APPENDIX U

Hawkins Companies
Knighton Road Project
Shasta County, California

Stormwater Retention Storage
Churn Creek Floodplain

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Introduction

Hawkins Companies, LLC is submitting plans for a proposed development known as the Knighton Road Hawkins Project. (see Figure 1, Project Vicinity Map) The project is on approximately 92 acres of land located adjacent and north of Knighton Road between Churn Creek Road and Interstate 5 in Shasta County.

One purpose of this study is to evaluate the surface water hydrology of the existing project site and the effect of the project land use and facilities on downstream peak flows in local drainages which either cross Interstate 5 and enter the Sacramento River or enter Churn Creek. The primary issue addressed is a requirement for retention storage to prevent project-induced runoff increases downstream.

The other purpose of this study is to evaluate the 100 year floodplain due to overflow from Churn Creek. The project will be designed to prevent increases in water surface elevations or extent of flooding due to project grading. Proposed grading will be approved by FEMA in a CLOMR.

Methodology

The Redding Hydrology Manual (*Hydrology manual, City-wide Master Storm Drain Study, Appendix C, City of Redding Department of Public Works, 1993, Revised 2005*) was used to evaluate the hydrology of the project. The hydrologic model uses the U.S. Army Corps of Engineers HEC-1 (version 4.1, June 1998) flood hydrograph model. The HEC-1 data processor was written with XML format and Microsoft Dot Net Framework. The U.S. Army Corps of Engineers HEC-RAS (version 3.1.2, April 2004) model was used to evaluate the floodplain.

Project Description

The proposed project will convert grassland or vacant agriculture land to commercial land use. The total project area is 92 acres of which 83 acres is connected to the storm water runoff system. The other 9 acres consists of buffer strips to the north and west and the diversion channel on the east side. Approximately 74 acres of the 83 storm water system acres is pavement and buildings. The project area soil type is 95% NRCS Class B and 5% Class C. Figure 2 shows existing land use and soils. Figure 3 shows project land use and hydrologic subbasins. .Table 1 describes the existing land use.

Table 1. HEC-1 Model Descriptions

HEC-1 Operation	Location	Land Use
Subbasin K1	North of Smith Road	Agriculture/Rural Res.
Subbasin K2	North of Niles Road	Agriculture/Rural Res.
Combine K1	at Niles Road	
Subbasin K3	Interstate Local	Agriculture/Rural Res.
Combine K2	Interstate 5 36"	
Subbasin K4	Project Buffer North	Agriculture/Vacant
Subbasin K5	Project Northwest	Agriculture/Vacant
Subbasin K6	Project West	Agriculture/Vacant
Combine K5	Project	
Subbasin K7	Project East	Agriculture/Vacant
Combine K4	Project	
Subbasin K8	Project Southwest	Agriculture/Vacant
Combine K6	Project	
Subbasin K9	Project Southeast	Agriculture/Vacant
Combine K7	Project	
Combine K8	Project Knighton Rd.	
Subbasin K10	Truck Stop	Commercial
Subbasin K11	Interstate Local	Grassland
Combine K10		
Subbasin K12	Interstate Local	Grassland
Combine K11	Interstate 5 36"	

