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Sediment Discharge and Erosion Assessment Report
Westside Water Quality Coalition

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Prepared for

Westside Water Quality Coalition
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K/J Project No. 1365037*03

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Section 1: Introduction

This *Sediment Discharge and Erosion Assessment Report* (SDEAR) has been prepared on behalf of the Westside Water Quality Coalition (WWQC) in accordance with the Central Valley Regional Water Quality Control Board (Regional Board) Waste Discharge Requirements General Order for Growers Within the Tulare Lake Basin Area That Are Members of a Third-Party Group, Order No. R5-2013-0120 (Order). The WWQC serves as the third-party entity representing members located within the Coalition Area boundaries, shown on Figure 1.

The goal and objective of this SDEAR is defined in item six of Attachment B to the Order, the Monitoring and Reporting Program, which states that:

> *The goal of the report is to determine which irrigated agricultural areas within the Tulare Lake Basin Area are subject to erosion and may discharge sediment that may degrade surface waters. The objective of the report is to determine which Member operations are within such areas, and need to develop a Sediment and Erosion Control Plan.*

1.1 Description of Coalition Area

The Coalition Area includes portions of Kern and Kings Counties on the west side of the Tulare Lake Basin, as well as small areas of Fresno and San Luis Obispo Counties in the Supplemental Coverage Area. The Primary Coverage Area is approximately 255,800 acres located in the Antelope Valley and Antelope Plain, in the west side of the Tulare Lake Basin. The Supplemental Coverage Area is approximately 432,300 acres, mostly located on the east slopes of the Diablo and Temblor Ranges and including the Kettleman Plain, Kettleman Hills, Pyramid Hills, and Sunflower Valley. The Primary and Supplemental Coverage areas of the Coalition are shown on Figure 1.

The climate of the Coalition Area is arid with an average of less than 6 inches of rain per year, based on historical records for the Buttonwillow co-op station, which is located southwest of the Coalition Area (Western Regional Climate Center 2015). Most precipitation occurs in the winter months and summers are hot and dry. Average daily precipitation from November through May is generally below 0.05 inches, and the historical maximum daily precipitation is generally less than one inch. The Supplemental Coverage Area extends into the heights of the Coast Ranges where there may be slightly more precipitation.

Within the Coalition Area, there are no perennial or intermittent streams or rivers. Ephemeral creeks are present when there are stormwater flows, generally in the winter season, from the mountains and hills in the north and west parts of the Supplemental Coverage Area. Most of the creeks are small and disappear when they reach the valley floor where the agricultural fields are located. There are only five areas where a creek runs alongside agricultural fields, shown on Figure 2. None of the creeks drain to a stream or other waterbody that flows out of the Coalition Area. There is no surface drainage or return flow of irrigation water from fields back into waterbodies in the Coalition Area.

Irrigated agriculture covers approximately 17% of the Coalition Area, most of which is located within the Primary Coverage Area, as shown on Figure 2. Figure 2 also shows that a number of the permitted agricultural fields are uncultivated, and there are dry farmed fields along the western ridge in San Luis Obispo County. Most of the irrigated agriculture consists of permanent crops such as almonds and pistachios. In addition to agricultural land use, there are several active oil fields in both the Primary and Supplemental Coverage Areas.

Section 2: Procedure

For this SDEAR, erosion potential was calculated using the methodology for the sediment risk calculation for the California State Water Resources Control Board (State Board) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit). The methodology for the Construction General Permit is based on the Soil Conservation Services' Revised Universal Soil Loss Equation (RUSLE). Input values were obtained from the State Board and the United States Environmental Protection Agency (USEPA), and the degree of risk was determined using the State Board risk factors from the Construction General Permit. The RUSLE is the generally accepted basic method for modeling erosion and sediment loss, with modified versions and an updated parameter database also available for the RUSLE2. The RUSLE v1 was chosen because the data to support the various factors in the RUSLE equation are readily available for the entire State of California and for the Coalition Area, and because the State Board has established an existing definition for low sediment risk, protective of waterbodies, using the RUSLE v1.

2.1 Revised Universal Soil Loss Equation

The United States Department of Agriculture (USDA) developed the RUSLE to update an earlier equation, the USLE, first developed by the USDA in 1965 to estimate soil erosion. The RUSLE was documented in 1997 in *Agricultural Handbook 703* (USDA 1997). A more updated version, RUSLE2, has been developed as a computer program, but due to its complexity, its use is not ubiquitous and the State Board and USEPA still use the RUSLE for regulation of stormwater.

The RUSLE calculates the soil erosion rate using six factors to account for rainfall, soil erosivity, slope, and surface management practices.

$$A = R \cdot K \cdot L \cdot S \cdot C \cdot P$$

where
A = average soil loss [typically in units of tons/acre/year]
R = rainfall-runoff erosivity factor [(hundreds of feet • ton • inches)/(acre • hour • year)]
K = soil erodibility factor [(ton • acre • hour)/(hundreds of acre-foot • ton • inch)]
L = slope length factor [unitless]
S = slope steepness factor [unitless]
C = cover-management factor [unitless]
P = support practice factor [unitless]

2.2 Site Sediment Risk Methodology

As the purpose of the SDEAR is not to calculate the estimated erosion rate from a field or a small area, but to determine the potential for erosion, the sediment risk methodology for the Construction General Permit was followed in order to simplify the RUSLE. The calculation of site sediment risk does not include the cover management factor, C, or the support practice factor, P. Those factors would be expected to vary for each field and throughout the year, and would

be addressed, if necessary, for irrigated agricultural fields that are found to have a high potential for erosion by the development of a Sediment and Erosion Control Plan.

The simplified calculation of site sediment risk is based on the following equation, with the inputs and risk categories obtained from the State Board.

$$Site\ sediment\ risk = R \bullet K \bullet L \bullet S$$

The individual factors, data sources, and process of analysis are described in the following subsections.

2.3 Rainfall-Runoff Erosivity Factor, R

The rainfall-runoff erosivity factor, R, represents the effect of the impact of the rainfall on the erosion rate. For a particular storm, the rainfall erosivity is calculated from the total energy of a storm (E) times the maximum 30-minute intensity (I). The average annual total EI for all storms in a particular location is the R factor. (USDA 1997) The USEPA has mapped isoerodent contours, contour lines of constant R value, based on precipitation data collected over decades, with the minimum R value being 10. For calculations over periods of less than one year an Erosivity Index Table was developed to provide the distribution of R over the course of the year for different zones throughout the country (USEPA 2012).

The rainfall-runoff erosivity factor, R, reflects the effect of rainfall on erosion, and not irrigation practices, but since irrigation practices vary from field to field and data on that scale are not available for this analysis, the erosion potential is calculated based on rainfall only.

