APPENDIX F

Preliminary Drainage Study

Preliminary Drainage Study
August 2008

Proposed Prison Medical Facility
NCYCC Stockton Site

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1. EXECUTIVE SUMMARY

1.1 PURPOSE AND OBJECTIVES

Kimley-Horn and Associates, Inc. is submitting the following Drainage Study of the proposed medical facility at the Northern California Youth Correctional Center (NCYCC). This document contains the results from our hydrologic and hydraulic study, the capacity assessment of the system and provides alternatives for the proposed storm drain system.

The objectives of this study are:

- To assess the existing system capacity and detention basin operation and capacity.
- To present the runoff flow rates of the facilities in the existing condition and the runoff flow rates for the proposed medical facility for the 10-year and 100-year storm events.
- To prepare conceptual diagrams of alternatives for a storm drain system alignment and connection points.
- To prepare conceptual diagrams for relocating the existing agricultural drainage ditch.
- To present an opinion of probable construction cost for suggested improvements.
- To present the timeline for required permits and approvals.

2. BACKGROUD

2.1 SITE LOCATION / WATERSHED DESCRIPTION

The NCYCC site is located south east of the City of Stockton in a portion of the San Joaquin Valley characterized by flat topography that generally slopes from east to west towards the San Joaquin River and Delta. Exhibit 1 shows a vicinity map of the area and identifies the location of the NCYCC. Most of the NCYCC site drains to the south into the North Fork of South Littlejohns Creek. South Littlejohns Creek flows into French Camp Slough, which flows into the San Joaquin River. These stormwater drainage paths are shown in Exhibit 1.

2.2 STORM DRAIN SYSTEM DESCRIPTION

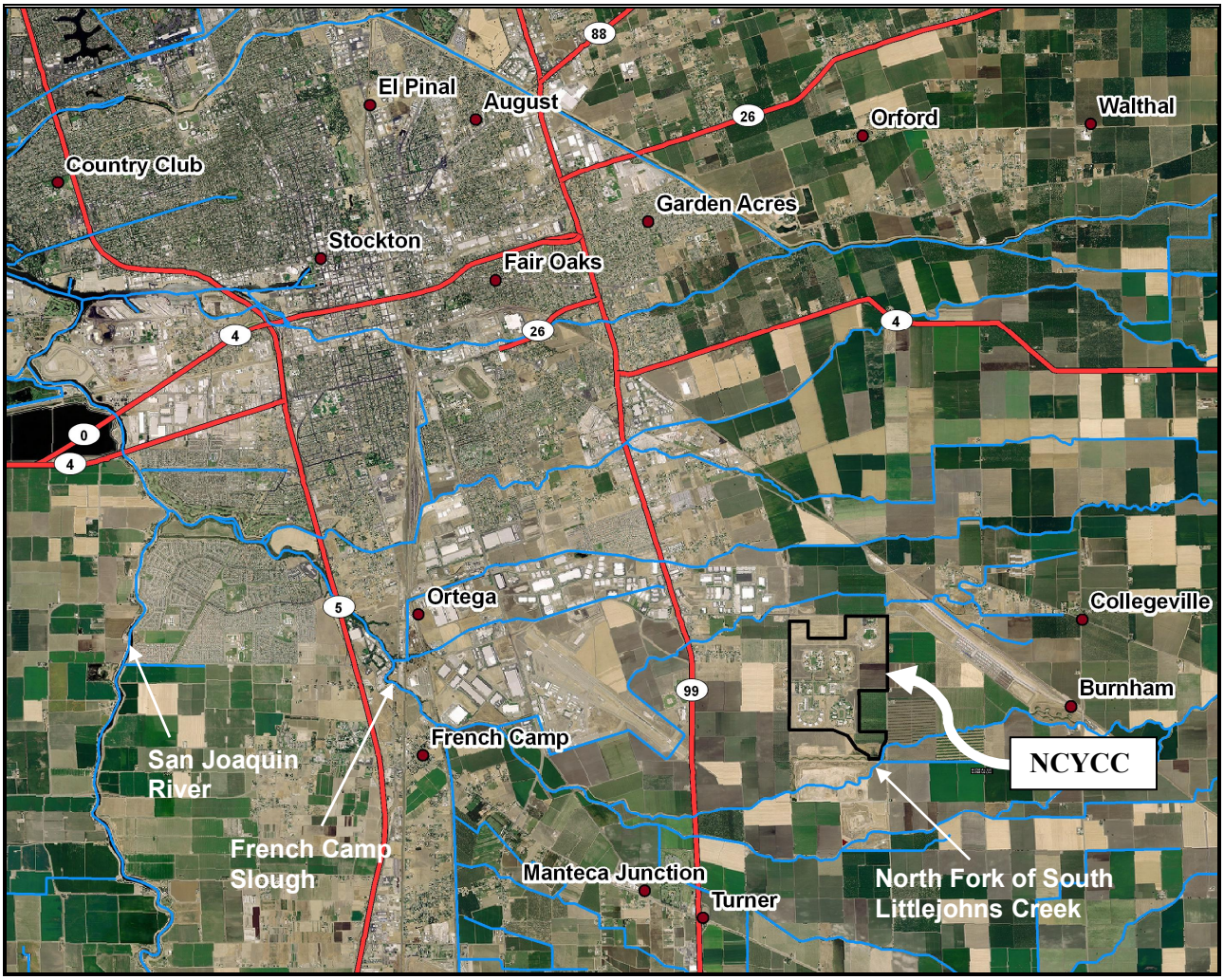
The existing stormwater drainage system is shown in Appendix A - Figure 1. Each developed facility within the NCYCC drains into this system. The existing NCYCC drainage system includes a trunk line that collects runoff from the Women's Facility in a 30" storm drain that increases to 36" with the inflow from the O.H. Close Facility and to 42" with the inflow from the Karl Holton Facility. The 42" line flows into a sump at stormwater Pump Station No. 1 near the center of the site. Four stormwater pumps (three 40 hp pumps and one 15 hp pump) discharge into a concrete trapezoidal channel which conveys the flow south and south east to a 30 acre-feet retention basin adjacent to the North Fork of South Littlejohns Creek. Pump Station No. 2, which contains two pumps (one 15 hp pump and one 50 hp pump), is located within the retention basin to pump runoff into the North Fork of South Littlejohns Creek should the retention basin rise to a high level.

2.3 FLOOD HAZARD ZONES ON PROPERTY, FIRM MAPS

To determine the impact that flooding could have on drainage from the site, FEMA Flood Insurance Rate Maps were researched. FIRM 0602990465 C, dated April 2, 2002 and FIRM 0602990470 B, dated April 2, 2002 indicate that this site is located entirely within Zone C. Per FEMA, Zone C is defined as areas of minimal flooding. To see the proximity of the project site to the nearest floodplain refer to Appendix C – Flood Insurance Rate Map.

The land areas west of SR 99 tend to be low with much of the area in FEMA floodplains and many of the creeks and channels, including Littlejohns Creek, with levees. East of SR 99, the land tends to be higher without levees. The NCYCC site is not in the FEMA floodplain, but is surrounded by areas that are. The property just north of Arch Road and areas farther to the west of the site, along SR 99, are included in FEMA Zone AO. Per FEMA, Zone AO is defined as areas of 100-year shallow flooding where depths are between one and three feet.

Exhibit 1. Vicinity Map



3. HYDROLOGIC ANALYSIS

3.1 METHODOLOGY

The method used to determine the runoff flow rates for this analysis is as described in Section D – "Rational Method" of the County of San Joaquin Hydrology Manual (Hydrology Manual) dated September 1997. The rational method is used to estimate peak discharges from small developed areas that are usually less than one square mile. The rational method relates rainfall intensity, the drainage area of the watershed, and a runoff coefficient to estimate peak runoff flow rates using the following equation.

$$Q = CIA$$

Where:

Q = the peak discharge in cubic feet per second (cfs)

C = a runoff coefficient representing the ratio of runoff depth to rainfall depth (dimensionless)

I = the time-averaged rainfall intensity for a storm duration equal to the time of concentration in inches/hour (in/hr)

A = drainage area in acres (ac)

A hydrologic analysis of the entire NCYCC was conducted to allow a comparison of the estimated runoff flow rates to the capacity of the existing storm drain system and facilities. This comparison is examined and discussed in Section 4.

3.1.1 Area

The survey by Conti and Associates, Inc. of the Karl Holton Youth Correctional Facility dated June 7, 2008 provided the information to delineate the extents of the drainage area for that facility. Based on the survey, the perimeter road of the Karl Holton YCF acted as the divide for that drainage area. Any rainfall that falls outside of the perimeter road does not enter the NCYCC underground storm drain system. This assumption was applied for the remaining youth correctional facilities, namely that the perimeter road of each facility was used as the boundary of each drainage area.

The connecting streets between the youth correctional facilities also contain storm drains that connect to the 42-inch storm drain trunk that is being analyzed. These areas were delineated based on the as-builts of the storm drain system in those areas.

Each drainage area was then sub-divided into impervious and pervious areas to be used to determine the appropriate runoff coefficient and rate of infiltration as described in Section 3.1.3. An aerial photograph along with the Conti survey was used to differentiate pervious and impervious areas. The impervious area for the proposed Medical Facility was estimated based on the Draft Medical Facility Site Plan dated May 15, 2008.

Table 3-1. Drainage Areas

Drainage Area	Abbreviated Name	a_i (ac)	a_p (ac)	a_{Total} (ac)
Women's Facility	Women's	10.9	31.6	42.5
O.H. Close YCF	Close	12.5	20.5	33.0
Karl Holton YCF	Holton	13.7	26.9	40.6
Area around Slane Road	Slane Rd	7.6	11.0	18.6
Area around 3rd Street	3rd St	7.8	6.5	14.3
Area around McKesson Street	McKesson	11.6	11.9	23.5
Dewitt Nelson YCF	Nelson	12.3	28.4	40.7
N.A. Chaderjian YCF	Chaderjian	18.3	39.8	58.1

3.1.2 Intensity

The mean annual precipitation for the NCYCC site, based on Figure B-1 – Isohyetal Rainfall Map from the Hydrology Manual, is 14 inches. Intensity-Duration-Frequency curves were developed using the mean annual precipitation for the project site and the values provided in Table B.10 and B.13 of the Hydrology Manual. Table 3-2 shows a summary of the rainfall intensities for the 10-year and 100-year events.

Table 3-2. Rainfall Intensities

Duration	Intensity (in)	
	10-year	100-year
5 min	2.94	4.18
10 min	1.94	2.76
15 min	1.52	2.16
30 min	1.01	1.43
1 hr	0.66	0.94
2 hr	0.44	0.62
3 hr	0.34	0.49
6 hr	0.23	0.32
12 hr	0.15	0.21
24 hr	0.10	0.14

The intensity used in the rational method to determine peak flow rates was interpolated from this data based on the time of concentration of each drainage area. The time of concentration for a watershed is defined as the time required for rainfall from the most hydraulically remote portion of the drainage area to reach the point of concentration. The time of concentration for each drainage area was determined by first establishing the flow path from the most hydraulically remote portion of each drainage area as shown on Figures 1& 2. Then the length of the flow path was sub-divided into the length governed by sheet

flow and the length governed by channel flow. Slopes and surface types were used to estimate the travel time for each length and combined to estimate the time of concentration for Karl Holton YCF. The same time of concentration was assumed for other youth correctional facilities. Appendix B contains worksheets that summarize the time of concentration and related intensities for each drainage area.

3.1.3 Runoff Coefficient

The runoff coefficient is the ratio of rate of runoff to the rate of rainfall at an average rainfall intensity at the time of concentration. According to the Hydrology Manual, the runoff coefficient depends on the rainfall intensity, drainage area slope, type and amount of vegetative cover, and infiltration capacity of the ground surface. The Hydrology Manual defines the runoff coefficient with the following equation.

$$C = 0.90\ (a_i + a_p(I-F_p)/I), \text{ for I greater than } F_p \text{ or}$$

$$C = 0.90\ a_i, \text{ for I less than or equal to } F_p$$

Where:

C = runoff coefficient

I = rainfall intensity (inches/hour)

F_p = area-averaged infiltration rate (inches/hour)

a_i = ratio of impervious area to total area (decimal fraction)

a_p = ratio of pervious area to total area (decimal fraction)

The area-averaged infiltration rate (F_p) is a function of the curve number as shown in Figure C-5 of the Hydrology Manual. Curve numbers are dimensionless values developed by the SCS for different cover types that represent the relative amounts of runoff given a rainfall event. The appropriate selection of a curve number for a cover type is dependent on the nature of the soil.

