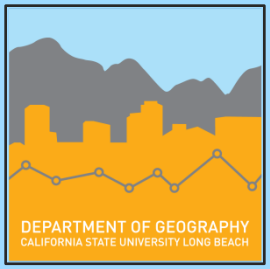
BIOASSESSMENT OF STREAM HEALTH IN THE SANTA ANA WATERSHED USING GEOGRAPHIC WEIGHTED REGRESSION



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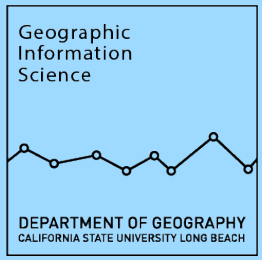
19 November 2014

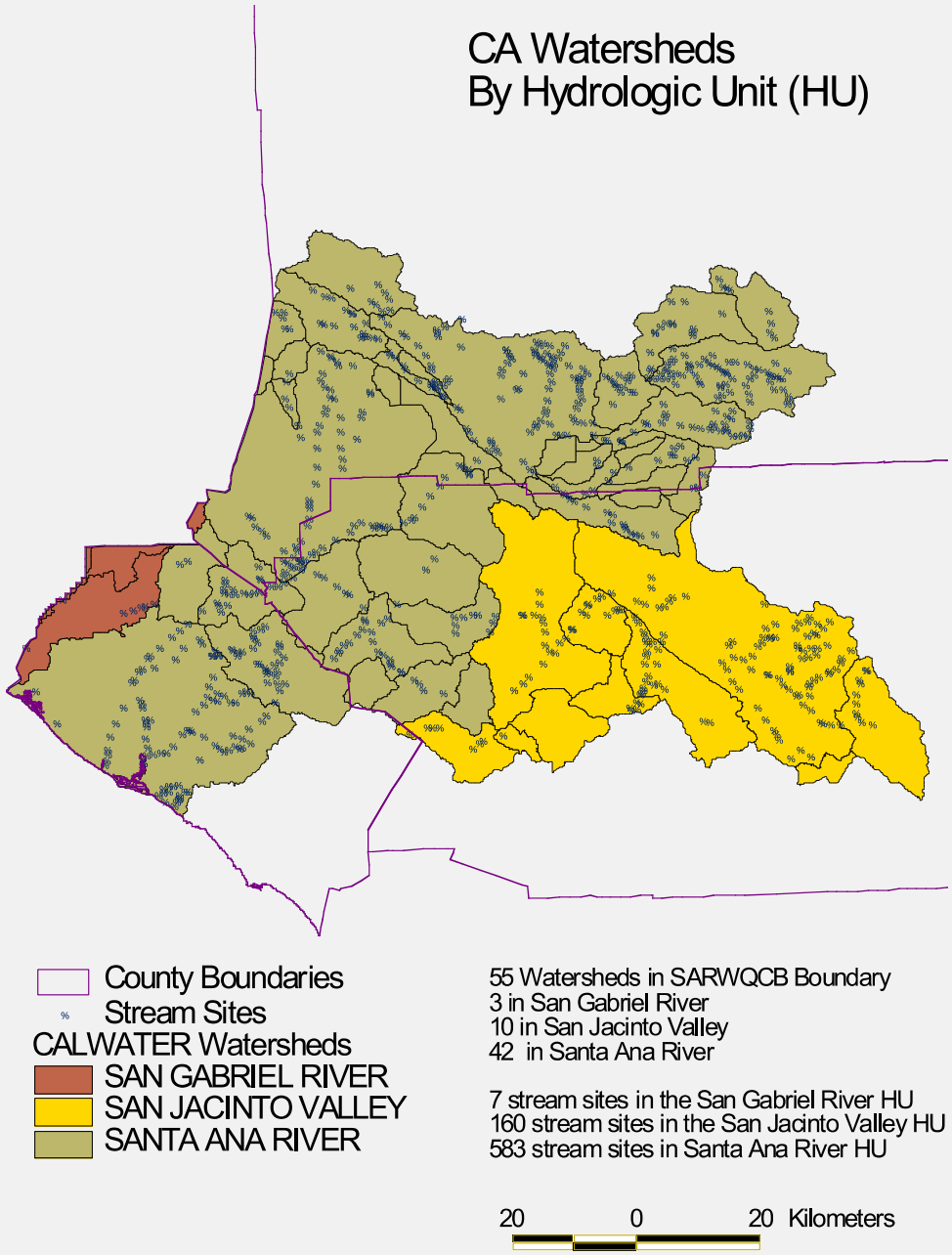
CABW Presentation

Master of Science in Geographic Information Science



STUDY AREA

- Region 8: Located in southern California, the Santa Ana watershed flows west from the San Bernardino Mountains through urban, industrial, commercial, and agriculture land use types, before entering the Pacific Ocean.
- Covers four counties (San Bernardino, Riverside, Los Angeles, and Orange)
- 6 million people in 2010



Sites were categorized into three elevation strata within two hydrologic units to ensure sampling occurred throughout the region each year.

