San Joaquin Valley Drainage Authority

Westside San Joaquin River Watershed Coalition

Sediment Discharge and Erosion Assessment Report

In compliance with Order R5-2014-0002

March 17, 2015

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Introduction

The Westside San Joaquin River Watershed Coalition (Westside Coalition) serves as the Third Party Group for member growers in the western part of the San Joaquin River watershed for the purpose of implementing applicable portions of the Irrigated Lands Regulatory Program (IRLP) as specified in Order Number R5-2014-0002 (Order). The Westside Coalition spans from approximately Mendota on the South to Tracy on the North, and is approximately bounded by the San Joaquin River on the West and the ridgeline of the Coastal Mountain Range on the East, although the majority of agricultural activity stops near Interstate 5.

The Order requires the Westside Coalition to assess the coalition area for lands that may be susceptible to water-driven soil erosion that would result in the discharge of sediment into waterways. This report summarizes the results of that assessment in compliance with the Order.

Background

Waterborne sediment is discharged by the movement of water across the ground. In the case of non-farmed or undeveloped areas, this is typically limited to rain induced runoff. Farmed areas add irrigation practices as a mechanism that can contribute the discharge of sediment. Surface irrigation methods such as furrow and flood irrigation, which rely on gravity to move water across the field, are particular contributors to sediment discharge potential.

This assessment evaluated practical factors related to topography and soil characteristics. It is important to note that this assessment focused on the potential for soil erosion and sediment discharge within the Westside Coalition area, regardless of the level of development or membership.

Method and Approach

There are a number of established methods for estimating and modeling erosion and soil loss, ranging from relatively simple to highly complex. The details and specifics of these various approaches have been described by others and will not be reviewed here. The Westside Coalition utilized variations of the Revised Universal Soil Loss Equation (RUSLE) and the Modified Universal Soil Loss Equation (MUSLE). This approach was selected because:

- The method is capable of estimating soil loss in terms of tons per acre per year for a large area.
- The method accounts for relevant and applicable characteristics such as soil texture and topographic gradient.
- The data necessary to perform the calculations is available and relatively complete.
- The method is identical to approaches used by adjacent Third-Party Groups, most specifically the East San Joaquin River Water Quality Coalition. This provides consistent analysis and results from growers across the central valley, and provides a fair evaluation for members of both Coalitions.

The revised universal soil loss equation is:

$$A = R * K * L * S * C * P$$

Where:

A is the annual soil loss in terms of tons per acre per year

R is the rainfall erosivity factor derived from rainfall intensity and storm energy

K is the soil erodibility factor derived from soil properties

L is the slope length factor

S is the slope-gradient factor

C is the crop management factor

P is the conservation practice factor

As the purpose of this evaluation is to assess the potential to discharge sediment discharge, some of these factors can be simplified and others are acquired from available geographic information system (GIS) data. The primary factors driving the soil loss calculations are the rainfall intensity (R), the soil erodibility characteristics (K) and the field slope and slope length (L & S). Although crop management practices (C) and conservation practices (P) would certainly impact actual soil loss, these factors could change over time with crop rotations and ownership changes, and therefore do not reflect the potential for sediment discharge. For the purposes of this evaluation, factors C and P were considered constants across the Westside Coalition, and the soil loss equation used topographic and soil physical characteristic GIS data to estimate the geographic potential for soil loss within the Westside Coalition.

Data for rainfall erosivity, soil erodibility, slope and length factors were obtained from the Regional Water Quality Control Board's FTP site. The URL is below.
ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/

The K factor for each soil type was developed by the Regional Water Quality Control Board based on soil data from NRCS and is shown in Figure 1. Soils with low erodibility potential are either clayey soils or sandy soils. Clayey soils tend to have low erosion potential due to cohesive properties. Sandy soils tend to resist erosion due to high permeability/low surface runoff. Silty/loamy soils tend to have the high K values due to low permeability and minimal cohesive properties. According to the data, a strong majority of soils in the Westside coalition fall within the silty/loamy category with some lower K values occurring in the northerly areas of the coalition.

The L and S (LS) factors were also developed by the regional board using a 30 meter digital elevation model, see Figure 2. The LS factor corrects the product of R and K based on topography since the accumulation of runoff and the velocity thereof is dependent on slope length and gradient respectively.

