Groundwater Sustainability Commission
for the San Luis Obispo Valley Groundwater Basin

Agenda
March 11, 2020

NOTICE IS HEREBY GIVEN that the Groundwater Sustainability Commission for the San Luis Obispo Valley Groundwater Basin will hold a meeting at **3:30 P.M. on Wednesday, March 11, 2020** at the **Ludwick Community Center**, 864 Santa Rosa St, San Luis Obispo, CA 93401.

NOTE: If you need disability-related modifications or accommodations, including translation services, to participate in this meeting, please contact Joey Steil at (805) 781-4076. The Groundwater Sustainability Commission reserves the right to limit each speaker to three (3) minutes per subject or topic.

Adam Hill, Member, County of San Luis Obispo
Bob Schiebelhut, Chair, EVGMWC
Dennis Fernandez, Member, ERMWC/VRMWC
Mark Zimmer, Vice Chair, GSWC
Andy Pease, Member, City of San Luis Obispo

Bruce Gibson, Alternate, County of San Luis Obispo
George Donati, Alternate, EVGMWC
James Lokey, Alternate, ERMWC/VRMWC
Toby Moore, Alternate, GSWC
Aaron Floyd, Alternate, City of San Luis Obispo

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1. **Call to Order** (Chair)
2. **Roll Call** (County Staff: Mychal Boerman)
3. **Pledge of Allegiance** (Chair)
4. **Public Comment – Items not on Agenda** (Chair)
5. **Approval of Meeting Minutes** (Chair)
   a) December 11, 2019
6. **Project Status Updates** (City and County Staff: Mychal Boerman and Dick Tzou)
   a) Overview of Governance/Quarterly Progress on Stakeholder Engagement
   b) Project Activity Updates
      i. Quarterly Newsletter Update Vol. 3
      ii. Comments on Draft Chapters 3 and 4
7. **Draft GSP Chapter 5 for Review and Comment** (WSC Consultant Team: David O'Rourke)
   Recommendation
   a) Consider recommending that each GSA receives and files Draft GSP Chapter 5 and provide direction as necessary.
      - Draft Chapter 5 – Groundwater Conditions
8. **An Overview on Sustainable Management Criteria** (WSC Consultant Team: Dave O'Rourke and Michael Cruikshank)
   Recommendation
   a) Receive a general overview on the sustainable management criteria.

9. Integrated Groundwater/Surface Water (GW/SW) Modeling Update (WSC Consultant Team: Dave O'Rourke)

Recommendation

a) Receive an update on the integrated GS/SW modeling efforts and consider recommending that each GSA receives and files Draft Surface Water/Groundwater Modeling Approach Technical Memorandum (Modeling TM #1).

- Draft Modeling TM #1

10. A Preview of What's Next? (WSC Consultant Team: Michael Cruikshank and Tiffany Meyer)

Recommendation

a) Receive a preview of upcoming SGMA activities and provide direction as necessary.

i. Timeline of Events

ii. Sustainable Goal Setting Workshop

a. What to expect?

iii. Upcoming Chapters to review – Chapter 6 Groundwater Budget

iv. County Monitoring Well Program

v. Quarterly Newsletter Update Vol. 4

11. Future Items (Chair)

a) Sustainable Goal Setting Workshop

b) Review of Draft Chapter 6 – Water Budget

c) Data Management System Overview

12. Next Regular Meeting: June 10, 2020

13. Adjourn (Chair)

Groundwater Sustainability Commission
Regular Meeting Minutes (DRAFT)
December 11, 2019

The following members or alternates were present:

Bob Schiebelhut, Chair, EVGMWC
Mark Zimmer, Vice Chair, GSWC
Adam Hill, Member, County of San Luis Obispo
Dennis Fernandez, Member, ERMWC/VRMWC
Andy Pease, Member, City of San Luis Obispo

1. Call to Order	Chair Schiebelhut: calls the meeting to order at 3:30 PM.
2. Roll Call	City Staff, Mychal Boerman: calls roll.
3. Pledge of Allegiance	Chair Schiebelhut: leads the Pledge of Allegiance.
4. Public Comment – Items not on Agenda	Chair Schiebelhut: opens the floor for public comment. Nick Torino: asks if a portion of your property is in the district, but your source of water is not, will you have to comply with the findings? County Staff, Dick Tzou: replies that each situation will be evaluated on a case by case basis. Golden State Water Company, Toby Moore: comments on DWR's GSP review process for critically overdrafted basins, the GSP annual report timeline, an upcoming DWR workshop on January 8, 2020, the State Water Resources Control Board (SWRCB) efforts to streamline permit processes for surface water to be used for groundwater recharge, and a new GIS overlay tool that graphically shows fully appropriated streams, which could be used for the SLO Basin GSP. Chair Schiebelhut: closes the floor for public comment.
5. Approval of Meeting Minutes a) September 11, 2019	Chair Schiebelhut: opens discussion for Agenda Item 5 - Approval of Meeting Minutes for the September 11, 2019 Groundwater Sustainability Commission Meeting and asks for comments from the Commission; there are none. **Motion By:** Member Zimmer **Second By:** Member Pease **Motion:** The Commission moves to approve the September 11, 2019 Meeting minutes.

Members	Ayes	Noes	Abstain	Recuse
Bob Schiebelhut (Chair)	X			
Mark Zimmer (Vice Chair)	X			
Adam Hill (Member)	X			
Andy Pease (Member)	X			
Dennis Fernandez (Member)	X			

<table>
<tr><td>6. Project Status Updates</td><td>City Staff, Mychal Boerman and County Staff, Dick Tzou: present a project status update including an overview of the basin's governance structure, SGMA and GSP timelines, and a summary of stakeholder outreach activities for the SLO Basin GSP development process.

Meeting materials and audio for this item can be accessed by visiting:
https://www.slowaterbasin.com/resources

<u>Discussion Summary</u>
• The public comment period for the Draft Communication & Engagement Plan closed on August 31, 2019.
• The public comment period for GSP Draft Chapters 1 and 2 closed on October 31, 2019.
• GSP Draft Chapters 3 and 4 are now available for public review. The public comment period will remain open until January 31, 2020.

Member Pease: asks for an update on stakeholder outreach metrics.

County Staff, Dick Tzou: responds that staff will include outreach effort metrics at future GSC meetings.

Chair Schiebelhut: opens the floor for public comment; there are none.</td></tr>
<tr><td>7. Draft GSP Chapters 3 & 4 for Review and Comment</td><td>WSC consultant, Michael Cruikshank: presents an overview of GSP Draft Chapters 3 & 4, including SGMA and GSP governance timelines and how the public can submit comments on the GSP Chapters 3 & 4 by visiting the SLOWaterBasin.com portal during the comment period.

Meeting materials and audio for this item can be accessed by visiting:
https://www.slowaterbasin.com/resources

The below Draft Chapters can be accessed by visiting:
https://www.slowaterbasin.com/review-documents
• GSP Draft Chapter 3 - Description of Plan Area
• GSP Draft Chapter 4 - Basin Setting

<u>Discussion Summary</u>
Commission Members and the consultant team discuss the County's well database, the ability to identify and track different types of wells, de minimis users, land use, and the efforts of attaining new well information throughout the GSP development process.

Motion By: Chair Schiebelhut
Second By: Member Pease
Motion: Motion to recommend that each GSA receive and file Draft GSP chapters 3 and 4 as presented.</td></tr>
</table>

Members	Ayes	Noes	Abstain	Recuse
Bob Schiebelhut (Chair)	X			
Mark Zimmer (Vice Chair)	X			
Adam Hill (Member)	X			
Andy Pease (Member)	X			
Dennis Fernandez (Member)	X			

8. An Overview on Groundwater Conditions	WSC Consultant, Dave O'Rourke: provides a presentation on the Groundwater Conditions in the SLO Basin. *Meeting materials and audio for this item can be accessed by visiting: https://www.slowaterbasin.com/resources*
9. Geophysical Survey Results	WSC consultant, Spencer Harris: provides a presentation on the results of the geophysical survey in the vicinity of the bedrock divide identified in the 2018 SLO Basin Characterization Report. *Meeting materials and audio for this item can be accessed by visiting: https://www.slowaterbasin.com/resources*
10. An Overview on Water Budget	WSC Consultant, Spencer Harris: provides a presentation on the basin water budget framework. *Meeting materials and audio for this item can be accessed by visiting: https://www.slowaterbasin.com/resources*
11. Integrated Groundwater/Surface Water (GW/SW) Modeling Update	WSC Consultant, Dave O'Rourke: presents an update on the integrated GS/SW model. This presentation can be accessed by visiting: https://www.slowaterbasin.com/resources
12. A Preview of What's Next?	WSC Consultant, Michael Cruikshank, presents upcoming GSP activities: • Chapters 1 and 2 received and filed and will be uploaded to slowaterbasin.com. • Next Regular GSC meeting on March 11, 2020. • Next public workshop in April will focus on sustainable goal setting: groundwater sustainability indicators and what groundwater sustainability means to the basin. • A quarterly newsletter will soon be available on slowaterbasin.com • Review of Draft Chapters 5 and 6.

13. Future Items	(none)
14. Next Regular Meeting	Wednesday, March 11, 2020 at 3:30 pm Ludwick Community Center 864 Santa Rosa St, San Luis Obispo, CA, 93401
15. Adjourn	**Motion By:** Chair Schiebelhut **Second By:** Vice Chair Zimmer **Motion:** The Commission moves to adjourn the meeting at 5:30 PM

Members	Ayes	Noes	Abstain	Recuse
Bob Schiebelhut (Chair)	X			
Mark Zimmer (Vice Chair)	X			
Adam Hill (Member)	X			
Andy Pease (Member)	X			
Dennis Fernandez (Member)	X			

DRAFTED BY: City Staff, Hayley Sabatini
County Staff, Joey Steil

GROUNDWATER SUSTAINABILITY COMMISSION
for the San Luis Obispo Valley Groundwater Basin
September 11, 2019

Agenda Item 6 – Project Status Update
(Presentation Item)

<u>**Prepared By**</u>
Mychal Boerman and Dick Tzou, County and City of San Luis Obispo

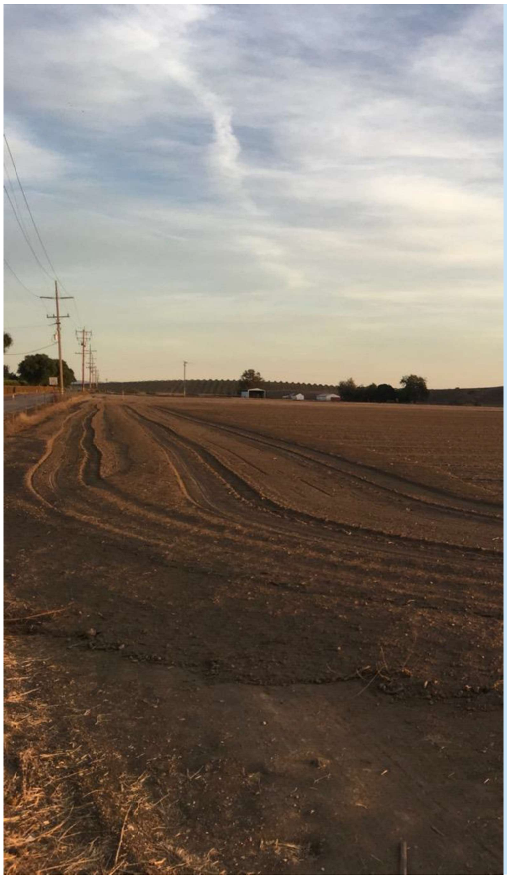
<u>**Discussion**</u>
The purpose of this item is to provide a status update on the GSP project. A brief overview on the GSA governance structure will be presented. Starting in the March 2020 GSC meeting moving forward, a quarterly progress update on the stakeholder engagement process will be presented following a brief presentation of the GSA governance structure. A set of metrics have been developed by the Consultant Team to quantify the effectiveness of the stakeholder outreach program. The metrics consist of a set of measurable statistics on the various stakeholder engagement efforts such as attendance level of stakeholder participation, project website performance, number of subscribers on the stakeholder list, and extent of stakeholder outreach touch points. The current results to date (January 2020) for the metrics are included in the attached SLO Basin GSP Quarterly Progress Report on pages 4 and 5. This stakeholder engagement progress report will be used as a baseline to compare to future metrics to evaluate progress. Results in January 2020 indicated that there are about 400 subscribers to the email list, which is over 30 percent increase in membership since June 2019 when the stakeholder outreach started. The average GSC meeting attendance is about 40 people and over 50 interested parties attended the first workshop in August 2019.

The Consultant Team and City and County staff are currently developing various strategies for the next step in stakeholder engagement as described in the Quarterly Newsletter Update Vol. 3 (attached), which is a workshop about setting sustainability goals. The workshop will be designed to introduce, educate, and solicit feedback from interested stakeholders about how to establish goals to sustainably manage the groundwater basin. This workshop will be the first of the two workshops on sustainability goal setting. Other GSP efforts have been focused on analyzing and defining the groundwater conditions, developing a water budget, and constructing a numerical integrated surface water and groundwater model. Updates on the technical efforts will be presented in separate agenda items by the Consultant Team.

The County Board of Supervisors have received and filed the draft GSP Chapters 3 and 4 on December 17, 2019. The comment period for draft GSP Chapters 3 and 4 closed January 31, 2020, and all comments (see attached) received are now published online and may be viewed at: *https://www.slowaterbasin.com/review-documents* Public or GSA comments received during each draft GSP chapter/section's comment period will be considered when sections are compiled into a complete public draft GSP document, slated for further public review in summer of 2021. However, if there are critical comments by the public or GSC members that needed immediate attention so that the project can continue to progress in the right direction, staff may bring forward these issues to the GSC for resolution and further direction on a case by case basis during the following GSC meeting.

Attachments:

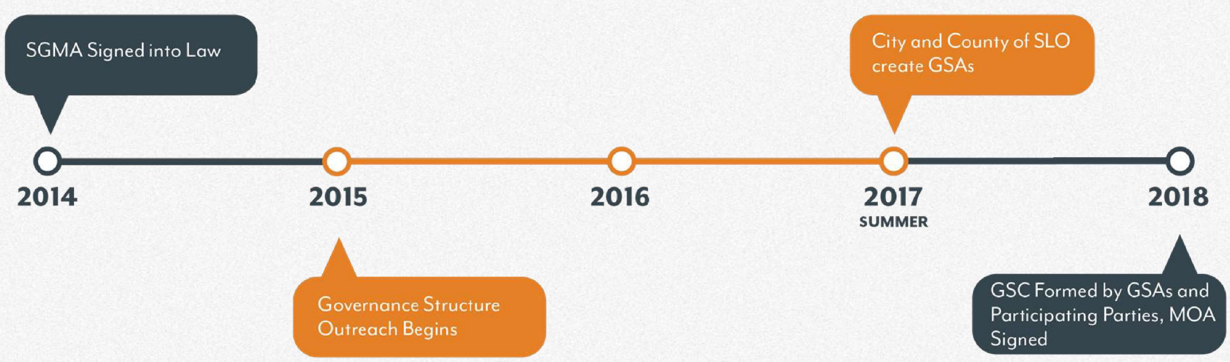
1. Presentation
2. SLO Basin GSP Quarterly Progress Report
3. Quarterly Newsletter Update Vol. 3
4. GSP chapter comments (all)



PROJECT STATUS UPDATE

Mychal Boerman and Dick Tzou, City and County of San Luis Obispo

GOVERNANCE TIMELINE



GSP GOVERNANCE

Groundwater Sustainability Agencies (GSA) | Groundwater Sustainability Commission

CITY OF SLO GSA

MYCHAL BOERMAN
Deputy Director of Water, City of San Luis Obispo

GSA STAFF

COUNTY OF SLO GSA

DICK TZOU, PE
Water Resources Engineer, County of San Luis Obispo

GROUNDWATER SUSTAINABILITY COMMISSION

County of San Luis Obispo	City of San Luis Obispo	Edna Valley Growers MWC	Edna Ranch and Varian Ranch MWC	Golden State Water Company
ADAM HILL *Member*	ANDY PEASE *Member*	BOB SCHIEBELHUT *Chair*	DENNIS FERNANDEZ *Member*	MARK ZIMMER *Vice Chair*
BRUCE GIBSON *Alternate*	AARON FLOYD *Alternate*	GEORGE DONATI *Alternate*	JAMES LOKEY *Alternate*	TOBY MOORE *Alternate*

SLO BASIN GSP CHAPTER SCHEDULE

GSP Chapters	2019									2020												2021												2022			
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
Executive Summary																																		GSP Due - January 31, 2022			
Chapter 1: Introduction																																					
Chapter 2: Agency Information (§ 354.6)																																					
Chapter 3: Description of Plan Area (§ 354.8)																																					
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Final GSP																													F			A					

SLO BASIN GROUNDWATER SUSTAINABILITY PLAN

San Luis Obispo Valley Basin

QUARTERLY PROGRESS REPORT

Delivered January 2020

COUNTY of SAN LUIS OBISPO

CITY OF SAN LUIS OBISPO

PREPARED BY WATER SYSTEMS CONSULTING

STAKEHOLDER ENGAGEMENT GOALS TO ACTUAL

GOALS

- Create an inclusive, transparent participation experience that builds public trust in the Groundwater Model and GSP and optimizes participation among all those impacted.
- Employ outreach methods that facilitate shared understanding of the importance of sustainable groundwater and its impact on stakeholders.
- Communicate "early and often," and actively identify and eliminate barriers to participation.
- Develop a cost-effective, stakeholder-informed GSP supported by best-in-class technical data.

RESULTS TO DATE

STAKEHOLDER OUTREACH TOUCHPOINTS

4	1	3	7	5	5*
QUARTERLY GSC MEETINGS HELD APR '19, JUL '19, SEP '19, DEC '19	STAKEHOLDER WORKSHOP HELD AUG '19	QUARTERLY NEWSLETTERS DISTRIBUTED JUL '19, OCT '19, JAN '20	EMAIL BULLETINS DISTRIBUTED TO EMAIL LIST (details on p.6)	EVENT PUBLIC NOTICES POSTED (details on p.6)	STAKEHOLDER ORGS RECEIVED DIRECT OUTREACH

STAKEHOLDER LIST

393	+30%	7/10
SUBSCRIBERS TO EMAIL LIST	SUBSCRIBERS SINCE JUN '19	STAKEHOLDER GROUPS REPRESENTED ON LIST (See details on page 5, likely true representation is closer to 9/10)

STAKEHOLDER PARTICIPATION

40	+50	3
AVERAGE STAKEHOLDER ATTENDANCE TO GSC MTGS	ATTENDANCE STAKEHOLDER WORKSHOP #1	ONLINE PUBLIC COMMENTS RECEIVED

PROJECT WEBSITE PERFORMANCE (SLOWaterBasin.com)

253	00:02:51	2.12
TOTAL SESSIONS SINCE LAUNCH	AVERAGE SESSION DURATION	AVERAGE PAGES PER SESSION

*** Includes: City of San Luis Obispo, County of San Luis Obispo, SLO Chamber of Commerce, Edna Valley Municipal Water District, and Golden State Water.**

STAKEHOLDERS / REPRESENTATION AND PARTICIPATION

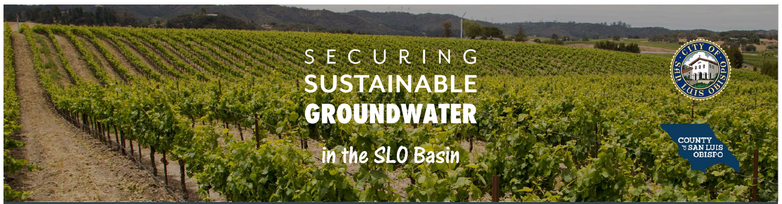
	On email list	Targets
GENERAL PUBLIC OR UNKNOWN	175 ON EMAIL LIST	Citizen groups, community leaders
LAND USE	32 ON EMAIL LIST	**GSC Agencies** (City of San Luis Obispo Mayor and City Council; County of San Luis Obispo Dept. of Planning and Building staff); **US Forest Service; Land Use Commission**
PRIVATE, RURAL GW USERS	0 * ON EMAIL LIST	Private pumpers, domestic users (townhome and mobile home communities, campgrounds, private home-owners)
AGRIC. WATER USERS	34 ON EMAIL LIST	**GSC Agencies** (Golden State Water Company, Mutual Water Companies); **water purveyors; farm bureaus** (San Luis Obispo County Farm Bureau); **individual agric. landowners** (Cal Poly); ALAB
URBAN / INDUSTRIAL USERS	0 * ON EMAIL LIST	Commercial and industrial users
INTEGRATED WATER MANAGEMENT	16 ON EMAIL LIST	SLO County Flood and Water Conservation District, IRWM Group; Water Resource Advisory Committee; Zone 9 Flood Control District; DWR
ENVIRO. AND CONSERV. ORGS	30 ON EMAIL LIST	Federal and state agencies; environmental groups; conservation groups; resource conservation districts
ECONOMIC DEV.	17 ON EMAIL LIST	SLO Economic Development Corp; Hourglass Project; wine association; elected officials
HUMAN RIGHT TO WATER	4 ON EMAIL LIST	Disadvantaged communities; Rural Community Assistance Corp
TRIBES	0 * * ON EMAIL LIST	The Chumash people

* This segment is likely represented on our email list among those who did not self-identify an affiliation, which are listed within the "general public or unknown" category above.

** Though there are no Native American lands within the Basin, the County of SLO is in the process of contacting the Chumash people about the GSP development in a formal letter.

PROJECT ACTIVITY UPDATES

- Quarterly Newsletter Update Vol. 3
- Comments for Draft Chapters 3 & 4



A QUARTERLY UPDATE OF THE SLO BASIN GROUNDWATER SUSTAINABILITY PLAN DEVELOPMENT
VOLUME 3 | FEBRUARY 2020

Next Step: Set Sustainability Goals

Stakeholders Can Participate at April Workshop

In this issue

MEETING SUMMARIES – page 2
HOW TO PARTICIPATE – page 3
KEY TERMS – page 4
ACCOMMODATIONS – page 4

ABOUT THE PROJECT: Two water sources—surface water and groundwater—serve all of the needs within the San Luis Obispo Valley Basin (SLO Basin). SGMA, the Sustainable Groundwater Management Act, signals the first time in California's history that groundwater will be formally managed. As required by SGMA, the SLO Basin Groundwater Sustainability Agencies (GSAs) are developing a Groundwater Sustainability Plan (GSP) now through January 2022. The GSP will guide groundwater users on how to reach sustainable groundwater levels in the future.

PROGRESS TO DATE: The first two steps in the GSP development process are nearing completion, as illustrated below. Within these two steps no groundwater management decisions have been made. **Step 1** documents the basic administrative information and background of the GSP. **Step 2**, now underway, is to build a thorough picture of the Basin (what we call Basin Setting), including documenting the Basin's geology, groundwater levels and quality, water accounting, and future land use plans, among other data. This data helps predict future groundwater demand and it informs how sustainable levels can be achieved in the future.

WHAT'S NEXT: At the April 8th workshop (details on p.3), stakeholders can participate in **Step 3** in the GSP development process—setting sustainability goals for the Basin. Participants will first be given an overview of the Basin Setting. The team will then introduce what goes into creating groundwater sustainability goals, per SGMA requirements, such as maintaining groundwater levels at a specific depth. Participants will then work in small groups with groundwater experts to help land the preliminary sustainability goals for the Basin.

5 Steps to Sustainable Groundwater in the SLO Basin

Step #1	Step #2	Step #3	Step #4	Step #5
ESTABLISH GOVERNANCE STRUCTURE	DOCUMENT BASIN SETTING	SET SUSTAINABILITY GOALS	DEVELOP PLAN TO SUSTAINABILITY	ADOPT THE PLAN
CHAPTERS 1-2 Document the basic administrative information, purpose, and background of the GSP.	**CHAPTERS 3-6** Profile the Basin geology; groundwater use, levels and quality; water accounting; and future land use plans.	**CHAPTERS 7-8** Set measurable goals per SGMA requirements, and well monitoring networks to monitor progress.	**CHAPTERS 9-10** Identify the projects and management actions to be implemented to meet the sustainability goals.	**FINISHED PLAN** The SLO Basin GSAs vote to adopt the Groundwater Sustainability plan.
2019	2020		2021	JAN. 2022

WE ARE HERE

SLOWaterBasin.com — GET INVOLVED NOW

COMMENTS ON CHAPTERS 3 & 4

DRAFT

Chapters 3 and 4

San Luis Obispo Valley Basin Groundwater Sustainability Plan

Available for viewing in the Dec 11, 2019 Agenda Packet:	Dec 3, 2019
Recommended the GSAs to receive and file for public comments:	Dec 11, 2019
Available for public comments on www.slowaterbasin.com:	Dec 12, 2019
Close of public comment period:	Jan 31, 2020

Per the GSC's recommendation on Dec 11, 2019, the Draft Chapters 3 and 4 will be distributed to the City and County GSAs to receive and file. These draft documents are now posted on the web portal: www.slowaterbasin.com for public comments. Comments from the public are being collected using a comment form available at www.slowaterbasin.com by clicking on "Submit Comment". If you require a paper form to submit by postal mail, please contact your local Groundwater Sustainability Agency (GSA). All comments submitted will also be posted online for viewing.

SLO Groundwater Sustainability Plan Public Comments / Updated: 02/04/2020 • Page 2 of 3

George Donati	SLO Basin GSP Chapters 3 & 4 - DRAFT	3.1 SLO Basin Introduction - We need to include the history of the Edna Valley Basin. In the 1950's - 1960's the East branch of the Corral de Piedra creek was dammed to install a 500 acre foot reservoir. In the 1970's, this dam was raised for a 1000 acre foot reservoir. This dam removed all flow of water into the Edna Valley Basin as the water was used for crop irrigation outside of the Edna Valley Basin. The flow downstream of the dam is not properly managed by the owner of the dam and the state water board. This has greatly reduced the re-charge of the Edna Valley Basin for the past 50 years.3.4.1 Water Source Types - This states " Excluding the Edna Valley Golf Course, all water demand in the SLO Basin are met with groundwater" - This needs to be clarified. The Golf course uses ground water to irrigate the course, and the golf course sells groundwater water to Golden State Water Company for residential use. 3.4.2 Water Use Sectors - Industrial - The ground water wells that supply water to the Price Canyon Oil Field are just outside of the basin boundary. Why are these wells not considered to use groundwater from the Edna Valley Basin since a natural flow from the creek passes adjacent to these wells 3.6.1.3. We are monitoring the flow of San Luis Obispo Creek as surface water leaves the San Luis Basin. Why not monitor the flow of the other major creeks, east and west Corral de Piedra at the edge of the Edna Valley Basin to determine the flow that is leaving the Basin? Or better yet, the flow that could be coming into the basin below the Dam on the East side of the valley.	1/30/20 8:10

SLO BASIN GROUNDWATER SUSTAINABILITY PLAN

San Luis Obispo Valley Basin

QUARTERLY PROGRESS REPORT

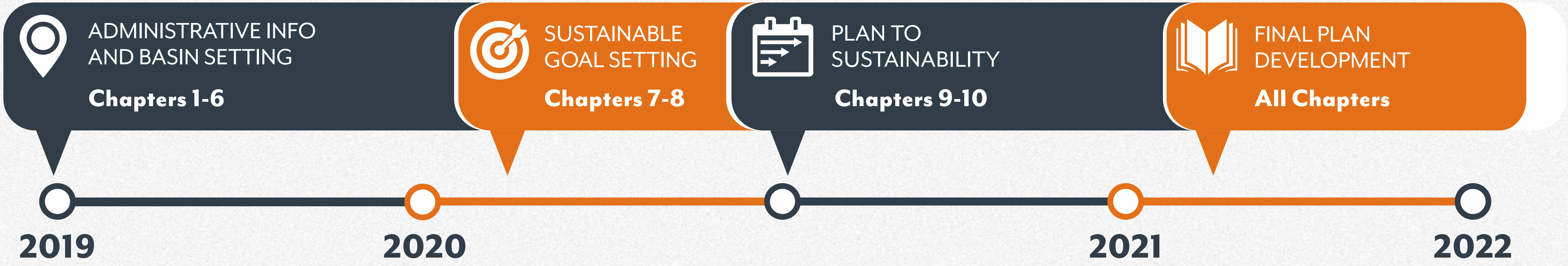
Delivered January 2020

COUNTY of SAN LUIS OBISPO

CITY OF SAN LUIS OBISPO

PREPARED BY WATER SYSTEMS CONSULTING

PROJECT TIMELINE



GSP CHAPTER TIMELINE

GSP Chapters	2019									2020												2021												2022			
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STAKEHOLDER ENGAGEMENT
GOALS TO ACTUAL

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RESULTS TO DATE

STAKEHOLDER OUTREACH TOUCHPOINTS

4
QUARTERLY GSC MEETINGS HELD
APR '19, JUL '19, SEP '19, DEC '19

1
STAKEHOLDER WORKSHOP HELD
AUG '19

3
QUARTERLY NEWSLETTERS DISTRIBUTED
JUL '19, OCT '19, JAN '20

7
EMAIL BULLETINS DISTRIBUTED TO EMAIL LIST
(details on p.6)

5
EVENT PUBLIC NOTICES POSTED
(details on p.6)

5 *
STAKEHOLDER ORGS RECEIVED DIRECT OUTREACH

STAKEHOLDER LIST

393
SUBSCRIBERS TO EMAIL LIST

+30%
SUBSCRIBERS SINCE JUN '19

7/10
STAKEHOLDER GROUPS REPRESENTED ON LIST
(See details on page 5, likely true representation is closer to 9/10)

STAKEHOLDER PARTICIPATION

40
AVERAGE STAKEHOLDER ATTENDANCE TO GSC MTGS

+50
ATTENDANCE STAKEHOLDER WORKSHOP #1

3
ONLINE PUBLIC COMMENTS RECEIVED

PROJECT WEBSITE PERFORMANCE (SLOWaterBasin.com)

253
TOTAL SESSIONS SINCE LAUNCH

00:02:51
AVERAGE SESSION DURATION

2.12
AVERAGE PAGES PER SESSION

*** Includes: City of San Luis Obispo, County of San Luis Obispo, SLO Chamber of Commerce, Edna Valley Municipal Water District, and Golden State Water.**

STAKEHOLDERS / REPRESENTATION AND PARTICIPATION

GENERAL PUBLIC OR UNKNOWN	LAND USE	PRIVATE, RURAL GW USERS	AGRIC. WATER USERS	URBAN / INDUSTRIAL USERS	INTEGRATED WATER MANAGEMENT	ENVIRO. AND CONSERV. ORGS	ECONOMIC DEV.	HUMAN RIGHT TO WATER	TRIBES
175 ON EMAIL LIST	**32** ON EMAIL LIST	**0** * ON EMAIL LIST	**34** ON EMAIL LIST	**0** * ON EMAIL LIST	**16** ON EMAIL LIST	**30** ON EMAIL LIST	**17** ON EMAIL LIST	**4** ON EMAIL LIST	**0** ** ON EMAIL LIST
TARGETS: Citizen groups, community leaders	**TARGETS:** **GSC Agencies** (City of San Luis Obispo Mayor and City Council; County of San Luis Obispo Dept. of Planning and Building staff); **US Forest Service; Land Use Commission**	**TARGETS:** Private pumpers, domestic users (townhome and mobile home communities, campgrounds, private home-owners)	**TARGETS:** **GSC Agencies** (Golden State Water Company, Mutual Water Companies); w**ater purveyors; farm bureaus** (San Luis Obispo County Farm Bureau); **individual agric. landowners** (Cal Poly); ALAB	**TARGETS:** Commercial and industrial users	**TARGETS:** SLO County Flood and Water Conservation District, IRWM Group; Water Resource Advisory Committee; Zone 9 Flood Control District; DWR	**TARGETS:** Federal and state agencies; environmental groups; conservation groups; resource conservation districts	**TARGETS:** SLO Economic Development Corp; Hourglass Project; wine association; elected officials	**TARGETS:** Disadvantaged communities; Rural Community Assistance Corp	**TARGETS:** The Chumash people

*** This segment is likely represented on our email list among those who did not self-identify an affiliation, which are listed within the "general public or unknown" category above.**

**** Though there are no Native American lands within the Basin, the County of SLO is in the process of contacting the Chumash people about the GSP development in a formal letter.**