Two hydrologic units:

San Jacinto

Santa Ana

Elevation strata:

0 - 350 meters

350 - 700 meters

700+ meters

SITES SAMPLED

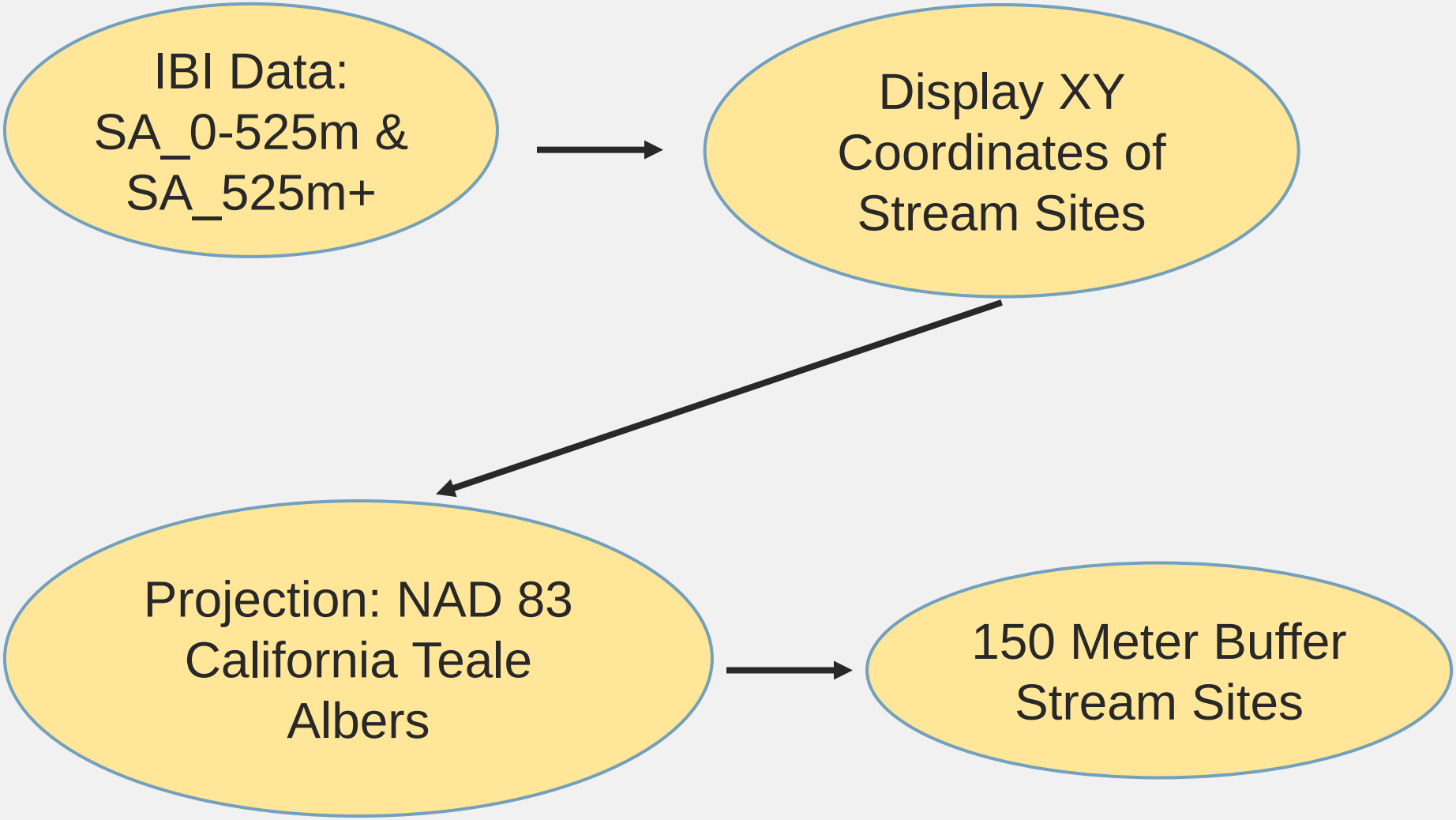
	Total	2006	2007	2008	2009	2010	2011	Total
SA_0-350	237	7	2	14	14	9	12	**46**
SA_350-700	127	8	3	4	3	9	2	**27**
SA_700+	226	7	16	12	13	9	8	**57**
SJ_350-700	93	3	3	0	0	0	0	**6**
SJ_700+	67	5	6	4	5	4	0	**24**
	750	30	30	34	35	31	22	**182**

