2 - Berm 2'x10'x7000'				
Ditch 3'x30'x4700'	CY	15 700	2 00	31 000
10. Railroad @Avenue 11 - Clean Box	LS		1,000 00	1 000
Deepen Ditch West of R/R	CY	1 700	1 00	1 700
Deepen Ditch E/O R/R	CY	1 000	1 50	1 500
Madera Ranchos South - Alternative III Improvement Total				78 840
Improvement Contingency - 15%				11 830

COST ESTIMATE

MADERA RANCHOS SOUTH

ALTERNATIVE III

FLOW UNDER CANAL

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
11. Land Costs				
Detention Basin Item 1	AC	100	2,250 00	225 000
Detention Basin Item 2	AC	25	3,000 00	75 000
Ditch 40' x 4700' Item 9	AC	4.2	4,000 00	16 500
Reset Row End Stakes	LS		8,000 00	8 000
Total Land - Madera Ranchos South Alt III				324 500
Land Contingency - 10%				32 450
				447 616
Operations & Maintenance				
Root Creek Diversion Pumping				900 yr
Trigo Basin Pumping				200 yr
Operations & Maintenance Total				1 100

COST ESTIMATE

MADERA RANCHOS WEST

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
1. Grade between Lots	CY	612	2 00	1 230
2. Grade Roadside Ditches	CY	207	2 00	520
3. Road Culverts 12"&18" cmp (4loc)	LF	200	14 00	2 800
Pavement Replacement	SF	432	2 00	900
4. Road 36½ - 2'x4' Concrete Gutter	LF	400	14 75	6 900
5. Road 36 @ Blossom (1) 24" cmp	LF	50	20 00	1 000
Pavement Replacement	SF	168	2 00	350
6. Road 36 & Avenue 12 - Ditch 2000'	CY	1 300	1 50	1 950
IMPROVEMENT SUBTOTAL				14 650
IMPROVEMENT CONTINGENCY - 15%				2 200
7. Land Costs				
Items 1 and 4 (400'x10'x4)	AC	.36	6,000 00	2 200
Item 6 (20'x2000')	AC	1	6,000 00	6 000
LAND SUBTOTAL				8 200
LAND CONTINGENCY - 10%				820
TOTAL				25 900
OPERATION AND MAINTENANCE INCLUDED IN MADERA RANCHOS NORTH				

COST ESTIMATE

BONADELLE RANCHOS

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
1. Rd 38 - Roadside Berm	CY	1 125	2 00	2 250
Extend 18" Culvert	LF	15	20 00	300
2. Road 36 - 42" CMP F.L. 330	LF	50	53 00	2 650
Remove & Replace Pavement	SF	240	2 00	480
3. Road 35 - (3) 36" CMP	LF	225	45 00	10 140
Remove & Replace Pavement	SF	1 080	2 00	2 160
4. Road 34½ - (3) 36" CMP	LF	150	45 00	6 750
Remove & Replace Pavement	SF	432	2 00	900
Ditch around Field	CY	10 400	1 50	15 600
5. 1000' West of Railroad				
(2) 5000 gpm Pumps (50 HP)	EA	2	9,000 00	18 000
Pump Electrical Installation	LS			10 000
Ditch to Road 30½	CY	3 700	2 00	7 400
Road 30½ Culvert - 30" CMP	LF	60	24 00	1 440
Remove & Replace Pavement	SF	120	2 00	240
IMPROVEMENT SUBTOTAL				78 300
IMPROVEMENT CONTINGENCY - 15%				11 745
6. Land for Item 1	AC	10	1,500 00	15 000
Land for Item 4	AC	1	1,500 00	1 500
LAND SUBTOTAL				16 500
LAND CONTINGENCY - 10%				1 650
TOTAL				108 200
Pumping				514 yr
Maintenance				552 yr
ADDITIONAL OPERATION & MAINTENANCE TOTAL				1 066 yr

COST ESTIMATE

ROOT CREEK

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST
1. Detention Dam-West of Railroad				
Grading - 9' high x 1400'	CY	9 000	2 00	22 500
Outlet (30" cmp & gate)	LS			6 000
2. Pump Station - (3) 10,000 gpm	EA	3	13,000 00	39 000
Pump Switchgear	LS			9 000
Pump Outlet Ditch to Canal	CY	6 650	1 50	10 000
Canal Inlet-(3) 36 w/gates	EA	3	5,000 00	15 000
IMPROVEMENT SUBTOTAL				101 500
IMPROVEMENT CONTINGENCY - 15%				15 225
3. Land for New Basin West of R/R	AC	66	4,000 00	263 544
LAND CONTINGENCY - 10%				26 354
TOTAL				406 600
Maintenance - Dam, Pump, Outlet	LS		500 00	500 yr
Pumping of Existing Storm	LS			2 350 yr
OPERATION & MAINTENANCE TOTAL				2 850

RECOMMENDED IMPROVEMENTS

The recommended improvements consist of those included in Madera Ranchos South Alternative II, Madera Ranchos North Alternative II, the Madera Ranchos West improvements and improvements to the area west of Road 36. These improvements are shown on the attached drawings (Sheet 1 through 12). All costs described in the discussion are estimates of construction costs only. Right of way costs are shown on the cost estimate sheets.

MADERA RANCHOS SOUTH

The key feature of the Madera Ranchos South is the detention basin shown on Sheet 11. This detention basin will hold peak flows and eliminate downstream flooding that would have resulted from these peak flows. The estimated cost of the construction of this detention basin with contingencies is approximately $30,000.

Flow continues in the Madera Ranchos South downstream of the proposed detention basin through an existing water catchment to the Madera Canal lateral. At this point it is recommended in the alternative that the two existing 42 inch diameter culverts under the canal be blocked and that a 42 inch diameter culvert with a flap gate inlet into the canal be installed. Considering the resulting storage upstream of the canal along with the discharge to the canal of a maximum of approximately 70 cfs, all flows upstream of the canal will be diverted into the Madera Canal system and conveyed to a point for utilization for ground water recharge or wasted to the San Joaquin River.

As a result of these detentions and diversions no culvert improvements will be required through the Madera Ranchos South area as shown on Sheet 10.

It is recommended that one of the existing 36 inch diameter culverts at Maywood Drive be blocked. The blocking of this culvert would allow for additional storage to be gained and to reduce downstream peak flows. The estimated cost of the blocking of this culvert including contingencies is approximately $575. This blockage eliminates culvert and ditch enlargements which would otherwise be needed at Berkshire Drive, Road 37, and Sparta Avenue. The cost saving is approximately $19,500 (See Page 48).

There are then no other required improvements on Madera Ranchos South through the urbanized area. Flooding limits are shown on Sheet 9.

To the west of the urbanized area flood flows will continue on through the existing channel west of Road 36. The capacity of this channel is not sufficient to pass the 100-year discharge of 140 cfs at Road 36 and 550 cfs at Road 33 1/2. As a result there will be some sheet flow proceeding towards the west and southwest to Trigo and to Root Creek.

No improvements in the channel are recommended as this sheet flow does not jeopardize any structures, is of short duration, is consistent with existing conditions, occurs at rare intervals and does little damage considering the existing land use. If at a future time land use is changed for this area, it may be

necessary to either expand the capacity of the existing channel or provide alternative methods of conveying the flood flows. The flood limits are shown on Sheet 6. Channelization of this flow would require a ditch 6 feet deep with a bottom width of 15 feet at a cost of $9 to $12 per foot. Total cost would be $130,000 or more.

Flood flow limits for both the existing and proposed condition continuing to Road 33 1/2 are shown on Sheet 5. A berm and ditch is proposed along the east side of Road 33 1/2 to direct flows to the Root Creek basin, protect Trigo, and minimize flows into Trigo Basin, which, unlike Root Creek, has no low level outlet. The estimated cost of this ditch and berm with contingencies is approximately $36,000.

There are additional flows that will result from local runoff to the west of Avenue 33 1/2. These flows will be routed along Avenue 11 as shown on Sheets 5 and 4. As shown on Sheet 4, these flows will be routed along the west side of the railroad tracks through an improved ditch and improved box culvert. The cost of these improvements is estimated to be approximately $4,800 with contingencies.

The flow then terminates in the detention site as shown on Sheet 4 west of Trigo.

MADERA RANCHOS NORTH

The improvements on Madera Ranchos North do not include any new facilities at Road 38 or Road 37 3/4. The first upstream

improvement recommended is the addition of a 12 inch culvert to supplement the existing culvert under Myrtlewood Drive. It is recommended that the existing culvert under Avenue 13 to the north be blocked and a berm constructed along the reach between Mesa Drive and Road 37 1/2. The berm elevation is 384.5 as noted on Sheet 8 and is only one foot higher than the road low point. The cost is estimated at less than $500 and eliminates the need for most culvert or channel improvements. This berm is the most important recommended feature for protection of Madera Ranchos North.

The alternative to this simple berm would be an addition of culverts at every road at an average cost of $23,000 each and excavation of a ditch three feet deep by 15 feet wide at a cost of $3.50 per lineal foot. A total cost from Road 38 to Road 36 of about $491,000.

It is recommended that an additional 18 inch diameter culvert be added under Marciel Drive. No additional changes are required down to Road 36 1/2. At Road 36 1/2 two additional 18 inch diameter culverts are proposed to be installed. An additional 18 inch culvert is proposed to be installed at Charlton Road. At Road 36 an additional 24 inch diameter culvert is proposed and grading improvements will be required along Marciel Drive. The ditch should be deepened at Road 34 1/2 as shown on the drawings.

It is recommended that a two foot berm be added to the north side of Avenue 12 between Roads 33 1/2 and 32 to direct the flows to

the west and prevent overtopping of Avenue 12. At the intersection of Avenue 12 and the railroad the existing 36 inch diameter culvert should be blocked in order to allow the flows to parallel the railroad through a proposed five foot wide ditch to the Bonadelle drainage area. Disposal of water from the Bonadelle basin to Cottonwood Creek is less expensive than disposal from the Trigo basin.

At the Road 32 crossing of Madera Ranchos North it is proposed to add four 54 inch diameter culverts to allow the flows to pass under Road 32. It is also proposed to add two 42 inch culverts under the railroad tracks. The total cost of all facilities on Madera Ranchos North to this point as shown on the cost estimate is approximately $121,000 including contingencies.

In order to drain the flooded area west of Trigo it is proposed to install two 5,000 gpm pumps, that pump outlet pipes be constructed under Avenue 12, and ditches be excavated to convey the flow to the Bonadelle drainage outlet ditch to Cottonwood Creek. The cost of the pumps and drainage facilities is estimated to be approximately $43,000.

MADERA RANCHOS WEST

The Madera Ranchos West improvements are shown on Sheet 9 and include a small amount of ditching between Gleason Drive, Gabor Way, Trieste Road and Road 36 1/2 to drain the area. The ditch size varies from a depth of two feet and a width of ten feet to a concrete lined ditch two feet deep and four feet wide.

Improvements of the existing ditch paralleling Road 36 are also recommended.

To make the drainage continuous new culverts are proposed from Gabor Way to Road 36 1/2 and one new 24" diameter culvert is proposed to be constructed at Road 36. All drainage will be added to that flowing in Madera Ranchos North along Avenue 12. The cost of these improvements with contingencies is estimated to be approximately $17,000.

BONADELLE RANCHOS

In the Bonadelle Ranchos as shown on Sheet 11, it is proposed that a berm be constructed at the edge of Road 38 to an elevation of 358 and to extend the existing 18 inch culvert to provide a small amount of detention at this point. The next improvements as shown on Sheet 3 are an additional 42 inch diameter culvert under Road 36; channel improvements as shown along Avenue 13; three additional 36 inch diameter culverts to be installed at the crossing of Road 35; improvements on the ditch towards the north to the crossing of the intersection of Road 34 1/2 and Avenue 13 1/2 and west along Avenue 13 1/2 to the old channel; and by the addition of three 36 inch diameter culverts at Avenue 13 1/2. These improvements will bring the flows to the terminal storage of the Bonadelle Ranchos. It is proposed that two 5,000 gpm pumps be added at a point about 1,000 feet west of the railroad tracks, to pump the stored water to Cottonwood Creek just south of Avenue 13 by way of existing ditches which will require some

modification. The construction cost of all improvements on the Bonadelle Ranchos is estimated to be approximately $90,000.