For the purposes of this SDEAR, a period of one year is assumed, which is conservative in that it establishes a “worst case” scenario of soil disturbance throughout the year. In an agricultural setting, fields with multiple croppings may have soil disturbance throughout the year, but there is a high percentage of cropped area in the Coalition Area that is covered with permanent crops or only a single seasonal crop. The Erosivity Index Table for soil disturbance durations less than one year was not used to modify R. The R factor was interpolated using Geographic Information System (GIS) software from the isoerodent contours with an interval of 10 as provided by USEPA to develop more refined isoerodent contours with an interval of 1 for the small area located between the 10 and 20 contour lines. Below the minimum R value of 10 the contours were not refined. The isoerodent contour map for California, and for the Coalition Area are provided in Appendix A.

2.4 Soil Erodibility Factor, K

The soil erodibility factor, K, represents the effect of soil properties on the erosion rate, including the detachability and transportability of the soil particles. Soils that are high in clay generally have low K values due to low detachability, while soils that are high in silt generally have high K values due to high detachability. Soils that are high in sand may have low K values due to high infiltration and low runoff. The State Board has created a map of K factor values for whole soil based on data from the Natural Resources Conservation Service. (State Board 2009a) The State Board’s K Factor Whole Soils map, and the K factor map for the Coalition Area are provided in Appendix A.

2.5 Slope Length and Steepness Factors, LS

The slope length factor, L, and the slope steepness factor, S, represent the effect of topography on the erosion rate. The potential for erosion increases with both the length and steepness of the hillslope. On longer slopes there is greater progressive accumulation of runoff, and on steeper slopes the runoff has greater velocity. The State Board has created a map of LS factor values based on a computer model. (State Board 2009b) The State Board's RUSLE LS Values map, and the LS factor map for the Coalition Area are provided in Appendix A.

2.6 GIS Analysis and Calculation of Sediment Risk

The overall process of calculating the sediment risk for the Coalition Area involved unifying the spatial data layers for R, K, and LS using a GIS spatial analysis feature, and calculating the sediment risk factor for each subarea that was generated in the analysis. The purpose of the spatial union was to generate a single layer containing all three factors of the RUSLE formula so that multiplication of the factors for each subarea would be possible.

The K and LS factor data layers obtained from the State Board were already in polygon formats with matching borders for the subareas. The isoerodent map layer from USEPA did not have the same subareas, though, so when the data layers were unified, the subareas for K and LS were split along the isoerodent contours so that each subarea has a unique combination of R, K, and LS factors. Calculation of the sediment risk involved simple multiplication of the R, K, and LS factors for each subarea. The calculated sediment risk was then overlain on the map of irrigated agricultural fields, in order to evaluate areas where a Sediment and Erosion Control Plan may need be necessary in accordance with the Order. Uncultivated and dry-farmed fields were not included in this analysis. If the uncultivated or dry-farmed fields, or any other lands, are converted back to irrigated agriculture in the future, the location can be compared with the calculated sediment risk data at that time. The sediment risk calculation results are presented on Figures 3 and 4 and discussed in Section 3.

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Section 3: Results and Discussion

3.1 Results

The sediment risks calculated for the entire Coalition Area, using the methods described in Section 2, are shown on Figure 3. The erosion potential is low for 84% of the area, using the State Board's definition of less than 15 tons/acre for low sediment risk, protective of water bodies. Areas of higher erosion potential are generally located in the uplands along the west boundary of the Coalition Area within the Supplemental Coverage Area, and not in areas that have historically been cultivated.

Figure 4 shows the sediment risk for the irrigated agricultural lands within the Coalition Area, based on the 2013/2014 crop data. All of the agricultural lands are low sediment risk. The maximum calculated erosion potential for the 2013/2014 crop lands is 14.3 tons/acre for a 15 acre portion of one field. In addition, the potential for sediment to be transported to a waterbody in the Coalition Area is very low because the creeks are ephemeral, the types of crops do not generally require significant earth movement in the winter time, and the creeks do not flow to any downstream water body. The maximum calculated erosion potential for a field adjacent to a creek is 3.0 tons/acre, which is much less than the 15 tons/acre threshold for low sediment risk and there is no surface drainage from irrigated fields back into any waterbodies in the Coalition Area.

3.2 Discussion of Inputs

As discussed in Section 1.1, the Coalition Area is an arid area, and most precipitation events do not generate significant runoff. As shown on Appendix Figure A-2, over 99% of the Coalition Area, except for a small 3,400 acre area on the western boundary, is within the lowest isoerodent contour, R=10. With the linear interpolation between the R=10 and R=20 contour lines, the maximum R value within the Coalition Area is 12.

Within the Coalition Area, soil erodibility K varies from 0.15 to 0.49 with the lower values occurring on the slopes of the Temblor and Coast Ranges, and the higher values occurring on the plains and hills of the San Joaquin Valley as shown on Appendix Figure A-4. Agricultural fields are generally located in higher-K areas.

The Coalition Area is divided between relatively flat plains and valleys, including the Antelope Plain, and Kettleman Plain in the eastern half and the Antelope Valley and Sunflower Valley extending to the west, and the hills of the Coast and Temblor Ranges. Irrigated agricultural lands are found in the flat lowlands of the Coalition Area. There are no agricultural lands on the slopes of the hills themselves. Appendix Figure A-6 shows the range of LS from the lowest value of 0.12 in the flat lowlands to the highest value of 12.70 on the slopes of the Coast Range.

3.3 Conclusions

The agricultural fields in the WWQC Coalition Area are of low sediment risk therefore do not trigger preparation of an Erosion and Sediment Control Plan. All irrigated agricultural fields in

the Coalition Area have a calculated erosion potential of less than 15 tons/acre, and most have a calculated erosion potential of less than 5 tons/acre. There is very low potential for transport of sediment into waterbodies as the largest calculated erosion potential for a field adjacent to a creek is 3.0 tons/acre, and there is no surface drainage from fields into waterbodies in the Coalition Area.

References

California State Water Resources Control Board. 2009a. *RUSLE K Factor Watershed Map Methodology*.