KEY ACCOMPLISHMENTS / SINCE PROJECT START

	APR-JUN '19	JUL-SEP '19	OCT-DEC '19
C&E PLAN DEVELOPMENT	• C&E Plan public comment period opened Jul. 24, 2019, closed Aug. 31, 2019 (1 comment received) • C&E Workplan was developed and implemented	C&E Plan was received/filed by the County Board of Supervisors on August 20, 2019	- - - - -
GSP DEVELOPMENT			
ADMINISTRATIVE INFO / Chapters 1-3	- - - - -	• Chapters 1-2 public comment period opened Sep. 13, 2019	• Chapters 1-2 public comment period closed Oct. 31, 2019 (2 comments received) • Chapter 3 public comment period opened Dec. 12, 2019, closes Jan. 31, 2020 (1 comment received) • Chapter 1-2 was received/filed by County Board on Oct 22, 2019 • Chapter 3 was received/filed by County Board on Dec 17, 2019
BASIN SETTING / Chapters 4-6	- - - - -	- - - - -	• Chapters 4 public comment period opened Dec 12, 2019, closes Jan. 31, 2020 (0 comments received) • Chapter 4 was received/filed by County Board on Dec 17, 2019
SUSTAINABLE GOAL SETTING / Chapters 7	- - - - -	- - - - -	- - - - -
PLAN TO SUSTAINABILITY / Chapters 9-10	- - - - -	- - - - -	- - - - -
FINAL PLAN DEVELOPMENT / All Chapters	- - - - -	- - - - -	- - - - -
MEETINGS	• **Apr, County Board of Supervisors Meeting held** • **Jun. County Board of Supervisors Meeting held** • **Apr. GSC Meeting held** • **Jun. GSC Meeting held**	• **Aug. County Board of Supervisors Meeting held** • **Sep. GSC Meeting held**	• **Attended Nov. SLO Chamber of Commerce meeting to promote GSP involvement** • **Dec. County Board of Supervisors Meeting held** • **Dec. GSC Meeting held**
STAKEHOLDER WORKSHOPS	- - - - -	• August **Workshop #1: Groundwater and SGMA 101** held	
STAKEHOLDER OUTREACH	• Mailer sent to 410 stakeholders announcing project and inviting to join US mail or email list • Master messaging, graphics and outreach materials developed • **SLOWaterBasin.com** portal launched • FAQs published to website • 4 Public notices published promoting GSA and GSC meetings • 1 Quarterly newsletter sent, email and US mail as requested (with workshop promotion)	• **SLOWaterBasin.com** website published on Wix.com platform with improved user experience • FAQs published to website • 1 Quarterly newsletter sent, email and US mail as requested • 3 Public notices published promoting GSA and GSC meetings, and workshop • 2 Emails sent, workshop reminders	• 1 Quarterly newsletter sent to stakeholder email list and US mail as requested • 2 Public notices published promoting GSA and GSC meetings • 1 Email sent, GSC meeting reminder • 1 blog post published to website • Meeting agenda packet, minutes, recording published to website

WHAT'S AHEAD / NEXT 90 DAYS

	JAN '20	FEB '20	MAR '20
GSP DEVELOPMENT			
ADMINISTRATIVE INFO / Chapters 1-3	- - - - -	- - - - -	- - - - -
BASIN SETTING / Chapters 4-6	• Chapters 4 public comment period opened Dec 12, 2019, closes Jan. 31, 2020 (0 comments received)	• Chapter 5 development	• Chapter 5 public comment period opens following approval at Mar. GSC meeting
SUSTAINABLE GOAL SETTING/ Chapters 7-8	- - - - -	- - - - -	- - - - -
PLAN TO SUSTAINABILITY / Chapters 9-10	- - - - -	- - - - -	- - - - -
FINAL PLAN DEVELOPMENT / All Chapters	- - - - -	- - - - -	- - - - -
MEETINGS	- - - - -	- - - - -	• **Mar. County Board Meeting** • **Mar. 11 GSC Meeting**
STAKEHOLDER WORKSHOPS	- - - - -	• Prep of **Workshop #2: Sustainable Goal Setting**	• March educational Webinar to prepare stakeholders for April workshop • Prep of **Workshop #2: Sustainable Goal Setting**
STAKEHOLDER OUTREACH SLO GSP EMAIL LIST, WEBSITE, PUBLIC NOTICES	• Quarterly newsletter to be sent, email and US mail as requested (with workshop promotion) • 1 Email to be sent, comment period reminder • Apr. Workshop and Mar. GSC mtg added to SLOWaterBasin.com event calendar	• 1 Email to be sent, workshop + GSC meeting promotion • Prep and promote webinar / education for stakeholders coming to April workshop	• 1 Public Notice, GSC Meeting • 1 Public Notice, Workshop • 1 Email to be sent, GSC Meeting reminder • 1 Email to be sent, Workshop promotion • 1 Email to be sent, Webinar promotion
AGRIC. WATER USERS / WATER PURVEYORS	• 1:1 mtg with each organization to confirm partner role in promoting participation to their constituents	• Distribute article/content schedule and confirm publication dates/channels with each agency	• Deliver article content to distribute to their constituents
ENVIRONMENTAL AND CONSERV. ORGS	- - - - -	• 1:1 mtg with each organization to confirm partner role in promoting participation to their constituents • Distribute article/content schedule and confirm publication dates/channels with each agency	• Deliver article content to distribute to their constituents
ECONOMIC DEVELOPMENT	- - - - -	• 1:1 mtg with each organization to confirm partner role in promoting participation to their constituents • Distribute article/content schedule and confirm publication dates/channels with each agency	• Deliver article content to distribute to their constituents

SECURING SUSTAINABLE GROUNDWATER in the SLO Basin

A QUARTERLY UPDATE OF THE SLO BASIN GROUNDWATER SUSTAINABILITY PLAN DEVELOPMENT
VOLUME 3 | FEBRUARY 2020

Next Step: Set Sustainability Goals

Stakeholders Can Participate at April Workshop

In this issue

MEETING SUMMARIES – page 2
HOW TO PARTICIPATE – page 3
KEY TERMS — page 4
ACCOMMODATIONS — page 4

ABOUT THE PROJECT: Two water sources—surface water and groundwater—serve all of the needs within the San Luis Obispo Valley Basin (SLO Basin). SGMA, the Sustainable Groundwater Management Act, signals the first time in California's history that groundwater will be formally managed. As required by SGMA, the SLO Basin Groundwater Sustainability Agencies (GSAs) are developing a Groundwater Sustainability Plan (GSP) now through January 2022. The GSP will guide groundwater users on how to reach sustainable groundwater levels in the future.

PROGRESS TO DATE: The first two steps in the GSP development process are nearing completion, as illustrated below. Within these two steps no groundwater management decisions have been made. **Step 1** documents the basic administrative information and background of the GSP. **Step 2**, now underway, is to build a thorough picture of the Basin (what we call Basin Setting), including documenting the Basin's geology, groundwater levels and quality, water accounting, and future land use plans, among other data. This data helps predict future groundwater demand and it informs how sustainable levels can be achieved in the future.

WHAT'S NEXT: At the April 8th workshop (details on p.3), stakeholders can participate in **Step 3** in the GSP development process—setting sustainability goals for the Basin. Participants will first be given an overview of the Basin Setting. The team will then introduce what goes into creating groundwater sustainability goals, per SGMA requirements, such as maintaining groundwater levels at a specific depth. Participants will then work in small groups with groundwater experts to help land the preliminary sustainability goals for the Basin.

5 Steps to Sustainable Groundwater in the SLO Basin

Step #1	Step #2	Step #3	Step #4	Step #5
ESTABLISH GOVERNANCE STRUCTURE	DOCUMENT BASIN SETTING	SET SUSTAINABILITY GOALS	DEVELOP PLAN TO SUSTAINABILITY	ADOPT THE PLAN
CHAPTERS 1-2 Document the basic administrative information, purpose, and background of the GSP.	**CHAPTERS 3-6** Profile the Basin geology; groundwater use, levels and quality; water accounting; and future land use plans.	**CHAPTERS 7-8** Set measurable goals per SGMA requirements, and well monitoring networks to monitor progress.	**CHAPTERS 9-10** Identify the projects and management actions to be implemented to meet the sustainability goals.	**FINISHED PLAN** The SLO Basin GSAs vote to adopt the Groundwater Sustainability plan.
2019	**2020**		**2021**	**JAN. 2022**

WE ARE HERE

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December 11, 2019 GSC Meeting Summary

GSC Previews Data and Tools that Will Support Future SLO Basin Management

At its quarterly meeting on December 11, GSA staff provided an update on the GSP development status to the GSC and nearly two dozen stakeholders, including an overview of key data and analysis that will inform how groundwater will be managed in the Basin moving forward.

Official review and comment was accepted for the draft of *Chapter 3: Description of the Plan Area* and *Chapter 4: Basin Setting*. Public comment on these chapters ended January 31. Chapter 3 provides a description of the SLO Basin plan area including its jurisdictional boundaries, the location and density of wells, future land use plans, and existing groundwater monitoring and management programs. Chapter 4 describes the Basin topography and boundaries, the primary users of groundwater in the Basin, regional geology, principal aquifers, surface water bodies, and an analysis of the Basin's subsidence potential.

Next, the project team provided attendees a preview of key data that will be published in *Chapter 5: Groundwater Conditions,* scheduled for release at the March 11, 2020 GSC meeting, and *Chapter 6: Water Budget*, which will be released at the June 10, 2020 GSC meeting.

Using a series of topographical maps, the project team demonstrated the historical changes in groundwater levels throughout the SLO Basin, namely in areas of concern such as Edna Valley from Spring 1997 to Spring 2011, a time period demarked by widespread vineyard planting just before the most recent drought. Within that period, groundwater declined more than 40 feet near the Tiffany Ranch Road area on the southern tip of the Edna Valley Basin near Arroyo Grande.

The team also previewed results of their geophysical survey and the water budget, now in development. The geophysical survey defined the depth and thickness of various subsurface layers to characterize their water supply capacity, especially near the divide of the San Luis and Edna Valley areas. Further, the project team reported that progress is still being made on the development of the Integrated Groundwater/Surface Water Model.

The team also announced its next public workshop on April 8, where participants can work with the project team to define the sustainability goals for the Basin. This is first interactive workshop in the planning process.

Listen to an audio recording of the meeting or view the agenda packet at: **SLOWaterBasin.com/resources.**

Know Your Representative in the SLO Basin GSP Process

GROUNDWATER SUSTAINABILITY COMMISSION (GSC) MEMBERS				
IF YOU'RE A MEMBER OF ... EDNA VALLEY GROWERS MUNICIPAL WATER COMPANY	IF YOU'RE A MEMBER OF ... EDNA RANCH & VARIAN RANCH MUNICIPAL WATER COMPANIES	IF YOU GET YOUR WATER BILL FROM ... Golden State Water Company (A Subsidiary of American States Water Company)	IF THE LEFT DON'T APPLY AND YOU LIVE OUTSIDE THE CITY OF SLO ... COUNTY of SAN LUIS OBISPO	IF YOU LIVE IN THE CITY OF SLO ... CITY OF SAN LUIS OBISPO
YOUR SLO GSP REPRESENTATIVE IS: BOB SCHIEBELHUT	YOUR SLO GSP REPRESENTATIVE IS: DENNIS FERNANDEZ	YOUR SLO GSP REPRESENTATIVE IS: MARK ZIMMER	YOUR SLO GSP REPRESENTATIVE IS: ADAM HILL	YOUR SLO GSP REPRESENTATIVE IS: ANDY PEASE

Do You Have Groundwater or Well Data? Let's Talk!

We need your help filling current gaps in well data for the SLO Basin. If you are a land or well owner with data you're willing to share (and/or you believe data is being collected on your well by your well service contractor), please contact Michael Cruikshank at WSC at **mcruikshank@wsc-inc.com** or 949-528-0960 ext. 601.

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Opportunities to Participate

To meet the required completion deadline of January 31, 2022, the GSP will be developed in phases through the end of 2021. During this period, there will be ample opportunity for the public to participate in the plan development process, including participation in quarterly public GSC meetings, interactive workshops, and review and comment periods for each GSP chapter/section.

VIEW SUBMITTED COMMENTS

- **Communications & Engagement Plan**
- **Chapters 1-2: Administrative Information**
- **Chapter 3-4: Description of Plan Area and Basin Setting**

The commenting period for the documents above is now closed. To view all public comments submitted for these documents go to **SLOWaterBasin.com/review-documents** and scroll down to "Documents Closed for Public Comment."

UPCOMING MEETINGS AND WORKSHOPS

March GSC Meeting

MAR. 11, 2020 • 3:30pm-5:30pm — The public is invited to join the next quarterly GSC meeting. An agenda for this meeting will be posted at **SLOWaterBasin.com** as soon as it becomes available.

WHERE: Ludwick Community Center, 864 Santa Rosa Street, San Luis Obispo, CA.

WHO SHOULD ATTEND: Stakeholders interested in or affected by the management of groundwater in the SLO Basin. Registration is strongly encouraged but not required at **SLOWaterBasin.com**, scroll down to "Meetings."

Sustainable Goal Setting Workshop

APR. 8, 2020 • 6:00pm-8:00pm — The public is invited to join the next workshop to participate in the third step in the GSP development process—setting sustainability goals for the Basin. The project team will provide an educational grounding of the Basin setting that both predicts future groundwater demand and describes the unique makeup and challenges associated with groundwater management in the SLO Basin. The team will then introduce what goes into creating groundwater sustainability goals, per the requirements of SGMA. Participants will then work in small groups with groundwater experts to help define the preliminary sustainability goals for the SLO Basin.

WHERE: Ludwick Community Center, 864 Santa Rosa Street, San Luis Obispo, CA.

WHO SHOULD ATTEND: Stakeholders interested in or affected by the management of groundwater in the SLO Basin. Registration is strongly encouraged but not required at **SLOWaterBasin.com**, scroll down to "Workshops."

FUTURE GSP CHAPTER/SECTION REVIEW OPPORTUNITIES

Chapter 5: Groundwater Conditions

Chapter 5 of the GSP documents the current and historical groundwater conditions of the SLO Basin. The items to be covered in Chapter 5 include groundwater elevation contours, estimates of groundwater in storage, groundwater quality distribution, subsidence and identification of interconnected groundwater-surface features, and groundwater dependent ecosystems.

GSC MEETINGS: 03/11/2020
WORKSHOP: 04/08/2020
REVIEW AND COMMENT: Released upon GSC approval at the 03/11/2020 GSC Meeting; comment period is anticipated to close 30 days or more following the GSC meeting.

Chapter 6: Water Budget

Chapter 6 of the GSP describes the historical and current groundwater budget for the SLO Basin including water coming in (inflows), water pumping and discharging (outflows), and changes in storage. It will also quantify the current overdraft in the Basin and estimate the Basin's sustainable yield.

GSC MEETINGS: 06/10/2020
WORKSHOP: 04/08/2020
REVIEW AND COMMENT: Released upon GSC approval at the 06/10/2020 GSC Meeting; comment period is anticipated to close 30 days or more following the GSC meeting.

Chapters 7-8: Sustainable Management Criteria and Monitoring Network

Chapters 7 and 8 identify the undesirable results for each of the five sustainability indicators required by SGMA and relevant to the SLO Basin, including: further groundwater level decline; reduction in groundwater storage; depletion of interconnected surface water bodies; water quality degradation; and land subsidence.

GSC MEETINGS: 06/10/2020; 09/09/2020; 12/09/2020
WORKSHOP: 08/2020
REVIEW AND COMMENT: Released upon GSC approval at the 12/09/2020 GSC Meeting; comment period is anticipated to close 30 days or more following the GSC meeting.

Chapters 9-10: Projects, Management Actions and Implementation Plan

Chapters 9 and 10 will identify projects, management actions, and the implementation plan that will bring groundwater use into balance and meet the sustainable management criteria identified in Chapters 7 and 8.

GSC MEETINGS: 12/09/2020; 03/10/2021
WORKSHOP: 02/2021
REVIEW AND COMMENT: Released upon GSC approval at the 03/10/2021 GSC Meeting; comment period is anticipated to close 30 days or more following the GSC meeting.

Key Terms

Groundwater Sustainability Agency (GSA) — One or more local agencies may establish a GSA. It is the GSA's responsibility to develop and implement a groundwater sustainability plan that considers all beneficial uses and users of groundwater in the basin. Two GSAs (i.e., the City and County of San Luis Obispo) have been formed for the SLO Basin to cover the whole basin area.

Groundwater Sustainability Commission (GSC) — The Groundwater Sustainability Commission is an advisory body that is established by the City and County GSAs to advise the GSAs in connection with preparation of the GSP for the SLO Basin. The GSC is currently comprised of the following individuals and related agencies: Bob Schiebelhut, Chairperson, Edna Valley Growers Mutual Water Company; Mark Zimmer, Vice Chairperson, Golden State Water Company; Dennis Fernandez, Member, Edna Ranch Mutual Water Company/Varian Ranch Mutual Water Company; Andy Pease, Member, City of San Luis Obispo; Adam Hill, Member, County of San Luis Obispo.

Groundwater Sustainability Portal (Portal) — Located at SLOWaterBasin.com, the Portal is the central online communication hub for public participation and information sharing on the GSP project. Any interested party can subscribe to receive project updates and/or to review and submit public comment on GSP chapters/sections through the Portal.

GSC Meetings — Quarterly public meetings held by the Groundwater Sustainability Commission. The general public is encouraged to attend to learn about project progress, ask questions, and/or provide and share input. For a full calendar of meetings visit the Portal at SLOWaterBasin.com and click on "calendar."

Groundwater Sustainability Plan (GSP) — A management plan developed by the GSAs to provide a framework for managing the groundwater basin sustainably to meet the requirements of the Sustainable Groundwater Management Act (SGMA).

San Luis Obispo Valley Groundwater Basin (SLO Basin) — A groundwater basin area within the San Luis Valley and Edna Valley that has been designated as a high priority basin by the State Department of Water Resources (DWR).

Stakeholder Communication and Engagement Plan (C&E Plan) — Groundwater is best managed at the local level. GSAs are required to develop and implement a C&E Plan to ensure the timely, forthright, and consistent communication among all beneficial users of groundwater and stakeholders affected by the GSP.

Sustainable Groundwater Management Act (SGMA) — SGMA is a package of three bills (AB 1739, SB 1168, and SB 1319) that provide local agencies with a framework for managing groundwater basins in a sustainable manner. Recognizing that groundwater is most effectively managed at the local level, the SGMA requires local agencies to achieve sustainability within 20 years.

Stakeholder Workshops — Four public workshops are anticipated to be held at specific milestones in the GSP development process to allow for inclusive and meaningful opportunities for affected stakeholders to participate and contribute in the plan design. Find details on scheduled workshops at SLOWaterBasin.com, click on "calendar."

Stakeholder Engagement Snapshot

A Groundwater Sustainability Plan (GSP) considers all beneficial uses and users of groundwater—making meaningful stakeholder engagement an important part of the planning process. Highlights of the project team's stakeholder engagement efforts are as follows:

393
SUBSCRIBERS TO EMAIL LIST

+30%
SUBSCRIBERS SINCE JUN '19

9/10
STAKEHOLDER SEGMENTS REPRESENTED ON EMAIL LIST

30
AVERAGE GSC MEETING ATTENDANCE BY STAKEHOLDERS

+50
AVERAGE WORKSHOP ATTENDANCE BY STAKEHOLDERS

Questions and Accommodation Requests

If you have any questions, if you wish to receive materials about the GSP development by mail, or if you'd like to request accommodations to attend an upcoming event or workshop including translation services, contact Dick Tzou at dtzou@co.slo.ca.us or 805-781-4473.

You can also contact us by mail:
County of San Luis Obispo Department of Public Works
County Government Center, Room 206
San Luis Obispo, CA 93408

Si necesita solicitar alojamiento para asistir a un próximo evento, incluidos los servicios de traducción, comuníquese con Dick Tzou a dtzou@co.slo.ca.us o al 805-781-4473.

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SLO Groundwater Sustainability Plan Public Comments Updated: 02/04/2020

Name	Comment Subject	Comment	Date/Time
James Waldsmith	GSP Chapters 1 & 2 - DRAFT	Could you send me a copy of the presentations presented on 9-11-19 in PDF format? In reviewing the available download of chapters 1 and 2 I do not find any of the Hydrology data presented. Please confirm receipt of this communication.	9/14/19 13:24
Toby Moore	GSP Chapters 1 & 2 - DRAFT - Agency Information	Golden State Water Company is of the opinion that an advisory body, similar or with the same structure of the current Groundwater Sustainability Commission (GSC), may be beneficial and perhaps necessary for GSP implementation. The MOU establishing the GSC contemplates this and does have language stating the following, "Depending on the content of the GSP the Parties may decide to enter into a new agreement to coordinate implementation." Inclusion of this language in Section 2.3.2 is recommended.Please consider the addition of the following text before the last sentence in Section 2.3.2. "The Parties may decide to enter into a new agreement to coordinate GSP implementation."	10/31/19 9:17

George Donati	SLO Basin GSP Chapters 3 & 4 - DRAFT	3.1 SLO Basin Introduction - We need to include the history of the Edna Valley Basin. In the 1950's - 1960's the East branch of the Corral de Piedra creek was dammed to install a 500 acre foot reservoir. In the 1970's, this dam was raised for a 1000 acre foot reservoir. This dam removed all flow of water into the Edna Valley Basin as the water was used for crop irrigation outside of the Edna Valley Basin. The flow downstream of the dam is not properly managed by the owner of the dam and the state water board. This has greatly reduced the re-charge of the Edna Valley Basin for the past 50 years.3.4.1 Water Source Types - This states " Excluding the Edna Valley Golf Course, all water demand in the SLO Basin are met with groundwater" - This needs to be clarified. The Golf course uses ground water to irrigate the course, and the golf course sells groundwater water to Golden State Water Company for residential use. 3.4.2 Water Use Sectors - Industrial - The ground water wells that supply water to the Price Canyon Oil Field are just outside of the basin boundary. Why are these wells not considered to use groundwater from the Edna Valley Basin since a natural flow from the creek passes adjacent to these wells 3.6.1.3. We are monitoring the flow of San Luis Obispo Creek as surface water leaves the San Luis Basin. Why not monitor the flow of the other major creeks, east and west Corral de Piedra at the edge of the Edna Valley Basin to determine the flow that is leaving the Basin? Or better yet, the flow that could be coming into the basin below the Dam on the East side of the valley.	1/30/20 8:10

Toby Moore	Communication and Engagement Plan	Appendix B of the plan describes the Groundwater Communication Portal's functionality which includes a repository of comments provided by stakeholders. However, it does not indicate whether the comments submitted will be visible or available via other means for stakeholders to review. Currently there appears to not be such functionality. As a member of the Groundwater Sustainability Commission, I feel this functionality is helpful and would encourage its implementation.	8/29/19 9:20

GROUNDWATER SUSTAINABILITY COMMISSION
for the San Luis Obispo Valley Groundwater Basin
March 11, 2020

Agenda Item 7 – Draft GSP Chapter 5 for Review and Comment (Action Item)

Recommendation

a) Consider recommending that each GSA receives and files Draft GSP Chapter 5 and provide direction as necessary.

Prepared by

Dave O'Rourke, GSI

Discussion

The WSC Team, has been tasked with the preparation of the Groundwater Sustainability Plan (GSP) for the SLO Basin to meet the requirements of SGMA. Chapter 5: Groundwater Conditions has been released as part of this Agenda packet. Chapter 5 of the GSP documents the current and historical groundwater conditions of the SLO Basin. Chapter 5 includes groundwater elevation contour maps, estimates of groundwater in storage, groundwater quality distribution, subsidence and identification of interconnected groundwater-surface features, and groundwater dependent ecosystems.

Chapter 5 will be uploaded to SLOWaterBasin.com for review during public comment period after the GSC has recommended that each GSA receives and files the draft chapters. The WSC Team will present an overview of Chapter 5 and show the attendees how to use SLOWaterBasin.com to download and provide comments.

Attachments:

1. Presentation
2. Draft Chapter 5

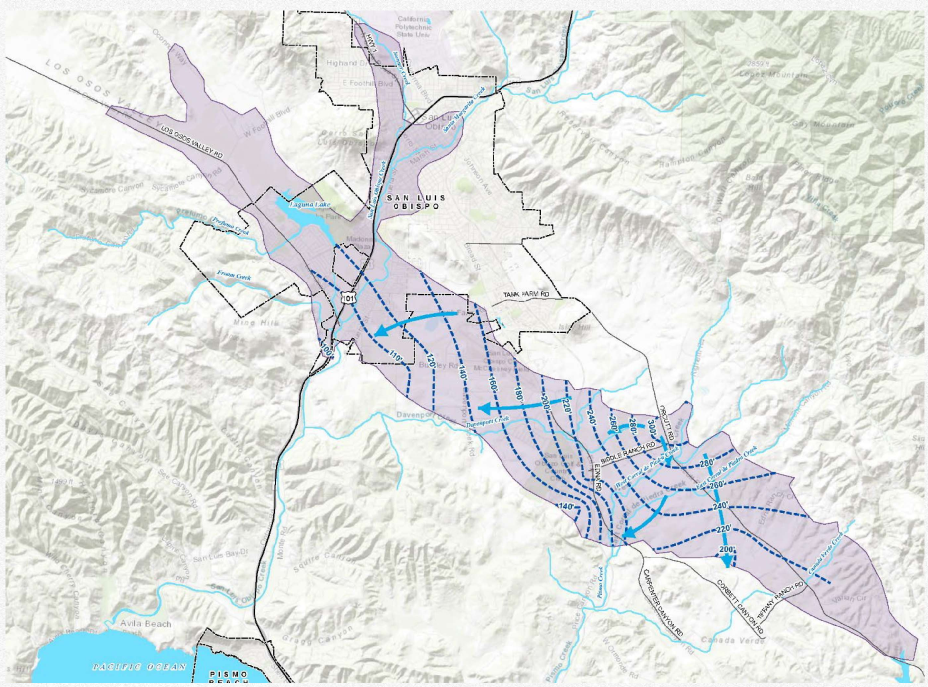
DRAFT CHAPTER 5: GROUNDWATER CONDITIONS

Dave O'Rourke, GSI

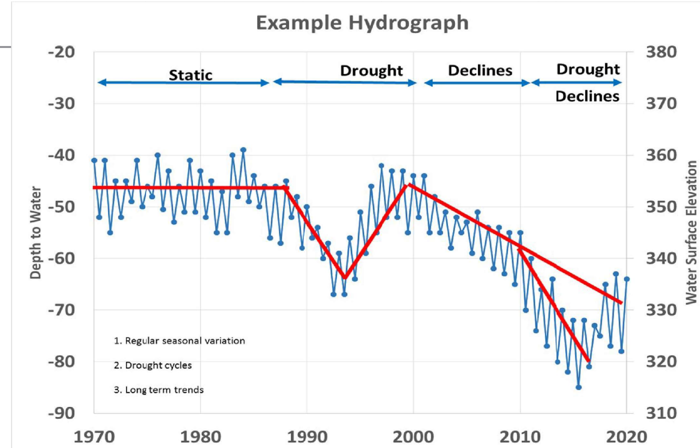
GSP CHAPTER 5: GROUNDWATER CONDITIONS

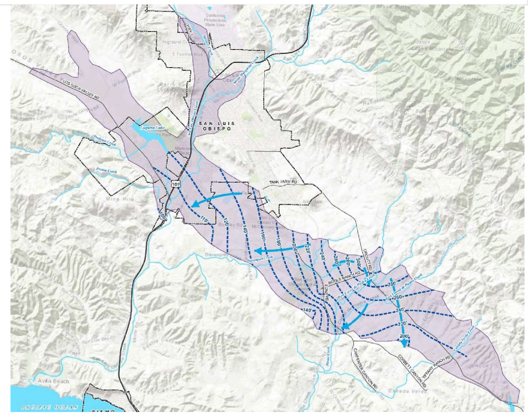
THIS CHAPTER COVERS:

- Groundwater Elevation Maps
- Estimates of Groundwater in Storage
- Groundwater Quality
- Subsidence
- Groundwater/Surface Water Interaction
- Groundwater Dependent Ecosystems (GDEs)



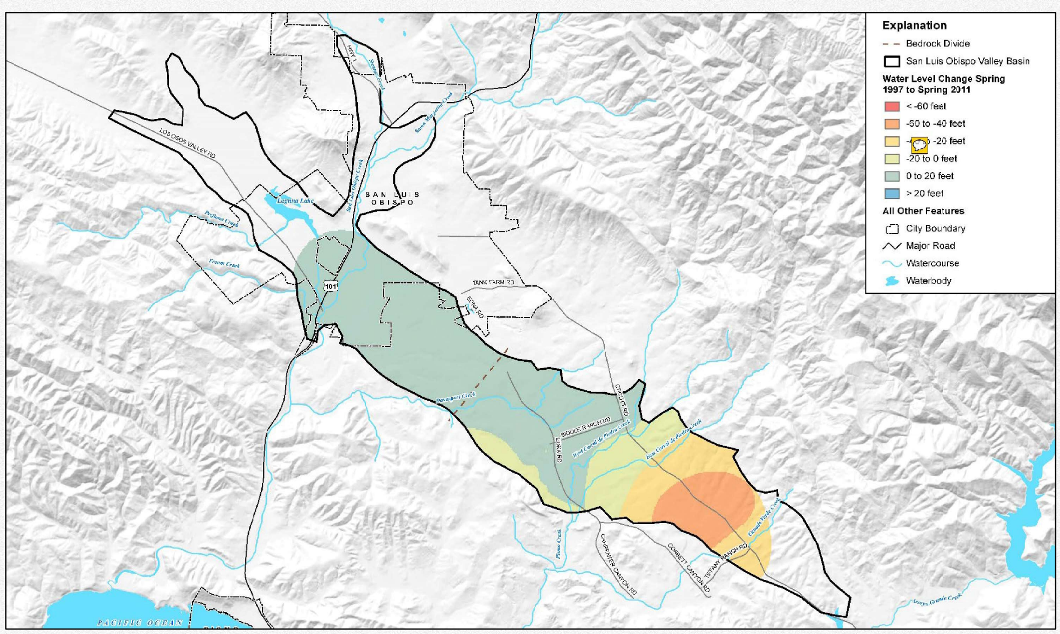
PREVIOUSLY PRESENTED GROUNDWATER CONDITIONS DATA
SLO BASIN





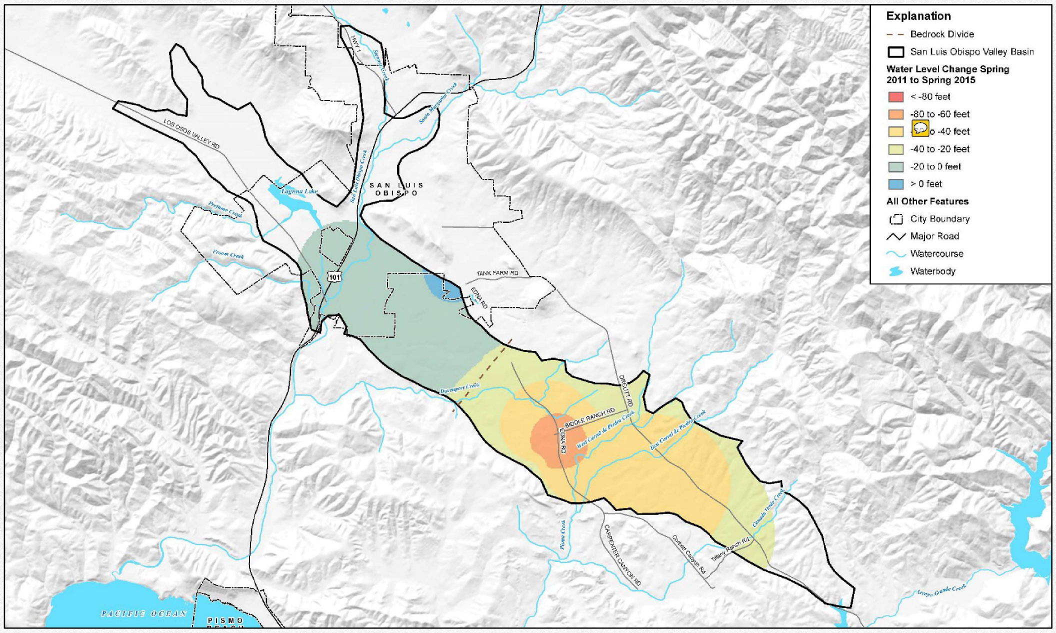
- **Hydrographs –** A single point in space across the entire time period of record. Shows trends through time.
- **Groundwater Contour Maps –** A single point in time across the entire area of interest. Shows groundwater flow direction, discharge and recharge areas.
- **Groundwater Elevation Change Maps**- Changes in conditions across the entire area of interest over a specified time period