Improvements on Root Creek include the construction of a detention dam west of the railroad tracks to increase storage to that required. This dam will be approximately nine foot high and 1,400 feet long with a 30 inch diameter gated outlet. The approximate construction cost of facility is estimated to be $33,000. As shown on Sheet 12 this water will be conveyed to the Madera Canal by the installation of three 10,000 gpm pumps, appropriate switch gear, and ditching in order to drain this area consistent with the criteria. The construction cost of these facilities is approximately $84,000 including contingencies.

The top four feet of the maximum pool (about 55% of the volume) will drain into the Madera Irrigation District Canal without pumping after construction of the connection ditch and inlet pipes. This would give partial control and disposal without installation of the pumps at a cost saving of about $50,000.

Elimination of the pumps would require at least 45% of storage in the basin be drained by release of the water at a controlled rate in sheet flow along Avenue 10 and thru crop land to the south west.

The pump installation is recommended because it allows complete control and drainge of the storage area in a maximum of 16 days and allows all water to be routed to recharge areas.

IMPLEMENTATION PLAN

When implementing the drainage system there are certain structures and excavation activities that should precede others to insure that flood control benefits are obtained in proportion to funds expended.

The priority of improvements is as follows:

1. Construct detention basins on Madera Ranchos South.

2. Construct inlet to Madera Irrigation District canal and block culverts under canal.

3. Construct berm along North Side of Avenue 13 between Mesa Drive and Road 37 1/2 on Madera Ranchos North.

4. Construct Improvements in Madera Ranchos West.

5. Construct new culverts on Madera Ranchos North beginning from the west and proceeding towards the east and block culvert at Maywood on Madera Ranchos South.

6. Construct improvements west of Road 36.

METHOD OF FINANCING

Several methods are available for financing the necessary improvements. Common financing mechanisms utilized for drainage improvements include the following: covenant agreement with land developer requiring the developer to provide the necessary financing, formation of assessment districts with special assessments to the beneficiaries of the project, a special tax, or a drainage fee.

In the Madera Ranchos area we recommend a benefit assessment under authority given in Chapter 261 of the Government Code and a countywide drainage fee be assessed.

Chapter 261 as amended in 1979 by AB 549 (Frazee) authorizes the County to fix and collect charges for an extended service such as the proposed drainage improvements. The law requires that the amount of the assessment be proportional to the benefit received. The requirements for notice, hearings and voter approval are described in the statute.

Drainage fees are normally based on a dollar amount per acre or a dollar amount per square foot of impervious area. The fee is paid only when property is developed. All new development and additions to existing development would bear a share of the cost of drainage improvements. The fee would be paid prior to the

issuance of a building permit or prior to approval of a final map for a subdivision. The cost to each development would vary with the number of units per acre or the amount of impervious area created. The more units per acre the greater the cost per acre. This relationship is proportional to the expected rainfall runoff for the various impervious area densities. For ease of administrating the ordinance these could be expressed in dollars per unit for the various densities of residential land use. For additions to existing developments the fee would be assessed as a flat dollar amount per square foot of new impervious area.

In the established master drainage plan there are two distinct types of recipients of benefits from the drainage improvements. There are those people who currently have developed lands that have inadequate flood protection and those lands which still remain agricultural with inadequate drainage. These areas can be separated out as those areas along the waterways studied between Roads 36 and 38, and all other areas.

The proposed facilities that directly benefit the area between Roads 36 and 38 are the detention basin as proposed in Alternative II, the inlet to the Madera Irrigation District lateral, and the channel and culvert improvements between Roads 36 and 38.

We recommend that a benefit district be established within the limits of the urbanized area that would sell bonds to pay the

cost of construction of these facilities. All other recommended facilities should be paid for as they are constructed from drainage fees assessed to those who will be improving the lands.

It can be seen from the cost estimates within this report that the actual burden of these costs to the beneficiaries will not be large. Therefore the attractiveness to this type of high benefit investment should be great for those property owners involved.

APPENDIX A
COMPARISON OF ALTERNATIVES

This appendix contains comparison information for the many considerations involved in arriving at the recommended alternatives. For clarity of presentation and comparison this data is presented in a tabular form. These comparisons and considerations can best be followed while reviewing sheets 1 through 12.

MADERA RANCHOS NORTH

LOCATION	POSSIBLE ALTERNATIVES	RECOMMENDATION	COSTS		CAPACITIES - (Q_{25} OUT / V_{100})			WATER SURFACE		INFLOW
			POSSIBLE ALTERNATIVE	RECOMMENDED ALTERNATIVE	EXISTING CFS/AF	NEEDED CFS/AF	PROPOSED CFS/AF	UPSTREAM	DOWNSTREAM	Q_{25} CFS
1. RD 38 S/O DUBLIN	ADD CULVERTS FOR Q_{25} INFLOW	NOTHING NEEDED (E) 12" CMP	$ 0	$ 0	3.5/4.4	3.5/4.2	3.5/4.4	354.0	353.0	30
2. ROAD 37 3/4	ADD CULVERTS	NOTHING NEEDED (E) 12" CMP	$ 0	$ 0	3.0/1.7	3.0/1.7	3.0/1.7	349.0	348.0	18
3. MYRTLEWOOD DRIVE	ADD CULVERTS (N) 12" CMP	ADD ONE 12" CMP (E) 12" CMP	$ 600	$ 600	2.0/0.6	4.0/0.6	4.0/0.6	346.0	345.5	24
4. *ROAD 37½	ADD CULVERTS	NOTHING NEEDED (E) 12" CMP	$ 0	$ 0	4.5/1.2	4.5/2.6	4.5/1.2	345.5	344.5	17.5
5. FERNWOOD DRIVE	ADD CULVERTS	NOTHING NEEDED (E) 12" CMP	$ 0	$ 0	4.0/1.9	4.0/1.8	4.5/1.9	343.9	342.5	21.5
6A. AVENUE 13 - MESA	CONSTRUCT BERM & BLOCK 12" CULVERT RAISE AVENUE 13 & BLOCK 12" CULVERT	CONSTRUCT BERM - BLOCK CULVERT	$ 400 $ 21,600	$ 400 $ 0	16/18	50/45	50/45	348.0	347.5	100
6B. MANON DRIVE	ADD CULVERTS	NOTHING NEEDED (E) 18" CMP	$ 0	$ 0	10/4.2	10/1.0	10/1.0	345.4	345.0	49
7. MARCIEL DRIVE	ADD CULVERTS (N) 18" CMP	ADD ONE 18" CMP - (E) 12" CMP	$ 820	$ 820	5/2.4	13/2.6	13/2.6	344.0	342.5	66
8. MESA DRIVE	ADD CULVERTS	NOTHING NEEDED (E) TWO 18" CMP	$ 0	$ 0	19/0.8	19/0.8	19/0.8	342.0	340.8	33
9. ROAD 37	ADD CULVERTS	NOTHING NEEDED (E) 18" CMP	$ 0	$ 0	11/18	7.5/7.5	7.5/7.5	340.9	339.5	60
10. *GLEASON DRIVE	ADD CULVERTS	NOTHING NEEDED (E) 18" CMP	$ 0	$ 0	8.2/3.2	8.2/4.3	8.2/3.2	339.5	337.0	46
11. TRIESTE	ADD CULVERTS	NOTHING NEEDED (E) 18" CMP	$ 0	$ 0	10.0/8.5	6.0/3.9	6.0/3.9	337.0	336.0	41.5
12. ROAD 36½	ADD CULVERTS (N) TWO 18" CMP	ADD TWO 18" CMP (E) 18" CMP	$ 1,540	$ 1,540	4.6/0.6	14/0	13.8/0.2	333.5	333.0	35.6
13. CHARLTON ROAD	ADD CULVERTS (N) 18" CMP (2)	ADD TWO 18" CMP (E) 18" CMP	$ 1,540	$ 1,540	6.6/4.0	13.2/2.2	13.2/2.0	331.0	329.8	79
14. *ARDATH AVENUE	ADD CULVERTS RAISE STREET & ADD 36" CMP	NOTHING - (E) 18" CMP DO NOTHING - LET STREET FLOOD	$ 0 $ 14,500	$ 0 $ 0	3.5/0.8	2.3/2.7	3.5/0.8	329.8 330.0	329.8 329.8	23.8 23.8
15. ROAD 36	ADD CULVERTS (N) 24" CMP	ADD ONE 24" CMP (E) 18" CMP	$ 1,170	$ 1,170	6.0/3.4	18.8/3.1	18.8/3.1	329.8	329.0	56.3
16. MARCIEL DRIVE EAST OF ROAD 36	ADD CULVERTS (E) 18" CMP - 4 LOCATIONS GRADE DITCH ALONG SOUTH SIDE OF MARCIEL	BYPASS CULVERTS WITH DITCH GRADE DITCH - 4' x 1300'	$ 6,000 $ 2,800	$ 0 $ 2,800	6.0 52	52 52/2.7	52 52/2.7	325.5	323.5	52
17. ROAD 35½	ADD CULVERTS	NOTHING NEEDED (E) 12" & 24" CMP	$ 0	$ 0	26.5/4.1	26.5/3.8	26.5/0	323.2	320.0	117
18. ROAD 35	ADD CULVERTS	NOTHING NEEDED (E) 18" CMP	$ 0	$ 0	11.5/28	11.5/18.6	11.5/18.6	317.0	315.5	84
19. ROAD 34½ - BLOSSOM	ADD CULVERTS	NOTHING NEEDED (E) 18" CMP	$ 0	$ 0	6.5/3.3	6.5/5.6	6.5/3.3	309.5	308.5	44
20. ROAD 34½	DEEPEN DITCH TO AVE. 12 ON WEST SD. RD. 34½	DEEPEN DITCH - 4' x 1800', F.L. 308	$ 2,400	$ 2,400	UNKNOWN	6.5	6.5	308.5	308.0	6.5
21. *ROAD 34½ - AVE. 12	ADD CULVERTS & RAISE ROAD	NOTHING - FLOW OVER ROAD 34½	$ 0	$ 0	170/0	170/45	170/0	308.5	307.5	170
22. *ROAD 33½ - AVE. 12	ADD CULVERTS 4-48" CMP WEST	NOTHING - FLOW OVER ROAD 33½	$ 17,600	$ 0	346/0	346/111	346/0	300.0	289.0	346
23. AVENUE 12/ROAD 33½	ADD CULVERTS 4-54" CMP SOUTH CONSTRUCT BERM ON NORTH SIDE AVENUE 12 - ROAD 32 TO ROAD 33½	NOTHING NEEDED - (E) 18" CMP CONSTRUCT BERM 2'Hx6'Wx7900'	$ 15,400 $ 7,000	$ 0 $ 7,000	12/32 UNKNOWN	0/0 346/0	12/32 346/0	298.0 298.0	295.0 280.5	346 346
24. AVENUE 12/RAILROAD	ADD CULVERTS GRADE DITCH NORTH TO BONADELLE BASIN	NOTHING NEEDED - (E) 36" CMP 12' x 5' x 1100' DITCH - CLOSE 36" CMP	$ 0 $ 3,200	$ 0 $ 3,200	70/130 346/70	70/130 346/199	70/130 346/199	280.5 277.0	276.0 276.0	346 346
25. *ROAD 33½ S/O AVE 12	ADD CULVERTS - 1-36" CMP	NOTHING REQUIRED (E) 18" CMP	$ 3,000	$ 0	7.0/18.0	143/18	7.0/1.9	294.5	293.0	143

