16 ATTACHMENT 9 - ECONOMIC ANALYSIS – FLOOD DAMAGE REDUCTION COSTS AND BENEFITS

16.1 Plum Basin Project

This project is expected to generate minor flood damage reduction benefits for agricultural lands. The project is located immediately adjacent to the tail end of Deep Creek in Tulare County, but there are currently no facilities in the plan to take water from Deep Creek. The facility is designed to take water from the Tulare ID Main Canal and this system is regulated and is not required to take flood water above the capacity of the channel. So to generate flood damage reduction benefits the facility would have to take delivery of Kaweah River supplies through the District's delivery system that would otherwise have flooded agricultural lands in the bottom of the Tulare Lakebed.

In the Tulare Lakebed, landowners have developed a very compartmentalize flood damage reduction system that utilizes cells bound by tall earthen levees that can be sequentially filled so as to allow for a minimum amount of agricultural land to be flooded. These cells can then be drained for beneficial use of the water at a later date when there is irrigated demand. However, if less floodwater were delivered to the Tulare Lakebed then an additional cell of agricultural land might not have to be flooded.

For the purposes of this grant it was assumed that floodwater would be available to the project from the Kaweah River every three years. However, it was further assumed that the instance when the situation of avoiding an additional flooded cell would occur every third flood year, or every nine calendar years. The project's expected life is approximately 50 years so it was assumed that five occurrences of flood damage avoidance would occur each avoiding approximately $1,000,000 in flood damage per occurrence.

This project is expected to generate minor flood damage reduction benefits for City of Tulare. The project is located immediately adjacent to the tail end of Deep Creek in Tulare County. The City of Tulare's storm water is delivered to local creek systems. The Plum Basin Project would function to take water upstream of the city and free capacity of the downstream ditches. This will alleviate the City of Tulare's system from being impounded by the high water level of the creeks they discharge too. While it is known that the project will aid in flood control, it is not possible to quantify the benefit.

16.2 Water Reuse Pipeline Project

This project is not expected to generate any flood damage reduction benefits.

16.3 Paregien Basin Project

16.3.1 Background

This project is expected to generate significant flood damage reduction benefits for the City of Farmersville. Farmersville is a rural city in Tulare that covers approximately 1.88 square miles of area and in 2009 had a population of approximately 10,000 residents. The primary flood control facility for the City of Farmersville is Deep Creek, a local creek that is tributary to the Kaweah River. The major flood protection facility on the Kaweah River is Terminus Dam which is approximately 17 miles from the City of Farmersville.

The past history of flooding in the City of Farmersville suggests that the flood season extends from November through June, with general rain floods occurring between November and April and snowmelt floods occurring from April to June. The majority of large floods have occurred during December, January and February, and have been the result of heavy rains combined with snowmelt from the foothills and the Sierra Nevada Mountains.[20]

The City of Farmersville has experienced some very significant flooding events in the last 50 years that have been recorded and analyzed by the Federal Emergency Management Agency (FEMA) and the Army Corps of Engineers. A Flood Insurance Study on the City of Farmersville from June 1983 stated that major flooding events had occurred in Farmersville in November 1950, December 1955, December 1966 and January 1969 and that major flooding in Farmersville has been by breakouts of Deep Creek.

In FEMA's 1983 report, the 100-year peak discharge for the Deep Creek channel downstream of Avenue 288 was estimated to be 2,850 CFS. Downstream channel overflows reduce the channel discharge to 1,550 CFS where it crosses the Southern Pacific Railroad. The remaining 1,300 CFS was assumed to flow in the west overbank toward Farmersville. Additional overflows were assumed to occur between East Ash Street and Farmersville Boulevard, such that the 100-year discharge remaining in the channel at Farmersville Boulevard was only 410 CFS. This equates to approximately 2,440 CFS that is not contained by the Deep Creek channel and is causing significant damage within the community of Farmersville during a 100-year event.

[20] Flood Insurance Study, City of Farmersville, California, Tulare County, Federal Emergency Management Agency, June 15, 1983, Community Number 060405.

16.3.2 Community Information

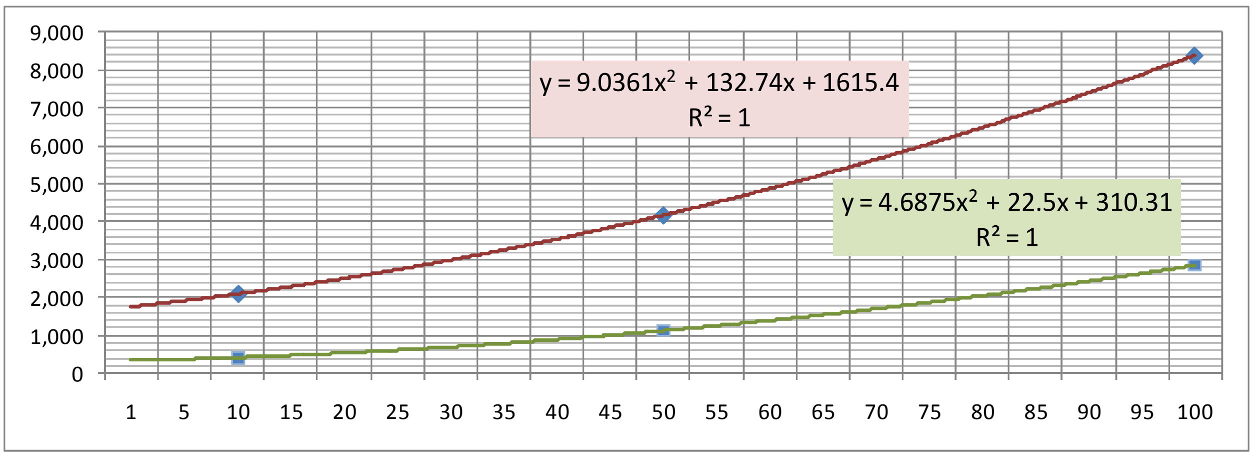
The City of Farmersville covers approximately 1.88 square-miles or 1,203 acres in central Tulare County. The current population is 10,078 residents which is up 15.3% since 2000 and up 35.6% since 1990. The community is predominantly Hispanic and work in the local agricultural economy. The estimated median household income in 2009 was $32,581, which is up from $27,682 in 2000. This estimated average median household income qualifies Farmersville as a disadvantaged community. The estimated median house or condo value in 2009 was $141,047, which is significantly lower than the California average of $384,200. In 2009 approximately 30.7% of the residents in Farmersville had an income below the poverty level, and 13.0% of residents also had an income 50% below the poverty level.

Deep Creek travels through roughly a third of the city, and it functions as the City's primary method of evacuating storm water (meaning that most of the City's storm water systems discharge to Deep Creek).

16.3.3 Flood Event Estimates

There is very limited information on the historic flood events that have occurred in Farmersville and there are fewer records on the estimated flows during those events. However, in the 1983 FEMA Flood Insurance Study on Farmersville a peak 100-year flood flow was estimated for the portion of Deep Creek just upstream of Farmersville. However the rest of the available information is focused on the Kaweah and St. Johns Rivers, Terminus Dam, and the minor watersheds that connect with the Lower Kaweah River downstream of Terminus Dam. For that reason it was decided to approximate or estimate Deep Creek flooding events from events based on the Kaweah River.

Kaweah River peak flood flows for a 10 year, 50 year and 100 year storm were available downstream of McKays Point through the most recent FEMA analysis of flood events in Tulare County (2009). McKays Point is a location on the Kaweah River that is downstream of Terminus, but it is upstream of where Deep Creek splits off of Cameron Creek. The available peak flood flows were graphed versus their reoccurrence interval and the equation of the best fit line was calculated. Then the peak 100 year storm flow in Deep Creek near the project site was compared to the peak 100 year storm flow downstream of McKays point and the Deep Creek flow was found to be 34% of the McKays Point flow. This reducing percentage was initially applied to the 10 year and 50 year flows at McKays Point to see if a straight percentage reduction would appear reasonable. However, it did not as the very regular events (1-year, 5-year, 10-year) appeared to be larger than the estimated channel capacity through Farmersville and from local experience flooding is not an every year occurrence. Therefore a lower percentage of 20% of the flows at McKays Point was used to estimate the 10-year peak flow because this percentage appeared to reduce the peak flow enough so that the estimate did not overestimate the occurrence of flooding in the City. In turn the 50-year peak flood flow water estimate to be 27% of the flows at McKays point as this percentage was half of the difference between the other two used. The available peak flood flows were graphed versus their reoccurrence interval and the equation of the best fit line was calculated. The equation was used to calculate peak flood flows for other events between the 10-year, 50-year and 100-year events.

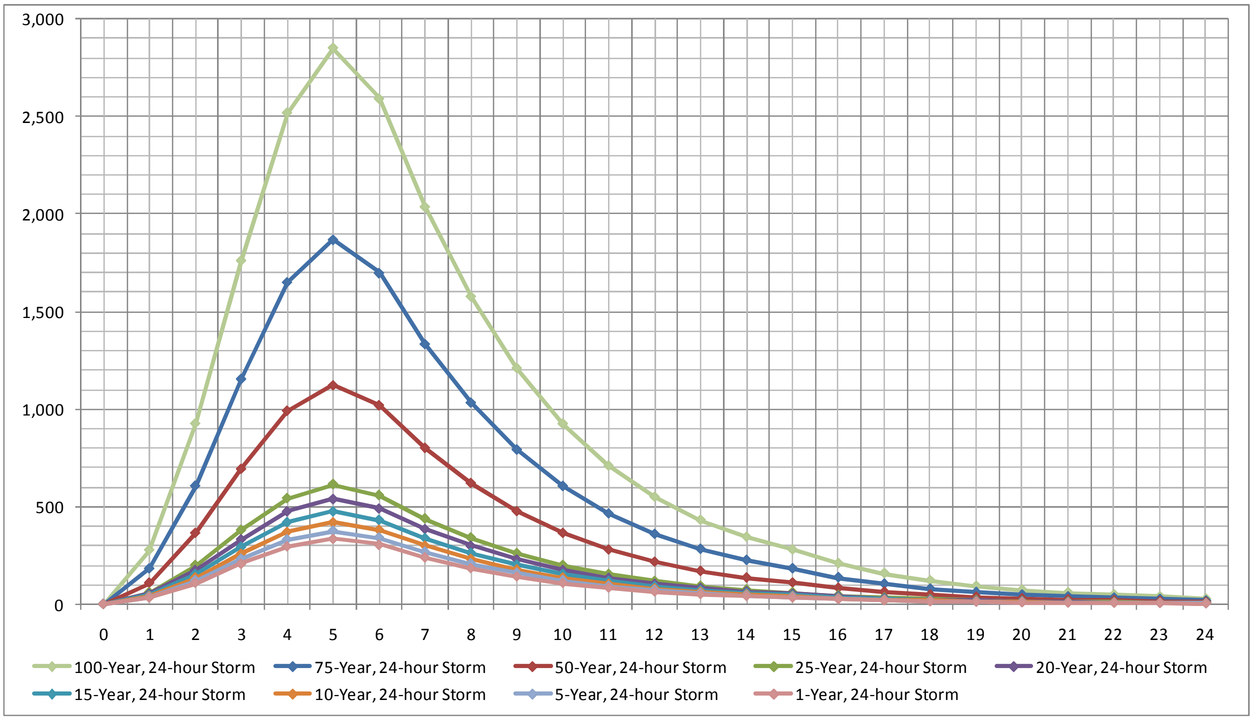


Next a unit hydrograph for the Kaweah River was researched and found to have been produced by the Army Corps of Engineers in a report that considered the raising of Terminus Dam that was accomplished in the early 2000s. This unit hydrograph for the Kaweah River was used to create a shape for the flows that occurred during 24-hour storms and it was assumed that this shape would also be applicable to flood events on Deep Creek, which is tributary to Kaweah River. The estimated peak flood flows were then used to inflate or reduce the Kaweah River unit hydrograph to generate 24-hour storm hydrographs for Deep Creek for a variety of reoccurrence interval storms.

The estimated channel capacities in the area of the project and the City of Farmersville were used from the 1983 FEMA Report to analyze what reoccurrence interval storms would cause flows in excess of the channel capacities and thereby flooding in Farmersville. The estimated hydrographs were used to estimate the volume of stormwater that would be delivered by each storm reoccurrence interval. From the analysis that the existing channel can safely convey the flows associated with up to a 15-year event, but reoccurrence intervals greater than that will cause varying levels of flooding in Farmersville.