CHANGE IN GROUNDWATER ELEVATIONS
Spring 1997 to Spring 2011



CHANGE IN GROUNDWATER SURFACE

Spring 2011 to Spring 2015



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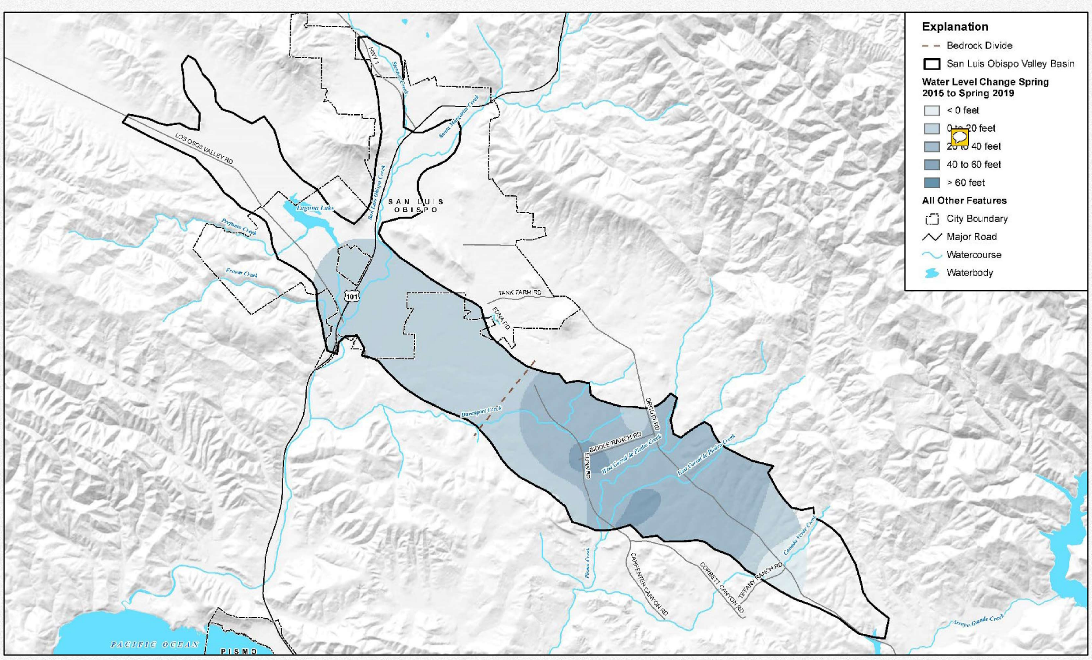
CHANGE IN GROUNDWATER SURFACE

Spring 2015 to Spring 2019



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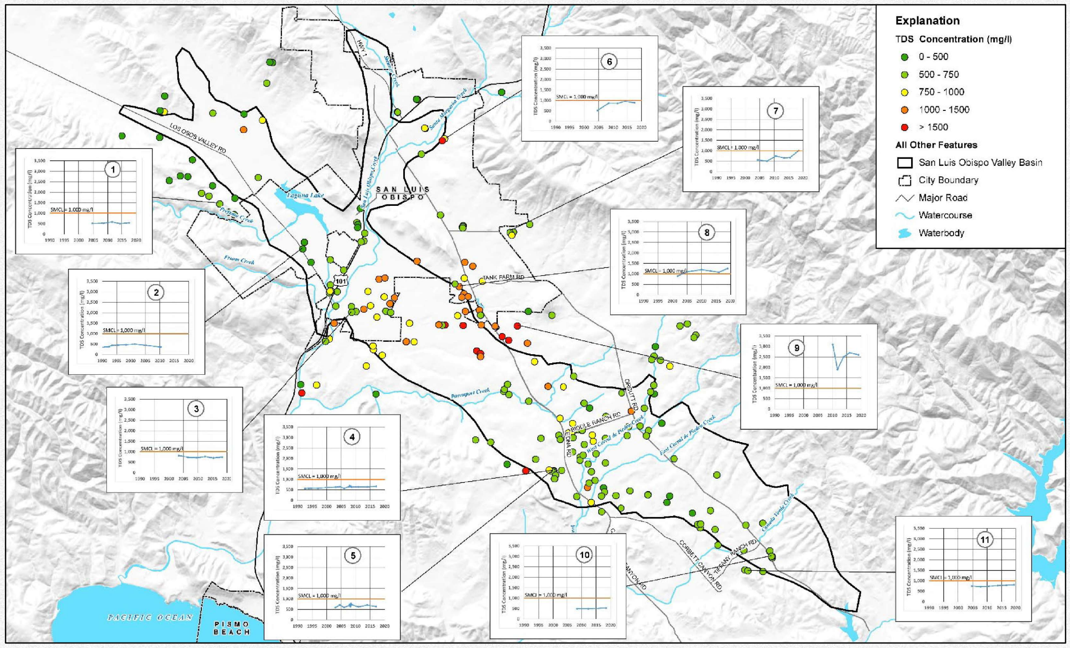
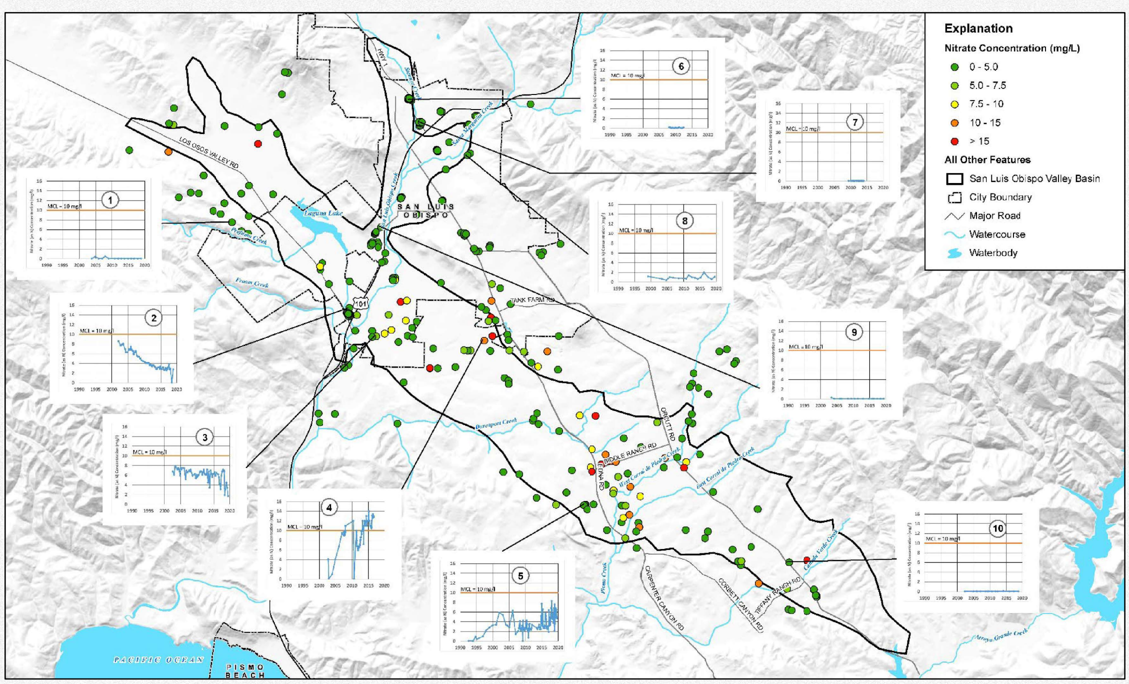
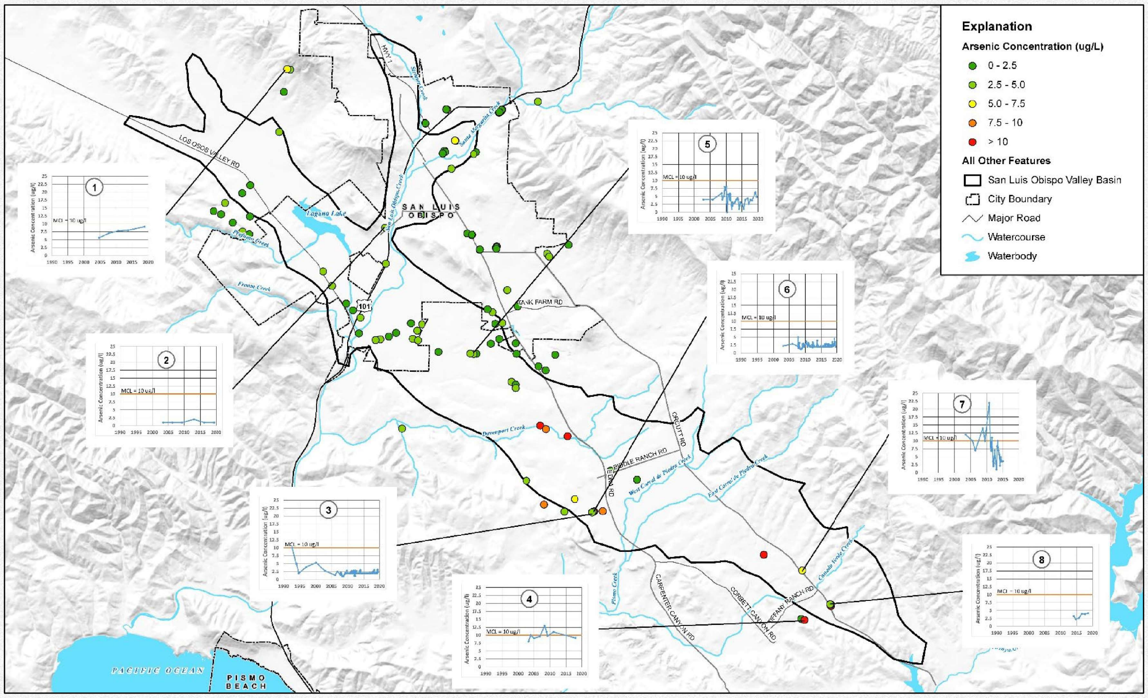
GROUNDWATER QUALITY – TOTAL DISSOLVED SOLIDS (TDS)



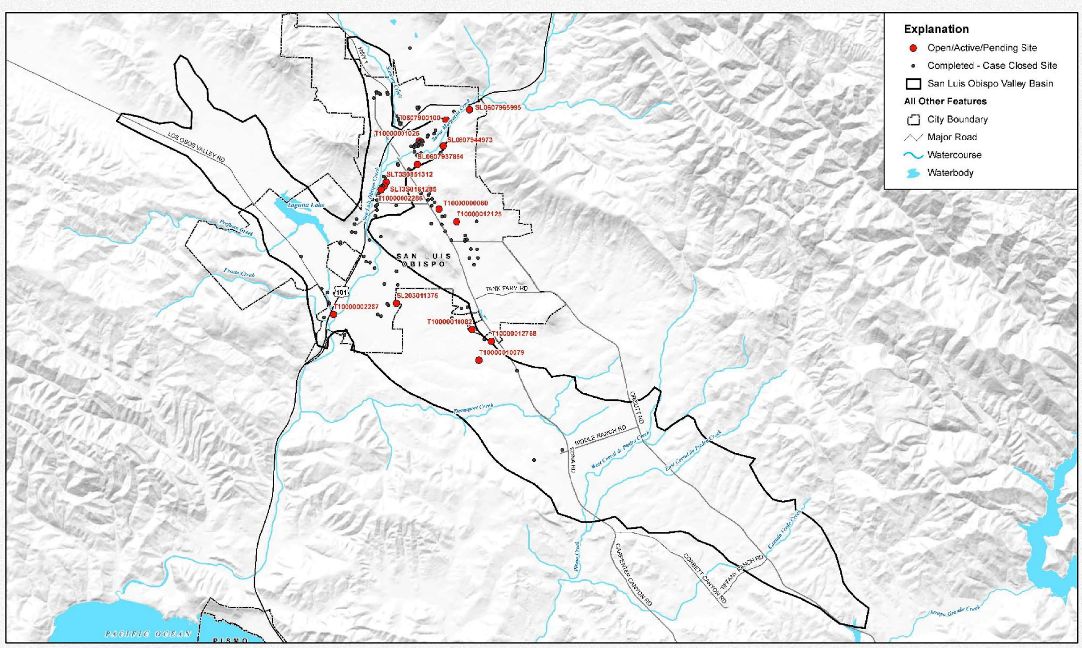
GROUNDWATER QUALITY – NITRATES



GROUNDWATER QUALITY – ARSENIC

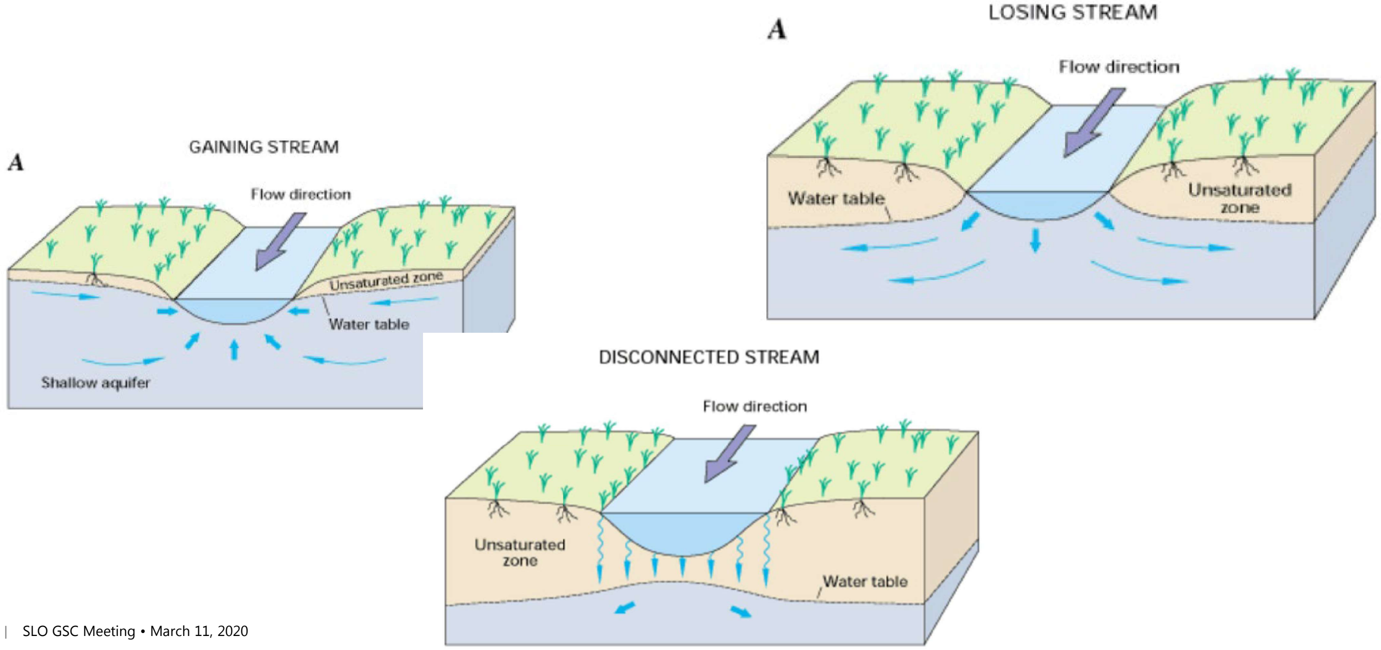


GROUNDWATER QUALITY POINT SOURCE CONTAMINANT CASES



GROUNDWATER SURFACE WATER INTERACTION

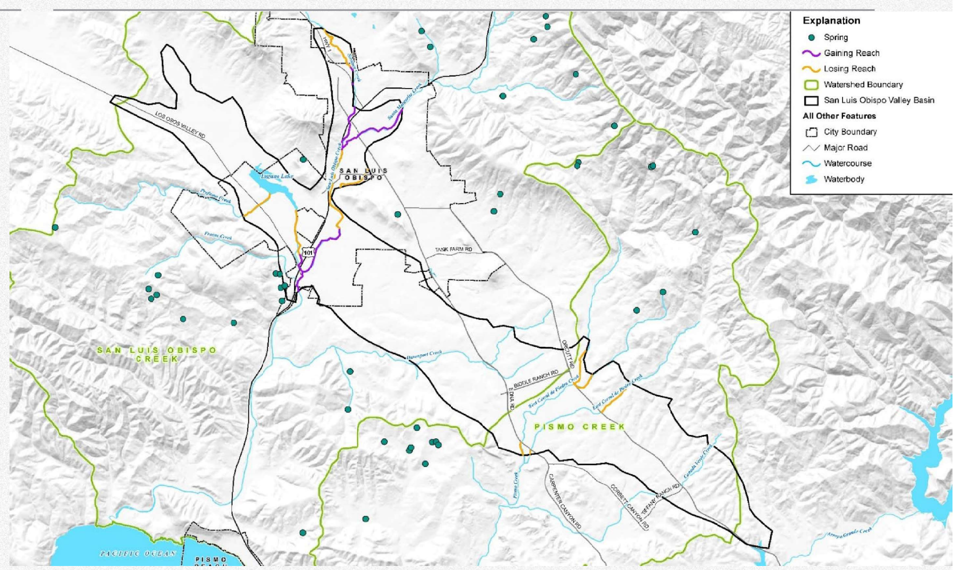
Gaining and losing streams examples

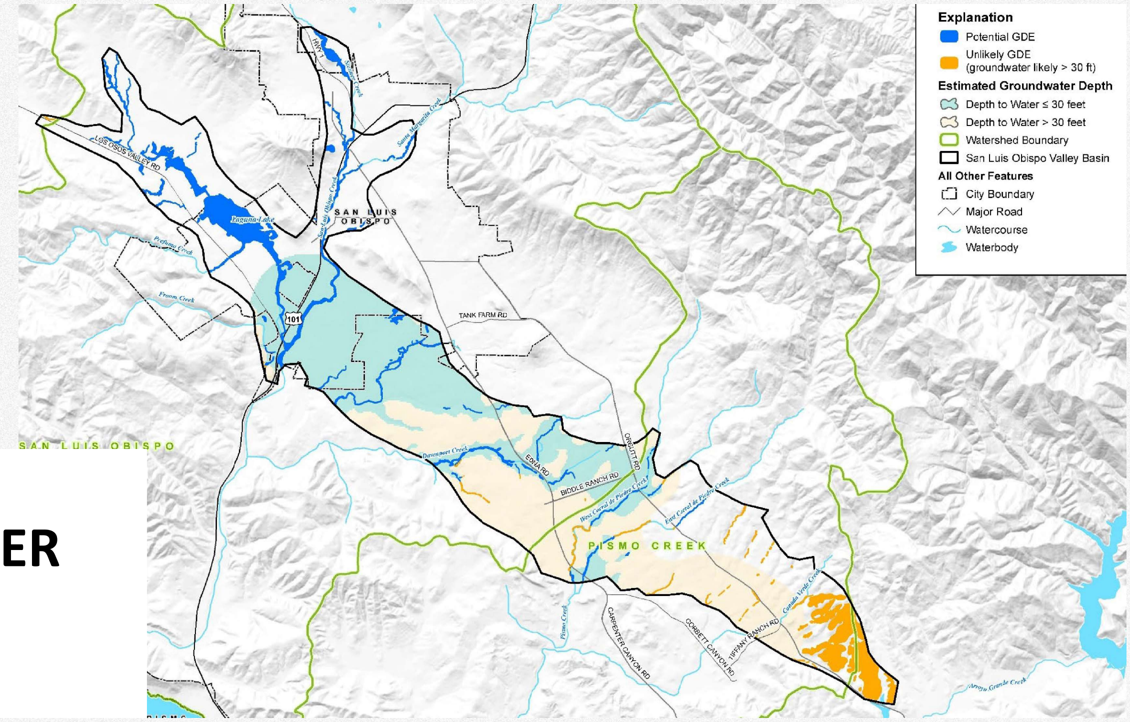


SLO BASIN GAINING AND LOSING STREAMS

- **SLO Valley** – Water levels are high enough that streams are connected (both gaining and losing). If no significant water level declines occur, this should be maintained.

- **Edna Valley** – Water levels are well below stream elevations. Streams are losing or disconnected.





POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS

HOW TO SUBMIT PUBLIC COMMENT

REVIEW AND COMMENT.

Chapter 5: Groundwater Conditions Public Comment period will be open tomorrow upon GSC approval and closes 04/30/20 — 49 days.

Go to **SLOWaterBasin.com** click on "Review Documents"

PUBLIC MEETINGS.

GSC Public Meeting
06/10/20 • 3:30pm-5:30pm

Learn more or register at **SLOWaterBasin.com**, click on "Calendar"

Draft

Groundwater Sustainability Plan
Chapter 5 – Ground Water Conditions

for the

San Luis Obispo Valley Groundwater Basin
Groundwater Sustainability Agencies

Prepared by

3/1/2020

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APPENDICES

LIST OF TERMS USED

Abbreviation	Definition
AB	Assembly Bill
ADD	Average Day Demand
AF	Acre Feet
AFY	Acre Feet per Year
AMSL	Above Mean Sea Level
Basin Plan	Water Quality Control Plan for the Central Coast Basin
Cal Poly	California Polytechnic State University
CASGEM	California State Groundwater Elevation Monitoring program
CCR	California Code of Regulations
CCRWQCB	Central Coast Regional Water Quality Control Board
CCGC	Central Coast Groundwater Coalition
CDFM	Cumulative departure from the mean
CDPH	California Department of Public Health
CIMIS	California Irrigation Management Information System
City	City of San Luis Obispo
County	County of San Luis Obispo
CPUC	California Public Utilities Commission
CPWS-52	Cal Poly Weather Station 52
CRWQCB	California Regional Water Quality Control Board
CWC	California Water Code
DDW	Division of Drinking Water
Du/ac	Dwelling Units per Acre
DWR	Department of Water Resources
EPA	Environmental Protection Agency
ERMWC	Edna Ranch Mutual Water Company
ET_0	Evapotranspiration
EVGMWC	Edna Valley Growers Ranch Mutual Water Company
°F	Degrees Fahrenheit
FAR	Floor Area Ratio
FY	Fiscal Year
GAMA	Groundwater Ambient Monitoring and Assessment program
GHG	Greenhouse Gas
GMP	Groundwater Management Plan
GPM	Gallons per Minute
GSA	Groundwater Sustainability Agency
GSC	Groundwater Sustainability Commission
GSP	Groundwater Sustainability Plan
GSWC	Golden State Water Company
IRWMP	San Luis Obispo County Integrated Regional Water Management Plan
kWh	Kilowatt-Hour
LUCE	Land Use and Circulation Element
LUFTs	Leaky Underground Fuel Tanks
MAF	Million Acre Feet
MCL	Maximum Contaminant Level

Abbreviation	**Definition**
MG	Million Gallons
MGD	Million Gallons per Day
Mg/L	Milligrams per Liter
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MWR	Master Water Report
NCDC	National Climate Data Center
NOAA	National Oceanic and Atmospheric Administration
NWIS	National Water Information System
RW	Recycled Water
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SGMA	Sustainable Groundwater Management Act
SGMP	Sustainable Groundwater Management Planning
SGWP	Sustainable Groundwater Planning
SLO Basin	San Luis Obispo Valley Groundwater Basin
SLOFCWCD	San Luis Obispo Flood Control and Water Conservation District
SCML	Secondary Maximum Contaminant Level
SOI	Sphere of Influence
SNMP	Salt and Nutrient Management Plan
SWRCB	California State Water Resources Control Board
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
USFW	United States Fish and Wildlife Service
USTs	Underground Storage Tanks
UWMP	Urban Water Management Plan
UWMP Act	Urban Water Management Planning Act
UWMP Guidebook	Department of Water Resources 2015 Urban Water Management Plan Guidebook
VRMWC	Varian Ranch Mutual Water Company
WCS	Water Code Section
WMP	Water Master Plan
WPA	Water Planning Areas
WRF	Water Reclamation Facility
WRCC	Western Regional Climate Center
WRRF	Water Resource Recovery Facility
WSA	Water Supply Assessment
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

This section to be completed after GSP is complete.

5 GROUNDWATER CONDITIONS (§ 354.16)

This section describes the current and historical groundwater conditions in the Alluvial Aquifer, the Paso Robles Formation Aquifer, and the Pismo Formation Aquifer in the San Luis Obispo Valley Groundwater Basin. In accordance with the SGMA Emergency Regulations §354.16, current conditions are any conditions occurring after January 1, 2015. By implication, historical conditions are any conditions occurring prior to January 1, 2015. This Chapter focuses on information required by the GSP regulations and information that is important for developing an effective plan to achieve sustainability. The organization of Chapter 5 aligns with the six sustainability indicators specified in the GSP regulations, including:

1. Chronic lowering of groundwater elevations;
2. Groundwater storage reductions;
3. Seawater intrusion;
4. Land Subsidence;
5. Depletion of interconnected surface waters, and;
6. Degradation of groundwater quality.

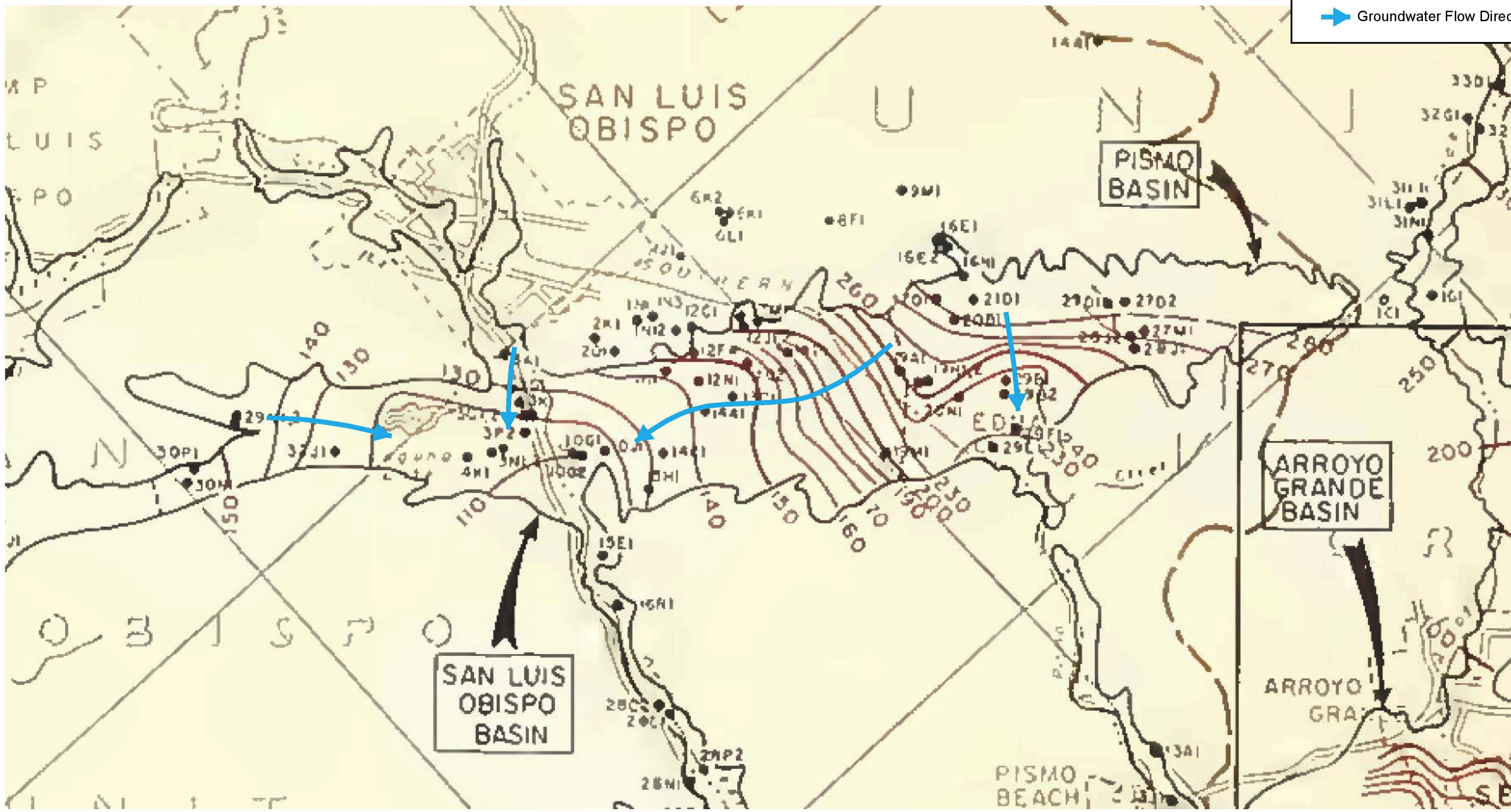
5.1 GROUNDWATER ELEVATIONS AND INTEPRETATION

As discussed in Chapter 4, information from available boring logs indicates that there is no regional or laterally extensive aquitard separating the Alluvial Aquifer, Paso Robles Formation aquifer, and Pismo Formation aquifer in the Basin. In the San Luis Valley, a physical distinction between Alluvium and Paso Robles Formation is often not apparent, and information from well completion reports in the Basin indicate that wells are regularly screened across productive strata in both formations, which effectively function as a single hydrogeologic unit. Likewise, in the Edna Valley, information from well completion reports indicates that wells are routinely screened across productive strata in both the Paso Robles Formation Aquifer and the Pismo Formation Aquifer, which effectively function as a single hydrogeologic unit. Boyle (1991) states that there is no strict boundary between the Alluvial Aquifer and the Paso Robles Formation Aquifer in the Buckley Road area. DWR (1997) states that all the sediments in the Subbasin are in hydraulic continuity. Because there is no available groundwater elevation data specific to the three individual aquifers, and because these formations appear to function as combined hydrogeologic units, groundwater elevation data are combined and presented as a single groundwater elevation map for each time period presented.

In general, the primary direction of groundwater flow in the Basin is from the area of highest groundwater elevations in the Edna Valley northwestward toward San Luis Creek, where the flow leaves the Basin along the stream course. Groundwater in the northwestern areas of the Basin near the City of San Luis Obispo boundary and Los Osos Valley Road flows southeastward toward the San Luis Creek alluvium. In the southeastern portion of the Basin there are also local areas of flow discharging from the Basin along Pismo Creek tributaries of East and West Corral de Piedras Creek, and alluvium of other smaller tributaries further to the south. Groundwater Elevation maps for various recent and historical time periods are presented and discussed in the following sections.

5.1.1 Fall 1954 Groundwater Elevations

DWR (1958) published a series of maps depicting groundwater elevations for various basins in the County, including groundwater elevations in the San Luis Obispo Valley Groundwater Basin for fall 1954 (Figure 5-1), with contours based on field measurements of over 40 control points in the Basin. Groundwater flow direction arrows were added to Figure 5-1 to illustrate the primary direction of flow in the Basin. This is the oldest Basin-wide groundwater elevation data available. In the Los Osos Valley portion of the Basin, this map displays dominant groundwater flow direction from higher elevations in the in the northwestern extent of the Basin southeastward toward the discharge area where San Luis Creek leaves the Basin. The hydraulic gradient (the ratio of horizontal distance along the groundwater flow path to the change in elevation) in this area is approximately 0.004 feet/feet (ft/ft). In the Edna Valley portion of the Basin, the dominant groundwater flow direction is northwestward from the higher groundwater elevations in the southeastern part of the Basin (over 280 ft AMSL) to lower elevations (less than 110 feet AMSL) where San Luis Creek exits the Basin. The gradient across this area is steeper than in Los Osos Valley, approximately 0.009 ft/ft. This map also displays local areas of discharge coincident with the areas where San Luis Creek and Pismo Creek tributaries leave the Basin.



Explanation

Groundwater Level Contour (10 feet)

Groundwater Flow Direction

Prepared for:

Author: AB
Date: 11/26/2019

SAN LUIS OBISPO VALLEY BASIN GSP

0 0.25 0.5 1 Miles

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obsipo County Investigationm State Water Resources Board Bulletin No. 18, Place 9B, May 1958.