Soils are classified into four hydrologic soil groups. The hydrologic soil group information for this analysis was obtained from shapefiles of the State Soil Geographic (STATSGO) database distributed by the Environmental Protection Agency (EPA) through their website. Figure 4 displays the different general types of soil groups that exist in the areas surrounding the NCYCC. The information from the STATSGO was confirmed with the soil map 2 of 4 of the San Joaquin County Flood Control and Water Conservation District found in the back of the Hydrology Manual. The hydrologic soil group for the NCYCC is group D. As described in the Hydrology Manual, group D is characterized as a soil with high runoff potential. Group D soils are soils with very slow infiltration rates and consist chiefly of clay soils and/or soils with a permanent high water table.

As described in Section 3.1.1, the drainage areas were sub-divided into pervious and impervious areas. Pervious areas were generally defined as a cover type of good annual or perennial grass. Impervious areas were defined as a cover type of paved parking lots, roofs, and driveways. The curve numbers for these cover types are summarized in the table below.

Table 3-3. Curve Numbers

Cover Type	Curve Number
Pervious - Grass, Annual or Perennial (Good)	80
Impervious - Paved parking lots, Roofs, Driveways	98

3.1.4 Confluence Analysis

The use of the rational method only results in an estimation of the peak discharge from a drainage area. Because one of the purposes of this study is to evaluate the capacity of the existing storm drain system, it was necessary to combine the results of the rational method used on each drainage basin to obtain an estimate for the rate of flow in the 42-inch storm drain trunk and other downstream storm drain facilities. Section D.9 of the Hydrology Manual provides a procedure to conduct a confluence analysis at the junction of two or more streams. This confluence analysis was applied at all of the points of concentration identified on Figures 1 and 2. A summary of the existing and proposed flow rates at the point of connection for the current Karl Holton YCF and future Medical Facility and existing and proposed flow rates entering Pump Station No. 1 are summarized below.

Table 3-4. Summary of Runoff Flow Rates

	Existing (Karl Holton YCF)		Proposed (Medical Facility)	
	10-year	100-year	10-year	100-year
Point of Connection	59.6 cfs	89.1 cfs	93.1 cfs	143.8 cfs
Downstream Segment of 42”	106.5 cfs	160.8 cfs	134.4 cfs	207.5 cfs
Entering Pump Station No. 1	131.4 cfs	200.2 cfs	156.1 cfs	242.4 cfs

3.1.5 Storm Runoff Volume Estimation

Because all of the runoff from the NCYCC site entering the storm drain system eventually flows to the retention basin at the southeast corner of the property, the volume of runoff was estimated so that it could be compared to the storage capacity of the existing retention basin. The volume of runoff was estimated following the example from Section E.14 of the Hydrology Manual. Table 3-5 shows the estimated volume of runoff for the existing conditions and the estimated volume of runoff when the Medical Facility is constructed.

Table 3-5. 100-year Storm Runoff Volume

	Cover Type	Area (ac)	Area Fraction	Soil	CN	S	Ia	Y	Area Total (ac)	100yr P24 (in)	Total Y	Runoff Volume (ac-ft)
Existing	Impervious	94.75	0.35	D	98	0.20	0.04	0.98	271.3	3.36	0.88	**66.8**
	Pervious	176.53	0.65	D	80	2.5	0.50	0.83				
Proposed	Impervious	123.00	0.33	D	98	0.20	0.04	0.98	370.0	3.36	0.88	**90.9**
	Pervious	246.95	0.67	D	80	2.5	0.50	0.83				

3.2 HYDROLOGIC RESULTS

Appendix B contains the four Rational Method Study Forms in the format required in the Hydrology Manual for the existing and proposed conditions for the 10-year and 100-year return periods. These forms summarize the hydrologic analysis. The only change between the existing and proposed conditions is the conversion of the Karl Holton YCF to the proposed Medical Facility. Part of this conversion will direct runoff from areas outside of the current NCYCC facilities into the storm drain system. The total drainage area of the NCYCC will increase by 98.7 acres with the construction of the proposed Medical Facility. The increased drainage area of the Medical Facility as compared to the Karl Holton YCF increased the peak runoff by 33.7 cfs (138%) during the 10-year event and 55.2 cfs (149%) during the 100-year event.

4. HYDRAULIC ANALYSIS

4.1 CAPACITY OF EXISTING SYSTEM

The existing capacity of several of the NCYCC drainage facilities were estimated and compared to the results from the hydrologic analysis.

4.1.1 42-inch Storm Drain Trunk

Information for the 42-inch storm drain trunk was taken from as-builts for the structure as shown on the State of California General Services Department Office of Architecture and Construction Plans dated December 24, 1964. The slope of the 42-inch trunk is 0.0010 ft/ft and the material of the trunk line was assumed to be reinforced concrete pipe (RCP). The full flow capacity of the 42-inch trunk line was determined to be 31.8 cfs using Manning's Equation. A FlowMaster worksheet showing a summary of the calculations titled "Worksheet for 42" Storm Drain Trunk" is included in Appendix E.

4.1.2 Pump Station No. 1

The discharge capacities for one of the 40 hp pumps was listed at 7,500 gpm at 16 feet of total dynamic head (TDH), according to its motor name-plate. The operating conditions of the other three 40 hp pumps was assumed to be the same. The capacity of the 15 hp pump was estimated based on the pump power equation below:

$$efficiency(\%)P(horsepower) = \gamma(\frac{lb}{ft^3})Q(\frac{ft^3}{\sec})H(ft)$$

where

$$\gamma = 62.4\frac{lb}{ft^3}\ ,\ H=16'\ ,\ g = 32.2\frac{ft}{\sec^2}\ ,\ Q = pumping\,flow\,rate$$

The total dynamic head of the 15 hp pump was assumed to be 16', similar to the 40 hp pumps. Based on these calculations, the stormwater pumps have the following capacities:

Table 4-1. Flow Capacity of Pump Station No. 1

Stormwater Pump Station No. 1 Pump Capacities			
Pump Number	**Power(hp)**	**TDH(ft)**	**Q(cfs)/(gpm)**
1	15	16'	6.0 / 2,700
2	40	16'	16.7 / 7,500
3	40	16'	16.7 / 7,500
4	40	16'	16.7 / 7,500
		Total	56.1 / 25,200

4.1.3 Concrete-Lined Channel

Pump Station No. 1 discharges into the upstream end of a concrete-lined channel that conveys runoff to the detention/retention basin situated southeast of the NCYCC. Information for the concrete-lined channel was taken from as-builts for the channel as shown on the State of California General Services Department Office of Architecture and Construction Plans dated July 29, 1965. Drawing C-6 shows the

detail of the typical channel cross section. The slope of the channel was taken from sheets C-2, C-3, and C-4 and is 0.0012 ft/ft and the material of the trunk line is concrete. The full flow capacity of the concrete-lined channel was determined to be 241.6 cfs using Manning's Equation. A FlowMaster worksheet showing a summary of the calculations titled "Worksheet for Concrete-Line Drainage Channel" is included in Appendix E.

4.1.4 Retention Basin

A preliminary analysis was performed to generally evaluate the adequacy of the existing retention / detention pond to store stormwater from the existing NCYCC site and from the site if the proposed medical facility is constructed. The as-built plans for the basin show that it is roughly rectangular in plan view, measuring 400' by 375'. At its most shallow point, the pond is roughly 11.5' deep. To calculate a conservative volume of the pond, a 3' freeboard was assumed. The total estimated volume of the pond is therefore:

$$400' x 375' x 8.5' = 1{,}275{,}000\, ft^3 = 29.3 AF$$

4.2 PROPOSED DRAINAGE SYSTEM IMPROVEMENTS

This section describes the drainage improvements that will be necessary regardless of the alternative selected to minimize the effects of the increase in runoff flow rate and volume. A discussion of the proposed alternatives can be found in Section 6.

4.2.1 Unlined Agricultural Drainage Ditch Realignment

An unlined agricultural ditch which flows from east to west, currently runs through the field to the east of the Karl Holton YCF until it jogs around the northeast corner of the facility and then continues west. The current alignment of this unlined ditch travels through the center of the proposed medical facility. This unlined drainage ditch should be realigned to run along the northern boundary of the potential medical facility site as shown in the drainage map for the proposed conditions (Figure 2). Altering the drainage ditch along this alignment will allow the length of the ditch to remain approximately the same. This will allow the channel to maintain the existing slope and thus the existing capacity. The topography in this area is essentially flat so the ditch should be able to maintain the existing depth and freeboard. A watercourse encroachment permit will need to be filed with the County of San Joaquin before work realigning the drainage can commence. Permits are typically approved provided the modifications do not alter the points at which the watercourse enter and exit the property, as is the case with this proposed realignment.

5. COMPARISON BETWEEN CAPACITY AND RUNOFF

Based on the estimates and calculations made in Sections 3 and 4, a comparison can be made between the existing capacity of the different facilities making up the NCYCC's storm drain system and the anticipated runoff. Table 5-1 summarizes the major facilities within the storm drain system, their estimated capacities and the excepted runoff based on the conditions (existing and proposed) and the storm frequencies (10-year and 100-year). The storm drain system should be able to convey the 10-year storm event per county standards and the retention basin should store the volume from the 100-year storm event. Numbers in red indicate that the facility is undersized for the given condition and storm frequency.

Table 5-1. Storm Drain Facility Capacity Assessment

Facility	Capacity	10-year		100-year	
		Existing	Proposed	Existing	Proposed
42-inch Storm Drain	31.8 cfs	106.5 cfs	134.4 cfs	160.8 cfs	207.5 cfs
Pump Station No. 1	56.1 cfs	131.4 cfs	156.1 cfs	200.2 cfs	242.4 cfs
Concrete Lined Channel	241.6 cfs	131.4 cfs	156.1 cfs	200.2 cfs	242.4 cfs
Retention Basin	29.3 ac-ft	-	-	66.8 ac-ft	90.9 ac-ft

From Table 5-1 it is evident that all of the major facilities, expect for the concrete-lined channel, are undersized for the existing and proposed conditions. In fact, the existing system is significantly undersized according to the hydrologic analysis. Therefore, no additional capacity within the existing system is available to convey the increased runoff from the proposed medical facility.

The NCYCC staff indicated during field investigation visits that there has not been a failure of the storm drain system to their memory. Based on the difference between the capacity of the system and the calculated peak flow rates, it seems a failure within the system should have occurred at some point during the existence of the facility. A possible explanation as to why the peak flow rates calculated are not being witnessed is that with the flat terrain, a significant amount of ponding is occurring before runoff enters the storm drain system, effectively attenuating the peak flow rate.

6. ALTERNATIVES

Given the results from the capacity analysis of the existing storm drain system and the expected runoff estimated from the proposed medical facility, a number of alternatives exist for conveying runoff from the site. This section discusses the benefits and drawbacks of these alternatives. Figures X-Y illustrate the components of the different alternatives.

6.1 DRAIN ENTIRE SITE TO EXISTING STORM DRAIN SYSTEM (ALTERNATIVE NO. 1)

This section investigates the alternative to convey the storm water runoff from the proposed medical facility site to the existing storm drain system at essentially the same connection point.

6.1.1 On-Site Detention

Because the medical facility is estimated to increase the peak runoff flow rate due to the increase in total surface area and impervious surface area, the proposed 10-year peak flow rate of 93.1 cfs will need to be attenuated to the existing 10-year peak flow rate of 59.6 cfs. A method to accomplish this is to install detention basin(s) on-site. Based on preliminary calculations, the detention basin is likely to require a surface area of 22,500 ft^2 (150-ft x 150-ft), assuming a depth of 4 feet, to maintain the existing flow rate. The construction of the on-site detention basin can be completed with the other construction activities during the development of the medical facility. Using on-site detention basins to keep runoff flow rates to existing levels will minimize the impact to the existing system.

6.1.2 Increase Capacity of Existing System

Although the construction of on-site detention basins will keep the runoff exiting the medical facility site to existing conditions, the capacity of the 42-inch trunk and pump station No. 1 may still need to be increased. The hydrologic analysis showed that these facilities are currently over capacity during the 10-year storm event. Even if the proposed medical facility detains the runoff from its site and only releases the existing peak flow rate, the site may still experience localized flooding if downstream facilities are over capacity.