Figure 1: Vicinity Map

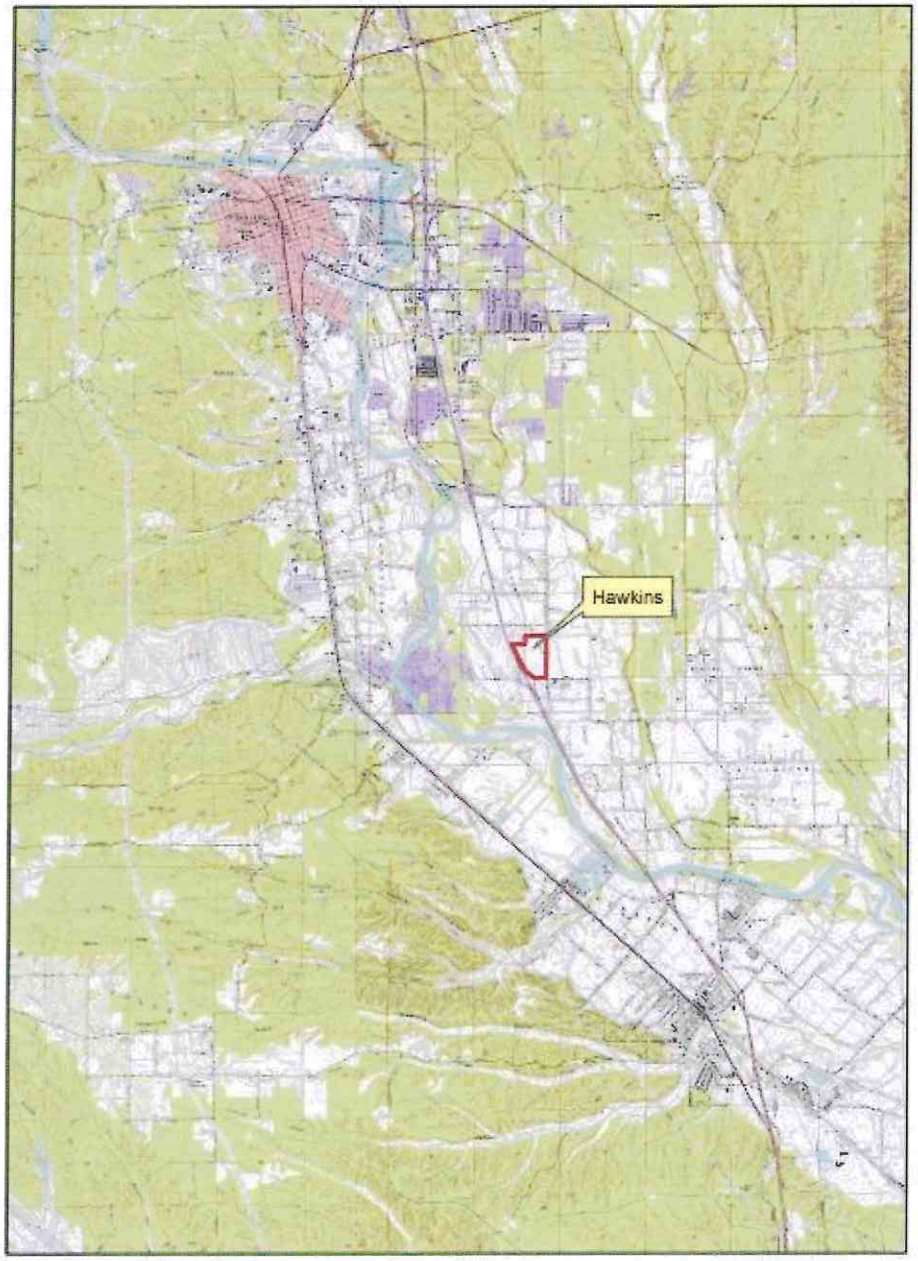


Figure 2: Existing Land Use and Soils