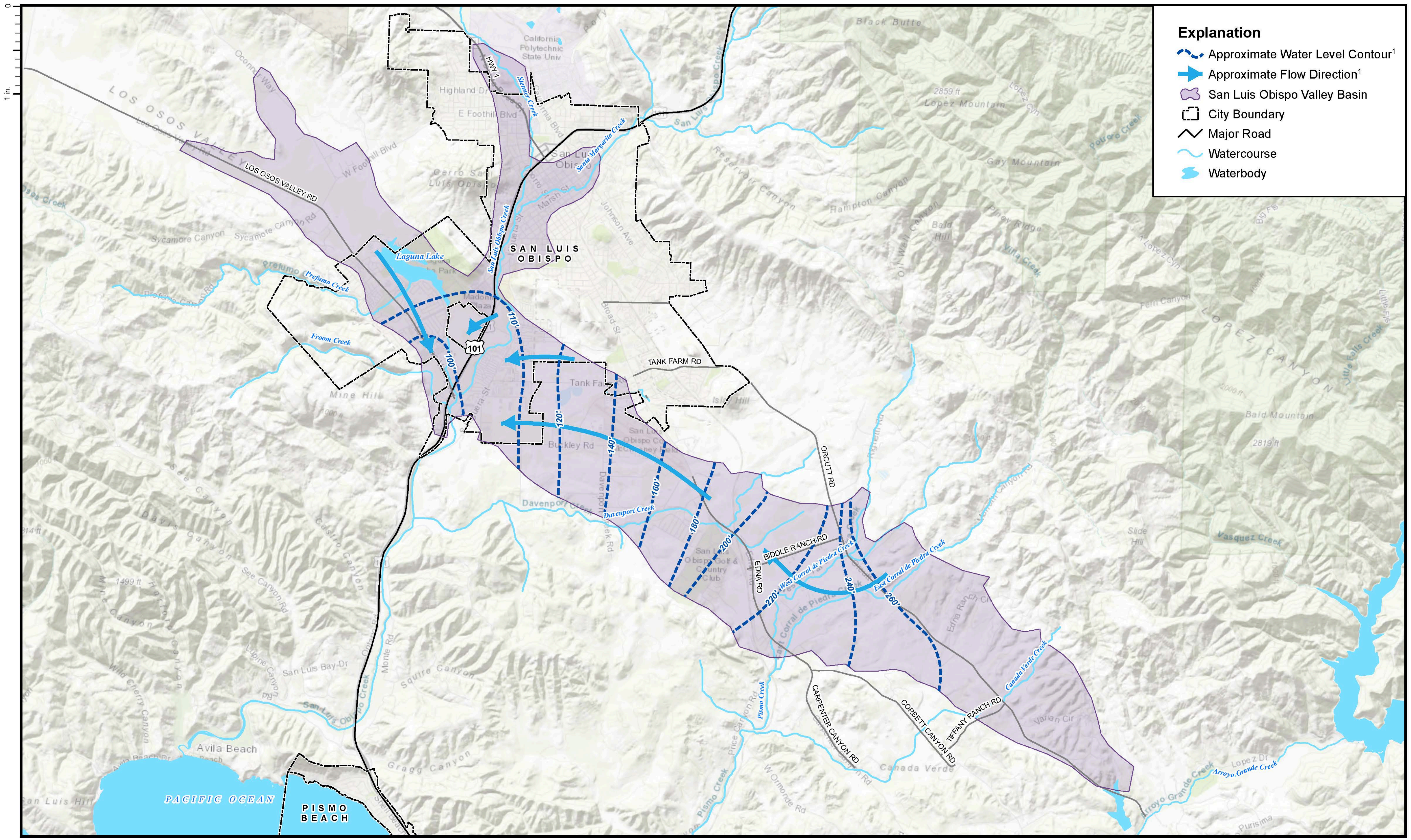
Groundwater Elevation Surface
Fall 1954

Figure 5-1

4

5.1.2 Spring 1990 Groundwater Elevations

Boyle (1991) presents water level elevation contour maps for the spring of 1986 and 1990, based on water level data collected from 18 control points in the field. A digitized recreation of the Boyle groundwater elevation contours for spring of 1990 is presented in Figure 5-2 and displays patterns of groundwater flow direction in the Basin similar to those exhibited in the DWR 1954 map, although the flow gradient does not appear to be as steep as it is in the 1954 map. The year 1990 was in the midst of a significant period of drought in the Basin. The northwestward gradient across the central area of the Basin is approximately 0.006 ft/ft. Contours for the spring of 1986 are not re-presented in this report, but 1986 represents wetter conditions than the 1990 map, and it is noted in Boyle (1991) that there is a difference of approximately 10 feet of elevation between the two maps, representing the variation in water levels observed between wet and dry weather cycles in this time period. The contours in Figure 5-2 do not display an area of discharge where Corral de Piedras Creeks leave the Basin, but this is likely due to a lack of control points in this area.



Prepared for:

Author: AB
Date: 11/26/2019

SAN LUIS OBISPO VALLEY BASIN GSP

N

0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. ESRI

Notes:
1. Contours and flow direction were adapted from 1991 Boyle Groundwater Basin Evaluation, Plate 8.
2. Control points not displayed due to confidentiality agreements.

Groundwater Elevation Surface Spring 1990

Figure 5-2

6

5.1.3 Modeled 1990s Groundwater Elevations

In its draft report, DWR (1997) used a computer groundwater model to generate a series of modeled water level maps representing wet, dry, and average weather conditions. The model results are not re-presented in this GSP, but a review of the draft report indicates the maps display the same general flow direction patterns as the DWR (1958) and Boyle (1991) maps, which were based on data collected in the field. Water level elevations in the San Luis Valley in wet years were approximately 10 to 20 feet higher than in dry years. In the Edna Valley, the difference in groundwater elevations between wet and dry years was greater, approximately 20 to 30 feet.

5.1.4 Spring 1997 Groundwater Elevations

More recent groundwater level data collected as a part of San Luis Obispo County's groundwater monitoring program were obtained and used to generate groundwater elevation maps to evaluate more recent conditions. The following assessment of groundwater elevation conditions is based primarily on data from the San Luis Obispo County Flood Control and Water Conservation District's (SLOFCWCD) groundwater monitoring program. Groundwater levels are measured through a network of public and private wells in the Basin. Figure 5-3 through Figure 5-7 presents the contours generated from the data for the Spring 1997, Spring 2011, Spring 2015, Spring 2019, and Fall 2019 monitoring events.

The set of wells used in the groundwater elevation assessment were selected based on the following criteria:

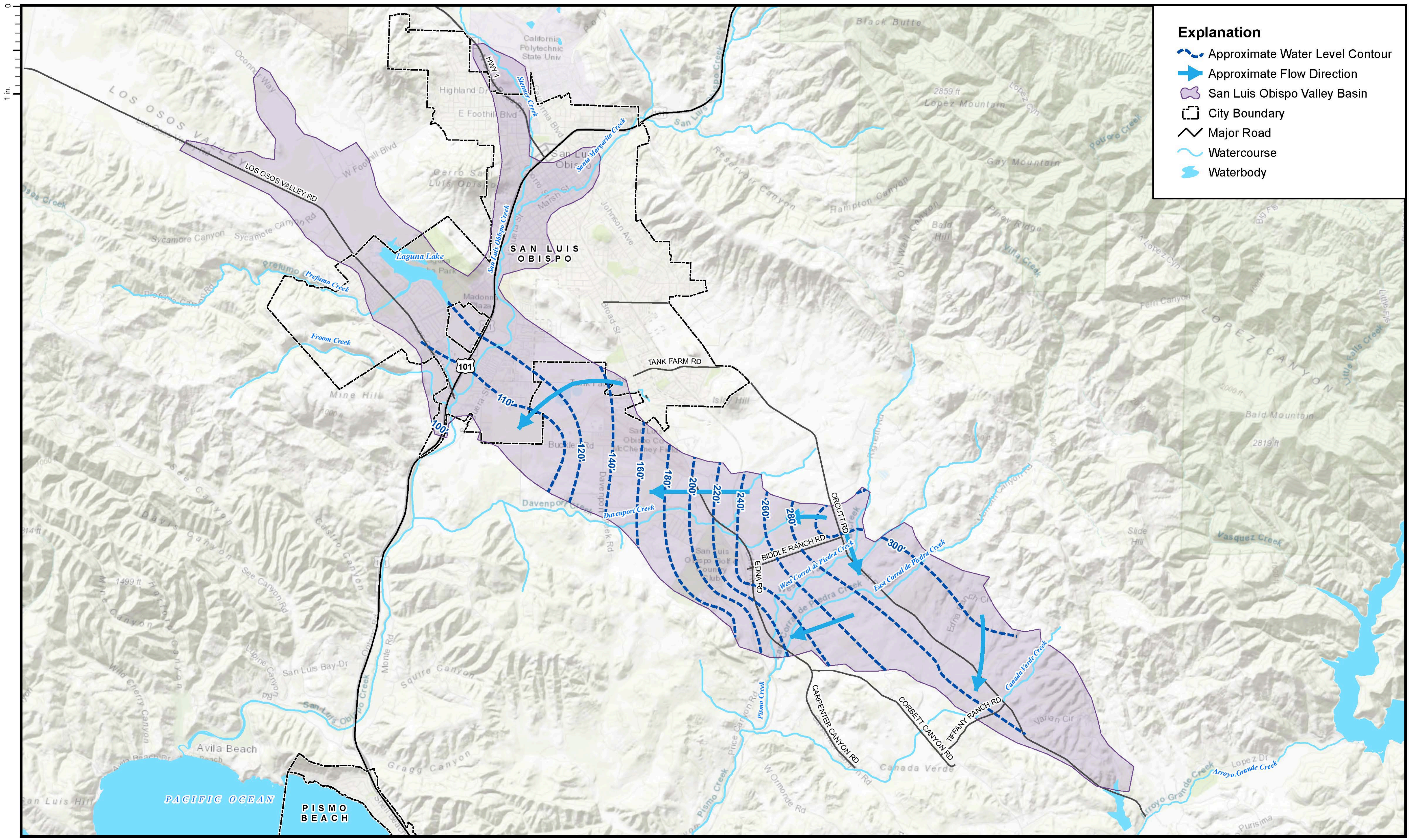
- The wells have groundwater elevation data for the periods of record of interest;
- Groundwater elevation data were deemed representative of static conditions.

Additional information on the monitoring network is provided in Chapter 8 – Monitoring Networks.

Based on available data, the following information is presented in subsequent subsections.

- Groundwater elevation contour maps for spring 1997, 2011, 2015, 2019, and Fall 2019;
- A map depicting the change in groundwater elevation between 1997 and 2011;
- A map depicting the change in groundwater elevation between 2011 and 2015;
- A map depicting the change in groundwater elevation between 2015 and 2019;
- Hydrographs for select wells with publicly available data.

Figure 5-3 presents a groundwater surface map for Spring 1997 based on field data collected by the County (control points are not displayed to maintain confidentiality agreements negotiated with well owners). The southeast (near Lopez Lake) and northwest (Los Osos Valley) areas of the Basin had no wells monitored during these events to calculate water levels, so contours are not presented for those areas. Several features on this map are apparent. First, a pronounced groundwater mound is evident at the location where West Corral de Piedras Creek enters the Basin in Edna Valley, near the corner of Biddle Ranch Road and Orcutt Road; three control points are present in this area, providing reliable documentation for water levels in this vicinity. This indicates that this is a groundwater recharge area. The regional northwesterly flow direction apparent in the previously discussed water level maps is still evident here; the groundwater flow gradient is about 0.011 ft/ft, somewhat steeper than the Spring 1990 gradient presented by Boyle.



Prepared for:

Author: AB
Date: 11/26/2019

SAN LUIS OBISPO VALLEY BASIN GSP

0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. ESRI

Note:
1. Control points not displayed dur to confidentiality agreements.

Groundwater Elevation Surface
Spring 1997

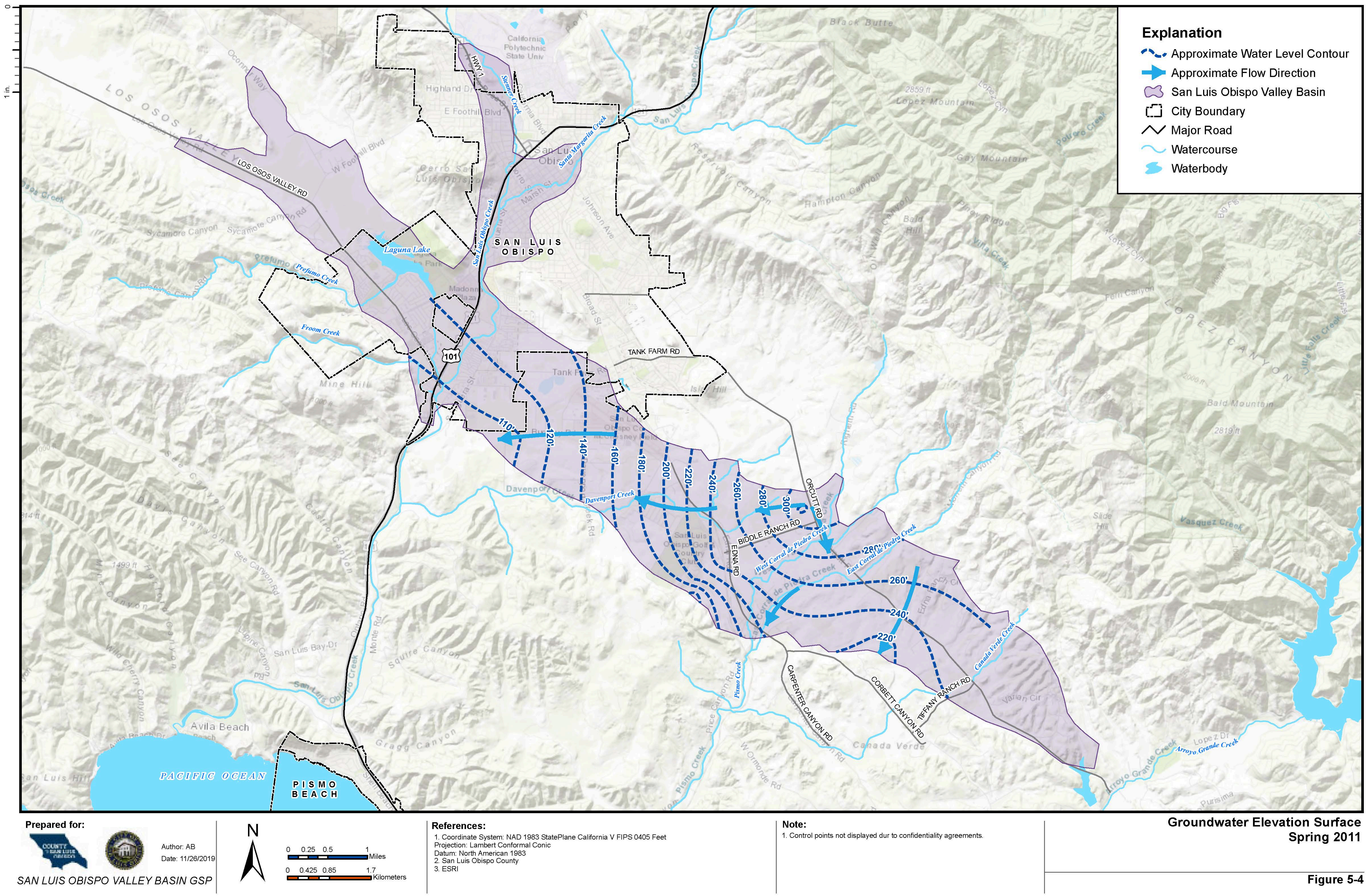
Figure 5-3

8

5.1.5 Spring 2011 Groundwater Elevations

Spring 2011 represents a time period just prior to the recent drought, but after the expansion of agricultural pumping in Edna Valley (discussed further in Chapter 6, Water Budget). As such, effects of the recent drought should not yet be apparent, but reduced groundwater levels due to expanded agricultural pumping should be evident.

Figure 5-4 displays groundwater elevation contours for Spring 2011. The groundwater mound near Biddle Ranch Road and Orcutt Road is again evident, with a maximum groundwater elevation of over 320 feet. Groundwater flow direction appears to indicate areas of discharge from the Basin in Edna Valley along Corral de Piedras Creeks and Canada Verde Creek, and along San Luis Creek in San Luis Valley. The area near Edna Road and Biddle Ranch Road indicates a steep local gradient, likely associated with local pumping. The contour near the exit of Corral de Piedras Creeks is 180 feet. The gradient across the central Basin is almost identical to the Spring 1997 map, about 0.011 ft/ft. The gradient is much shallower in the San Luis Valley part of the Basin.



References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. ESRI

Note:
1. Control points not displayed dur to confidentiality agreements.

Groundwater Elevation Surface
Spring 2011

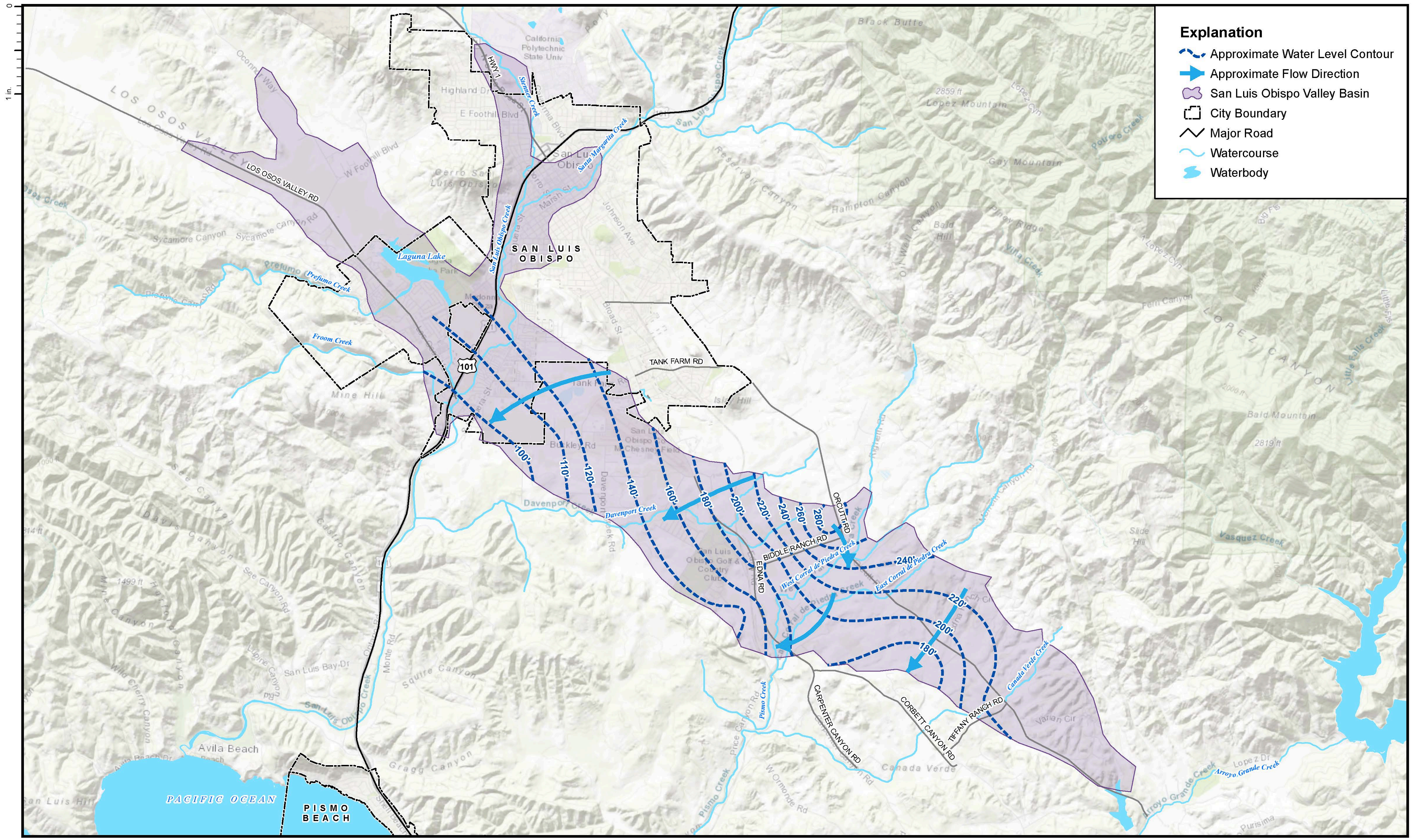
Figure 5-4

10

5.1.6 Spring 2015 Groundwater Elevations

Figure 5-5 presents groundwater elevation contours for Spring 2015. Spring 2015 represents a time period in the midst of the recent drought, and after the expansion of agricultural pumping in Edna Valley.

The effects of the drought are apparent upon close inspection of the contours in Figure 5-5. In the Edna Valley, the maximum contour of the recharge area near Orcutt Road and Biddle Ranch Road is 280 feet, about 40 feet lower than in the Spring 2011 map. The contours immediately west of the mound are still steep, but flatten out significantly along Davenport Creek, resulting in a much shallower gradient in this area than in the Spring 2011 map. Contours east of the mound along Orcutt Road are 20 to 40 feet lower than in the Spring 2011 map. In the San Luis Valley, a 100-foot contour is evident near the exit of San Luis Creek from the Basin, which is about 10 feet lower than the contour in the Spring 2011 map.



Prepared for:

Author: AB
Date: 11/26/2019

SAN LUIS OBISPO VALLEY BASIN GSP

N

0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. ESRI

Note:
1. Control points not displayed dur to confidentiality agreements.

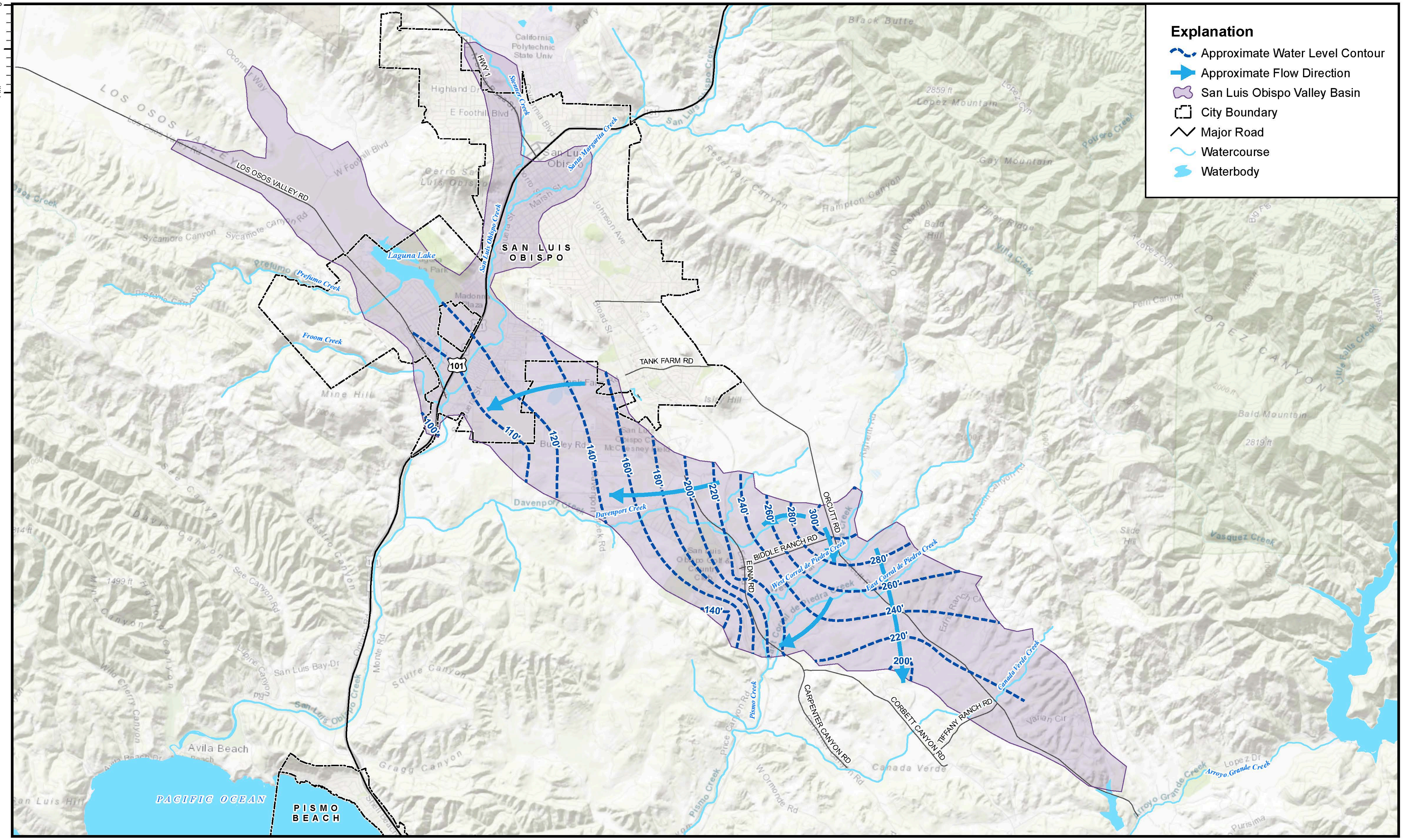
Groundwater Elevation Surface Spring 2015

Figure 5-5

12

5.1.7 Spring 2019 Groundwater Elevations

Figure 5-6 presents a groundwater surface elevation map for Spring 2019. Spring 2019 represents a time period at the end of seasonal winter rains, and after the end of the recent drought. Rebounds of groundwater elevations from the drought are apparent upon inspection of the contours. In the Edna Valley, the maximum contour of the recharge area near Orcutt Road and Biddle Ranch Road is 300 feet, about 20 feet higher than in the Spring 2015 map. Contours east of the mound are about 20 feet higher than in the Spring 2015 map. Contours along Davenport Creek are about 20 feet higher than in the Spring 2015 map. The elevation at Edna Road and Biddle Ranch Road is about 230 feet, over 50 feet higher than in the Spring 2015 map.



Prepared for:

Author: AB
Date: 11/26/2019

SAN LUIS OBISPO VALLEY BASIN GSP

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0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. ESRI

Note:
1. Control points not displayed dur to confidentiality agreements.

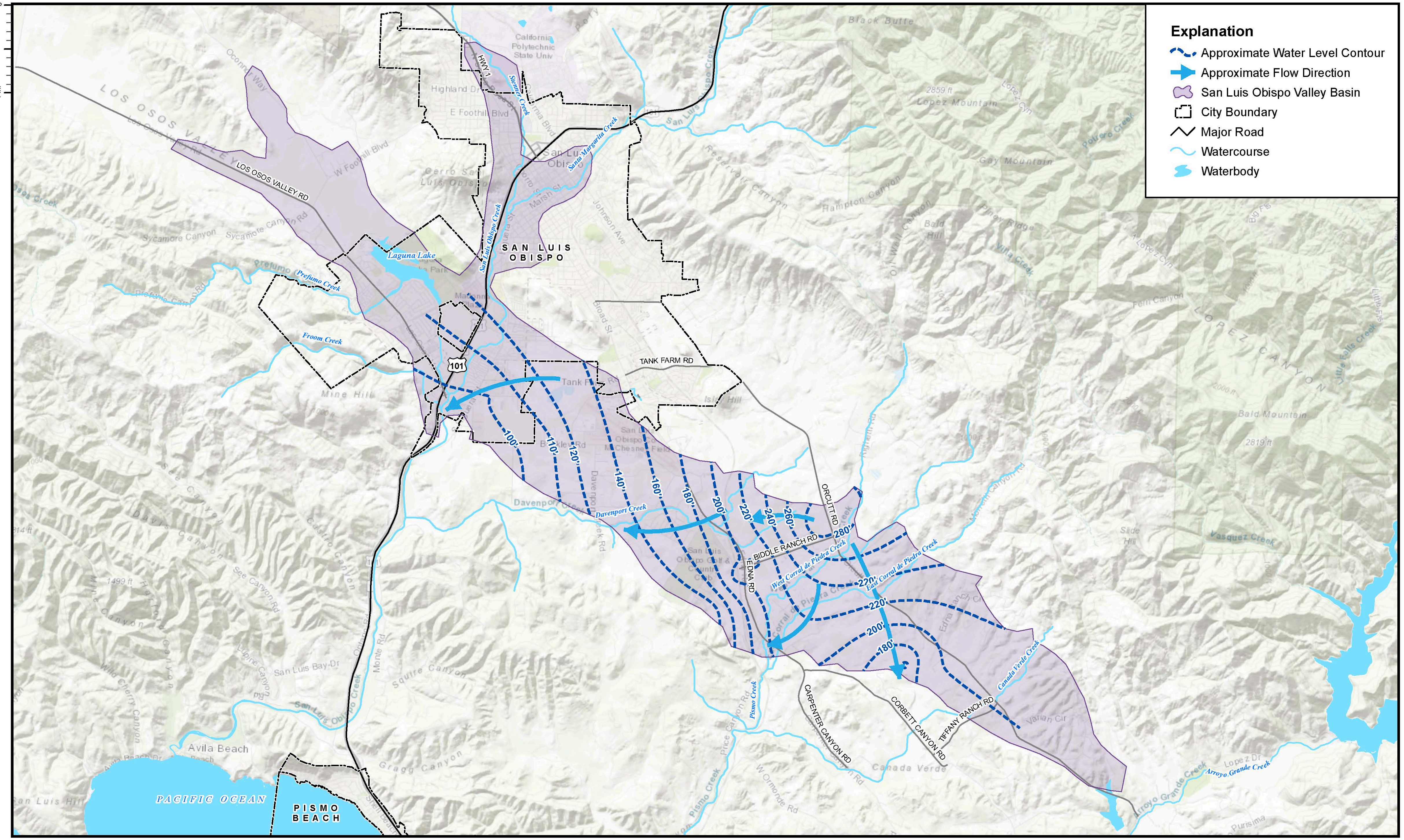
Groundwater Elevation Surface
Spring 2019

Figure 5-6

14

5.1.8 Fall 2019 Groundwater Elevations

Figure 5-7 presents a groundwater surface elevation map for Fall of 2019. This time period represents recent conditions at the end of the summer dry season for comparison against the spring conditions. Overall, the contours indicate lower groundwater levels than those displayed in the Spring 2019 map. Groundwater contours east of the recharge mound at West Corral de Piedras are about 20 feet lower than the Spring 2019 map. The groundwater elevation at Edna Road and Biddle Ranch Road is about 220 feet, approximately 10-20 feet lower than in the Spring 2018 map.



Prepared for:

SAN LUIS OBISPO VALLEY BASIN GSP

Author: AB
Date: 11/26/2019

0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. ESRI

Note:
1. Control points not displayed dur to confidentiality agreements.

Groundwater Elevation Surface Fall 2019

Figure 5-7

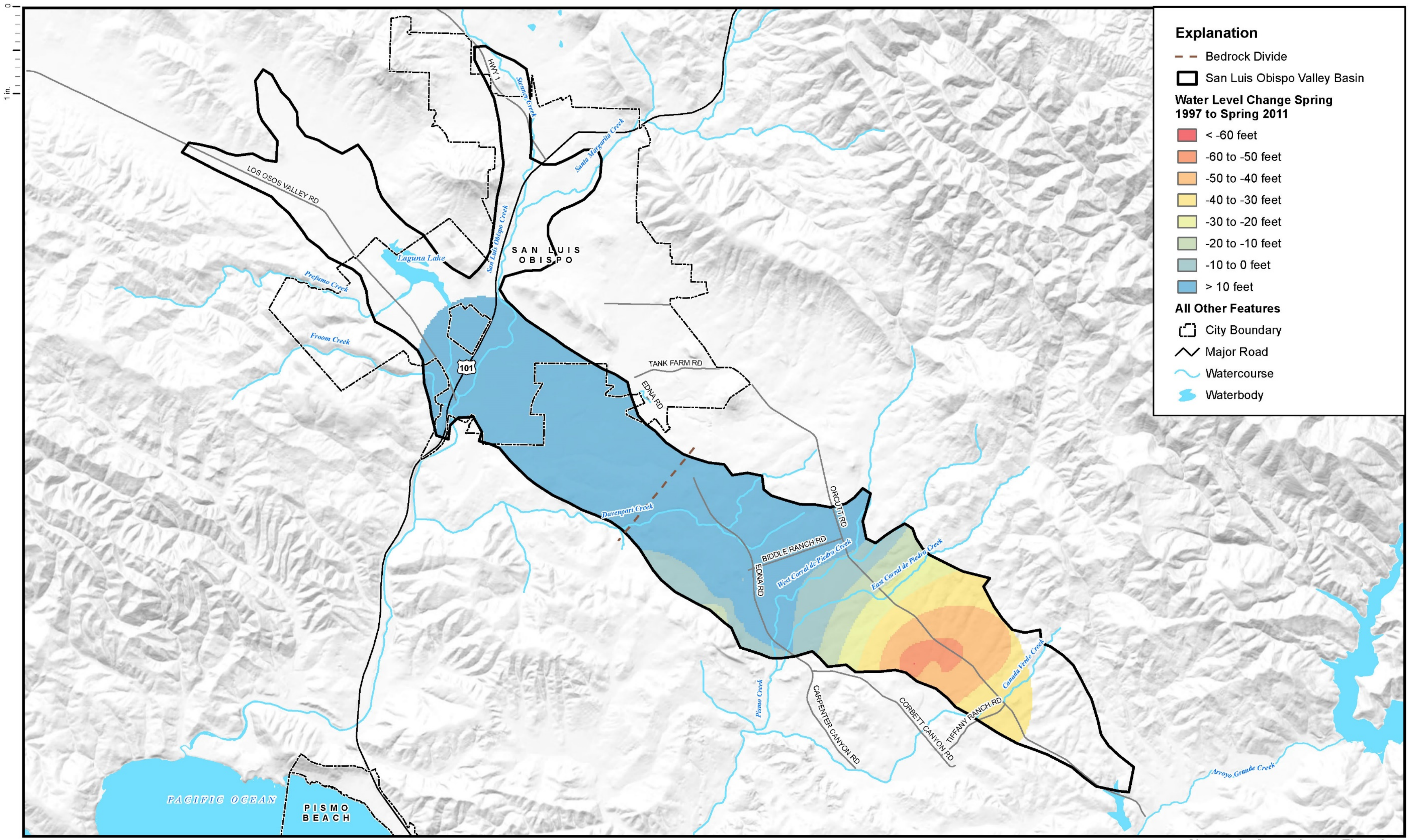
5.1.9 Changes in Groundwater Elevation

In order to demonstrate how groundwater elevations have varied over the recent history of the Basin, a series of maps were generated that display changes in groundwater elevation. These maps were developed by comparing groundwater elevations from one year to the next and calculating the differences in elevation over the specified time period. It should be noted that the results of this analysis are largely dependent on the density of data points, and should be viewed as indicative of general trends, not necessarily as accurate in specific areas where little data is available.