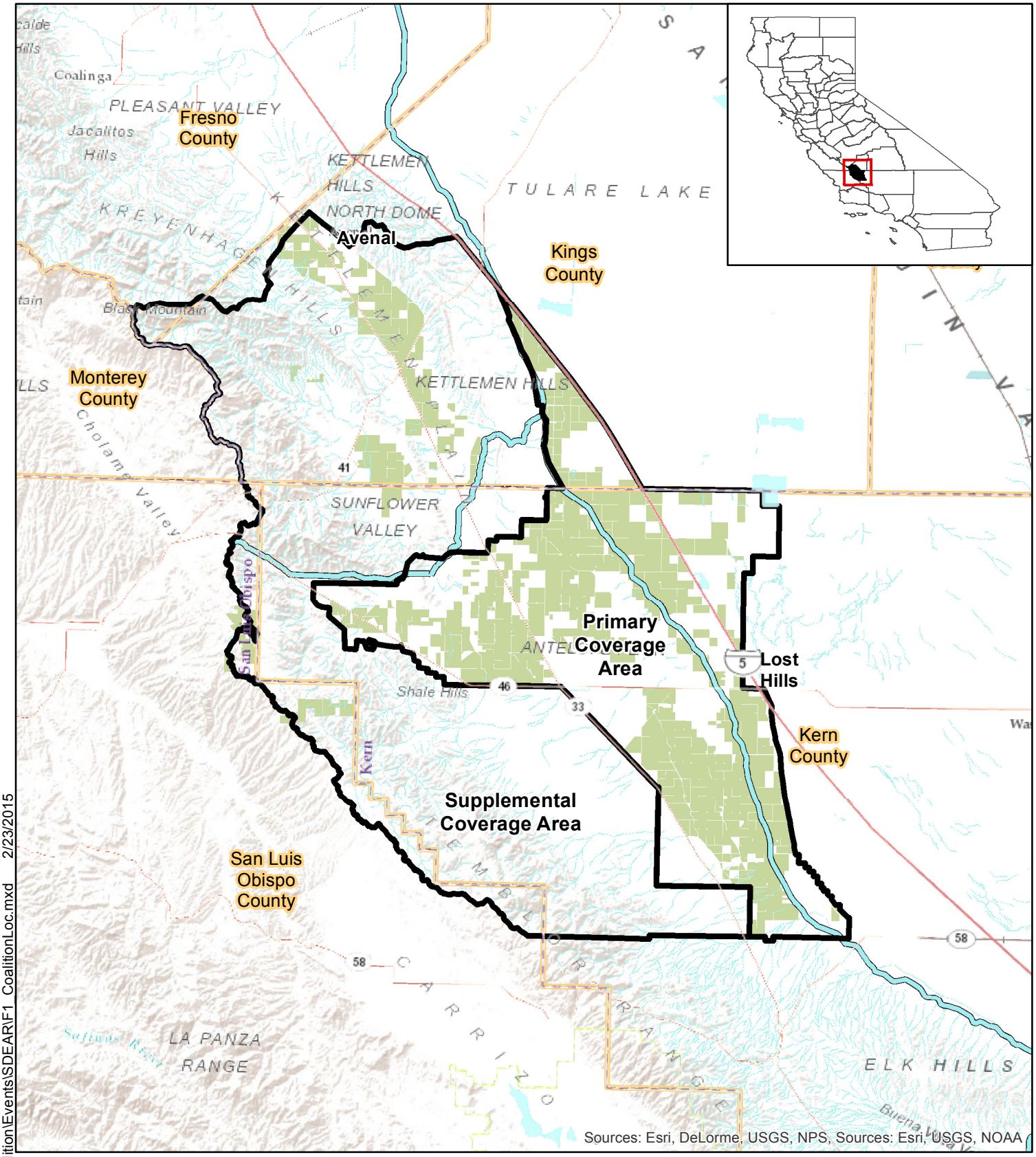
California State Water Resources Control Board. 2009b. *RUSLE LS Factor Watershed Map Methodology*.

United States Department of Agriculture. 1997. *Agricultural Handbook Number 703: Predicting Soil Erosion By Water: A Guide to Conservation Planning With The Revised Universal Soil Loss Equation (RUSLE).* January 1997.

United States Environmental Protection Agency. 2012. *Stormwater Phase II Final Rule Fact Sheet 3.1: Construction Rainfall Erosivity Waiver.* EPA 833-F-00-014. Revised March 2012.

Western Regional Climate Center. 2015. Monthly Climate Summary for Buttonwillow, California (041244). http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca1244. Accessed February 2015.

Figures



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Coalition Area

Agricultural Field, 2013/2014

Governor Edmund G Brown Coastal Branch California Aqueduct

Ephemeral or Intermittent Creek

County Boundary

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Coalition Area Location Map

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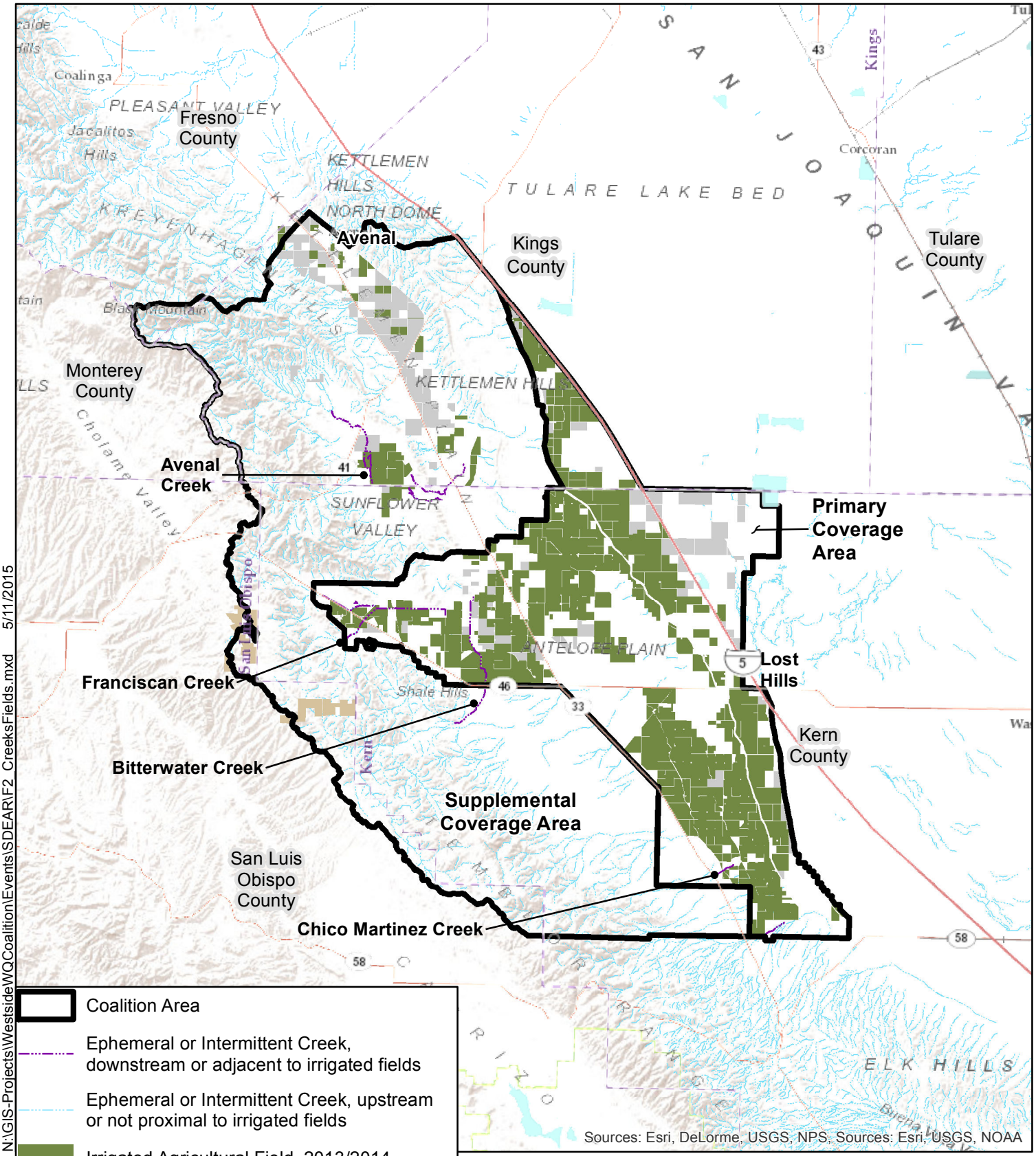
Figure 1