The R factor was obtained from isoerodent maps developed by the USDA's Soil Conservation service, Agricultural Research Service and others and is shown in Figure 3. The majority of Coalition has an R value of 10 ton ft in/acre hr year. Values of 20 and 40 occur moving westward into the coastal mountain range.

Determination and Results

The soil loss equation predicted the average annual soil loss potential in terms of tons per acre per year on a geographic basis across the Westside Coalition. For a given area or property to be considered vulnerable for sediment discharge, a threshold of 5 tons per acre per year was used. This value was specified by the National Resource Conservation Service (NRCS) as a standard for sustainable farming, fields with a soil loss exceeding 5 tons per acre per year cannot sustain long-term farming.

Figure 4 shows the sediment and erosion potential for the Westside Coalition based on the soil loss equation model. The model predicts very few agricultural areas with potential for soil loss exceeding 5 tons/acre/year. One high vulnerability area east if the I-5 was identified near Stevinson, east of the San Joaquin River. Sediment discharge has been observed in areas that the RUSLE did not predict using the 5 ton/acre/year threshold. In order to address this issue and supplement the RUSLE results, recent sediment toxicity and total suspended solids (TSS) measurements (occurring in or after January, 2012) were reviewed.

The presence of sediment in water at a monitoring location was determined by reviewing TSS readings. The West Stanislaus Resource Conservation Service and the Natural Resource Conservation Service set a target threshold/goal for TSS readings at 300 mg/L for the West Stanislaus Hydrologic Unit Area. For the purposes of this review, the 300 mg/L threshold was used. Monitoring sites with more than 20% of the readings exceeding the 300 mg/L threshold over the study period were considered significant. Figure 5 shows the monitoring sites and associated watershed boundaries having significant TSS readings.

The quality of the sediment at monitoring sites was determined by review of sediment toxicity tests. A *Hyalella azteca* survival rate of less than 80% occurring more than one time over the study period was considered significant. Figure 6 shows the monitoring sites with significant sediment toxicity based on the study criteria.

A combination of soil loss potential, significant TSS readings and observed sediment toxicity is presented in Figure 7. This combination shows the areas which have high sediment erosion potential according to RUSLE and areas with high sediment toxicity and TSS readings. These areas may be considered as vulnerable for sediment discharge and erosion potential.

References

United States Department of Agriculture. Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation. January 1997.

State Water Resources Control Board. RUSLE K Factor Watershed Map Methodology. ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/

State Water Resources Control Board. RUSLE LS Factor Watershed Map Methodology. ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/

