REVISED
SOUTH YUBA DRAINAGE MASTER PLAN

1992

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ENGINEERS & SURVEYORS SINCE 1892

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I. EXECUTIVE SUMMARY

Drainage problems in South Yuba County have been documented in numerous reports since 1962. Suggestions for improvements have been proposed over the years, but not generally implemented. Meanwhile the existing communities of Linda and Olivehurst are frequently subjected to flooding. New development being approved in the East Linda Specific Plan and other large tracts in South Yuba County will compound the drainage problems by creation of more impervious surfaces to increase significantly rain water runoff into inadequate systems. These changing conditions and the need to find solutions to existing drainage problems create the need for preparation of this Revised South Yuba Drainage Master Plan (Revised SYDMP).

This plan covers a watershed area of about 10,000 acres lying south of the Yuba River and east of lands with Reclamation District 784 in Yuba County, California. The Revised SYDMP analyzes previous studies on the drainage in the area, establishes accepted norms for calculation of storm runoff, the existing drainage system, special problems which affect area, and the implications of future development planned for the area. Based on the analysis the Plan proposes solutions to existing and future drainage problems in the South Yuba County Area.

A. EAST LINDA DRAINAGE

Drainage from the existing and proposed development in the East Linda Area, lying east of the Southern Pacific Railroad right of way, would normally flow west and south into Olivehurst to the Clark Lateral, then to Reeds Creek, then to the Western Pacific Interceptor Canal, and ultimately flows into the Bear River. The increased runoff flows projected from new development would severely affect Olivehurst directly, by running into the community via the Linda Drain (Horseman's Creek) and the Olivehurst Drain (Clark Slough), and indirectly by adding to the peak Bear River flows which are allowed to back up toward Olivehurst.

This Revised SYDMP considered several imperative issues:

1. Prevention of increased flows into the community of Olivehurst from the developing East Linda area.
2. Avoidance of increased flows from the area detrimentally affecting peak flows to the Bear River and potentially increasing the area of inundation of East Plumas Lake.
3. Prevention of adverse effects on Reeds Creek resulting from changes in flowage of runoff waters.

The need to accommodate the anticipated increased flows of runoff coupled with the above imperatives issues resulted in development of four alternative plans of action. All of the alternatives have three common improvements; a. construction of a regulation basin above Reeds Creek to act as a detention storage facility capable of holding the flows generated in East Linda and controlling outflow into the creek to equivalent pre-development (historical) flow rates from the East Linda area which passed under the Southern Pacific Railroad tracks in the existing culverts, b. construction of an area into the community of Olivehurst, and c. construction of a new channel parallel to Reeds Creek.

1. Alternative Improvements

a. Alternative No. 1: OLIVEHURST INTERCEPTOR

This alternative proposes construction of a large canal parallel to and east of the Southern Pacific Railroad tracks between Erle Road and Reeds Creek in addition to the regulation basin and Reeds Creek channel specified above. Areas to the north and east of the intersection of Erle Road and the railroad would drain into improved sections of what are now the Linda and Olivehurst Drains, but would flow into the new canal rather than into Olivehurst. Storm water intercepted would flow southerly through the canal to the regulation basin and thence be metered into the new channel of Reeds Creek at the estimated historical rate of flow from the East Linda Area. The canal proposed here is similar to the canal proposed in the 1981 South Yuba Master Drainage Plan.

b. Alternative No. 2: P. G. & E. POWERLINE CHANNEL

This alternative proposes construction of a large channel following the P.G.&E. transmission line tower easement from the vicinity of Yuba College on the Linda drain south to the intersection of the powerline with the Southern Pacific Railroad tracks then southerly, at Reeds Creed cited above. A lesser drainage canal would run northerly along the Southern Pacific Railroad tracks from the large channel to intercept an improved Linda Drain and the Olivehurst Drain. Storm water intercepted would flow southerly through the canal to the regulation basin and thence be metered into the new channel of Reeds Creek at the estimated historical rate of flow from the East Linda Area.

c. Alternative No. 3: EASTSIDE INTERCEPTOR

This alternative would create a diversion canal from the upper Linda Drain, at a point near the intersection of Griffith Avenue and Hammonton-Smartsville Road, southerly parallel to Griffith Avenue to the Olivehurst Drain near North Beale Road, thence along the alignment of the existing Olivehurst Drain to its intersection with the Southern Pacific Railroad tracks, thence southerly along those tracks as in Alternative No. 1 above to the

regulation basin and new Reeds Creek channel. This alternative provides for redirecting a large portion of the flow that would have passed through the Linda Drain and thereby allows reduction in the size of the Linda Drain improvements necessary in Alternatives No.'s 1 or 2. This alternative also would serve the proposed alignment of the Route 70/Marysville By-Pass.

d. Recommended Alternative

This alternative is a combination of Alternatives No.'s 2 and 3. It is recommended as the best solution to immediate development and long term needs to serve the East Linda Area. It is suggested to develop this alternative in phases as needed to serve developing tracts of land:

1) Creation of the P. G. & E. Powerline channel as outlined in Alternative No. 2. This channel would serve development in the Erle Road area and the region north of Yuba College;

2) Creation of the Eastside Interceptor as outlined in Alternative No. 3. This facility would intercept much of the drainage that would otherwise be handled in the P. G. & E. Powerline channel as well as drainage from new development along the easterly portion of the development area and future Route 70. Storm water intercepted from the new developments would flow down the channels to the regulation basin and be metered into new Reeds Creek channel and thence to the Bear River.

2. Alternative Costs

COST SUMMARY FOR ALTERNATIVES

Alternative	Construction Cost*
1.	$8,890,000
2.	$8,810,000
3.	$8,425,000
Recommended	$8,919,000

*Includes 20% miscellaneous and contingency costs.

3. Implementation

The sequence of improvements suggested in the recommended plan are:

Phase		Description of Work	Estimated Cost
#1	a.	Construct Olivehurst Interceptor	
	b.	Close culverts into Olivehurst	
	c.	Construct regulation pond (to control peak outflow under existing conditions)	
	d.	Construct Reeds Creek channel	
		Subtotal	$3,386,500
#2		Construct PG&E Powerline Channel	$ 944,500
#3		Construct Eastside Interceptor	$2,041,000
#4		Reconstruct regulation pond (to control peak outflow under future conditions)	$1,060,500
		Subtotal	$7,432,500
		20% Contingencies	$1,486,500
		Total	$8,919,000

B. OLIVEHURST DRAINAGE

The community of Olivehurst experiences flooding from direct rainfall, drainage entering the area from the east through the Olivehurst Drain and the Linda Drain, backwater effects from the Bear River and combinations of the above. Previous studies by the Corps on Engineers and others all propose that the most effective means of preventing flooding in Olivehurst must involve a system including:

1. Interception and prevention of drainage flows from the east.
2. A levee at the southern end of Olivehurst along Reeds Creek to prevent flooding from the Bear River.
3. A pumping plans(s) to remove runoff collected in Olivehurst.

The first problem could be remedied by the improvements suggested in the foregoing section about East Linda Drainage. The third problem is relatively simply remedied by installation of one or more detention basins and a pumping plant. The second problem is extremely complicated.

Currently flood waters from the Bear River flow into and inundate portions of the southerly end of Yuba County as pat of the operations of the State of California flood control system. A portion of South Yuba County is used to store flood water from Rear River; mitigating peak river elevations to minimize the risk of overtopping levees. The

State of California, through the Sacramento and San Joaquin Drainage District, has easement rights to flood that south end of Yuba County. Those easement rights cover areas including the southerly end of Olivehurst.

The levee necessary to prevent backflow from the Bear River would extend from Route 65 to the vicinity of Route 70 north of Reeds Creek. Existing pipes for the Clark Lateral under Route 70 would have to be equipped with flap gates to prevent water from flowing into the community of Olivehurst. But the potential downstream effects of the levee system may be significant.

Prior to any construction of a levee to keep the Bear River backflow out of the community of Olivehurst it is presumed that the State will want to be assured that; a. a satisfactory plan to create a replacement volume of storage in or out of Olivehurst equivalent to the volume of water currently entitled by easement to flow over the land to be reclaimed has been prepared and approved by the State, or b. that the State does not need the easements.

1. Alternative Improvements

Assuming that the State's inundation rights can be resolved as suggested in the preceding paragraph and that areas designated by FEMA as subject to flooding from 100 year storms but not subject to State flood control operations easements do not require equivalent volumes replacement, the following is proposed as an alternative for providing flood protection for the community of Olivehurst"

a. The East Linda Area drainage improvements as listed in any of the alterna tives listed above are constructed.

b. The Olivehurst levee would be constructed from Route 65 westerly to Route 70. The source of soil for this levee could be created by the Reeds Creek Channel improvements for East Linda and any necessary inundation area created to replace the equivalent storage volume protected by this levee.

c. A detention basin and pumping station would be installed north of the levee to handle local runoff when gravity flow is not possible due to high flows in Reeds Creek.

d. The area of Olivehurst west of Route 70 would be protected from flooding by expanding the existing detention basin south of McGowan Parkway. The pond would be expanded both north and south along the Clark Lateral to a volume sufficient to handle local runoff from this area. A ponding area would be created where the Clark Lateral crosses under Route 70 to contain a volume of water equivalent to the State's inundation rights, estimated to be 400 acre-feet. The cost of protecting this area west of Route 70 would be $2,151,000.

e. The area of Olivehurst east of Route 70 would be protected from flooding by the Olivehurst Levee. A detention pond and pumping station would be re-

quired to remove storm water generated in this portion of the community. The cost of constructing the Olivehurst Levee and the associated detention/pumping facility is estimated to be $1,692,000. These improvements would only benefit the area south of McGowan Parkway between Route 65 and 70.

II. BACKGROUND

This revision to the South Yuba Drainage Master Plan (SYDMP) has been prepared primarily to; a. assess the impacts of future development in South Yuba County lying east of the Southern Pacific Railroad (S.P.R.R.) tracks, north of Reeds Creek, and south of the Yuba River and b. develop alternative drainage improvement scenarios to accommodate increased discharge of storm water runoff from that future development. The area designated for development is shown on Figure 1. The development area is within an 11.75 square mile watershed which includes the community of Linda. That watershed drains storm water runoff to both the Linda Drain and the Olivehurst Drain (See Figure 2). These drains are major watercourses which traverse the community of Linda in a general southwesterly direction to discharge beneath the S.P.R.R. tracks through culverts into the community of Olivehurst and then flow southerly down the Clark Lateral and through culverts under Route 70 to Reeds Creek and eventually via the Western Pacific Interceptor Canal into the Bear River. The drainage ways are variously known as the Linda Drain (Horseman's Ditch), the Olivehurst Drain (Clark Slough), and the Clark Lateral. Discharge from the Western Pacific Interceptor Canal to the Bear River is a gravity drain. The gravity drain does not function during periods when the River flow is higher than the Canal flow. During those periods the Bear River flow backs up the Western Pacific Interceptor Canal and Reeds Creek.