Coalition Area

Ephemeral or Intermittent Creek, downstream or adjacent to irrigated fields

Ephemeral or Intermittent Creek, upstream or not proximal to irrigated fields

Irrigated Agricultural Field, 2013/2014

Uncultivated Agricultural Field, 2013/2014

Dry Farmed Fields, 2013/2014

Sources:
Kern County Department of Agriculture and Measurement Standards (2013, 2014)
Kings County Agriculture Department (2014)
USGS National Hydrography Dataset (downloaded 2014)

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Map of Waterbodies and Irrigated Agricultural Fields

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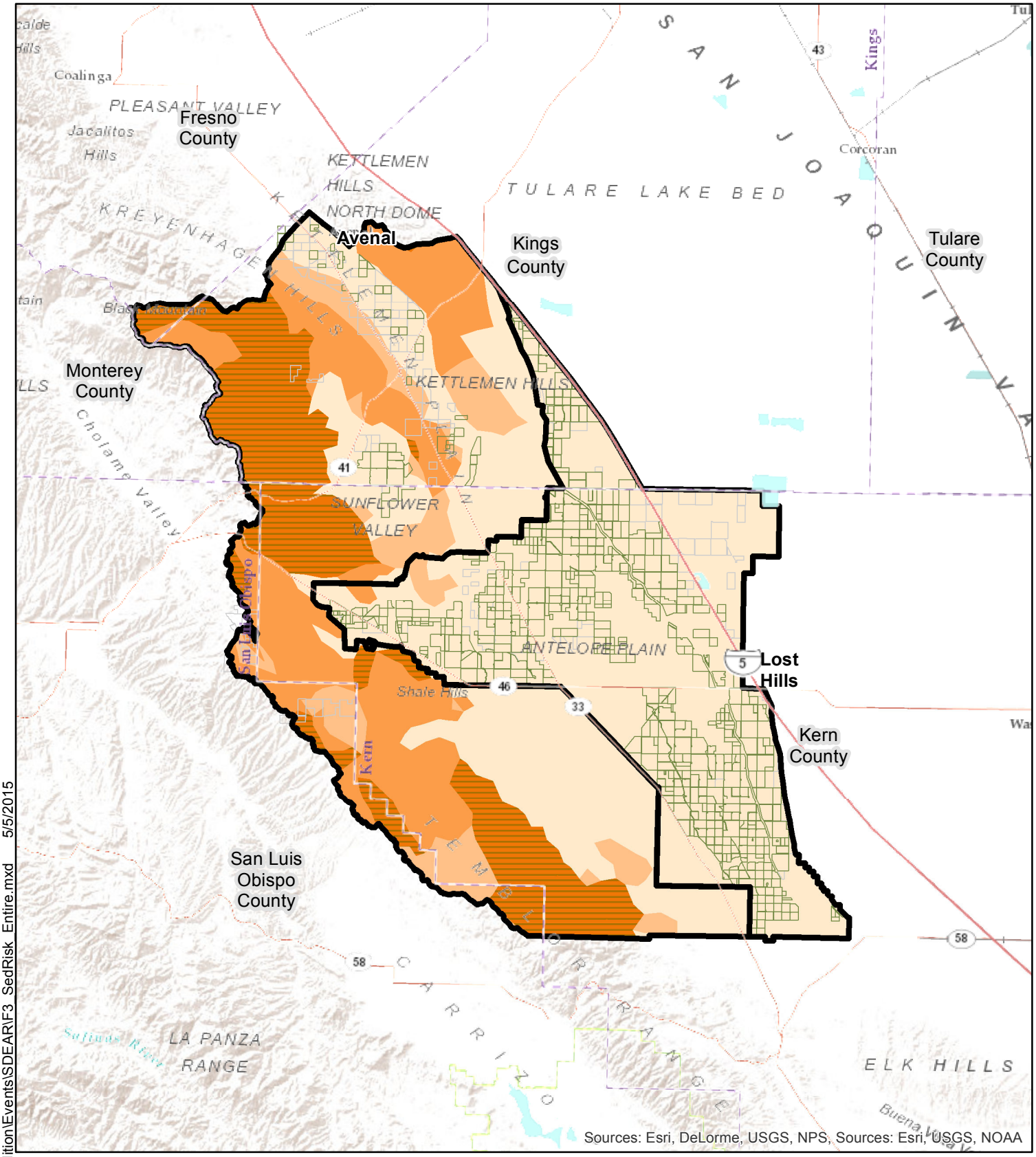
Figure 2



Calculated Sediment Risk

- 0 - 5 tons/acre: 408,672 acres (59%)
- 5 - 10 tons/acre: 53,798 acres (8%)
- 10 - 15 tons/acre: 116,228 acres (17%)
- 15 - 47 tons/acre: 109,400 acres (16%)
- Irrigated Agricultural Field, 2013/2014
- Uncultivated or Dry-Farmed Field, 2013/2014

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Sediment Risk Map for Entire Coaltion Area