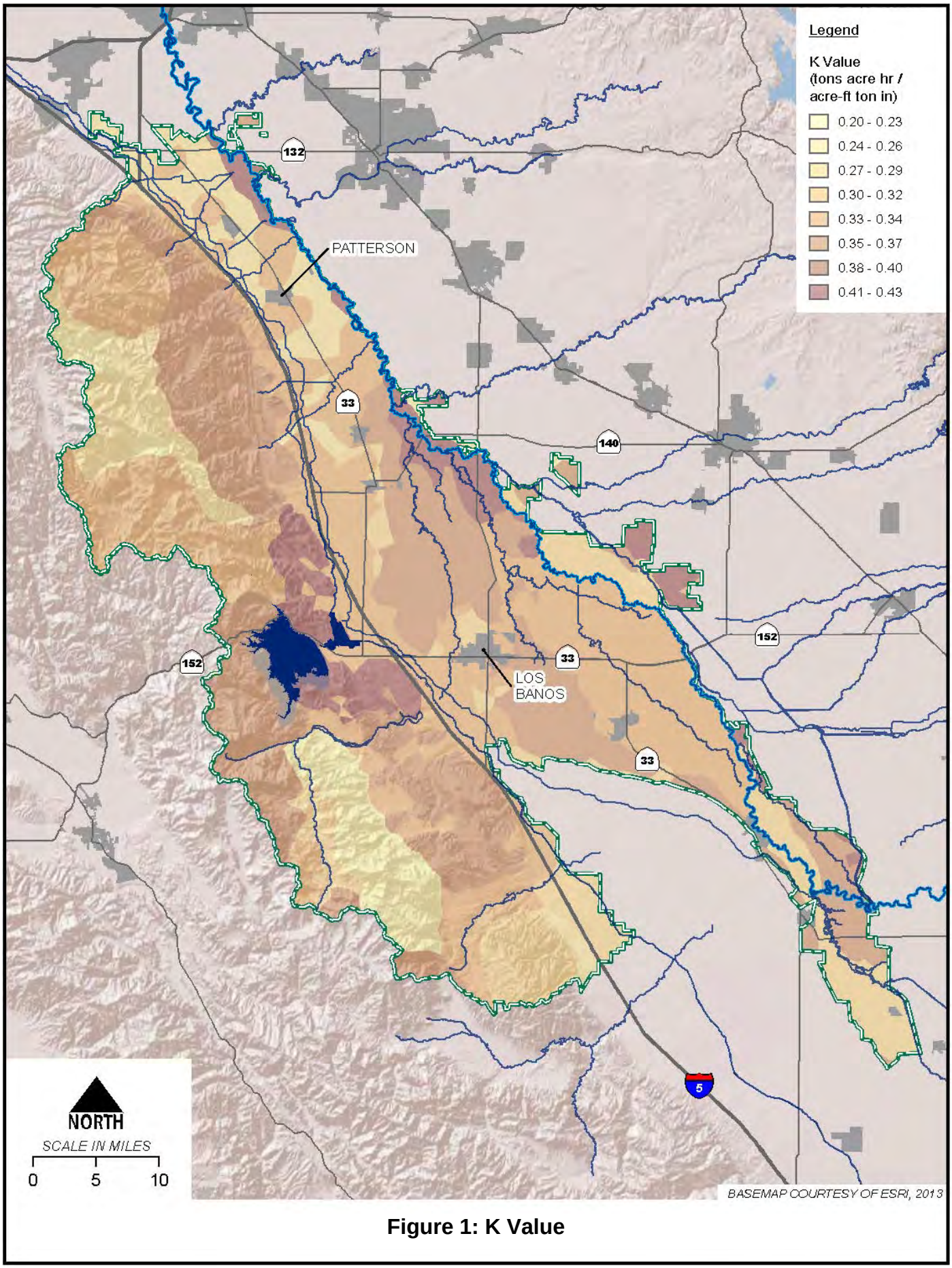

Figure 1: K Value

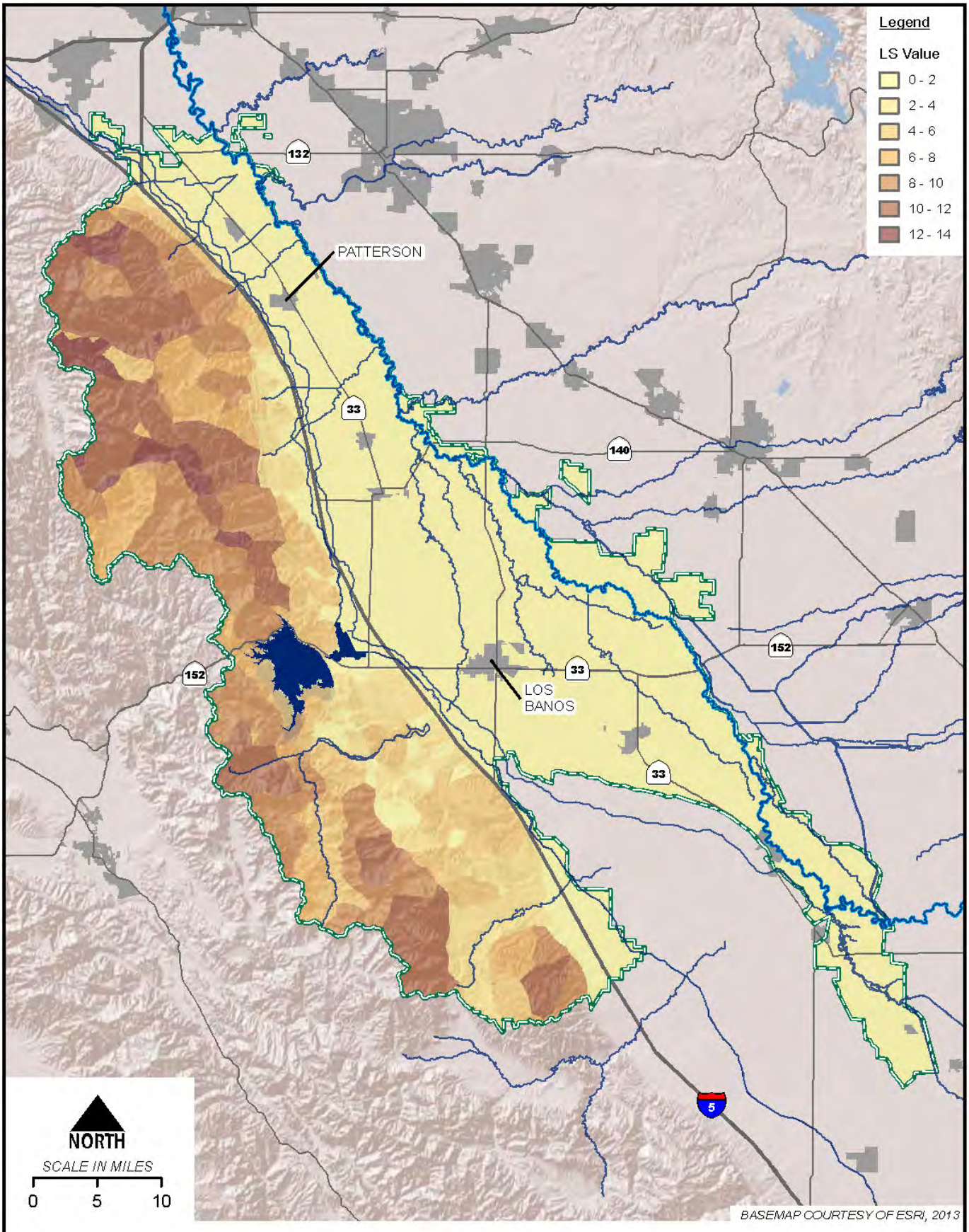