Localized flooding periodically occurs within the study area as a result of rainfall due to existing inadequate and/or obstructed drainage facilities. These flooding occurrences are periodically compounded by the backwater effects of the Bear River at high water stages.

The Olivehurst area west of and adjacent to the study area receives discharge from the study area as noted above. This discharge compounds with rainwater runoff and any backflow from the Bear River to create localized flooding in the community of Olivehurst. Long range planning efforts have recommended intercepting flows from east of the S. P. R. R. tracks to reduce flooding in Olivehurst. That diversion has commonly been referred to as the "Olivehurst Interceptor Channel Improvement". An analysis in the 1972 U. S. Army Corps of Engineers' report "Bear River California - Feasibility for Water Resources Development" (Ref 2) and the 1981 SYDMP by MHM, Inc. (Ref 3) recommended that a levee be constructed to prevent flooding of the southerly portion of Olivehurst adjacent to Reeds Creek. Those reports also recommended creation of a detention pond within the community of Olivehurst to hold local storm waters for later pumping after downstream waters have receded.

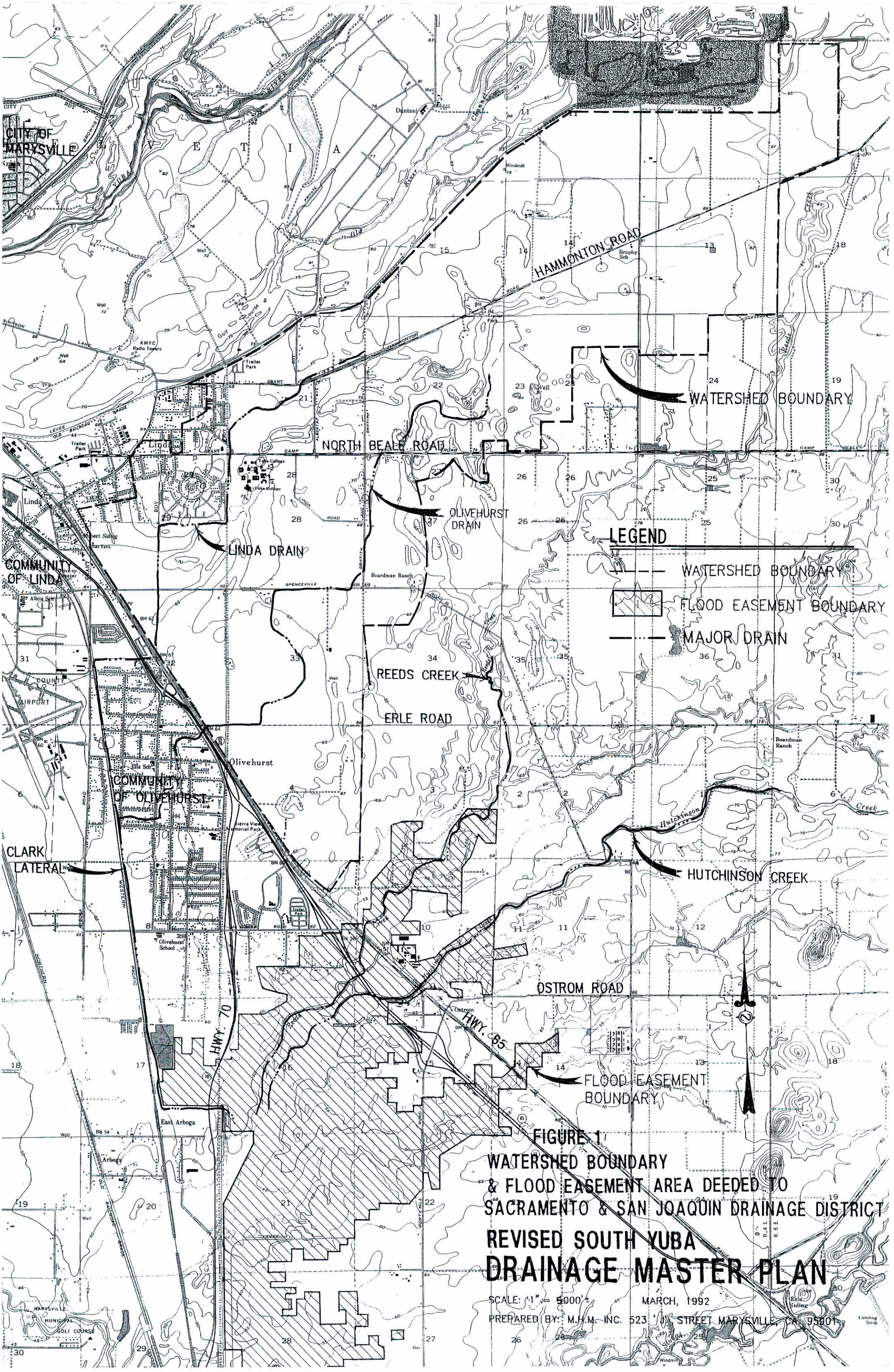


FIGURE 1

WATERSHED BOUNDARY
& FLOOD EASEMENT AREA DEEDED TO
SACRAMENTO & SAN JOAQUIN DRAINAGE DISTRICT

REVISED SOUTH YUBA DRAINAGE MASTER PLAN

SCALE: 1" = 5000' MARCH, 1992

PREPARED BY: M.H.M. INC. 523 'J' STREET MARYSVILLE, CA. 95901

III. GOALS OF THIS STUDY

The basic goal of this study is to update the 1981 South Yuba Drainage Master Plan. To that end this Revised SYDMP contains all relevant information available and proposes realistic improvements to solve the drainage problems in the study area. Improvements suggested would meet the goals of Yuba County to:

1. Eliminate storm water runoff from the East Linda Area flowing into the community of Olivehurst and adding to flood problems in that community.
2. Insure that adequate flood protection is provided to developing areas in East Linda Area.

IV. STUDY USE

This Revised South Yuba Master Drainage Plan has been prepared for use as an aid to land planning infrastructure financing studies currently being conducted by Yuba County. The intent of this study is to assess existing conditions and facilities and to determine possible drainage infrastructure alternatives and discharge volumes. Cost estimates have been prepared and are of a preliminary level for budgetary and planning purposes. Field surveys or topographic mapping were not conducted or prepared for the study. Existing information was the basis of this study.

V. PREVIOUS STUDIES

The South Yuba area drainage and flooding issues subject of this study have been investigated by many agencies over the years. The Federal Emergency Management Agency (FEMA) conducted a flood insurance study for unincorporated areas of Yuba County, including this Revised SYDMP area, in 1981 (Ref. 1). The Army Corps of Engineers issued reports on the Bear River in 1972 and 1981 referencing this study area (Ref. 2 and 12). MHM, Inc. prepared the original South Yuba Drainage Master Plan (SYDMP) in 1981 (Ref. 4). Lampman and Associates prepared a study of necessary drainage improvements for the community of Olivehurst in 1973 (Ref. 5).

The previous studies make assumptions that are now known to be out of date:

1. Large portions of the area east of the S.P.R.R. were assumed to remain in agricultural use, especially in rice farming, with little urban use and associated impervious surfaces projected.
2. A 50-year, 24 hour, storm cycle was used to estimate runoff volumes from the land and subsequent dosing of facilities in the original SYDMP.
3. The significance of the Bear River backflow and inundation rights to flood portions of the South Yuba area was not considered adequately.

The studies did not account for the urbanization currently projected of the study area by the County Board of Supervisors nor did they use a more acceptable 100-year, 24 hour duration return period storm or the significance of inundation easements for their analysis. This Revised South Yuba Drainage Master Plan incorporates that current information.

IV. EXISTING CONDITIONS

A. INTRODUCTION

The study area includes 11.75 square miles of watershed as noted above. Current land usage is shown in Table 1. An additional watershed of 2.24 square miles covers the developed and undeveloped area of the community of Olivehurst and is considered in this planning process.

Localized flooding periodically occurs at three locations on the Linda Drain in the study area east of the S. P. R. R. tracks; a. upstream of the Linda Drain crossing of the S. P. R. R. tracks in the vicinity of Yuba College and the Country Club Park subdivision, b. in an area lying between Rupert and Park Avenues south of Hammonton Smartsville Road and c. in large open fields lying north and south of Erle Road and west of Griffith Avenue south of Linda Avenue. Localized flooding periodically occurs on the Olivehurst Drain in the study area east of the S. P. R. R. tracks just upstream of the crossing.

The community of Olivehurst is not only inundated by storm waters from the 11.75 square mile watershed east of the S. P. R. R. tracks and its own 2.24 square miles of watershed but is periodically inundated from the backwater effects of Reeds Creek due to the Bear River flows. Olivehurst is hydraulically connected to Reeds Creek by culverts under Route 70. Reeds Creek also inundates areas along Mage Avenue just downstream from the Route 70 crossing and in the vicinity of Hale Road upstream of its crossing under both the S. P. R. R. tracks and Route 65.

Model simulations were conducted using the Army Corps of Engineers' HEC-1 program to estimate 100-year, 24-hour duration storm peak discharges and runoff volumes for existing watershed conditions throughout the study area. Peak discharge and runoff volumes were determined from each subwatershed independently, as well as cumulatively, along the drainage courses within each watershed area. Discharges at key locations are shown on Figure 2.