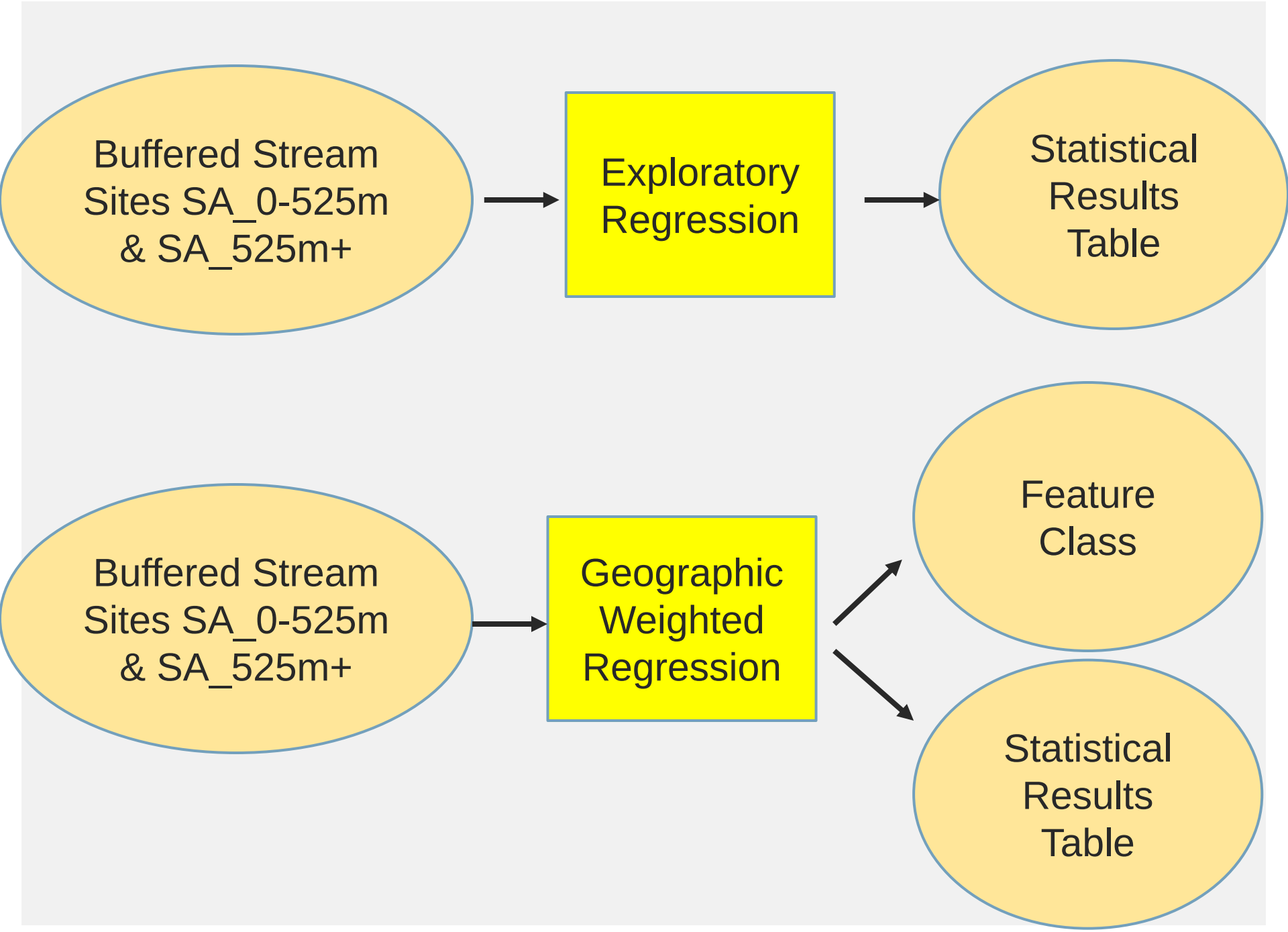
GIS

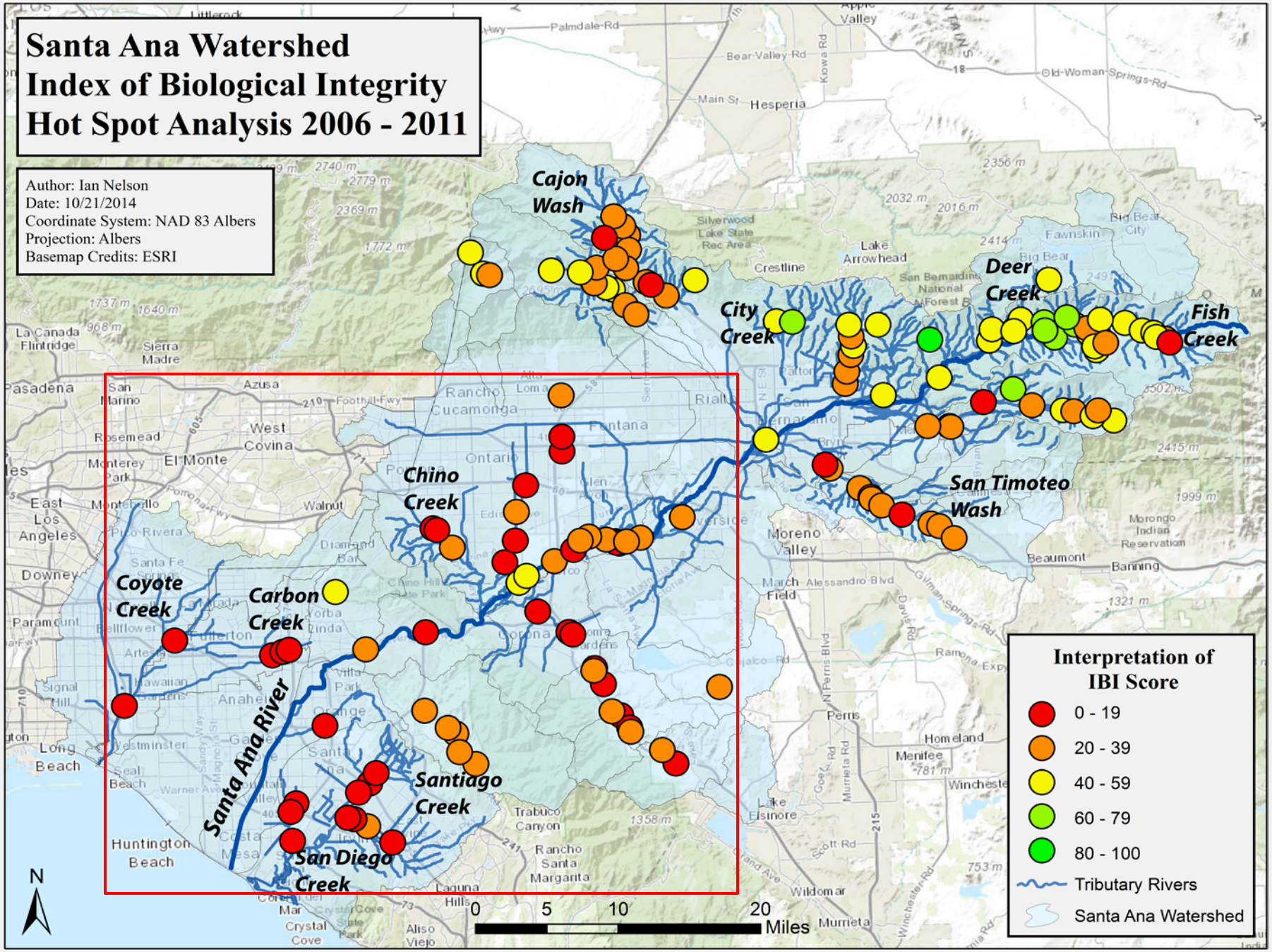
- **GIS for Bioassessment/Casual Assessment/Watershed Management**
  - Visually representing data
  - Geographic patterns of BMI's
  - Spatial statistics
  - Trend monitoring
  - Identify areas of interest (regions of streams most at risk)