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Figure 3

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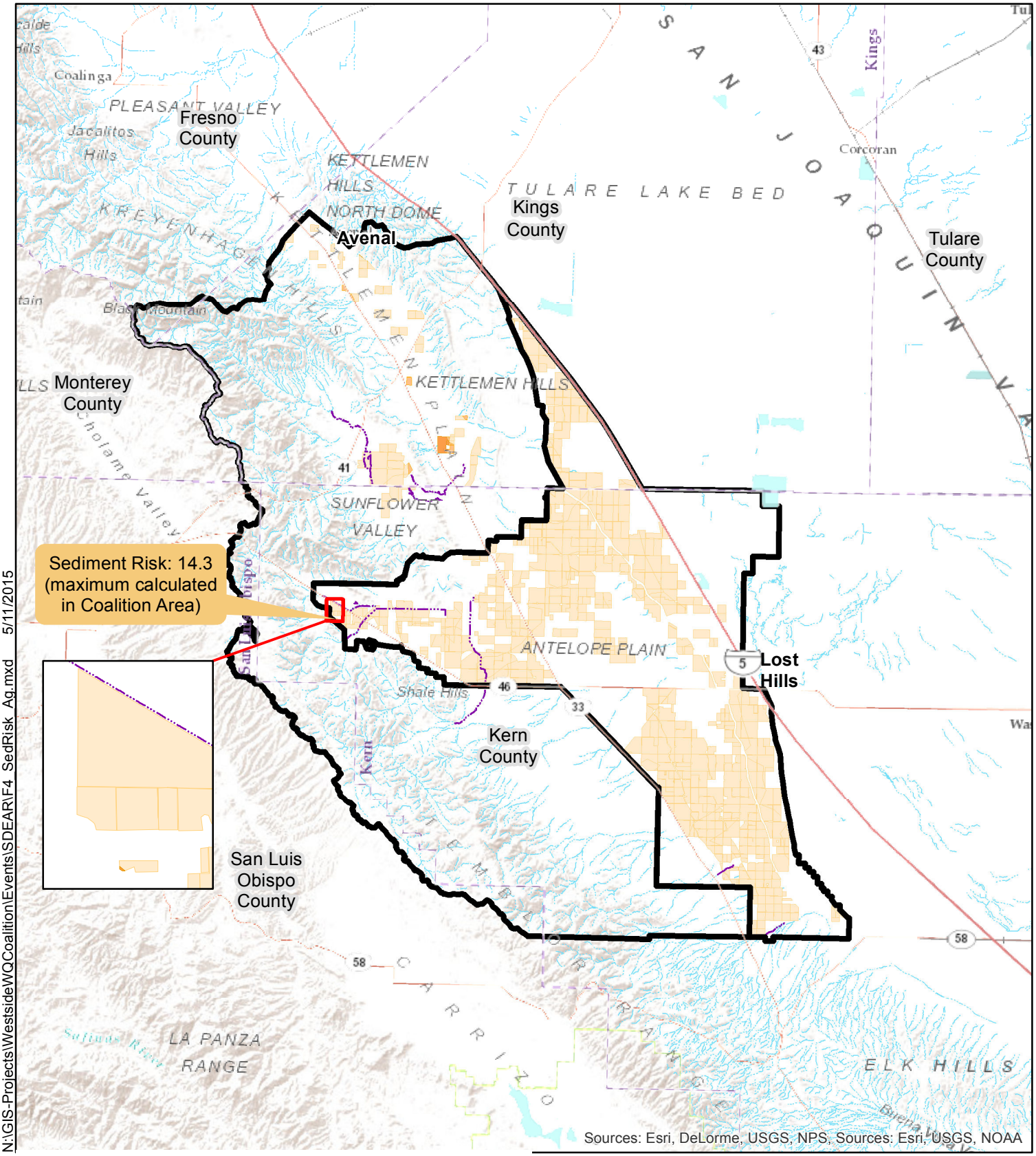

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Sediment Risk, Irrigated Agricultural Fields

- 0 - 5 tons/acre: 123,659 acres
- 5 - 10 tons/acre: 608 acres
- 10 - 15 tons/acre: 750 acres
- > 15 tons/acre: 0 acres
- Ephemeral or Intermittent Creek, downstream or adjacent to irrigated fields

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Sediment Risk Map for Irrigated Agricultural Fields in Coalition Area

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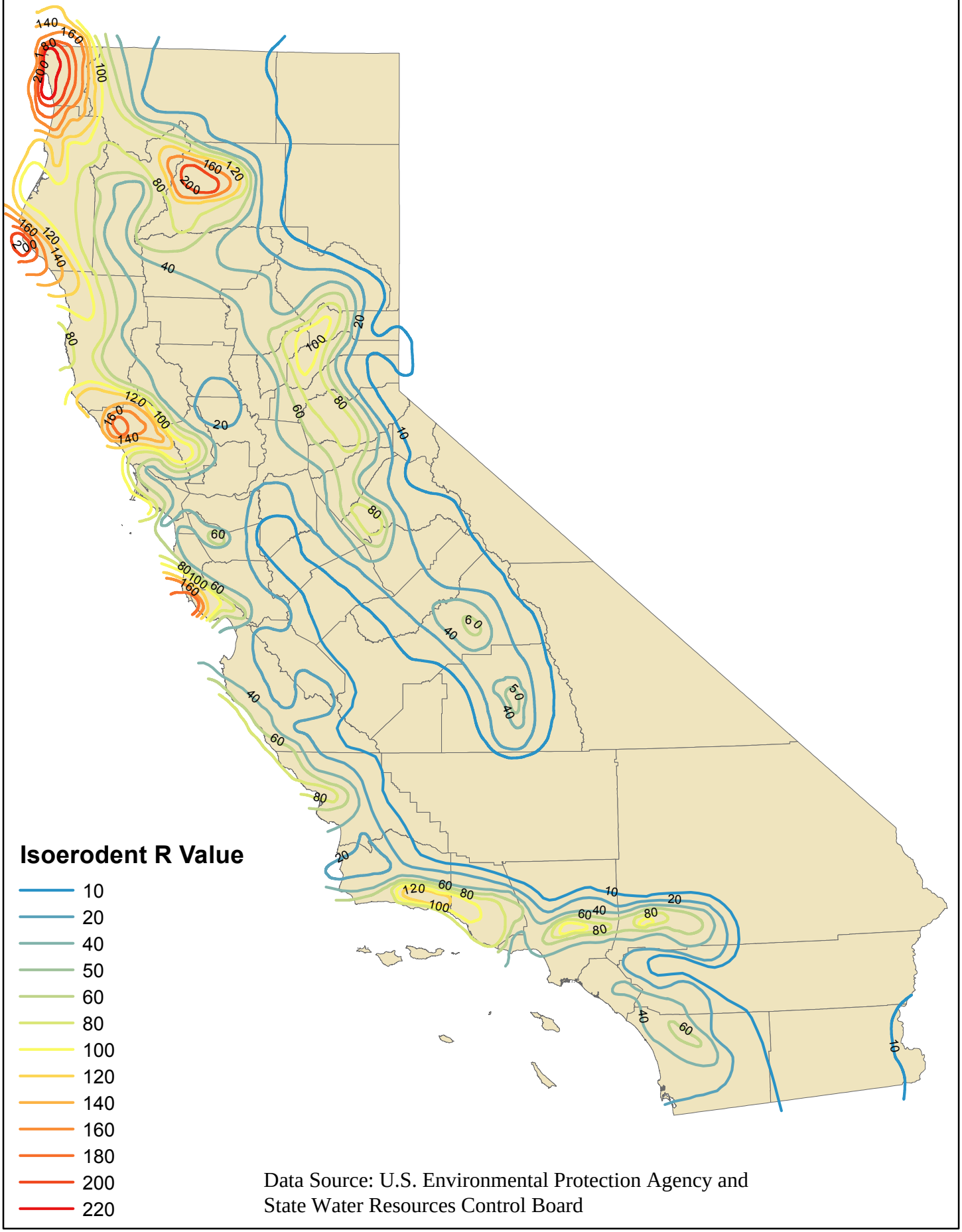
Figure 4