*ROADS WHICH FLOOD IN 100 YEAR STORM

MADERA RANCHOS NORTH

	LOCATION	POSSIBLE ALTERNATIVES	RECOMMENDATION	COSTS		CAPACITIES - (Q_{25} OUT / V_{100})			WATER SURFACE		INFLOW
				POSSIBLE ALTERNATIVE	RECOMMENDED ALTERNATIVE	EXISTING CFS/AF	NEEDED CFS/AF	PROPOSED CFS/AF	UPSTREAM	DOWNSTREAM	Q_{25} CFS
26.	ROAD 32 AT TRIGO	ADD CULVERTS FOR FLOW SOUTH OF AVE 12 ONLY	ADD FOUR - 54" CMP (E) 36" CMP	$ 14,600	$ 14,600	34/5	261/5	261/5	277.0	276.5	261
		GRADE DITCH TO RAILROAD	GRADE DITCH F.L. 273.0 - c' X 40'	$ 2,700	$ 2,700	261/10	261/10	261/10	276.5	276.5	261
		ADD CULVERTS FOR TOTAL FLOW - 10-54" CMP	NOT REQUIRED - SEE 23 & 24 ABOVE	$ 48,000	$ 0	34/5	589/5	261/5	277.0	276.5	589
27.	RAILROAD	ADD CULVERTS FOR SOUTH OF AVE 12 ONLY	ADD TWO 42" STEEL (E) 24" CMP	$ 66,000	$ 66,000	18/95	182/15	182/15	276.5	273.0	261
		ADD CULVERTS FOR TOTAL FLOW (4-54" STEEL)	UNNEEDED-SEE 23 ABOVE	$132,000	$ 0	18/95	424/15	424/15	276.5	273.0	589
28.	AVE 12 2800' WEST OF RAILROAD	CONSTRUCT PUMP STATION (2) 5000 GPM	CONSTRUCT	$ 28,000	$ 28,000	0	22/486	22/486	266.0/271.5	282.0	261
		CONSTRUCT DITCH TO BONADELLI	CONSTRUCT	$ 7,600	$ 7,600	0	22/486	22/486			
		CONSTRUCT CULVERT UNDER AVE 12 (30" CMP)	CONSTRUCT	$ 1,700	$ 1,700	0	22/486	22/486			
			IMPROVEMENT TOTAL		$142,100						

MADERA RANCHOS WEST

LOCATION	POSSIBLE ALTERNATIVES	RECOMMENDATION	COSTS		CAPACITIES - (Q_{25} OUT / V_{100})			WATER SURFACE		INFLOW
			POSSIBLE ALTERNATIVE	RECOMMENDED ALTERNATIVE	EXISTING CFS/AF	NEEDED CFS/AP	PROPOSED CFS/AP	UPSTREAM	DOWNSTREAM	Q_{25} CFS
1. GLEASON TO CARRON	GRADE SWALE BETWEEN LOTS	GRADE SWALES	$ 1,230	$ 1,230	UNKNOWN	41/4.8	41/4.8	339.5	334.0	41
	ADD CULVERTS (E) 12" CMP	ADD ONE 18" CMP AT EACH STREET	$ 3,700	$ 3,700	UNKNOWN	41/4.8	4.5/4.8			41
	GRADE ROADSIDE DITCH	GRADE DITCH - CARRON & TRIESTE	$ 520	$ 520	UNKNOWN	41/4.8	41/4.8			41
2. CARRON TO ROAD 36½	BUILD CONCRETE GUTTER	BUILD GUTTER 2' DEEP x 4' WIDE	$ 5,900	$ 5,900		41/4.8	41/4.8	334.0	332.0	41
3. ROAD 36 AT BLOSSOM	ADD CULVERTS (E) 3-18"	ADD ONE - 24" CMP	$ 1,350	$ 1,350	13.5/18	28/18	28/18	327.4	326.9	141
	GRADE DITCH TO DRAIN 5' x 2000'	GRADE DITCH - F.L. 324.5, 5' WIDE	$ 1,950	$ 1,950		28/18	28/18	326.9	324.9	28
4. ROAD 36 AT AVE. 12	CONNECT DITCH TO 24" CIPP F.L. 324.4	NOT RECOMMENDED	$ 2,000	$ 0	16	28/18				
		IMPROVEMENT TOTAL		$14,650						

BONADELLE RANCHOS DRAINAGE

LOCATION	POSSIBLE ALTERNATIVES	RECOMMENDATION	COSTS		CAPACITIES - (Q_{25} OUT / V_{100})			WATER SURFACE		INFLOW
			POSSIBLE ALTERNATIVE	RECOMMENDED ALTERNATIVE	EXISTING CFS/AF	NEEDED CFS/AF	PROPOSED CFS/AF	UPSTREAM	DOWNSTREAM	Q_{25} CFS
1. RD 38 S. OF AVE. 13	CONSTRUCT BERM - EXTEND 18" CMP	CONSTRUCT BERM & CULVERT	$ 2,600	$ 2,600	11/1.5	11/8.2	11/8.2	355.9	353.0	52
2. AVE. 13 @ RD 37 3/4	ADD CULVERTS (E) TWO 18" CMP	NOTHING REQUIRED (E) TWO 18" CMP	$ 0	$ 0	16/3.3	16/0	16/1.6	351.5	350.0	20
3. RD 36 @ AVENUE 13	ADD CULVERTS (E) 24" CMP	ADD ONE 42" CMP - L = 50'	$ 3,200	$ 3,200	19/9.8	87/9.8	87/9.8	335.0	333.0	340
4. RD 35 @ AVENUE 13¾	ADD CULVERTS (E) 24" CMP	ADD THREE 36" CMP - L = 75'	$12,300	$12,300	9.6/4.0	124/4.0	124/4.0	320.5	319.0	320
5. RD 34½ @ AVENUE 13½	ADD CULVERTS (E) 12 & 18" CMP	ADD THREE 36" CMP - L = 50'	$ 7,650	$ 7,650	BLOCKED	150/11.4	150/11.4	314.0	312.5	300
	CONSTRUCT DITCH AROUND CORNER	CONSTRUCT DITCH 23' X 5' X 1700'	$15,600	$15,600	BLOCKED	150	150	312.5	310.5	150
6. CULVERT AT RAILROAD	ADD CULVERTS (E) 30" RCP	NOTHING REQUIRED	$ 0	$ 0	60/370	477/370	60/370	376.0	376.0	477
7. 1000' WEST OF R/R	RAISE EXISTING LEVEE	NOTHING REQUIRED	$ 0	$ 0	60/470	60/470	60/470	376.0	376.0	60
	INSTALL PUMPS & DRAIN DITCH (DRAIN TIME 11 DAYS)	INSTALL TWO 50 HP/5000 GPM	$28,000	$28,000	60/98	23/0	22/446	276.0	280.0	60
		INSTALL 4' X 3' X 2500' DITCH	$ 7,400	$ 7,400		23/0	22/446	280.0	279.0	23
		INSTALL 27" CMP @ ROAD 30½	$ 1,680	$ 1,680		23/0	22/446	279.0	278.0	23
		TOTAL		$78,300						

MADERA RANCHOS SOUTH

	LOCATION	POSSIBLE ALTERNATES	RECOMMENDATION	COSTS		CAPACITIES Q_{25}/V_{100}			WATER SURFACE		Q_{100}
				POSSIBLE ALTERNATIVE	RECOMMENDED ALTERNATIVE	EXISTING CFS/AF	NEEDED CFS/AF	PROPOSED CFS/AF	UPSTREAM	DOWNSTREAM	INFLOW CFS
1.	3500' W/O RD 39½	DETENTION BASIN OUTLET THRU DAM	CONSTRUCT DAM & OUTLET 750'x13'	25,400	25,400	870/312	54/284	54/284	365.5	355	870
2.	MID CANAL	RAISE CANAL BANK (E)ELEV 349.5	NOTHING	7,600	0	280/36	162/267	100/267	355.3	346	900
		BLOCK ONE 42"ϕ CULVERT-CONC PLUG		500	0	280/36	100/29	100/29	348.6	NA	
		GATE INLET INTO CANAL-BLOCK EXIST 42"(2)	36" INLET-BLOCK BOTH CULVERTS	14,700	14,700	0	100/17	70/40	349.5	342.3	901
		PAVED SPILLWAY INTO CANAL		7,000	0	901/267	750/36	0			901
		BYPASS SWALE SO TO ROOT CREEK		34,000	0	901/185	900/17	0	349.0	345.0	
3.	ROSEMEAD AVE (2-36)	BYPASS SWALE ALONG N SIDE ROAD	NOTHING	700	0	170	15/0	15/0	344.5	344.0	15
		ADD CULVERTS		0	0						
4.	ROAD 37 3/4 (2-36)	ADD CULVERTS	NOTHING REQUIRED	0	0	140	30	140	343.2	340.7	35
5.	AVENUE 12¼ (2-36)	ADD CULVERTS	NOTHING REQUIRED	0	0	100	45	100	340.7	338.9	36
		DEEPEN DOWNSTREAM SWALE	NOTHING	1,000	0		45	45	337.5		36
6.	ROAD 37½ (2-36)	ADD CULVERTS	NOTHING	2,400	0	64	64/3.0	64/3.0	338.9	337.5	93
7.	FERNWOOD DR (2-36)	ADD CULVERTS	NOTHING REQUIRED	0	0	74	56/4.17	56/4.17	337.5	336.5	74
8.	MAYWOOD DR (2-36)	BLOCK ONE (E) CULVERT	BLOCK ONE CULVERT	500	500	52	33/9.73	33/9.73	336.5	335.6	74
		ADD CULVERTS		4,850	0	52	33	0	336.5	335.6	74
		DEEPEN DOWNSTREAM SWALE		700	0		46	46	332.5		
9.	BERKSHIRE (2-36)	ADD CULVERTS	NOTHING REQUIRED	6,950	0	50	46/1.61	46/1.61	335.6	335.1	46
		DEEPEN DOWNSTREAM SWALE		500	0		61	130	331.0		
10.	ROAD 37 (2-36)	ADD CULVERTS S/O SPARTA (NEW LOCA)	NOTHING REQUIRED	4,850	0	0	62	84	335.5	335.0	61
		GRADE NEW SWALE ON SO SIDE SPARTA		2,800	0	NA	62	200	331.0		
		ADD CULVERTS AT EXISTING LOCATION	LEAVE EXISTING TWO 36"ϕ	4,850	0	60	61/.6	61/.6	335.1	334.2	61
		LOWER EXISTING SWALE TO SPARTA	NOTHING REQUIRED	500	0	100	61	100	335.25	335.15	
11.	SPARTA (2-36)	ADD CULVERTS	LEAVE EXISTING TWO 36"ϕ CMP	4,850	0	69	69/0	69/0	334.2	331.4	69
		LOWER SWALE TO DRAIN TO AVENUE 12	NOTHING	500	0	426	69	426	330.5		
		BYPASS SPARTA W/SWALE S/O SPARTA	NOTHING - SEE 10 ABOVE	-	-	-	-		-	-	-
12.	AVE 12 (1-41x71)	ADD CULVERTS	NOTHING REQUIRED	0	0	170	73/0	170/0	331.4	330.1	73
13.	TRIESTE (2-42)	ADD CULVERTS	LEAVE EXISTING TWO 42" CMP	2,650	0	120	108/11	108/11	330.1	328.5	162
14.	ROAD 36½ (2-42)	ADD CULVERTS (1) 36"ϕ CMP	NOTHING	2,400	0	160	121/5.1	121/5.1	328.5	326.0	137
		CONSTR DITCH SOUTH TO MID CANAL (20'X7')	NOT REQUIRED	13,500	0	0	121	0	329.6	326.8	137
		CONSTR CULVERTS UNDER KENSINGTON (42")	NOT REQUIRED	12,240	0	0	121	0	328.9	327.5	121
		CONSTR INLET TO MID CANAL	NOT REQUIRED	19,800	0	0	121	0	326.8	325.5	121
		INSTALL GATES ON (E) 42" CULVERT	NOT REQUIRED	6,000	0	0	NA	NA	329.6	325.0	-
15.	HAVEN ROAD (2-42)	ADD CULVERTS (2 36"ϕ CMP)	NOTHING	4,850	0	128	120/8	120/8	326.0	323.6	139
16.	ROAD 36 (2-48)	ADD CULVERTS (2-48"ϕ CMP)	NOTHING	8,800	0	140	140/8.9	140/8.9	323.7	322.5	182
		WIDEN DOWNSTREAM DITCH BY 15'	NOTHING	17,000	0	235	140	235	322.5	322.0	140
17.	ROAD 36/ROOT CREEK	SPILL CANAL VIA (E) OUTLET	NOTHING REQUIRED	0	0	640	70	640	326.5	294±	70