TABLE 1
EXISTING LAND USE
(acres)

Sub-Area	Total Area	Agriculture			Urban						
		Rice	Leveled (Not Rice)	Not Leveled	Rural Residential	Low Density Residential	Medium Density Residential	High Density Residential	Parks	Schools	Commercial/ Industrial
I A	1038		1038		44						
II A	843		801	35	7						
III A	175			80	95						
IV A	819	609	43	101	59					7	
V A	248		37	205			6				
VI A	121			24	97						
VII A	433			221	6	140	6			60	
VIII A	330	111	64	44	77	8		14		12	
IX A	227			38		189					
X A	102			76		26					
XI A	456	12		444							
I B	660	200		382	70						8
II B	611	167		362	77		5				
III B	918	789		119	5		5				
C	487	300		187							

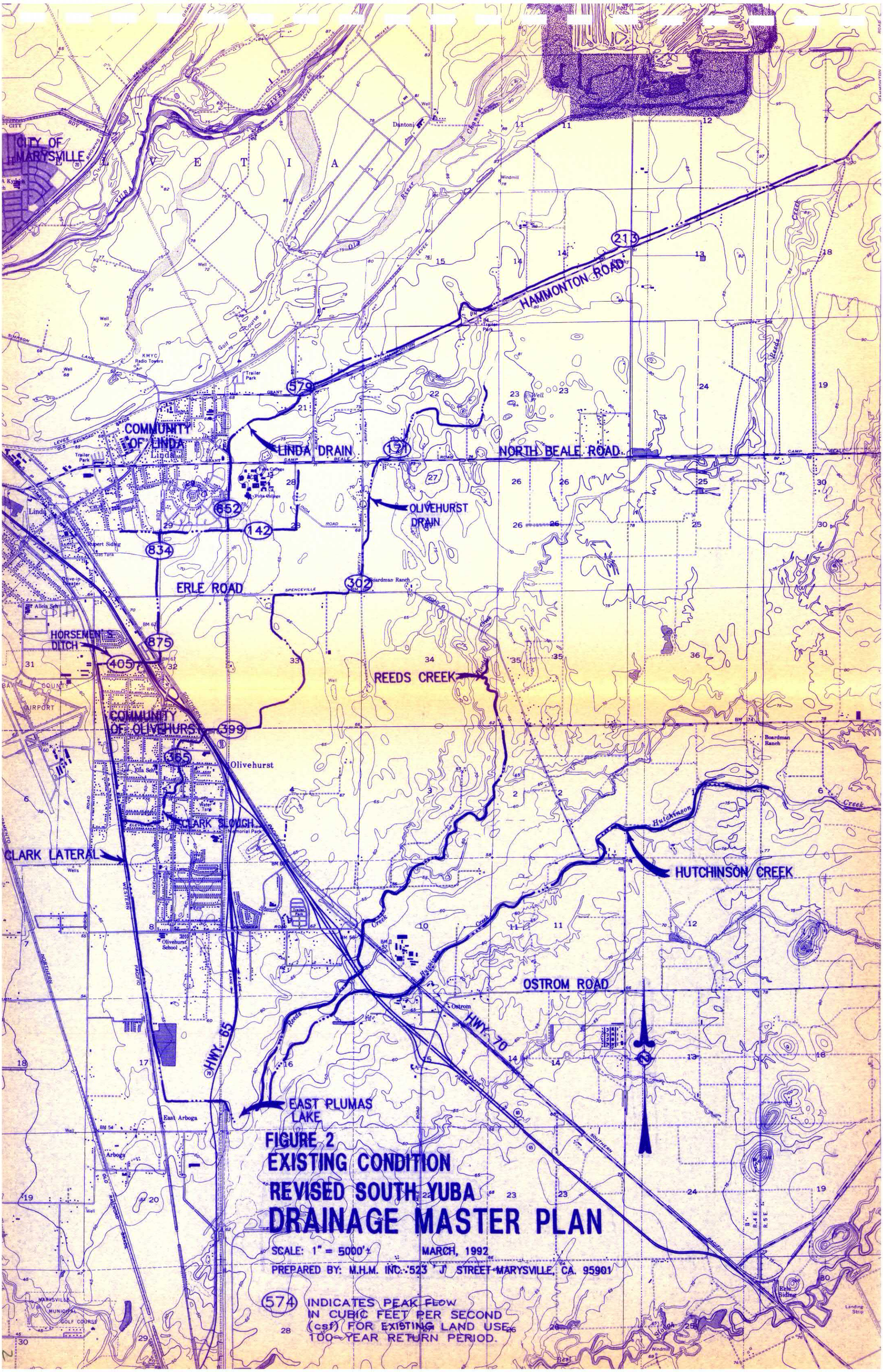


FIGURE 2
EXISTING CONDITION
REVISED SOUTH YUBA
DRAINAGE MASTER PLAN

SCALE: 1" = 5000'± MARCH, 1992

PREPARED BY: M.H.M. INC. 523 "J" STREET MARYSVILLE, CA. 95901

(574) INDICATES PEAK FLOW IN CUBIC FEET PER SECOND (cfs) FOR EXISTING LAND USE 100-YEAR RETURN PERIOD.

1. Parameters of the Study

This section of the report discusses the hydrological parameters of the Revised SYDMP study area. Values used in the plan for design rainfall precipitation, infiltration rate characteristics, corresponding runoff potential, time of concentration and similar standards of evaluation are set out.

a. Design Rainfall Precipitation

For the purposes of this study the design rainfall event was simulated with the Army Corps of Engineers HEC-1 watershed model to represent a 100-year frequency, recurrent storm event of 24 hour duration falling on the study area.

Precipitation values for such an event were obtained for the City of Wheatland rain gauge station (Ref. 8). The value was reported to be 4.16 inches. Storm precipitation values utilized in the HEC-1 model were subjected to a Type I, SCS, temporal distribution with no spatial variability, which conservatively assumes the entire storm falls over the entire study area as opposed to spatial movement of the storm over the watersheds.

b. Infiltration Rate Characteristics

The amount of infiltration potential is related to the permeability of the surficial soils, the local geomorphology and the amount and type of vegetation cover or canopy. As development proceeds within a natural watershed the percentage of directly connected impervious area are correspondingly increased and the runoff potential increases throughout the watershed. Soil survey maps prepared by the Yuba County Soil Conservation Service (SCS) were used to determine the extent of Types A, B, C, and D hydrological soil groups within each watershed area. The areas of each respective soil group were then summarized for each watershed and assigned an SCS curve number corresponding to a Type II and Type III antecedent moisture condition (AMC II and AMC III), representing the average curve number and greatest runoff potential curve number. AMC III curve numbers were utilized for the 100-year storm event simulations. Summaries of the curve number analysis are given in Table 2. These curve numbers represent the hydrological soil groups in a natural condition and related to the proper developed condition using percent directly connected impervious area.

TABLE 2
SUMMARY OF WATERSHED CURVE NUMBERS
EXISTING, ALTERNATIVE I AND III

(AMC II CONDITION)

CN-"A" SOILS: 49 CN-"C" SOILS: 79
CN-"B" SOILS: 69 CN-"D" SOILS: 84

SUBBASIN DESIGNATION	AREA A-SOILS	AREA B-SOILS	AREA C-SOILS	AREA D-SOILS	AREA TOTAL	WEIGHTED CN
IA		676.08	4.27	401.38	1081.73	76.65
IIA	193.57	493.90		155.14	842.61	73.08
IIIA	7.12	18.50		149.45	175.07	80.00
IVA		54.09	51.24	713.08	818.41	78.37
VA		127.74		119.93	247.67	77.63
VIA		24.20		96.78	120.98	80.00
VIIA		130.95		301.74	432.69	79.23
VIIIA		51.24		278.26	329.50	80.33
IXA		35.58		190.73	226.31	80.32
XA		29.89		72.59	102.48	79.31
XIA		108.17		347.29	455.46	79.72
IB		249.08		411.34	660.42	78.67
IIB		220.61		389.99	610.60	78.79
IIIB		120.98		797.06	918.04	80.51
C		73.30		413.48	486.78	80.37

(AMC III CONDITION)

CN-"A" SOILS: 69 CN-"C" SOILS: 91
CN-"B" SOILS: 85 CN-"D" SOILS: 94

SUBBASIN DESIGNATION	AREA A-SOILS	AREA B-SOILS	AREA C-SOILS	AREA D-SOILS	AREA TOTAL	WEIGHTED CN
IA		676.08	4.27	401.38	1081.73	88.36
IIA	193.57	493.90		155.14	842.61	82.98
IIIA	7.12	18.50		149.45	175.07	92.03
IVA		54.09	51.24	713.08	818.41	93.22
VA		127.74		119.93	247.67	89.36
VIA		24.20		96.78	120.98	92.20
VIIA		130.95		301.74	432.69	91.28
VIIIA		51.24		278.26	329.50	92.60
IXA		35.58		190.73	226.31	92.59
XA		29.89		72.59	102.48	91.38
XIA		108.17		347.29	455.46	91.86
IB		249.08		411.34	660.42	90.61
IIB		220.61		389.99	610.60	90.75
IIIB		120.98		797.06	918.04	92.81
C		73.30		413.48	486.78	92.64

c. Runoff Potential

Runoff potential used in this study was developed based on analysis of existing land use computed from studies and aerial photographs and application of standard assumptions for such land use as described below in the description of watersheds.

d. Time of Concentration

Time of concentration assumptions used in this study were developed based on analysis of land use and application of standard assumptions for such land use as used in the HEC-1 Army Corps of Engineer's flood hydrography program (Ref. 5).

B. WATERSHEDS

The 11.75 square mile watershed considered in this study were divided into watersheds and subwatersheds for analysis to better represent the runoff patterns that occur under existing conditions. Designated land usage and urban area densities were estimated as was the extent of current development within each area. An average percentage value of directly connected impervious area was assigned to each land usage. The following descriptions give the area, land usage, existing drainage facility accepting storm water generated, and number of subwatersheds used in computational analysis.

Watershed A is comprised of approximately 7.6 square miles of mixed residential, commercial and agricultural land usage. The residential and commercial portion of this watershed is concentrated in part of the land covered by the East Linda Specific Plan. The agricultural usage and some rural residential usage are generally outside the boundaries of the Specific Plan area. This watershed drains into the Linda Drain. The watershed was divided into 11 subwatersheds for the purpose of this planning study.

Watershed B is comprised of approximately 3.4 square miles of rural residential and agricultural land usage. This watershed drains into the Olivehurst Drain. Between the easterly extension of Linda Avenue and Erle Road the channel of the Olivehurst Drain is undefined due to farming operations and sheet flows to inundate a large area. The watershed was divided into 3 subwatersheds for the purpose of this planning study.

Watershed C is comprised of approximately 0.8 square miles of agricultural land usage in the southernmost portion of the study area. This watershed drains directly by sheet flow into Reeds Creek. The watershed was not divided into subwatersheds.