Figure 2: LS Value

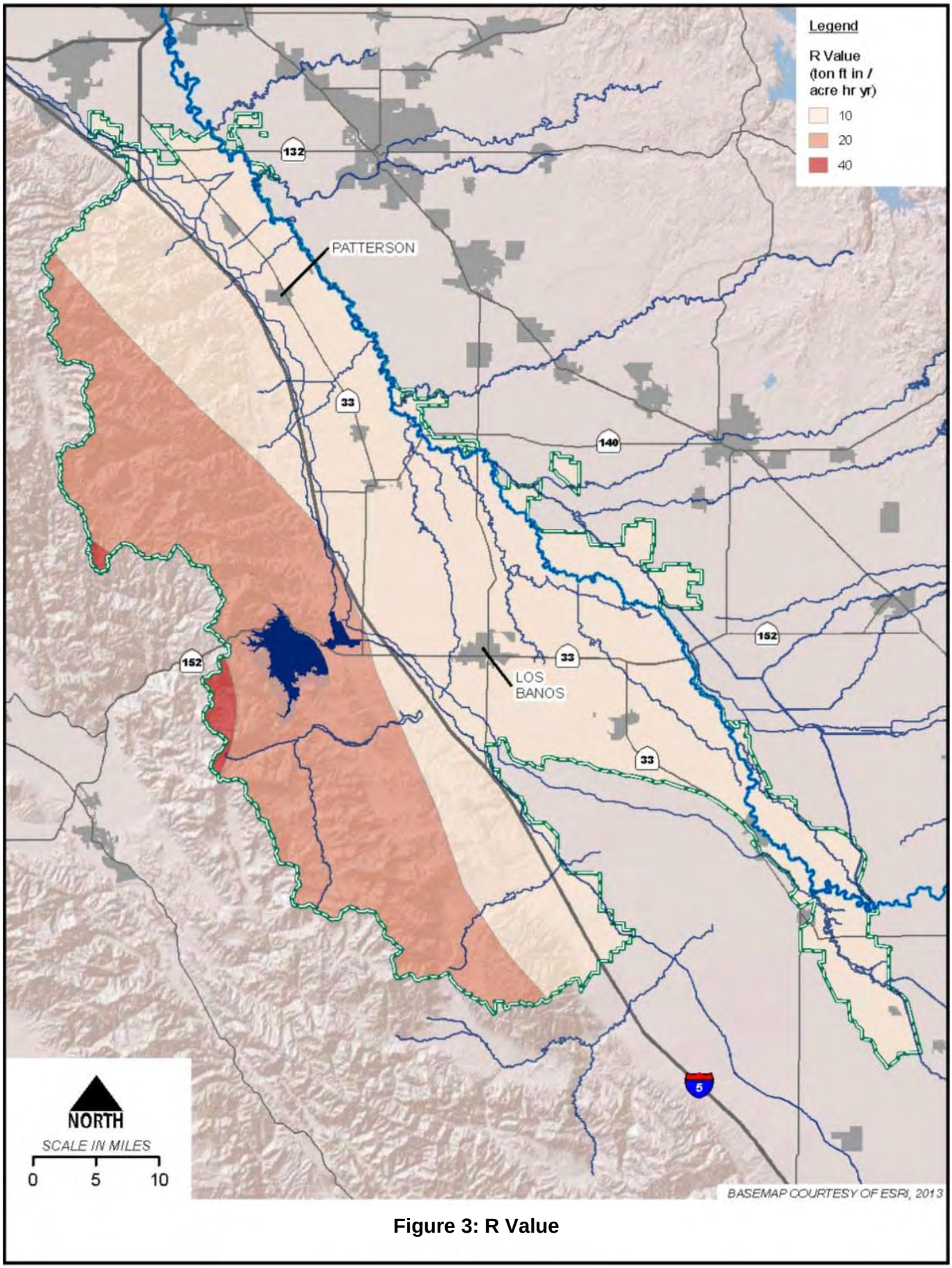

Figure 3: R Value