MADERA RANCHOS SOUTH

	LOCATION	POSSIBLE ALTERNATES	RECOMMENDATION	COSTS		CAPACITIES Q_{25}/V_{100}			WATER SURFACE		Q_{100}
				POSSIBLE ALTERNATIVE	RECOMMENDED ALTERNATIVE	EXISTING CFS/AF	NEEDED CFS/AF	PROPOSED CFS/AF	UPSTREAM	DOWNSTREAM	INFLOW CFS
18.	ROAD 34/SO OF AVE 12	DITCH/BERM NORTH TO MADERA RANCHOS NO	NOTHING	36,000	0	SHEET	384	384	304.5	300.5	84
		DITCH/BERM SOUTH TO ROOT CR WITH AVE 11 CULVERT		58,000	0	NA	384	384	304.5	300.0	384
19.	AVE 11/RD 33½	RD 33½ CULVERT-ADD (3-5'ϕ CMP)	NOTHING	17,400	0	20	423	423	297.5	294.0	423
		DITCH FROM 33½ WEST ¼ MILE-3'x21'		16,000	0	100	423	423	294.0	289.0	423
		BERM 3'Hx10'W & DITCH 3'DX30'W ALONG E R/W RD 33½ SO TO ROOT CREEK	CONSTR BERM & DITCH SOUTH	31,000	31,000	0	659	659	299.0	294.5	659
20.	AVE 11/MILE 33	CULVERT UNDER AVE 11 SO		16,200	0	0	431	431	290.0	288.0	431
		DITCH AVE 11 TO ROOT CK-7.5'x20'	NOTHING-SEE 19	63,000	0	0	431	431	287.0	284.0	431
		ROADSIDE DITCH DRAIN E TO DRAIN		1,000	0						
21.	ROAD 32/11	ADD CULVERTS UNDER ROAD 32 (4-50x31CMP)	NOTHING	13,000	0	30	253	253	281.5	280.5	253
		SWALE THRU POLE YARD-30'x1.5'w4:1	GRADE 3'x30' SWALE THRU YARD	1,500	1,500	0	253	253	281.5	280.5	253
		DEEPEN (E) R/R CULVERTS-4-4'x4' WOOD	DEEPEN CULVERTS	1,000	1,000	100	253	253	280.5	280.5	253
		DEEPEN (E) DITCH W SIDE R/R	DEEPEN DITCH TO ELEV 278.5	1,700	1,700	UNKNOWN	253	253	280.5	280.0	253
			RECOMMENDED IMPROVEMENT TOTAL		75,800						

ROOT CREEK DRAINAGE

	LOCATION	POSSIBLE ALTERNATIVES	RECOMMENDATION	COSTS		CAPACITIES - (Q_{25} OUT / V_{100})			WATER SURFACE		INFLOW
				POSSIBLE ALTERNATIVE	RECOMMENDED ALTERNATIVE	EXISTING CFS/AF	NEEDED CFS/AF	PROPOSED CFS/AF	UPSTREAM	DOWNSTREAM	Q_{25} CFS
1.	HIGHWAY 41	ADD CULVERTS (E) 36" CMP	NOTHING REQUIRED	$ 0	$ 0				369.5	358.0	
2.	AVE 12 W. OF HWY 41	ADD CULVERTS (E) 18" CMP	NOTHING REQUIRED	$ 0	$ 0				376.5	363.0	
3.	ROAD 40	ADD CULVERTS (E)	NOTHING REQUIRED (ROAD FLOODS)	$ 0	$ 0		805/242		340.0	336.0	805
4.	ROAD 38	ADD CULVERTS (E)	NOTHING REQUIRED (ROAD FLOODS)	$ 0	$ 0		391/141		317.0	312.0	391
5.	ROAD 36	ADD CULVERTS (E) 6' CMP	NOTHING REQUIRED (ROAD FLOODS)	$ 0	$ 0		963/592		296.5	294.0	963
6.	MILE 35 - 1 MILE WEST OF ROAD 36	CONSTRUCT DETENTION DAM	NOTHING REQUIRED	$ 0	$ 0		1224/814		305.0	286.0	1224
7.	ROAD 33½	ADD CULVERTS (E) 5' CMP	NOTHING REQUIRED (ROAD FLOODS) 279.5	$ 0	$ 0		1375/1349		281.0	279.5	1375
8.	AT & SF RAILROAD	ADD CULVERTS (E) 36" RCP	NOTHING	$ 0	$ 0	130/2170	1797/2700	130/2170	284.0	277.0	1797
		CONSTRUCT PUMP STA - 30,000 GPM THRU R/R	CONSTRUCT 9. BELOW	$ 48,000	$ 0		67/2700		270/283	283.0	1797
		CONSTRUCT PUMP OUTLET DITCH (3100') THRU R/R		$ 47,000	$ 0		67/2700		283.0	282.3	67
		CONSTRUCT CANAL INLET (3-36' WITH GATES)		$ 15,000	$ 0		67/2700		282.3	281.8	67
9.	1100' W. OF R/R	CONSTRUCT DETENTION DAM & OUTLET (1400'x9')	CONSTRUCT DAM & OUTLET TO RECHARGE	$ 28,500	$ 28,500	100/0	NA/2698	167/2650	283.0	276.5	130
		CONSTRUCT PUMP STA 3-10,000 GPM	CONSTRUCT PUMP STA (10 DAY PUMPOUT)	$ 48,000	$ 48,000	0	67	67	270/283	283.0	130
		CONSTRUCT PUMP OUTLET DITCH (1900')	CONSTRUCT OUTLET DITCH (1900' x 3' x 20')	$ 10,000	$ 10,000	0	67	67	283.0	282.3	67
		CONSTRUCT CANAL INLET (3-36" WITH GATES)	CONSTRUCT INLET (3-36" WITH GATES)	$ 15,000	$ 15,000	0	67	67	282.3	281.8	67
10.	ROAD 30 AT AVE 5½ TO SAN JOAQUIN RIVER	ENLARGE EXISTING CANAL TO RIVER	NOTHING REQUIRED	$ 0	$ 0	60	67	60	275.0	272.0	67
			TOTAL		$101,500						

APPENDIX B
COMMENTS ON DRAWINGS

Appendix B contains an explanation of and considerations involved in the recommended plan shown on sheets 1 through 12 in Appendix D.

COMMENTS ON DRAWINGS

Sheet 2

- The railroad embankment, small culvert and levee west of the tracks in lower Bonadelle Ranchos drainage area acts as a detention basin and likely provides some groundwater recharge. Additional study may reveal methods to enhance the groundwater recharge.

- A ditch 6 feet wide and 3 feet deep at elevation 278 could be constructed from the Bonadelle Ranchos detention area to Road 30 1/2, with a culvert under Road 30 1/2 to drain the flood water via existing ditches to Cottonwood Creek. Pumping would be required to lift the water from the storage area (4 to 10 feet) to the ditch. A 10,000 gpm pump capacity would drain the entire area in approximately 11 days and protect the area from multiple storms. For reliability it is advisable to use two pumps with 5,000 gpm capacity each.

- Water collected along Avenue 12 can be drained into the Bonadelle Ranchos drainage via a ditch north along the easterly railroad right-of-way.

- See sheet 4 for the combination of improvements to bring drainage to a point for transfer to the Bonadelle drainage.

- If the culvert on the north side of Avenue 12 at the railroad were blocked, all flooding to the west of the railroad would be eliminated and flows into the Trigo storage area would be eliminated. It appears preferable to put flows into Bonadelle drainage where they can be pumped to Cottonwood Creek. Flows into Trigo storage area cannot be as easily disposed of because of distance from Cottonwood Creek.

  It appears feasible to install a second pump station south of Avenue 12 with a ditch north to the ditch from the Bonadelle Ranchos detention area to Road 30 1/2 to drain the Trigo storage area to Cottonwood Creek .

Sheet 3

- A ditch should be constructed along road 34 1/2 and the westerly extension of Avenue 13 1/2 to correct for blockage of the existing drain by levelling and filling of the field west of Road 34 1/2.

- On Avenue 13 the driveways west of Road 36 need to be improved along with ditch improvements by landowner.

Because of the large size of the culvert required and consequent expense low level fords with small pipes to carry low flows are suggested as the most acceptable solution.

Sheet 4

- Areas of flooding as the result of a 100-year storm both before and after proposed diversions are made to Bonadelle and Root Creek storage areas.

- There is a potential for groundwater recharge at the Trigo storage area.

- There is no natural outlet to the Trigo storage area. Traditionally the stored water evaporates and percolates.

- The improvements show diversion to Bonadelle Ranchos and Root Creek decrease the traditional flows into the Trigo storage area.

- Pumping is required to drain this area with a lift of 11 to 14 feet.

- The recommended alternative on Madera Ranchos South shows an increase in the culvert size under the railroad. The cost summary shows the cost of this culvert. If culvert enlargement is not added Road 32

will flood to a depth of approximately 4 feet during a 100-year flood and the railroad will be overtopped at elevation 281.

- Flooding in Trigo appears to result from inadequate culvert and ditch along the railroad near Avenue 11. Deepening of both is proposed.

Sheet 5

- Culvert sizes and ditch routing of flows as shown. Existing flows are largely undefined overland travel through uninhabited crop land. Low berms along Avenue 12 and Road 33 1/2 are low cost methods of controlling the direction of these flows.

Sheet 6

- Culvert sizes and ditch routing of flows as shown. A small ditch along the south side of Marciel Drive is a low cost and effective alternative to enlarging four existing culverts.

Sheet 7

- The culvert on Madera Ranchos North at Road 36 prevents flood flows from overflowing south along Road 36 to Avenue 12.

- Culverts at Road 36 and Blossom Avenue and the ditch to Avenue 12 alleviate flooding of 13 structures in the vicinity.

- Existing culverts have enough capacity for 100 year flows where detention and peak flow reduction are considered. This is true only when the detention basin near Road 39 1/2 is constructed.

Sheet 10

- Note that the existing culverts are adequate to convey even 100-year storm flows after construction of detention basins east of MID Canal 6.2, and the 42 inch culverts under the canal are blocked.

- One culvert should be blocked at Maywood to decrease the downstream peak flow from 74 to 33 cfs and protect the culverts downstream. Without this closing of one culvert, the culverts at Berkshire, Road 37 and Sparta must be enlarged to accommodate 100-year flows.

Sheet 11

- The storage areas shown are the key elements in eliminating present flooding problems. No economically practical alternative has been identified.

Sheet 12

- Note pumping is required to drain Root Creek storage to canal. The top 3.7 feet of storage will drain by gravity into the canal, but this peak pool occurs only in very large storms.

- Root Creek flooding shown results from the occurrence of single and double 100-year floods. Road 33 1/2 is flooded to 3.5 foot depth during a double 100-year storm.

- The drainage time for the storage is ten days or less with 30,000 gpm pump discharge or discharge through the dam drain culvert. The existing minimum outfall is 70 cfs and pumping into the canal must be monitored so the total canal flow does not exceed capacity.