Assuming the entire medical facility drains to a detention system and then to the storm drain system, two options exist to address the lack of capacity in the 42-inch trunk to Pump Station No. 1. First, a new 54-inch trunk can be constructed in parallel to the existing 42-inch trunk. The 54-inch trunk will provide the required capacity for the expected runoff from the medical facility and will relieve the stress on the capacity of the existing 42-inch main by taking flow from the medical facility. Second, the existing 42-inch trunk can be replaced-in-place with a 66-inch trunk to provide sufficient capacity for the estimated flows from the entire NCYCC. It is anticipated that due to the cost to remove and dispose of the existing 42-inch trunk and abundance of area in which to place a parallel trunk, the option of constructing a 54-inch parallel line will be the less expensive option. These options, among others, should be further analyzed during the design of the medical facility.

Pump Station No. 1 will also need additional capacity added to be capable of conveying the estimated flow rate to the concrete-line channel. This can be accomplished by replacing existing stormwater pump(s) with larger pump(s) and/or adding a new pump. There are available connections and space to add a fifth pump to the pump station. Pump Station No.1 will need to be capable of pumping 131.4 cfs based on the hydrologic analysis.

The retention basin is currently undersized for the estimated runoff from the NCYCC site for the existing conditions. Although the proposed on-site detention basin(s) at the medical facility will keep the peak flow rates to existing levels, the total volume of runoff will still increase. Based on the estimates of this study, the retention basin will need approximately 62 additional acre-feet of storage. This is an increase of approximately 200% of the current amount of storage. Figure 5 shows the boundary of the existing retention basin as shown on the as-builts superimposed on the aerial photo. From the aerial photo, it appears ponding extends beyond the boundary of the basin defined in the as-builts. It also appears that this area of ponding that extends beyond the designed detention basin is currently fenced in. Assuming a constant depth across the extended basin, an additional 43 acre-feet of storage is currently available in addition to the 29.3 ac-ft calculated from the as-builts. However, to retain the 100-year storm per county requirements, assuming a constant depth, the boundary of the basin would need to be extended approximately 2.5 acres to provide the needed capacity. The county has other requirements for retention ponds that will need to be evaluated during design such as emptying the required volume in 10 days.

6.2 NEW CHANNEL TO NORTH FORK OF SOUTH LITTLEJOHNS CREEK (ALTERNATIVE NO. 2)

Alternative No. 2 proposes that the runoff from the medical facility be completely removed from the existing storm drain system by constructing a new 54-inch storm drain from the facility to the North Fork of South Littlejohns Creek. This would remove the need to improve any of the downstream facilities since the runoff from the site will not flow through any of the facilities. A storm drain will have to be used from the detention basin to the creek because the county standards only allows open channels if the flow exceeds the capacity of a 66-inch pipe. As described in Section 6.1.2, the required pipe size to convey runoff from the proposed medical facility is 54-inches.

Figure 6 shows a preliminary alignment for the detention basin and storm drain. This alignment shows the storm drain emptying directly into South Littlejohns Creek. This would eliminate the need to increase the storage capacity of the existing retention basin since the storm drain would bypass the basin. However, discharging directly to the North Fork of South Littlejohns Creek could possibly require additional permitting. Alternatively, the new storm drain from the medical facility could empty into the retention basin, possibly avoiding some of the permitting requirements (Alternative 2B on Figure 6). This would require the storage of the retention basin to be increased as described in Section 6.1.2.

6.3 SPLIT FLOW (ALTERNATIVE NO. 3)

Alternative No. 1 and Alternative No. 2 both collect runoff that currently drains to the unlined agricultural ditch and redirect it to the NCYCC's storm drain system. This effectively takes the runoff from 49 acres, which currently empties into the Weber Slough and would direct it to the North Fork of South Littlejohns Creek. Both the Weber Slough and South Littlejohns Creek empty into the French Camp Slough.

Alternative No. 3 would preserve the existing divide within the potential medical facility site and have a portion of the site continue to drain to the unlined agricultural ditch and the other portion drain to the storm drain system. This option would alleviate complications should any concerns be anticipated involving the rerouting of runoff. However, this option may prove more costly since runoff will be leaving the site at two locations and two detention systems will be needed to keep flow rates at existing levels. Additionally, Alternative No. 3 will probably not eliminate the need to improve the existing storm drain system or construct a new channel to drain the facility. This means that Alternative No. 3, if used, will have to be incorporated with Alternative No. 1 or Alternative No. 2.

7. PERMITTING TIMELINE

7.1 WATERCOURSE ENCROACHMENT PERMIT

The proposed improvement to realign the existing unlined drainage channel will require a submittal of an application for a permit with the County of San Joaquin Department of Public Works and the completion of an Environmental Assessment Questionnaire for San Joaquin County Watercourse Encroachment Permit. Because no other existing improvements are recommended, no additional permits will be required. Based on discussions with San Joaquin Flood Control District staff, permits typically are processed in two months. Modifications are typically approved provided the entry and exit points of the ditch from the property are not modified and the ditch maintains its current flow capacity. As discussed in Section 4.2.1, it is recommended that the realignment of the existing unlined channel enter and exit the property at the current locations.

7.2 NPDES PERMIT

8. OPINION OF PROBABLE CONSTRUCTION COST

Kimley-Horn and Associates, Inc. **Opinion of Probable Construction Cost**

Client:	**NCYCC - Stockton**	**Date:**	**8/8/2008**
Project:	**Drainage Study**	**Prepared By:**	**E. Nielsen**
KHA No.:	**097551001**	**Checked By:**	**C. Spinks**
Location:	**Stockton, California**	**Dollars:**	**Q2 2008**

Title:	**Storm Drain Improvements**	**Sheet**	**1**

Item No.	Item	Quantity	Unit	Unit Cost	Cost
Alternative 1 – Tie into Existing Storm Drain System					
1	Excavation and Grading of Detention Basin	3,333	CY	$ 50	$ 166,600
2-i	Replace 42-inch Storm Drain with 66-inch RCP	1,750	LF	$ 460	$ 805,000
2-ii	Parallel 54-inch RCP Storm Drain	1,750	LF	$ 305	$ 533,800
4	Additional Pumps at Pump Station No. 1	1	LS	$ 200,000	$ 200,000
5	Excavation and Grading to Expand Retention Basin	20,000	CY	$ 50	$ 1,000,000
				Sub-Total =	$2,705,400
				Contingency @ 20% =	$541,000
				ALTERNATIVE NO. 1 TOTAL ESTIMATED COST =	$3,246,400

Item No.	Item	Quantity	Unit	Unit Cost	Cost
Alternative 2 – Bypass Existing Storm Drain System					
6	Excavation and Grading of Detention Basin	3,333	CY	$ 50	$ 166,600
7	New 54-inch RCP Storm Drain to Creek	4,600	LF	$ 305	$1,403,000
				Sub-Total =	$1,569,600
				Contingency @ 20% =	$313,900
				ALTERNATIVE NO. 2 TOTAL ESTIMATED COST =	$1,883,500

Special Considerations:

Assumptions:

1. This total does not reflect engineering or technical services.

9. CONCLUSIONS

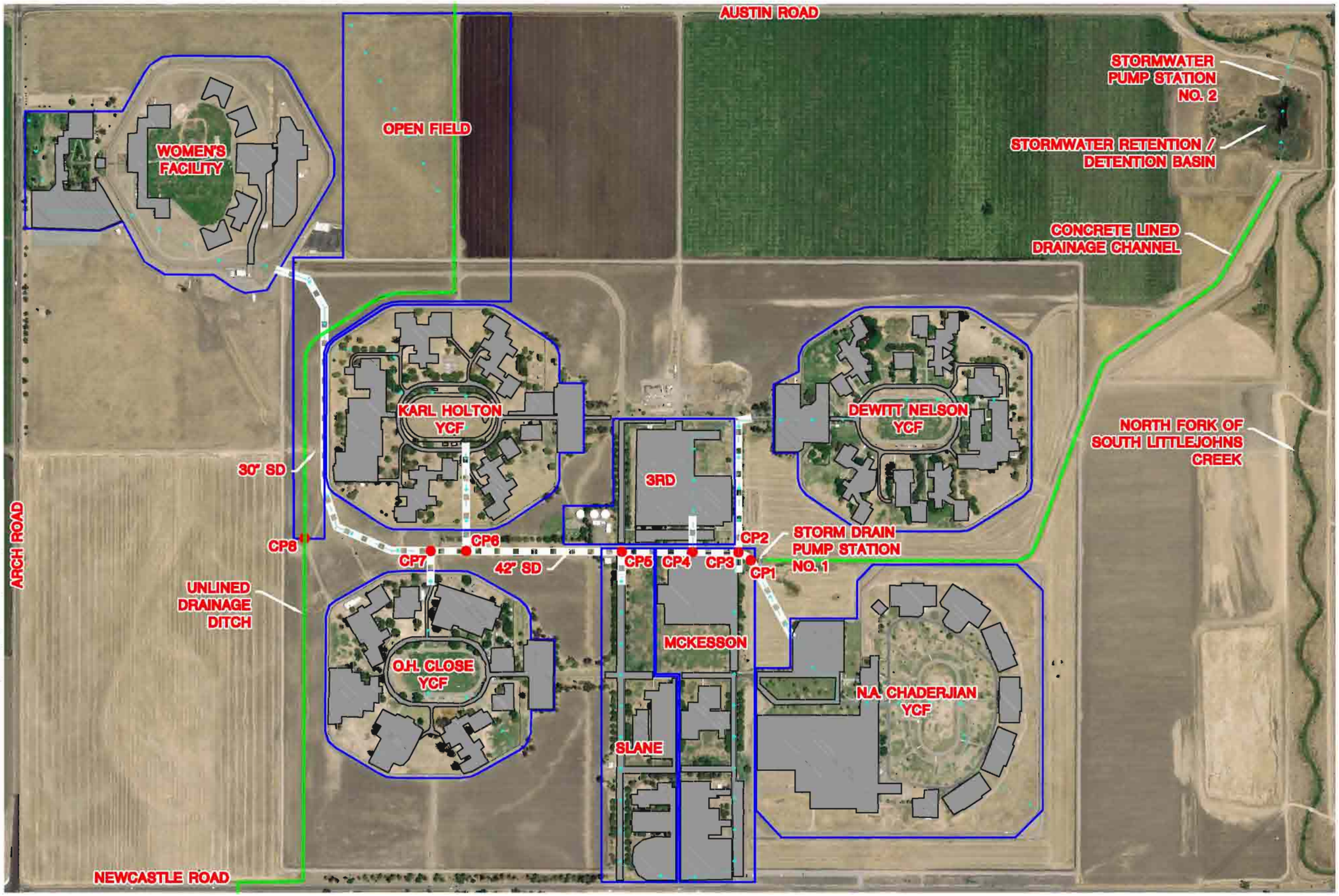
(to be completed after review)

10. REFERENCES

- County of San Joaquin Hydrology Manual, Final Draft, September 1997
- County of San Joaquin Improvement Standards
- Phase 2 – Site Assessment Report for Northern California Youth Correctional Center – Stockon prepared by Kimley-Horn and Associates, Inc., June 3, 2008
- As-builts of Contract Drawings for the General Administration and Services Facilities for the Department of the Youth Authority at the Northern California Youth Center, Stockton, 1964

Appendix A

Drainage Area Maps

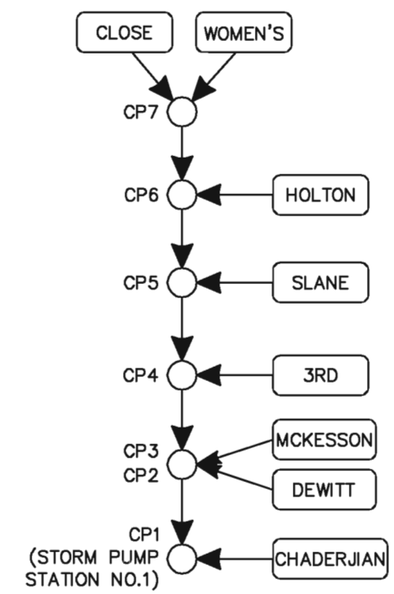


Scale: 1"=600'