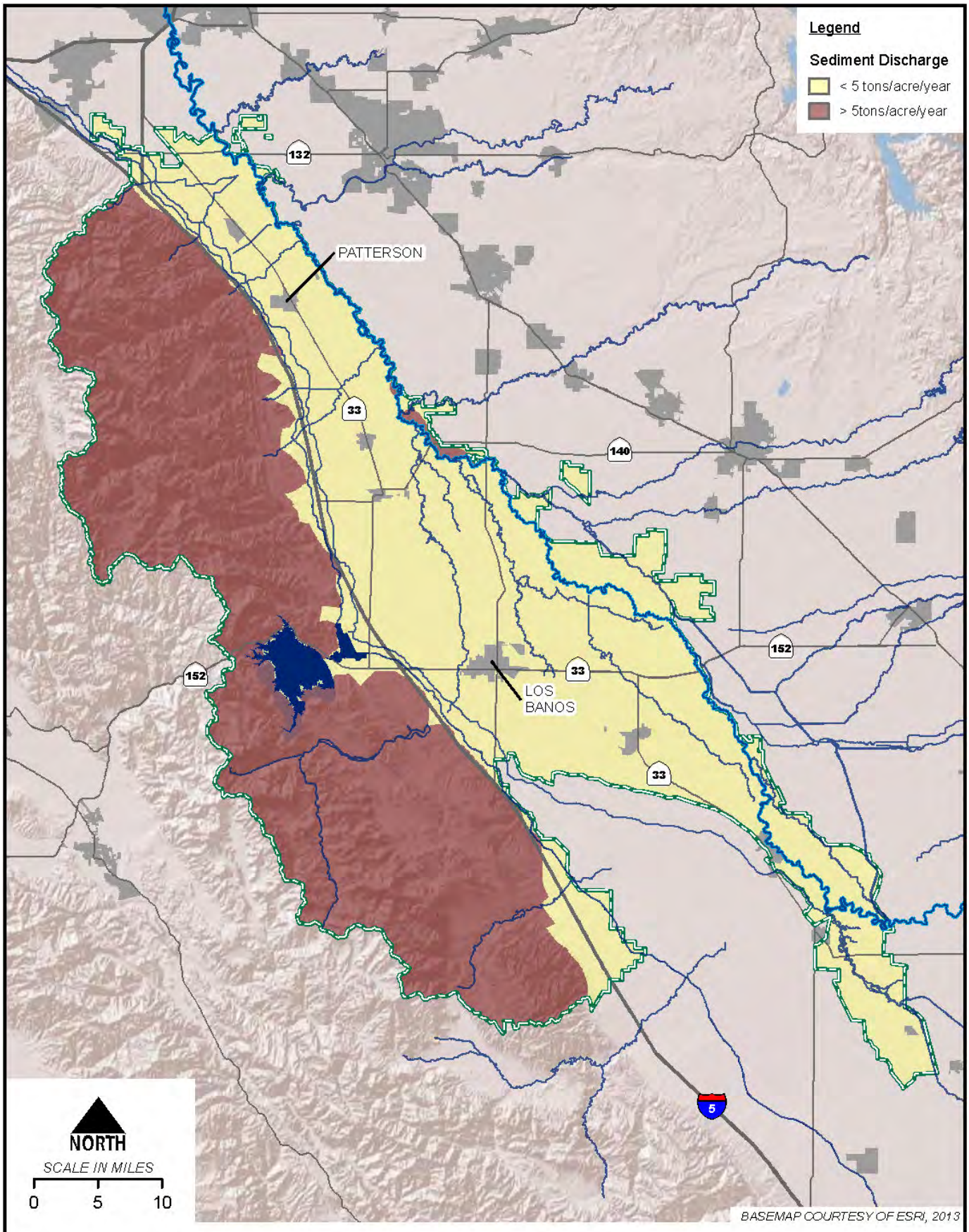

Figure 4: RUSLE Sediment Discharge and Erosion Potential