Table 16-1: Estimated Deep Creek Storm Hydrographs

			Deep Creek Estimated Storm Hydrographs								
(Hour)	Kaweah River Unit Hydrograph		100-Year, 24-hour Storm	75-Year, 24-hour Storm	50-Year, 24-hour Storm	25-Year, 24-hour Storm	20-Year, 24-hour Storm	15-Year, 24-hour Storm	10-Year, 24-hour Storm	5-Year, 24-hour Storm	1-Year, 24-hour Storm
	(CFS)		(CFS)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)
0	0		0	0	0	0	0	0	0	0	0
1	506		277	182	109	60	53	46	41	36	33
2	1,688		925	607	365	199	175	154	136	121	109
3	3,212		1,760	1,155	695	379	333	293	259	231	208
4	4,594		2,517	1,652	994	542	477	420	371	330	298
5	5,201		2,850	1,870	1,125	614	540	475	420	374	337
6	4,726		2,590	1,699	1,022	558	491	432	382	340	306
7	3,714		2,035	1,335	803	438	386	339	300	267	241
8	2,876		1,576	1,034	622	340	299	263	232	207	186
9	2,206		1,209	793	477	260	229	201	178	159	143
10	1,686		924	606	365	199	175	154	136	121	109
11	1,293		709	465	280	153	134	118	104	93	84
12	1,001		549	360	217	118	104	91	81	72	65
13	787		431	283	170	93	82	72	64	57	51
14	628		344	226	136	74	65	57	51	45	41
15	509		279	183	110	60	53	46	41	37	33
16	382		209	137	83	45	40	35	31	27	25
17	289		158	104	63	34	30	26	23	21	19
18	220		121	79	48	26	23	20	18	16	14
19	170		93	61	37	20	18	16	14	12	11
20	134		73	48	29	16	14	12	11	10	9
21	109		60	39	24	13	11	10	9	8	7
22	90		49	32	19	11	9	8	7	6	6
23	71		39	26	15	8	7	6	6	5	5
24	50		27	18	11	6	5	5	4	4	3
Percentage of Unit Hydrograph peak to other peak storm			54.80%	35.95%	21.63%	11.81%	10.38%	9.13%	8.08%	7.19%	6.48%



16.3.4 Envisioned Project Operations

The Paregien Basin project is an in-line basin that will hold back waters in Deep Creek upstream of the City of Farmersville. A new concrete structure in Deep Creek is envisioned to be outfitted with a large radial gate to regulate flows through the channel. Earthen levees will transition away from the catwalk deck of the concrete control structure and will retain ponded water levels over a native depressed area that is owned by Kaweah Delta WCD. During flood times, the facility is envisioned to allow flows that can be contained within the Deep Creek channel to pass through the facility without any retention. However, when flows in excess of the channel capacity downstream of the facility are measured, then the radial gate would be used to begin to restrict flow through the structure so that the water surface on the upstream side was raised. Then when flows through the facility began to decrease, because the peak of the storm had passed, the water retained behind the structure would be reregulated back to downstream surface water users for irrigation supplies or recharge the water in the in-line basin.

16.3.5 Flood Damage Reduction Benefits

The 24-hour hydrographs for varying reoccurrence interval flood event were first compared to the existing published channel capacities through the City of Farmersville. A conservative look at this comparison showed that without the Paregien Basin Project, flood events greater than a 15-year event would cause overflow of Deep Creek through the City of Farmersville and flood damage for a number of hours before the flows in the creek receded enough to begin relieving the flood water that escaped out of the banks.

The 24-hour hydrographs for varying reoccurrence interval flood event were used to estimate the volume of water that was produced every hour by each storm. During the periods when the Deep Creek channel capacity was insufficient to carry the flood water from the storm, the volume of water above channel capacity was calculated and hourly accounted as a volume of flood water in acre-feet. For each storm these amounts were summed together to provide an understanding of the magnitude of floodwater per reoccurrence interval flood event.

As can be seen from the table below, the flooding from 15, 20 and 25 year storms was relatively small in volume, with a range of 5 to 38 acre-feet in floodwater. Since the Paregien Basin Project has an estimated basin capacity of 61 acre-feet it was concluded that the project would relieve the entire amount of floodwater previously suffered within the City of Farmersville. However, the flooding from 50, 75 and 100 year storms was relatively large in volume, with a range of 229 to 1,074 acre-feet in floodwater. The project's available diversion volume was insufficient to fully protect the City of Farmersville from flooding impacts during these storms, but was sufficient to significantly reduce the volume of flooding.

The damage associated with each flooding event is based on a series of assumptions that are based in local knowledge of flooding events in the Tulare County area. These assumptions have been made because at this point in the development of the project, no such previous effort has ever attempted to quantify flood control benefits in terms of avoided financial damage. As far as could be determined by the City of Farmersville, this had never been done by the City for flood events on Deep Creek in any of their stormwater masterplans or other planning documents.

In order to be conservative in the estimates of financial impacts from flood damage, it was assumed that only damage associated with residential housing would be quantified. This damage was envisioned to be mostly non-structural and associated with the replacement of drywall, carpet, furniture and the typical appurtenances associated with families living in a rural residential area. Smaller volumes of flood water (15, 20 and 25 year storms) were assumed to produce an average flooding depth of 6-inches because of the relatively small time duration of these events and the terrain within Farmersville. In a general sense, lands on both sides of Deep Creek slope very slightly towards the creek, but individual subdivisions are usually fairly uniform in terms of the elevation of homes. The flooding volume and the average depth of 6-inches were then used to estimate the impacted area.

An average area per home within the City of Farmersville was also estimated. The City covers approximately 1.88 square-miles or 1,203 acres. There are 10,078 residents currently listed as living in the City and an average of 4.0 residents per home was listed in 2009 City statistics. Dividing the number of residents in the City by the average residents per home indicates that there are 2,520 homes in the City and that those homes could each represent an area of 0.48 acres. This is a very conservative approach to analyzing the number of homes impacted by flood damage because the actual density of homes in the area is much greater (ignoring the area for streets, parks, and open spaces within the City) and no commercial or industrial uses are being included in the analysis.

Larger volumes of flood water (50, 75 and 100 year storms) were assumed to produce average flooding depths of 9-inches, 18-inches and 21-inches because of the longer time duration of these events and the much larger volumes of floodwater that in excess of the Deep Creek channel capacity within Farmersville. These assumptions were checked against historic descriptions of flooding within the City and they appear to be reasonable. For instance, the 100-year flood event is estimated to impact 613 acres within Farmersville from Deep Creek flooding and this is consistent with the description of the flood event that occurred in December 1966 from Tulare County records.

Finally, the avoided flood damage that the project would have on each flooding event was estimated by reducing the volume of flood water from Deep Creek by the project's storable capacity. If the project had sufficient storable capacity to divert all of the flood water, then the total pre-project flood damage was counted as avoided flood damage benefit.

Table 16-2: Estimated Flood Damage without Paregien Basin Project

Capacity of Paregien Project =				150	AF	
Storm (year)	Est. Flood Water (AF)	Est. Depth of Flooding (ft)	Est. Area of Flooding (Acres)	Est. Number of homes damaged [1]	Est. Flood damage to avgerage home [1]	Est. Total Flood Damage [1]
1	0.0	--	--	--	--	
5	0.0	--	--	--	--	
10	0.0	--	--	--	--	
15	5.0	0.50	10.00	20.8	$5,000	$104,000
20	19.6	0.50	39.20	81.7	$5,000	$408,500
25	37.8	0.50	75.60	157.5	$5,000	$787,500
50	229.2	0.75	305.60	636.7	$10,000	$6,367,000
75	576.9	1.50	384.60	801.3	$20,000	$16,026,000
100	1073.7	1.75	613.54	1278.2	$22,000	$28,120,400

Table 16-3: Estimated Flood Damage with Paregien Basin Project

Storm (year)	Post-Project Est. Flood Water (AF)	Post-Project Est. Depth of Flooding (ft)	Post-Project Est. Area of Flooding (Acres)	Post-Project Est. Number of homes damaged [1]	Post-Project Est. Flood damage to avgerage home [1]	Post-Project Est. Total Flood Damage [1]
1	0.0	--	--	--	--	--
5	0.0	--	--	--	--	--
10	0.0	--	--	--	--	--
15	0.0	--	--	--	--	--
20	0.0	--	--	--	--	--
25	0.0	--	--	--	--	--
50	79.2	0.55	144.00	300.0	$6,000	$1,800,000
75	426.9	1.25	341.50	711.5	$18,000	$12,807,000
100	923.7	1.75	527.80	1099.6	$22,000	$24,191,200

For the flood events where the project’s storable capacity was not enough to divert the total volume of flood water, the diverted water was removed from the flood water for the event. Then for the new flood water volume a new average depth of flooding was generated and an average damage estimated for the associated depth of flooding. With the new depth of flooding an area was calculated from the flooded volume, and this area was then translated to a number of homes damaged using the previously used area per home. The number of homes damaged was then multiplied by the average damage per home that was associated with the average depth of flooding. The benefits from the project then became the difference between the financial flood damage without the project and with the project.

Table 16-4: Paregien Basin Project Flood Benefit Table (Table 18)

Table 18 - Deep Creek Flood Event Damage in the City of Farmersville Project: Paregien Basin Project							
Hydrologic Event	Event Probability	Damage if Flood Structures Fail	Probability Structural Failure		Event Damage		Event Benefit (Million $)
			Without Project	With Project	Without Project	With Project	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
					(c) x (d)	(c) x (e)	(f) – (g)
10-Year	0.100	$0	0.50	0.000000	$0	$0.00	$0
15-Year	0.067	$104,000	0.75	0.000000	$78,000	$0.00	$78,000
20-Year	0.050	$408,500	1.00	0.000000	$408,500	$0.00	$408,500
25-Year	0.040	$787,500	1.00	0.000000	$787,500	$0.00	$787,500
50-Year	0.020	$6,367,000	1.00	0.282708	$6,367,000	$1,800,000	$4,567,000
75-Year	0.013	$16,026,000	1.00	0.799139	$16,026,000	$12,807,000	$3,219,000
100-Year	0.010	$28,120,400	1.00	0.860272	$28,120,400	$24,191,200	$3,929,200

Table 16-5: Paregien Basin Project Annual Flood Damage Benefits (Table 19)

Table 19 - Present Value of Expected Annual Damage Benefits Project: Paregien Basin Project			
(a)	Expected Annual Damage Without Project (1)		**$371,203**
(b)	Expected Annual Damage With Project (1)		**$177,361**
(c)	Expected Annual Damage Benefit	(a) – (b)	**$193,842**
(d)	Present Value Coefficient (2)		**15.76**
(e)	**Present Value of Future Benefits** **Transfer to Table 20, column (e), Exhibit F: Proposal Costs and Benefits Summaries.**	**(c) x (d)**	**$3,055,318**

16.4 Oakes Basin Habitat Enhancement Project

This project is not expected to generate any flood damage reduction benefits.

16.5 GW Quality Protection and Investigation

This project is not expected to generate any flood damage reduction benefits.

ATTACHMENT 9 – ECONOMIC ANALYSIS – FLOOD DAMAGE REDUCTION COSTS AND BENEFITS

APPENDIX A

Flood Insurance Study for the City of Farmersville, Tulare County

FLOOD INSURANCE STUDY

CITY OF FARMERSVILLE, CALIFORNIA
TULARE COUNTY

JUNE 15, 1983

Federal Emergency Management Agency

COMMUNITY NUMBER - 060405

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Exhibit 1 - Flood Insurance Rate Map

FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Farmersville, Tulare County, California, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Farmersville to the regular program of flood insurance by the Federal Emergency Management Agency. Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the State (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by James M. Montgomery, Consulting Engineers, Inc., for the Federal Emergency Management Agency, under Contract No. H-4727. This work, which was completed in March 1982, covered all significant flooding sources affecting the City of Farmersville.

1.3 Coordination

Areas requiring detailed study were identified at a meeting held in May 1978, attended by representatives of the Federal Emergency Management Agency, the study contractor, and the City of Farmersville. Results of the hydrologic analyses for Farmersville were coordinated with the U.S. Army Corps of Engineers, the U.S. Geological Survey, the U.S. Soil Conservation Service, the California Department of Water Resources, and the Tulare County Flood Control District.

Preliminary results of the study were presented to the community at an intermediate/final coordination meeting held on November

18, 1981, and attended by representatives of the City of Farmersville, the study contractor, and the Federal Emergency Management Agency. The study was acceptable to the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Farmersville, Tulare County, California. The area of study is shown on the Vicinity Map (Figure 1).

The limits of study in Farmersville were determined by the Federal Emergency Management Agency with community and study contractor consultation at the meeting in May 1978. Floods caused by overflow of Deep Creek within the corporate limits of the city were originally intended to be studied by detailed methods. However, preliminary hydraulic calculations indicated that 100-year flooding in Farmersville would not be readily associated with the Deep Creek channel, and would be at an average depth of less than 3 feet. Therefore, Deep Creek overflows were studied by the methods prescribed for conditions of shallow flooding, and the Deep Creek channel was studied by approximate methods. Extension Ditch was studied by approximate methods.

Those areas studied were chosen with consideration given to all proposed construction and forecasted development through 1987.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the Federal Emergency Management Agency and the City of Farmersville.