The first time period selected compares changes in groundwater elevation from 1997 through 2011. The year 1997 was selected as a starting point because it is assumed to represent conditions prior to the significant expansion of agricultural groundwater pumping in the Basin. The year 2011 was selected as the end point because it represents conditions prior the start of the recent drought. Calculated changes in groundwater elevation over this 14-year period are presented in Figure 5-8. This figure indicates a maximum decline in groundwater elevation of over 60 feet in the Edna Valley, southeast of East Corral de Piedras Creek between Orcutt Road and Corbett Canyon Road. The calculated groundwater elevation shows declining groundwater levels to the northwest of this location. No significant declines are indicated northwest of Biddle Ranch Road over this time period.

The next time period selected compares changes in groundwater elevation from 2011 through 2015. This time period was selected to capture the start of the drought to a point four years into the drought, thereby capturing the period of greatest groundwater elevation change. Calculated changes in groundwater elevation over this 4-year period are presented in Figure 5-9. This figure indicates a maximum decline in groundwater elevation of over 80 feet located in the Edna Valley, near the intersection of Edna Road and Biddle Ranch Road. The calculated reductions in groundwater elevation decline in all directions from this location. No significant declines are indicated in the San Luis Creek Valley portion of the Basin over this time period.

The next time period selected compares changes in groundwater elevation from 2015 through 2019. This time period was selected to capture the potential recovery of the Basin following the drought. Calculated changes in groundwater elevation over this 3-year period are presented in Figure 5-10. Groundwater elevations are shown to have rebounded throughout the entire area in which data was available. The greatest increase in groundwater elevation is coincident with the area of greatest declines from 2011-2015, near the intersection of Edna Road and Biddle Ranch Road.



Prepared for:

Author: AB
Date: 2/28/2020

SAN LUIS OBISPO VALLEY BASIN GSP

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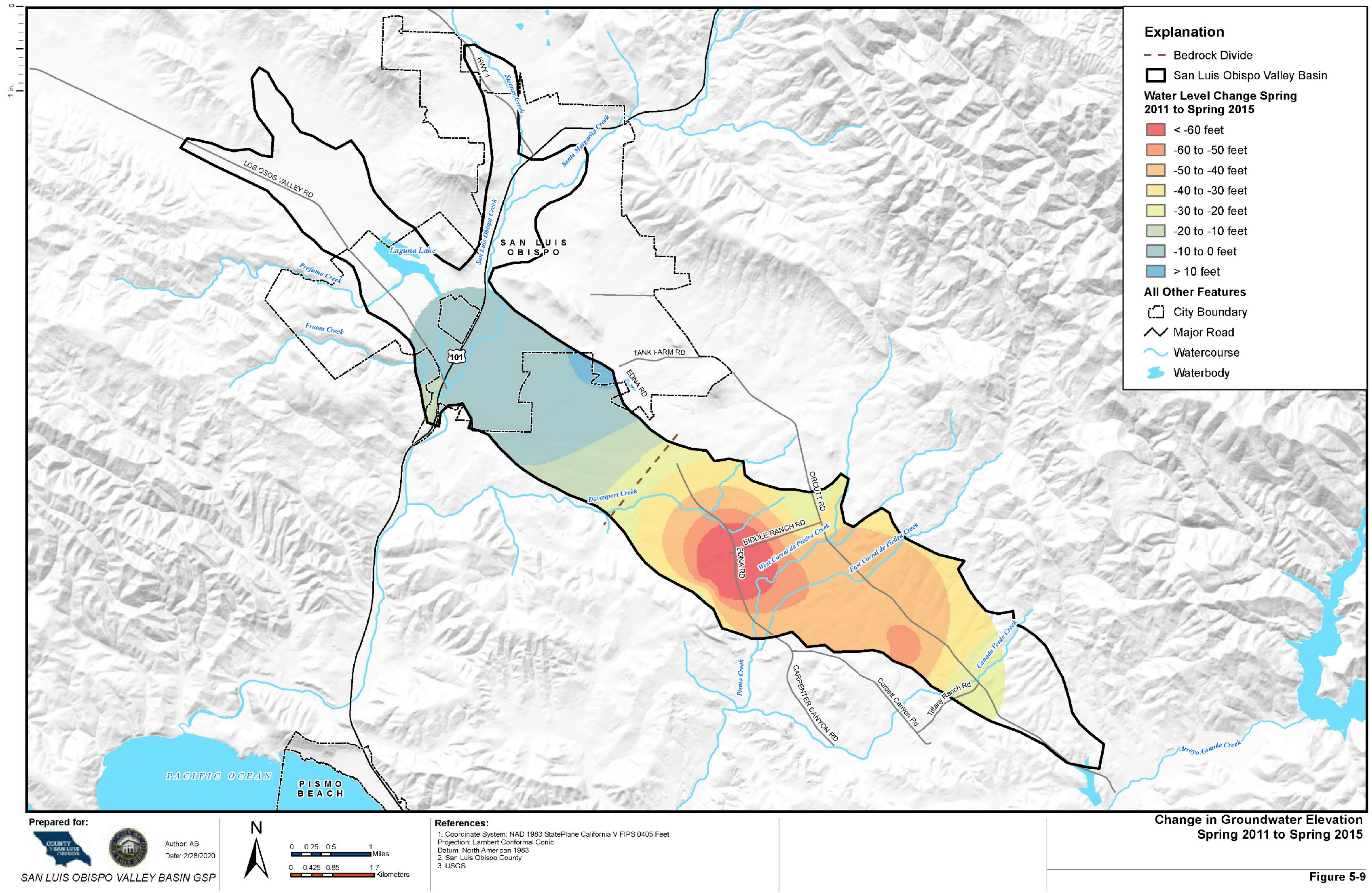
0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. USGS

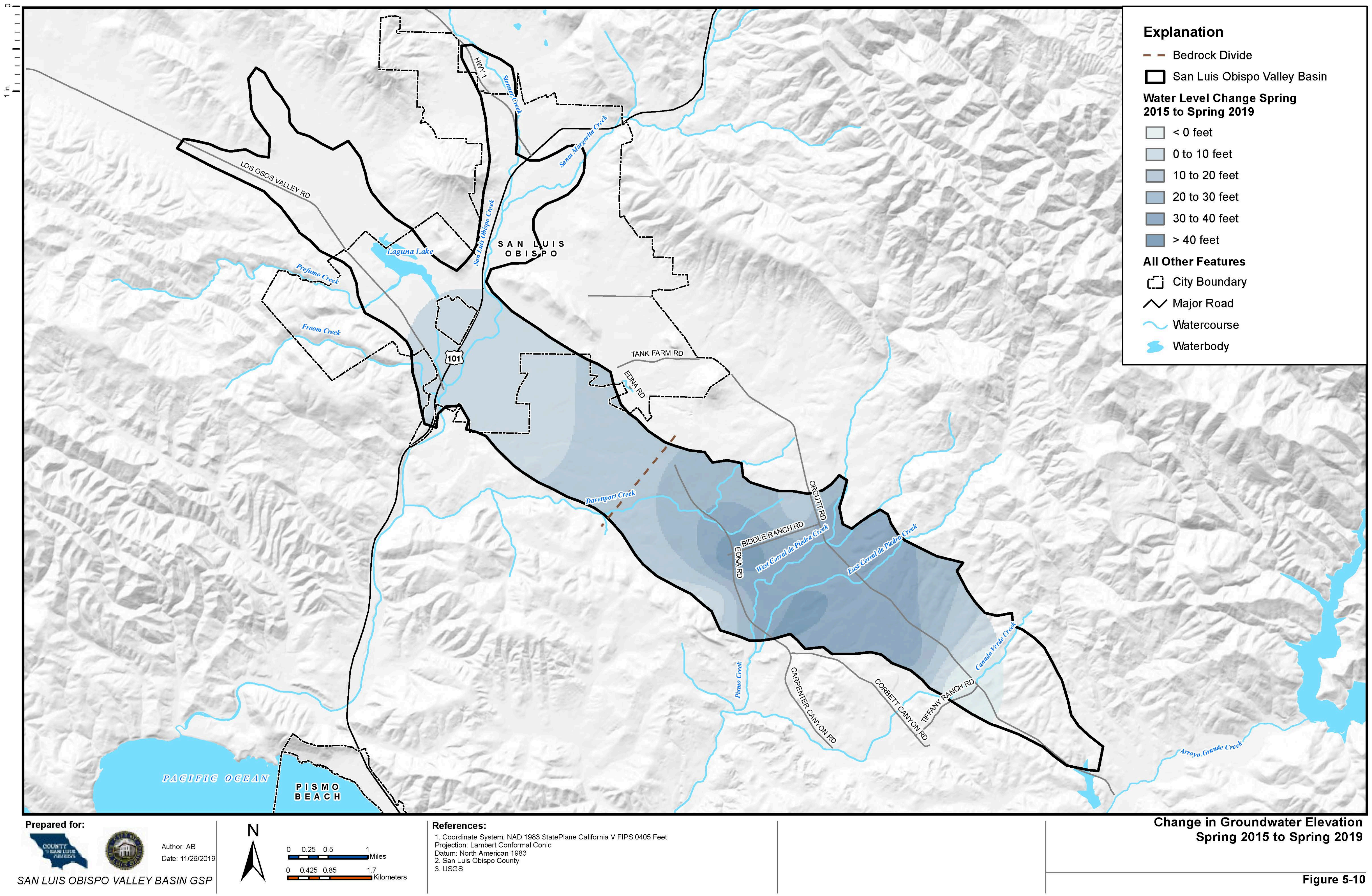
Change in Groundwater Elevation Spring 1997 to Spring 2011

Figure 5-8



Change in Groundwater Elevation
Spring 2011 to Spring 2015

Figure 5-9



Change in Groundwater Elevation
Spring 2015 to Spring 2019

Figure 5-10

20

5.1.10 Vertical Groundwater Gradients

Vertical groundwater gradients are calculated by measuring the difference in head at a single location between specific and distinct strata or aquifers. The characterization of vertical gradients may have implications with respect to characterization of flow between aquifers, migration of contaminant plumes, and other technical details describing groundwater flow in specific areas. In order to accurately characterize vertical groundwater gradient, it is necessary to have two (or more) piezometers sited at the same location, with each piezometer screened across a unique interval that does not overlap with the screened interval of the other piezometers(s). If heads at one such piezometer are higher than the other(s), the vertical flow direction can be established, since groundwater flows from areas of higher heads to areas of lower heads. However, because such a "well cluster" must be specifically designed and installed as part of a broader investigation, limited data exists to assess vertical groundwater gradients. Previous hydrologic studies of the Basin (Boyle 1991, DWR 1997) indicate that groundwater elevations are generally higher in the Alluvial Aquifer than the underlying Paso Robles Formation Aquifer, resulting in groundwater flow from the Alluvial Aquifer to the underlying Paso Robles Formation aquifer (although this may change seasonally). The lack of nested or clustered piezometers to assess vertical gradients in the Basin is a data gap that will be discussed further in Chapter 8.

There are no paired wells that provide specific data comparing water levels in wells screening the bedrock and the Basin sediments. However, from a conceptual standpoint, the Monterey Formation is assumed to receive rainfall recharge in the surrounding mountains at higher elevations than the Basin sediments. For this reason, it is assumed that an upward vertical flow gradient exists between the bedrock and the overlying Basin sediments. Because the bedrock formations are significantly less productive than the Basin sediments, the rate of this flux is not expected to be significant.

5.2 GROUNDWATER ELEVATION HYDROGRAPHS

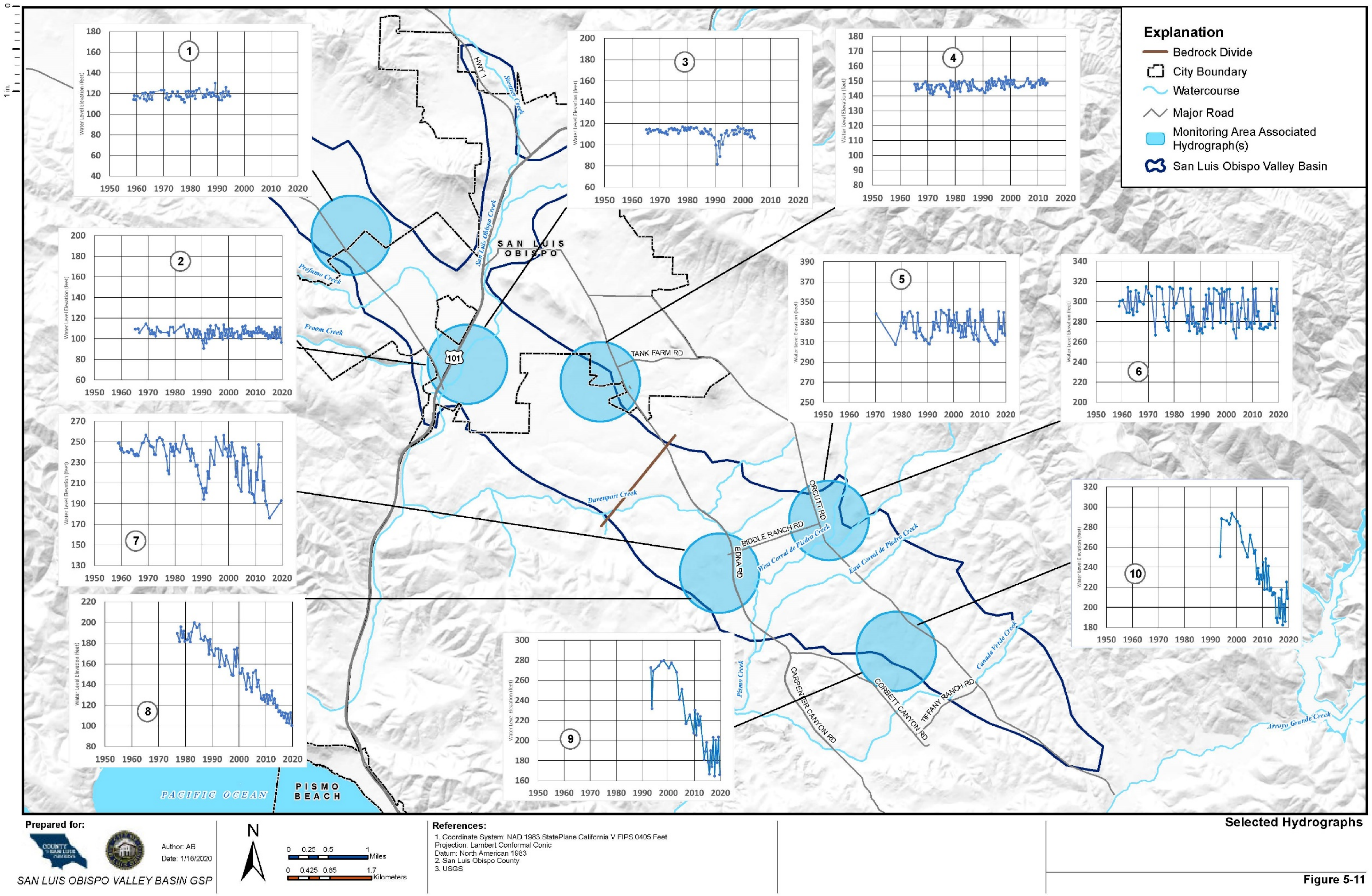
The San Luis Valley and the Edna Valley are characterized by different patterns of groundwater use. In the San Luis Valley, groundwater use has been dominated by municipal and industrial use, with total groundwater use decreasing since the 1990s, as the City has diversified its surface water supplies, and placed most of its wells on standby status. During this time several in-City agricultural operations have also been developed into housing and commercial districts and now rely on the City's surface water supplies in place of groundwater pumping. In the Edna Valley, groundwater use is dominated by agricultural use, with total use increasing since the 1990s. During the past 15 to 20 years, wine grapes have supplanted other crop types (such as pasture grass and row crops) as the dominant agricultural use within the Edna Valley. Available water level data was reviewed, and data from wells with the longest period of record are presented in Figure 5-11, and discussed in this section. Most of the data was obtained from the County's groundwater monitoring network database.

Figure 5-11 presents groundwater elevation hydrographs for the ten wells throughout the Basin with the longest period of record. State well identification numbers are not displayed for reasons of owner confidentiality. Appendix 5A presents depth to water hydrographs for all wells for which the county had water level data. Three distinct patterns are evident in different areas of the Basin and are discussed below.

The hydrographs for the wells in the San Luis Valley indicate that water levels in these wells, although somewhat variable in response to seasonal weather patterns, water use fluctuations, and longer-term dry weather periods, are essentially stable. There are no long-term trends indicating steadily declining or increasing water levels in this area. The wells along Los Osos Valley Road (hydrographs 1 and 2 on Figure 5-11) display fluctuations within a range of less than 20 feet over a period of record from the late 1950s to the mid-1990s. This period includes the drought of the late 1980s to early 1990s. The well just west of the intersection of Tank Farm Road and Orcutt Road (hydrograph 4 in Figure 5-11) displays a similar pattern, with water level variations within a range of about 10 feet from 1965 to 2013. The wells in the vicinity of Highway 101 and Los Osos Valley Road (hydrograph 3 in Figure 5-11) also display water levels in relative equilibrium, with the exception of the early 1990s, when drought-related pumping and weather patterns resulted in noticeable declines in the water level in this well. These water levels recovered to their pre-drought levels by the mid-1990s. The long-term stability of groundwater elevations in these hydrographs indicates that groundwater extractions and natural discharge in the areas of these wells are in approximate equilibrium with natural recharge and subsurface capture, and that no trends of decreasing groundwater storage are evident.

A second distinct pattern is evident in hydrographs from wells in the area immediately east of the intersection of Biddle Ranch Road and Orcutt Road, where West Corral de Piedras Creek enters the Basin (hydrographs 5 and 6 in Figure 5-11). The hydrographs of the two wells in this area display much greater volatility in response to seasonal and drought cycle fluctuations than the wells in San Luis Valley, with water levels fluctuating within a range of over 40 feet, as opposed to the range of 10 to 20 feet in the San Luis Valley wells. However, water levels appear to rebound to pre-drought levels when each drought cycle ends. Groundwater elevations displayed in these two hydrographs do not display a long-term decline of water levels. This pattern is likely associated with local recharge of the aquifer derived from percolation of stream water in West Corral de Piedras Creek as it leaves the mountains and enters the Basin.

By contrast, several wells in the Edna Valley display steadily declining water levels during the past 15 to 20 years. Hydrographs for four wells (hydrographs 7, 8, 9, and 10 on Figure 5-11) in the Edna Valley display groundwater elevation declines of about 60 to 100 feet since the year 2000. Groundwater elevations in the Edna Valley displayed the largest historical declines in the Basin. This hydrograph pattern indicates that a reduction of groundwater storage has occurred over this period of record in the area defined by these well locations. It is understood, and will be discussed in greater detail in Chapter 6 (Water Budget), that agricultural pumping has increased in Edna Valley during this time period, likely explaining the patterns of declining groundwater elevations in these hydrographs.



Selected Hydrographs

Figure 5-11

5.3 GROUNDWATER RECHARGE AND DISCHARGE AREAS

Areas of significant areal recharge and discharge within the Basin are discussed below. Quantitative information about all natural and anthropogenic recharge and discharge is provided in Chapter 6: Water Budgets.

5.3.1 Groundwater Recharge Areas

In general, natural areal recharge occurs via the following processes:

1. Distributed areal infiltration of precipitation,
2. Subsurface inflow from adjacent “non-water bearing bedrock”, and
3. Infiltration of surface water from streams and creeks.
4. Anthropogenic recharge

The following sections discuss each of these components.

5.3.1.1 Infiltration of Precipitation

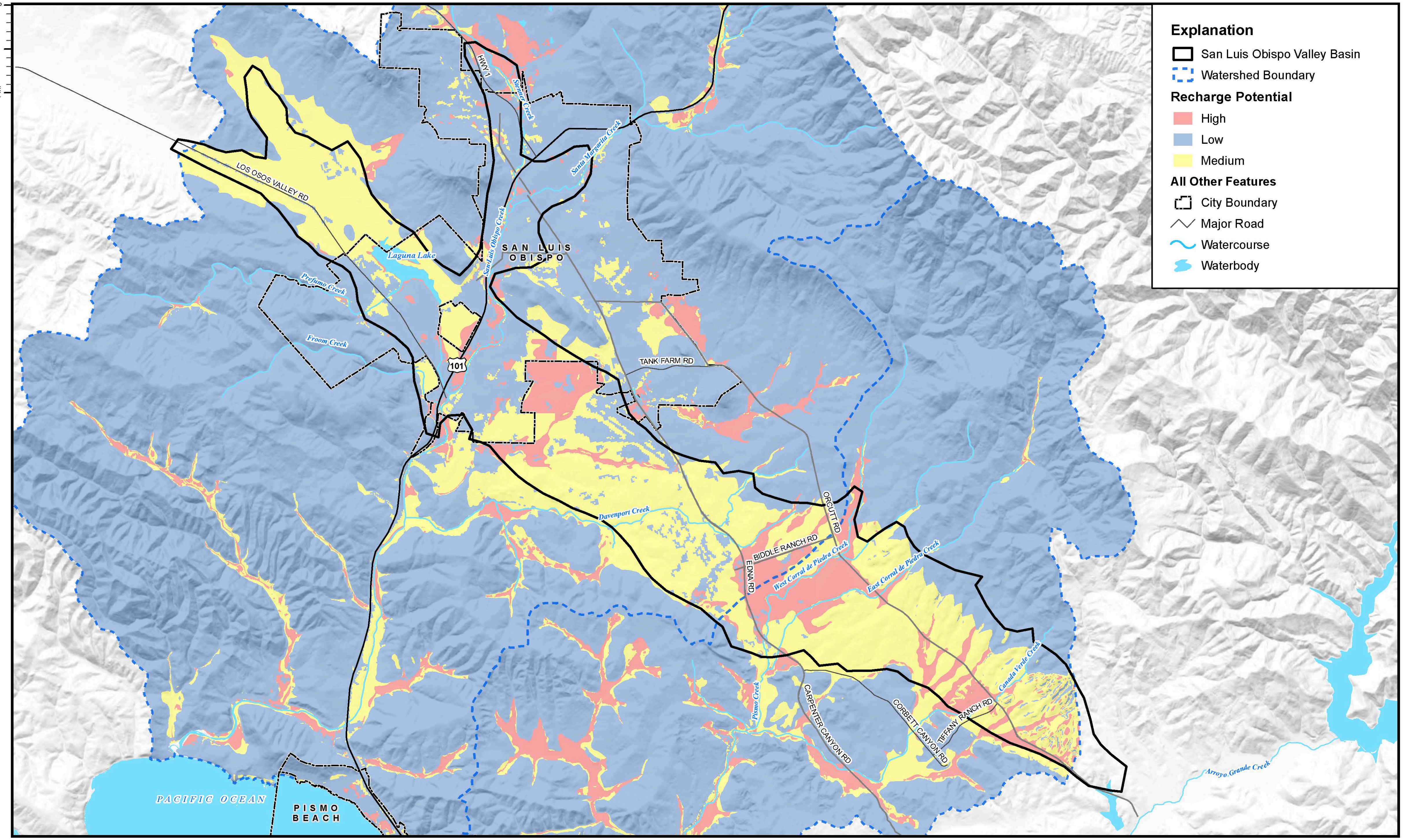
Areal infiltration of precipitation is a significant component of recharge in the Basin. Water that does not run off to stream or get taken up via evapotranspiration migrates vertically downward through the unsaturated zone until it reaches the water table. By leveraging available GIS data that defines key factors such as topography and soil type, locations with higher likelihood of recharge from precipitation have been identified. These examinations are desktop studies and therefore are conceptual in nature, and any recharge project would need a site-specific field characterization and feasibility study before implementation. Still, although they differ in scope and approach, the results of these studies provide an initial effort at identifying areas that may have the intrinsic physical characteristics to allow greater amounts of precipitation-based recharge in the Basin.

Stillwater Sciences (Stillwater), in cooperation with the Upper Salinas-Las Tablas Resource Conservation District (USLTRCD), published a grant funded study (Stillwater 2015) designed to improve data gaps in the County’s Integrated Regional Water Management (IRWM) plan. The Percolation Zone Study of Pilot-Study Groundwater Basins in San Luis Obispo County, California identified areas with relatively high natural percolation potential that, through management actions, could enhance local groundwater supplies for human and ecological benefits to the aquatic environment for steelhead habitat. The study used existing data in a GIS analysis to identify potentially favorable areas for enhanced recharge projects in the combined San Luis Creek and Pismo Creek Watershed. The results of the Stillwater-USLTRCD study are presented in Figure 5-12. The analysis indicates that approximately 2,220 acres in the Basin are categorized with high potential for intrinsic percolation, and 6,583 acres have medium potential. Conceptually, areas with higher potential for intrinsic percolation would transmit a higher percentage of rainfall to aquifer recharge. The largest area in the Basin that is classified with high recharge potential is the alluvium along East and West Corral de Piedras Creeks in the Edna Valley.

The University of California (UC) at Davis and the UC Cooperative Extension published a study in 2015 that also uses existing GIS data to identify areas potentially favorable for enhanced groundwater recharge projects (UC Davis Cooperative Extension, 2015). While the Stillwater study focused on local San Luis

Obispo stream corridors and emphasized fish habitat conditions, the UC study is statewide in scope includes more than 17.5 million acres, is scientifically peer reviewed, and focuses on the possibilities of using fallow agricultural land as temporary percolation basins during periods when excess surface water is available. The UC study developed a methodology to determine a Soil Agricultural Groundwater Banking Index (SAGBI) to assign an index value to agricultural lands through the state. The SAGBI analysis incorporates deep percolation, root zone residence time, topography, chemical limitations (salinity), and soil surface conditions into its analysis. The results of the SAGBI analysis in the Basin are presented in Figure 5-13. Areas with excellent recharge properties are shown in green. Areas with poor recharge properties are shown in red. Not all land is classified, but similar to the Stillwater map in Figure 5-12, this map provides guidance on where natural recharge likely occurs.

The two studies discussed herein yield similar results in the Basin, particularly in Edna Valley. The Stillwater study identifies much of the drainage area of East and West Corral de Piedras Creeks, as well as area of alluvium of smaller streams t the southeast, as having high recharge potential. The SAGBI study identifies very similar areas in Edna Valley as having a moderately to good index value. These two studies, with differing methodologies, study areas, and objectives, converge on the characterization of the same portions of Edna Valley as having high natural recharge potential. By extension, areas with high natural recharge potential would be favorable locations to investigate the feasibility of enhanced recharge projects. If source water is available, water in these areas would have a higher likelihood of percolating to the underlying aquifers.



Prepared for:

Author: AB
Date: 1/20/2020

SAN LUIS OBISPO VALLEY BASIN GSP

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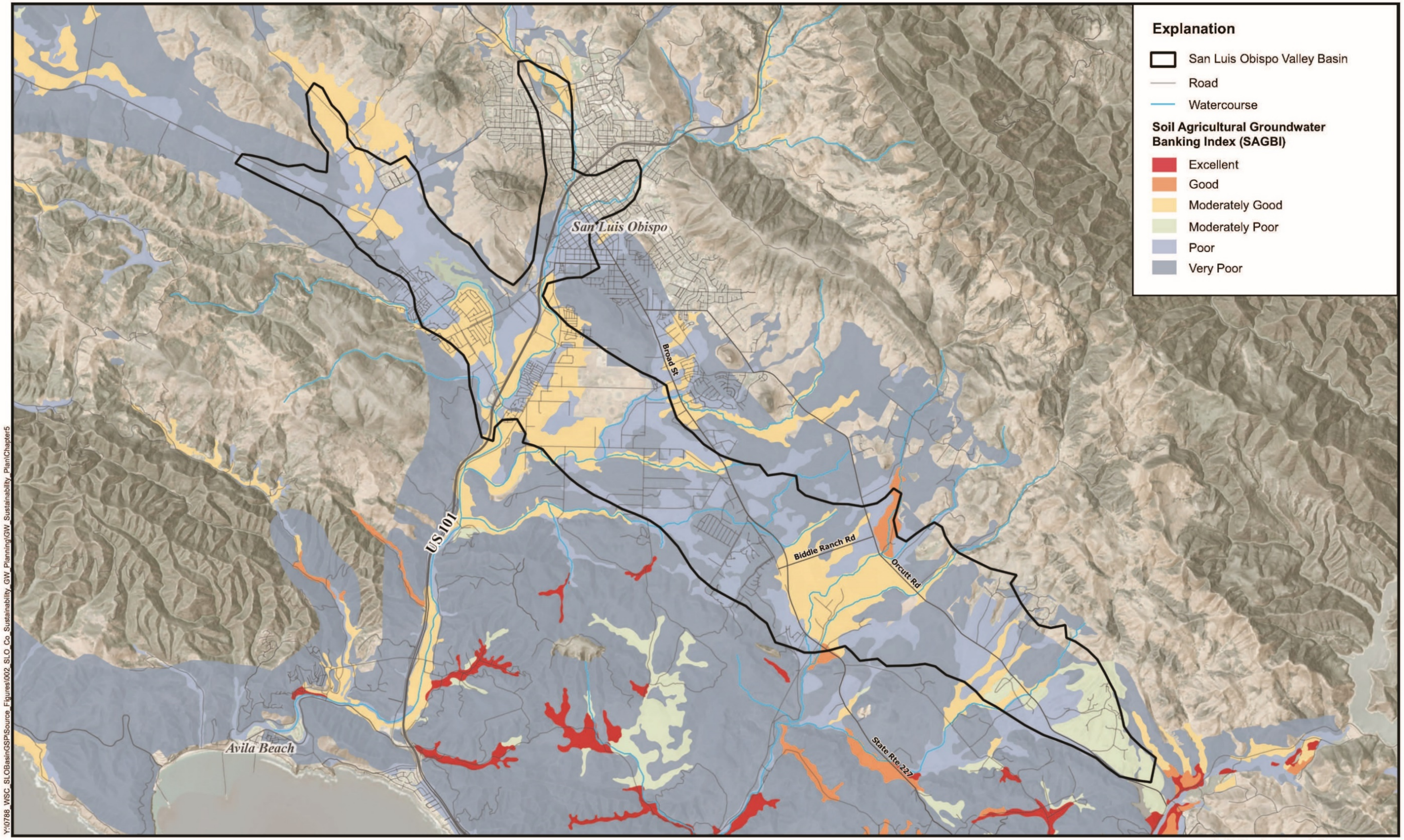
0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2.San Luis Obispo County
3. The Percolation Zone Study of Pilot-Study Groundwater Basins in San Luis Obispo County, California (Stillwater, 2015)

Stillwater Percolation Zone Study Results

Figure 5-12



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Prepared for:

COUNTY of SAN LUIS OBISPO

Author: NP
Date: 1/14/2020

SAN LUIS OBISPO VALLEY BASIN GSP

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0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. Soil Suitability Index Identifies Potential Areas for Groundwater Banking on Agricultural Lands, UC Davis and UC Cooperative Extension.

Soil Agricultural Groundwater Banking Index Study Results

Figure 5-13

5.3.1.2 Subsurface Inflow

Subsurface inflow is the flow of groundwater from the surrounding bedrock into the basin sediments. This process is sometimes referred to as mountain front recharge. Groundwater flows from areas of high head to areas of lower head, and water levels in the mountains are at a higher elevation than the Basin. Flow across the basin boundary is predominantly via highly conductive, but random and discontinuous fracture systems. The rate of subsurface inflow to the Basin from the surrounding hill and mountain area varies considerably from year to year depending upon precipitation (intensity, frequency and duration, seasonal totals, etc.) and groundwater level gradients. There are no available published or unpublished inflow data for the hill and mountain areas surrounding the Basin. An estimate of this component of recharge is presented in Chapter 6 (Water Budget).

5.3.1.3 Percolation of Streamflow

Percolation of streamflow is a locally significant source of recharge in areas where the local creeks enter the Basin. Water levels in wells monitored by the County in the area where Corral de Piedras Creeks enter the Basin reflect this phenomenon, as discussed in the previous discussion of water level elevations in the Basin. Groundwater recharge from percolation of streamflow is thought to occur in the area along Davenport Creek, near Buckley Road as well. Most wells in this vicinity are on the order of 100 feet deep, which is too deep to be screened only in the local alluvium; these wells are assumed to screen the Paso Robles Formation Aquifer. During the seasonal winter rains when the creeks are flowing, groundwater levels are at approximately the same level as the water in the creek. During the dry season, water levels decrease to about 15 to 20 feet below land surface. Therefore, the alluvium appears to recharge the underlying Paso Robles Formation in this area. It is likely that similar processes contribute to recharge via percolation of streamflow along the San Luis Creek corridor, as well. Specific isolated monitoring of alluvial wells compared to the underlying aquifers' water levels could clarify this recharge component.