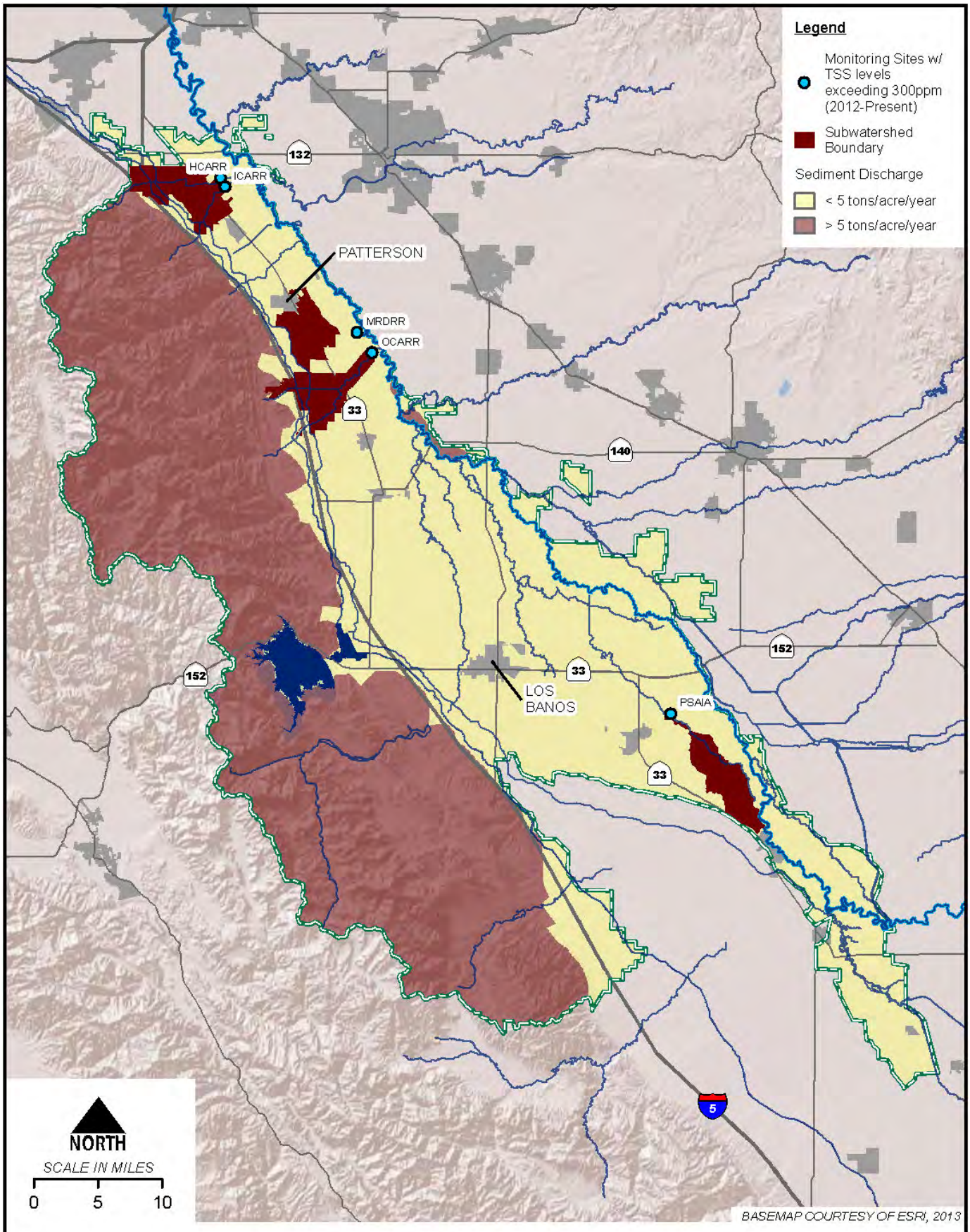

Figure 5: Monitoring Sites with Significant TSS Results