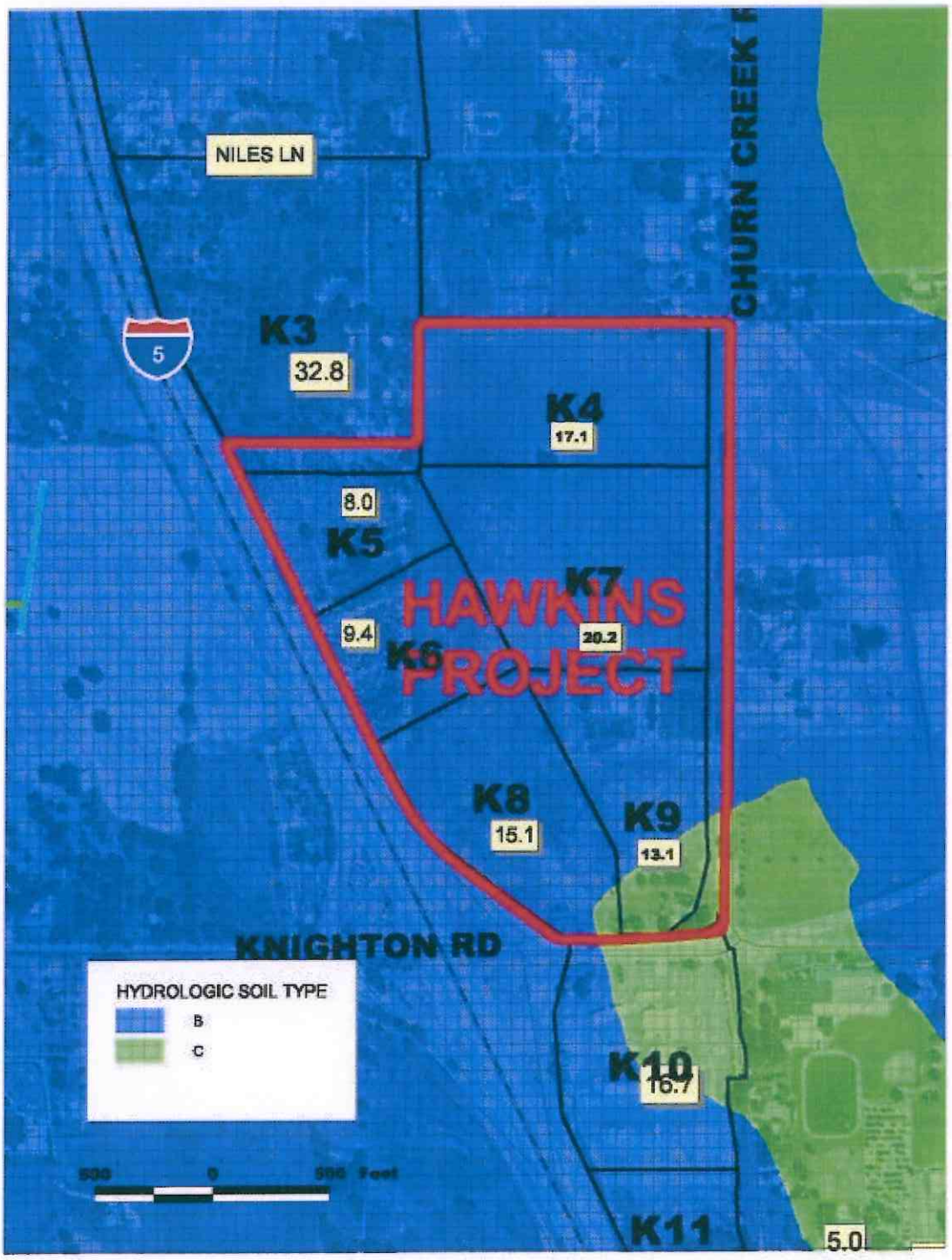
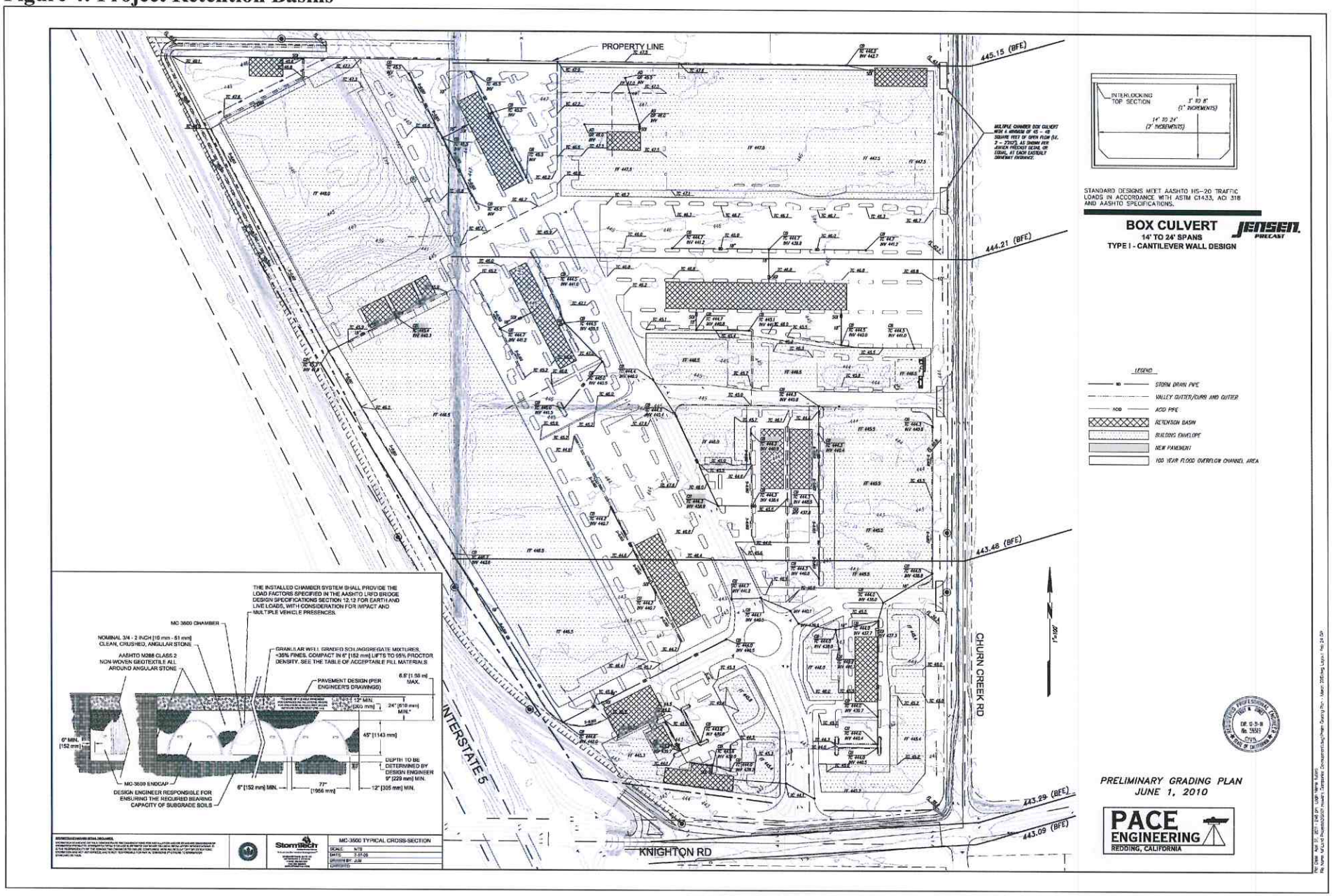