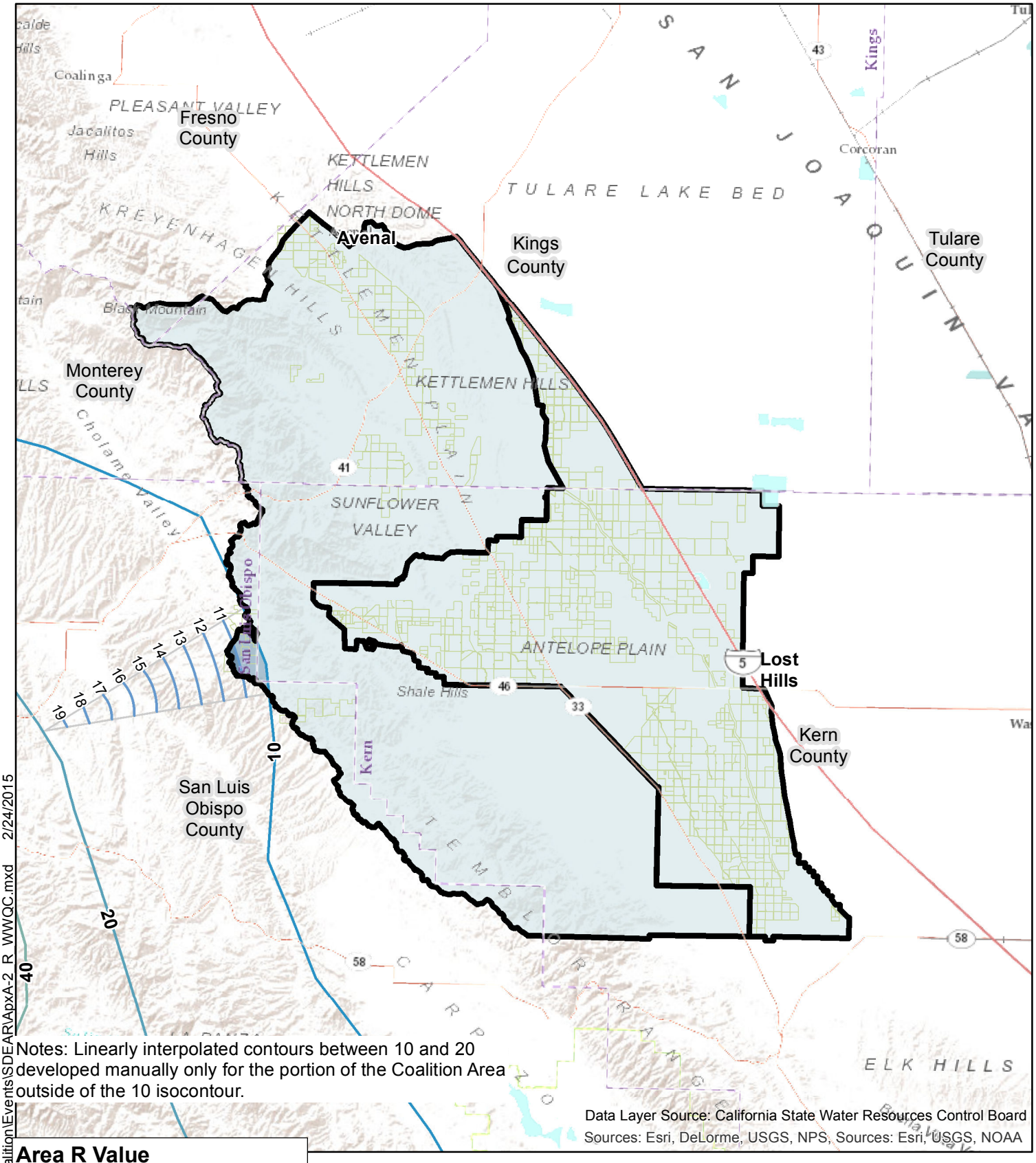
Appendix A

GIS Input Data Maps



Data Source: U.S. Environmental Protection Agency and
State Water Resources Control Board

Figure A-1



Notes: Linearly interpolated contours between 10 and 20 developed manually only for the portion of the Coalition Area outside of the 10 isocontour.

Data Layer Source: California State Water Resources Control Board
Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

Area R Value

- 10: 684,700 acres (99.5%)
- 11: 2,900 acres (0.4%)
- 12: 500 acres (0.1%)
- Isoerodent Contour (R Value)
- Coalition Area
- Agricultural Field, 2013/2014

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Isoerodent R Value Map for the Coalition Area

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Figure A-2

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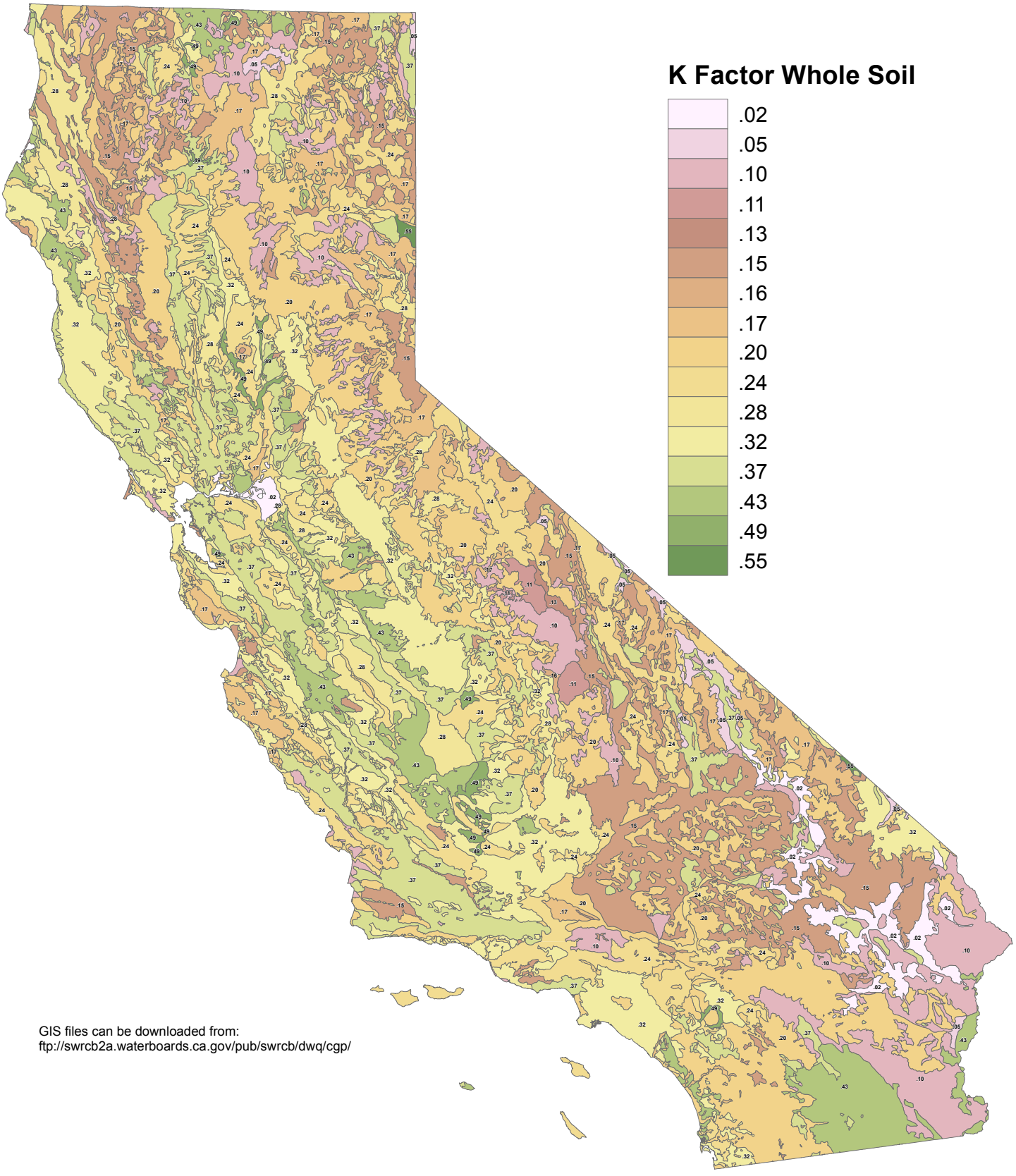
RUSLE K Values