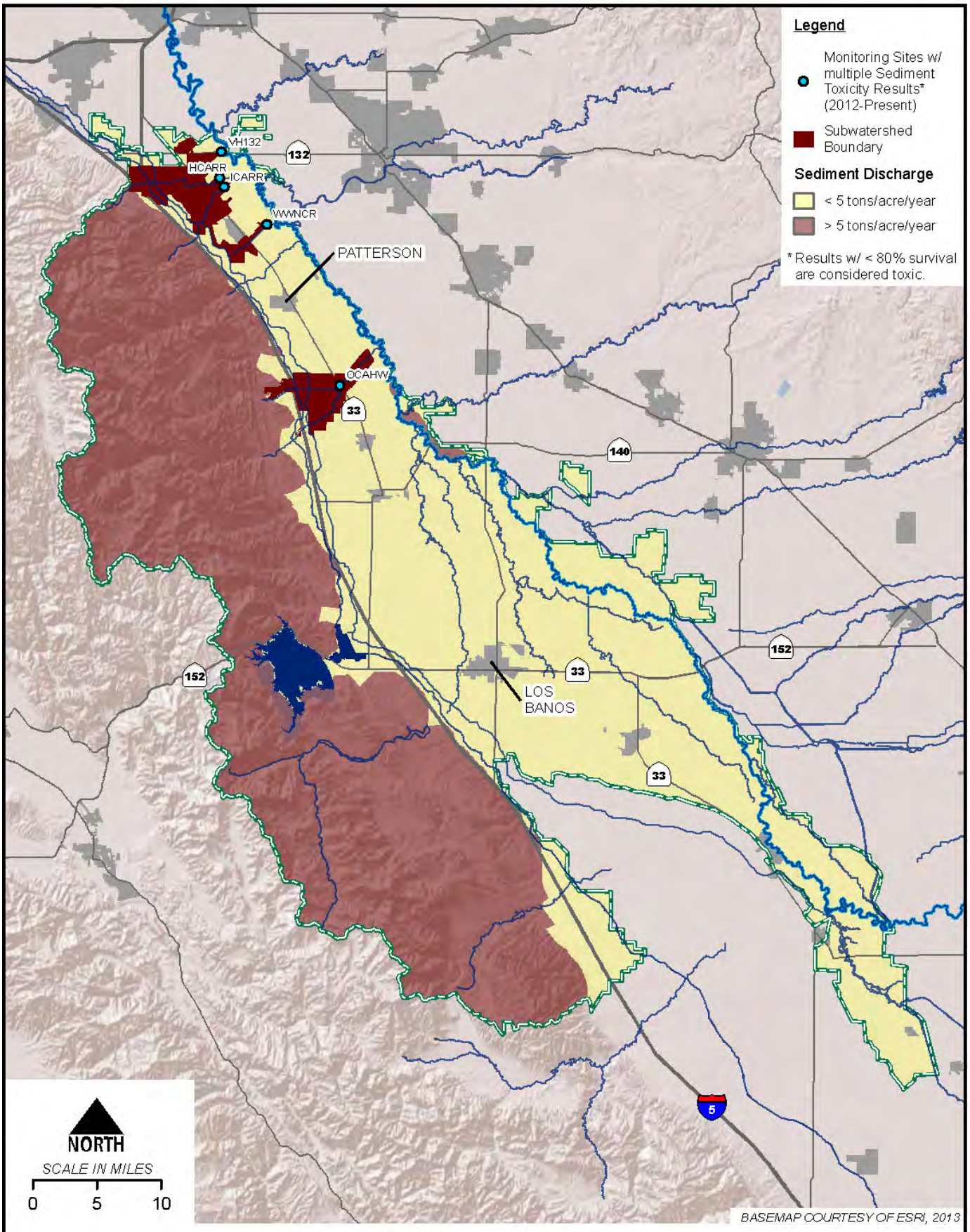

Figure 6: Monitoring Sites with Significant Toxicity Results