LEGEND

- WATERSHED BOUNDARY
- STORMWATER DRAINAGE PATH
- CONCENTRATION POINT
- STORM DRAIN
- IMPERVIOUS AREA

SCHEMATIC



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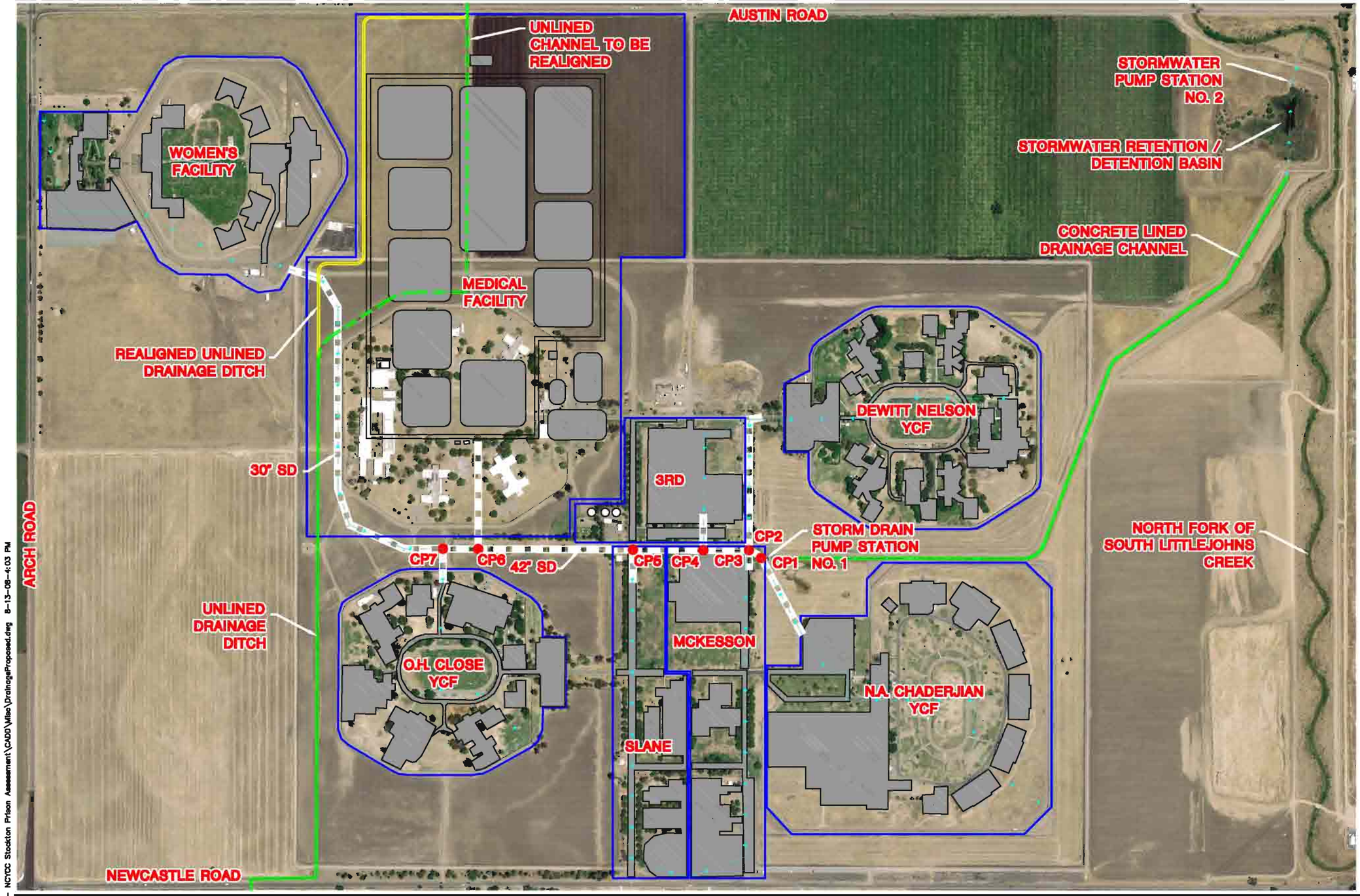
Engineering, Planning and Environmental Consultants

Figure 1
Drainage Map - Existing Conditions
August 2008



Scale: 1"=600'

LEGEND

- WATERSHED BOUNDARY
- STORMWATER DRAINAGE PATH
- CONCENTRATION POINT
- STORM DRAIN
- IMPERVIOUS AREA

SCHEMATIC

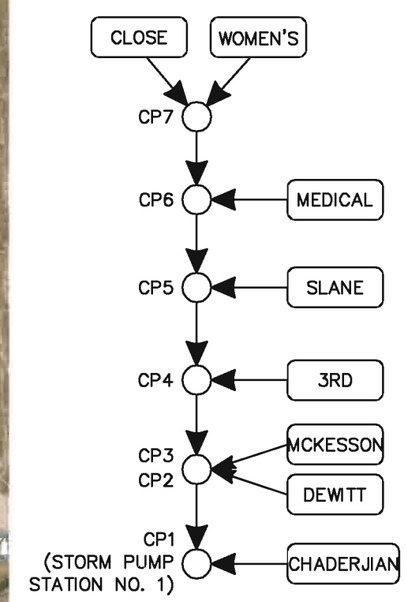


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Figure 2
Drainage Map - Proposed Conditions
August 2008

Appendix B

Basin Flow Rate Calculations

Rational Method Study Form	Study Name: NCYCC Drainage Study	Calc'd By: EJN	Date: 8/13/2008
San Joaquin County	Frequency: 10 year (Existing Conditions)	Chk'd By: CRS	Date:
Hydrology Manual	MAP: 14" 24-hr: 2.37 in		Page 1 of 4

CP	Area (ac) Subarea	Area (ac) Total	Soil Type	Dev. Type	Tt min.	T min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow path Length ft.	Slope ft/ft	V ft/sec	Hydraulics and Notes
Women's	42.5	42.5	D	YCF		50	0.74	0.23	0.23	19.7	3,900	0.0055		
Close	33.0	33.0	D	YCF		40	0.85	0.16	0.16	20.3	2,150	0.0055		
CP #7		67.0				50	0.74			39.3				Women's + Close
Holton	40.6	40.6	D	YCF		40	0.85	0.19	0.19	24.2	2,150	0.0056	0.5	
CP #6		107.6			1	51	0.73			59.6	215	0.001	3.5	Confluence #7 + Holton
Slane Rd	18.6	18.6	D	Indus.		30	1.01	0.15	0.15	14.4				
CP #5		126.2			4	55	0.70			69.4	935	0.001	3.5	Confluence #6 + Slane
3rd St	14.3	14.3	D	Indus.		20	1.28	0.09	0.09	15.3				
CP #4		140.5			2	58	0.68			77.2	425	0.001	3.5	Confluence #5 + 3rd
McKesson	23.5	23.5	D	Indus.		30	1.01	0.11	0.11	18.9				
CP #3		164.0			1	59	0.67			89.2	275	0.001	3.5	Conflu #4 + McKesson
Nelson	40.7	40.7	D	YCF		40	0.85	0.20	0.20	23.6	2,150	0.0055		
CP #2		204.7			0	59	0.67			106.5	10	0.001	3.5	Confluence #3 + Nelson
Chaderjian	58.1	58.1	D	YCF		40	0.85	0.20	0.20	34.0	2,150	0.0055		
CP #1		262.8			1	59	0.67			131.4	120	0.001	3.5	Conflu #2 + Chaderjian
Open Field	49.2	49.2	D	Ag		90	0.52	0.22	0.22	13.2				Drains to unlined ditch

Rational Method Study Form	Study Name: NCYCC Drainage Study	Calc'd By: EJN	Date: 7/23/2008
San Joaquin County	Frequency: 100 year (Proposed Conditions)	Chk'd By: CRS	Date:
Hydrology Manual	MAP: 14" 24-hr: 3.36 in		Page 4 of 4

CP	Area (ac) Subarea	Area (ac) Total	Soil Type	Dev. Type	Tt min.	T min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow path Length ft.	Slope ft/ft	V ft/sec	Hydraulics and Notes
Women's	42.5	42.5	D	YCF		50	1.05	0.23	0.23	31.3	3,900	0.0055		
Close	33.0	33.0	D	YCF		40	1.20	0.16	0.16	30.7	2,150	0.0055		
CP #7		75.5				50	1.05			57.6				Women's + Close
Medical	139.3	139.3	D	YCF		60	0.94	0.20	0.20	92.2	3,700	0.0032	0.5	
CP #6		214.7			1	61	0.93			143.8	215	0.001	3.5	Confluence #7 + Holton
Slane Rd	18.6	18.6	D	Ind.		30	1.42	0.15	0.15	21.4				
CP #5		233.4			4	65	0.89			156.9	935	0.001	3.5	Confluence #6 + Slane
3rd St	14.3	14.3	D	Ind.		20	1.82	0.09	0.09	22.2				
CP #4		247.6			2	68	0.87			167.1	425	0.001	3.5	Confluence #5 + 3rd
McKesson	23.5	23.5	D	Ind.		30	1.42	0.11	0.11	27.8				
CP #3		271.2			1	69	0.86			183.2	275	0.001	3.5	Conflu #4 + McKesson
Nelson	40.7	40.7	D	YCF		40	1.20	0.20	0.20	36.5	2,150	0.0055		
CP #2		311.9			0	69	0.86			207.5	10	0.001	3.5	Confluence #3 + Nelson
Chaderjian	58.1	58.1	D	YCF		40	1.20	0.20	0.20	52.4	2,150	0.0055		
CP #1		370.0			1	69	0.86			242.4	120	0.001	3.5	Conflu #2 + Chaderjian

Rational Method Study Form	Study Name: NCYCC Drainage Study	Calc'd By: EJN	Date: 8/13/2008
San Joaquin County	Frequency: 100 year (Existing Conditions)	Chk'd By: CRS	Date:
Hydrology Manual	MAP: 14" 24-hr: 3.36 in		Page 2 of 4

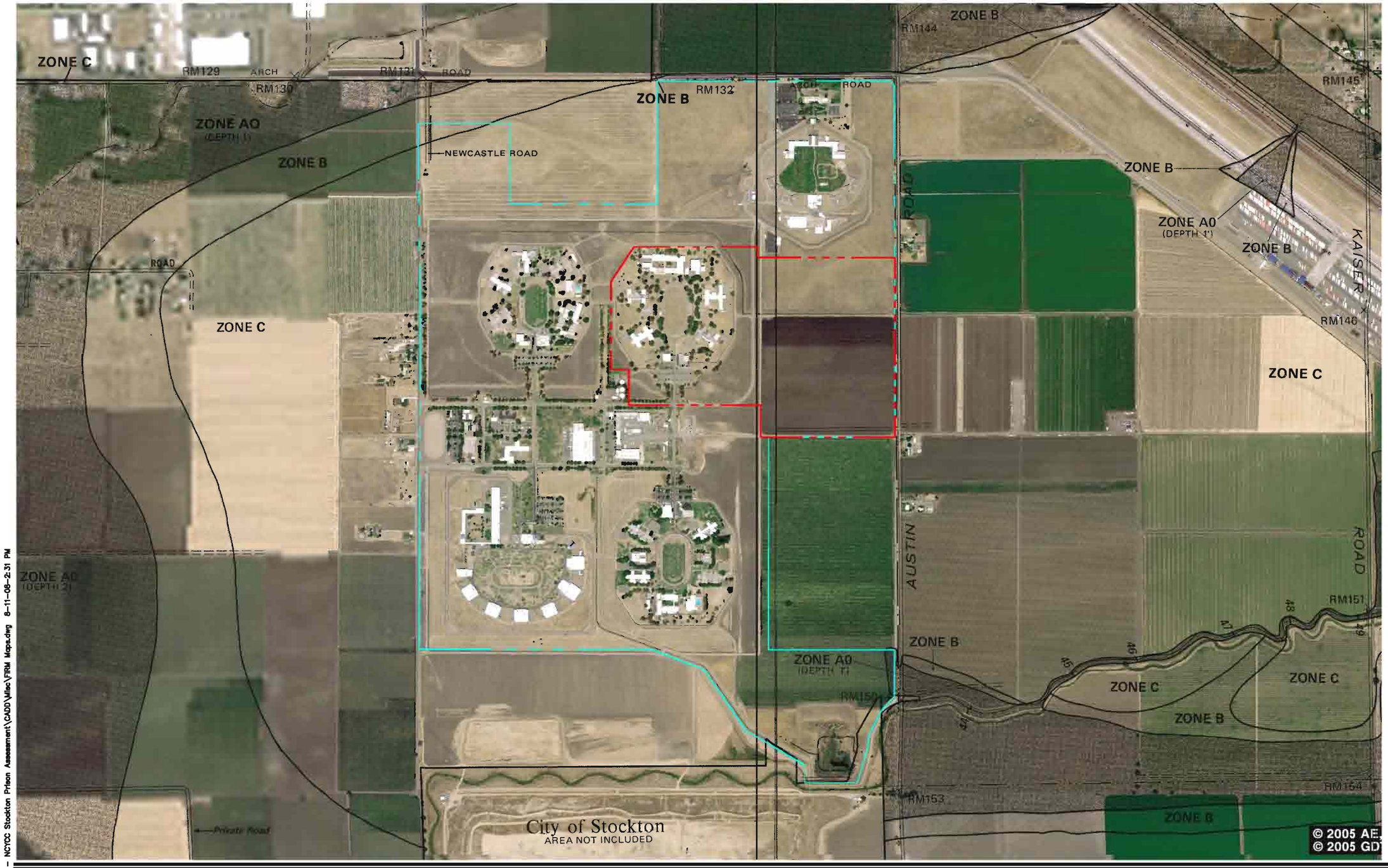
CP	Area (ac) Subarea	Area (ac) Total	Soil Type	Dev. Type	Tt min.	T min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow path Length ft.	Slope ft/ft	V ft/sec	Hydraulics and Notes
Women's	42.5	42.5	D	YCF		50	1.05	0.23	0.23	31.3	3,900	0.0055		
Close	33.0	33.0	D	YCF		40	1.20	0.16	0.16	30.7	2,150	0.0055		
CP #7		75.5				50	1.05			57.6				Women's + Close
Holton	40.6	40.6	D	YCF		40	1.20	0.19	0.19	37.0	2,150	0.0056	0.5	
CP #6		116.1			1	51	1.04			89.1	215	0.001	3.5	Confluence #7 + Holton
Slane Rd	18.6	18.6	D	Ind.		30	1.42	0.15	0.15	21.4				
CP #5		134.7			4	55	0.98			103.9	935	0.001	3.5	Confluence #6 + Slane
3rd St	14.3	14.3	D	Ind.		20	1.82	0.09	0.09	22.2				
CP #4		149.0			2	58	0.96			115.4	425	0.001	3.5	Confluence #5 + 3rd
McKesson	23.5	23.5	D	Ind.		30	1.42	0.11	0.11	27.8				
CP #3		172.5			1	59	0.95			133.4	275	0.001	3.5	Conflu #4 + McKesson
Nelson	40.7	40.7	D	YCF		40	1.20	0.20	0.20	36.5	2,150	0.0055		
CP #2		213.2			0	59	0.95			160.8	10	0.001	3.5	Confluence #3 + Nelson
Chaderjian	58.1	58.1	D	YCF		40	1.20	0.20	0.20	52.4	2,150	0.0055		
CP #1		271.3			1	59	0.94			200.2	120	0.001	3.5	Conflu #2 + Chaderjian