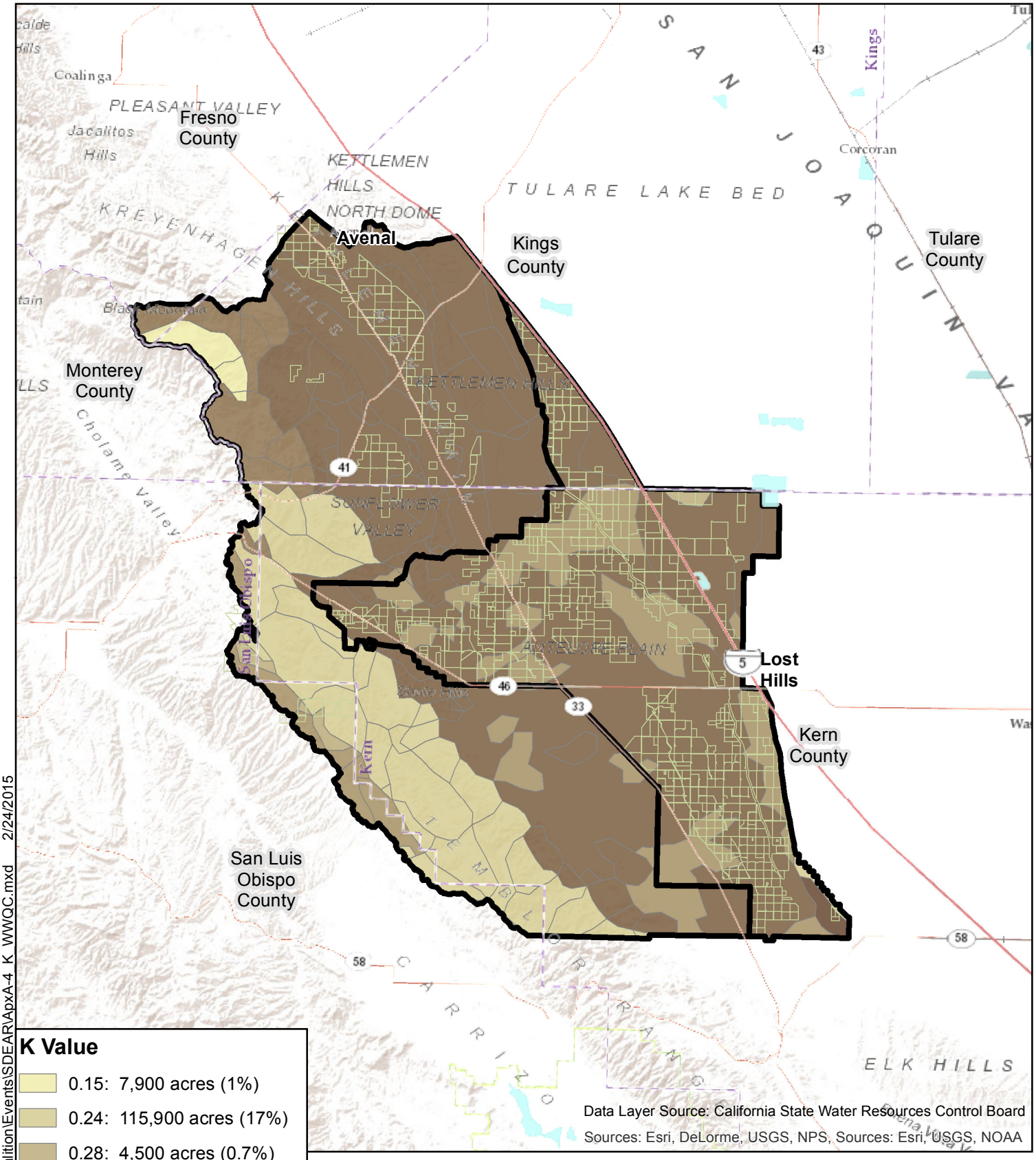


GIS files can be downloaded from:
ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/

Water Boards

Data Source: *Natural Resources Conservation Service, U.S. Dept. of Agriculture and State Water Resources Control Board*

Figure A-3



Data Layer Source: California State Water Resources Control Board

Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

K Value

- 0.15: 7,900 acres (1%)
- 0.24: 115,900 acres (17%)
- 0.28: 4,500 acres (0.7%)
- 0.32: 93,900 acres (13.6%)
- 0.37: 29,800 acres (4.3%)
- 0.43: 433,600 acres (63%)
- 0.49: 2,500 acres (0.4%)
- Coalition Area
- Agricultural Field, 2013/2014

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RUSLE K Value Map for the Coalition Area