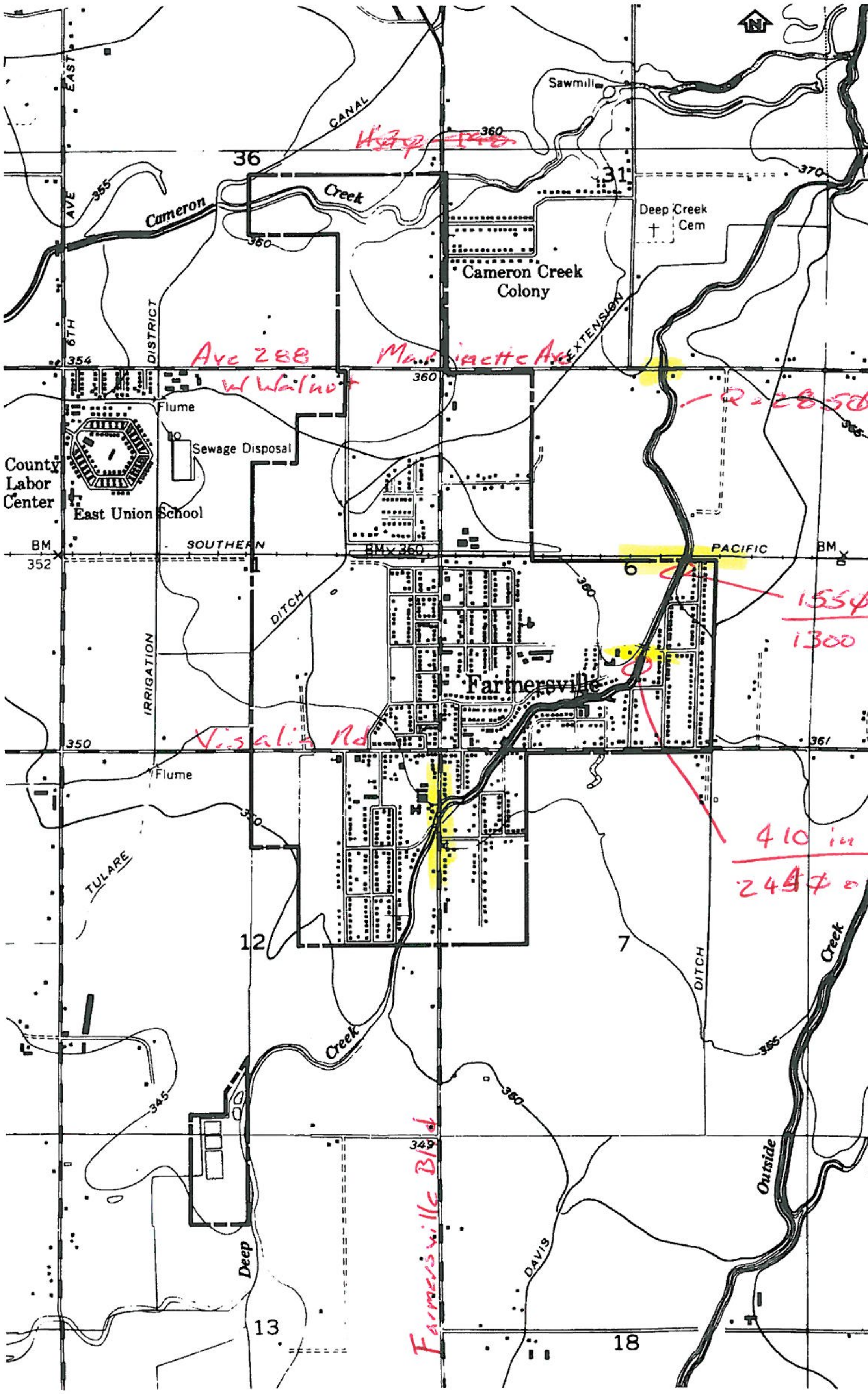
2.2 Community Description

The City of Farmersville is located in the San Joaquin Valley in central California, in the central portion of Tulare County. Farmersville is situated approximately 46 miles southeast of Fresno and 5 miles east of Visalia and is surrounded by unincorporated areas of Tulare County. The total land area incorporated by the city is approximately 1.2 square miles.

According to U.S. Census Bureau figures, the population increased from 3456 in 1970 to an estimated 3780 in 1975 (Reference 1). The population in 1980 was 5544, an increase in population of 60 percent since 1970 (Reference 2).

Development consists primarily of residences and commercial establishments. Approximately 93 percent of the residential housing units are single family dwellings. A large portion of the industry

Hwy 198



APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF FARMERSVILLE, CA
(TULARE CO.)

FIGURE 1

is related to agriculture, the dominant business in the San Joaquin Valley. The main transportation artery serving the city is State Highway 198, which passes approximately one mile north of the corporate limits.

The primary watercourse contributing to flooding in Farmersville is Deep Creek, a distributary of Kaweah River. Deep Creek passes through the center of the city, and two other Kaweah River distributaries, Cameron Creek and Outside Creek, pass within one mile to the north and east, respectively, of Farmersville. Several irrigation canals are located in the vicinity of Farmersville including Extension Ditch, which receives its water from Consolidated Peoples Ditch and Deep Creek.

The climate is semi-arid and may be classified as "interior Mediterranean". Summers are hot and dry with low humidity, while winters are very mild with infrequent snowfall. Temperatures vary from average summer highs of approximately 100°F to average winter lows near freezing. The average annual precipitation at Farmersville is approximately 10.5 inches. However, floodwaters affecting Farmersville may originate near the headwaters of Kaweah River, where the average annual precipitation exceeds 45 inches. Eighty-five percent of the annual precipitation occurs between November and April (References 3 and 4).

The predominant soil type underlying Farmersville and the Deep Creek flood plain is described generally as a very deep fine sandy loam, nearly level to gently sloping, and moderately well to excessively drained. Vegetation is largely determined by current agricultural uses (Reference 5).

2.3 Principal Flood Problems

The past history of flooding in the City of Farmersville suggests that the flood season extends from November through June, with general rain floods occurring between November and April and snowmelt floods occurring from April to June. The majority of large floods have occurred during December, January, and February, and have been the result of heavy rains combined with snowmelt from the foothills and the Sierra Nevada Mountains.

There have been several major floods in recent history in the vicinity of Farmersville. These occurred in November 1950, December 1955, December 1966, and January 1969. In the past, the major flooding in Farmersville has been caused by breakouts of Deep Creek.

2.4 Flood Protection Measures

The primary flood protection facility affecting flooding in the Kaweah River distributary system is Terminus Dam, which has been operated for flood control by the U.S. Army Corps of Engineers since 1962. Lake Kaweah has a gross capacity of approximately 150,000 acre-feet (Reference 5). This dam has reduced potential flood hazards on Kaweah River and its distributaries, including Deep Creek. For example, the peak inflow to Lake Kaweah during the 1969 flood was 35,600 cubic feet per second (cfs), whereas the maximum release was 4,342 cfs. It is estimated that the project provides protection against a flood which would occur approximately once in 50 years.

No flood plain ordinances or flood protection measures are in effect in Farmersville.

3.0 ENGINEERING METHODS

In this engineering study, the nature of flooding in Farmersville has been identified as "shallow flooding". This is characterized by sheet flow or ponding with depths less than 3 feet. For the shallow flooding sources studied, standard hydrologic and hydraulic methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equalled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for flood plain management and for flood insurance premium rates. Statistically, this event, commonly termed the 100-year flood, has a 1.0 percent chance of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, "rare" floods could occur at short intervals or even within the same year. The risk of experiencing a "rare" flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Peak discharges for Deep Creek were determined as part of an overall hydrologic analysis of the Kaweah River distributary system. This analysis involved detailed hydrograph calculations, modified Puls routing, and divided flow analysis. A starting 100-year flood hydrograph was obtained for McKays Point, the upstream end of the distributary system, from an unpublished U.S. Army Corps of Engineers study for Kaweah River. This hydrograph was then adjusted to match the hydrograph peak discharge to the value presented on the graph "Rain-Flood Frequency Curves", October 1971, in the November 1971 revision of the reservoir regulation manual for Terminus Dam prepared by the U.S. Army Corps of Engineers (Reference 6). The resulting hydrograph was then routed downstream to Deep Creek using the modified Puls method. Major flow divisions between McKays Point and Deep Creek were determined by hydraulically modeling the major stream courses and flood plains utilizing the HEC-2 computer program. Minor diversions were accounted for using published flow capacities (Reference 6). Major tributary inflows were assumed to be constant at the mean annual peak flow.

Based on this analysis, the 100-year peak discharge for the Deep Creek channel downstream of Avenue 288 is estimated to be 2850 cfs. Downstream channel overflows reduce the channel discharge to 1550 cfs at the Southern Pacific Railroad; the remaining 1300 cfs is assumed to flow in the west overbank toward Farmersville. Additional overflows are assumed to occur between East Ash Street and Farmersville Boulevard, such that the 100-year discharge remaining in the channel at Farmersville Boulevard is 410 cfs.

3.2 Hvdraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Elevations and depths of shallow flooding throughout Farmersville were computed using HEC-2 backwater analyses (Reference 7) and normal depth calculations. The cross sections and spot elevations needed in this analysis were obtained by photogrammetric techniques from aerial photographs taken in February 1979 at a scale of approximately 1 inch equals 925 feet (Reference 8) and from the most current U.S. Geological Survey topographic mapping for the study areas (Reference 9).

Channel roughness factors (Mannings "n" value) used in the hydraulic computations were chosen by engineering judgment and based on field observations of the study area. Roughness values ranged from 0.045 for agricultural areas to 0.100 for developed areas to account for obstructions and buildings.

The Federal Emergency Management Agency does not require the preparation of flood profiles in areas studied by approximate or shallow flooding methods; therefore, no flood profiles are presented in this report.

Shallow flooding is often characterized by highly unpredictable flow directions caused by low relief or shifting channels and high debris loads. Where such conditions exist, the entire area susceptible to this unpredictable flow has been delineated as a zone of equal risk. Small scale topographic variations have been averaged across inundated areas in determining flood elevations.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency as the base flood for purposes of flood plain management measures. The boundaries of the 100-year flood have been delineated using the flood depths determined at cross sections and spot elevations; between points of known elevation, the boundaries were interpolated using rectified photo topographic maps at a scale of 1:4,800 (Reference 10).

Flood boundaries are indicated on the Flood Insurance Rate Map (Exhibit 1). On this map, the 100-year flood boundary corresponds to the boundary of the areas of special flood hazards (Zone AH). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights.

The Federal Emergency Management Agency does not require delineation of a floodway in areas studied by approximate or shallow flooding methods. Therefore, no floodway has been computed for the City of Farmersville.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Emergency Management Agency has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

Because flooding in Farmersville is shallow, the area does not lend itself to standard reach determinations as defined by the Federal Emergency Management Agency. Consequently, none were developed in these areas, and flood insurance zones were assigned directly based on the type of flooding conditions present in the community.

5.2 Flood Hazard Factors

The FHF is the Federal Emergency Management Agency device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

No Flood Hazard Factors were computed for the shallow flooding zones in Farmersville because they were not required under Federal Emergency Management Agency guidelines.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Farmersville was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zone AH: Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHFs are determined.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

The flood insurance zones and base flood elevations for each flooding source studied in detail in the community are summarized in Table 1.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Farmersville is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Deep Creek Shallow Flooding	0001	N/A	N/A	N/A	N/A	AH	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF FARMERSVILLE, CA
(TULARE CO.)

FLOOD INSURANCE ZONE DATA

DEEP CREEK

TABLE 1

accordance with the latest flood insurance map preparation guidelines published by the Federal Emergency Management Agency.

6.0 OTHER STUDIES

Flood Hazard Boundary Maps for the City of Farmersville and unincorporated areas of Tulare County have been published (References 11 and 12). These maps show boundaries of a Special Flood Hazard Area but do not show depths. This Flood Insurance Study indicates slightly more area flooded than shown on the Flood Hazard Boundary Maps. The difference is attributed to the availability of more complete and detailed topographic information and updated hydrologic data. This study supersedes the Flood Hazard Boundary Maps.

A Flood Plain Information report (Reference 4) was published by the U.S. Army Corps of Engineers in May 1972. In this report, flood boundaries for intermediate Regional Flood and Standard Project Flood conditions were shown. The Intermediate Regional Flood is a flood having an average frequency of occurrence on the order of once in 100 years, although the flood may occur in any year. This Flood Insurance Study indicates slightly less area flooded than shown for the Intermediate Regional Flood in the Flood Plain Information report. The difference is attributed to the availability of more complete and detailed topographic information and updated hydrologic data.

A Flood Insurance Study is being prepared for the unincorporated areas of Tulare County, California (Reference 13). Flood data computed and shown for unincorporated areas adjacent to the Farmersville corporate limits are consistent with the data given in this report.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Building 105, Presidio of San Francisco, San Francisco, California 94129.

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ATTACHMENT 9 – ECONOMIC ANALYSIS – FLOOD DAMAGE REDUCTION COSTS AND BENEFITS

APPENDIX B

City of Farmersville – Storm Drainage Master Plan

CITY OF FARMERSVILLE

STORM DRAINAGE MASTERPLAN

MAY, 1989

CITY OF FARMERSVILLE

STORM DRAINAGE MASTER PLAN

Adopted June 14, 1989

Prepared by:
QUAD Engineering
5110 West Cypress
Visalia, California 93278

88606

OFFICIALS

CITY COUNCIL

Al Vanderslice	Mayor
Ray Parker	Mayor Pro Tem
Charles Felix	Council Member
Don Rowlett	Council Member
Judy Barnes	Council Member

ADMINISTRATION

Patrick M. King	City Manager
Ruben DeLeon	Public Works Director

PROJECT STAFF (QUAD ENGINEERING)

Harry Tow	Principal-in-Charge
Charles Sanford	Project Manager
Kenneth Ramage	Project Engineer

COORDINATION

Dennis Moffitt	Consolidated People's Ditch Company
Herbert Knierim	Tulare County Flood Control

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APPENDIX

A. Consolidated People's Ditch Company Agreement

B. Design Criteria

C. Recommended System Calculations

D. Cost Estimates

E. Project Review Dates

CHAPTER ONE

INTRODUCTION

This report has been prepared under the authorization of the City Council of the City of Farmersville in order to provide for the orderly and planned disposal of storm drainage run-off.