C. EXISTING DRAINAGE SYSTEM

1. Linda Drain

The Linda Drain, parts of which are referred to as Horseman's Ditch, begins on the north side of Hammonton Smartsville Road about 19,000 feet northeasterly of the intersection of Alberta Avenue. It generally flows in a southwesterly down the north side of Hammonton Smartsville Road to cross that road in a culvert and arcs down to a southerly direction along the east side of the College Park subdivision. The Linda Drain turns west along the south side of the College Park subdivision and across to the southwest corner of that subdivision where it turns southward again after picking up water from a lesser tributary. The Drain runs south across undeveloped land and through culverts under Erle Road to the S.P.R.R. mainline tracks. It flows westward again through culverts under the tracks and under Route 70 directly into and across the north end of Olivehurst between Aspen Way and Second Avenue to the Clark Lateral on the east side of the Union Pacific right of way. The Clark Lateral then flows southerly to The Western Pacific Interceptor Canal. The Linda Drain relies on gravity flow into the interceptor which can be affected by high flows in that waterway caused by high flows in Bear River and resultant backwater effects.

The existing condition and capacity of the Linda Drain channel and its culverts varies, but as noted in the introduction to this section, existing conditions now cause localized flooding during minor rainstorm events. Under existing land use conditions, the estimated storm runoff that would occur in the Linda Drain at the S.P.R.R. culvert during a 100-year frequency storm event would be 875 cubic feet per second (cfs). The culvert under the S.P.R.R. has an estimated capacity of only 400 cfs. This restricted condition would produce flooding upstream of the S.P.R.R.. Similarly flooding would occur downstream or west of the S.P.R.R., within the community of Olivehurst, due to the many capacity restrictions in this section of the Linda Drain (Horseman's Ditch) resulting in significantly less capacity than 400 cfs.

2. Olivehurst Drain

The Olivehurst Drain, portions of which are referred to as Clark Slough, meanders in a generally southwesterly direction to cross under North Beale Road in a culvert about 700 feet East of the intersection of Griffith Avenue. It then runs in a southerly direction to parallel and finally follow the east side of Griffith Avenue to the intersection of Erle Road which is crossed under by a culvert. The Drain runs westerly along the south side of Erle Road about 3,500 feet and then turns southerly to meander across farm land to a point about a mile south of Erle Road and a half mile east of the S.P.R.R. mainline tracks. The Drain then runs more or less westerly to cross under the tracks, Route 70 and Powerline

Road through culverts on a line about 800 feet north of Sixth Avenue into the community of Olivehurst. The Drain then meanders south roughly parallel to the east of Olivehurst Avenue to cross that Avenue in a culvert to run west about 300 feet north of Eleventh Avenue. The Drain runs west between Tenth and Eleventh Avenues to the Clark Lateral Canal on the east side of the Union Pacific right of way. The Clark Lateral flows southerly to the Western Pacific Interceptor Canal, which as noted above is adversely affected by backwater caused by high flows in the Bear River. The Olivehurst Drain relies on gravity flow into the Lateral which can be affected by high flows backing up from the Bear River.

The existing condition and capacity of the Olivehurst Drain channel and its culverts varies, but as noted in the introduction to this section, existing conditions now cause localized flooding during minor storm events. Under existing land use conditions, the estimated storm runoff that would occur in the Olivehurst Drain at the S.P.R.R. culvert during a 100-year frequency storm event would be 400 cubic feet per second (cfs). The culvert under the S.P.R.R. has an estimated capacity of only 365 cfs. This restricted condition would produce flooding upstream of the S.P.R.R.. Similarly flooding would occur downstream or west of the S.P.R.R., within the community of Olivehurst, due to the many capacity restrictions in this section of the Olivehurst Drain (Clark Slough) resulting in significantly less capacity than 365 cfs.

3. Reeds Creek

Reeds Creek meanders through the South Yuba area in a south-westerly direction starting above Hammonton Smartsville Road, across the northeast corner of Beale A.F.B. and down to and across North Beale Road in a culvert about 0.8 mile east of Brophy Road. The creek continues to meander southwesterly to cross Erle Road in a culvert about mid-way along the diagonal section of Erle Road north of Duggin Street. The creek continues to meander across farmland and open land to cross Hale Road in a culvert about 3,200 feet east of the intersection of Bernice Avenue and cross both the S.P.R.R. mainline and Rancho Road opposite the east end of McGowan Parkway. Reeds Creek dips south to cross under Route 65 under a bridge about 1,900 feet south of McGowan Parkway and southwesterly again to cross Route 70 under a bridge about 1,200 feet north of the north leg of Plumas-Arboga Road and then run west to the Western Pacific Interceptor canal. As noted above in the introduction of this section some flooding problems are associated with the condition of Reeds Creek.

4. Western Pacific Interceptor Canal

The Western Pacific Interceptor Canal runs southeasterly along the east side of Route 70 right of way from the convergence of the Clark Lateral, Reeds Creek and Hutchinson Creek in the East Plumas Lake ponding area down to convergence with Best Slough. The canal continues southeasterly along the east side of the Union Pacific Railroad right of way

(formerly the Western Pacific Railroad) and drains by gravity into the Bear River during normal water flows. The drainage way is in fairly good condition except when it acts as a reverse drain to bring waters north from high waters in the Bear River.

5. Bear River Backflow

Bear River backflow is most significant because it involves the water backing up over south Olivehurst. The Bear River drains a watershed area of about 550 square miles including the study area and areas to the south which flow into the Western Pacific Inter-ceptor Canal. As noted previously in this report the Western Pacific Interceptor Canal flows into Bear River by gravity flow when the water surface level in the River is below the water surface level in the Canal. When the Bear River water surface is above the Canal surface level, flow from the River will enter the South Yuba area through the Canal and the backwater surface will equalize to the level in the River.

The surface elevation of the Bear River resulting from the design 100-year, 24-hour duration, storm event is reported to be nominally 60.0 feet above sea level based on U. S. G. S. datum. When the River is at that level, water surface levels in the South Yuba area will seek to be at the same level. The result of this backwater effect inundates approximately 6,000 acres of the lands north of the River based on Federal Emergency Management Agency (FEMA) datum. That inundation extends into the periphery of the East Linda area and the southern portions of the community of Olivehurst.

Currently flood waters from the Bear River flowing into portions of the southerly end of Yuba County are part of the operations of the State of California flood control system. A portion of South Yuba County is used to store flood water from Bear River; mitigating peak river elevations to minimize the risk of overtopping levees. The State of California, through the Sacramento and San Joaquin Drainage District, has easement rights to flood that south end of Yuba County. Those easement rights cover areas including the southerly end of Olivehurst. (See Figure 1)

The levee necessary to prevent backflow from the Bear River would extend from Route 65 to the vicinity of Route 70 north of Reeds Creek. Existing pipes for the Clark Lateral under Route 70 would have to be equipped with flap gates to prevent water from going the into the community of Olivehurst. But the potential downstream effects of the levee system could be significant.

Prior to any construction of a levee to keep the Bear River backflow out of Olivehurst it is presumed that the State will want to be assured that; a. a satisfactory plan to create a replacement volume of storage in or out of Olivehurst equivalent to the volume of water currently entitled by easement to flow over the land to be reclaimed has been prepared and approved by the State, or b. that the State does not need the easements.

D. Flood Plain Designations

The Federal Emergency Management Agency (FEMA) has prepared a series of flood plain delineation maps, titled Flood Insurance Rate Maps (FIRM), to delineate areas subject to flooding in the study area. The maps were prepared based on engineering studies on the Linda and Olivehurst Drains, Reeds Creek, Hutchinson Creek and the Western Pacific Interceptor Canal as well as other minor and unnamed tributaries. The study was performed as part of FEMA's general flood plain studies of the unincorporated portions of Yuba County (Ref. 1).

The maps prepared by FEMA show extensive areas within and surrounding the study area designated as "Zone A" defined as "areas of 100-year flooding; base elevations and flood hazard factors not determined."

E. Sacramento-San Joaquin Drainage District Inundation Rights

The inundation rights held by the Sacramento-San Joaquin Drainage District are described above in VI. Existing Conditions, C. Existing drainage system, 5. Bear River backflow. (See Figure 1)

VII. FUTURE CONDITIONS

A. MODEL SIMULATION

Model simulations were conducted using the Army Corps of Engineers' HEC-1 program to estimate 100-year, 24-hour duration storm peak discharges and runoff volumes for existing and future watershed conditions throughout the study area. Peak discharge and runoff volumes were determined from each subwatershed independently, as well as cumulatively, along the drainage courses within each watershed area. Future development patterns were derived from the East Linda Specific Plan and plans for development in other areas of the South Yuba County area, including the Yuba County General Plan, as well as proposed highway improvements. (See Tables 3 and 4)

1. Parameters of Study

This section of the report discusses the hydrological parameters of the Revised SYDMP study area. Values used in the plan for design rainfall precipitation, infiltration rate characteristics, corresponding runoff potential, time of concentration and similar standards of evaluation are set out.

a. Design Rainfall Events

For the purposes of this study the design rainfall event was simulated with the Army Corps of Engineers HEC-1 watershed model to represent a 100-year frequency, recurrent storm event of 24 hour duration falling on the study area.

Precipitation values for such an event were obtained for the City of Wheatland rain gauge station (Ref. 8). The value was reported to be 4.16 inches. Storm precipitation values utilized in the HEC-1 model were subjected to a Type I, SCS, temporal distribution with no spatial variability, which conservatively assumes the entire storm falls over the entire study area as opposed to spatial movement of the storm over the watersheds.