5.3.1.4 Anthropogenic Recharge

Significant anthropogenic recharge occurs via the three processes discussed below:

1. Percolation of treated wastewater treatment plant (WWTP) effluent,
2. Percolation of return flow from agricultural irrigation, and
3. Percolation of return flow from domestic septic fields.

A wastewater treatment plant serving the City of San Luis Obispo operates within the Basin on Prado Road along San Luis Creek. Treated wastewater effluent from this plant is discharged to San Luis Creek and used in the City's recycled water system for irrigation and construction-related uses. The County operates a small WWTP near the golf course in the service area of Golden State Water Company, and uses the effluent largely to irrigate the golf course. Residences in Edna Valley beyond the city or county WWTP service area dispose of wastewater via septic tanks. Water from septic fields can percolate into the underlying aquifers.

Irrigated agriculture is prevalent in the Basin, especially along Los Osos Valley Road and in Edna Valley. Return flows from irrigated agriculture occur when water is supplied to the irrigated crops in excess of the crop's water demand. This is done to avoid excess build-up of salts in the soil and overcome non-uniformity in the irrigation distribution system. These are all general standard practices.

5.3.2 Groundwater Discharge Areas

Natural groundwater discharge occurs as discharge to springs, seeps and wetlands, subsurface outflows, and evapotranspiration (ET) by phreatophytes. Figure 5-14 includes the locations of significant active springs, seeps, and wetlands within or adjacent to the Basin identified from previous studies or included on USGS topographic maps covering the watershed area. There are no mapped springs or seeps located within the Basin boundaries; most are located at higher elevations in the surrounding mountain areas.

Natural groundwater discharge can also occur as discharge from the aquifer directly to streams. Groundwater discharge to streams and potential groundwater dependent ecosystems (GDEs) are discussed in Section 5.8. In contrast to mapped springs and seeps, whose source water generally comes from bedrock formations in the mountains, groundwater discharge to streams is derived from the alluvium. Discharge to springs or streams can vary seasonally as precipitation and stream conditions change throughout the year. Groundwater discharge to the Corral de Piedras Creeks occur seasonally at the location where the creeks leave the basin, where relatively impermeable bedrock rises to the surface along the Edna Fault, causing groundwater to daylight at this location, at least in the wet season. Subsurface outflow and ET by phreatophytes are discussed in Chapter 6 (Water Budget).

5.4 CHANGE IN GROUNDWATER STORAGE

Changes in groundwater storage for the Alluvial Aquifer and Paso Robles Formation Aquifer are correlated with changes in groundwater elevation, previously discussed, and are addressed in Chapter 6 (Water Budget).

5.5 SEAWATER INTRUSION

Seawater intrusion is not an applicable sustainability indicator for the Basin. The Basin is not adjacent to the Pacific Ocean, a bay, or inlet.

5.6 SUBSIDENCE

Land subsidence is the lowering of the land surface. While several human-induced and natural causes of subsidence exist, the only process applicable to the GSP is subsidence due to lowered groundwater elevations caused by groundwater pumping. Historical incidence of subsidence within the Basin was discussed in Chapter 4 (Basin Setting).

Direct measurements of subsidence have not been made in the Basin using extensometers or repeat benchmark calibration; however, interferometric synthetic aperture radar (InSAR) has been used in the County to remotely map subsidence and DWR is expected to continue to collect InSAR data. This technology uses radar images taken from satellites that are used to map changes in land surface elevation. One study done in the area, which evaluates the time period between spring 1997 and fall 1997 (Valentine, D. W. et al., 2001), did not report any measurable subsidence within the Basin.

Subsidence as a sustainability indicator will be addressed further in Chapter 8.

5.7 INTERCONNECTED SURFACE WATER

Surface water/groundwater interactions may represent a significant, portion of the water budget of an aquifer system. Where the water table is above the streambed and slopes toward the stream, the stream receives groundwater from the aquifer; that is called a gaining reach (i.e., it gains flow as it moves through the reach). Where the water table is beneath the streambed and slopes away from the stream, the stream loses water to the aquifer; that is called a losing reach. In addition, a stream may be disconnected from the regional aquifer system if the elevation of streamflow and alluvium is significantly higher than the elevation of the water table in the underlying aquifer.

The spatial extent of interconnected surface water in the Basin was evaluated using water level data from Alluvial Aquifer and Paso Robles Formation Aquifer wells adjacent to the Basin creeks and streams. In accordance with the SGMA Emergency Regulations §351 (o), "Interconnected surface water refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted". The interconnected surface water analysis for the Basin consisted of comparing average springtime water level elevations in wells adjacent to the San Luis Creek with the elevation of the adjacent San Luis Creek channel. In cases where average springtime water levels were greater than the elevation of the adjacent San Luis Creek channel, the stream reach was considered as potentially 'gaining'. In cases where average springtime water levels were below the adjacent channel elevation, the stream reach was considered 'losing' and potentially 'disconnected'. It is important to recognize that the results of these analyses may reflect conditions that occur occasionally, in response to precipitation events. They may not be representative of long-term average conditions.

The analysis outlined above resulted in identification of two areas of San Luis Creek that occasionally 'gain' water from the Alluvial Aquifer; the confluence of Stenner Creek and San Luis Creek, and the reach of San Luis Creek downstream from the Wastewater Treatment Plant to the confluence with Prefumo Creek. These are displayed in Figure 5-14. Several reaches of San Luis Creek are identified that occasionally 'lose' water to the Alluvial Aquifer. Groundwater levels in the San Luis Valley part of the Basin are generally high enough that the creek is connected to the underlying aquifer. Along most of Corral de Piedras Creeks, by contrast, surface water levels are generally greater than 30 feet above the groundwater level, and the streams are considered disconnected from the underlying Alluvial Aquifer in this area.

5.7.1 Depletion of Interconnected Surface Water

Groundwater withdrawals are balanced by a combination of reductions in groundwater storage and changes in the rate of exchange across hydrologic boundaries. In the case of surface water depletion, this rate change could be due to reductions in rates of groundwater discharge to surface water, and increased rates of surface water percolation to groundwater. Seasonal variation in rates of groundwater discharge to surface water or surface water percolation to groundwater occur naturally throughout any given year, as driven by the natural hydrologic cycle. However, they can also be affected by anthropogenic actions. Since, as presented in the discussion of hydrographs in the San Luis Valley in Section 5.2, there has been no long-term water level declines in this area, there is no evidence of long-term depletion of interconnected surface water in this area.

5.8 POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS

The SGMA Emergency Regulations §351.16 require identification of groundwater dependent ecosystems within the Basin. Several datasets were utilized to identify the spatial extent of potential groundwater dependent ecosystems (GDEs) in the Basin, as discussed in the following sections. In accordance with the SGMA Emergency Regulations §351 (o), “groundwater dependent ecosystems refers to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface”. In areas where the water table is sufficiently high, groundwater discharge may occur as evapotranspiration (ET) from phreatophyte vegetation within these GDEs. The overall distribution of potential GDEs within the Basin has been initially estimated in the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (DWR, 2018). This dataset was reviewed by Stillwater Sciences, and the resulting distribution of potential GDEs is shown in Figure 5-15. There has been no verification that the locations shown on this map constitute GDEs. Additional field reconnaissance is necessary to verify the existence and extent of these potential GDEs, and may be considered as part of the monitoring network for future planning efforts.

5.8.1 Hydrology

5.8.1.1 Overview of GDE Relevant Surface and Groundwater Hydrology

Instream flows in San Luis and Pismo Creeks can be divided into wet season flows, typically occurring from January to April, and dry season flows, typically from June to October. Short transitional periods occur between the wet and dry seasons. Wet season instream flows originate from a range of sources including precipitation-driven surface runoff events, water draining from surface depressions or wetlands, shallow subsurface flows (e.g., soil), and groundwater discharge. Dry season instream flows, however, are likely fed primarily by groundwater discharge. As groundwater levels fall over the dry season, so do the corresponding instream flows. If groundwater elevations remain above instream water elevations, groundwater discharges into the stream and surface flows continue through the dry season (creating perennial streams). If groundwater elevations fall below the streambed elevation, the stream can go dry. Streams that typically flow in the wet season and dry up in the dry season are termed intermittent. Over time, streams can transition from historically perennial to intermittent conditions due to climactic changes or groundwater pumping (Barlow and Leake 2012). Dry season flows supported by groundwater are critical for the survival of various special status species, including the federally threatened California red-legged frog (Rana draytonii) and Steelhead (Oncorhynchus mykiss).

San Luis Creek and Pismo Creek are underlain by the Alluvial Aquifer, the Paso Robles Formation Aquifer, and the Pismo Formation Aquifer, as previously discussed. These aquifers have hydraulic connection to one another, and to surface waters, but the degree of connection varies spatially. Aquifers can include confined aquifers, unconfined aquifers, and perched aquifers (Chapter 4). Aquifers can discharge into ponds, lakes or creeks or vice versa. In the San Luis Obispo Valley Groundwater Basin, little data exists to characterize the connection between surface water and groundwater.

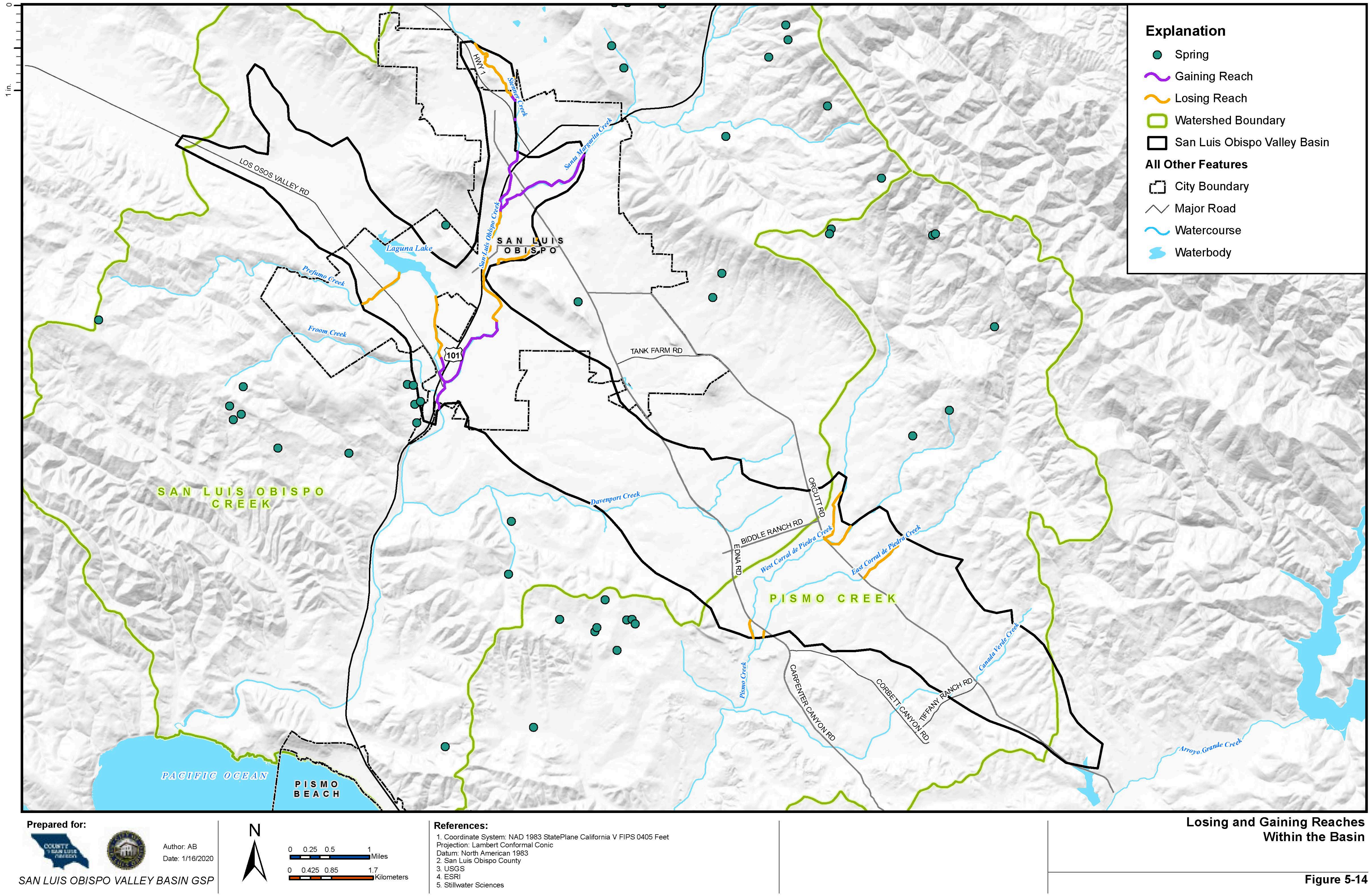
While the groundwater in the San Luis Valley and Edna Valley is hydraulically connected, a shallow subsurface bedrock divide between the two sub-areas partially isolates the deeper portions of the two aquifers (Figure 5-10 and Figure 5-11). Groundwater in the Edna Valley flows both towards the San Luis Valley in the northwest portion of the basin and towards Price Canyon in the southwest portion of the basin. Groundwater flowing towards Price Canyon rises to the surface as it approaches the bedrock constriction of Price Canyon and the Edna fault system. The 1954 DWR groundwater elevation map (Figure 5-1) best illustrates the pre-development groundwater flow from the Edna Valley both towards San Luis Obispo and into Price Canyon. Observations of stream conditions indicate a perennial reach of Pismo Creek that flows through Price Canyon and supports year-round critical habitat for threatened steelhead just south of the Basin Boundary. A conceptual explanation for this is that groundwater from the Edna sub-area flows towards the discharge area at Price Canyon, and rises to the surface (daylights) as the groundwater flow encounters the impermeable zone of the Edna Fault and the bedrock outside of the Basin. Piezometers in this area could confirm this interpretation of observed stream conditions.

5.8.1.2 Losing and Gaining Reaches

Streams are often subdivided into losing and gaining reaches to describe their interaction of surface water in the stream with groundwater in the underlying aquifer. In a losing reach water flows from the stream to the groundwater, while in a gaining reach water flows from the groundwater into the stream. The connection between losing reaches to the regional aquifer may be unclear as water can be trapped in perched aquifers above the regional water table. Figure 5-14 shows the likely extent of known gaining and losing reaches in San Luis and Pismo Creeks during typical dry season conditions. This map is compiled from various data sources, including:

- A field survey of wet and dry reaches of San Luis Creek (Bennett 2015),
- Field surveys and flow measurements of Pismo Creek (Balance Hydrologics 2008),
- An instream flow study of Pismo Creek (Stillwater Sciences 2012),
- A regional instream flow assessment that included San Luis and Pismo Creeks (Stillwater Sciences 2014),
- Spring and summer low flow measurements in San Luis and Pismo Creeks (2015–2018) (Creek Lands Conservation 2019), and
- Consideration of the effects of local geologic features such as bedrock outcrops and faults, both of which can force deeper groundwater to the surface.

The effect of faults and bedrock outcrops can be localized or extend for some distance downstream. Portions of the San Luis and Pismo Creeks and their tributaries for which no data exist are left unhighlighted in Figure 5-14. In general, the extent of losing or gaining reaches can vary by water year type or pumping conditions. East and West Corral de Piedras Creeks on the north-east side of the basin can be dry in the spring and summer during drier years but be flowing, losing reaches in wetter years (Creek Lands Conservation 2019). (To be clear, a stream segment can be a losing reach even if it is not hydraulically connected to the aquifer, since the stream will be losing surface flow to the subsurface via percolation.) In contrast, gaining reaches shown on San Luis Obispo Creek are fairly consistent across water year types (Bennett 2015, Creek Lands Conservation 2019). Figure 5-14 is based on limited data sources. Improved surface flow monitoring is recommended to refine and update the extent of losing and gaining reaches, as well as to provide data for unhighlighted reaches.



References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. USGS
4. ESRI
5. Stillwater Sciences

Losing and Gaining Reaches Within the Basin

Figure 5-14

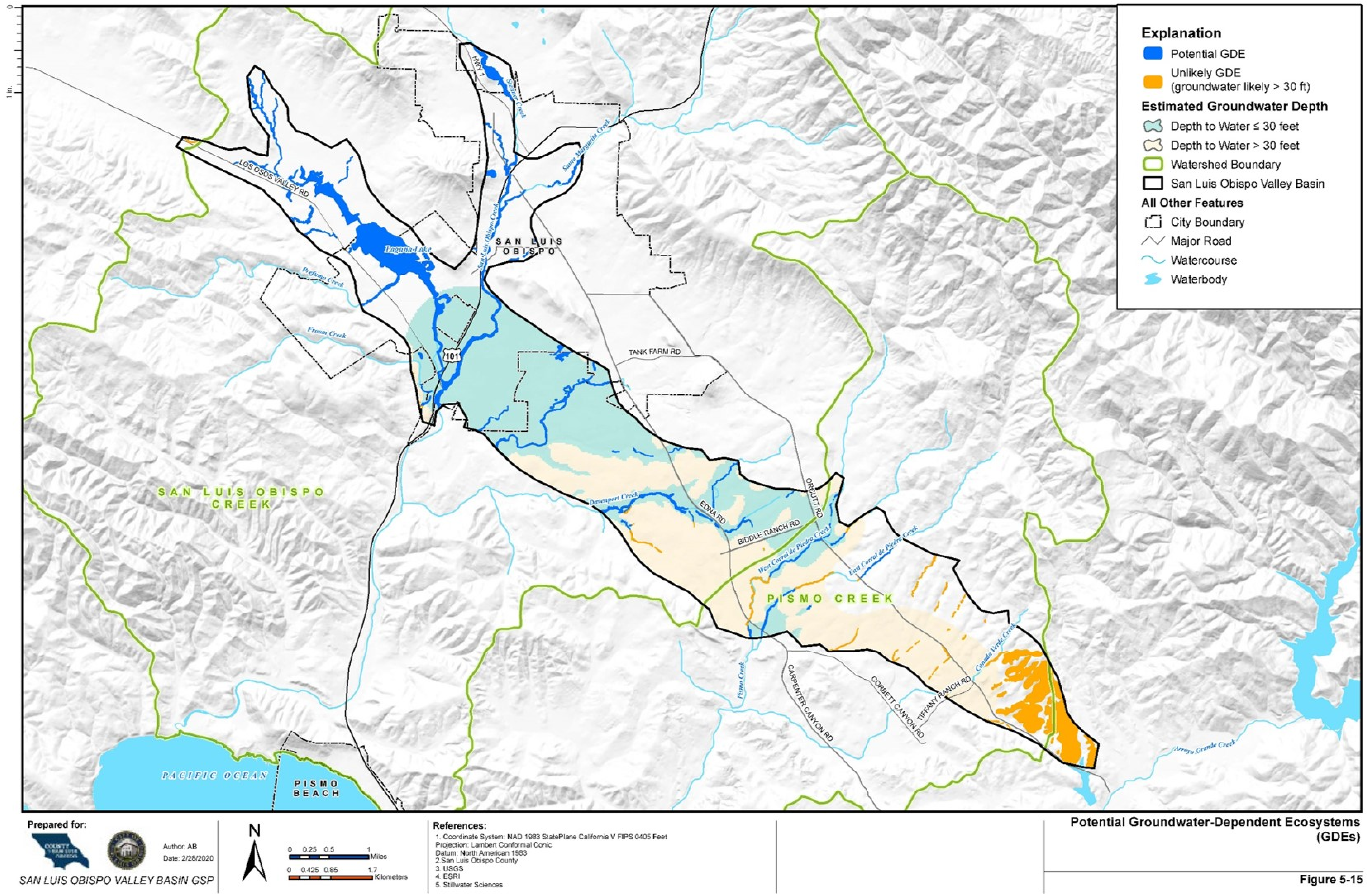
33

5.8.2 Vegetation and Wetland Groundwater Dependent Ecosystem Identification

DWR has compiled a statewide Natural Communities Commonly Associated with Groundwater (NCCAG) database (DWR 2019). This database identifies potentially groundwater dependent ecosystems based on the best available vegetation and wetland data (Klausmeyer et al. 2018). DWR identifies potentially groundwater dependent wetland areas using National Wetland Inventory (NWI) wetland data (USFWS 2018). These data were evaluated and assessed to accurately capture wetland and riverine features. In the Basin, the best available vegetation mapping data set was from the California Fire and Resource Assessment Program Vegetation (FVEG, California Department of Forestry and Fire Protection 2015). FVEG is a remotely sensed dataset that classifies vegetation to coarse types (i.e., the California Wildlife Habitat Relationship System). Given the limitations of this dataset to accurately capture and identify vegetation using a precise classification system, it was deemed inappropriate for use in determining potential GDEs. Instead, a manual assessment of vegetation with potential groundwater dependence was conducted using National Agricultural Imagery Program 2018 color aerial imagery (NAIP 2018). Vegetation communities identified as potentially groundwater dependent included riparian trees and shrubs, and oak woodlands. Oak woodlands were considered potentially groundwater dependent due to their deep rooting depths (up to 70 feet [Lewis and Burgy 1964]).

Potential vegetation and wetland GDEs were retained if the underlying depth to water in 2019 was inferred to be 30 feet or shallower based on the existing well network (Figure 5-15). Depth to groundwater was interpolated from seventeen wells for which groundwater level data was available in the spring of 2019 (Figure 5-6). The depth to groundwater estimated in Figure 5-15 is assumed to represent regional groundwater levels; however, the screening depth is known for only 6 of the 17 of the wells. Wells where the screened depth is unknown may be measuring groundwater levels for deeper aquifers that are unconnected to the shallow groundwater system, and thus groundwater deeper than 30 ft for a given well may not reflect the absence of shallow groundwater, but instead reflects the absence of data. To determine the hydraulic connectivity between potential perched aquifers to the regional aquifer, additional monitoring with nested piezometers could be utilized.

For the purposes of differentiating between potential and unlikely GDE's, different assumptions were made for the San Luis Valley versus Edna Valley in areas of no groundwater data. In the San Luis Valley, underlying San Luis Creek, it was assumed that the depth to regional groundwater was less than 30 feet because the limited available data indicate that groundwater in this sub-area is generally relatively shallow. In the Edna Valley (underlying Pismo Creek), it was assumed that the depth to regional groundwater was more than 30 feet because the limited available data indicate that the groundwater in this sub-area is generally deeper; therefore, much of the area of the lower reaches of East and West Corral de Piedras Creeks is unlikely to have GDEs. One exception to this assumption was made on upper East Corral de Piedra where the conditions were assumed to be similar to those on upper West Corral de Piedra where early dry season wet conditions have been observed by Stillwater Sciences and Balance Hydrologics (2008). The 30-foot depth criterion is consistent with guidance provided by The Nature Conservancy (Rohde et al. 2019) for identifying GDEs. Additionally, the area where East and West Corral de Piedras Creeks leave the Basin near Price Canyon has groundwater elevation data within 30 feet of the streams, and so are presented as having potential GDEs.



Potential Groundwater-Dependent Ecosystems (GDEs)

Figure 5-15

5.8.3 Identification of Special-Status Species and Sensitive Natural Communities Associates with GDE's

For the purposes of this GSP, special-status species are defined as those:

- Listed, proposed, or under review as endangered or threatened under the federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA);
- Designated by California Department of Fish and Wildlife (CDFW) as a Species of Special Concern;
- Designated by CDFW as Fully Protected under the California Fish and Game Code (Sections 3511, 4700, 5050, and 5515);
- Protected under the federal Bald and Golden Eagle Protection Act;
- Designated as rare under the California Native Plant Protection Act (CNPPA); and/or
- Included on CDFW's most recent Special Vascular Plants, Bryophytes, and Lichens List (CDFW 2019a) with a California Rare Plant Rank (CRPR) of 1, 2, 3, or 4.

In addition, sensitive natural communities are defined as:

- Vegetation communities identified as critically imperiled (S1), imperiled (S2), or vulnerable (S3) on the most recent California Sensitive Natural Communities List (CDFW 2019b).

To determine the terrestrial and aquatic special-status species that may utilize potential GDE units overlying the Basin, Stillwater ecologists queried existing databases on regional and local occurrences and distributions of special-status species. Databases accessed include the California Natural Diversity Database (CNDDB) (CDFW 2019c), eBird (2019), and TNC freshwater species list (TNC 2019). Spatial database queries were centered on the potential GDEs plus a 1-mile buffer. Stillwater's ecologists reviewed the database query results and identified special-status species and sensitive natural communities with the potential to occur within or to be associated with the vegetation and aquatic communities in or immediately adjacent to the potential GDEs. The table in Appendix 5B lists these special-status species and sensitive natural communities, describes their habitat preferences and potential dependence on GDEs, and identifies known nearby occurrences (Appendix B - Table 1). Wildlife species were evaluated for potential groundwater dependence using the Critical Species Lookbook (Rohde et al. 2019).

The San Luis Obispo Valley Groundwater Basin supports steelhead belonging to the South-Central California Coast Distinct Population Segment (DPS) which is federally listed as "threatened." Within this DPS, the population of steelhead within the San Luis Creek, and Pismo Creek portions of the groundwater basin have both been identified as Core 1 populations which means they have the highest priority for recovery actions, have a known ability or potential to support viable populations, and have the capacity to respond to recovery actions (NMFS 2013). One critical recovery action listed by the National Marine Fisheries Service (NMFS) includes the management of groundwater extractions for protection and restoration of natural surface flow patterns to ensure surface flows allow for essential steelhead habitat functions (NMFS 2013).

Based on criteria promulgated by The Nature Conservancy (TNC), the San Luis Obispo Valley Groundwater Basin was determined to have high ecological value because: (1) the known occurrence and presence of suitable habitat for several special-status species including the Core 1 population status of South-Central California Coast Steelhead DPS and several special-status plants and animals that are directly or indirectly dependent on groundwater (Appendix B - Table 1); and (2) the vulnerability of these species and their habitat to changes in groundwater levels (Rohde et al. 2018).

5.9 GROUNDWATER QUALITY DISTRIBUTION AND TRENDS

Groundwater quality samples have been collected and analyzed throughout the Basin for various studies and programs and are collected on a regular basis for compliance with regulatory programs. Water quality data surveyed for this GSP were collected from:

- The California Safe Drinking Water Information System (SDWIS), a repository for public water system water quality data,
- The National Water Quality Monitoring Council water quality portal (this includes data from the recently decommissioned EPA STORET database, the USGS, and other federal and state entities [Note: in the Basin the agencies include USGS, California Environmental Data Exchange Network (CEDEN), and Central Coast Ambient Monitoring Program {CCAMP}]), and
- The California State Water Resources Control Board (SWRCB) GeoTracker GAMA database.

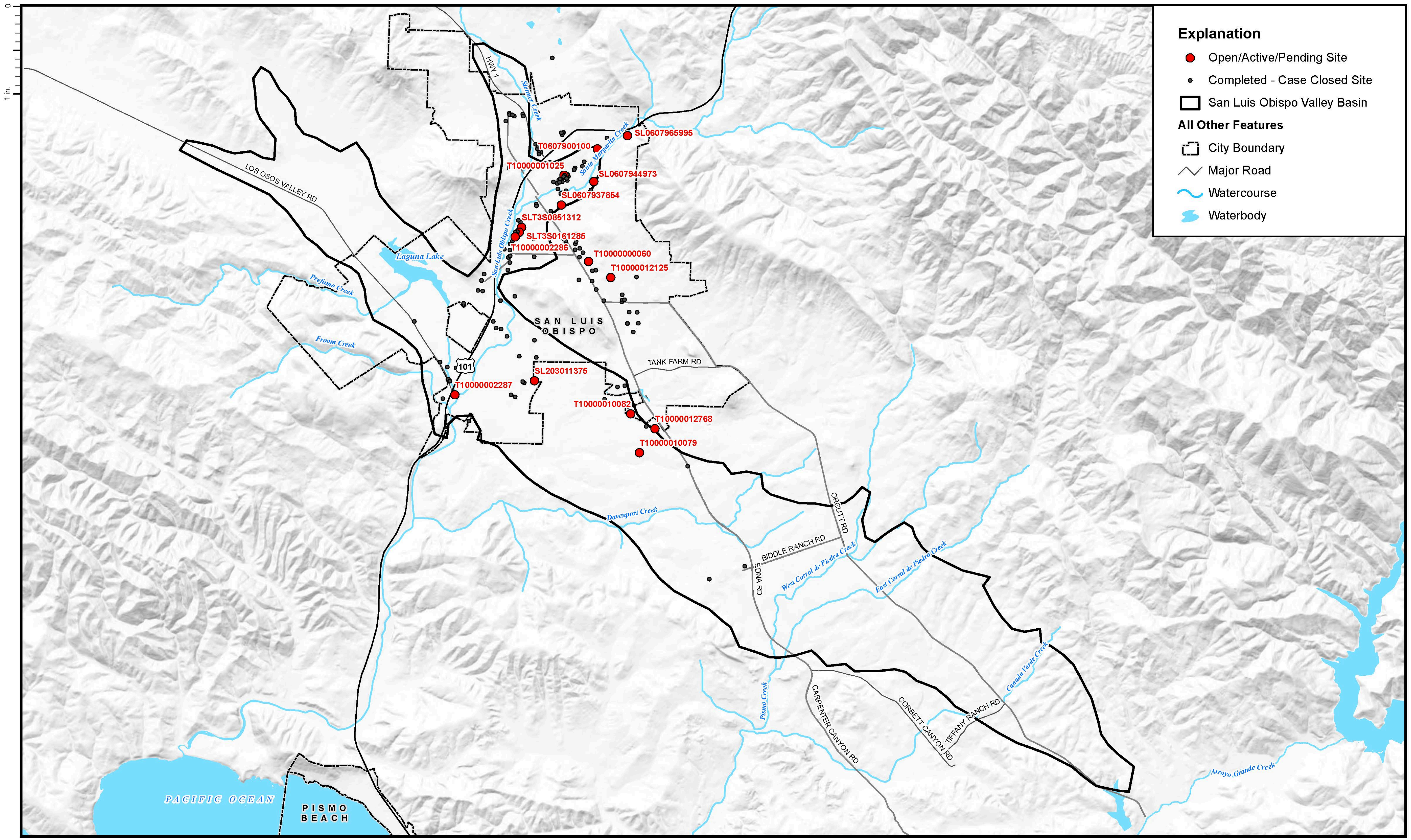
In general, the quality of groundwater in the Basin is good. Water quality trends in the Basin are stable, with no significant trends of ongoing deterioration of water quality based on the Regional Water Quality Control Board's Basin Objectives, outlined in the Water Quality Control Plan for the Central Coast Basin (Basin Plan, June 2019). The Basin Plan takes all beneficial uses into account and establishes measurable goals to ensure healthy aquatic habitat, sustainable land management, and clean groundwater. The distribution, concentrations, and trends of some of the most commonly cited major water quality constituents are presented in the following sections.

5.9.1 Groundwater Quality Suitability for Drinking Water

Groundwater in the Basin is generally suitable for drinking water purposes. Groundwater quality data was evaluated from the SDWIS and GeoTracker GAMA datasets. The data reviewed includes 2,885 sampling events from 403 supply wells and monitoring wells in the Basin, collected between June 1953 and September 2019. Primary drinking water standards Maximum Contaminant Levels (MCLs) and Secondary MCLs (SMCLs) are established by Federal and State agencies. MCLs are legally enforceable standards, while SMCLs are guidelines established for nonhazardous aesthetic considerations such as taste, odor, and color. Primary water quality standard exceedances in the Basin include exceedance of the MCL for nitrate, which equaled or exceeded the standard in 269 samples out of 2,605 samples (or 10% of samples, with 190 of the exceedances occurring in four wells), and exceedance of the MCL for arsenic, which exceeded the MCL in 30 out of 771 samples (or 4% of samples collected). The SMCL for total dissolved solids (TDS) was equaled or exceeded in 126 out of 843 samples (or 15% of total samples). In the case of public water supply systems, these water quality exceedances are effectively mitigated with seasonal well use, treatment, or water blending practices to reduce the constituent concentrations to below their respective water quality standard. In general, these statistics meet the Central Coast Water Board Basin Plan measurable goals that by 2025, 80% of groundwater will be clean, and the remaining 20% will exhibit positive trends in key parameters.

5.9.2 Distribution and Concentrations of Point Sources of Groundwater Constituents

Potential point sources of groundwater quality degradation due to release of anthropogenic contaminants were identified using the State Water Resources Control Board (SWRCB) Geotracker website. Waste Discharge permits were also reviewed from on-line regional SWRCB websites. Table 5-1 summarizes information from these websites for open/active sites. Figure 5-16 shows the locations of these open groundwater contaminant point source cases, and the locations of completed/case closed sites. Based on available information there are no mapped ground-water contamination plumes at these sites.