Rational Method Study Form	Study Name: NCYCC Drainage Study	Calc'd By: EJN	Date: 7/23/2008
San Joaquin County	Frequency: 10 year (Proposed Conditions)	Chk'd By: CRS	Date:
Hydrology Manual	MAP: 14" 24-hr: 2.37 in		Page 3 of 4

CP	Area (ac) Subarea	Area (ac) Total	Soil Type	Dev. Type	Tt min.	T min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow path Length ft.	Slope ft/ft	V ft/sec	Hydraulics and Notes
Women's	42.5	42.5	D	YCF		50	0.74	0.23	0.23	19.7	3,900	0.0055		
Close	33.0	33.0	D	YCF		40	0.85	0.16	0.16	20.3	2,150	0.0055		
CP #7		67.0				50	0.74			39.3				Women's + Close
Medical	139.3	139.3	D	YCF		60	0.67	0.20	0.20	57.9	3,700	0.0032	0.5	
CP #6		206.2			1	61	0.66			93.1	215	0.001	3.5	Confluence #7 + Holton
Slane Rd	18.6	18.6	D	Ind.		30	1.01	0.15	0.15	14.4				
CP #5		224.9			4	65	0.63			101.7	935	0.001	3.5	Confluence #6 + Slane
3rd St	14.3	14.3	D	Ind.		20	1.28	0.09	0.09	15.3				
CP #4		239.1			2	68	0.62			108.6	425	0.001	3.5	Confluence #5 + 3rd
McKesson	23.5	23.5	D	Ind.		30	1.01	0.11	0.11	18.9				
CP #3		262.7			1	69	0.61			119.3	275	0.001	3.5	Conflu #4 + McKesson
Nelson	40.7	40.7	D	YCF		40	0.85	0.20	0.20	23.6	2,150	0.0055		
CP #2		303.4			0	69	0.61			134.4	10	0.001	3.5	Confluence #3 + Nelson
Chaderjian	58.1	58.1	D	YCF		40	0.85	0.20	0.20	34.0	2,150	0.0055		
CP #1		361.5			1	69	0.61			156.1	120	0.001	3.5	Conflu #2 + Chaderjian

Appendix C

Flood Insurance Rate Maps



Scale: NA

TITLE REPORT PARCEL BOUNDARY

POTENTIAL MEDICAL FACILITY SITE

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Figure 3
FEMA FIRM Map Overlay
August 2008

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RM148 *	59.888	A bench mark disk stamped "P 958 1962," set in the southeast concrete abutment of a Mariposa Road bridge 0.5 mile southeast of Jack Tone Road.
RM149 *	63.22	A spike painted and inscribed "US BM 63," set in the base of a county windmill on the south side of Mariposa Road, 1.0 mile southeast of Jack Tone Road.

*ESTABLISHED BY U.S. GEOLOGICAL SURVEY

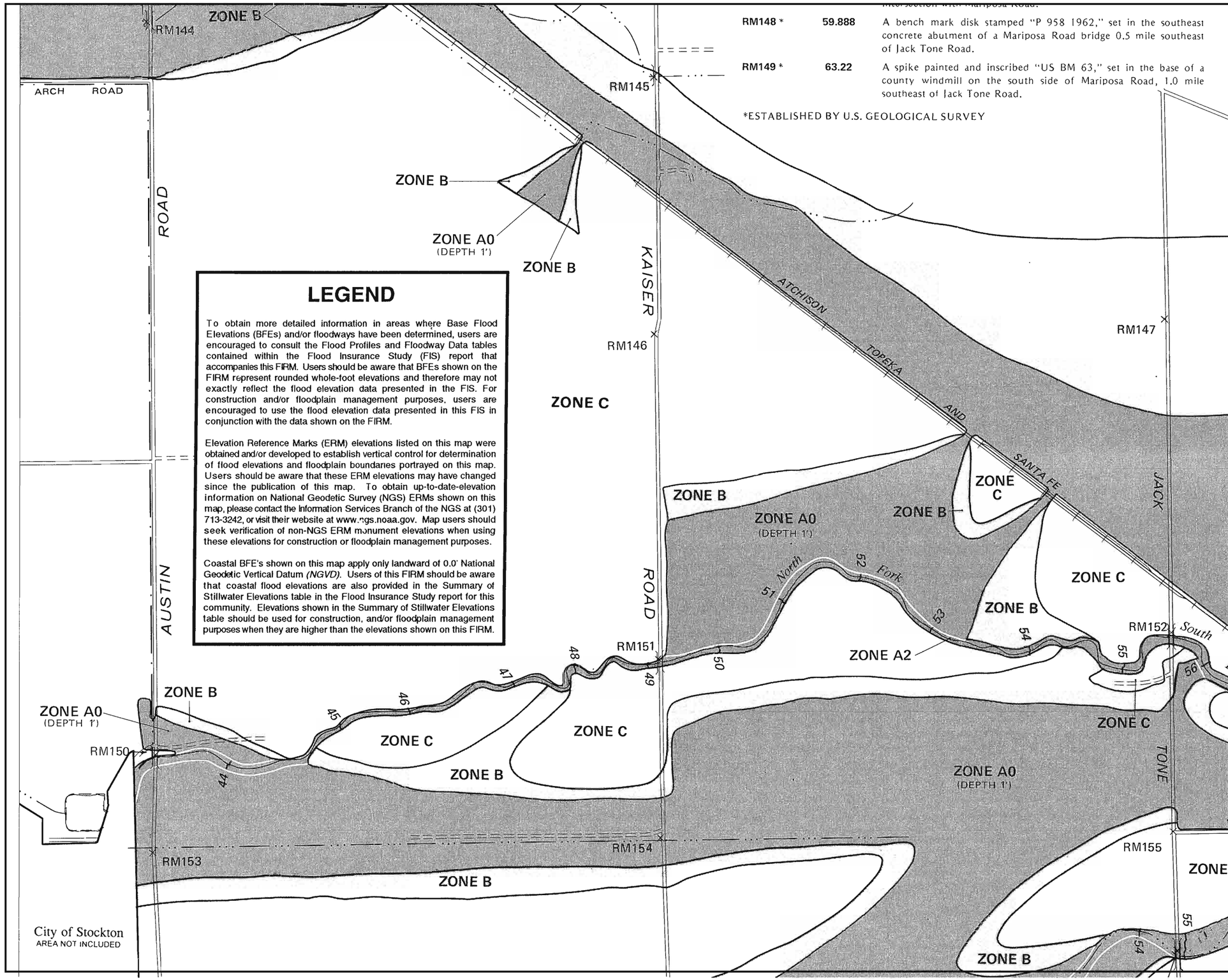
APPROXIMATE SCALE IN FEET
1000 0 1000

LEGEND

To obtain more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations and therefore may not exactly reflect the flood elevation data presented in the FIS. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Elevation Reference Marks (ERM) elevations listed on this map were obtained and/or developed to establish vertical control for determination of flood elevations and floodplain boundaries portrayed on this map. Users should be aware that these ERM elevations may have changed since the publication of this map. To obtain up-to-date-elevation information on National Geodetic Survey (NGS) ERMs shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS ERM monument elevations when using these elevations for construction or floodplain management purposes.

Coastal BFE's shown on this map apply only landward of 0.0' National Geodetic Vertical Datum *(NGVD)*. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this community. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

SAN JOAQUIN COUNTY, CALIFORNIA
(UNINCORPORATED AREAS)

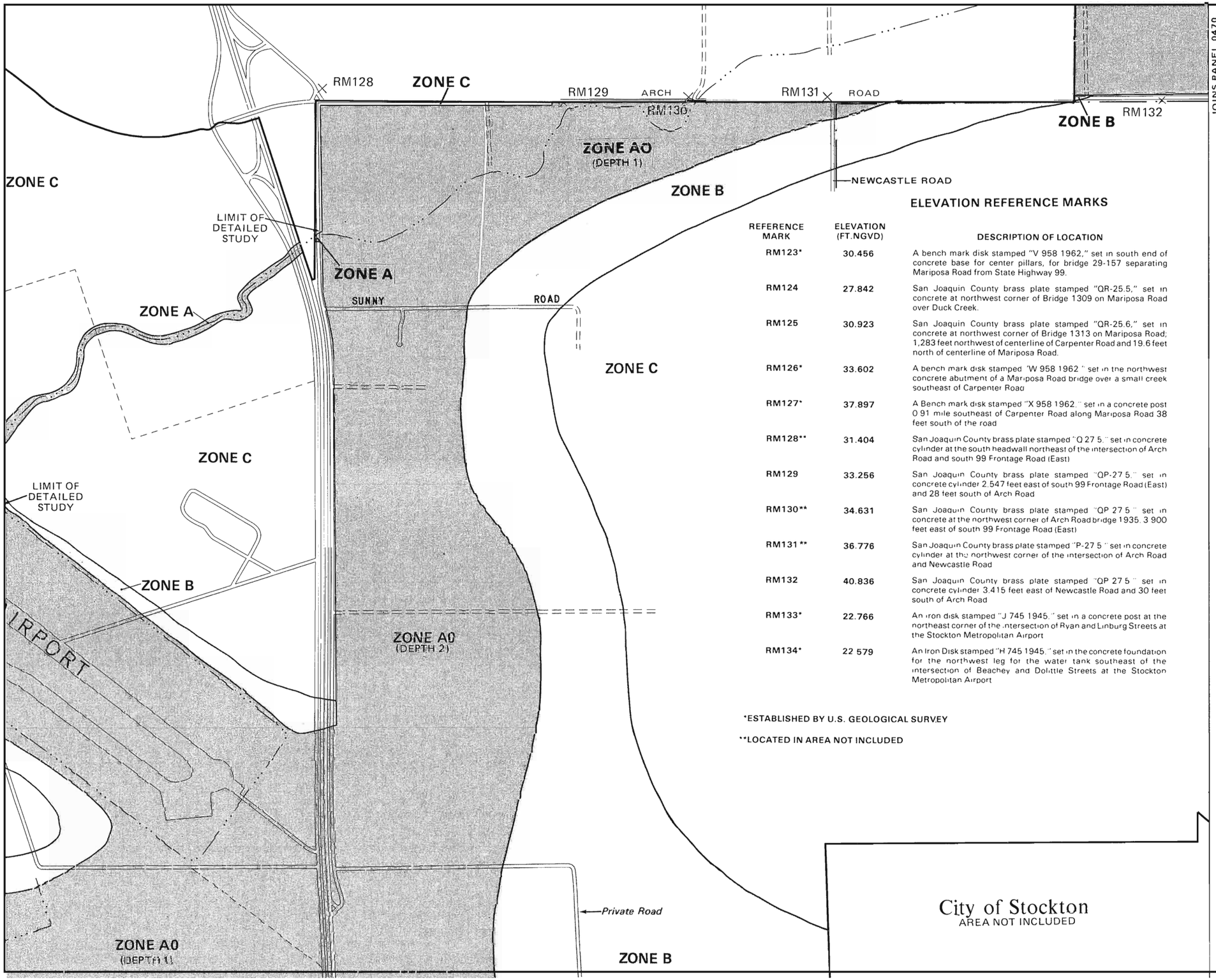
PANEL 470 OF 925
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
0602990470 B