  - Facilitate information to stakeholders

DATA AND DATA SOURCES

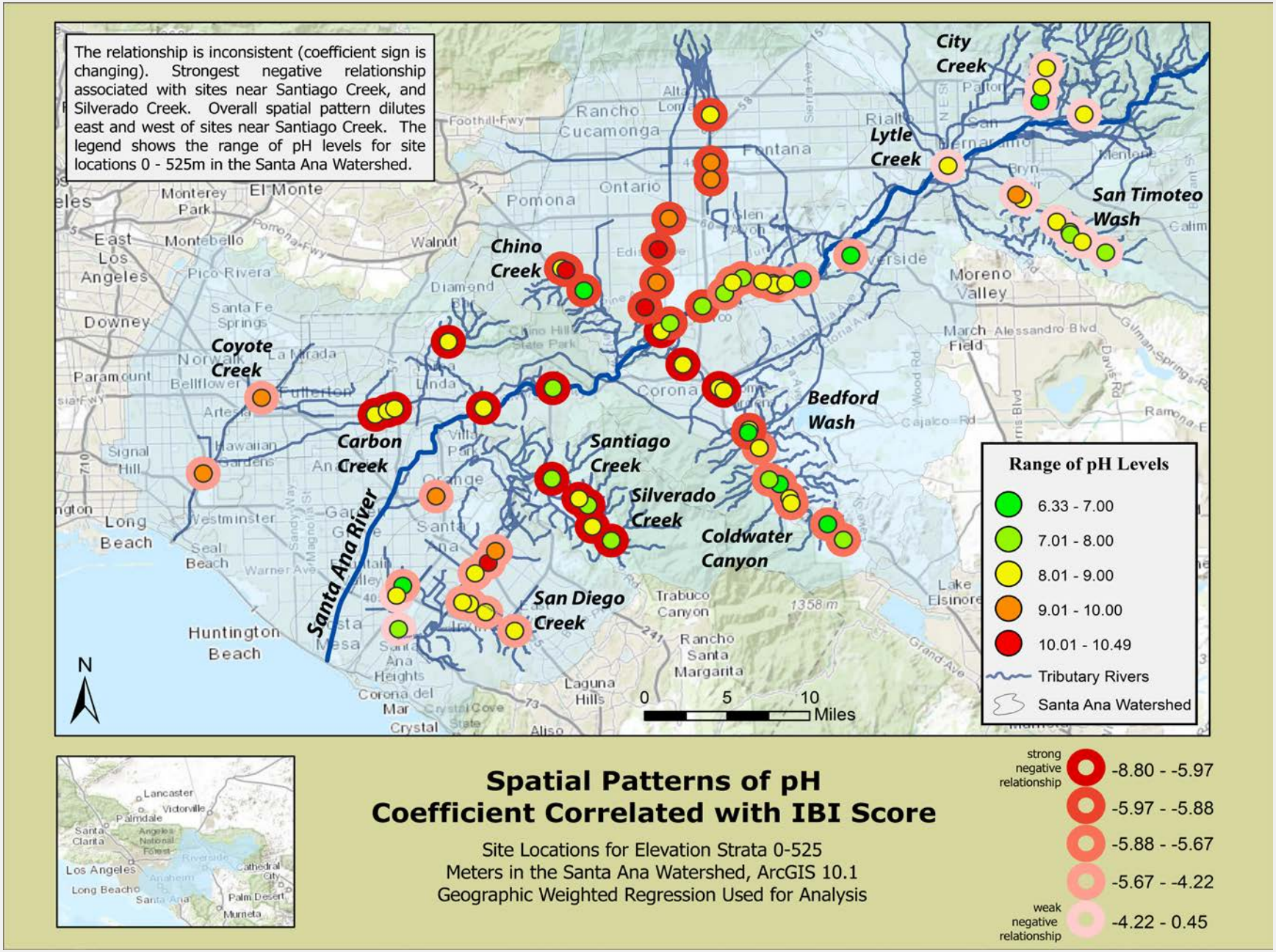
Dataset	Source
WATERSHEDS	CALWATER (WWW.CALWATER.ORG)
RIVERS	CALWATER (WWW.CALWATER.ORG)
BASE MAP	ESRI ARCGIS 10.1
INDEX OF BIOLOGICAL INTEGRITY (IBI)	DR. DESSIE UNDERWOOD