Prepared for:

Author: AB
Date: 11/27/2019

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References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2.San Luis Obispo County
3. Digiglobe 2018

Location of Potential Point Sources of Groundwater Contaminants

Figure 5-19

Table 5-1: Potential Point Sources of Groundwater Contamination

Site ID	Site Name	Case Type	Status	Constituent(s) of Concern (COCs)	Potentially Affected Media
T0607900100	American Gas and Tire	LUST Cleanup Site	Open - Verification Monitoring	Benzene, Gasoline, MTBE / TBA / Other Fuel Oxygenates	Aquifer used for drinking water supply
SL203011375	Chevron (Former UNOCAL) - Tank Farm Road Bulk Storage	Cleanup Program Site	Open - Remediation	Arsenic, Lead, Asphalt, Crude Oil, Other Petroleum	Contaminated Surface / Structure, Other Groundwater (uses other than drinking water), Soil, Surface water
T10000002287	Conoco Phillips site # 5143	Cleanup Program Site	Open - Site Assessment	Crude Oil, Diesel, Gasoline	Soil
SL0607944973	COP Pipeline at San Luis Drive	Cleanup Program Site	Open - Assessment & Interim Remedial Action	Crude Oil	Other Groundwater (uses other than drinking water), Well used for drinking water supply
T10000001025	KIMBALL MOTORS	Cleanup Program Site	Open - Verification Monitoring	Other Chlorinated Hydrocarbons, Tetrachloroethylene (PCE), Trichloroethylene (TCE), Vinyl chloride	Aquifer used for drinking water supply, Soil
SLT3S0851312	MODEL INDUSTRIAL SUPPLY	Cleanup Program Site	Open - Site Assessment		Aquifer used for drinking water supply
SLT3S0161285	PG&E-FORMER MANUFACTURED GAS PLANT-SAN LUIS OBISPO	Cleanup Program Site	Open - Remediation		Aquifer used for drinking water supply
SL0607937854	PISMO ST. AND MORRO ST. PIPELINE RELEASE	Cleanup Program Site	Open - Site Assessment	Crude Oil	Aquifer used for drinking water supply
T10000012768	SAN LUIS COUNTY RGNL	Non-Case Information	Pending Review	Per- and Polyfluoroalkyl Substances (PFAS)	
T10000002286	South Higuera St & Pismo St Pipeline (Chevron Site 351317)	Cleanup Program Site	Open - Site Assessment	Crude Oil, Diesel, Gasoline	Aquifer used for drinking water supply, Soil
T10000010079	Thread Lane Properties, LLC	Cleanup Program Site	Open - Site Assessment		
SL0607965995	TRACT 1259	Cleanup Program Site	Open - Assessment & Interim Remedial Action	Crude Oil	Aquifer used for drinking water supply
T10000000060	Union Pacific Railroad - Round House/Pond Site	Cleanup Program Site	Open - Inactive	Waste Oil / Motor / Hydraulic / Lubricating	Other Groundwater (uses other than drinking water), Soil
T10000012125	UPRR Tie Fire	Non-Case Information	Pending Review		
T10000010082	Volny Investment Company	Cleanup Program Site	Open - Site Assessment		

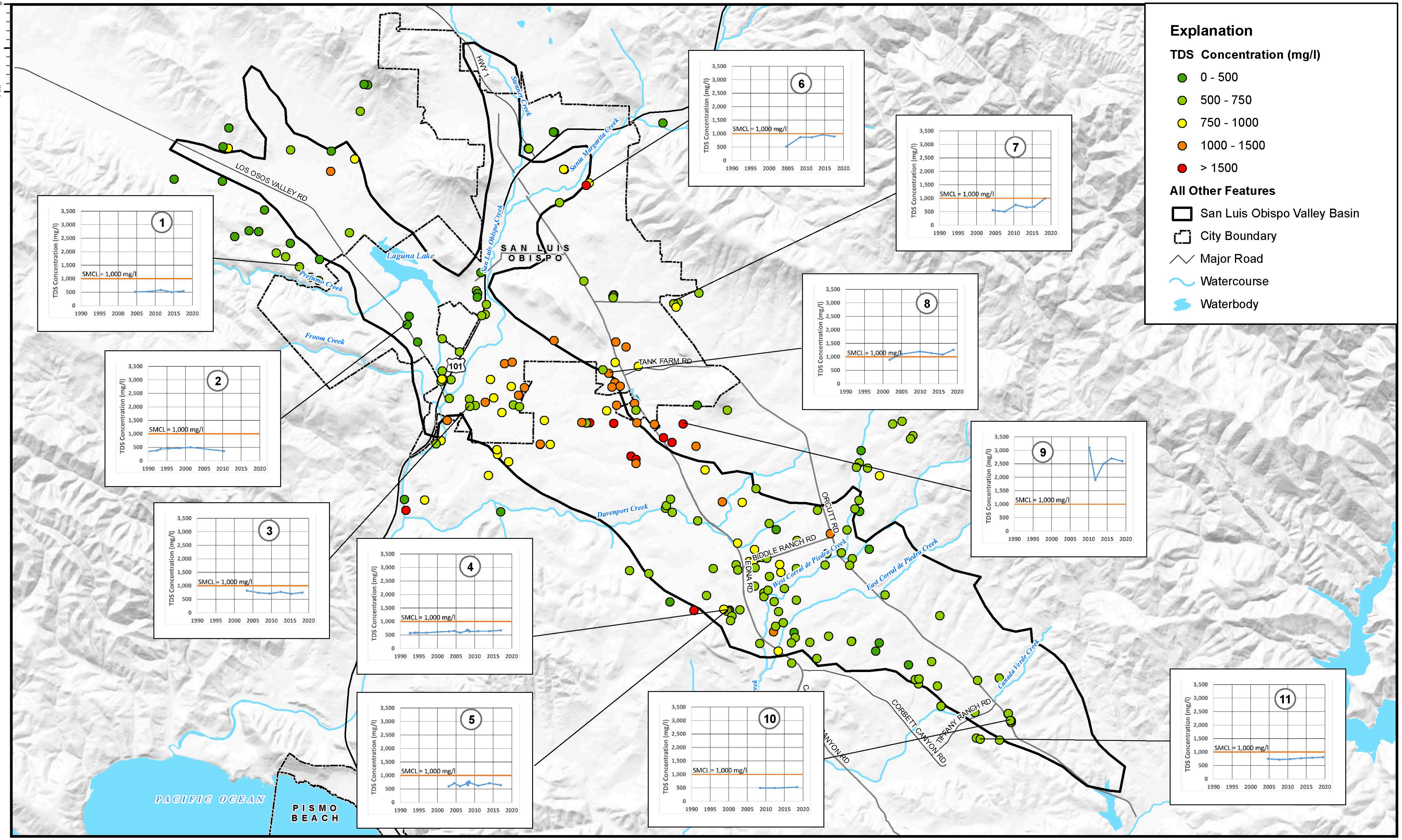
5.9.3 Distribution and Concentrations of Diffuse or Natural Groundwater Constituents

The distribution and concentration of several constituents of concern are discussed in the following subsections. Groundwater quality data was evaluated from the SDWIS and GeoTracker GAMA datasets. The data reviewed includes 2,884 sampling events from 403 wells in the Basin, collected between June 1953 and June 2019. Each of the constituents are compared to their drinking water standard, if applicable, or their Basin Plan Median Groundwater Quality Objective (RWQCB Objective) (CCRWQCB, 2017). This GSP focuses only on constituents that might be impacted by groundwater management activities. The constituents discussed below are chosen because they have either a drinking water standard, a known effect on crops, or concentrations have been observed above either the drinking water standard or the level that affects crops.

5.9.3.1 Total Dissolved Solids

TDS is defined as the total amount of mobile charged ions, including minerals, salts or metals, dissolved in a given volume of water and is commonly expressed in terms of milligrams per liter (mg/L). Specific ions of salts such as chloride, sulfate, and sodium may be evaluated independently, but all are included in the TDS analysis, so TDS concentrations are correlated to concentrations of these specific ions. Therefore, TDS is selected as a general indicator of groundwater quality in the Basin. TDS is a constituent of concern in groundwater because it has been detected at concentrations greater than its RWQCB Basin Objective of 900 mg/l in the Basin. The TDS Secondary MCL has been established for color, odor and taste, rather than human health effects. This Secondary MCL includes a recommended standard of 500 mg/L, an upper limit of 1,000 mg/L and a short-term limit of 1,500 mg/l. TDS water quality results ranged from 180 to 3,100 mg/l with an average of 727 mg/l and a median of 613 mg/l.

The distribution and trends of TDS concentrations in the Basin groundwater are presented on Figure 5-16. TDS concentrations are color coded and represent the average result if multiple samples are documented. Most of the samples with the highest values (dark red in the figure) are outside or on the edge of the Basin. This is consistent with observations that groundwater from the Basin sediments generally has better water quality than groundwater from bedrock wells. Eleven wells with the greatest amount of data over time were selected. Graphs displaying TDS concentration with time are included on Figure 5-17. Most of these graphs do not display any upward trends in TDS concentrations with time. The sustainability projects and management actions implemented as part of this GSP are not anticipated to increase groundwater TDS concentrations in wells that are currently below the SMCL.



Prepared for:

SAN LUIS OBISPO VALLEY BASIN GSP

Author: AB
Date: 1/16/2020

N

0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2.San Luis Obispo County
3. USGS

Distribution of TDS in Basin

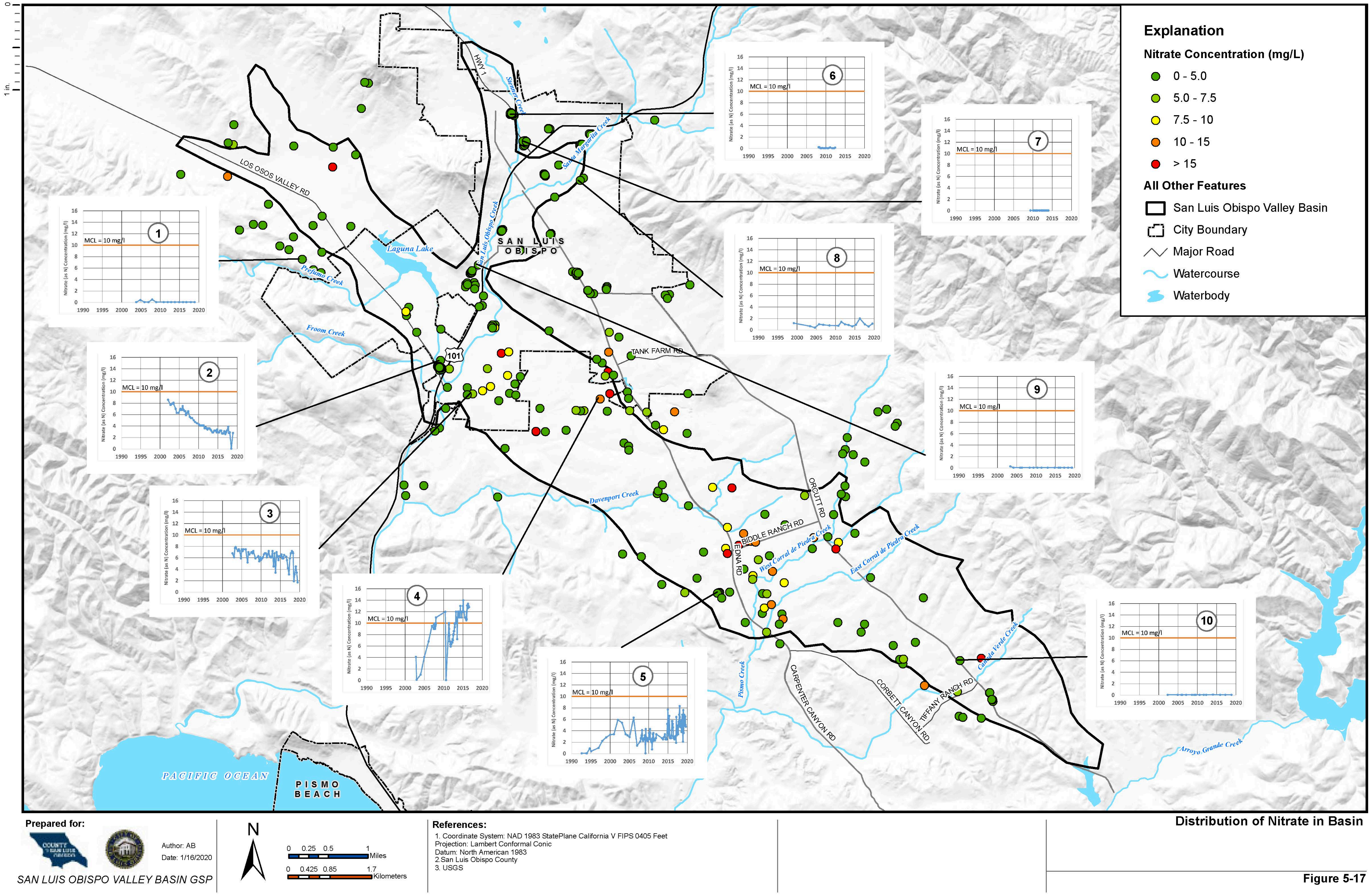
Figure 5-16

5.9.3.2 Nitrate

Nitrate (as Nitrogen) is a widespread contaminant in California groundwater. Although it does occur naturally at low concentrations, high levels of nitrate in groundwater are associated with agricultural activities, septic systems, confined animal facilities, landscape fertilizers and wastewater treatment facilities. Nitrate is the primary form of nitrogen detected in groundwater. It is soluble in water and can easily pass through soil to the groundwater table. Nitrate can persist in groundwater for decades and accumulate to high levels as more nitrogen is applied to the land surface each year. It is a Primary Drinking Water Standard constituent with an MCL of 10 mg/l.

Nitrate is a constituent of concern in groundwater because it has been detected at concentrations greater than its RWQCB Basin Objectives of 5 mg/l (as N) in the Basin. The Nitrate MCL has been established at 10 mg/l (as N). Overall, nitrate water quality results ranged from below the detection limit to 80 mg/l (as N) with an average of 3.9 mg/l (as N) and a median value of 2.0 mg/l (as N).

Figure 5-18 presents occurrences and trends for nitrate in the Basin groundwater. Wells with the most sampling data over time were selected for presentation. The color-coded symbols represent the average result if multiple samples are documented. Most of the chemographs displayed on Figure 5-18 indicate concentrations of nitrate well below the MCL, and do not indicate trends of increasing concentrations with time. Chemographs labelled number 4 and 5 on Figure 5-18 do appear to indicate a slight upward trend in nitrate (as nitrogen) concentrations over the data period of record. Sustainability projects and management actions implemented as part of this GSP are not anticipated to increase nitrate concentrations in groundwater in a well that would otherwise remain below the MCL to increase above the MCL.



Distribution of Nitrate in Basin

Figure 5-17

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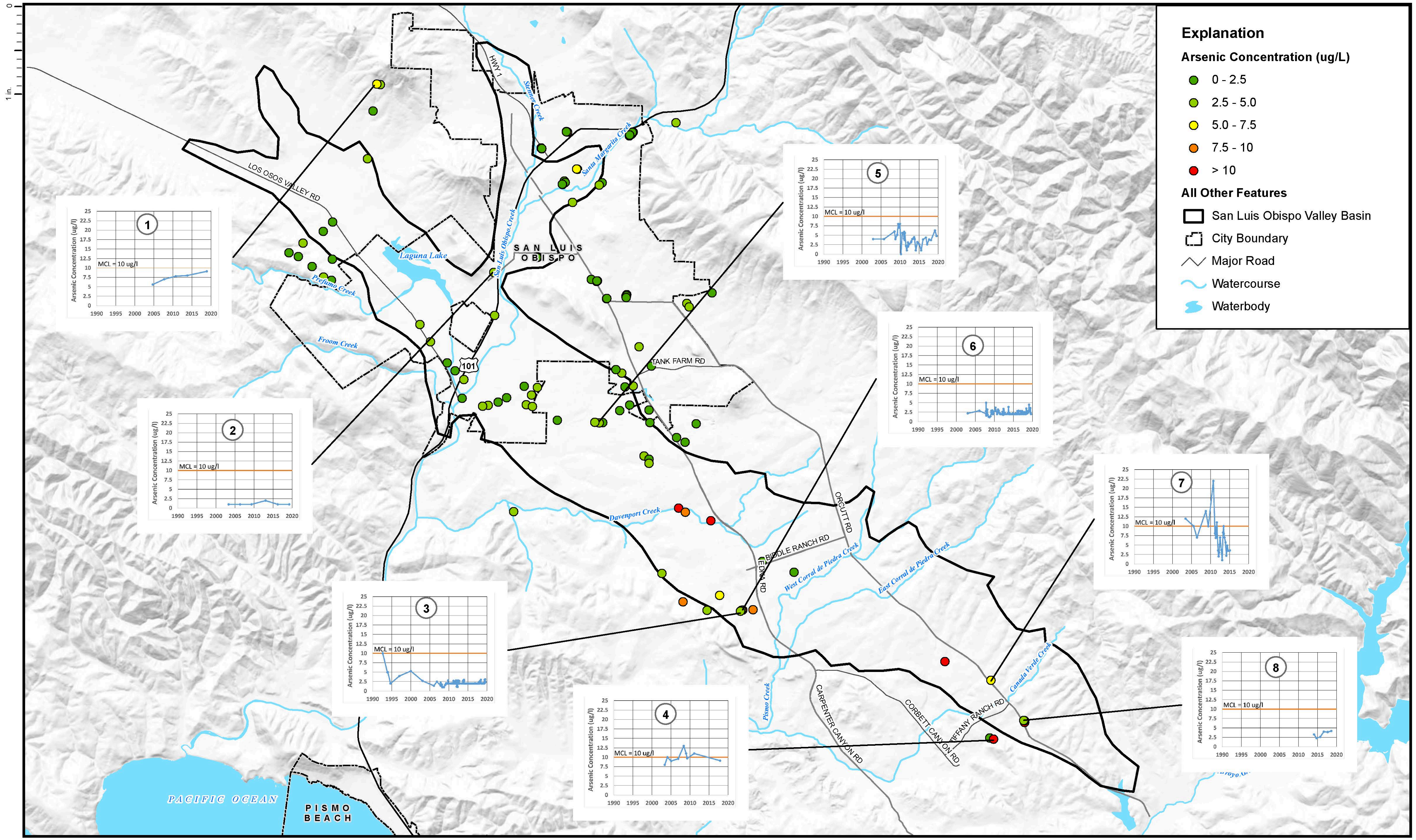
5.9.3.3 Arsenic

Arsenic is also a common contaminant in California groundwater. Although it does occur naturally at low concentrations, elevated levels of arsenic in groundwater may be associated with pesticide use, mining activities, and release of industrial effluent. Arsenic has a Primary Drinking Water Standard with an MCL of 10 ug/l. Overall, arsenic concentrations ranged from below the detection limit to 28 ug/l, with an average value of 2.5 ug/l and a median value of 2 ug/l.

Figure 5-19 presents occurrences and trends for arsenic in the Basin groundwater from wells with the most arsenic analytical data over time. The color-coded symbols represent the average result if multiple samples are documented. Wells screened in the bedrock aquifers may be expected to have higher natural arsenic concentrations than wells screened in Basin sediments due to increased degrees of mineralization in these waters. Most of the chemographs displayed show stable or decreasing concentrations of arsenic over the data period of record. (Graph number 1 shows a slight increase over time, but is still below the MCL). Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause arsenic concentrations in groundwater in a well that would otherwise remain below the MCL to increase above the MCL.



Prepared for:

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Author: AB
Date: 1/16/2020

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0 0.25 0.5 1 Miles
0 0.425 0.85 1.7 Kilometers

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. USGS

Distribution of Arsenic in Basin

Figure 5-18

5.9.3.4 Boron

Boron is an unregulated constituent and therefore does not have a regulatory standard. However, boron is a constituent of concern because elevated boron concentrations in water can damage crops and affect plant growth. Boron has been detected at concentrations greater than its RWQCB Basin Objective of 200 micrograms per liter (ug/l). Boron water quality results ranged from non-detect to 2,500 ug/l with an average of 0.16 ug/l and a median value of 0.12.

Boron concentrations in the Alluvial Aquifer have been relatively consistent throughout the period of record. Boron concentrations in the Paso Robles Formation Aquifer have generally remained steady or declined slightly over the period of record. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause boron concentrations in groundwater in a well to increase.

5.9.3.5 Other Constituents

Other constituents found in exceedance of their respective regulatory standard include arsenic, iron, gross alpha, manganese, selenium, and sulfate. Each of these exceedances occurred in samples from a small number of wells, indicating isolated occurrences of these elevated constituent concentrations rather than widespread occurrences, affecting the entire Basin. Isolated concentrations of arsenic, iron, gross alpha, and sulfate in the Basin have been relatively consistent throughout the period of record. Selenium concentrations have generally declined since 2007. There are not enough data to determine the trend of the elevated manganese concentrations in the Basin. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause concentrations of any of these constituents in groundwater to increase.

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GROUNDWATER SUSTAINABILITY COMMISSION
for the San Luis Obispo Valley Groundwater Basin
March 11, 2020

Agenda Item 8 – An Overview on Sustainable Management Criteria (Presentation Item)

Recommendation

a) Receive a general overview on the sustainable management criteria.

Prepared by

Dave O'Rourke, GSI and Michael Cruikshank, WSC

Discussion

The WSC Team, has been tasked with the preparation of the Groundwater Sustainability Plan (GSP) for the SLO Basin to meet the requirements of SGMA. The sustainability goal for the SLO Basin will be accomplished through the development of sustainable management criteria. The setting of the sustainability goal will occur through the stakeholder process at the GSA Workshops and GSC meetings with the objective of having no undesirable results in the SLO Basin by 2042. The GSP will identify one or more measurable objective for each of the sustainability indicators identified in SGMA 1) chronic lowering of groundwater levels, 2) reduction of groundwater in storage, 3) land subsidence, 4) water quality degradation, and 5) interconnected surface water depletions.

The WSC Team will provide an overview of the sustainable management criteria that will be featured in the upcoming Workshop and Chapter 7 of the GSP.

Attachments:

1. Presentation

AN OVERVIEW OF SUSTAINABLE MANAGEMENT CRITERIA

Dave O'Rourke, GSI
Michael Cruikshank, WSC

SUSTAINABLE MANAGEMENT CRITERIA (SMC)
SLO BASIN

SGMA allows all indicators but water quality to be assessed using water levels as a proxy metric for direct measurement.

SUSTAINABILITY INDICATORS	CHRONIC LOWERING OF GROUNDWATER LEVELS	REDUCTION OF GROUND-WATER STORAGE	SEAWATER INTRUSION	WATER QUALITY DEGRADATION	LAND SUBSIDENCE	INTER-CONNECTED SURFACE WATER DEPLETIONS
METRIC(S) DEFINED IN GSP REGULATIONS	**Groundwater Elevation**	**Total Volume**	**Chloride Concentration Isocontour**	**- Migration Plumes - # of Supply Wells - Volume - Location of Isocontour**	**Rate and extent of land subsidence**	**Volume or rate of surface water depletion**

SUSTAINABLE MANAGEMENT CRITERIA
SLO BASIN

Definitions 1

Management area.
An area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors

Sustainability indicator.
Any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).

Undesirable result.
Undesirable results occur when conditions related to any of the six sustainability indicators become significant and unreasonable. Undesirable results will be used by the Department to determine whether the sustainability goal has been achieved within the basin.

SUSTAINABLE MANAGEMENT CRITERIA
SLO BASIN

Definitions 2

Measurable Objectives.
Measurable objectives are quantitative goals that reflect the basin's desired groundwater conditions and allow the GSA to achieve the sustainability goal within 20 years.

Minimum Thresholds.
The quantitative value that represents the groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause an undesirable result(s) in the basin.

Interim Milestone.
A target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan

Representative Monitoring Sites.
A subset of a basin's complete monitoring network, where minimum thresholds, measurable objectives, and interim milestones are set.

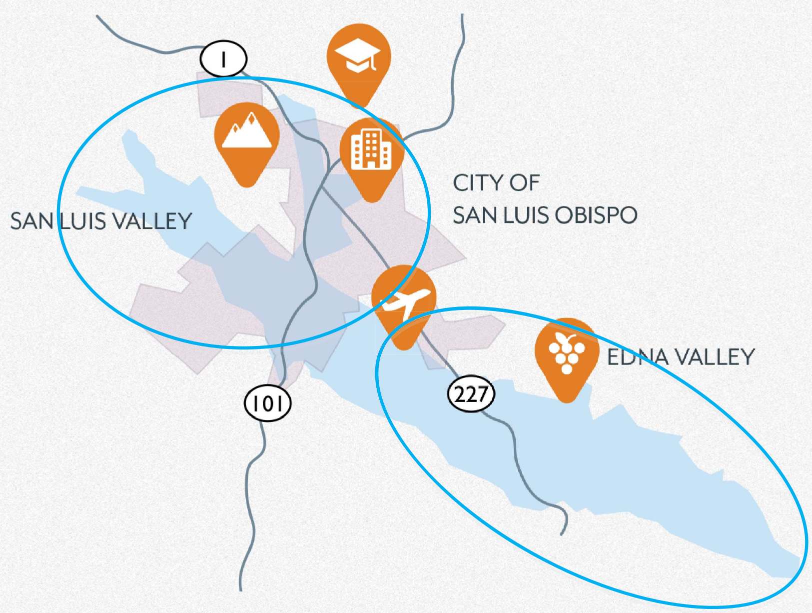
MANAGEMENT AREAS

- Geopolitical Boundary
  - City of San Luis Obispo GSA
  - County of San Luis Obispo GSA
- Hydrogeologic Boundaries

- Stakeholder input is key.
- Specific boundaries must be agreed upon

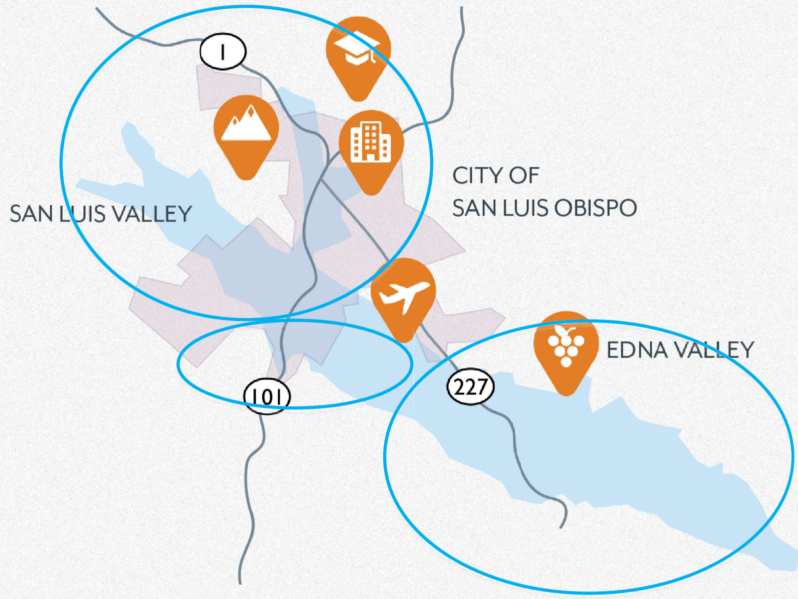
MANAGEMENT AREAS (Example 1)

- San Luis Obispo Valley Management Area
- Edna Valley Management Area



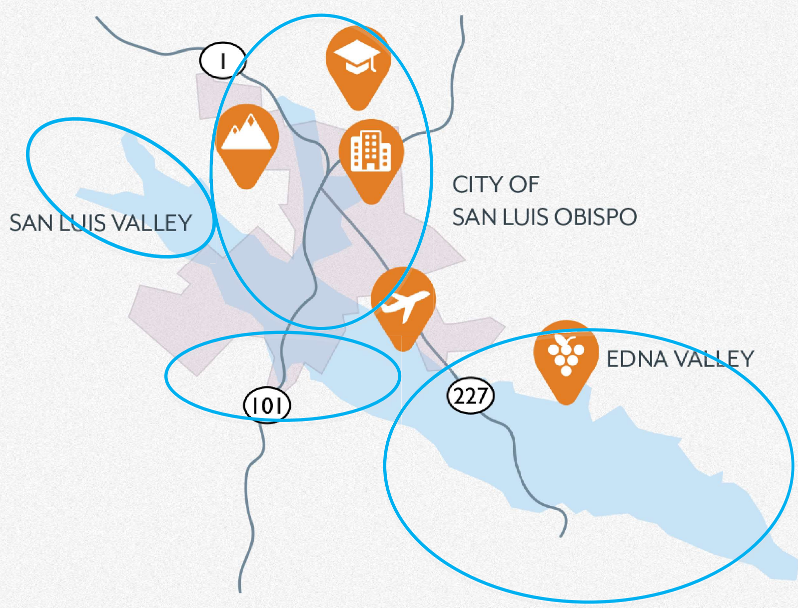
MANAGEMENT AREAS (Example 2)

- San Luis Obispo Valley Management Area
- Edna Valley Management Area
- Buckley Road Management Area



MANAGEMENT AREAS (Example 3)

- San Luis Obispo Valley Management Area
- Edna Valley Management Area
- Buckley Road Management Area
- Los Osos Valley Road Management Area



MANAGEMENT AREAS
NO MANAGEMENT AREAS

Management Areas are not required.

EXAMPLE: REPRESENTATIVE MONITORING SITES

- Subset of Basin Monitoring Network
- Used to Assign MOs and MTs

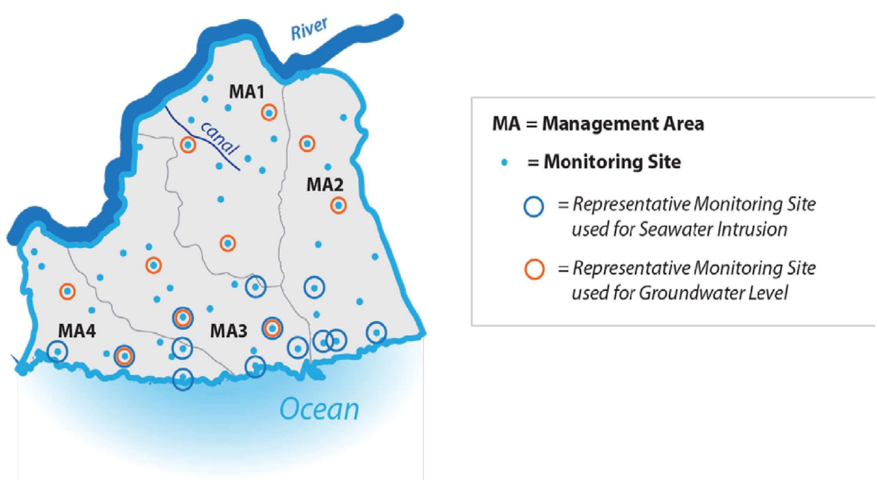
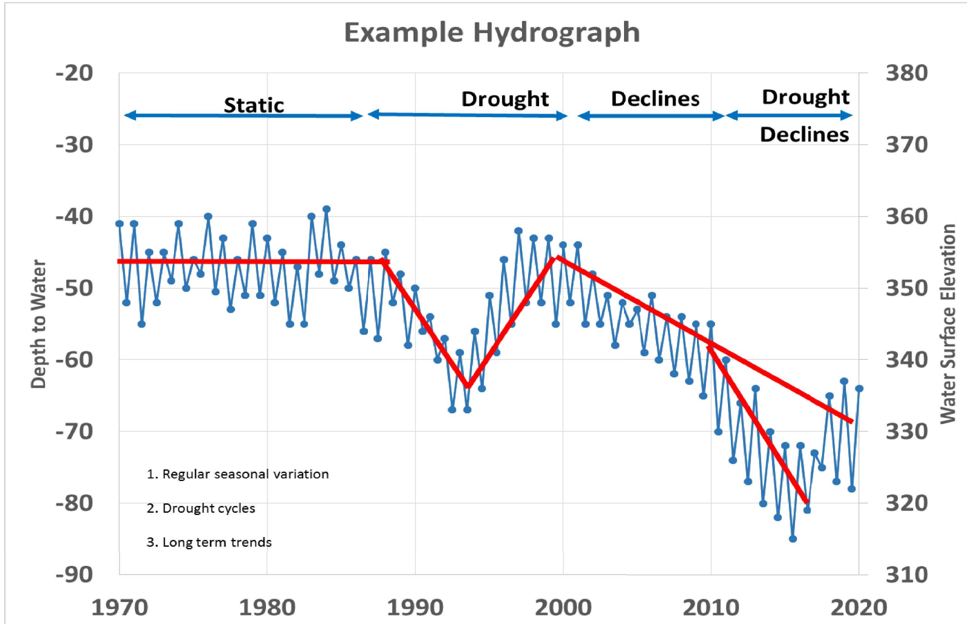
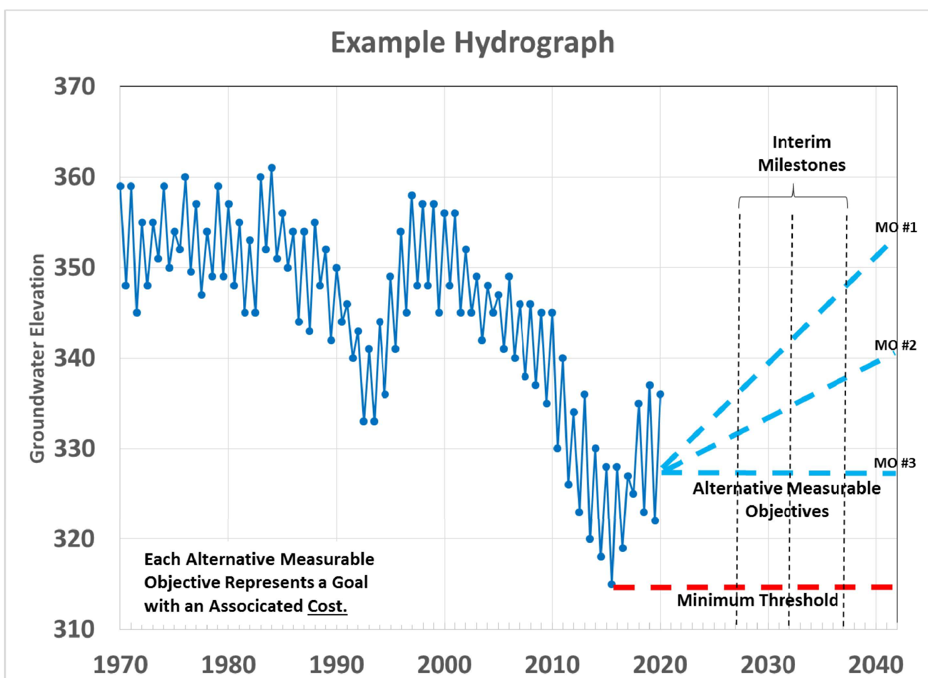


Figure 1. Example Monitoring Network and Representative Monitoring Sites

GROUNDWATER ELEVATION HYDROGRAPH (review)



EXAMPLE: SUSTAINABLE MANAGEMENT CRITERIA (SMCs)



GROUNDWATER SUSTAINABILITY COMMISSION

for the San Luis Obispo Valley Groundwater Basin

March 11, 2020

Agenda Item 9 –Integrated Groundwater/Surface Water (GW/SW) Modeling Update (Action Item)

Recommendation

a) Receive an update on the integrated GS/SW modeling efforts and consider recommending that each GSA receives and files Draft GW/SW Model TM #1.