- Water in canal can be routed to groundwater recharge areas or discharged to the San Joaquin River through the existing Madera Irrigation District spill point near Road 29 and Avenue 5 1/2.

- The berm along Road 33 1/2 is the lowest cost method of diverting Madera Ranchos South flows to Root Creek ($11,000 vs $113,000 for culverts under Road 33 1/2 and Avenue 11, large ditches along Avenue 11 and south to Root Creek).

Madera Ranchos North

Sheet 8

- Flow from east of Road 38 and north of Avenue 13 presently flows west about 1/4 mile north of Avenue 13 to Road 36 and only crosses into Madera Ranchos at Mesa and Avenue 13 in major storms when flow overtops Avenue 13. The 12 inch culvert under Avenue 13 cannot carry any real flow.

- Once flow over Avenue 13 is prevented by a berm, the small storage area behind each road is adequate to store the 100-year storm for its small tributary area so the flow thru the channel is limited to the culvert capacity and only a few culverts need to be enlarged.

Sheet 7

- Ardath Avenue is much lower than Road 36 downstream of it and preventing flooding of Ardath at elevation 329.0 with the channel at elevation 328.0 is impossible without extensive, otherwise unnecessary, downstream channel deepening. Therefore allowing Ardath to flood to 329.8 with no change to Ardath culvert seems the most practical course to follow since flooding will be infrequent and of short duration (less than 12 hours).

Sheet 5

- Local storage continues to contain local 100-year volumes to Road 34 1/2. West of that point there is little storage available.

- Flows presently cross Avenue 12 near Road 33 1/2 on the way to Trigo. The single 18 inch cmp with capacity of 12 cfs won't carry the Q25 of 346 across Avenue 12 and Avenue 12 is higher than the roadside so the drainage appears to flow west along the north side of Avenue 12, and crosses Avenue 12 a mile west of Road 33 1/2. Local runoff flows under the R/R and along Avenue 12, 1/4 mile farther and then over Avenue 12 into Trigo Storage Area. A small berm along Avenue 12 and a small ditch along the railroad will prevent this and insure flow to Bonadelle storage area and ultimate disposal to percolation areas or Cottonwood Creek.

- Drainage presently will flow north along the east side of the railroad to Bonadelle basin at elevation 380.5 but cannot go south over Avenue 12 at 282.0. Blocking the culvert under the railroad and a drain ditch 1000 feet long and 5 feet deep at elevation 277 would take all Madera Ranchos North flows north along the R/R to Bonadelle basin. Flows could then be drained by pump or siphon at elevation 280 to Cottonwood creek near Avenue

13 at Elevation 275. Present Bonadelle storage outflow flows south across Avenue 12 near Road 30 1/2 and into Trigo storage area or overland to Highway 99.

- This proposed berm ditch and pump alternative is preferred because it allows for flexibility in the ultimate disposal of storm flows to Cottonwood Creek and costs only $10,200 exclusive of Bonadelle pumps.

  The alternative would route all Madera Ranchos North drainage to Trigo Storage Area via enlarged culverts under Avenue 12, Road 32 and the Railroad at additional cost exceeding $136,000. This alternative would also result in a larger inundated area in the Trigo Storage Area, less flexibility in removal and disposal of flows to groundwater recharge or other disposal.

APPENDIX C
PROCEDURE TO COMPUTE LOCAL RUNOFF

The following procedure was developed for the Madera Ranchos area of Madera County. The procedure requires knowledge of the area to be analyzed and its land use.

Criteria

1. The 100-year flood shall be used for:

    a. Design of major channels, floodways and diversions with drainage areas.

    b. Design of permanent impoundments and flood retarding basins on channels and floodways to which the 100-year criterion applies.

    c. Design of pump stations with drainage areas in excess of approximately two square miles.

    d. Design of freeway and railroad drainage crossings.

    e. The location of homes and other non-floodproof structures out of the 100-year floodplain.

2. The 25-year flood shall be used for:

   a. Design of open and underground channels and storm drains with drainage areas larger than 50 acres.

   b. Pump stations with drainage areas less than two sq. mi.

   c. Storm drains with areas less than 50 acres with sump conditions or located such that there is no street or drainageway available to transmit excess flows along the same general path as the storm drain.

3. The 10-year flood shall be used for open or underground channels and storm drains with drainage areas less than approximately 50 acres.

Figures 7 and 8 may be used to estimate time of concentration and runoff coefficients and Figure 9 provides a form to simplify the accounting procedure when evaluating a larger drainage area with a number of sub-basins and tributaries.

Step 1 On a map or aerial photograph delineate the primary and tributary drainage channels.

Step 2 Compute the area of the drainage basin to be studied and of each sub-area where runoff is to be computed.

Step 3 Estimate the time of concentration (actual time of travel or use Figure 7).

Step 4 Determine the rainfall intensity, I, from the curve of Figure 4 for a duration equivalent to the time of concentration.

Step 5 Determine the runoff coefficient, C, using the curves of Figure 6.

Step 6 Compute the peak runoff for the subarea by $Q = CIA$.

Continuing Downstream

Step 7 Determine the average velocity of flow in the main channel to the next downstream inlet. Calculate the travel time, t_t.

Step 8 Compute the time of concentration at the next inlet as:

$$t_{c_2} = t_{c_1} + t_t, \quad \text{where}$$

t_{c_2} = time of concentration at downstream inlet

t_{c_1} = time of concentration at upstream inlet

t_t = travel time from upstream inlet to downstream inlet

Step 9 Compute the peak runoff for the next subarea using the new time of concentration and steps 4 through 6.

Step 10 Add the peak discharge for the new subarea to the previously computed peak discharge, $Q = Q_1 + Q_2$.

Continue Downstream as Needed

Step 11 Proceed downstream computing the new travel time of flow to the next downstream inlet, the new subarea peak discharge, and the new total peak discharge using Steps 7 through 10.

Combining Flows

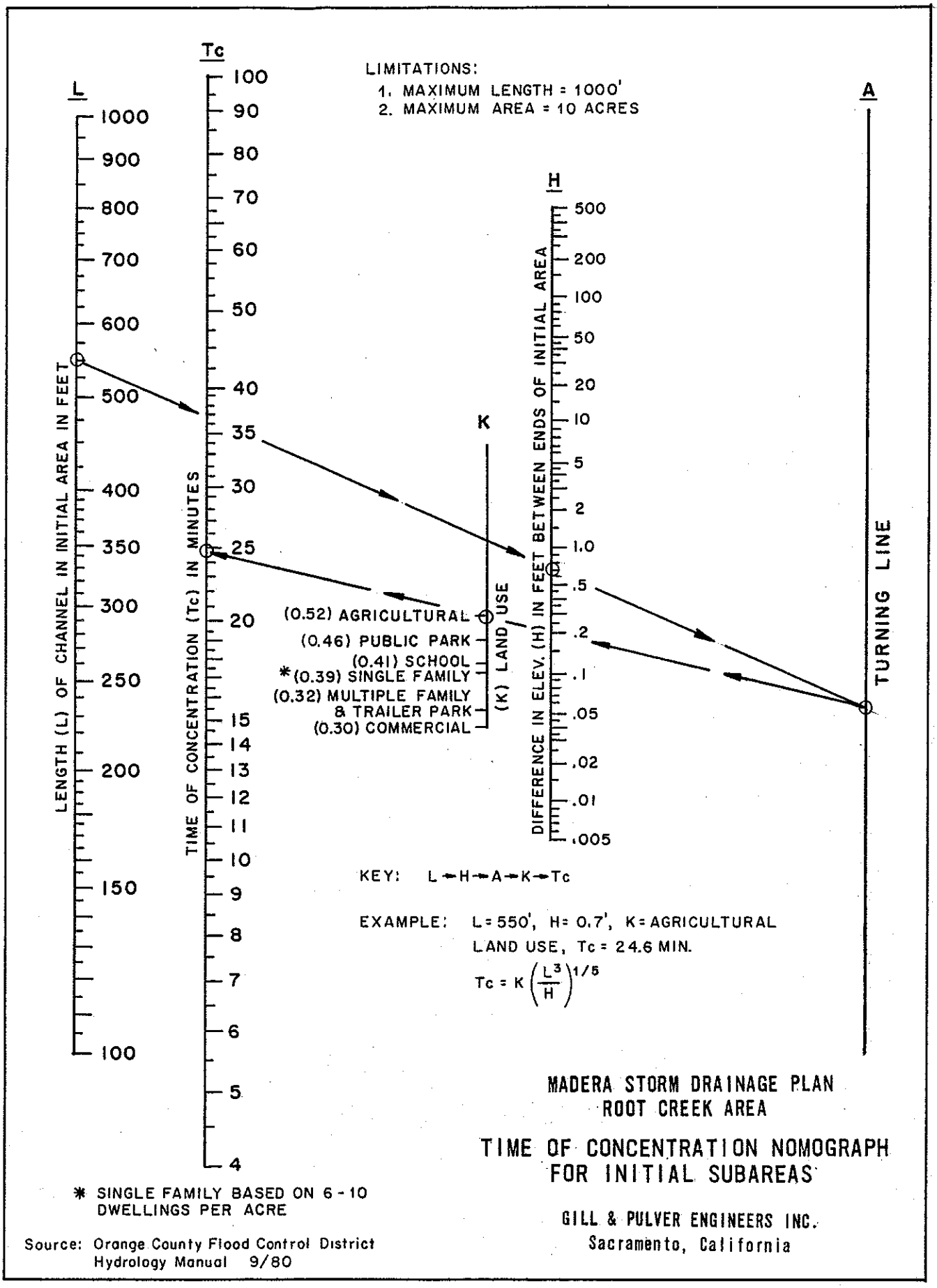
Step 12 The following method should be used to calculate the maximum flow leaving a confluence of two or more independent channels, having the same or varying (10-25 year) design storm recurrence intervals.

Assuming that $I_1 \leq I_2 \leq I_3$, determine the outflow at a confluence by the following:

$$Q_{tot} = \text{Maximum of } \bar{Q}_1 \text{ or } \bar{Q}_2 \text{ or } \bar{Q}_3$$

where:
$$\bar{Q}_1 = Q_1 + (I_1/I_2)\, Q_2 + (I_1/I_3)\, Q_3$$
$$\bar{Q}_2 = (I_1/I_2)\, Q_1 + Q_2 + (I_2/I_3)\, Q_3$$
$$\bar{Q}_3 = (I_1/I_3)\, Q_1 + (I_2/I_3)\, Q_2 + Q_3$$

Note that if $\bar{Q}_2$ is the maximum, then its corresponding t_c is chosen as the time of concentration and is used in the subsequent calculations.