MAP REVISED:
APRIL 2, 2002

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map It was extracted using F-MIT On-Line This map does not reflect changes or amendments which may have been made subsequent to the date on the title block For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www msc fema gov



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT.NGVD)	DESCRIPTION OF LOCATION
RM123*	30.456	A bench mark disk stamped "V 958 1962," set in south end of concrete base for center pillars, for bridge 29-157 separating Mariposa Road from State Highway 99.
RM124	27.842	San Joaquin County brass plate stamped "QR-25.5," set in concrete at northwest corner of Bridge 1309 on Mariposa Road over Duck Creek.
RM125	30.923	San Joaquin County brass plate stamped "QR-25.6," set in concrete at northwest corner of Bridge 1313 on Mariposa Road; 1,283 feet northwest of centerline of Carpenter Road and 19.6 feet north of centerline of Mariposa Road.
RM126*	33.602	A bench mark disk stamped "W 958 1962," set in the northwest concrete abutment of a Mariposa Road bridge over a small creek southeast of Carpenter Road
RM127*	37.897	A Bench mark disk stamped "X 958 1962," set in a concrete post 0.91 mile southeast of Carpenter Road along Mariposa Road 38 feet south of the road
RM128**	31.404	San Joaquin County brass plate stamped "Q 27 5," set in concrete cylinder at the south headwall northeast of the intersection of Arch Road and south 99 Frontage Road (East)
RM129	33.256	San Joaquin County brass plate stamped "QP-27 5," set in concrete cylinder 2,547 feet east of south 99 Frontage Road (East) and 28 feet south of Arch Road
RM130**	34.631	San Joaquin County brass plate stamped "QP 27 5," set in concrete at the northwest corner of Arch Road bridge 1935, 3 900 feet east of south 99 Frontage Road (East)
RM131**	36.776	San Joaquin County brass plate stamped "P-27 5," set in concrete cylinder at the northwest corner of the intersection of Arch Road and Newcastle Road
RM132	40.836	San Joaquin County brass plate stamped "QP 27 5," set in concrete cylinder 3,415 feet east of Newcastle Road and 30 feet south of Arch Road
RM133*	22.766	An iron disk stamped "J 745 1945," set in a concrete post at the northeast corner of the intersection of Ryan and Linburg Streets at the Stockton Metropolitan Airport
RM134*	22 579	An Iron Disk stamped "H 745 1945," set in the concrete foundation for the northwest leg for the water tank southeast of the intersection of Beachey and Dolittle Streets at the Stockton Metropolitan Airport

*ESTABLISHED BY U.S. GEOLOGICAL SURVEY

**LOCATED IN AREA NOT INCLUDED

APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

SAN JOAQUIN COUNTY, CALIFORNIA
(UNINCORPORATED AREAS)

PANEL 465 OF 925
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
0602990465 C

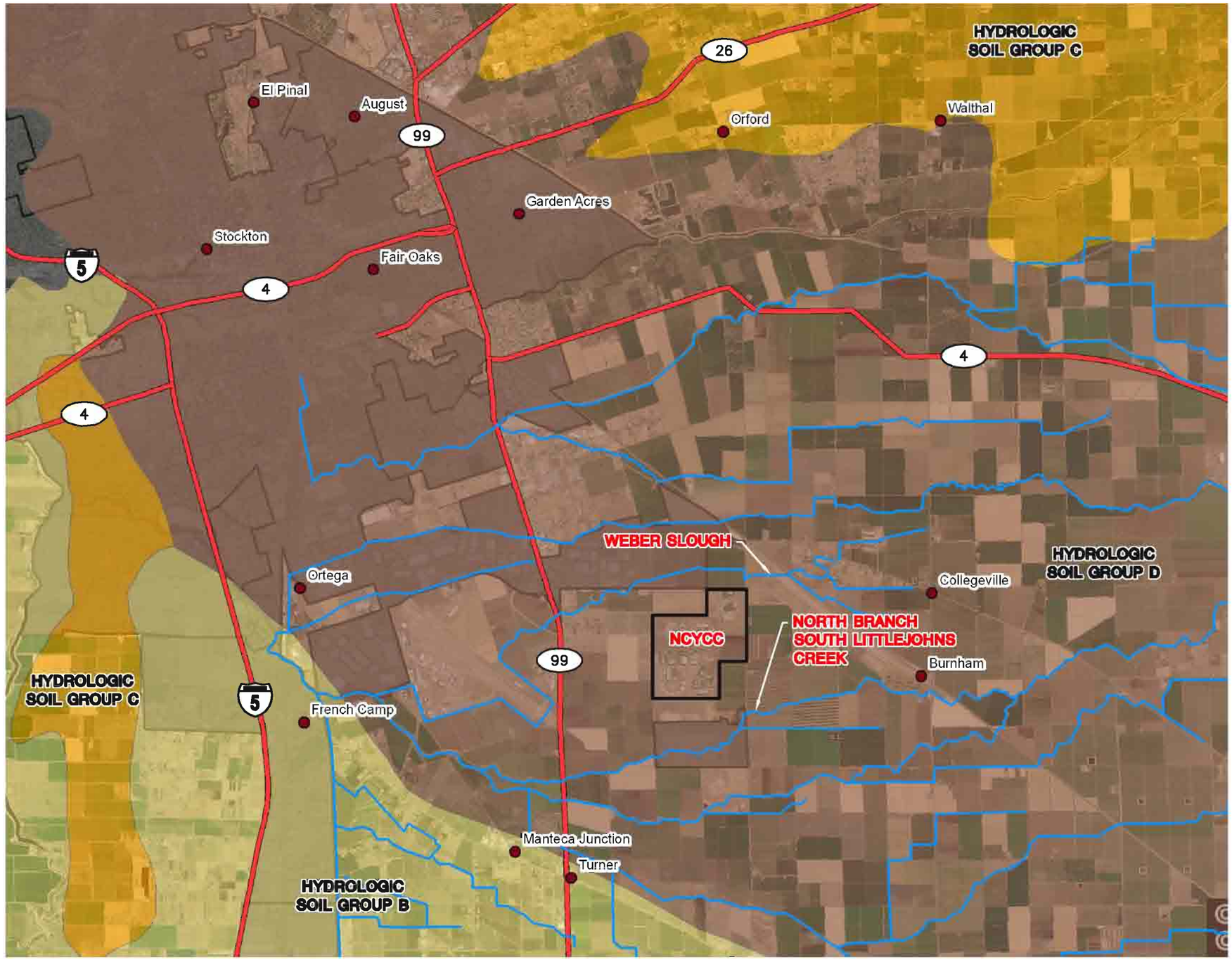
MAP REVISED:
APRIL 2, 2002

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map It was extracted using F-MIT On-Line This map does not reflect changes or amendments which may have been made subsequent to the date on the title block For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www msc fema gov

Appendix D

Soils Map



LEGEND

HYDROLOGIC SOIL GROUPS

- A
- B
- C
- D

Kimley-Horn and Associates, Inc.
Engineering, Planning and Environmental Consultants

Figure 4
Soils Map
August 2008

K:\Municipal\097551001 - NCYCC Stockton Prison Assessment\CADD\Misc\Soils Map.dwg 8-11-08-2:51 PM

Appendix E

FlowMaster Worksheets

Worksheet for 42" Storm Drain Trunk

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00100	ft/ft
Normal Depth	3.50	ft
Diameter	42.00	in
Discharge	31.81	ft^3/s

Results

Discharge	31.81	ft^3/s
Normal Depth	3.50	ft
Flow Area	9.62	ft^2
Wetted Perimeter	11.00	ft
Top Width	0.00	ft
Critical Depth	1.74	ft
Percent Full	100.0	%
Critical Slope	0.00404	ft/ft
Velocity	3.31	ft/s
Velocity Head	0.17	ft
Specific Energy	3.67	ft
Froude Number	0.00	
Maximum Discharge	34.22	ft^3/s
Discharge Full	31.81	ft^3/s
Slope Full	0.00100	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Worksheet for Concrete-Lined Drainage Channel

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00120	ft/ft
Normal Depth	4.00	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	5.00	ft

Results

Discharge	241.61	ft^3/s
Flow Area	36.00	ft^2
Wetted Perimeter	16.31	ft
Top Width	13.00	ft
Critical Depth	3.32	ft
Critical Slope	0.00245	ft/ft
Velocity	6.71	ft/s
Velocity Head	0.70	ft
Specific Energy	4.70	ft
Froude Number	0.71	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.00	ft
Critical Depth	3.32	ft
Channel Slope	0.00120	ft/ft
Critical Slope	0.00245	ft/ft

Worksheet for Parallel SD Main

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Diameter

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00100	ft/ft
Normal Depth	4.43	ft
Diameter	53.15	in
Discharge	59.60	ft^3/s

Results

Diameter	53.15	in
Normal Depth	4.43	ft
Flow Area	15.41	ft^2
Wetted Perimeter	13.91	ft
Top Width	0.00	ft
Critical Depth	2.25	ft
Percent Full	100.0	%
Critical Slope	0.00377	ft/ft
Velocity	3.87	ft/s
Velocity Head	0.23	ft
Specific Energy	4.66	ft
Froude Number	0.00	
Maximum Discharge	64.11	ft^3/s
Discharge Full	59.60	ft^3/s
Slope Full	0.00100	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Worksheet for Upsized SD Main

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Diameter

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00100	ft/ft
Normal Depth	5.51	ft
Diameter	66.07	in
Discharge	106.50	ft^3/s

Results

Diameter	66.07	in
Normal Depth	5.51	ft
Flow Area	23.81	ft^2
Wetted Perimeter	17.30	ft
Top Width	0.00	ft
Critical Depth	2.86	ft
Percent Full	100.0	%
Critical Slope	0.00354	ft/ft
Velocity	4.47	ft/s
Velocity Head	0.31	ft
Specific Energy	5.82	ft
Froude Number	0.00	
Maximum Discharge	114.56	ft^3/s
Discharge Full	106.50	ft^3/s
Slope Full	0.00100	ft/ft
Flow Type	SubCritical	