TABLE 3
Alternate I and III
Future Land Uses
(acres)

		Agriculture			Urban						
Sub-Area	Total Area	Rice	Leveled (Not Rice)	Not Leveled	Rural Residential	Low Density Residential	Medium Density Residential	High Density Residential	Schools	Parks	Commercial/ Industrial
I A	1082		1038		44						
II A	843		781	24	7		31				
III A	175						175				
IV A	819	609		101	102				7		
V A	248		38	164			35	11			
VI A	121						95				26
VII A	433		9			81	117	118	58	43	7
VIII A	330		44				105	79	43	10	49
IX A	227					175	6		16		30
X A	102					29	73				
XI A	456						223	32	11	55	125
I B	660	389		167	48	20		19	10	5	2
II B	611			158		264	137		35		17
III B	918			63	111		547	37	21	15	124
C	487				100	132	50	17		78	132

TABLE 4
Alternate II
Future Land Uses
(acres)

		Agriculture			Urban						
Sub-Area	Total Area	Rice	Leveled (Not Rice)	Not Leveled	Rural Residential	Low Density Residential	Medium Density Residential	High Density Residential	Schools	Parks	Commercial/ Industrial
I A	1082		1038		44						
II A	843		781	24	7		31				
III A	116						116				
IV A	819	609		101	102				7		
V A	248		38	164			35	11			
VI A	71						50				21
VII A	473		10			73	116	119	94	40	21
VIII A	334		44			7	95	95	43	6	44
IX A	406					245	133		21	7	
X A	421						348	34		39	
I B	705	400		132	48	17	64	19	10	6	9
II B	541			138	38	255	81		9		20
III B	779			63	105	198	286	37	21		69
C	225						26			15	184
D	415				129	79	19	18		81	89

b. Infiltration Rate Characteristics

The amount of infiltration potential is related to the permeability of the surficial soils, the local geomorphology and the amount and type of vegetation cover or canopy. As development proceeds within a natural watershed the percentage of directly connected impervious area are correspondingly increased and the runoff potential increases throughout the watershed. Soil survey maps prepared by the Yuba County Soil Conservation Service (SCS) were used to determine the extent of Types A, B, C, and D hydrological soil groups within each watershed area. The areas of each respective soil group were then summarized for each watershed and assigned an SCS curve number corresponding to a Type II and Type III antecedent moisture condition (AMC II and AMC III), representing the average curve number and greatest runoff potential curve number. AMC III curve numbers were utilized for the 100-year storm event simulations. Summaries of the curve number analysis are given in Tables 2 and 5. These curve numbers represent the hydrological soil groups in an undeveloped natural condition and account for developed areas by the use of percentage of directly connected impervious area.

c. Runoff Potential

Runoff potential used in this study was developed based on analysis of existing and future land use and application of standard assumptions for such land use as described below in the description of watersheds.

d. Time of Concentration

Time of concentration assumptions used in this study were developed based on analysis of existing and future land use and application of standard assumptions for such land use as used in the HEC-1 Army Corps of Engineer's flood hydrography program (Ref. 5).

TABLE 5
SUMMARY OF WATERSHED CURVE NUMBERS
ALTERNATE II

(AMC II CONDITION)

CN-"A" SOILS: 49 CN-"C" SOILS: 79
CN-"B" SOILS: 69 CN-"D" SOILS: 84

SUBBASIN DESIGNATION	AREA A-SOILS	AREA B-SOILS	AREA C-SOILS	AREA D-SOILS	AREA TOTAL	WEIGHTED CN
IA		676.08	4.27	401.38	1081.73	74.61
IIA	193.57	493.90		155.14	842.61	67.17
IIIA	7.12	18.50		149.45	175.07	80.99
IVA		54.90	51.24	713.08	819.22	82.68
VA		127.74		119.93	247.67	76.26
VIA		24.20		96.78	120.98	81.00
VIIA		130.95		301.74	432.69	79.46
VIIIA		54.09		254.77	308.86	81.37
IXA		81.13		324.52	405.65	81.00
XA		116.71		304.59	421.30	79.84
IB		256.20		448.35	704.55	78.55
IIB		217.77		323.09	540.86	77.96
IIIB		82.55		696.72	779.27	82.41
C		22.77		202.11	224.88	82.48
D		71.07		344.54	415.61	81.43

(AMC III CONDITION)

CN-"A" SOILS: 69 CN-"C" SOILS: 91
CN-"B" SOILS: 85 CN-"D" SOILS: 94

SUBBASIN DESIGNATION	AREA A-SOILS	AREA B-SOILS	AREA C-SOILS	AREA D-SOILS	AREA TOTAL	WEIGHTED CN
IA		676.08	4.27	401.38	1081.73	88.36
IIA	193.57	493.90		155.14	842.61	82.98
IIIA	7.12	18.50		149.45	175.07	92.03
IVA		54.90	51.24	713.08	819.22	93.21
VA		127.74		119.93	247.67	89.36
VIA		24.20		96.78	120.98	92.20
VIIA		130.95		301.74	432.69	91.28
VIIIA		54.09		254.77	308.86	92.42
IXA		81.13		324.52	405.65	92.20
XA		116.71		304.59	421.30	91.51
IB		256.20		448.35	704.55	90.73
IIB		217.77		323.09	540.86	90.38
IIIB		82.55		696.72	779.27	93.05
C		22.77		202.11	224.88	93.09
D		71.07		344.54	415.61	92.46

2. Backwater Effects

Backwater effects on the study area were investigated due to the impacts it has on discharge of storm runoff from the Linda and Olivehurst Drains to Reeds Creek and Western Pacific Interceptor Canal and the influence of other watercourses in the area including Hutchinson Creek and East Plumas Lake.

a. Bear River

Bear River backflow is most significant because it involves the water backing up over south Olivehurst. The Bear River drains a watershed area of about 550 square miles including the study area and areas to the south which flow into the Western Pacific Interceptor Canal. As noted previously in this report the Western Pacific Interceptor Canal flows into Bear River by gravity flow when the water surface level in the River is below the water surface level in the Canal. When the Bear River water surface is above the Canal surface level, flow from the River will enter the South Yuba area through the Canal and the backwater surface will equalize to the level in the River.

The surface elevation of the Bear River resulting from the design 100-year, 24-hour duration, storm event is reported to be nominally 60.0 feet above sea level based upon U.S.G.S. datum. When the River is at that level, water surface levels in the South Yuba area will seek to be at the same level. The result of this backwater effect inundates approximately 6,000 acres of the lands north of the River according to FEMA datum. That inundation extends into the periphery of the East Linda area and the southern portions of the community of Olivehurst.

This Revised SYDMP examined the effects of the runoff from additional development proposed in the South Yuba area as described above on the existing expected backflows. A worst case scenario was assumed.

3. Watersheds

The same watersheds and subwatersheds as described under existing conditions were used for Alternates I and III described below and modified for Alternative II, also described below, in the model projections combining existing and future drainage requirements. The impact of the combination of both existing and future land use intensities, as well as the backwater effects identified above, is described below.

B. IMPROVEMENT NEEDS AND PHASING

The results of the model simulations for future conditions give rise to identification of

improvement needs. This section will present a general outline of those needs and deal specifically with the needs to accommodate growth as projected by the Yuba County Board of Supervisors.

1. East Linda Drainage

Four alternative plans have been developed to provide necessary improvements to carry the future flows in this drainage facility as estimated by modeling. All of the alternatives have three common improvements; a. construction of a regulation basin above Reeds Creek to act as a detention storage facility capable of holding the flows generated in East Linda and controlling outflow into the Creek to equivalent pre-development (historical) flow rates from the East Linda area which passed under the Southern Pacific Railroad tracks in existing culverts, b. construction of an Olivehurst interceptor to prevent flow from East Linda into the community of Olivehurst, and c. construction of a new channel parallel to Reeds Creek.

a. Alternative No. 1: OLIVEHURST INTERCEPTOR

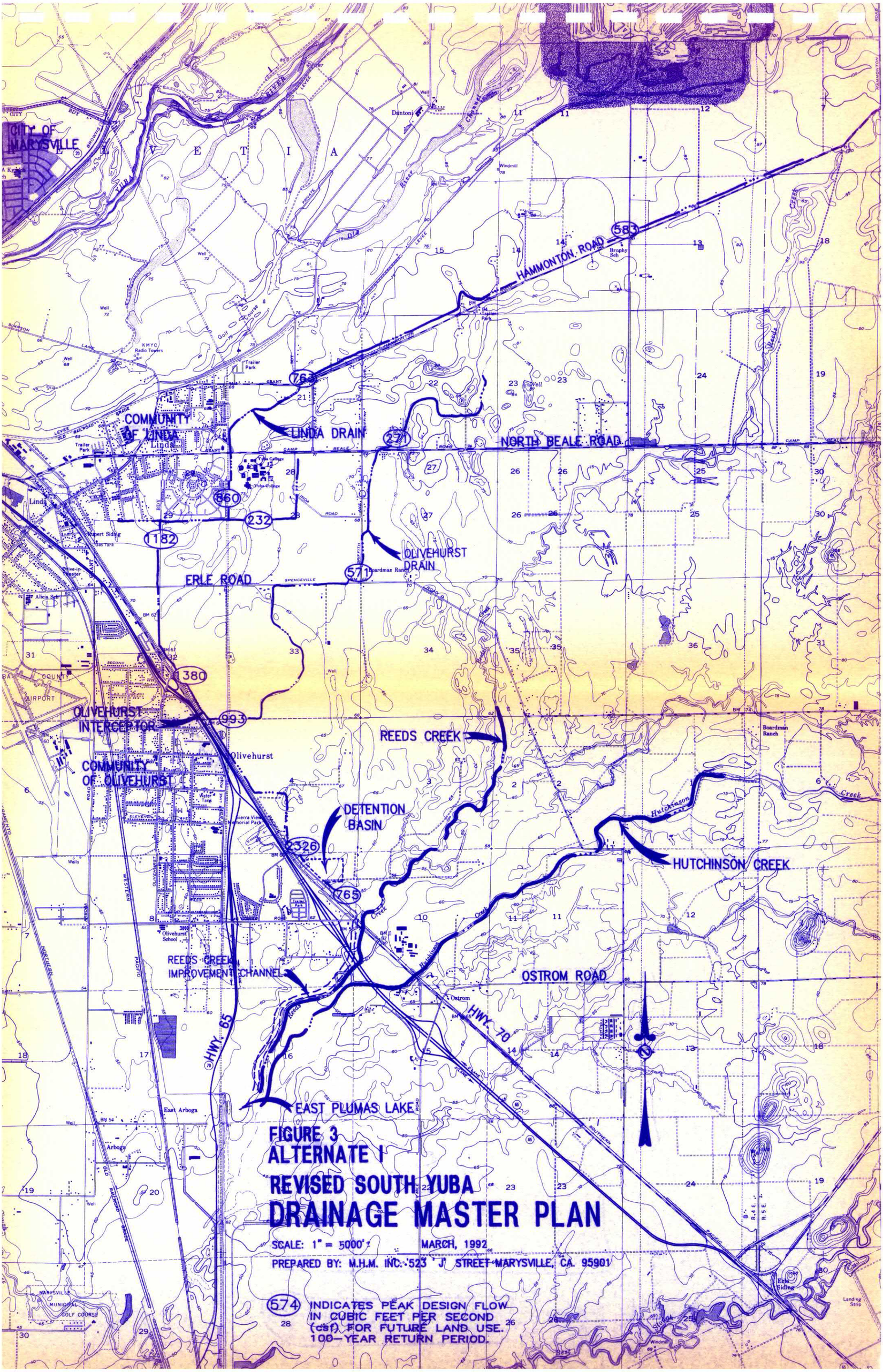
This alternative proposes construction of a large canal parallel to and east of the Southern Pacific Railroad tracks between Erle Road and Reeds Creek in addition to the regulation basin and Reeds Creek channel. Areas to the north and east of the intersection of Erle Road and the railroad would drain into improved sections of what are now the Linda and Olivehurst Drains, but would flow into the new canal rather than into Olivehurst. Storm water intercepted would flow southerly through the canal to the regulation basin and thence be metered into the new channel of Reeds Creek at the estimated historical rate of

flow from the East Linda Area. Discharge flow at key locations throughout the watershed are shown on Figure 3. The canal proposed here is similar to the canal proposed in the 1981 South Yuba Master Drainage Plan. The cost of the major work proposed in this alternative is estimated as follows:

Improvement	Cost
Olivehurst Interceptor	
Land Cost	$316,500
Excavation Cost	776,400
Culvert Cost	485,200
Linda Drain (lower)	
Land Cost	$132,900
Excavation Cost	346,400
Culvert Cost	1,009,600
Linda Drain (upper)	
Land Cost	$84,400
Excavation Cost	123,200
Culvert Cost	151,500
Olivehurst Drain	
Land Cost	$167,700
Excavation Cost	272,700
Culvert Cost	331,000
Detention Pond	
Land Cost	$592,800
Excavation Cost	1,736,000
Infrastructure	95,000
Reeds Creek Improvement Ditch	
Land Cost	$168,200
Excavation Cost	307,100
Culvert Cost	307,800
Subtotal	$7,404,400
Engineering/Contingencies @20%	1,480,900
TOTAL Alternative 1	$8,885,300

Phasing for Alternative No. 1 could be accomplished as follows:

Phase		Improvement	Cost
1	a.	Construct Olivehurst Interceptor	
	b.	Close off existing culverts into Olivehurst	
	c.	Construct Reeds Creek improvement ditch	
	d.	Construct portion of detention pond to control peak outflow under existing conditions	$3,602,200
2.	a.	Modify the lower Linda Drain to convey future conditions	$1,488,900
3.	a.	Modify the upper Linda Drain to convey future conditions	$359,100
4.	a.	Modify the Olivehurst Drain to convey future conditions	$771,400
5.	a.	Construct additional storage in detention to control peak outflow of future conditions as development progresses. This will occur even if phases 2-4 are not completed	$1,182,800
		Subtotal	$7,404,400
		Engineer and contingencies	$1,480,900
		TOTAL Alternative 1	$8,885,300


CITY OF MARYSVILLE
L I V E T I A
HAMMONTON ROAD
583
763
COMMUNITY OF LINDA
LINDA DRAIN
271
NORTH BEALE ROAD
860
232
1182
OLIVEHURST DRAIN
571
ERLE ROAD
380
OLIVEHURST INTERCEPTOR
993
REEDS CREEK
COMMUNITY OF OLIVEHURST
Olivehurst
DETENTION BASIN
2326
765
HUTCHINSON CREEK
REEDS CREEK IMPROVEMENT CHANNEL
OSTROM ROAD
HWY. 65
HWY. 70
EAST PLUMAS LAKE
FIGURE 3
ALTERNATE I
REVISED SOUTH YUBA
DRAINAGE MASTER PLAN
SCALE: 1" = 5000'±
MARCH, 1992
PREPARED BY: M.H.M. INC. 523 'J' STREET MARYSVILLE, CA. 95901
574
INDICATES PEAK DESIGN FLOW IN CUBIC FEET PER SECOND (cfs) FOR FUTURE LAND USE. 100-YEAR RETURN PERIOD.

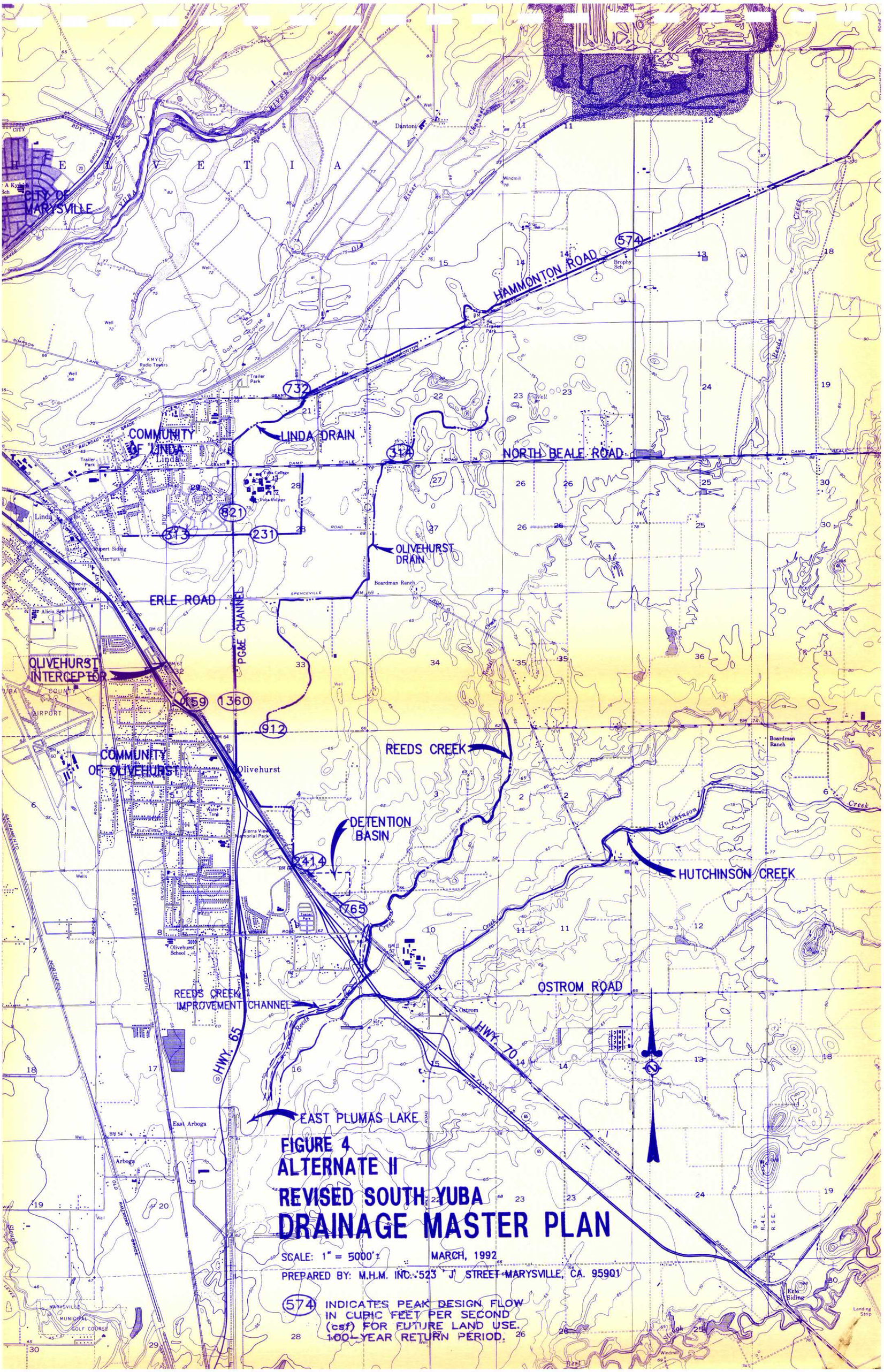
b. Alternative No. 2: P. G. & E. POWERLINE CHANNEL

This alternative proposes construction of a large channel following the P.G.&E. transmission line tower easement from the vicinity of Yuba College on the Linda Drain south to the intersection of the powerline with the Southern Pacific Railroad tracks then southerly, as in Alternative No. 1, along those tracks to the regulation basin at Reeds Creek cited above. A lesser drainage canal would run northerly along the Southern Pacific Railroad tracks from the large channel to intercept an improved Linda Drain and the Olivehurst Drain. Storm water intercepted would flow southerly through the canal to the regulation basin and thence be metered into the new channel of Reeds Creek at the estimated historical rate of flow from the East Linda Area. Discharge rates at key locations throughout the watershed are shown on Figure 4. The cost of the major work proposed in this alternative is estimated as follows:

Improvement	Cost
Linda Drain (lower) & P.G.&E. Channel	
Land Cost	$336,500
Excavation Cost	619,800
Culvert Cost	615,200
Linda Drain (upper)	
Land Cost	$85,200
Excavation Cost	125,100
Culvert Cost	151,400
Olivehurst Drain	
Land Cost	$179,700
Excavation Cost	254,000
Culvert Cost	368,400
Detention Pond	
Land Cost	$592,800
Excavation Cost	1,771,500
Infrastructure	95,000
Reeds Creek Improvement Ditch	
Land Cost	$168,200
Excavation Cost	307,100
Culvert Cost	308,800
Subtotal	$7,339,600
Engineering/Contingencies @20%	1,467,900
TOTAL Alternative 2	$8,807,500

Phasing for Alternative No. 2 could be accomplished as follows:

Phase		Improvement	Cost
1.	a.	Construct Olivehurst Interceptor	
	b.	Close off culverts into Olivehurst	
	c.	Construct detention pond to control peak outflow under existing conditions	
	d.	Construct Reeds Creek Improvement Ditch	$3,386,000
2.	a.	Modify the lower Linda Drain and P.G.&E. channel to convey future conditions	$1,571,500
3.	a.	Modify the upper Linda Drain to convey future conditions	$361,700
4.	a.	Modify the Olivehurst Drain to convey future conditions	$802,100
5.	a.	Construct additional storage in detention to control peak outflow of future conditions as development progresses. This will occur even if phases 2-4 are not completed	$1,218,300
		Subtotal	$7,339,600
		Engineer & contingency	$1,467,900
		TOTAL Alternative 2	$8,807,500


HAMMONTON ROAD
574
732
COMMUNITY OF LINDA
LINDA DRAIN
314
NORTH BEALE ROAD
821
513
231
OLIVEHURST DRAIN
ERLE ROAD
PG&E CHANNEL
OLIVEHURST INTERCEPTOR
059
1360
912
COMMUNITY OF OLIVEHURST
REEDS CREEK
DETENTION BASIN
2414
765
HUTCHINSON CREEK
OSTROM ROAD
REEDS CREEK IMPROVEMENT CHANNEL
HWY. 65
HWY. 70
EAST PLUMAS LAKE
FIGURE 4
ALTERNATE II
REVISED SOUTH YUBA
DRAINAGE MASTER PLAN
SCALE: 1" = 5000'
MARCH, 1992
PREPARED BY: M.H.M. INC. 523 "J" STREET MARYSVILLE, CA. 95901
574 INDICATES PEAK DESIGN FLOW IN CUBIC FEET PER SECOND (csf) FOR FUTURE LAND USE. 100-YEAR RETURN PERIOD.