* SINGLE FAMILY BASED ON 6 - 10 DWELLINGS PER ACRE

Source: Orange County Flood Control District Hydrology Manual 9/80

MADERA STORM DRAINAGE PLAN
ROOT CREEK AREA

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREAS

GILL & PULVER ENGINEERS INC.
Sacramento, California

FIGURE 7

MADERA COUNTY - RATIONAL METHOD DISCHARGE CALCULATION SHEET Sheet ___ of ___

FACILITY NO. & NAME _____

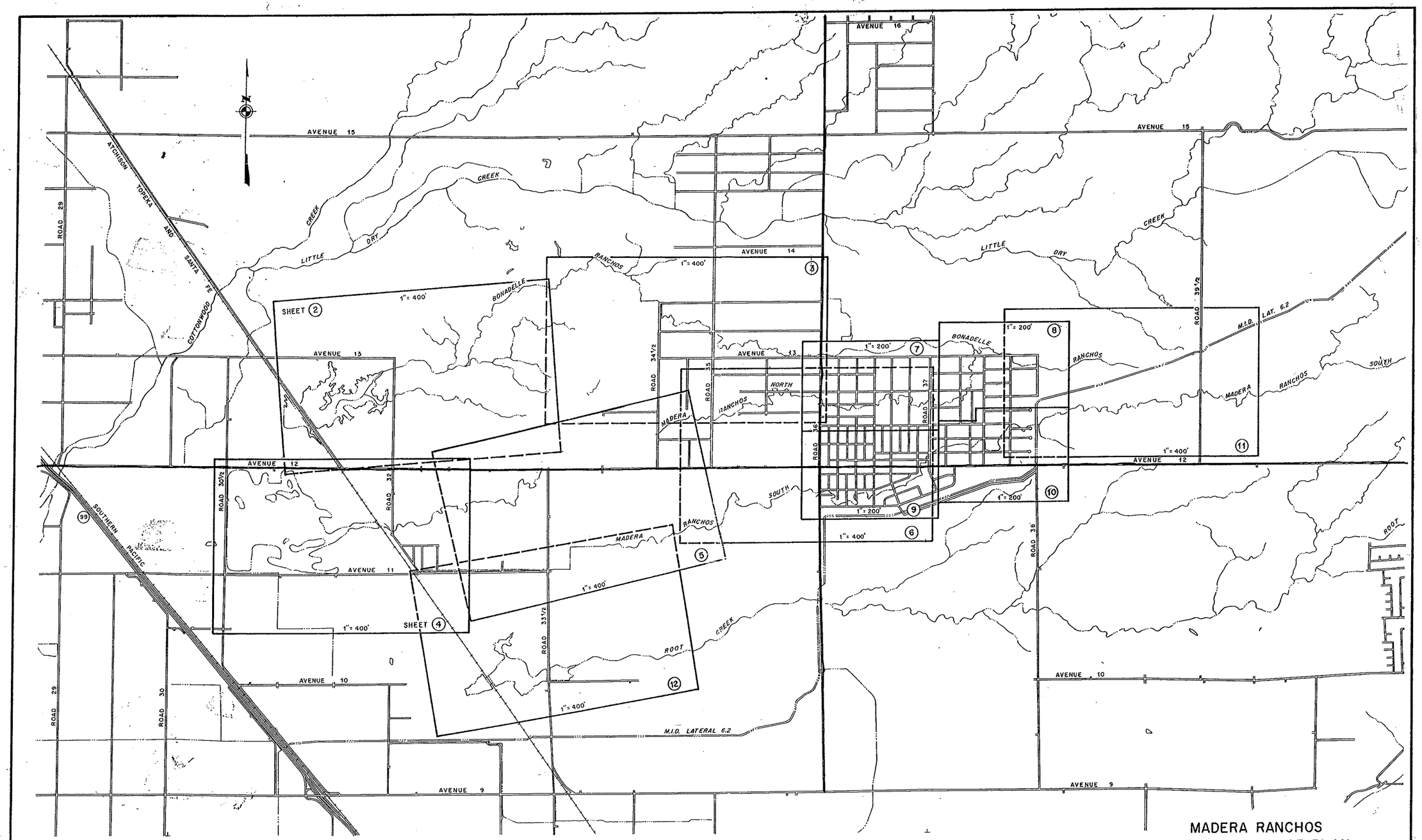
Calculated by _____ Date _____

Checked by _____ Date _____

Concentration Point Description	Sub Area			Land Use	t_t min	t_c min	Freq	I in/hr	C	Discharge in cfs		Flow Path Length ft.	Slope ft/ft	$\bar{V}$ ft/sec	Hydraulics and Notes
	No.	Acres Δ	Acres Σ							Δ	Σ				

FIGURE 8

APPENDIX D
MASTER DRAINAGE PLAN DRAWINGS



MADERA RANCHOS
MASTER DRAINAGE PLAN

JUNE 1984

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA

SHEET 1 OF 12 SHEETS

LEGEND

(E) EXISTING CULVERT

PROPOSED FLOOD PLAIN

302.5 WATER SURFACE ELEV.

100-YEAR FLOOD LIMITS (EXISTING)

SCALE: 1" = 400'
CONTOUR INTERVAL 5'

PROPOSED SITE FOR 10,000 GPM PUMP FOR DISPOSAL OF WATER TO COTTONWOOD CR.

1-30"Ø CULVERT (E)

PROPOSED CHANNEL 6'W x 3'D TO ROAD 30 1/2 & 27"Ø CULVERT UNDER THE ROAD

PROPOSED CHANNEL 6'W x 3'D

PROPOSED DITCH 5'WIDE

1-36"Ø CULVERT (E) TO BE BLOCKED

276.0

276.0 MAX. 277.0

280.5

ATCHISON TOPEKA AND SANTA FE

BONADELLE RANCHOS

AVENUE 12

ROAD 32

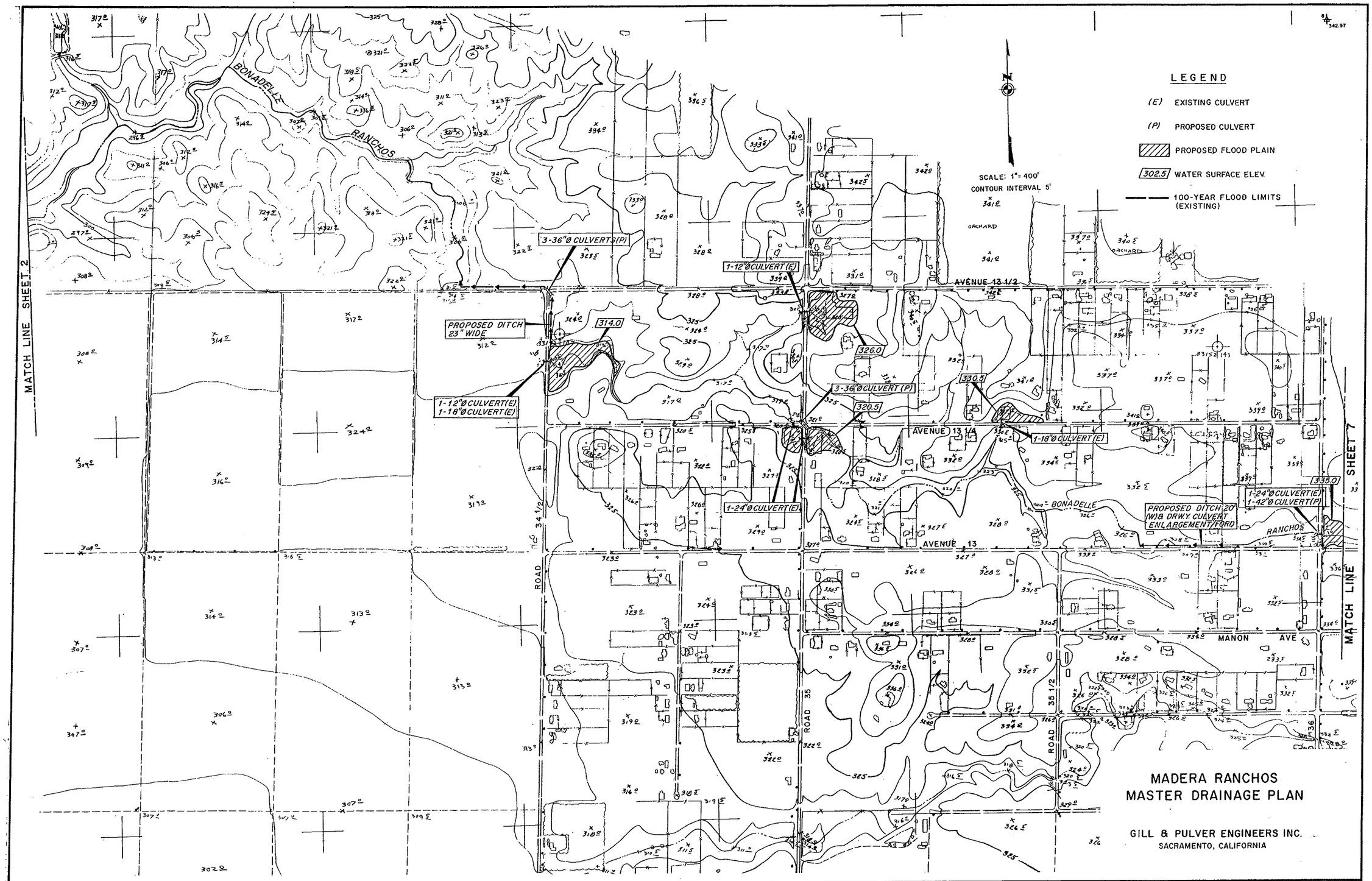
ROAD 33 1/2

MATCH LINE SHEET 4

MATCH LINE SHEET 3

MADERA RANCHOS MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA



SHEET 3 OF 12 SHEETS

PROPOSED SITE FOR 10,000 GPM PUMP FOR DISPOSAL OF WATER TO COTTONWOOD CR.

MATCH LINE SHEET 2

PROPOSED BERM 2' HIGH TO PREVENT FLOW SOUTH ACROSS ROAD

SCALE: 1"=400'
CONTOUR INTERVAL 5'

GRADE DITCH TO DRAIN, 40' WIDE

1-24"Ø CULVERT (E)
2-42"Ø CULVERTS (P)

1-36"Ø CULVERT (E)
4-54"Ø CULVERT (P)

PROPOSED DITCH TO ELEV. 278.5

DEEPEN DITCH & BOX CULVERTS

PROPOSE DITCH THRU POLE YARD, 20' WIDE

4-4'x3' WOOD BOX CULVERT (E)

1-36"Ø CULVERT (E)

1-18"Ø CULVERT (E)