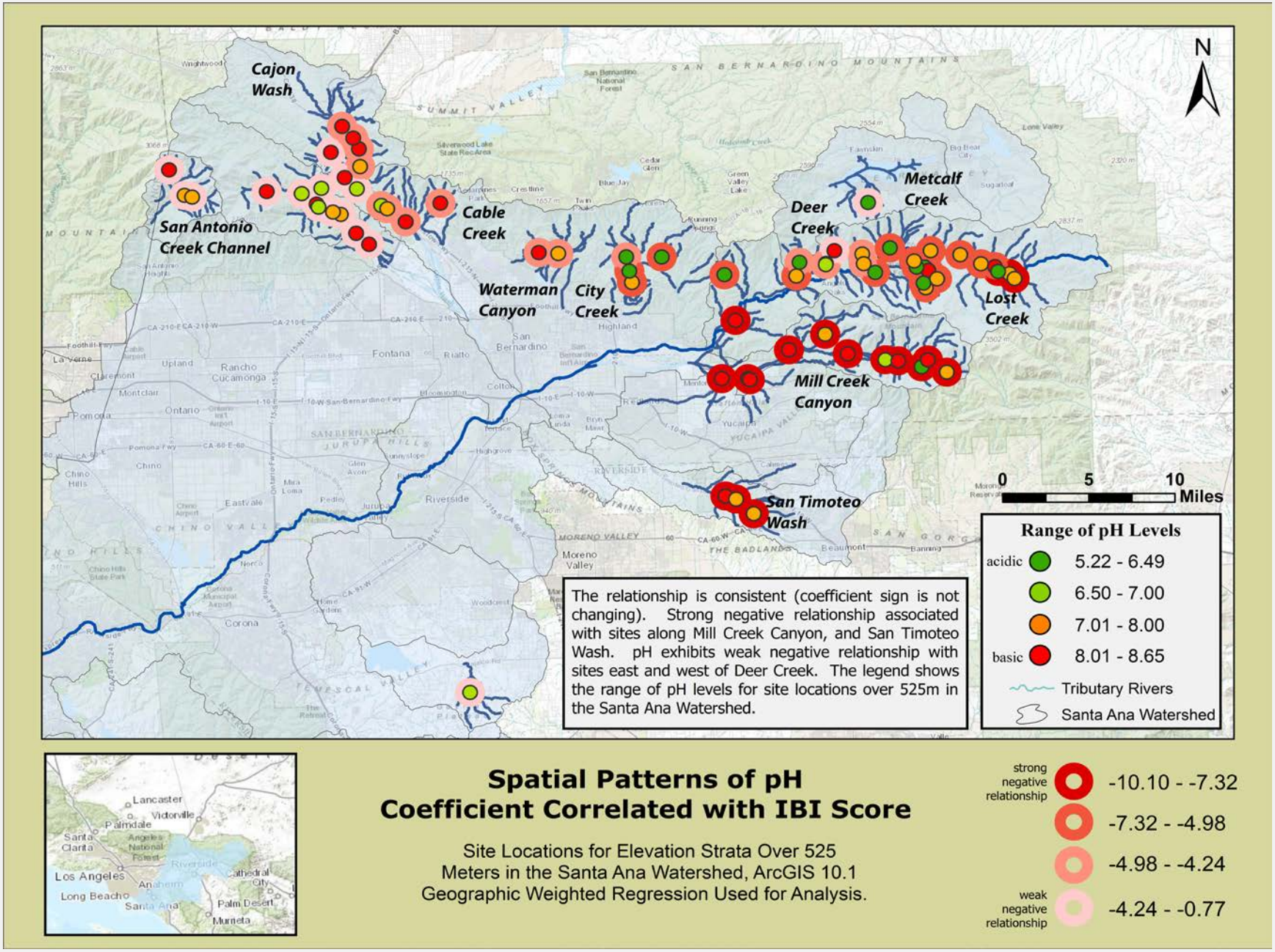

IBI Data:
SA_0-525m &
SA_525m+
Display XY
Coordinates of
Stream Sites
Projection: NAD 83
California Teale
Albers
150 Meter Buffer
Stream Sites

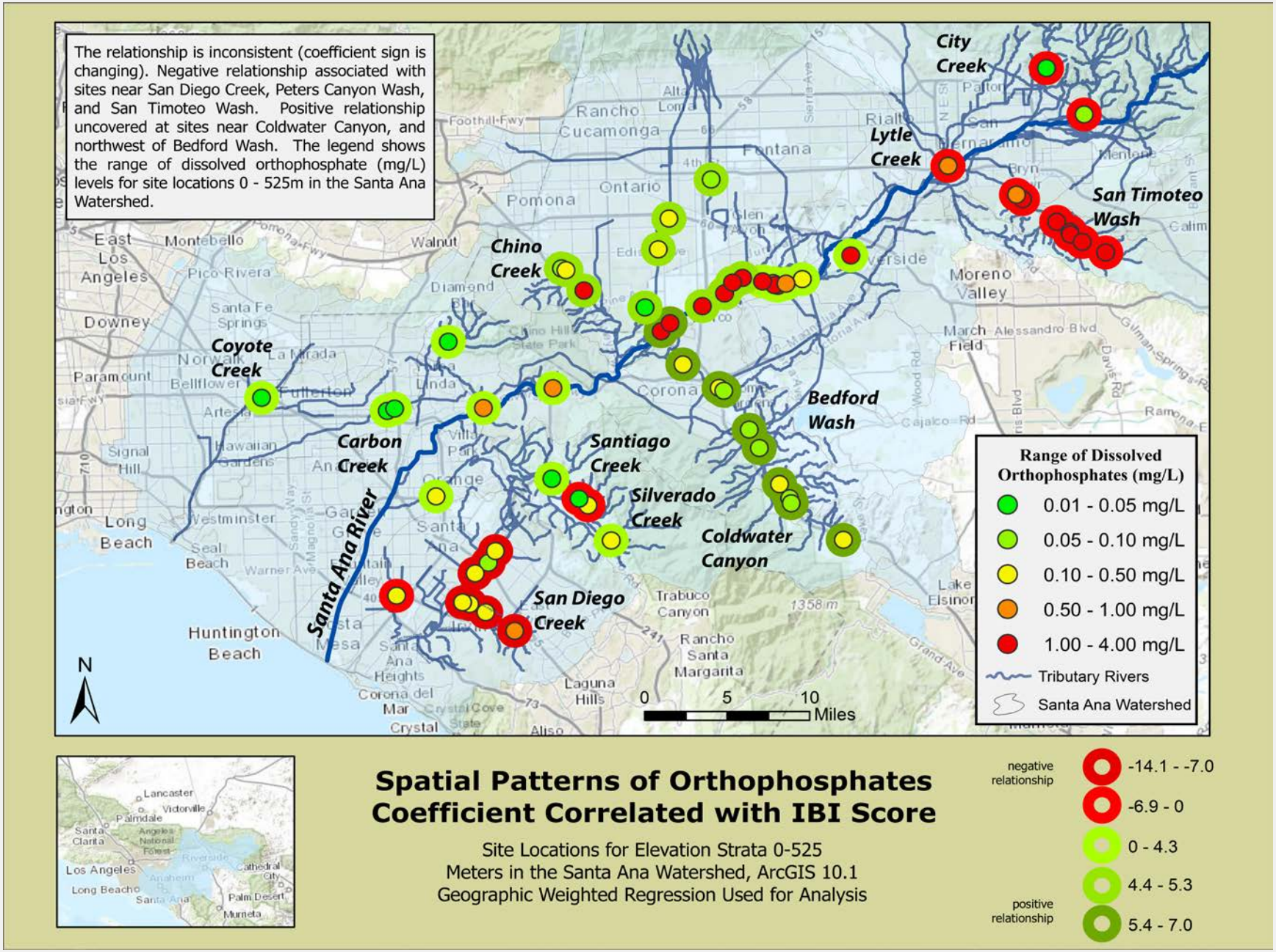

Buffered Stream Sites SA_0-525m & SA_525m+
Exploratory Regression
Statistical Results Table
Buffered Stream Sites SA_0-525m & SA_525m+
Geographic Weighted Regression
Feature Class
Statistical Results Table