c. Alternative No. 3: EASTSIDE INTERCEPTOR

This alternative would create a diversion canal from the upper Linda Drain, at a point near the intersection of Griffith Avenue and Hammonton-Smartsville Road, southerly parallel to Griffith Avenue to the Olivehurst Drain near North Beale Road, thence along the alignment of the existing Olivehurst Drain to its intersection with the Southern Pacific Railroad tracks, thence southerly along those tracks as in Alternative No. 2 above to the regulation basin and new Reeds Creek channel. This alternative provides for redirecting a large portion of the flow that would have passed through the Linda Drain and thereby allows reduction in the size of the Linda Drain improvements necessary in Alternatives No.s 1 or 2. This alternative also would serve the proposed alignment of the Route 70/Marysville By-pass. Discharge rates at key locations throughout the watershed basin are shown on Figure 5. The cost of the major work proposed in this alternative is estimated as follows:

Improvement	Cost
Olivehurst Interceptor	
Land Cost	$310,900
Excavation Cost	753,700
Culvert Cost	485,200
Eastside Interceptor (upper)	
Land Cost	$156,600
Excavation Cost	308,500
Culvert Cost	554,000
Eastside Interceptor (lower)	
Land Cost	$156,600
Excavation Cost	356,500
Culvert Cost	331,300
Linda Drain	
Land Cost	$26,700
Excavation Cost	24,500
Culvert Cost	472,200
Detention Pond	
Land Cost	$592,800
Excavation Cost	1,613,400
Infrastructure	95,000
Reeds Creek Improvement Ditch	
Land Cost	$168,200
Excavation Cost	307,100
Culvert Cost	308,800
Subtotal	$7,020,500
Engineering/Contingencies @20%	1,404,600
TOTAL Alternative 3	$8,424,600

Phasing for Alternative No. 3 could be accomplished as follows:

Phase		Improvement	Cost
1	a.	Construct Olivehurst Interceptor	
	b.	Close off culverts into Olivehurst	
	c.	Construct detention pond to control peak outflow under existing conditions	
	d.	Construct Reeds Creek Improvement Ditch (765 cfs)	
			$3,573,900
2	a.	Modify the Linda Drain to convey future conditions	
			$1,863,000
3	a.	Modify the Linda Drain to convey future conditions	
			$523,400
4	a.	Construct additional storage in detention to control peak outflow of future conditions as development progresses. This will occur even if phases 2-4 are not completed	
			$1,060,200
		Subtotal	$7,020,500
		Engineer & contingency	$1,404,100
		TOTAL Alternative 3	$8,424,600

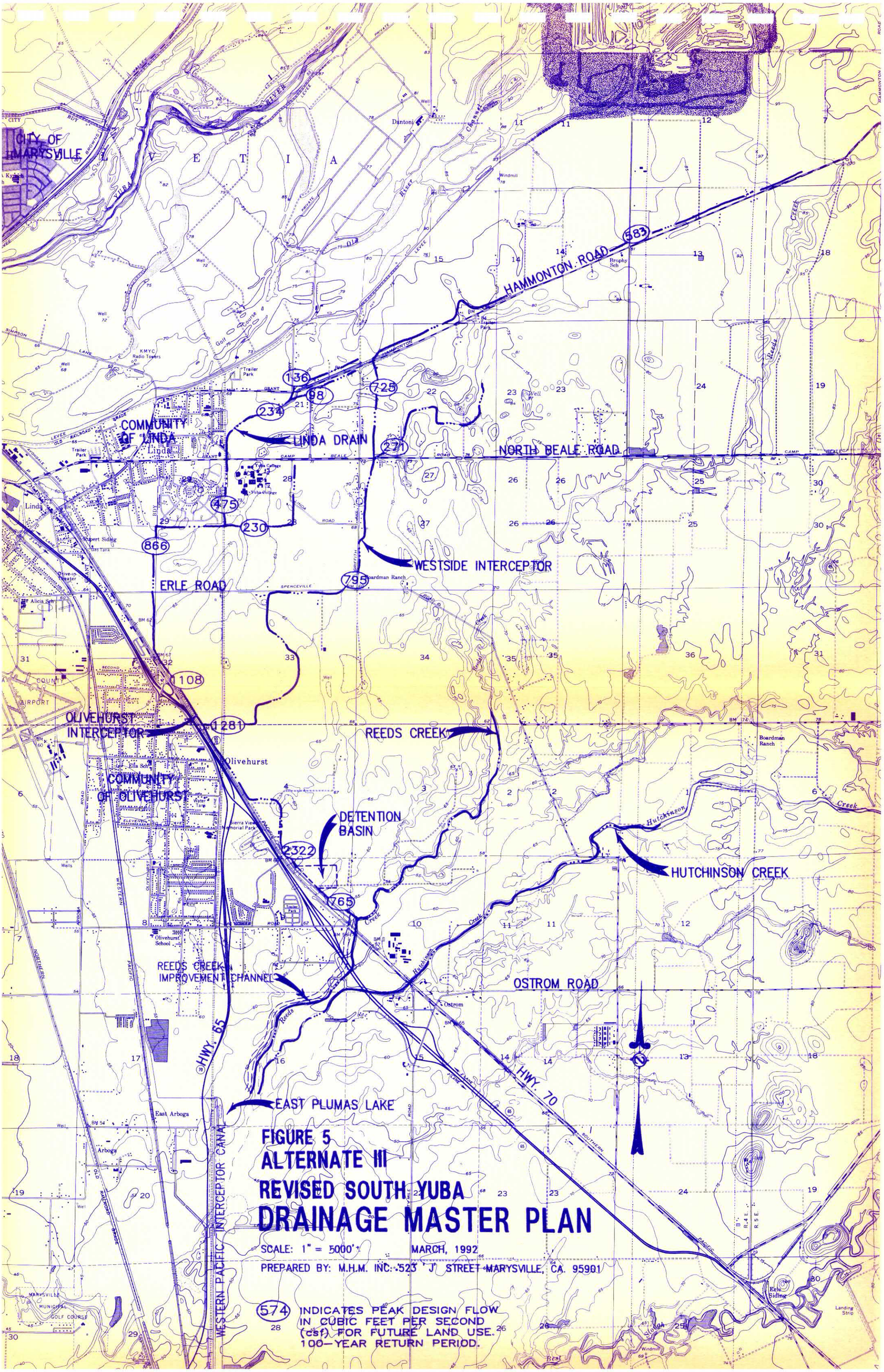


FIGURE 5
ALTERNATE III
REVISED SOUTH YUBA
DRAINAGE MASTER PLAN

SCALE: 1" = 5000' MARCH, 1992

PREPARED BY: M.H.M. INC. 523 'J' STREET MARYSVILLE, CA. 95901

(574) INDICATES PEAK DESIGN FLOW IN CUBIC FEET PER SECOND (csf) FOR FUTURE LAND USE. 100-YEAR RETURN PERIOD.

d. RECOMMENDED ALTERNATIVE

This alternative is a combination of Alternatives No.s 2 and 3. It is recommended as the best solution to immediate development and long term needs to serve the East Linda Area. Discharge rates at key locations throughout the watershed basin are shown on Figure __. It is suggested to develop this alternative in phases as needed to serve developing tracts of land:

1. Creation of the P.G.&E. Powerline channel as outlined in Alternative No. 2. This channel would serve development in the Erle road area and the region north of the college;
2. Creation of the Eastside Interceptor as outlined in Alternative NO. 3, except that a new canal would be constructed parallel to and east of the proposed Route 70 Bypass. This facility would intercept much of the drainage that would otherwise be handled in the P.G.&E. Powerline channel as well as drainage from new development along the easterly portion of the development area and future Route 70.

   Storm water intercepted from the new developments would flow down the channels to the regulation basin and be metered into new Reeds Creek channel and thence to the Bear River.

The cost of the major work proposed in this alternative is estimated as follows:

Improvement	Cost
Olivehurst Interceptor	
Land Cost	$225,000
Excavation Cost	578,000
Culvert Cost	558,000
P. G. & E. Channel and Linda Drain	
Land Cost	$161,500
Excavation Cost	283,000
Culvert Cost	500,000
Eastside Interceptor	
Land Cost	$396,000
Excavation Cost	759,500
Culvert Cost	885,500
Detention Pond	
Land Cost	$593,000
Excavation Cost	1,613,500
Infrastructure	95,000
Reeds Creek Improvement Ditch	
Land Cost	$168,500
Excavation Cost	307,000
Culvert Cost	309,000
Subtotal	$7,432,500
Engineering/Contingencies @20%	1,486,500
TOTAL Recommended Alternative	$8,919,000

Phasing for the Recommended Alternative could be accomplished as follows:

Phase		Improvement	Cost
1	a.	Construct Olivehurst Interceptor	
	b.	Close off culverts into Olivehurst	
	c.	Construct detention pond to control peak outflow under existing conditions	
	d.	Construct Reeds Creek Improvement Ditch	$3,386,500
2	a.	Construct channel parallel to P.G.&E. right of way and Linda Drain	$944,500
3	a.	Construct Eastside Interceptor	$2,041,000
4	a.	Construct additional storage in detention to control peak outflow of future conditions as development progresses. This will occur even if phase 2-4 are not completed	$1,060,500
		Subtotal	$7,432,500
		Engineer & contingency	$1,486,500
		TOTAL	$8,919,000

2. OLIVEHURST DRAINAGE

The community of Olivehurst experiences flooding from direct rainfall, drainage entering the area from the east through the Olivehurst Drain and the Linda Drain, backwater effects from the Bear River and combinations of the above. Previous studies by the Corps of Engineers and others all propose that the most effective means of preventing flooding in Olivehurst must involve a system including:

1. Interception and prevention of drainage flows from the east.
2. A levee at the southern end of Olivehurst along Reeds Creek to prevent flooding from the Bear River.
3. A pumping plant(s) to remove runoff collected in Olivehurst.

The first problem could be remedied by the improvements suggested in the foregoing section about East Linda Drainage. The third problem is relatively simply remedied by installation of one or more detention basins and pumping plants. The second problem is extremely complicated.