MATCH LINE SHEET 12

ATCHISON, TOPEKA AND SANTA FE RAILROAD

RANCHOS NORTH

MADERA RANCHOS SOUTH

AVENUE 11 1/4

ROAD 32

ROAD 30 1/2

AVENUE

MATCH LINE

ORCHARD

LEGEND

(E) EXISTING CULVERT

(P) PROPOSED CULVERT

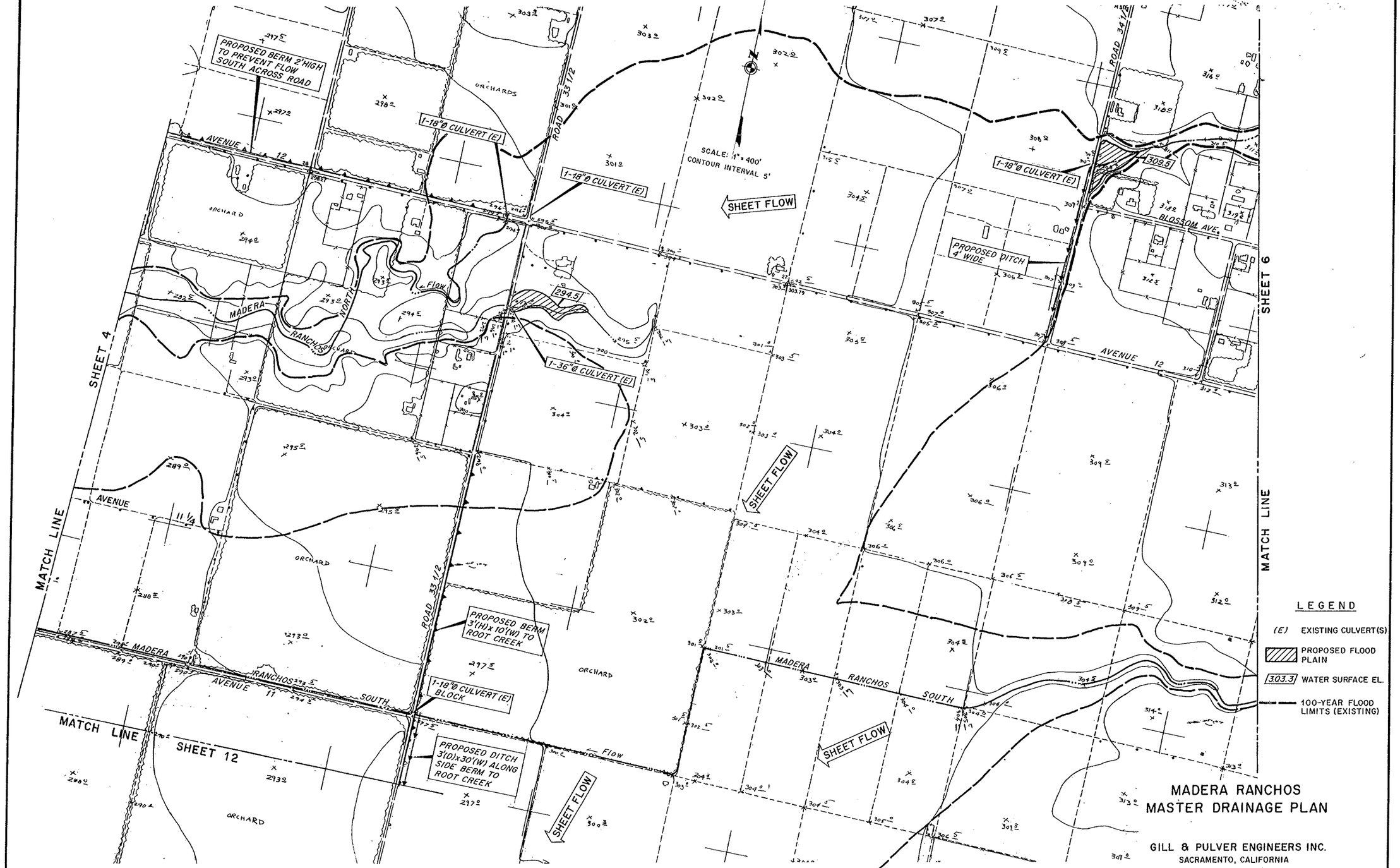
PROPOSED FLOOD PLAN

302.5 WATER SURFACE ELEV.

EXISTING 100-YEAR FLOOD LIMITS

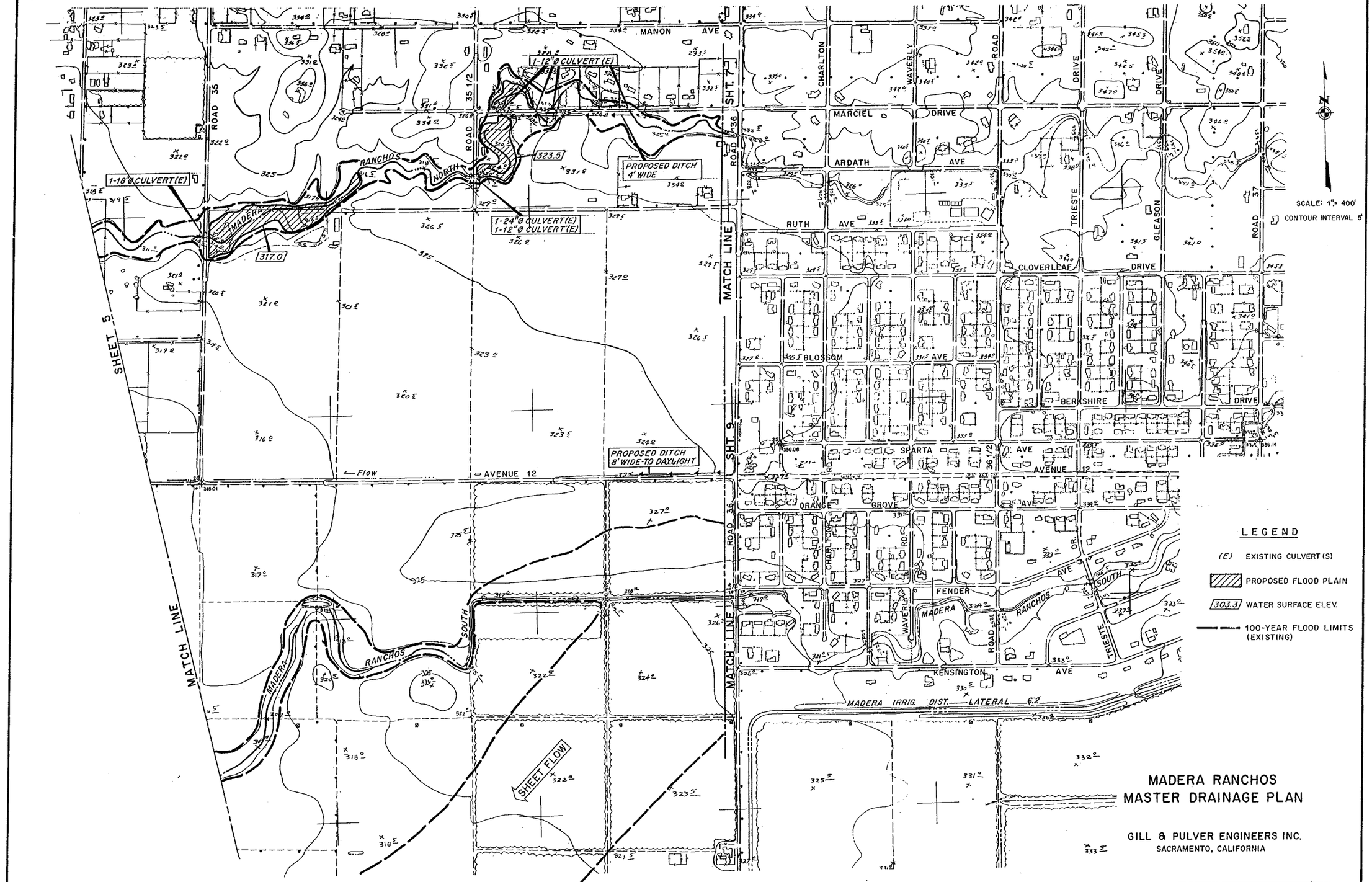
MADERA RANCHOS MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA



MADERA RANCHOS MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA



MADERA RANCHOS MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA

SCALE: 1" = 200'
CONTOUR INTERVAL 2'

LEGEND

(E) EXISTING CULVERT

(P) PROPOSED CULVERT

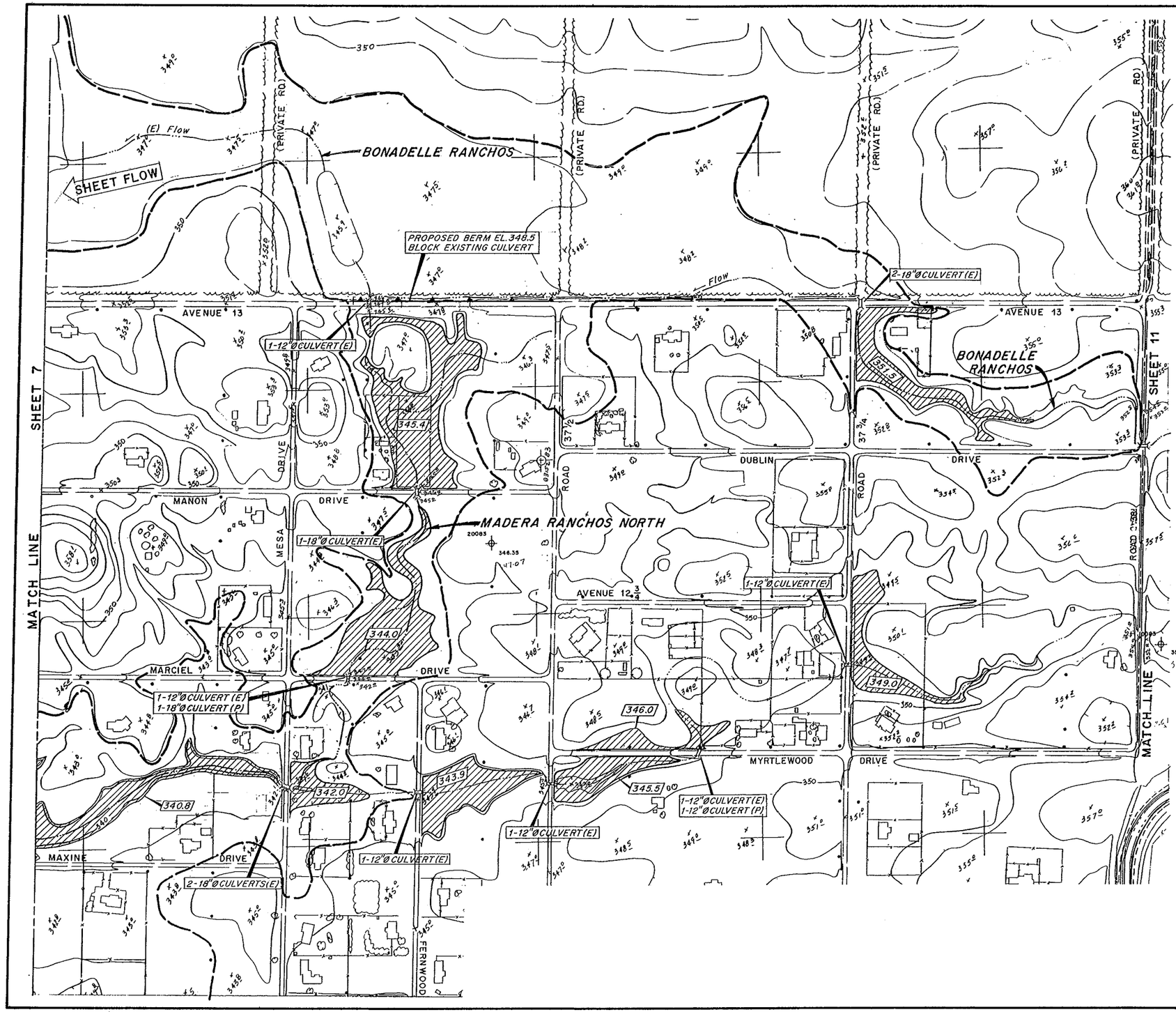
FLOOD PLAIN PROPOSED 100-YR.

302.5 WATER SURFACE ELEV.

100-YEAR FLOOD LIMITS (EXISTING)

MADERA RANCHOS MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA



MADERA RANCHOS
MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA

MATCH LINE SHEET 7

SHEET 10

MATCH LINE

SHEET 6

MATCH LINE

N

SCALE: 1" = 200'
CONTOUR INTERVAL 2'

1-18"Ø CULVERT (P)

1-12" CULVERT(P)

3-18"Ø CULVERTS(E)

1-24"Ø CULVERTS(P)

PROPOSED DITCH 3'(D)x7'(W)

PROPOSED DITCH 2'(D)x4'(W) CONC.

PROPOSED VEE SWALE 2'(D)x10'(W)

1-12" CULVERT (P)

2-36"Ø CULVERTS (E)

2-36"Ø CULVERTS (E)

2-36"Ø CULVERTS (E)

1-41"x71" CULVERT (E)

2-42"Ø CULVERTS (E)

2-48"Ø CULVERTS (E)

2-42"Ø CULVERTS(E)

2-42"Ø CULVERTS (E)

328.1

328.1

328.5

326.0

323.7

322.5

336.6

334.2

335.1

331.4

330.1

BLOSSOM AVE

SPARTA AVE

AVENUE 12

ORANGE GROVE AVE

FENDER AVE

BERKSHIRE DRIVE

KENSINGTON DRIVE

EDDINGS

KENSINGTON DR.