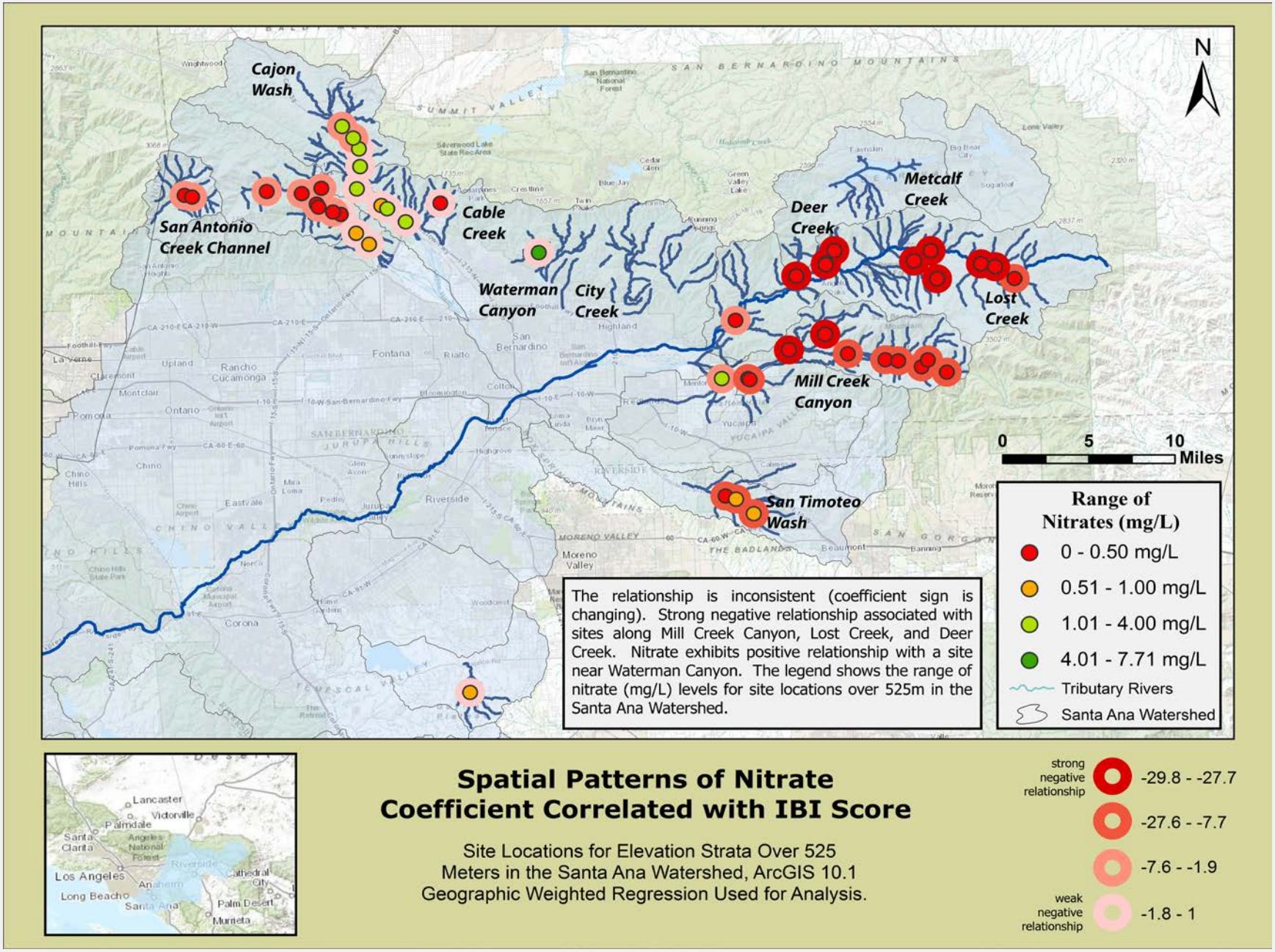

Santa Ana Watershed
Index of Biological Integrity
Hot Spot Analysis 2006 - 2011
Author: Ian Nelson
Date: 10/21/2014
Coordinate System: NAD 83 Albers
Projection: Albers
Basemap Credits: ESRI
Cajon Wash
City Creek
Deer Creek
Fish Creek
San Timoteo Wash
Chino Creek
Carbon Creek
Coyote Creek
Santa Ana River
Santiago Creek
San Diego Creek
Interpretation of IBI Score
0 - 19
20 - 39
40 - 59
60 - 79
80 - 100
Tributary Rivers
Santa Ana Watershed
N
0 5 10 20
Miles