GVF Input Data

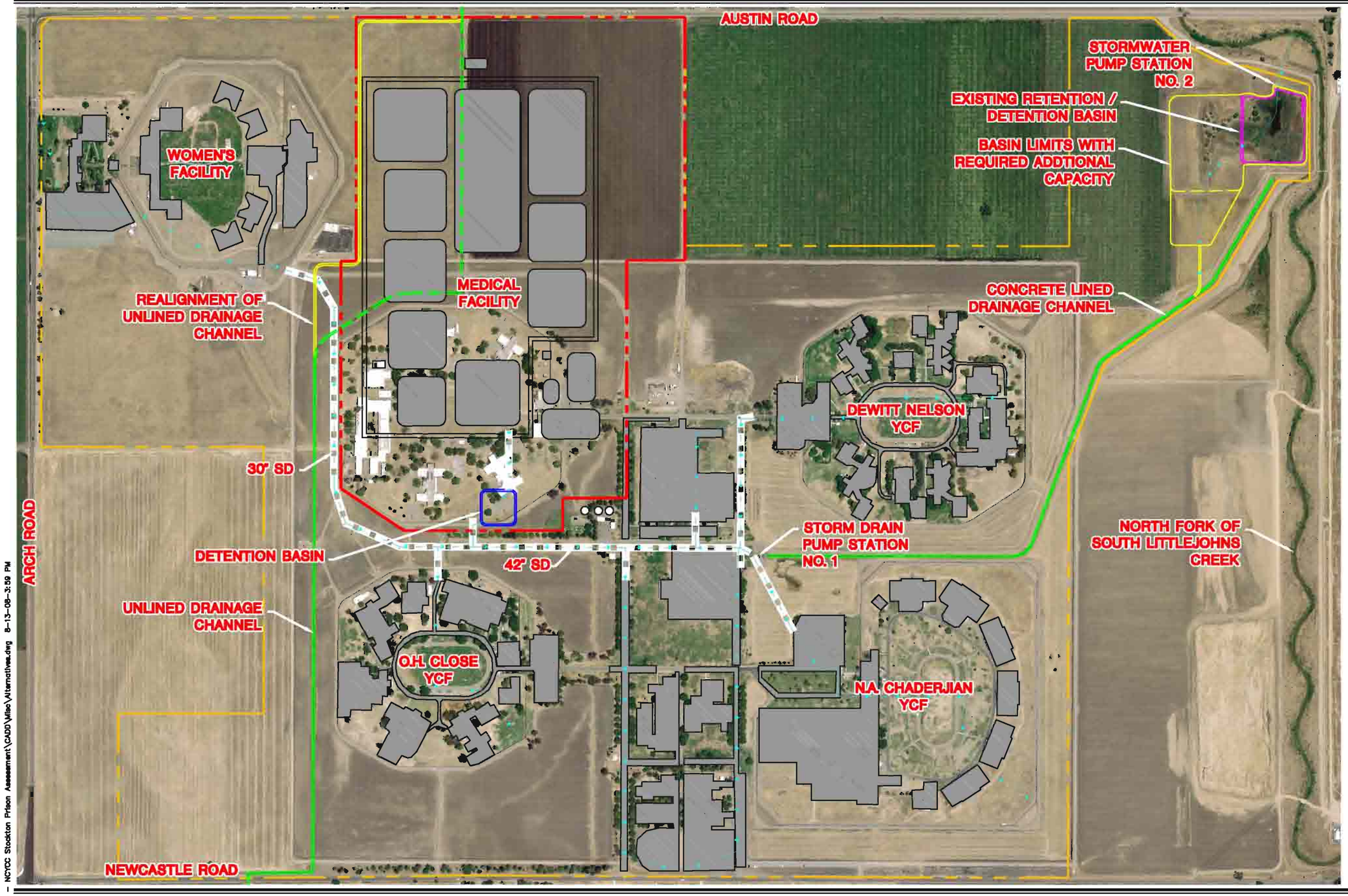
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Appendix F

Alternatives Figures



Scale: 1"=600'

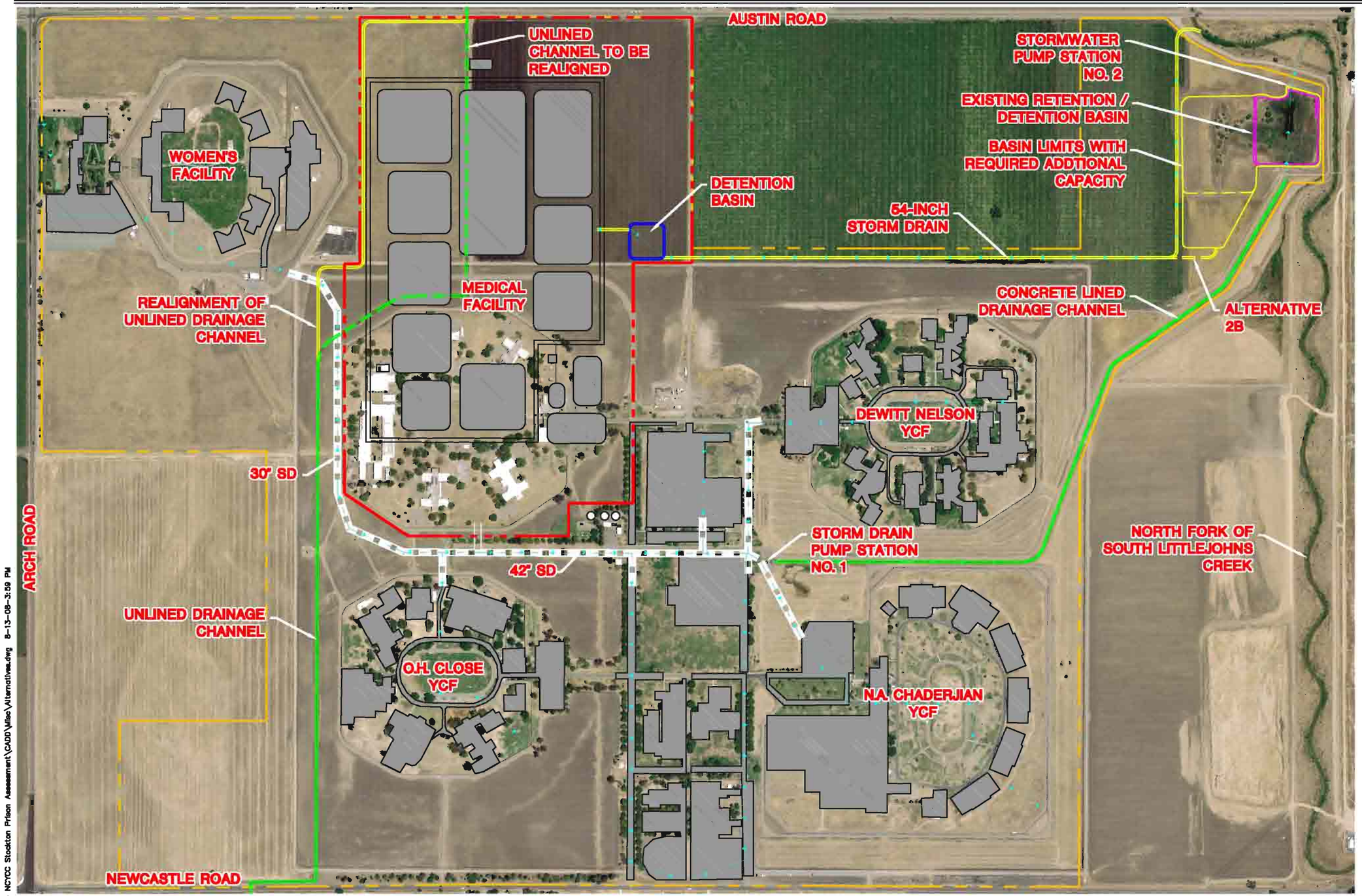
LEGEND

- STORMWATER DRAINAGE PATH
- STORM DRAIN
- IMPERVIOUS AREA
- TITLE REPORT PARCEL BOUNDARY
- POTENTIAL MEDICAL FACILITY SITE

K:\Municipal\097351001 - NCYCC Stockton Prison Assessment\CADD\Misc\Alternatives.dwg 8-13-08-3:59 PM

Kimley-Horn and Associates, Inc.
Engineering, Planning and Environmental Consultants

Figure 5
Alternative No. 1
August 2008



Scale: 1"=600'

LEGEND

- STORMWATER DRAINAGE PATH
- STORM DRAIN
- IMPERVIOUS AREA
- TITLE REPORT PARCEL BOUNDARY
- POTENTIAL MEDICAL FACILITY SITE

K:\Municipal\097351001 - NCYCC Stockton Prison Assessment\CADD\Misc\Alternatives.dwg 8-13-08-3:59 PM

Kimley-Horn and Associates, Inc.
Engineering, Planning and Environmental Consultants

Figure 6
Alternative No. 2
August 2008

Appendix G

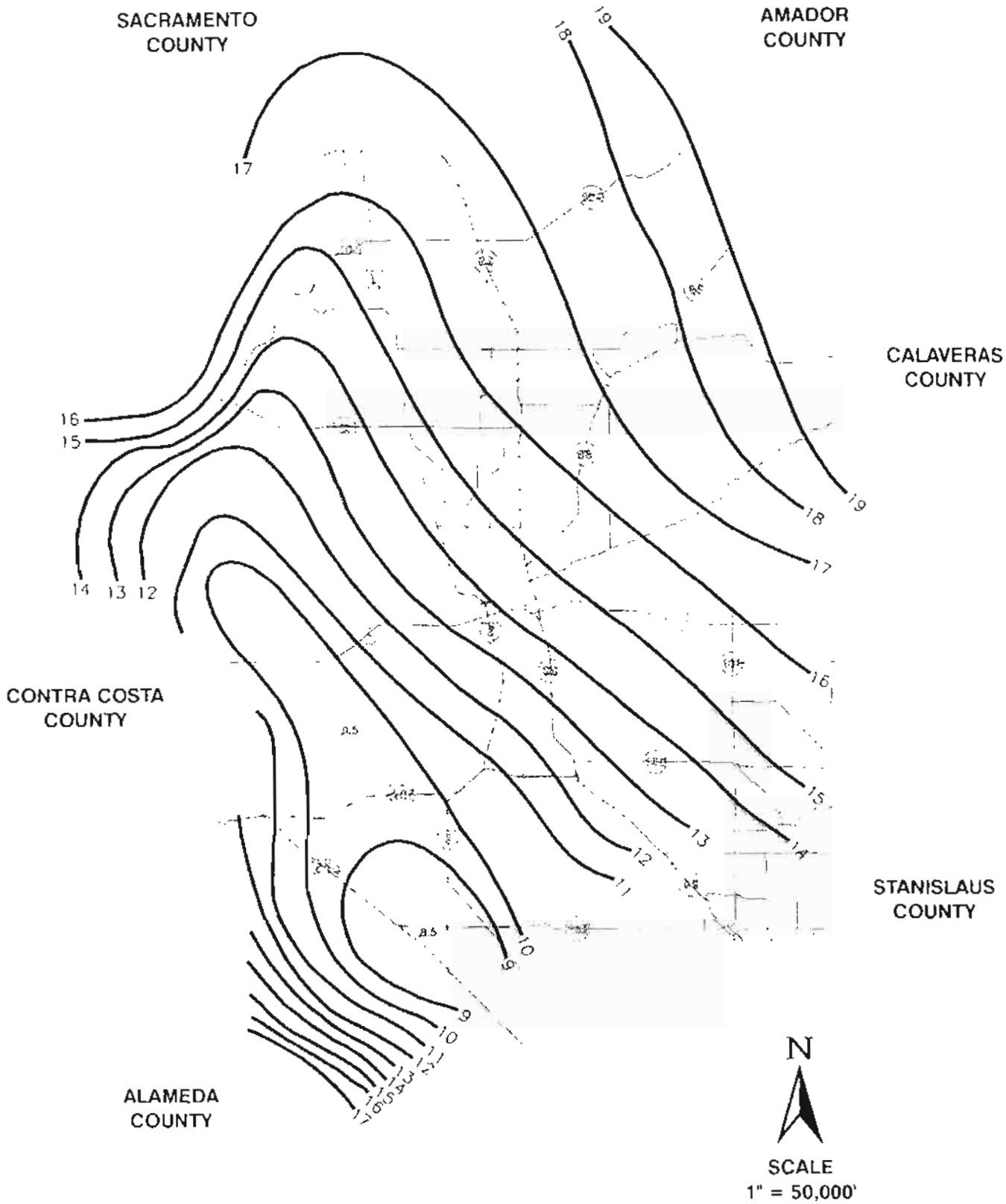
Excerpts from County of San Joaquin Hydrology Manual

DRAFT 6

HYDROLOGY MANUAL FOR

SAN JOAQUIN COUNTY CALIFORNIA

DEPARTMENT OF PUBLIC WORKS



SAN JOAQUIN COUNTY
HYDROLOGY MANUAL

ISOHYETAL RAINFALL MAP

FIGURE B-1

TABLE B.4

10-YEAR DEPTH-DURATION-FREQUENCY FOR COUNTY OF SAN JOAQUIN

10-year DEPTH-DURATION-FREQUENCY

K = 1.341

Skew = 1.1

Cv = 0.354

MAP	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
9	0.19	0.26	0.30	0.40	0.53	0.69	0.82	1.08	1.42	1.88
10	0.20	0.27	0.32	0.42	0.55	0.73	0.86	1.13	1.50	1.97
11	0.21	0.28	0.33	0.44	0.58	0.77	0.90	1.19	1.57	2.07
12	0.22	0.30	0.35	0.46	0.61	0.80	0.94	1.25	1.65	2.17
13	0.24	0.31	0.37	0.48	0.64	0.84	0.99	1.30	1.72	2.27
14	0.25	0.32	0.38	0.50	0.66	0.88	1.03	1.36	1.80	2.37
15	0.26	0.34	0.40	0.52	0.69	0.91	1.07	1.42	1.87	2.47
16	0.27	0.35	0.41	0.54	0.72	0.95	1.12	1.47	1.95	2.57
17	0.28	0.36	0.43	0.57	0.75	0.99	1.16	1.53	2.02	2.67
18	0.29	0.38	0.44	0.59	0.77	1.02	1.20	1.59	2.10	2.77
19	0.30	0.39	0.46	0.61	0.80	1.06	1.25	1.65	2.17	2.87