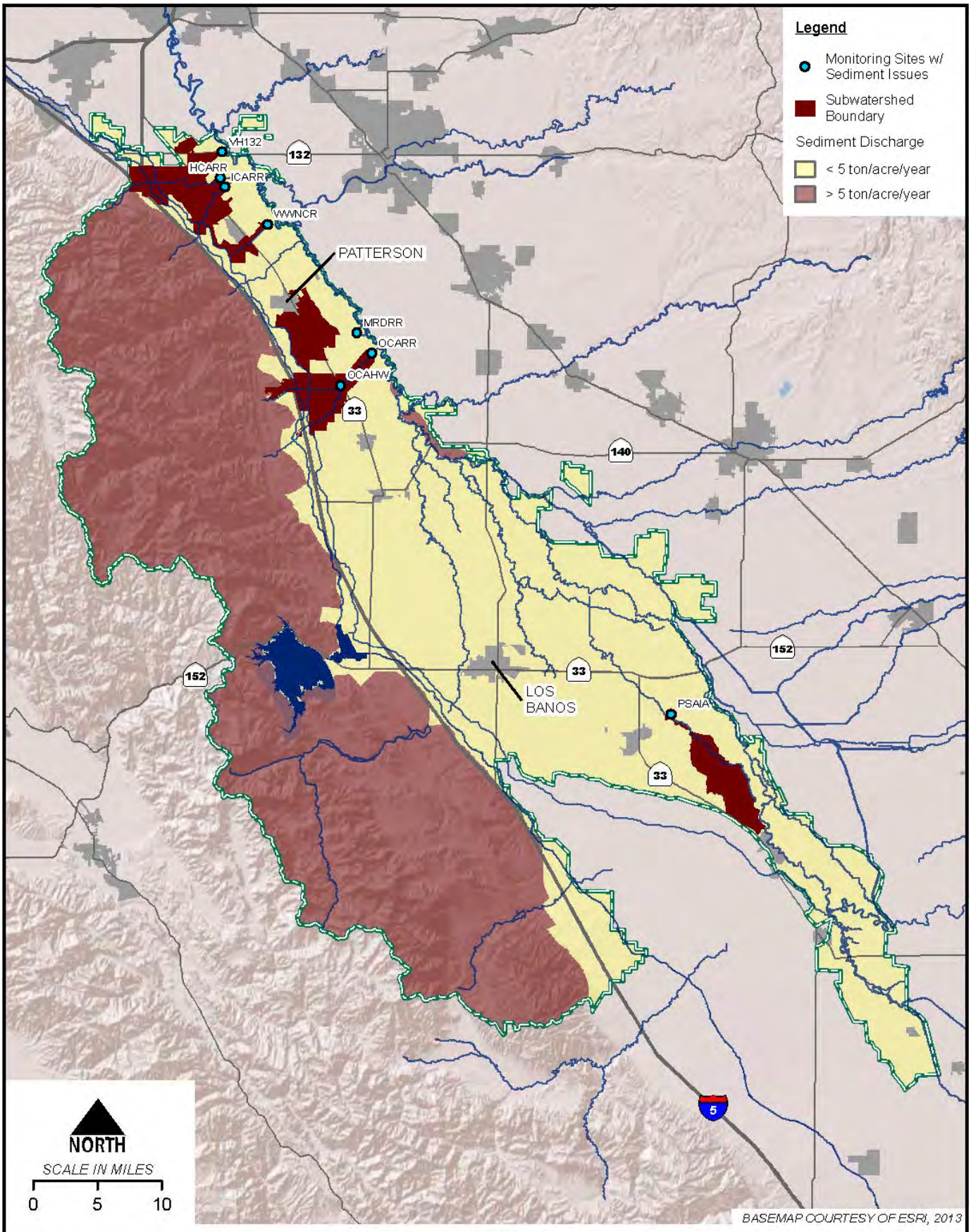

Figure 7: Areas with Sediment Discharge and Erosion Potential