Figure 3: Project Land Use

Figure 4: Project Retention Basins



Results of Hydrologic Analyses

The HEC-1 model was used to develop a 100-year recurrence runoff hydrograph for the project condition. This model runs used the storm water system collection area of 83 acres. The total volume of the 100-year 24-hour design storm was 5.71" or 39.5 acre-feet for 83 acres.

The retention facilities are located at several locations, with proportioned drainage collection areas. (for locations see Figure 4, the preliminary grading plan submitted to Shasta County). The combined surface area of the retention facilities is 3.0 acres. Percolation tests showed that the average percolation rate for the retention facilities would be 8.4 minutes per inch or 7.1 inches per hour, equivalent to 22 cfs. During the design storm, 30.3 ac-ft percolates. The remaining 9.2 acre-feet was provided as retention storage. Table 2 shows approximate specifications of the combined detention facilities.

Table 2. Combined Retention Description

			Storage	Elevation
Orifice Centerline Elevation:	437.8 ft		0 af	437
Orifice Area:	1.77 sq ft		2 af	438
Equation Factor Coefficient:	.63		4 af	439
Exponent	0.5		6 af	441
Spillway Elevation	443 ft		8 af	442
Max. 100 Year Elevation	442.1		9 af	443
Max. 100 Year Storage	9.2 af		10 af	444

100-Year HECRAS Water Surface Elevation Analysis

The effective FEMA floodplains are shown on Figure 5. Nearly all of the project is in Zone AO, an estimated shallow flood zone, without any determination of water surface elevations. The shallow flood zone was re-studied using a HEC-RAS model and detailed cross sections. Figure 6 shows the revised flood zone with actual water surface elevations. The revised analysis showed that bank overflow flood water from Churn Creek cannot reach the northwest part of the project area, due to existing berms and high ground. In addition, overflow flood water from Churn Creek cannot cross Knighton Road east of the project and is diverted by the Knighton Road embankment to the intersection of Churn Creek Road and Knighton Road.

The purpose of the HECRAS analysis was to determine the influence of project grading on the Churn Creek overflow 100-year floodplain. The project grading plan diverts part of the shallow overflow to the east side of the project. (see Figure 7). A channel will be constructed on the west side of Churn Creek Road to carry the diverted flow. The channel is adjacent to Churn Creek Road on the west. It varies from 30 ft wide and three feet deep for the north half to 50 ft wide and one foot deep for the south half. Table 3 shows the Churn Creek overflow 100-year floodplain elevations with and without the project. The proposed bypass ditch creates decreases in the 100-year water surfaces and compensates for flow displacement due to project grading and fill. There are no significant increases in water surface elevations due to the project.