Currently flood waters from the Bear River flow into and inundate portions of the southerly end of Yuba County as part of the operations of the State of California flood control system. A portion of South Yuba County is used to store flood water from Bear River; mitigating peak river elevations to minimize the risk of overtopping levees. The State of California, through the Sacramento and San Joaquin Drainage District, has easement rights to flood that south end of Yuba County. Those easement rights cover areas including the southerly end of Olivehurst.

The levee necessary to prevent backflow from the Bear River would extend from Route 65 to the vicinity of Route 70 north of Reeds Creek. Existing pipes for the Clark Lateral under Route 70 would have to be equipped with flap gates to prevent water from flowing into the community of Olivehurst. But the potential downstream effects of the levee system could be significant.

Prior to any construction of a levee to keep the Bear River backflow out of Olivehurst the State will want to be assured that; a. a satisfactory plan to create a replacement volume of storage in or out of Olivehurst equivalent to the volume of water currently entitled by easement to flow over the land to be reclaimed has been prepared and approved by the State, or b. that the State does not need the easements.

a. Alternative Improvements

Assuming that the State's inundation rights can be resolved as suggested in the preceding paragraph and that areas designated by FEMA as subject to flooding from 100 year storms

but not subject to State flood control operations easements do not require equivalent volumes replacement, the following is proposed as an alternative providing flood protection for Olivehurst:

1. The East Linda drainage improvements as listed in any of the alternatives listed above are constructed.
2. The Olivehurst levee would be constructed from Route 65 westerly to Route 70. The source of soil for this levee could be created by the Reeds Creek channel improvements for East Linda and any necessary inundation area created to replace the equivalent storage volume protected by this levee.
3. A detention basin and pumping station would be installed north of the Levee to handle local runoff when gravity flow is not possible due to high flows in Reeds Creek.
4. The area of Olivehurst west of Route 70 would be protected from flooding by expanding the existing detention basin south of McGowan Road. The pond would be expanded both north and south along the Clark Lateral to a volume sufficient to handle local runoff from this area. A ponding area would be created where the Clark Lateral crosses under Route 70 to contain a volume of water equivalent to the State's inundation rights, estimated to be 360 acre-feet.

The cost of constructing improvements to protect that portion of the community of Olivehurst lying west of Route 70 is estimated as follows:

1) West of Route 70

Improvement	Cost
Detention Pond	
Land Cost	$522,000
Excavation Cost	871,500
Pump Cost	300,000
Flap Cost	100,000
Subtotal	1,793,500
Engineering, etc. @20%	358,500
TOTAL	$2,151,000

The cost of constructing the Olivehurst Levee and the associated detention/pumping facility to protect the portion of the community of Olivehurst lying between Route 65 and Route 70 is estimated as follows and would only benefit the area south of McGowan Road between Route 65 and 70:

2) East of Route 70 and West of Route 65

Improvement	Cost
Detention Pond	
Land Cost	$173,000
Excavation Cost	807,000
Pump Station	200,000
Zone C Levee	
Land Cost	$110,000
Excavation Cost	120,000
Subtotal	$1,410,000
Engineering, etc. @ 30%	282,000
TOTAL	$1,692,000

VIII. POTENTIAL ENVIRONMENTAL & PERMITTING ISSUES

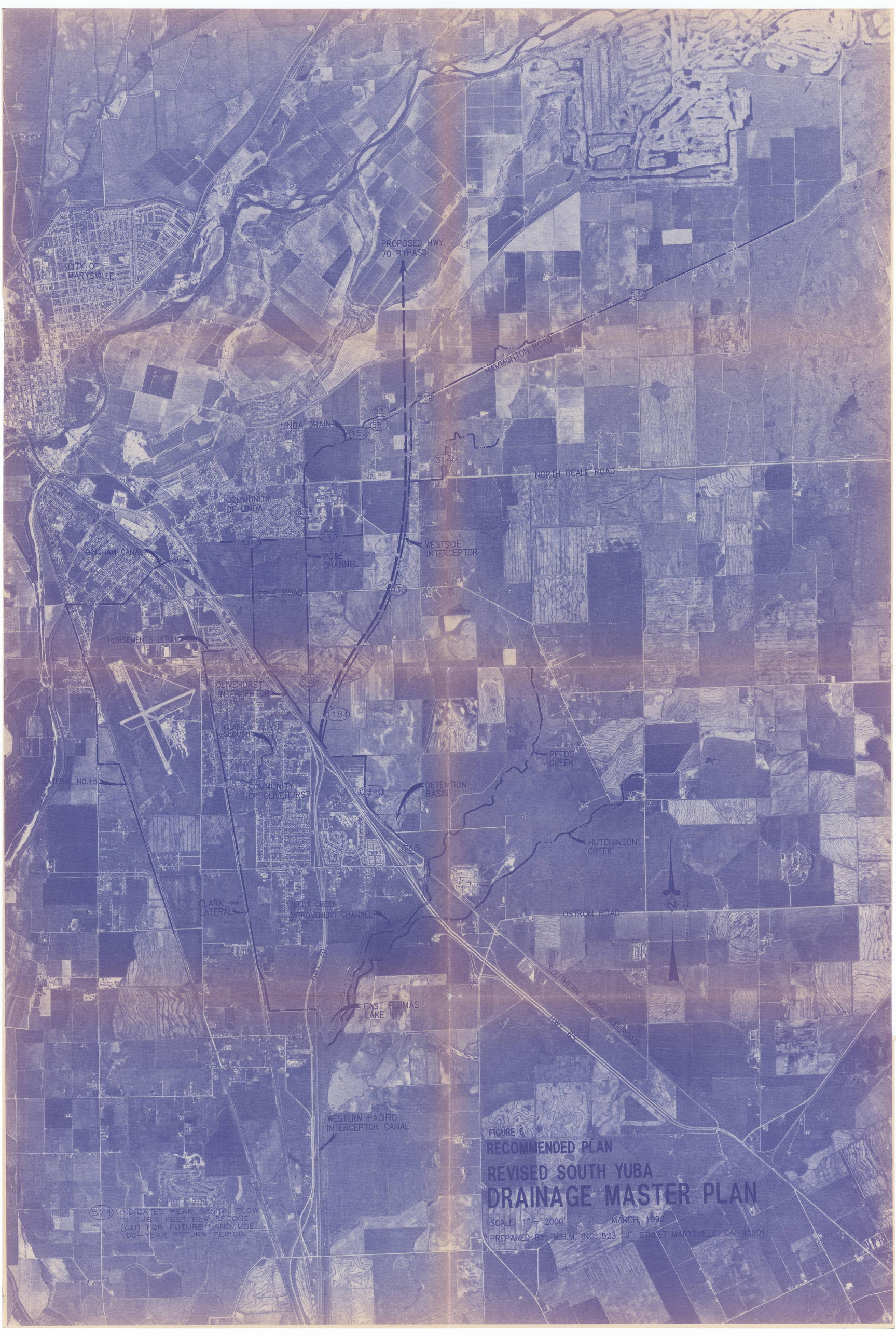
Implementation of the improvements suggested in this report will require adoption by the County of one of the alternative plans and the appropriate environmental assessment of that project.

Public agencies that would be involved in the environmental assessment and the required permit processing for the improvements include the State Reclamation Board, the U.S. Army Corps of Engineers, State and Federal Wildlife agencies and the State Regional Water Quality Control Board.

Areas of potential concern include the potential impacts on the rights of the State of California to utilize their inundation easements, review by the State and Corps of Engineers and potential impacts on regional flood operations and on wetlands and wetlands habitats.

REFERENCES

Reference No.	Document
1.	Federal Emergency Management Agency (FEMA), "Flood Insurance Study, Yuba County, California, Unincorporated Areas, Community Panel No. 060427, November, 1981."
2.	Army Corps of Engineers, "Bear River, California - Feasibility Report for Water Resources Development," September, 1972
3.	MHM Inc., "South Yuba Drainage Master Plan," Volume I, September 1981
4.	Lampman and Associates, "Olivehurst Drainage Study," October 1973
5.	U. S. Army Corps of Engineers, "HEC-1 Flood Hydrograph Package." Hydrologic Engineering Center, September 1990
6.	Department of Water Resources, State of California Resources Agency, "Rainfall Analysis for Drainage Design, Volume III,Intensity-Duration-Frequency Curves," Bulletin No. 195, October 1976
7.	U. S. Department of Agriculture, Soil Conservation Service, "Urban Hydrology for Small Watersheds," TR55, June 1986
8.	Yuba County Soil Conservation Service, Unpublished Soils Maps of Yuba County, March 1991
9.	Department of Water Resources, State of California, "California Flood Management: An Evaluation of Flood Damage Prevention Programs," Bulletin No. 199,October, 1978
10.	U. S. Department of the Interior Geological Survey, Water Resources Division, "California Streamflow Characteristics, Volume 2, Northern Great Basin and Central Valley," June 1971
11.	Department of Water Resources, State of California, "California High Water 1985-86," Bulletin No. 69-86, May, 1988
12.	U. S. Army Corps of Engineers, "Linda and Olivehurst Drains, Bear River Basin, California," January 1989
13.	Journal of Urban Planning and Development, "Sensitivity Study of Detention Basins in Urbanized Watersheds," Volume 115, Number 3, December, 1989
14	Journal of the Hydraulics Division, "Urbanization Impact on Streamflow," Volume 105, No. HY6, June, 1979


CITY OF MARYSVILLE
PROPOSED HWY. 70 BYPASS
HAMMONTON ROAD
574
719
92
58
150
LINDA DRAIN
314
NORTH BEALE ROAD
COMMUNITY OF LINDA
445
313
231
BINGHAM CANAL
PG&E CHANNEL
WESTSIDE INTERCEPTOR
ERLE ROAD
330
HORSEMEN'S DITCH
825
OLIVEHURST INTERCEPTOR
184
CLARK SEQUOIA
REEDS CREEK
LATERAL NO.15
COMMUNITY OF OLIVEHURST
2340
DETENTION BASIN
182
HUTCHINSON CREEK
CLARK LATERAL
REEDS CREEK IMPROVEMENT CHANNEL
OSTROM ROAD
HWY 70
SOUTHERN PACIFIC RAILROAD
EAST PLUMAS LAKE
HWY 65
WESTERN PACIFIC INTERCEPTOR CANAL
N
574 INDICATES PEAK DESIGN FLOW IN CUBIC FEET PER SECOND (csf) FOR FUTURE LAND USE, 100-YEAR RETURN PERIOD.
FIGURE 6
RECOMMENDED PLAN
REVISED SOUTH YUBA
DRAINAGE MASTER PLAN
SCALE: 1" = 2000'
MARCH 1992
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