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Figure A-4

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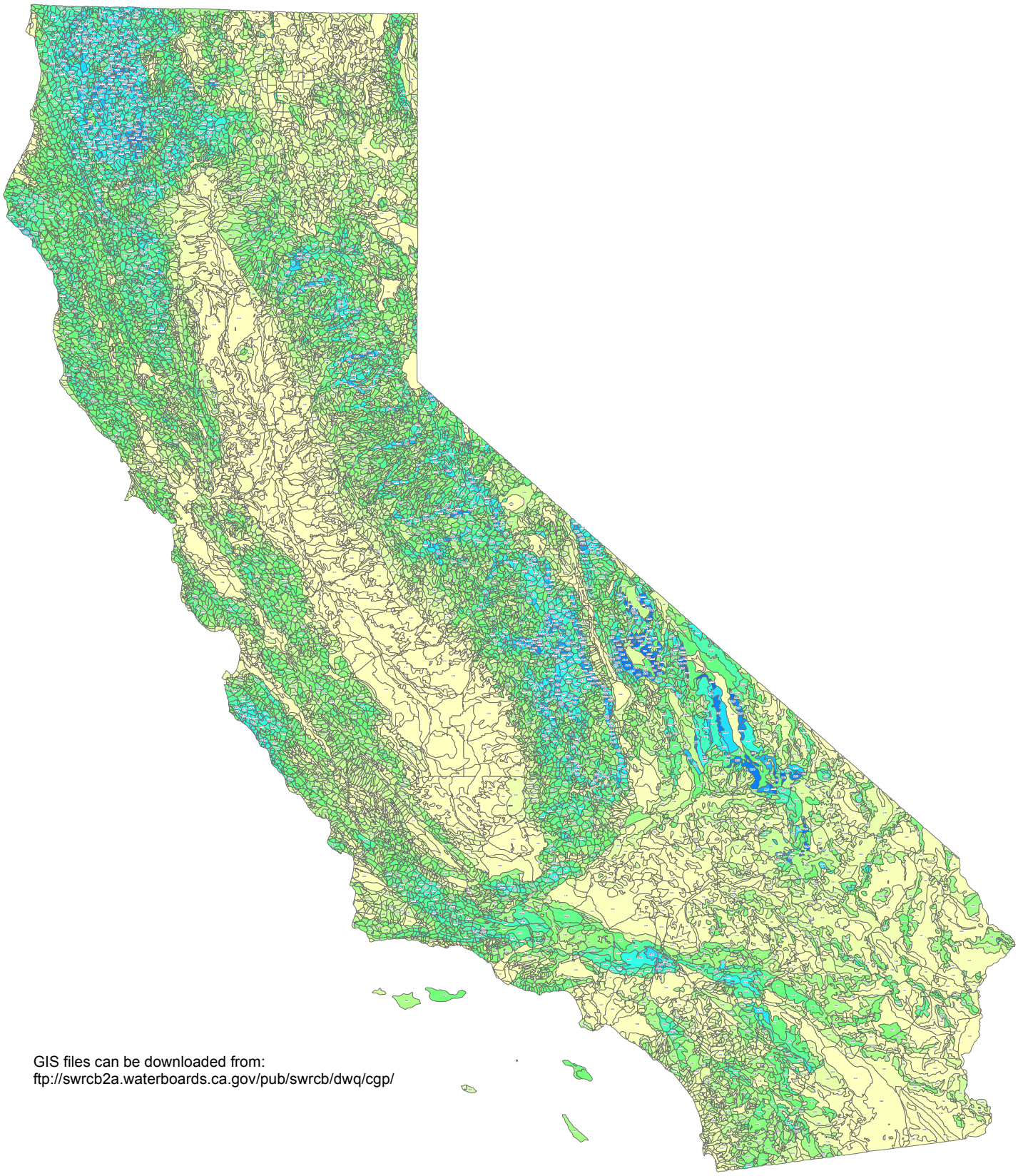
RUSLE LS Values



GIS files can be downloaded from:
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Water Boards

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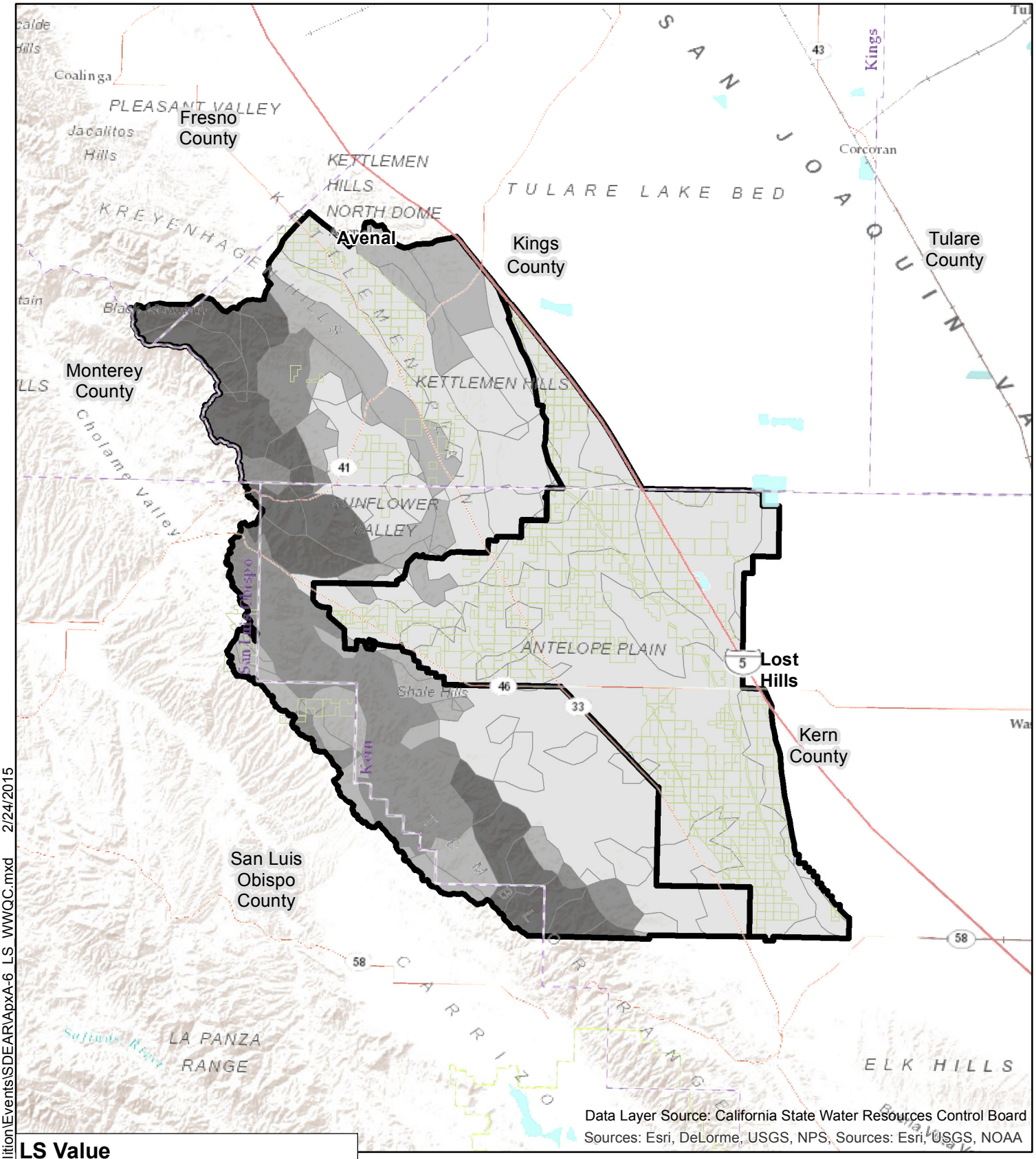
Data Source:*State Water Resources Control Board*

Figure A-5



LS Value

0.12 - 1.65:	431,900 acres	(63%)
1.89 - 4.30:	100,800 acres	(15%)
4.41 - 6.51:	76,900 acres	(11%)
7.23 - 12.70:	48,500 acres	(11%)

Coalition Area

Agricultural Field, 2013/2014

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RUSLE LS Value Map for the Coalition Area

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Figure A-6

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