Figure 5: Published Effective 100-Year FEMA Floodplain

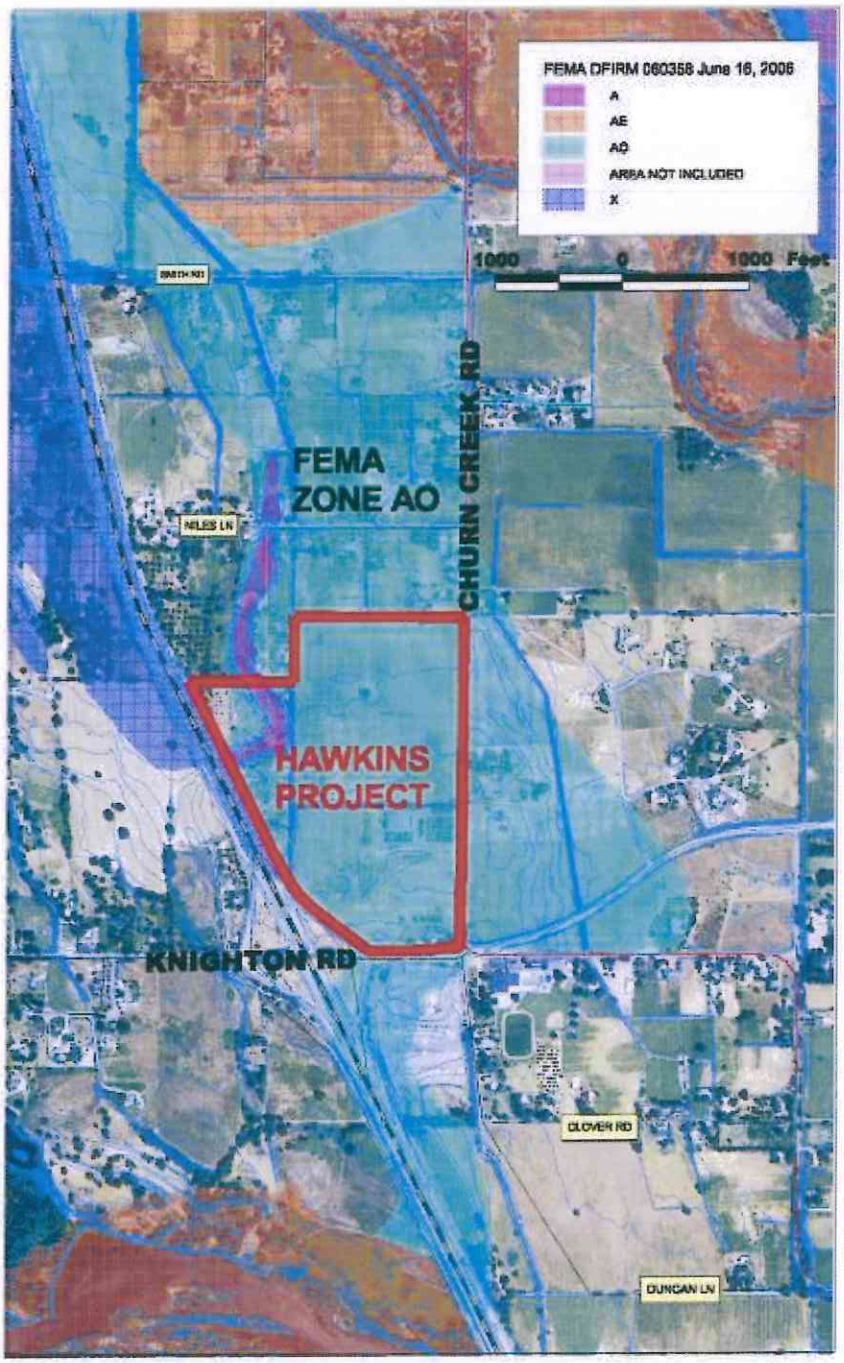


Figure 6: Revised FEMA 100-Year Floodplain

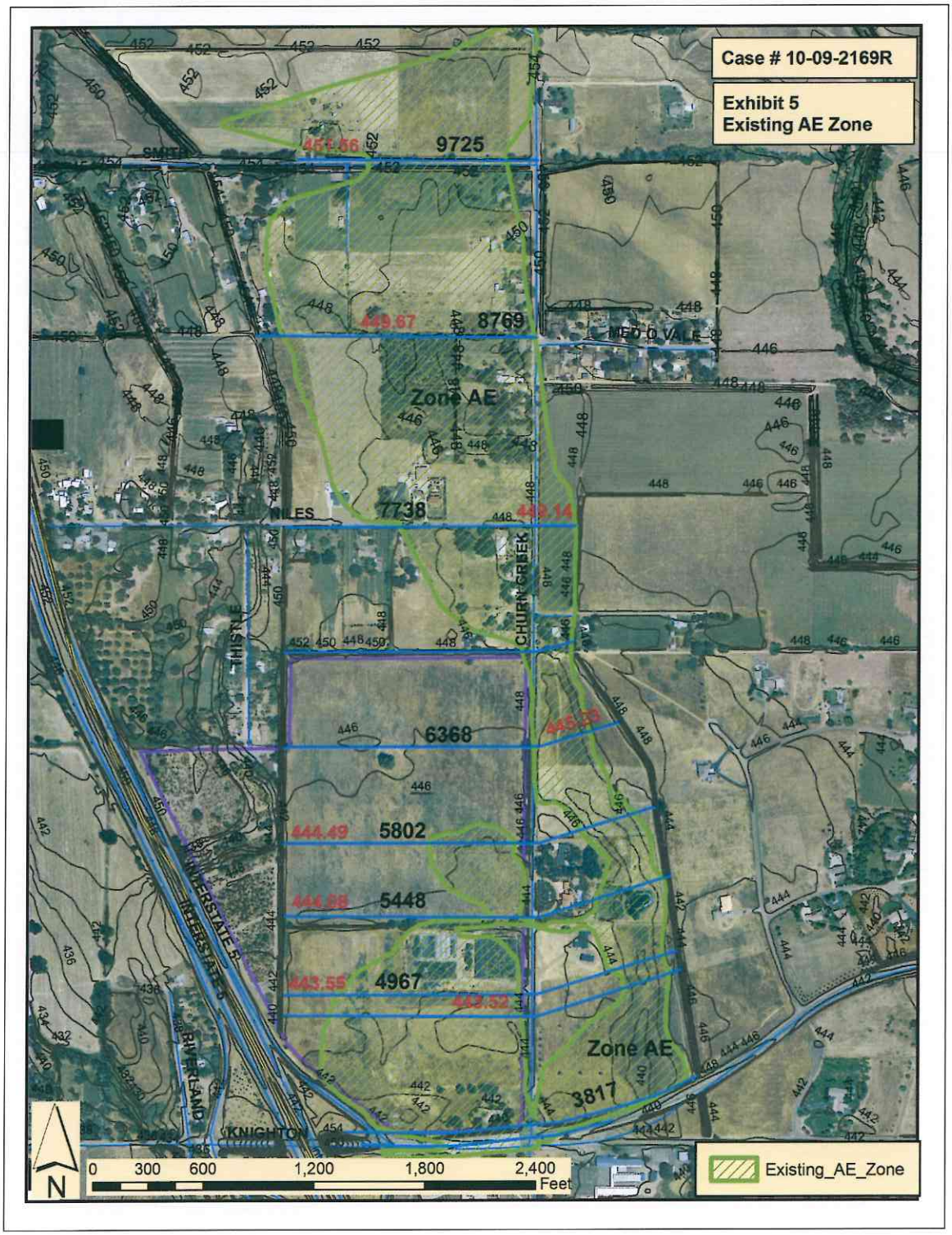


Figure 7: Project 100-Year Floodplain

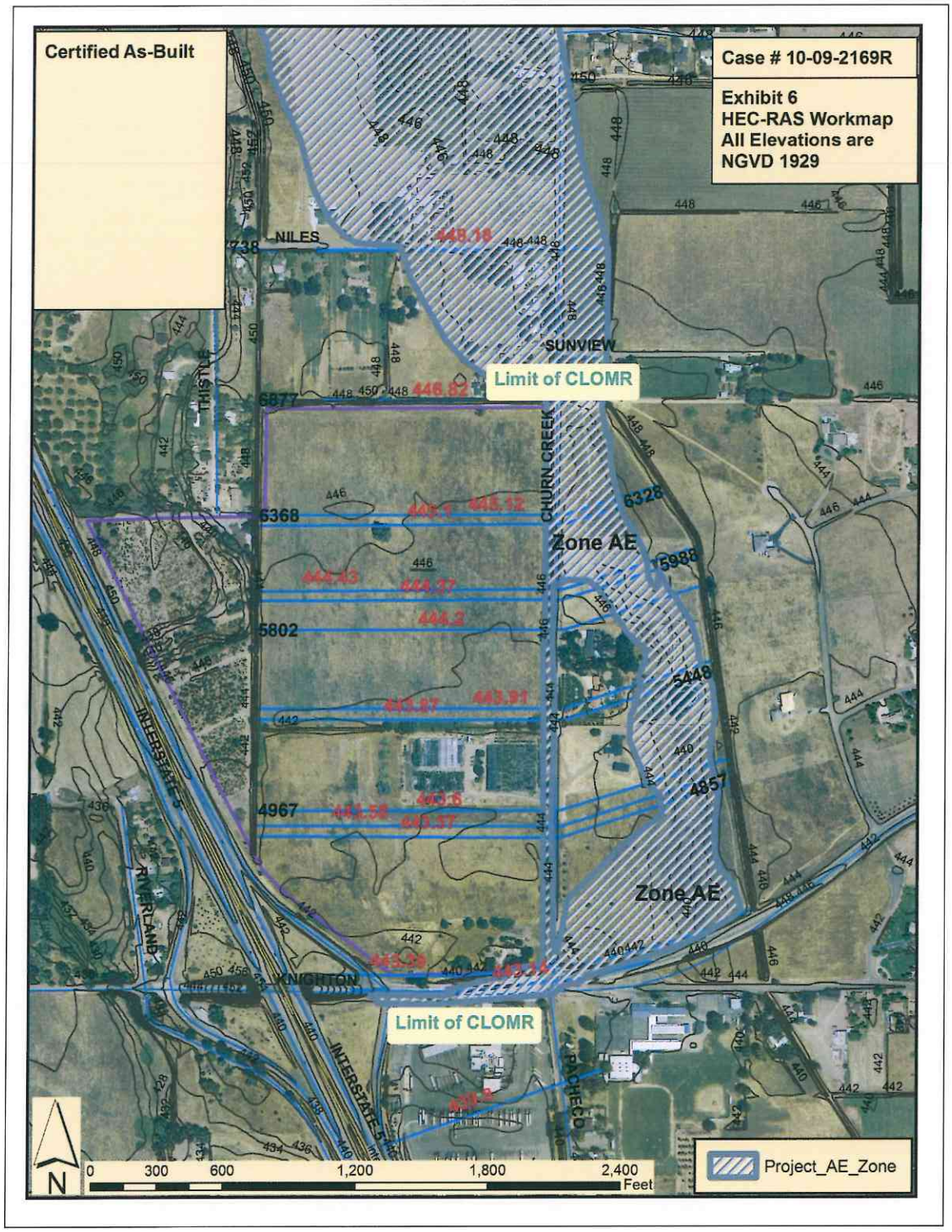


Table 3. 100-Year Cross Section Elevations

HECRAS River Sta	Q Total	Revised Existing 100-Year W.S. Elev	Project CLOMR 100-Year W.S. Elev	Difference
	(cfs)	(ft)	(ft)	(ft)
9725	1000	451.56	451.56	0.00
8769	1000	449.67	449.67	0.00
7738	1000	449.14	449.18	0.04
6877	1000	447.09	446.82	-0.27
6368	1000	445.23	445.12	-0.11
6348	Culvert			0.00
6328	1000		445.10	
6028	1000		444.43	
6008	Culvert			
5988	1000		444.37	
5802	1000	444.49	444.20	-0.29
5488	1000	444.07	443.91	-0.16
5468	Culvert			
5448	1000		443.87	
4967	1000	443.55	443.60	0.05
4897	1000		443.58	
4877	Culvert			
4857	1000	443.52	443.57	0.05
3817	1000	443.38	443.39	0.01
3726	1000	443.14	443.14	0.00
3243	1000	439.80	439.80	0.00
2469	1000	437.20	437.20	0.00
1697	1000	437.21	437.21	0.00
1029	1000	437.11	437.11	0.00
0	1000	435.00	435.00	0.00