The intent of this report is to develop a comprehensive storm drainage plan that will eliminate or reduce existing drainage problems and to plan for drainage facilities for future development of the areas in and adjacent to the City of Farmersville. It should be noted that the proposed drainage facilities incorporated in this report have been designed to provide drainage for local storm water runoff only. These facilities have not been designed to accommodate flood waters that are generated by large intensity storms outside of the study area that may enter the City of Farmersville by overland flow.

The specific scope of work for this study included the following:

1. Compilation of all available storm drainage data, both from records and field surveys.
2. Preparation of necessary calculations, forecasts and estimates.
3. Coordination of the study with the Tulare County Flood Control Agency, the Consolidated People's Ditch Company, and other interested or affected agencies.
4. Preparation of necessary maps, charts and graphs.
5. Development of a comprehensive storm drainage master plan, including required system facilities, design criteria, project financing, and system priorities. This study and the proposed fees are consistent with AB 1600, "Developer Impact Fee Legislation", which went into effect January 1, 1989.

6. Development of a storm water management program, which recommends operation and maintenance procedures for existing and proposed facilities. It also addresses possible impacts of point-source drainage discharge regulations which are under consideration by the EPA and the Regional Water Quality Control Board.

The sizes and location of proposed drainage facilities outlined in this master plan are preliminary designs only. The final size and location of the facilities in any drainage area can only be determined after specific circulation and land-use designs have been determined and after detailed field surveys and engineering designs have been completed.

CHAPTER TWO

INVENTORY AND EVALUATION OF EXISTING SYSTEM

The Farmersville storm drainage system is similar to that of other Tulare County communities and is a combination of surface drainage facilities and underground gravity flow pipelines. The two primary points of discharge are the Consolidated Peoples' Ditch Company's Extension Ditch and Deep Creek.

The existing system map was compiled from existing file information, field reviews and consultation with members of the Public Works Department. It is presented on Plate 1, "Existing Drainage System". An evaluation of the various sub-areas, as delineated on said Plate, is as follows:

Sub-Area A (Citrus Drive):

This area consists of approximately 32 acres, lying on both sides of Farmersville Boulevard. Surface flows run westerly to collection points at the west ends of Citrus and Ponderosa, where an undersized 12" pipeline carries 30% of the design flow northerly to a 5 H.P lift station which pumps into Extension Ditch. The curb and gutter, and cross-gutters along Citrus, between Farmersville Boulevard and Linnel are very flat, creating continuing drainage problems.

Sub-Area B (Petunia to Farmersville Boulevard):

The only drainage facility in this area is a "bubble-up" at Petunia and Farmersville Boulevard. Surface drainage flows to the railroad right of way or ponds on the north side of Petunia. Serious street ponding occurs in the vicinity of Petunia and Linnel even during low-intensity storms.

Sub-Area C (Front and Ventura):

This is a relatively new developed area, containing approximately 132 acres, created primarily by the various phases of Orchard Estates and Lewis Estates. A series of pipelines collect surface run-off and carry the flow to a pump station at the above intersection. Drainage problems have occurred in the past along Costner, at Steven, Matthew and Kern. The first two intersections have flooded primarily because of failures at the lift station. These failures have been substantially resolved with the installation of a trash screen at said station. The third intersection at Kern also floods; the 12" pipe carrying water north from this point is only capable of carrying 38% of design flows. (This is because Shasta and Linnel also drain to this point.) The remainder of the system, including the pump station, has adequate capacity.

Sub-Area D (Farmersville Boulevard):

This area contains approximately 65 acres, including Farmersville Boulevard, from the railroad to Deep Creek, Visalia Road easterly to Deep Creek, and the Birch/Magnolia area. The existing 15" pipe in Farmersville Boulevard, which gravity drains southerly to Deep Creek, is significantly undersized, and once south of Visalia Road is only capable of carrying 16% of design flows. The most serious drainage problem is on Magnolia, just north of Visalia Road. This area used to flood severely because water from Farmersville Boulevard would backup and "bubble-up" at this location. This problem was reduced in 1986 when a flap-gate was installed on the discharge, but the area is still susceptible to flooding.

Sub-Area E (Rose and Ash):

This area contains approximately 55 acres. The storm flows are collected by pipelines which ultimately drain through a 30" pipeline into Deep Creek. This system is adequate.

Sub-Area F (Pepper and Gene):

This area contains approximately 30 acres. The storm run-off is collected by pipelines which ultimately drain through a 27" pipeline into Deep Creek. The system also utilizes a lift station with 2-10 h.p pumps at Gene and Pepper. This system is adequate.

Sub-Area G (Dwight Avenue):

The storm run-off from this small area is collected by 12" and 15" pipelines which drain into Deep Creek. This system is adequate.

Sub-Areas H, I, J, K, L, M (along both sides of Deep Creek, from Hester to Southern Pacific Railroad) and;

Sub-Areas T, U, V (along both sides of Deep Creek, from Magnolia to Visalia Road):

These are all small drainage areas which each surface drain to a single drainage inlet or curb opening and then flow directly into Deep Creek. No drainage problems were identified by City staff in these areas.

Sub-Area N (E. Visalia Road):

This area contains approximately 40 acres. The storm run-off is collected into a pipeline running westerly along Visalia Road, which eventually discharges through a 21" pipeline into Deep Creek. Although the pipe sizes are adequate, the 21" pipeline enters Deep Creek below the bottom of the creekbed, and therefore must overflow into the creek through a recently installed outlet structure. This overflow reduces the system's effectiveness.

Sub-Area O (Hester and Larry):

This area contains approximately 13 acres. Storm flows drain along the alley north of Visalia Road by surface and "bubble-ups", to a 12" pipeline, which drains into Deep Creek. The 12" pipeline is capable of carrying only 63% of design flow.

Sub-Area P (Shasta and Visalia Road):

This area contains approximately 25 acres, with surface flows draining to a 12" pipeline along Visalia Road. This pipeline overflows through an outlet structure into Hart-Sweeney Ditch. The 12" pipeline is capable of carrying only 26% of design flow. Further, the surface drainage in the area of Peco and Linnel is inadequate.

Sub-Area Q (Truline/National Builders):

In this area surface waters are conveyed to two on-site retention basins constructed and maintained by Truline Industries and National Builders Supply. These systems are adequate.

Sub-Areas R and S (Shasta and Kern):

These two areas contain approximately 70 acres. Surface flows drain from the north end of these areas, south to Tulare Street, and then are collected into two undersized 12" pipelines (31% and 33% of design flows, respectively).

Sub-Area W (Langford Tract):

The run-off in this area is collected by an 18" pipeline, which drains into a retention ponding basin. This system is adequate.

Sub-Area X (Camella Avenue):

This area has no sub-surface collection or disposal system. Stormwater surface drains to the south end of Camella Avenue, where it drains onto vacant property to the south.

Sub-Area Y (S. Farmersville Boulevard):

This area's storm drainage is partially collected by an undersized 15" pipeline (50% of design flows) which drains to Deep Creek. Areas south of the 15", as well as overflow from the 15" pipeline, surface drain south onto vacant agricultural ground just south of the existing City limits. There are also onsite collection points at an apartment site and the City corporation yard which have gravity pipeline connections to Deep Creek.

Sub-Area Z (Farmersville Boulevard and Avenue 288):

The portion of this area on the east side of Farmersville Boulevard, southerly of Avenue 288, drains by curb and gutter to a drainage inlet, which is then conveyed by pipeline to Extension Ditch. No drainage problems have been identified in this area, and the system is considered adequate. The portion of this area on the west side of Farmersville Boulevard, northerly of Avenue 288, has curb and gutter installed in front of two existing commercial sites which provide for surface drainage flows southerly. There is currently no sub-surface collection system in this area, and surface run-off merely sheet-flows off the end of the curb onto the adjacent ground.

Existing Creeks and Ditches

Watercourses within the study area are Cameron Creek, Deep Creek, Extension Ditch, Blain Ditch, Lower Extension Ditch, Hart-Sweeney Ditch and Sims-Davis Ditch. Except for Cameron Creek, which is operated by Tulare Irrigation District, all of the channels are operated by Consolidated People's Ditch Company. In reviewing existing and proposed discharges into these channels, Dennis Moffitt, the District Manager, has indicated that Extension Ditch, and its branches (Blain, Lower Extension and Hart-Sweeney) are currently at capacity and no further discharges could be accepted by the District. Sims-Davis could take some limited additional discharge, and Deep Creek is capable of taking significant discharge increases (in the order of 20-30 cubic feet per second).

Discharges to Consolidated People's Ditch Company facilities are governed by an agreement between the company and the City of Farmersville, dated December 29, 1986, and modifications or additions to these discharges are subject to the ditch company's approval of a modification to said agreement. A copy of the agreement, which expires December 31, 1991, is found in Appendix A.

EXISTING SYSTEM

(See folded insert at back of report marked PLATE 1)

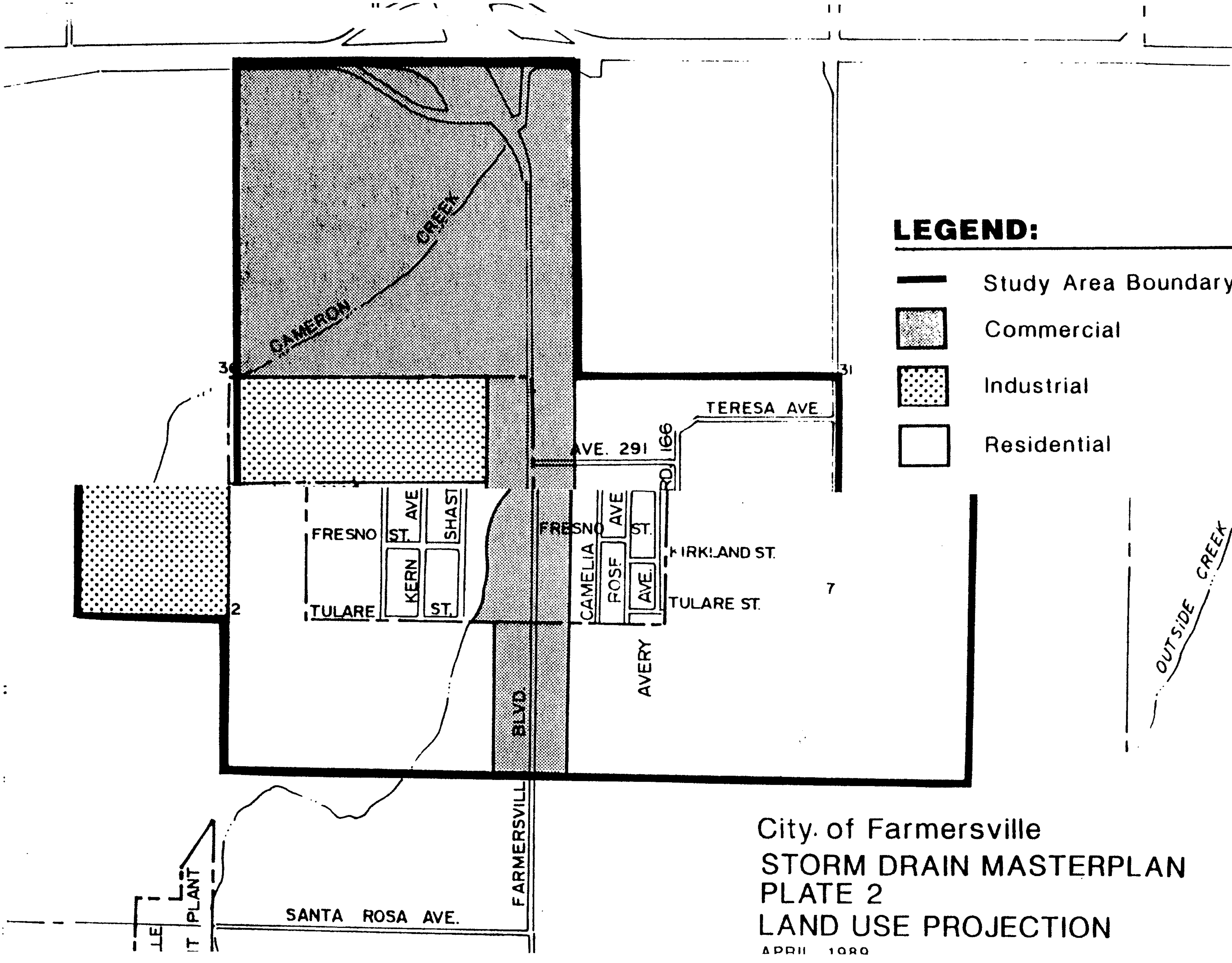
CHAPTER THREE

STUDY AREA/LAND USE PROJECTIONS

In order to retain consistency between this study, and the 1983 Sanitary Sewer Master Plan, the study area of that master plan was utilized to the extent possible. Minor modifications were made for consistency with the current Urban Area Boundary and General Plan and with existing property lines.

The land use projections were based on the current Land Use Element of the City's General Plan. In consultation with City staff, land use assumptions were made in areas designated "Urban Reserve". These assumptions were made solely to approximate the quantities of storm water run-off from different drainage areas, and in no way are these assumptions intended to "set" these future land uses.

The Study Area and Land Use Projections are reflected on Plate 2.



City of Farmersville
STORM DRAIN MASTERPLAN
PLATE 2
LAND USE PROJECTION
APRIL 1989

CHAPTER FOUR

DESIGN CRITERIA

DESIGN CRITERIA

Hydrology

An important step in preparation of this Master plan is the development of the hydrology criteria. This must occur before any determination can be made as to pipeline sizes and storm water basin capacities. Hydrology, in this sense deals with the characteristics of rainfall and surface water run-off.