TABLE B.5

25-YEAR DEPTH-DURATION-FREQUENCY FOR COUNTY OF SAN JOAQUIN

25-year DEPTH-DURATION-FREQUENCY

K = 2.066

Skew = 1.1

Cv = 0.354

MAP	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
9	0.23	0.30	0.35	0.47	0.62	0.81	0.96	1.26	1.67	2.20
10	0.24	0.32	0.37	0.49	0.65	0.86	1.01	1.33	1.76	2.32
11	0.25	0.33	0.39	0.52	0.68	0.90	1.06	1.40	1.84	2.43
12	0.26	0.35	0.41	0.54	0.71	0.94	1.11	1.46	1.93	2.55
13	0.28	0.36	0.43	0.57	0.75	0.99	1.16	1.53	2.02	2.67
14	0.29	0.38	0.45	0.59	0.78	1.03	1.21	1.60	2.11	2.78
15	0.30	0.40	0.47	0.62	0.81	1.07	1.26	1.66	2.20	2.90
16	0.31	0.41	0.48	0.64	0.84	1.11	1.31	1.73	2.29	3.02
17	0.32	0.43	0.50	0.66	0.88	1.16	1.36	1.80	2.37	3.13
18	0.34	0.44	0.52	0.69	0.91	1.20	1.41	1.86	2.46	3.25
19	0.35	0.46	0.54	0.71	0.94	1.24	1.46	1.93	2.55	3.37

TABLE B.6

50-YEAR DEPTH-DURATION-FREQUENCY FOR COUNTY OF SAN JOAQUIN

50-year DEPTH-DURATION-FREQUENCY

K = 2.420

Skew = 1.1

Cv = 0.354

MAP	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
9	0.24	0.32	0.38	0.50	0.66	0.87	1.03	1.36	1.79	2.36
10	0.26	0.34	0.40	0.53	0.70	0.92	1.08	1.43	1.88	2.49
11	0.27	0.36	0.42	0.55	0.73	0.96	1.14	1.50	1.98	2.61
12	0.28	0.37	0.44	0.58	0.77	1.01	1.19	1.57	2.07	2.74
13	0.30	0.39	0.46	0.61	0.80	1.06	1.24	1.64	2.17	2.86
14	0.31	0.41	0.48	0.63	0.84	1.10	1.30	1.71	2.26	2.99
15	0.32	0.42	0.50	0.66	0.87	1.15	1.35	1.78	2.36	3.11
16	0.33	0.44	0.52	0.69	0.91	1.20	1.41	1.86	2.45	3.23
17	0.35	0.46	0.54	0.71	0.94	1.24	1.46	1.93	2.54	3.36
18	0.36	0.48	0.56	0.74	0.98	1.29	1.52	2.00	2.64	3.48
19	0.37	0.49	0.58	0.77	1.01	1.33	1.57	2.07	2.73	3.61

TABLE B.7

100-YEAR DEPTH-DURATION-FREQUENCY FOR COUNTY OF SAN JOAQUIN

100-year DEPTH-DURATION-FREQUENCY

K = 3.087

Skew = 1.1

Cv = 0.354

MAP	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
9	0.28	0.36	0.43	0.56	0.75	0.98	1.16	1.53	2.02	2.66
10	0.29	0.38	0.45	0.59	0.78	1.04	1.22	1.61	2.12	2.80
11	0.30	0.40	0.47	0.62	0.82	1.09	1.28	1.69	2.23	2.94
12	0.32	0.42	0.50	0.65	0.86	1.14	1.34	1.77	2.34	3.08
13	0.33	0.44	0.52	0.68	0.90	1.19	1.40	1.85	2.44	3.22
14	0.35	0.46	0.54	0.71	0.94	1.24	1.46	1.93	2.55	3.36
15	0.36	0.48	0.56	0.74	0.98	1.30	1.52	2.01	2.66	3.51
16	0.38	0.50	0.59	0.77	1.02	1.35	1.59	2.09	2.76	3.65
17	0.39	0.52	0.61	0.80	1.06	1.40	1.65	2.17	2.87	3.79
18	0.41	0.54	0.63	0.83	1.10	1.45	1.71	2.25	2.98	3.93
19	0.42	0.56	0.65	0.86	1.14	1.50	1.77	2.33	3.08	4.07

TABLE B.10

10-YEAR INTENSITY-DURATION-FREQUENCY FOR COUNTY OF SAN JOAQUIN

10-year INTENSITY-DURATION-FREQUENCY

K = -0.180

Skew = 1.1

Cv = 0.354

MAP	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
9	2.33	1.54	1.21	0.80	0.53	0.35	0.27	0.18	0.12	0.08
10	2.45	1.62	1.27	0.84	0.55	0.36	0.29	0.19	0.12	0.08
11	2.57	1.70	1.33	0.88	0.59	0.38	0.30	0.20	0.13	0.09
12	2.70	1.78	1.40	0.92	0.61	0.40	0.31	0.21	0.14	0.09
13	2.82	1.86	1.46	0.96	0.64	0.42	0.33	0.22	0.14	0.09
14	2.94	1.94	1.52	1.01	0.66	0.44	0.34	0.23	0.15	0.10
15	3.07	2.02	1.59	1.05	0.69	0.46	0.36	0.24	0.16	0.10
16	3.19	2.11	1.65	1.09	0.72	0.47	0.37	0.25	0.16	0.11
17	3.31	2.19	1.71	1.13	0.75	0.49	0.39	0.26	0.17	0.11
18	3.44	2.27	1.78	1.17	0.77	0.51	0.40	0.26	0.17	0.12
19	3.56	2.35	1.84	1.22	0.80	0.53	0.42	0.27	0.18	0.12

TABLE B.11

25-YEAR INTENSITY-DURATION-FREQUENCY FOR COUNTY OF SAN JOAQUIN

25-year INTENSITY-DURATION-FREQUENCY

K = 0.745

Skew = 1.1

Cv = 0.354

MAP	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
9	2.73	1.80	1.42	0.93	0.62	0.41	0.32	0.21	0.14	0.09
10	2.88	1.90	1.49	0.98	0.65	0.43	0.34	0.22	0.15	0.10
11	3.02	2.00	1.56	1.03	0.68	0.45	0.35	0.23	0.15	0.10
12	3.17	2.09	1.64	1.08	0.71	0.47	0.37	0.24	0.16	0.11
13	3.31	2.19	1.71	1.13	0.75	0.49	0.39	0.26	0.17	0.11
14	3.46	2.28	1.79	1.18	0.78	0.51	0.40	0.27	0 18	0.12
15	3.60	2.38	1.86	1.23	0.81	0.54	0.42	0.28	0.18	0.12
16	3.74	2.47	1.94	1.28	0.84	0.56	0.44	0.29	0.19	0.13
17	3.89	2.57	2.01	1.33	0.88	0.58	0.45	0.30	0.20	0.13
18	4.03	2.66	2.09	1.38	0.91	0.60	0.47	0.31	0.21	0.14
19	4.18	2.76	2.16	1.43	0.94	0.62	0.49	0.32	0.21	0.14

TABLE B.12

50-YEAR INTENSITY-DURATION-FREQUENCY FOR COUNTY OF SAN JOAQUIN

50-year INTENSITY-DURATION-FREQUENCY

K = 2.420

Skew = 1.1

Cv = 0.354

MAP	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
9	2.93	1.93	1.52	1.00	0.66	0.44	0.34	0.23	0.15	0.10
10	3.09	2.04	1.60	1.05	0.70	0.46	0.36	0.24	0.16	0.10
11	3.24	2.14	1.68	1.11	0.73	0.48	0.38	0.25	0.16	0.11
12	3.40	2.24	1.76	1.16	0.77	0.51	0.40	0.26	0.17	0.11
13	3.55	2.34	1.84	1.21	0.80	0.53	0.41	0.27	0.18	0.12
14	3.71	2.45	1.92	1.27	0.84	0.55	0.43	0.29	0.19	0.12
15	3.86	2.55	2.00	1.32	0.87	0.57	0.45	0.30	0.20	0.13
16	4.02	2.65	2.08	1.37	0.91	0.60	0.47	0.31	0.20	0.13
17	4.17	2.75	2.16	1.42	0.94	0.62	0.49	0.32	0.21	0.14
18	4.33	2.86	2.24	1.48	0.98	0.64	0.50	0.33	0.22	0.15
19	4.48	2.96	2.32	1.53	1.01	0.67	0.52	0.35	0.23	0.15

TABLE B.13

100-YEAR INTENSITY-DURATION-FREQUENCY FOR COUNTY OF SAN JOAQUIN

100-year INTENSITY-DURATION-FREQUENCY

K = 3.087

Skew = 1.1

Cv = 0.354

MAP	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
9	3.30	2.18	1.71	1.13	0.75	0.49	0.39	0.25	0.17	0.11
10	3.48	2.30	1.80	1.19	0.78	0.52	0.41	0.27	0.18	0.12
11	3.65	2.41	1.89	1.25	0.82	0.54	0.43	0.28	0.19	0.12
12	3.83	2.53	1.98	1.31	0.86	0.57	0.45	0.29	0.19	0.13
13	4.00	2.64	2.07	1.37	0.90	0.60	0.47	0.31	0.20	0.13
14	4.18	2.76	2.16	1.43	0.94	0.62	0.49	0.32	0.21	0.14
15	4.35	2.87	2.25	1.49	0.98	0.65	0.51	0.34	0.22	0.15
16	4.53	2.99	2.34	1.55	1.02	0.67	0.53	0.35	0.23	0.15
17	4.70	3.10	2.43	1.61	1.06	0.70	0.55	0.36	0.24	0.16
18	4.88	3.22	2.52	1.67	1.10	0.73	0.57	0.38	0.25	0.16
19	5.05	3.33	2.61	1.73	1.14	0.75	0.59	0.39	0.26	0.17

Curve [1] Numbers of Hydrologic Soil-Cover Complexes for Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Ref. No. 21) (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Ref. No. 21) (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Ref. No. 21) (Chamise and Redskank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadows or Seasonal Wetlands (Ref. No. 21) (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	72	78
Open Brush (Ref. No. 21) (Soft wood shrubs-buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (4) (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawns, shrubs, etc.)	Good	39	61	74	80
Turf (Irrigated and mowed grass)	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80

REFERENCE NO. 26 UNLESS NOTED

SAN JOAQUIN COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

FIGURE C-2 (1 of 3)

Curve [1] Numbers of Hydrologic Soil-Cover Complexes for Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
AGRICULTURAL COVERS -					
Fallow (Bare Soil)		77	86	91	94
Close Seeded (alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Contoured	Poor	64	75	83	85
	Good	55	69	78	83
Countoured and Terraced	Poor	63	73	80	83
	Good	51	67	76	80
Orchards, Evergreen (Ref. No. 2) (Citrus, avacodos, etc.)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Pasture (Grassland or range, continuous forage for grazing)	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Contoured	Poor	47	67	81	88
	Fair	25	59	75	83
	Good	6	35	70	79
Row Crops (Straight row, non-contoured)	Poor	72	81	88	91
	Good	67	78	85	89
Contoured	Poor	70	79	84	88
	Good	65	75	82	86
Contoured and Terraced	Poor	66	74	80	82
	Good	62	71	78	81
Small Grain (Straight row, non-contoured))	Poor	65	76	84	88
	Good	63	75	83	87
Contoured	Poor	63	74	82	85
	Good	61	73	81	84
Contoured and Terraced	Poor	61	72	79	82
Grapes, New Orchards (4), and Decidious Orchards (Ref. No. 27)	Poor	62	76	84	88
	Fair	46	67	78	83
	Good	37	60	73	79

REFERENCE NO. 3 UNLESS NOTED

SAN JOAQUIN COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

FIGURE C-2 (2 of 3)

Notes:

1. Average runoff condition, Ia = 0.2(S)

2. Poor: Heavily grazed, regularly burned areas, or areas of high burn potential. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.

   Fair: Moderate cover with 50 percent to 75 percent of the ground surface protected. In wood areas the woods are grazed but not burned, and some forest litter covers the soil.

   Good: Heavy or dense cover with more than 75 percent of the ground surface protected. In wooded areas the woods are protected from grazing, litter and brush adequately cover soil.

3. See Figure C-1 for definition of cover types.

4. Based on 25% by vines or trees.

REFERENCE NO. 3

SAN JOAQUIN COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS
FOR
PERVIOUS AREAS

FIGURE C-2 (3 of 3)