TRIESTE AVE

AVENUE

ROAD 36 1/2

ROAD 37

GABOR WAY

GLEASON DRIVE

LOREN WAY

TOPPER

CHARLTON

HAVEN

WAVERLY

CRANBERRY

EXISTING DRAIN

EXISTING DRAIN

MADERA RANCHOS SOUTH DRIVE

MADERA IRRIGATION DISTRICT LATERAL 6.2

CANAL FL. 321.51

CANAL FL. 322.0

CANAL FL. 322.3

N16,000

N14,000

LEGEND

(P) PROPOSED CULVERT

(E) EXISTING CULVERT

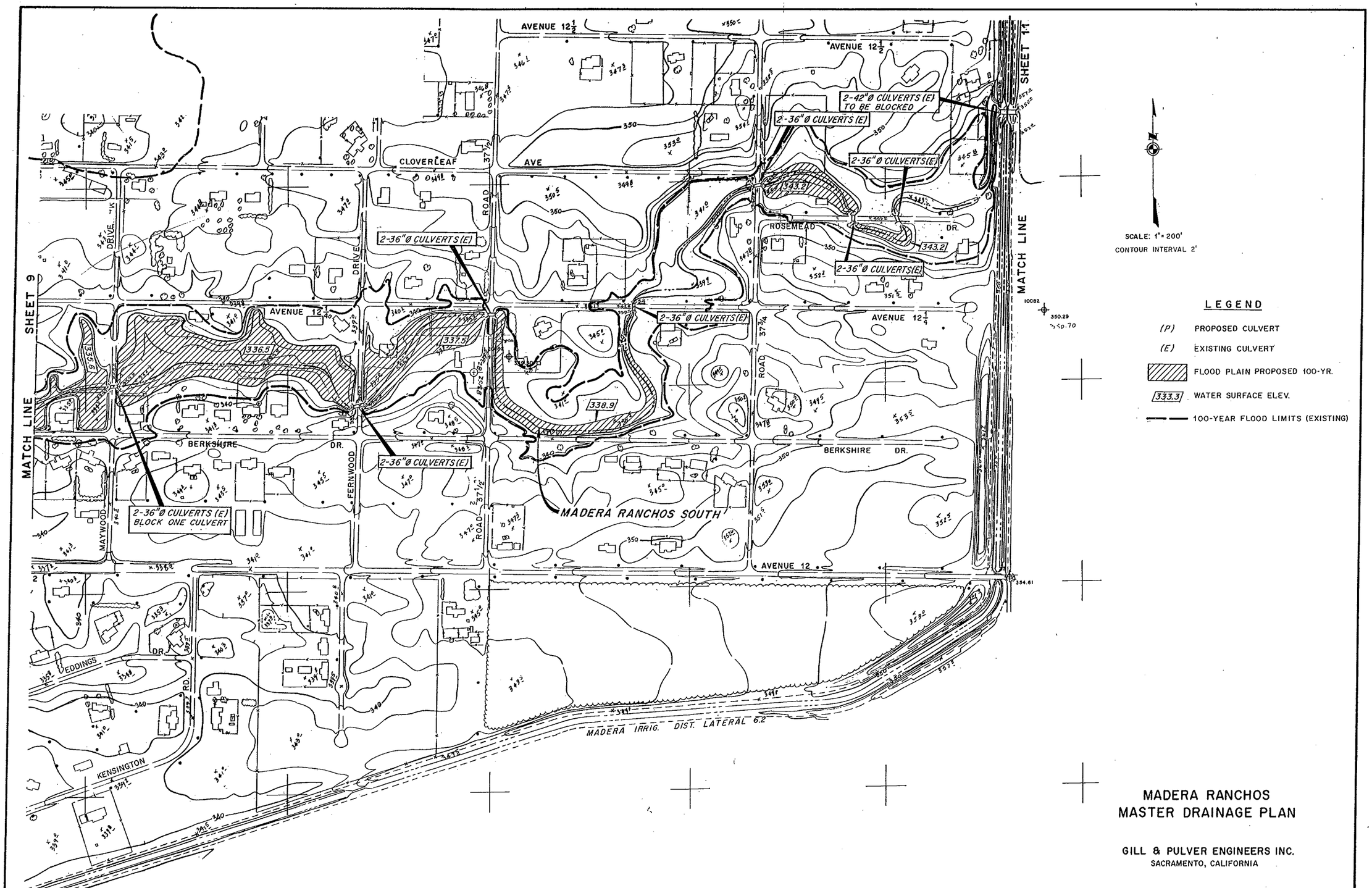
FLOOD PLAIN PROPOSED 100-YR.

333.3 WATER SURFACE ELEV.

100-YEAR FLOOD LIMITS (EXISTING)

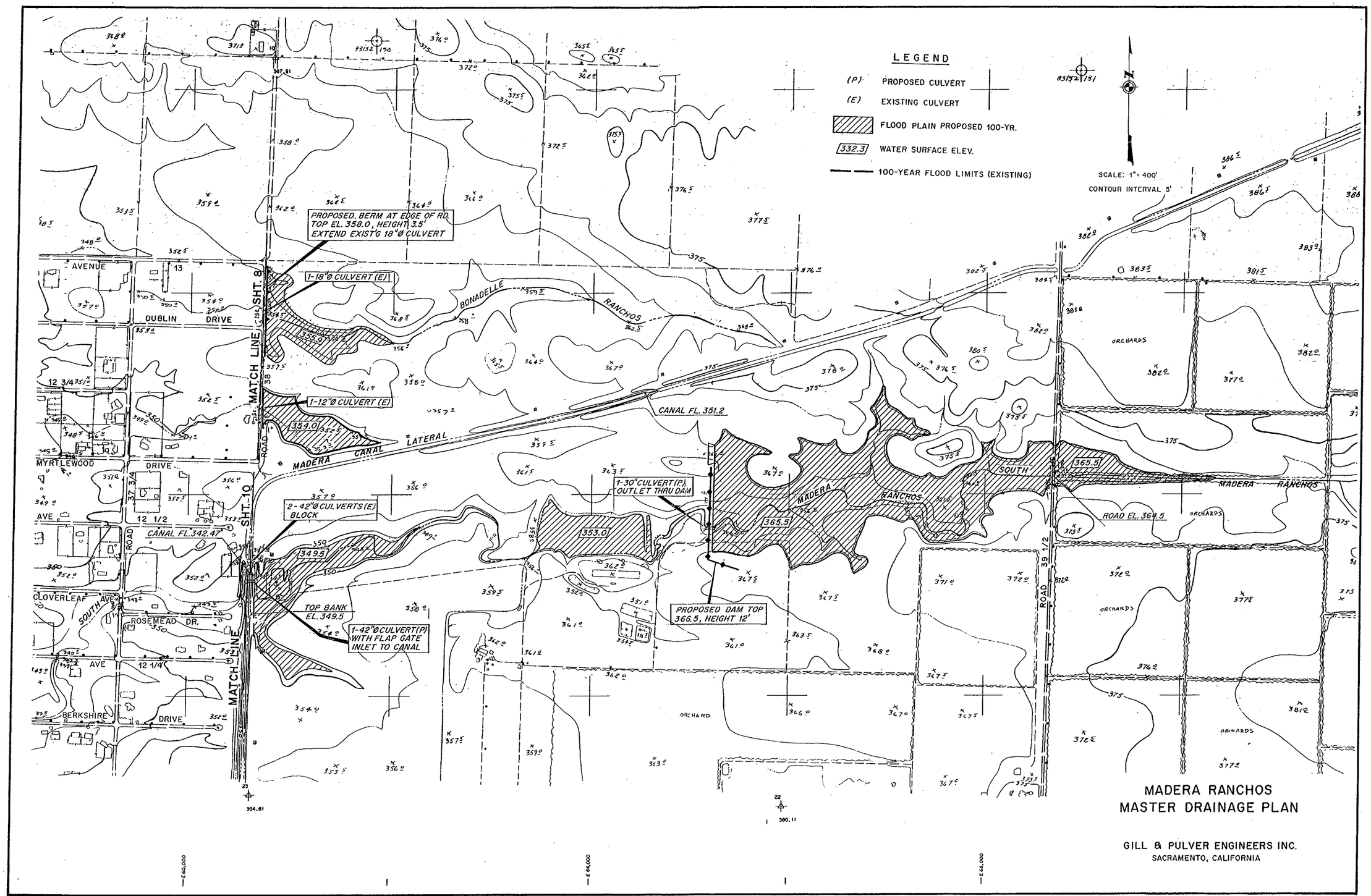
MADERA RANCHOS MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA



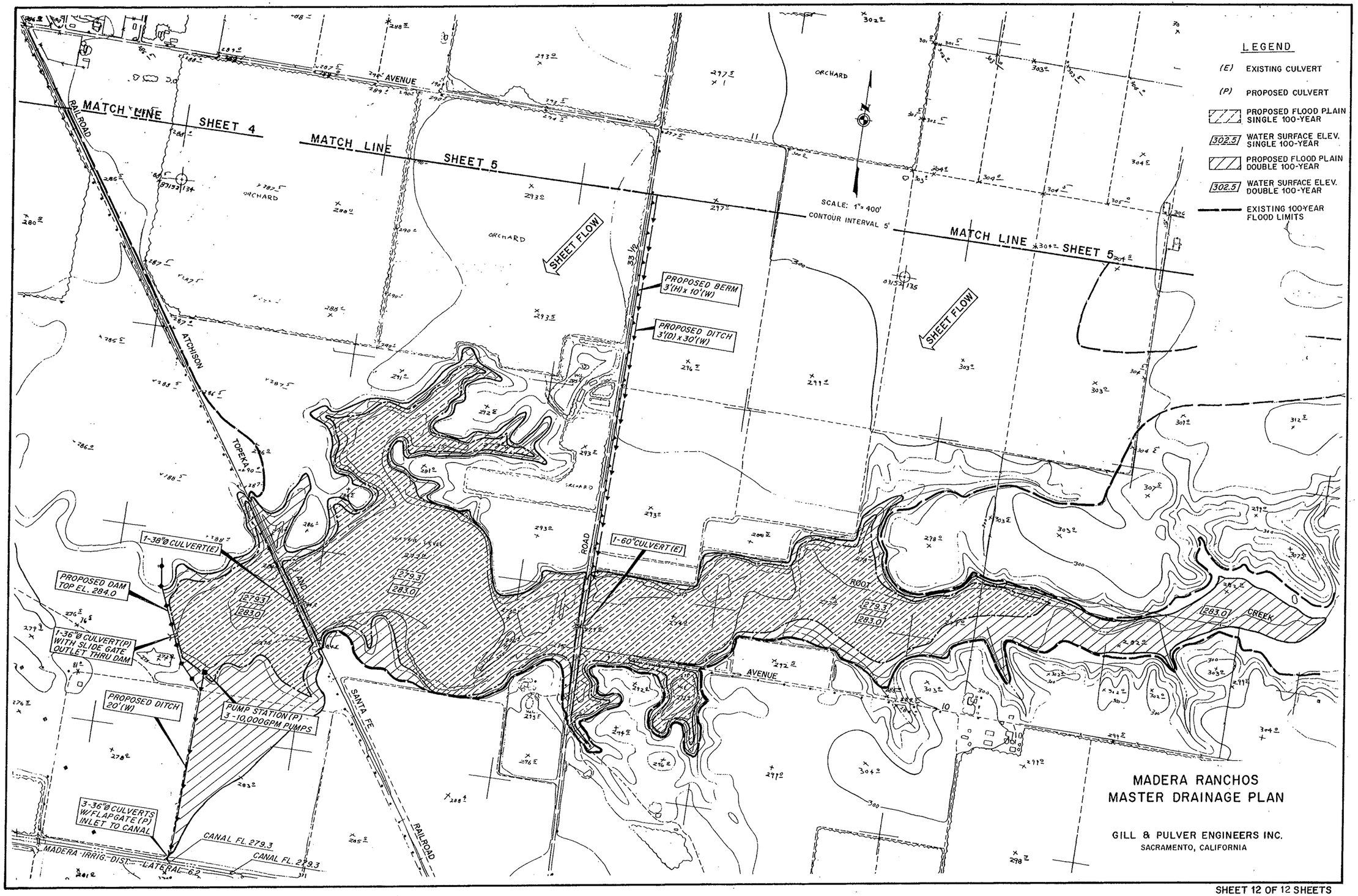
MADERA RANCHOS
MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA



MADERA RANCHOS
MASTER DRAINAGE PLAN

GILL & PULVER ENGINEERS INC.
SACRAMENTO, CALIFORNIA



SHEET 12 OF 12 SHEETS