The commonly accepted procedure utilized for urban drainage design for smaller urban areas, such as Farmersville, is called the Rational Method. The basic Rational Method formula, used in this study, is

$$Q = CIA$$

where Q = Peak flow rate in cubic feet per second, cfs.

C = Coefficient of Runoff

I = Average rainfall rate in inches per hour corresponding to the time of concentration

A = Drainage area in acres

The basic design criteria used in this report is the once-in-two-year storm, or more commonly referred to as a storm that has a two-year return period. It is important to remember "return period" does not imply that there will be a given number of years between storm events. It only means that over many years such a storm will occur on the average the number of years designated. The two-year return period storm, then, will occur on the average of 50 times in 100 years. Three of these storms may be in successive years, or all three may occur in the same year, or there may be many years between such events.

The coefficient of runoff (C) is primarily based on the land use of the drainage area. The coefficient of runoff is a dimensionless ratio which measures the amount of runoff that can be expected to occur for a particular land use. An example of this would be if 1" of rain falls on a residential lot, it is expected that 0.30" of rain would occur as runoff and the balance would be retained on the property. The coefficient of runoff would then be 0.30. The following values are used in this report:

COEFFICIENT OF RUNOFF (C)

LAND USE	(C)
Commercial/Industrial/Office	0.80
Residential	
Low Density	0.30
Medium Density	0.40
High Density	0.50
Parks, Open Space	0.15

The rainfall intensity (I) is based on the time of concentration and the storm frequency. The time of concentration is the time that it takes runoff to travel from the furthest point of the drainage area to the point for which the peak flow rate is being calculated. For the purpose of this study, time of concentration is equal to the lot time (or initial time) plus the travel time from the initial area to the point being considered. Lot time and gutter time criteria are outlined on Plate SD-1 and 1-A, in Appendix B. Pipeline velocities are outlined under "Hydraulics", in this chapter. The rainfall intensity (I) for a particular storm frequency at a particular time of concentration can then be obtained from SD-2 in Appendix B. This plate was developed by the use of the procedures outlined in the adopted Tulare County Flood Control Master Plan. These procedures were developed from hydrologic analysis of available data and studies of the National Weather Service and the California Department of Water Resources.

PONDING BASIN DESIGN

The basic storm criteria for the sizing of ponding basins is either (a) a ten-year storm with 18" freeboard below the lowest street-drainage curb inlet grate, or (b) a fifty-year storm with water at the top of the lowest top of curb within the drainage area, whichever creates the largest pond. This criteria is more conservative than the two-year return period because these ponding basins will, from time to time, receive and impound storm water in excess of the two-year storm. The pipeline collection system, which is only designed for a two-year occurrence, will become overloaded during a larger storm, causing temporary street ponding. However, the storm water which backs up into the streets will still reach the pond when the pipeline system "catches up".

Retention Basins:

The basic criteria for sizing total retention basins (no discharge except for percolation and evaporation) is either a ten-year or fifty-year storm as outlined above, for a duration of ten days. The storage equation is:

$$S = PCA/12$$

where S = Storage, in acre-feet
P = Rainfall depth for design storm in inches
C = Coefficient of Runoff
A = Drainage area in acres.

Rainfall depth, P, is the total amount of rainfall that will occur for a given design storm. The ten-year return period/ten day duration storm will yield a total of 4.3 inches. The fifty-year return period/ten-day duration storm will yield a total of 5.6 inches.

The coefficient of Runoff (C) and Drainage Area (A) are as defined earlier in this Chapter.

Detention Basins:

The basic criteria for sizing detention basins (discharge by pump or gravity flow during the design storm period) is the same ten or fifty-year storm as outlined, except that the duration period is chosen for that point during the design storm where the difference between total inflow and total discharge is the greatest. This duration period varies for each drainage area, and may be solved graphically utilizing Rainfall Depth Curves, SD-1-A, Appendix B.

HYDRAULICS

The method used to determine pipeline sizes in the drainage system is based upon the Manning's equation. This equation is:

$$Q = \frac{1.486}{n} AR^{2/3}S^{1/2}$$

where
- Q = Discharge of pipeline in cubic feet per second, cfs
- n = Coefficient of roughness
- A = Area of pipe based on Inside Diameter
- R = Hydraulic Radius
- S = Slope of the Energy Grade Line

In the use of this formula, the following assumptions and limitations are used:

1. Coefficient of roughness (n) = 0.013 for concrete pipe.

2. Pipes assumed to be flowing full.

3. Maintaining minimum velocities, when possible, of 2.5 feet per second, which is considered to be a minimum self-cleansing velocity.

CHAPTER FIVE

RECOMMENDED DRAINAGE SYSTEM

Prior to developing the detailed master plan, four alternative approaches were evaluated on a preliminary basis. These four alternatives were:

1. Alternate 1 - Develop a series of isolated drainage areas, each with its own trunk system, and detention basin, with pump station discharge to a creek or ditch.
2. Alternate 2 - Develop an interconnecting trunk line system, draining the entire town (except for the Highway 198 commercial area) to a single large ponding basin in the southwest part of town. This system would have no pumps, but would require large trunk lines.
3. Alternate 3 - Same as Alternate 2, except that trunk lines would be reduced in size by installing additional, smaller, surge ponds throughout the system.
4. Alternate 4 - Same as Alternate 1, except the ponds would be replaced by large, peak-capacity pump stations.

Alternate 1 was estimated to cost approximately $2 million dollars and would allow for for incremental development because each drainage area is self-contained. Alternates 2 and 3 both were estimated to cost approximately $3.5 million dollars, and would restrict incremental development because major trunk lines would have to be in place prior to development. Alternate 4 was rejected without an estimate because the required pumping capacity exceeded available ditch and creek capacities.

It was, therefore, determined that Alternate 1 would be the basis for the recommended system. Using the design criteria outlined in Chapter 4, the final system was established and is detailed on Plate 3, Proposed Drainage System. This system utilized those existing underground facilities, as outlined in Chapter 2, if they were determined to be hydraulically adequate to transport at least 80% of the design flows. Some specific features of the system are as follows:

Industrial Areas:

Two areas were delineated for possible industrial use in the northwest and southwest portions of town (see Plate 3). Due to possible water quality concerns from such sources, as outlined in Chapter 7, it is proposed that such industrial areas retain their drainage on-site. Therefore, no collection systems are master planned for these areas.

"No Change" Areas:

In areas so designated, existing facilities are adequate, and no new facilities are proposed (see Plate 3 for locations).

New Creek/Ditch Pump Station Discharges:

Pump station discharges are proposed to be added or deleted as follows:

a) Cameron Creek - one 10 cfs pump station is proposed from Area I (Hwy. 198 Commercial).

b) Extension Ditch - the existing 2.5 cfs pump station north of Citrus, in Area III, would be eliminated. Two 1 cfs stations would be added to Areas II and IX. No net increase in the discharge rate is proposed, in accordance with capacity limits as outlined in Chapter 2.

c) Sims-Davis Ditch - one 2 cfs pump station is proposed in Area VI.

d) Deep Creek - a 5 cfs station is proposed for Area V, while two 10 cfs stations are proposed for Areas VII/VIII (combined) and X/XI (combined). Since the Area VII/VIII (combined) station eliminates an approximate 5 cfs gravity discharge from the existing 21" in Area VII, the net increase to Deep Creek is 20 cfs.

Ponding Basins:

The acre-foot storage requirements of each proposed pond are indicated on Plate 3. The amount of land needed for each pond is also estimated, and listed on the same plate. This estimate of land was based on 6 feet of water depth for the 10-year criteria, and 8 feet of water depth for the 50-year criteria. Additionally, three of the larger ponds (Areas II, VII and X) have been designated to be multi-use park/ponds with minimum side-slopes of 6 to 1 (regular ponds have side-slopes of 2 to 1). Landscape/irrigation costs have been included in the estimates, but the costs for other park facilities, such as swings, slides, and back-stops, have not been included..

Cost Estimates:

Detailed estimates of all master planned facilities are included in Appendix D. A summary of these costs are as follows:

Area I (Commercial only)	$	429,250	$2,682/undeveloped acre
Area II-XI	$	2,675,700	$2,682/undeveloped commercial acre
			$2,292/undeveloped residential acre

The commercial area (Area I) was separated to establish a reasonable per acre cost for commercial properties. This cost/acre was then applied to Areas II-XI.

System Improvement Priorities:

Generally, the prioritization of the master planned improvements is subject to the location and timing of various land development projects. However, some specific priorities are as follows:

1. In undeveloped areas, the acquisition of the ponding basin site, through purchase or dedication in lieu of fees, should be the first priority. This allows much of the excavation to be completed for free by allowing the site to be used as a borrow pit for contractors needing dirt. If project timing and demand for fill dirt allows, pond excavation could be sold to help off-set master planned costs Also, some percentage of the drainage area can then develop before installation of the pump station and discharge line, since the pond can function as a retention basin until capacity is reached.
2. In Area III, the acquisition of the ponding basin, and the extension of the Petunia, Linnel and Citrus pipelines should be high priorities. The ponding basin would greatly improve the reliability of the existing Area IV system, and the line extension would relieve Citrus Avenue drainage problems, and eliminate the existing pump station. This existing pump must be eliminated prior to installation of the pumps in Areas II and IX, so that there is no net increase in the rate of discharge into Extension Ditch, and its branches.
3. The extension of the 15" and 12" lines in Ash Street, in Area IV, should be a high priority. This would relieve the drainage problems at Kern and Costner, by intercepting the Shasta and Linnel run-off north of Ash, which now drains to Costner.
4. The installation of the master plan pipelines in Visalia Road, between Magnolia and Larry, together with either (a) the installation of the

proposed pumping station, or, (b) the acquisition and improvement of the ponding basin, should be a high priority. This would relieve the Magnolia drainage problem, (Area VII), as well as eliminate the 21" discharge problem at Deep Creek (Area VI).

PROPOSED SYSTEM

(see folded insert at back of report marked PLATE 3)

CHAPTER SIX

SYSTEM FINANCING

Two components of the completion and operation of the facilities encompassed in the Master Plan must be financed:

- The property acquisition/construction costs of new drainage facilities which will serve currently undeveloped areas, and the upgrading of existing facilities as necessary to allow further growth.
- The operational and maintenance costs of all drainage facilities, both existing and master plan proposed.

The proposed financing program for each of these components will be separately discussed in this chapter. The fees outlined herein are consistent with AB 1600 as long as collected funds are assigned to budgeted projects, and the necessity of these projects is reviewed annually.

Capital Costs

Chapter 5 estimates the capital costs for eleven drainage sub-basins serving currently undeveloped areas and portions of the developed areas of the community which must be upgraded to allow adjacent areas to develop. The costs/acre, as outlined in Chapter 5, are $2,682/acre for commercial and $2,292/acre for residential properties. ENR BASE #5767 (LA)

It is proposed that under the authority of Section 66483, et. seq. of the California State Government Code: (BASE FEE) (NEW ENR# / OLD ENR#)

(1) The city adopt a storm drainage ordinance which provides for adoption of specific acreage fees by resolution. These fees will be applicable to all new development, and will be payable to the City at

the time of approval of parcel maps, subdivisions, or other development or building permits.

(2) That the ordinance provide that the City be responsible for acquiring and building the required facilities only when sufficient fee revenue has been received to complete such facilities.

(3) That developers and builders be required by such ordinance to build, if drainage area facilities are not available at the time of approval of or occupancy of their development or structures, on-site temporary facilities approved by the City.

(4) That the ordinance provide for in-kind contributions of land and or facilities by developers or builders in lieu of fees, at the City's sole option.

(5) That the ordinance contain a provision for annual review of fees, with such fees being adjusted each year in an amount not less than the Engineering News Record Construction Cost Index for that year.

June 1989 → ENR # 5767 (LA)

(6) That the ordinance exempt industrial areas from the fee as long as all drainage run-off is retained on-site.

(7) That the ordinance contain a provision for a reduction in the acreage fee for undeveloped lots in subdivisions which exist when the ordinance is adopted, if said subdivision installed adequate drainage facilities. The Director of Public Works will determine the amount of the reduction.

Operation and Maintenance Costs

In addition to use of City general funds and gas taxes, consideration could be given to the following:

- The maintenance of multi-use park/ponds serving currently undeveloped areas could be financed through assessment districts under the Landscaping and Lighting Act or other appropriate State enabling legislation. The establishing of assessment districts under the Lighting and Landscaping Act is relatively simple when undertaken with developer cooperation, and when the principal benefits of the park/pond developments accrue to the assigned areas.
- Other drainage facilities maintenance costs could be financed through a monthly service charge added to the City's water and sewer billing, under the authority of Government Code Sections 38900 et. seq.

CHAPTER SEVEN

STORM DRAINAGE MANAGEMENT PROGRAM

The three components of this chapter are recommended routine maintenance and operational procedures, emergency coordination with other local agencies, and evaluations of possible State mandated water quality regulations for point-source drainage discharges.

Routine Maintenance and Operational Procedures

Some general guidelines for system maintenance and operations are outlined as follows:

Weekly: Check pump station sumps for debris, and float switches for hang-ups. Pull screens and clean if warranted.