	Underwood's 2011 Technical Report			Revised Elevation Strata Regression Results	
	SA 0-350	SA 350-700	SA 700+	SA 0-525	SA 525+
pH	-.416**	0.121	-.304*	(-)**	(-)***
Dissolved Orthophosphates (mg/L)	.407**	-0.022	0.168	(+)**	
Nitrate-N (mg/L)	.294*	0.035	-.343**	(+)**	(-)***


The relationship is inconsistent (coefficient sign is changing). Strongest negative relationship associated with sites near Santiago Creek, and Silverado Creek. Overall spatial pattern dilutes east and west of sites near Santiago Creek. The legend shows the range of pH levels for site locations 0 - 525m in the Santa Ana Watershed.
City Creek
Lytle Creek
San Timoteo Wash
Chino Creek
Coyote Creek
Carbon Creek
Santiago Creek
Silverado Creek
Coldwater Canyon
Bedford Wash
Santa Ana River
San Diego Creek
Range of pH Levels
6.33 - 7.00
7.01 - 8.00
8.01 - 9.00
9.01 - 10.00
10.01 - 10.49
Tributary Rivers
Santa Ana Watershed
0 5 10 Miles
N
Spatial Patterns of pH
Coefficient Correlated with IBI Score
Site Locations for Elevation Strata 0-525
Meters in the Santa Ana Watershed, ArcGIS 10.1
Geographic Weighted Regression Used for Analysis
strong negative relationship
-8.80 - -5.97
-5.97 - -5.88
-5.88 - -5.67
-5.67 - -4.22
weak negative relationship
-4.22 - 0.45


Cajon Wash
San Antonio Creek Channel
Cable Creek
Waterman Canyon
City Creek
Deer Creek
Metcalf Creek
Lost Creek
Mill Creek Canyon
San Timoteo Wash
N
0 5 10 Miles
Range of pH Levels
acidic 5.22 - 6.49
6.50 - 7.00
7.01 - 8.00
basic 8.01 - 8.65
Tributary Rivers
Santa Ana Watershed
The relationship is consistent (coefficient sign is not changing). Strong negative relationship associated with sites along Mill Creek Canyon, and San Timoteo Wash. pH exhibits weak negative relationship with sites east and west of Deer Creek. The legend shows the range of pH levels for site locations over 525m in the Santa Ana Watershed.
Lancaster
Victorville
Palmdale
Santa Clarita
Los Angeles
Anaheim
Long Beach
Santa Ana
Palm Desert
Murrieta
Spatial Patterns of pH
Coefficient Correlated with IBI Score
Site Locations for Elevation Strata Over 525
Meters in the Santa Ana Watershed, ArcGIS 10.1
Geographic Weighted Regression Used for Analysis.
strong negative relationship
-10.10 - -7.32
-7.32 - -4.98
-4.98 - -4.24
weak negative relationship
-4.24 - -0.77


The relationship is inconsistent (coefficient sign is changing). Negative relationship associated with sites near San Diego Creek, Peters Canyon Wash, and San Timoteo Wash. Positive relationship uncovered at sites near Coldwater Canyon, and northwest of Bedford Wash. The legend shows the range of dissolved orthophosphate (mg/L) levels for site locations 0 - 525m in the Santa Ana Watershed.
City Creek
Lytle Creek
San Timoteo Wash
Chino Creek
Coyote Creek
Carbon Creek
Santa Ana River
Santiago Creek
Silverado Creek
Coldwater Canyon
Bedford Wash
San Diego Creek
Range of Dissolved Orthophosphates (mg/L)
0.01 - 0.05 mg/L
0.05 - 0.10 mg/L
0.10 - 0.50 mg/L
0.50 - 1.00 mg/L
1.00 - 4.00 mg/L
Tributary Rivers
Santa Ana Watershed
N
0 5 10 Miles
Spatial Patterns of Orthophosphates
Coefficient Correlated with IBI Score
Site Locations for Elevation Strata 0-525
Meters in the Santa Ana Watershed, ArcGIS 10.1
Geographic Weighted Regression Used for Analysis
negative relationship
-14.1 - -7.0
-6.9 - 0
0 - 4.3
4.4 - 5.3
positive relationship
5.4 - 7.0



Spatial Patterns of Nitrate Coefficient Correlated with IBI Score

Site Locations for Elevation Strata Over 525 Meters in the Santa Ana Watershed, ArcGIS 10.1
Geographic Weighted Regression Used for Analysis.

DISCUSSION

- Results and visual representation are founded on consistent significant relationships, supported with literature review, and validated with Underwood's 2011 technical report.
- The relationships among stressors and stream health are "interrelated" and vary geographically.
- We can more precisely locate stressors that are negatively affecting BMI's
- Our understanding of water quality and BMI's is improving through different aggregations.

SUGGESTIONS FOR FUTURE USE

- Census tracts/Block groups
  - Demographics
  - Area
- Land use
- Investigating relationships between stressors
  - Bivariate mapping
  - Multivariate mapping

ACKNOWLEDGEMENTS

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- Dr. Ban, Cartography Professor, CSULB
- Michael Shensky, GIS Manager, CSULB

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