Semi-Monthly: Manually run pumps and check starters, overload relays, alternators, level control system and alarm operation. If pump motors are tripping the overloads, check relays, check fuses for possible problems or pump impellors for obstructions. Listen to pump during operation to detect problems, obstructions, rough bearings, etc.

Monthly: Same as weekly except check amps motor is pulling to determine conditions of pump and motor. Call maintenance contractor if motor is pulling 10% over H.P. rated amps.

Annually: (Before rainy season begins) have maintenance contractor pull motor and pump and determine condition of impellers, bearings, seals. Also have a complete motor control panel and wiring check-up.

Ponds which are not being used as parks should be sterilized every one to two years to minimize weed control. Ponds should be cleaned and debris removed annually.

After First Big Rain:

Perform the weekly and semi-monthly routine immediately after storm has ended. Additionally, inspect inside manholes of all major trunk lines to locate and remove any debris collected during the storm.

Routine and Emergency Coordination With Other Agencies

Consolidated Peoples Ditch Company - The City should review the existing agreement annually. If new discharge points are anticipated that year, appropriate revisions to the agreement should be applied for well in advance. During periods of very heavy flood discharges through their ditches and creeks, coordination between the City's Director of Public Works and the ditch company's manager may be required to assure that City discharges, in conjunction with other flows, do not cause these ditches and creeks to overflow their banks. The installation of the proposed detention basins will give the City additional flexibility.

Tulare Irrigation District - At such time as Area I (Hwy 198 Commercial) starts to develop, an agreement for discharge to Cameron Creek must be negotiated with Tulare Irrigation District.

Tulare County Flood Control Agency - The only routine coordination between this agency and the City relates to the City's review and possible support of regional drainage facilities, such as the proposed dam on Dry Creek, or the raising of the Terminus Dam. The agency would initiate such proceedings. During periods of minor regional flooding, there would be informal cooperation between the agency and the City to keep each other informed. Should a disaster be declared, emergency management disaster procedures would be implemented.

Pending Discharge Requirements

Regulations which are currently being considered by the Regional Water Quality Control Board only require monitoring in communities of 100,000 or more (per U.S.E.D.A. draft rules for urban storm water discharge permits; published December 7, 1988). It is anticipated, however, that the City may eventually be required to "police" non-residential discharges into the City's drainage system (draft rules cover "smaller" communities by 1992). To minimize the City's liability in this area, industrial sites should be required to retain their storm drainage on-site, as Truline Industries did. This assures that on-site spills of hazardous wastes do not reach the City's System. These industries may eventually have to obtain their own State discharge permits. (Current draft rules only address discharges to the "receiving waters of the United States").

APPENDIX A

Consolidated People's Ditch Company Agreement

AGREEMENT
BETWEEN THE
CITY OF FARMERSVILLE
AND THE
CONSOLIDATED PEOPLE'S DITCH COMPANY

This Agreement, made and entered into this 29th day of December, 1986 by and between CONSOLIDATED PEOPLE'S DITCH COMPANY, a corporation, hereinafter designated as the "Company", and the CITY OF FARMERSVILLE, hereinafter designated as the "City":

W I T N E S S E T H

WHEREAS, the Company maintains an open ditch, called Extension Ditch and Deep Creek, running in a general east and west and north and south direction respectively in the city limits of the City; and

WHEREAS, the City wishes to empty and drain certain flood and surface water into Company's ditch at points designated as follows, to wit:

1. That point on the east bank of Deep Creek Canal, 215 feet west of drain inlet at end of cul-de-sac on N. Brundage Ave., Assessor's parcel book 129, Tulare County map.

2. That point on the east bank of Deep Creek Canal, 50 feet south of E. Pepper St. on N. Oakview Avenue, west side of the street, Assessor's parcel book 129, Tulare County map.

3. That point on the west bank of Deep Creek Canal, 100 feet south of of discharge point as stated in #2 above. Assessor's parcel book 129, Tulare County map.

4. That point at the northwest section of bridge on E. Ash St., 100 feet east of N. Dwight Ave. Assessor's parcel book 129, Tulare County map.

5. That point 30 feet northeast of drain inlet at the northwest corner of E. Elm St. and N. Dwight Ave. on the west bank of Deep Creek Canal. Assessor's parcel book 129, Tulare County map.

6. That point at the northeast section of bridge on N. Hester Ave., 160 feet south of E. Costner. Assessor's parcel book 129, Tulare County map.

7. That point at the west end of cul-de-sac on E. Costner St., 75 feet east of drain inlet to west bank of Deep Creek Canal. Assessor's parcel book 129, Tulare County map.

8. That point 130 feet southeast of drain inlet at the southeast corner of E. Costner St. and N. Rose Ave. on the north bank of Deep Creek Canal, Assessor's parcel book 129, Tulare County map.

9. That point at the southwest section of bridge at the intersection of E. Visalia Rd. and S. Rose Ave. Assessor's parcel book 129, Tulare County map.

10. That point on the west side of S. Rose Ave., 35 feet south of E. Visalia Rd. on the west bank of Deep Creek Canal, Assessor's parcel book 129, Tulare County map.

11. That point on the northeast section of bridge at the intersection of E. Visalia Rd. and S. Rose Ave., Assessor's parcel book 129, Tulare County map.

12. That point on the east bank of Deep Creek Canal, 170 feet north of E. Visalia Rd. and 230 feet west of Larry St., Assessor's parcel book 129, Tulare County map.

13. That point 30 feet northwest of drain inlet at the intersection of E. Sycamore and S. Camelia Ave., south bank of Deep Creek Canal, Assessor's parcel book 130, Tulare County map.

14. That point on the northeast section of bridge at the intersection of S. Farmersville Blvd. and E. Oakland St., Assessor's parcel book 130, Tulare County map.

15. That point on the southwest section of bridge at the intersection of S. Farmrsville Blvd. and W. Oakland St., Assessor's parcel book 130, Tulare County map.

16. That point on the east bank of Deep Creek Canal, 300 feet west of S. Farmersville Blvd. and 1000 feet south of W. Oakland. Assessor's parcel book 130, Tulare County map.

17. That point on the east bank of Deep Creek Canal 300 feet west of S. Farmersville Blvd. and 600 feet south of W. Oakland. Assessor's parcel book 130, Tulare County map.

18. That point on the east bank of Deep Creek Canal, 300 feet west of S. Farmersville Blvd. and 1400 feet south of W. Oakland. Assessor's parcel book 130, Tulare County map.

19. That point on the west bank of Deep Creek Canal, 30 feet east of drain inlet at the intersection of S. Shasta Ave. and W. Tulare St. Assessor's parcel book 130, Tulare County map.

20. That point at the east section of bridge (Extension Ditch) on W. Visalia Rd. 50 feet east of N. Steven Ave. Assessor's parcel book 128, Tulare County map.

21. That point on south bank of Extension Ditch, 50 feet northwest of intersection at W. Front St. and N. Ventura Ave. Assessor's parcel book 128, Tulare County map.

22. That point on south bank of Extension Ditch, 140 feet west of Forrest Place and 200 feet northwest of drain inlet on W. Citrus. Assessor's parcel book 128, Tulare County map.

23. That point at the northeast section of bridge on N. Farmersville Blvd., 370 feet north of E. Citrus Drive. Assessor's parcel book 128, Tulare County map.

NOW, THEREFORE, in consideration of the covenents and promises herein contained, it is mutually agreed as follows:

1. That the Company hereby gives unto the City the right to empty and drain its flood and surface waters, except sewer water, from within the city limits, at all points as described above.

2. The term of this agreement shall be five (5) years starting on December 31, 1986 and ending on December 31, 1991, except that this agreement may be renewed by the City for an additional term of five (5) years by written notice to the Company at any time within ninety (90) days prior to the expiration of the term or any extension thereof.

3. City agrees to pay to the Company the sum of $1,000 per year for the City's share of the maintenance of the facilities of the Company, payable on the first day of January of each year during the term of this agreement. Provided that if this agreement be extended for an additional term or terms for five (5) years by the City, the payment provided for in this paragraph shall be renegotiated by the parties so as to reflect any increase in the costs of operation of the Company.

4. In consideration of the rights so given to the City by the Company, the City hereby covenents and agrees to save the Company safe and harmless from all damage, liability, costs, attorney fees and expenses arising out of or resulting from the use of the right-of-way hereby given.

5. The City further covenents and agrees at its own cost and expense to construct and maintain all necessary connections between its flood and surface water drains and the Company's ditch at the point hereinaboved mentioned, and that same shall be constructed in a manner satisfactory to the Company's engineer or superintendent and shall be so maintained by the City at its own expense following the construction thereof.

6. The City agrees that it will not discharge or drain any water into the ditch or ditches of the Company which is of such poor quality as to violate whatever standards may be in existence under County, State or Federal regulations concerning the discharge of flood water or waste water to the underground water strata.

7. The City, at such time as may be necessary, agrees to pay all of the costs of the enlargement of or acquisition of facilities necessary to accomodate its discharge waters into canal system of the Company, including the acquisition of such ditch or pipeline easements and sinking or flowage easements.

8. It is further understood and agreed between the parties hereto that if the City shall fail, refuse or neglect any convenant or agreement herein contained on its part to be kept or performed, or shall fail, neglect or refuse to comply with any conditions herein expressed, then and in such event, this agreement may be terminated by the Company.

IN WITNESS THEREOF, the said Company has caused this agreement to be executed in its corporate name by its officer or officers thereunto duly authorized and the corporate seal to be affixed, and the City, acting in its representative capacity, by and through its City Council, has caused this agreement to be duly subscribed and signed by the Mayor of the City Council, and the City Clerk has caused its corporate name and seal to be hereto affixed, the day and year first written above.

Mayor, City of Farmersville

President, Consolidated
Peoples Ditch Company

City Clerk, City of Farmersville

Secretary, Consolidated
Peoples Ditch Company

APPENDIX B

Design Criteria

1. Peak Storm Run-off - Rational Method Q=C I A where:

Q = Peak flow rate in cubic feet/sec.
C = Coefficient by Runoff (see 6 below)
I = Rainfall intensity in inches/hr. (see SD-2)
A = Drainage area in acres.

2. Pipeline Capacity - Manning Equation, $Q = \frac{1.49}{n} A r^{2/3} s^{1/2}$

Where:
Q = Flow rate in cubic feet/sec.
A = Cross-sectional area of pipe in square feet
r = Hydraulic radius
s = Slope in feet per foot
n = Friction-loss coefficient = 0.013

3. Rainfall Intensity Duration Curve (see SD-2)

Two-year Return Period.

4. Detention Basins

Rainfall Depth - 10-year Return Period with 18" Freeboard Below Lowest Grate
or
50-year Return Period with HWL at Lowest TC. (whichever creates largest pond)

Duration Days - To be determined based on discharge criteria (see SD-3).

5. Retention Basins

Rainfall depth - 10-year Return Period/10-day Duration with 18" Freeboard Below Lowest Grate
or
50-year Return Period/10-Day Duration with HWL at Lowest TC.
(whichever creates largest pond) (see SD-3).

6. Coefficient of Runoff (minimum)

Parks/Open Areas	0.15
Residential:	
Low Density (Single Family)	0.30
Medium Density (Duplex, etc)	0.40
High Density (Apartments)	0.50
Commercial / Industrial / Office	0.80

7. Lot to Street Time = 20 min. (Residential only)

8. Gutter Velocity - (See SD-1A)

CITY OF FARMERSVILLE • Department of Public Works

STANDARD DRAWING FOR:

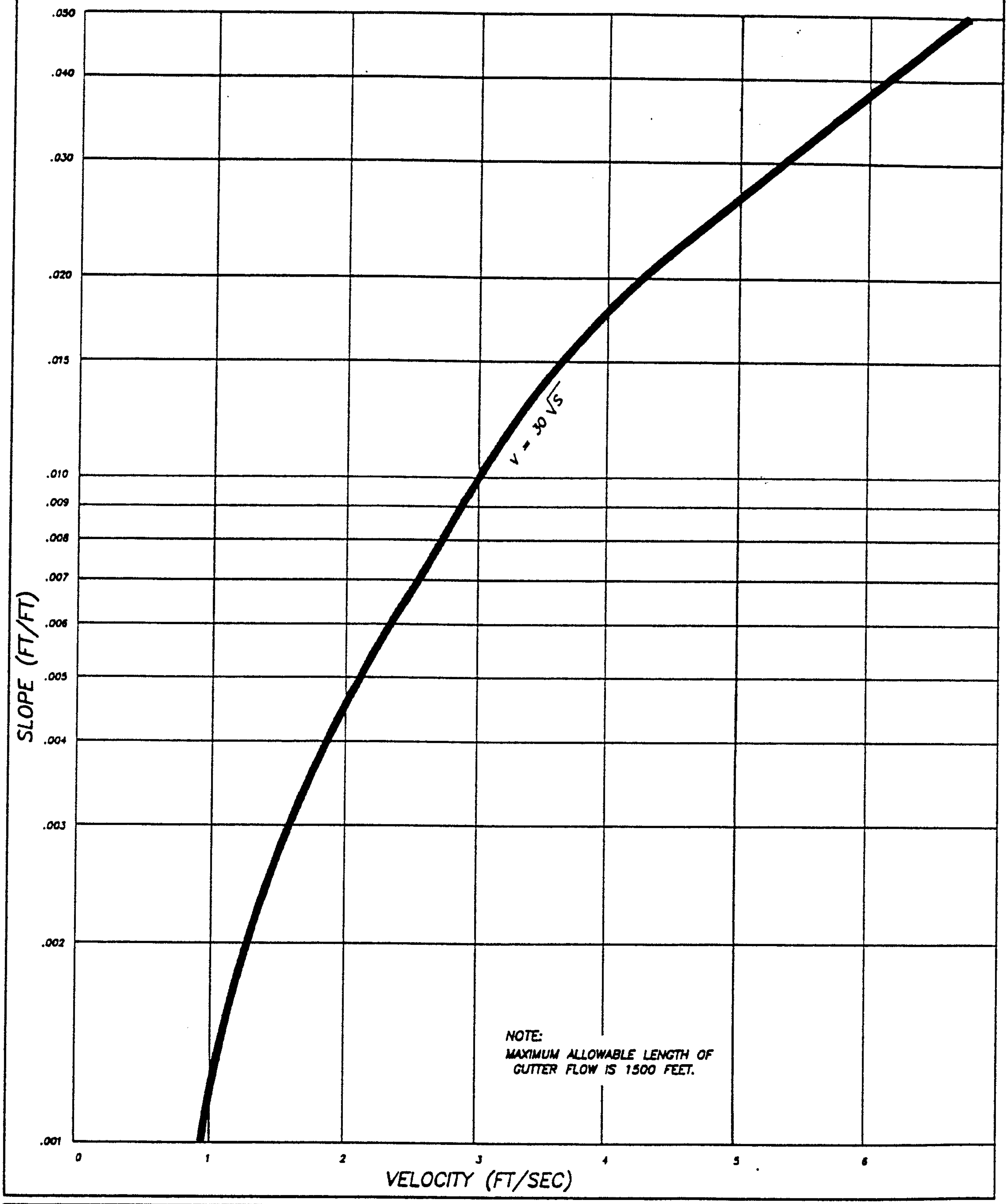
Storm Drain
Design Criteria

APPROVED BY CITY COUNCIL ON ______

APPROVED BY: ______ CITY ENGINEER

REVISED:

STD: SD-1



CITY OF FARMERSVILLE • Department of Public Works

STANDARD DRAWING FOR:

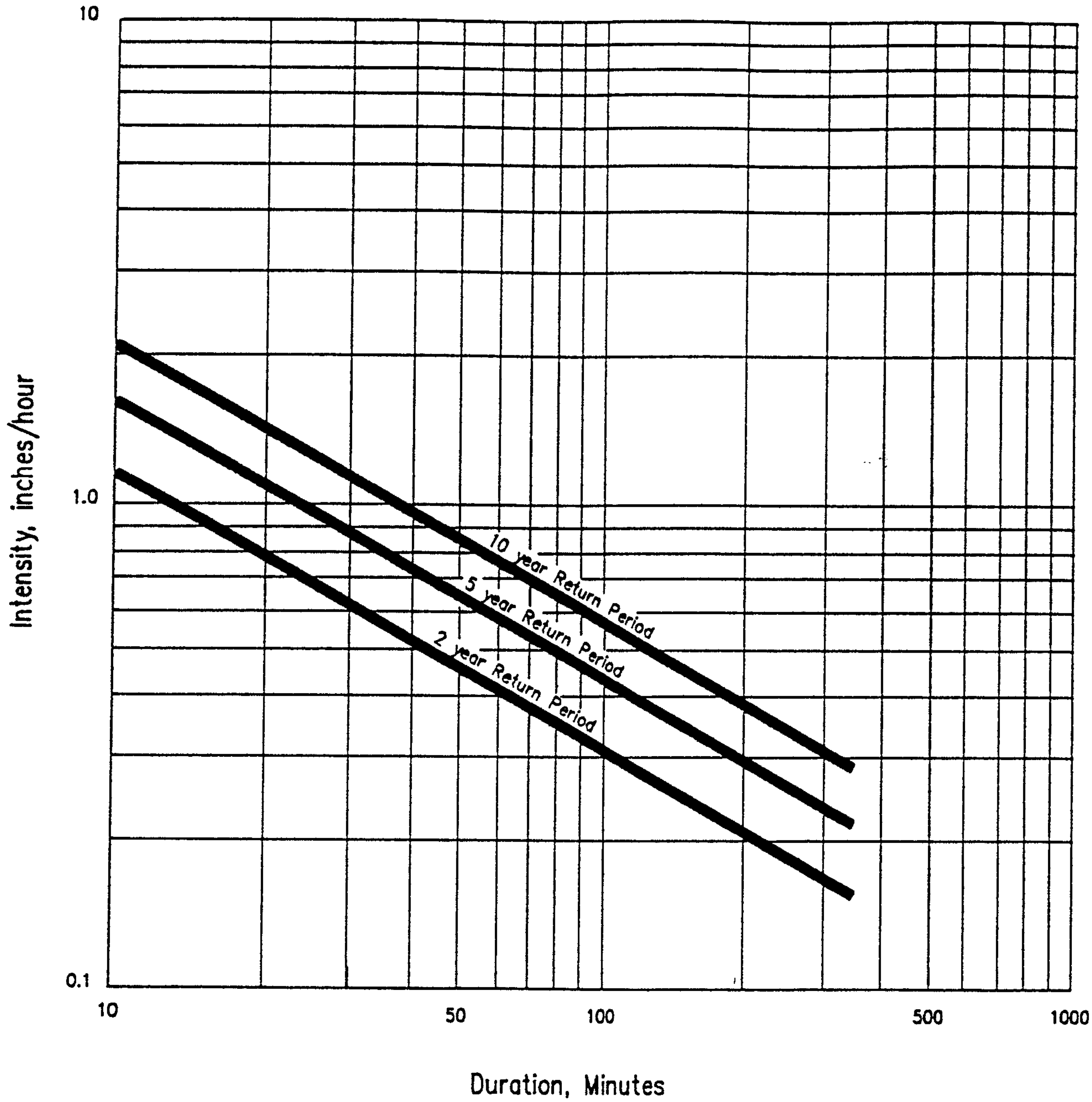
Velocity for Storm runoff in Curb and Gutter

APPROVED BY CITY COUNCIL ON ____________

APPROVED BY: ____________ CITY ENGINEER

REVISED:

STD: SD-1A



CITY OF FARMERSVILLE • Department of Public Works

Standard Drawing for:

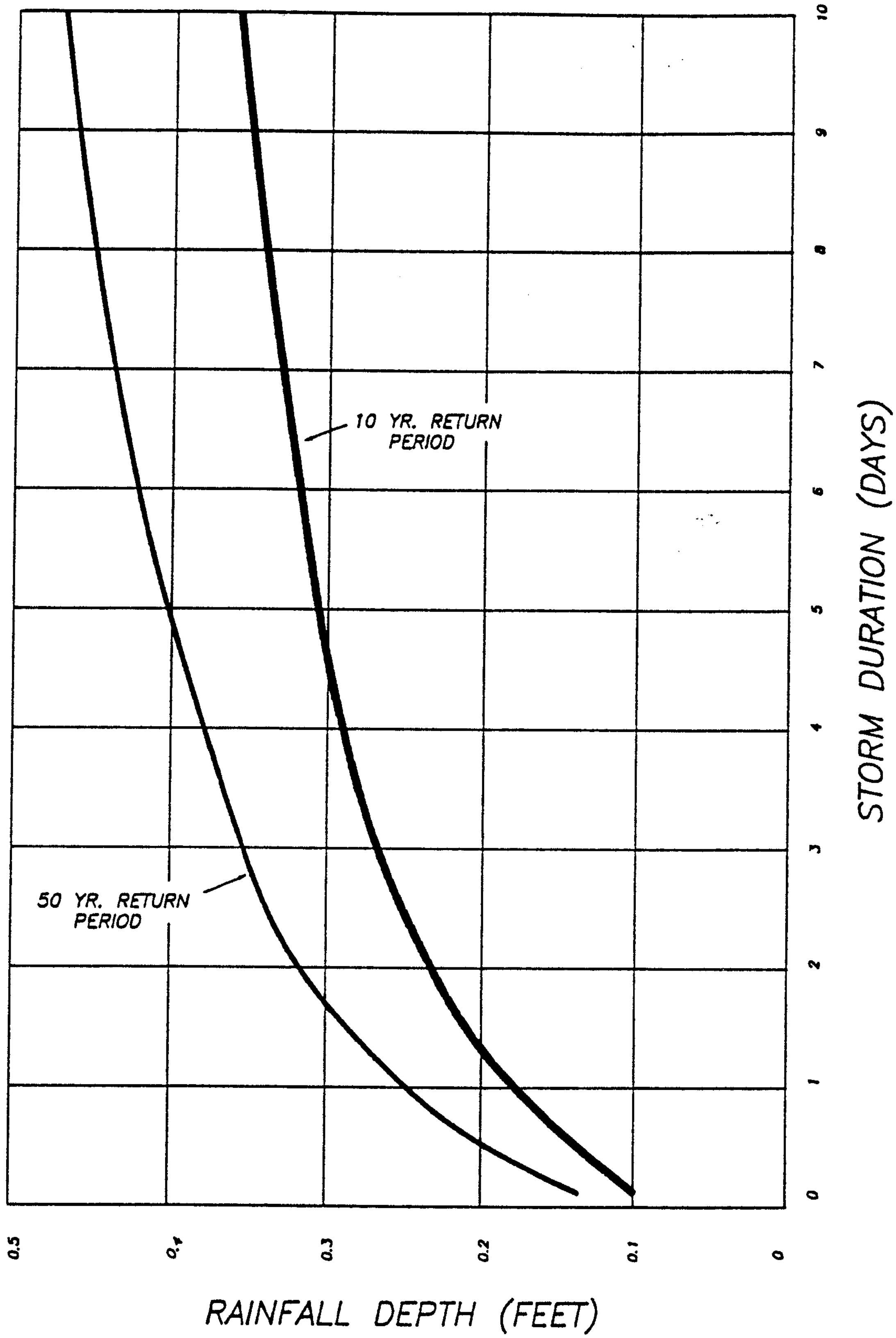
Rainfall Intensity Duration Curves

Approved by City Council on 4-27-88

APPROVED: City Engineer 4-28-88 Date

Revised:

SD-2



CITY OF FARMERSVILLE • Department of Public Works

STANDARD DRAWING FOR:

Rainfall Depth Curves

APPROVED BY CITY COUNCIL ON	APRIL 27, 1988
APPROVED BY:	CITY ENGINEER
REVISED: 04/89	STD: SD-3

APPENDIX C

Proposed System Drainage Calculations

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM
SUB-AREA : I (Hwy 198 Commercial)
CALC'D BY : J.K.R. DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min)				I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
		Init. T_c	Gutter Time	Pipe Time	New T_c							
A	1	20	1200/90	--	35	.56	10			5.6	21"	.0011
B	2				35	.56	10			5.6	21"	.0011
C	1-3	35	--	600/150	40	.52	33.5			17.4	33"	.001
D	1-4	40	--	600/150	45	.48	44			21.1	36"	.001
E	5	20	1500/90		35	.56	11			6.2	21"	.0014
F	1-6	45	--	600/150	50	.46	65.5			30.1	42"	.0009
G	7	20			35	.56	11.5			6.4	24"	.00075
H	7&8	35	--	650/150	40	.52	33.5			17.4	33"	.001
I	7-9	35			40	.52	41.5			21.6	36"	.001
J	10	20			35	.56	10			5.6	21"	.0011
K	10&11	35			40	.52	21			10.9	27"	.0012

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM
SUB-AREA : II (N. of Avenue 288 and E. of Farmersville Boulevard)
CALC'D BY : J.K.R DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min)				I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
		Init. T_c	Gutter Time	Pipe Time	New T_c							
A	1	20	1200/90	1200/150	40	.52	29.8	15.5	--	15.5	30"	.0014
B	2	20	800/90	--	29	.62	4.2	2.6	--	2.6	15"	.0015
C	2&3	29	--	400/150	32	.56	9.4	5.3	--	5.3	21"	.0011
D	4	20	1100/90	--	32	.56	3.8	2.1	--	2.1	12"	.0032
E	4&5	32	--	550/150	35	.56	13.9	7.8	--	7.8	24"	.0011

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM
SUB-AREA : III (W. of Farmersville Blvd, N. of RR)
CALC'D BY : J.K.R. DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min)				I	A x C	Q_A I x (AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
		Init. T_c	Gutter Time	Pipe Time	New T_c							
A	1	20	1800/90	--	40	.52	30.4	15.8	--	15.8	30"	.0014
B	1&2	40	--	700/150	45	.48	39.5	19.0	--	19.0	33"	.0012
C	4	20	1800/90	--	40	.52	11.5	6.0	--	6.0	21"	.0014
D	4&5	40	--	700/150	45	.48	19.2	9.2	--	9.2	24"	.0015
E	1-5	45	--	700/150	50	.46	67.8	31.2	--	31.2	39"	.0014
F	1-6	50	--	650/150	55	.44	80.4	35.4	--	35.4	42"	.0012
G	1-7	55	--	650/150	60	.42	93.0	39.0	--	39.0	42"	.0014
H	1-8	55	--	650/150	65	.40	99.0	39.6	--	39.6	42"	.0014
I	9	20	800/90	700/150	35	.56	9.4	5.3	--	5.3	21"	.0011
J	9&10	35	--	650/150	40	.52	16.4	8.5	--	8.5	24"	.0013

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM

SUB-AREA : III (Con't)

CALC'D BY : J.K.R. DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min) Init. T_c	Gutter Time	Pipe Time	New T_c	I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
K	11	20	400/90	350/120	30	.62	4.2	2.60	--	2.6	15"	.0015
L	11&12	30	--	500/150	30	.62	11.2	6.9	--	6.9	21"	.0015
M	11-13	30	--	800/150	35	.56	19.6	11.0	--	11.0	27"	.0012

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM
SUB-AREA : V (N. of RR & W. of Farmersville Boulevard)
CALC'D BY : J.K.R. DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min) Init. T_C	Gutter Time	Pipe Time	New T_C	I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
A	1	20	1100/90	700/150	40	.52	10.1	5.2	--	5.2	21"	.001
B	1&2	40	--	500/150	45	.48	25.1	12.1	--	12.1	30"	.00085
C	1-3	45	--	600/150	50	.46	40.1	18.4	--	18.4	33"	.0012
D	4	20	1100/90	--	35	.56	4.5	2.5	--	2.5	15"	.0014
E	5	20	1500/90	1100/150	45	.48	18.5	8.9	--	8.9	24"	.0014
F	5&6	45	--	800/150	50	.46	23.7	10.9	--	10.9	30"	.00065

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM
SUB-AREA : VI (N. of Visalia Road, E. of Town)
CALC'D BY : J.K.R. DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min)				I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
		Init. T_c	Gutter Time	Pipe Time	New T_c							
A	1	20	$\frac{1500}{90}$	$\frac{1000}{150}$	45	.48	21.7	10.4	--	10.4	27"	.001
B	1&2	45	--	$\frac{700}{150}$	50	.46	50.4	23.2	--	23.2	36"	.0012

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM
SUB-AREA : VII & VIII (Farmersville Blvd. & Visalia Road)
CALC'D BY : J.K.R. DATE : 04/10/89

	Pt. of Conc.	Areas Contrib.	Time of Concentration (min)				I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
			Init. T_c	Gutter Time	Pipe Time	New T_c							
VII	A	1	20	1800/90	--	40	.52	14.7	7.6	--	7.6	(Exist) 18"	.0034
	B	2	40	800/120	--	50	.40	24.4	11.2	--	11.2	(Exist) 21"	.0034
VIII	B	1&2	20	1800/90	--	40	.52	11.4	5.9	--	5.9	21"	.0013
	C	1-3	40	--	--	40	.52	16.2	8.4	--	8.4	24"	.0013
	D	4	20	900/90	--	30	.62	9.6	5.9	--	5.9	24"	.00065
	E	4&5	30	--	900/150	35	.56	15.7	8.8	--	8.8	27"	.00075
	F	1-6	40	--	900/150	45	.48	39.1	18.7	--	18.7	36"	.00075
	G	1-7	45	--	250/150	50	.46	51.3	23.6	--	23.6	39"	.0008
VII & VIII		VII 1-3 VIII 1-7	45	--	1250/150	55	.44	90.3	39.7	--	39.7	42"	.0015

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM

SUB-AREA : IX (N. side Visalia Road, W. of Town)

CALC'D BY : J.K.R. DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min)				I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
		Init. T_c	Gutter Time	Pipe Time	New T_c							
A	1	20	1400/90	1400/150	45	.48	13.3	6.4	--	6.4	21"	.0015
B	1&2	45	--	750/150	50	.46	37.4	17.2	--	17.2	30"	.0015

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM

SUB-AREA : X (S.W. Farmersville)

CALC'D BY : J.K.R. DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min)				I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
		Init. T_c	Gutter Time	Pipe Time	New T_c							
B	1&2	20	$\frac{1500}{90}$	$\frac{1500}{150}$	45	.48	32.6	15.6	--	15.6	33"	.00085
C	1-3	45	--	$\frac{900}{150}$	50	.46	52.2	24.0	--	24.0	39"	.00085
D	1-4	45	--	$\frac{500}{150}$	55	.44	65.5	28.8	--	28.8	42"	.0008

STORM DRAINAGE CALCULATION SHEET

SYSTEM : FARMERSVILLE - PROPOSED SYSTEM
SUB-AREA : XI (S.E. Farmersville)
CALC'D BY : J.K.R. DATE : 04/10/89

Pt. of Conc.	Areas Contrib.	Time of Concentration (min)				I	A x C	Q_A I x(AxC) (cfs)	Q_B Surcharge (cfs)	Q_{A+B} (total) (cfs)	Pipe Size (")	Hydraul. Gradiant
		Init. T_C	Gutter Time	Pipe Time	New T_C							
A	1	20	$\frac{1500}{90}$	$\frac{3000}{150}$	60	.42	50.0	21.0	--	21.0	36"	.00095
B	1&2	60	--	--	60	.42	78.0	32.7	--	32.7	42"	.001
C	3	20	$\frac{1400}{90}$	--	35	.56	5.2	2.9	--	2.9	15"	.002
D	1-4	60	--	$\frac{700}{150}$	65	.40	93.0	37.2	--	37.2	42"	.0013
E	5	20	$\frac{600}{90}$	--	30	.62	6.4	3.9	--	3.9	18"	.0013
F	1-6	65	--	$\frac{550}{150}$	70	.38	118.4	45.0	--	45.0	48"	.00095

APPENDIX D

Cost Estimates

FARMERSVILLE STORM DRAIN MASTER PLAN

COST ESTIMATE[1]

AREA I (HWY. 198 COMMERCIAL)

1.	2050' 21" @ $30/'	$	61,500
2.	650' 24" @ $42/'[2]	$	27,300
3.	350' 27" @ $37/'	$	12,950
4.	1000' 33" @ $45/'	$	45,000
5.	700' 36" @ $49/'	$	34,300
6.	200' 42" @ $56/'	$	11,200
7.	2.6 Acres Pond @ $60,000/ac.[3]	$	156,000
8.	1-10 cfs Pump Station @ $25,000	$	25,000
	Subtotal	$	373,250
	Contingencies & Engineering (15%)	$	56,000
		$	429,250

$429,250 acres/160 Acres = $2,682/Acre

(1) Note that all pipeline prices include manholes

(2) Costs include pavement removal and replacement

(3) Includes land purchase @ $40,000/acre, as well as excavation and fencing

FARMERSVILLE STORM DRAIN MASTER PLAN
COST ESTIMATE(1)
AREAS II-XI

1.	1350' 12" @ $20/'	$	27,000
2.	300' 12" @ $26/'(2)	$	7,800
3.	1000' 15" @ $23/'	$	23,000
4.	1350' 15" @ $29/'(2)	$	39,150
5.	1500' 18" @ $26/'	$	39,000
6.	750' 18" @ $33/'(2)	$	24,750
7.	2700' 21" @ $30/'	$	81,000
8.	950' 21" @ $38/'(2)	$	36,100
9.	2550' 24" @ $33/'	$	84,150
10.	1500' 24" @ $42/'(2)	$	63,000
11.	650' 27" @ $37/'	$	24,050
12.	500' 27" @ $47/'(2)	$	23,500
13.	4000' 30" @ $41/'	$	164,000
14.	1900' 33" @ $45/'	$	85,500
15.	650' 36" @ $49/'	$	31,850
16.	450' 36" @ $60/'(2)	$	27,000
17.	650' 39" @ $53/'	$	34,450
18.	950' 39" @ $64/'(2)	$	60,800
19.	4600' 42" @ $56/'	$	257,600
20.	250' 48" @ $60/'	$	15,000
21.	8.1 Acres Ponds @ $40,000/acre(3)	$	324,000
22.	10.7 Acre Park/Ponds @ $70,000/acre(4)	$	749,000
23.	2-1 cfs Pump Stations @ $10,000 ea	$	20,000
24.	1-2 cfs Pump Station @ $15,000 ea	$	15,000
25.	1-5 cfs Pump Stations @ $20,000 ea	$	20,000
26.	2-10 cfs Pump Stations @ $25,000 ea	$	50,000
	Subtotal	$	2,326,700
	Contingencies & Engineering (15%)	$	349,000
	Total - Areas II-XI	$	2,675,700

Estimated Undeveloped Commercial
Within Areas II-XI = 102 Acres

Commercial revenues 102 Ac x 2682(5)/acres	$	273,564
Remaining Cost to be Recovered from Undeveloped Residential	$	2,402,136
Residential Cost/Acre $2,402,136/1048 Acres	$	2292/Acre

(1) Note that all pipeline prices include manholes

(2) Costs include pavement removal and replacement

(3) Includes land purchase @ $20,000/acre, as well as excavation and fencing

(4) Same as (3), but also includes $30,000/acre for irrigation/landscape

(5) Established by Area I

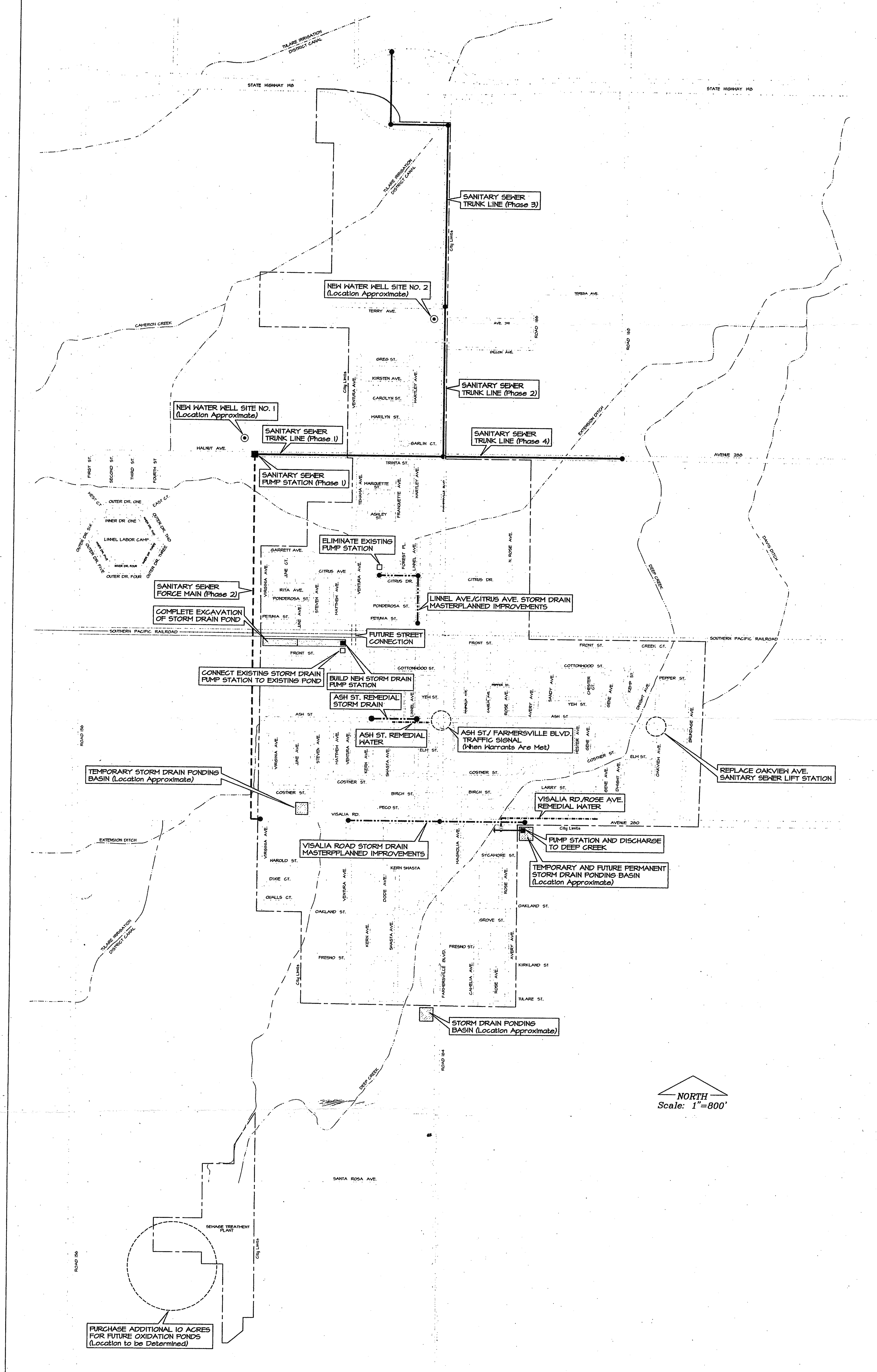
APPENDIX E

PROJECT REVIEW DATES

FARMERSVILLE STORM DRAIN MASTER PLAN

PROJECT REVIEW DATES

Reviewed existing facilities with Ruben DeLeon, Director of Public Works and other Public Works Department personnel.	December 28, 1988
Reviewed study area boundaries and land use projections with Karen Dennis, City Planner.	January 31, 1989
Reviewed initial design criteria and land use projections with Ruben DeLeon, Director of Public Works.	February 13, 1989
Reviewed creek/ditch system with Dennis Moffitt, Manager, Consolidated People's Ditch Company.	March 24, 1989
Reviewed initial design concepts and alternatives, and preliminary cost estimates with Patrick King, City Manager, and Ruben DeLeon, Director of Public Works.	March 31, 1989
Administrative draft submitted to City for review	April 21, 1989
Received comments from City regarding administrative draft	May 1, 1989
Final Draft Report submitted	May 8, 1989
Presentation to City Council	June 14, 1989



CITY OF FARMERSVILLE

1998 INFRASTRUCTURE PLAN

Quad Knopf