Prepared by

Dave O'Rourke, GSI

Discussion

The WSC Team, led by GSI Water Solutions, Inc. (GSI), and supported by WSC and Cleath Harris Geologists (CHG) has been tasked with the development of an integrated groundwater/surface water flow model for use in supporting the GSP development. The model will be used to estimate future groundwater levels in the basin, and to demonstrate the effects that various proposed projects and management actions will have on the goal of achieving sustainability by 2042.

The WSC Team will provide an update on the progress of the integrated groundwater surface water model and provide an overview of the contents of the GW/SW Model TM #1 and the next steps in the model development.

Attachments:

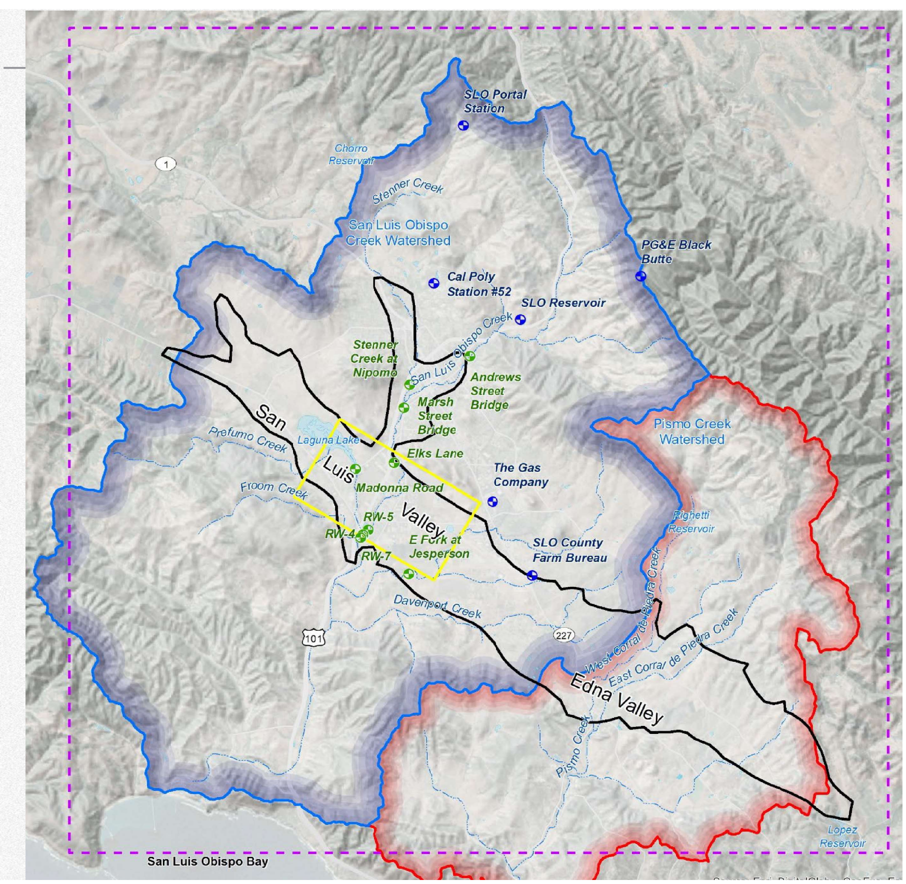
1. Presentation
2. GW/SW Model Technical Memorandum #1

INTEGRATED GROUNDWATER / SURFACE WATER MODEL UPDATE

Dave O'Rourke, GSI

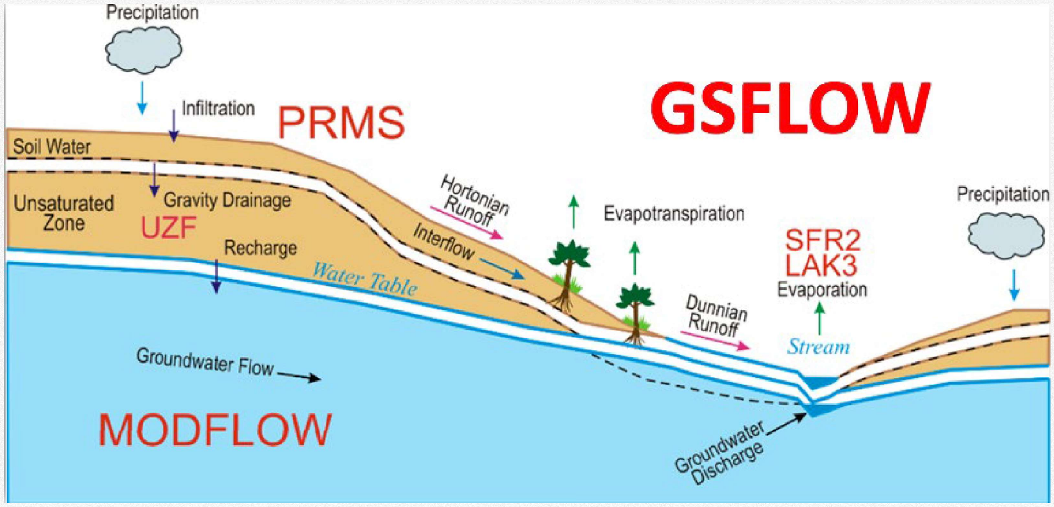
INTEGRATED GROUNDWATER / SURFACE WATER MODEL TM #1

- Hydrogeologic Conceptual Model
- Modeling Approach
- GSFLOW: Integrated Flow Model
  - PRMS: Surface Water Flow
  - MODFLOW: Groundwater Flow
- Next Steps



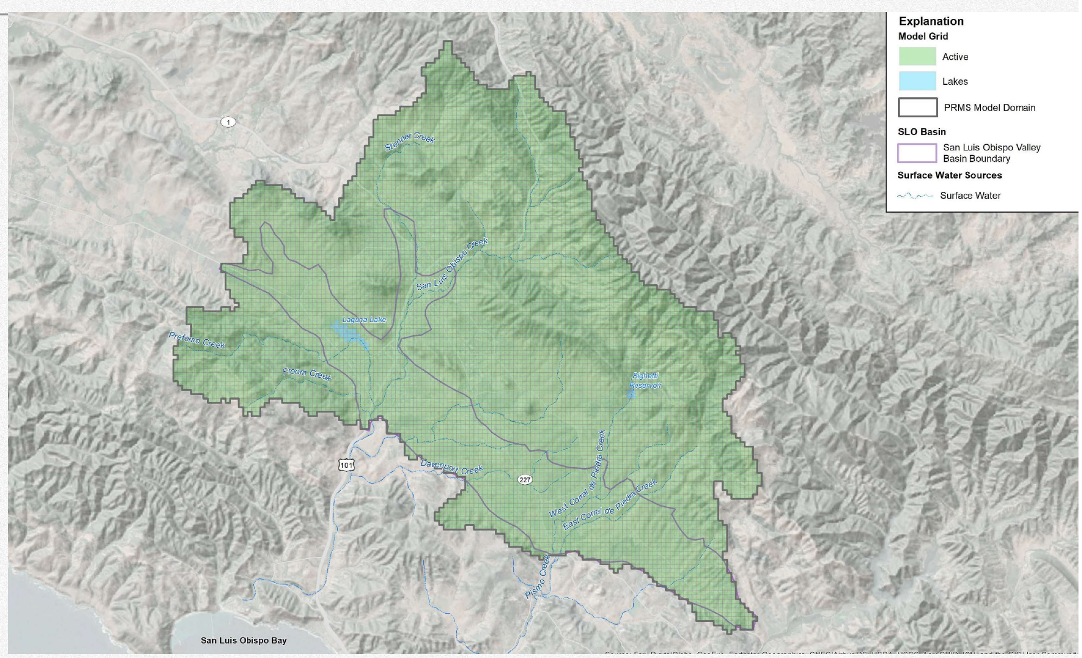
GSFLOW

- Coupled surface water/groundwater flow model
- Watershed Model
  - Precipitation Runoff Modeling System (PRMS)
- Groundwater Flow
  - MODFLOW
- GSFLOW accurately simulates the interactions of surface water and groundwater in the system

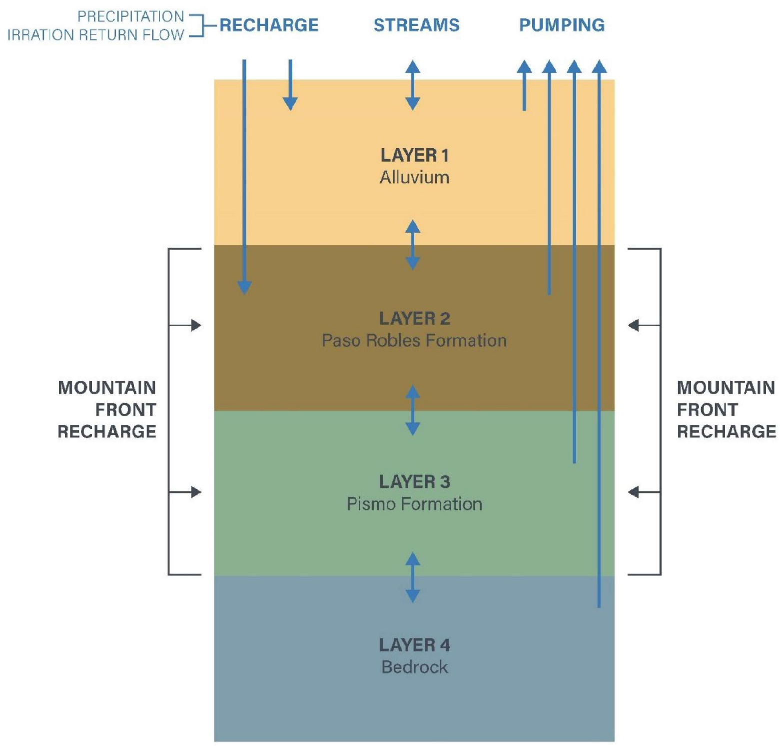


MODEL GRID

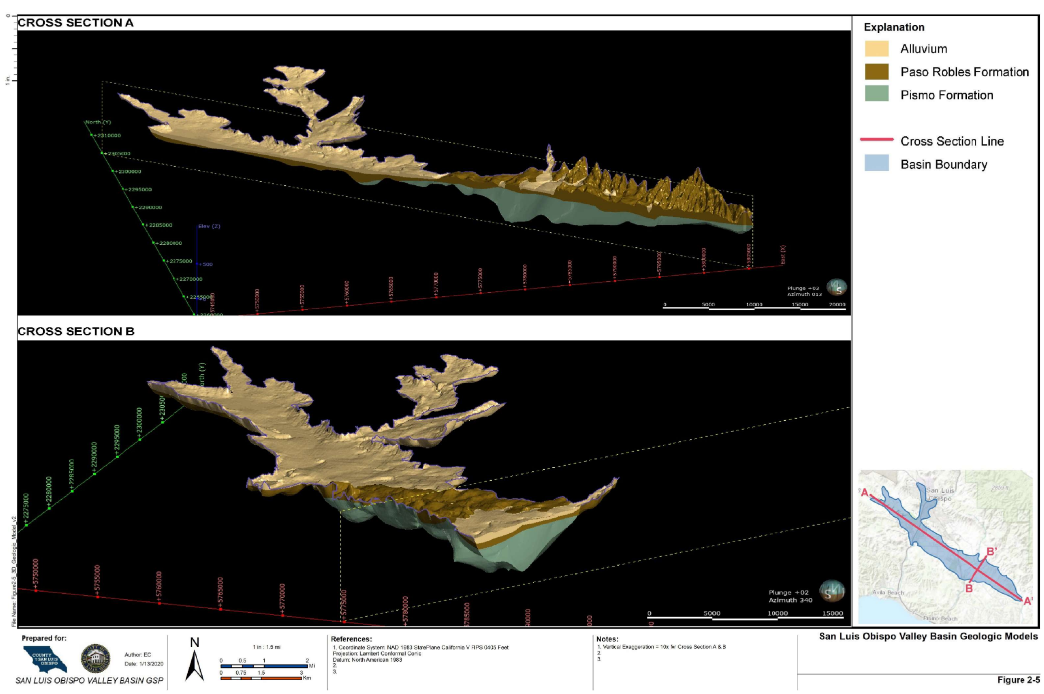
- Includes watershed areas that flow into Basin.
- 500 ft x 500 ft cells
- 115 Rows by 160 Columns
- 4 Layers:
  - Alluvium
  - Paso Robles Formation
  - Squire Member
  - Undifferentiated bedrock.



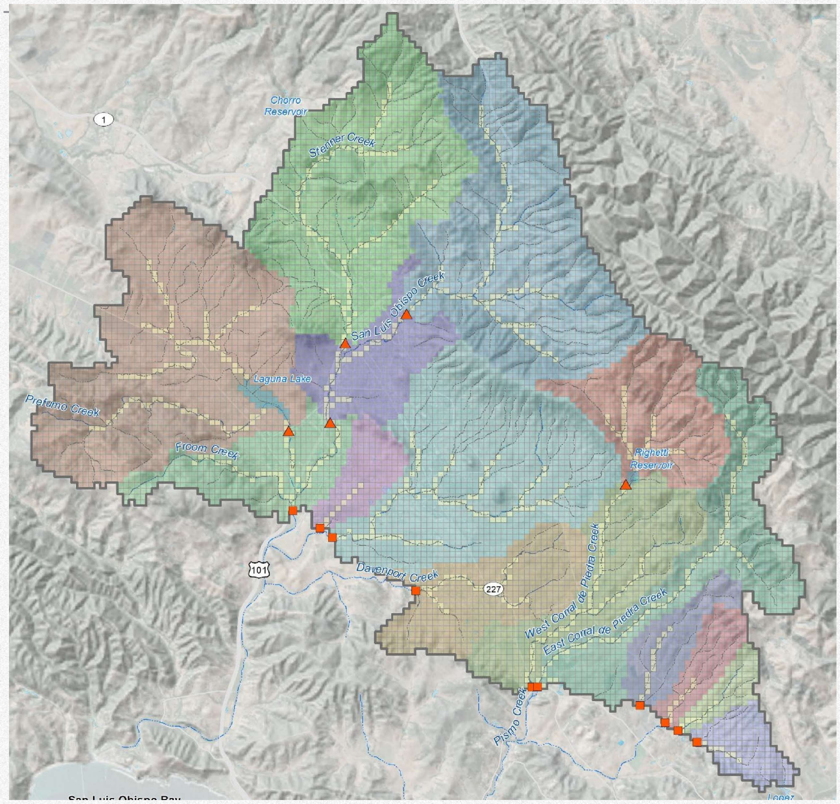
MODEL LAYERING AND HYDROLOGIC CONCEPTUAL MODEL



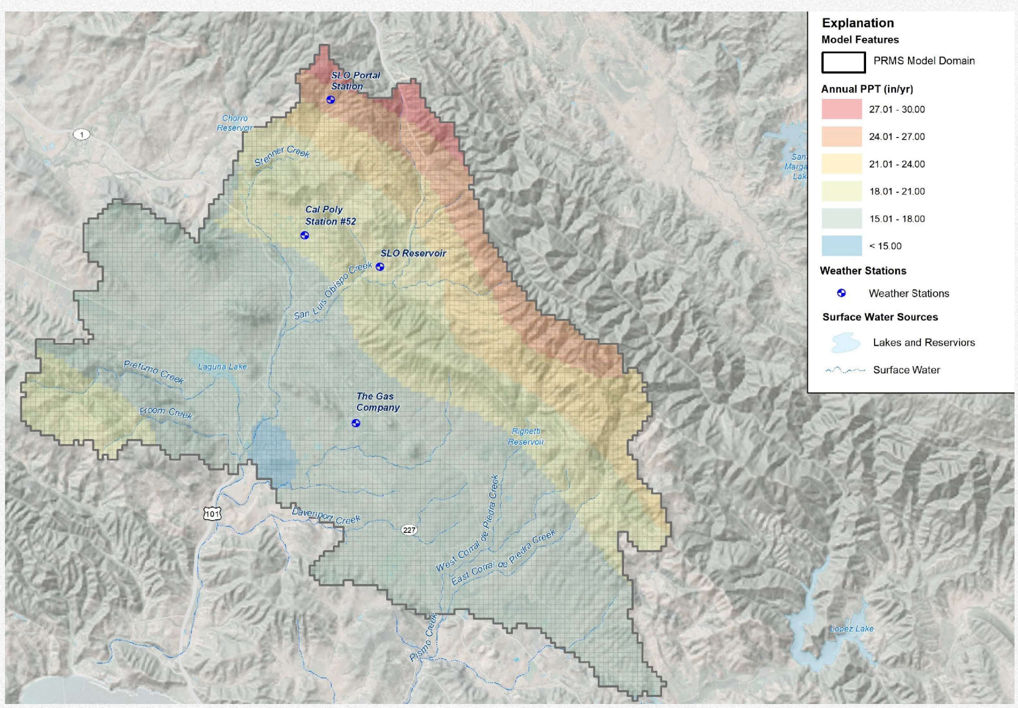
GEOLOGIC MODEL



SUB WATERSHEDS AND STREAM SEGMENTS



MEAN ANNUAL PRECIPITATION (1980 – 2010)



NEXT STEPS

- Model Calibration
- Sensitivity Analysis

Date: 2/27/2020

To: Dick Tzou, PE
Water Resources Engineer
County of San Luis Obispo

Mychal Boerman
Deputy Director of Utilities Department
City of San Luis Obispo

Phone: (805) 781-4473

CC: Mladen Bandov, PE

Prepared by: Adam Rianda, PE; Erik Cadaret, GIT; Dave O'Rourke, PG, CHG, PE

Reviewed by: Michael Cruikshank, PG, CHG

Project: SLO Basin Groundwater Sustainability Plan

Subject: **Draft** Surface Water/Groundwater Modeling Approach Technical Memorandum (Modeling TM No.1)

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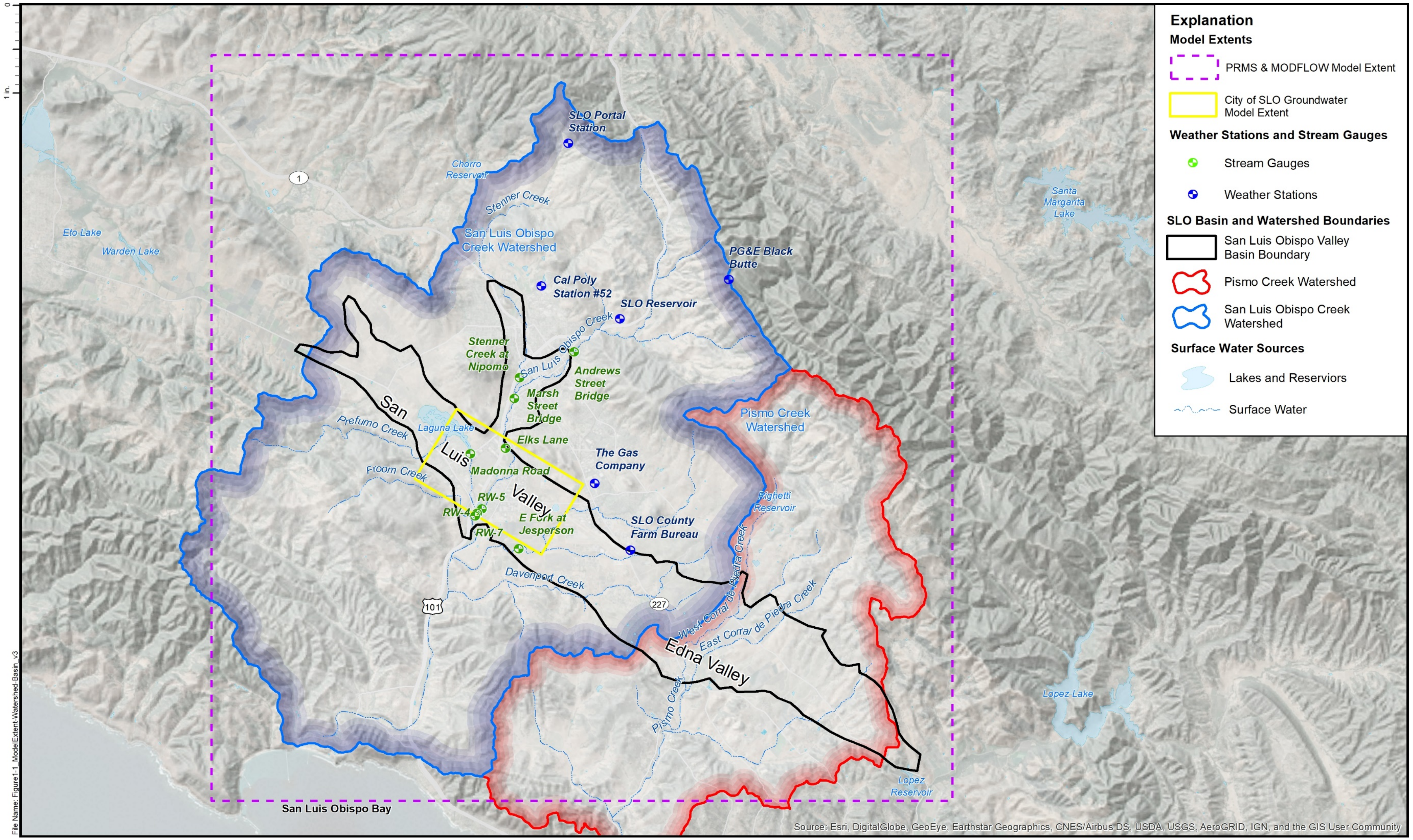
Section 1. Introduction

This draft Technical Memo (TM No.1) is prepared by Water Systems Consulting, Inc. (WSC) and GSI Water Solutions, Inc. (GSI), for the San Luis Obispo (SLO) County Groundwater Sustainability Agency (GSA) and the City of SLO GSA. As part of the Groundwater Sustainability Plan (GSP) for the SLO Valley Groundwater Basin (Basin), the consultant team is developing an integrated surface water-groundwater numerical model for the objective of evaluating the potential impacts of proposed projects and management actions associated with the GSP. The objective of this TM is to document the modeling approach and hydrogeologic conceptual model (HCM) associated with the construction of the integrated numerical model of the SLO Basin.

The Basin covers approximately 20 square miles in central San Luis Obispo County (County). The Basin extents are defined as the contact of water-bearing sediments with the non-water-bearing formations of the Santa Lucia Range to the northeast, and the San Luis Range and the Edna Fault Zone to the southwest. Annual average precipitation in the Basin is approximately 18 to 22 inches (GSI Water Solutions, Inc., 2018). The Basin is commonly divided into two sub-areas: the San Luis Valley and the Edna Valley. The San Luis Valley occupies approximately the northwestern half of the Basin; it includes the City of San Luis Obispo (City), and the primary land uses are municipal and industrial. Most water supply in the San Luis Valley is from both in-basin groundwater sources and imported surface water sources (Whale Rock Reservoir, Salinas Reservoir, and Nacimiento Reservoir). The Edna Valley occupies the southeastern half of the Basin. The primary land use is agriculture, with wine grapes as the dominant crop type. Groundwater is the major source of water supply in the Edna Valley.

To date, a watershed scale groundwater or integrated surface water-groundwater model has not been published for the entire Basin. In 1997, the California Department of Water Resources (DWR) performed initial work on a basin groundwater model, but the model was never published. A groundwater model was developed within a portion of the Basin that encompasses the San Luis Valley (the City of SLO model)(Cleath-Harris Geologists, 2018) and a surface water hydraulic model has been developed for the San Luis Obispo Creek watershed (Questa Engineering Corp., 2007). Figure 1-1 shows the watershed and Basin boundaries, and the proposed model extent for both PRMS and MODFLOW.

GSI developed a TM to evaluate multiple integrated surface water-groundwater modeling systems and identified the best modeling system to achieve compliance and project objectives for the SLO GSP (GSI Water Solutions, Inc., 2019). GSFLOW, a fully integrated hydrologic model (IHM) developed by the United States Geological Survey (USGS) (Markstrom, Niswonger, Regan, Prudic, & Barlow, 2008), was recommended to the GSP Groundwater Sustainability Commission (GSC) to be selected as the model system to be used for the GSP. IHM models like GSFLOW can provide important information about water resources and are often used as decision support tools for resource management (Laniak, et al., 2013). GSFLOW integrates the Precipitation-Runoff Modeling System (PRMS) watershed model code with the MODFLOW groundwater model code.



Prepared for:

SAN LUIS OBISPO VALLEY BASIN GSP

Author: EC
Date: 2/18/2020

N

1 in : 1.6 mi
0 0.5 1 2 Mi
0 0.75 1.5 3 Km

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2.
3.

Notes:
1.
2.
3.

Model Extents, Watershed, and Basin Overview

Figure 1-1

Section 2. Hydrogeologic Conceptual Model

This section of the TM summarizes the HCM for the San Luis Obispo Valley Groundwater Basin (Basin) (DWR Basin 3-09), including summary discussion of both geologic formations and hydrogeologic conditions significant to the development of the numerical model. These subjects are evaluated in greater detail in the Basin Characterization Report (GSI Water Solutions, Inc., 2018), and the reader is directed to that report for a more comprehensive discussion of relevant topics.

2.1. Geologic Formations and Water Bearing Properties

For the purpose of the GSP, the rocks in the Basin vicinity may be considered as two basic groups; the water-bearing sediments of the SLO Basin, and the consolidated bedrock of the surrounding hills and watershed. Compared to the saturated sediments that comprise the Basin aquifers, the consolidated bedrock formations are not considered to be water-bearing. Although bedding plane and/or structural fractures in these rocks may yield small amounts of water to wells, they do not represent a significant portion of the pumping in the area. In fact, the DWR Bulletin 118 delineation of the Basin boundaries is defined both laterally and vertically by the contacts of the Basin sediments with the surrounding and underlying consolidated bedrock formations.

Figure 2-1 displays a stratigraphic column of the significant local geologic units. Figure 2-2 presents a geologic map of the Basin vicinity (assembled from a mosaic of the Dibblee maps from the San Luis Obispo, Pismo Beach, Lopez Mountain, and Arroyo Grande NE quadrangles) showing where the various formations crop out at the surface.

Figure 2-2 also displays the Basin boundaries defined in DWR Bulletin 118. Inspection of Figure 2-2 indicates that the existing DWR GIS shapefiles for the Basin boundary do not match up precisely with the mapped extent of the water-bearing formations. This is likely an artifact of previous mapping being performed at a larger statewide scale.

The water-bearing sedimentary formations and the non-water-bearing bedrock formations are briefly described below, from the youngest to the oldest.

2.1.1. Basin Sedimentary Formations

Recent Alluvium

The Recent and Older Alluvium is the mapped geologic unit composed of unconsolidated sediments of gravel, sand, silt, and clay, deposited by fluvial processes along the courses of San Luis Obispo Creek, Davenport Creek, East and West Corral de Piedras Creeks, and their tributaries. Lenses of sand and gravel are the productive strata within the Alluvium. There is no significant difference in hydrogeologic properties between Recent and Older Alluvium. These strata have no significant lateral continuity across large areas of subsurface within the Basin. Thickness of Alluvium may range from just a few feet to greater than 50 feet.

Paso Robles Formation

The Paso Robles Formation underlies the Recent Alluvium throughout most of the Basin and overlies the Pismo Formation where present. It is composed of poorly sorted, unconsolidated to mildly consolidated sandstone, siltstone, and claystone, with thin beds of volcanic tuff in some areas. The Paso Robles Formation is exposed at the surface through much of the Edna Valley, except in areas where existing streams have deposited Recent Alluvium on top of it. Wells that screen both the Recent Alluvium and Paso Robles Formation have reported yields from less than 100 to over 500 gallons per minute (gpm). There is no laterally extensive fine-grained confining unit separating the Paso Robles formation from the Recent Alluvium in the Basin.

Pismo Formation

The oldest geologic water-bearing unit with significance to the hydrogeology of the Basin is the Pismo Formation. The Pismo Formation is a Pliocene-aged sequence of unconsolidated to loosely consolidated marine deposited sedimentary units composed of claystone, siltstone, sandstone, and conglomerate. There are five recognized members of the Pismo Formation (Figure 2-1). While all are part of the Pismo Formation, the distinct members reflect different depositional environments, and the variations in geology may affect the hydrogeologic characteristics of the strata. From the bottom (oldest) up, these are:

- The Edna Member, which lies unconformably atop the Monterey Formation, and is locally bituminous (hydrocarbon-bearing)
- The Miguelito Member, primarily composed of thinly bedded grey or brown siltstones and claystones
- The Gragg Member, usually described as a medium-grained sandstone
- The Bellview Member, composed of interbedded fine-grained sandstones and claystones
- The Squire Member, generally described as a medium- to coarse-grained fossiliferous sandstone of white to grey sands.

Previous reports have identified the significant thicknesses of sand at depth beneath the Paso Robles Formation in the Edna Valley as the Squire Member of the Pismo Formation. However, ambiguities exist in the identification of the individual Pismo Formation members, so for the purposes of this report, these sediments will be referred to more generally as the Pismo Formation. The Pismo Formation is extensive below the Paso Robles Formation in the Edna Valley. There is no laterally extensive fine-grained confining layer separating the Pismo Formation from the Paso Robles Formation in the Basin. Thicknesses of Pismo Formation up to 400 feet are reported or observed in well completion reports.

Wells that are completed in both the Paso Robles and Pismo Formations are reported to yield from less than 100 gpm to approximately 700 gpm.

2.1.2. Bedrock Formations

Monterey Formation

The Monterey Formation is a thinly bedded siliceous shale, with layers of chert in some locations. In other areas of the County outside of the Basin, the Monterey Formation is the source of significant oil production. While fractures in consolidated rock may yield small quantities of water to wells, the Monterey Formation is not considered to be a Basin aquifer for the purposes of this Study. Some wells in the Basin screen both Basin sediments and the upper portion of the Monterey Formation. Of the bedrock formations discussed here, the Monterey Formation is the one most often used for water supply in the Basin. There are no paired wells that provide specific data comparing water levels in wells screening the Monterey Formation and the Basin sediments. However, the Monterey Formation is assumed to receive rainfall recharge in the mountains at higher elevations than the Basin. For this reason it is assumed that an upward vertical flow gradient exists between the Monterey Formation and the overlying Basin sediments. Because the Monterey formation is significantly less productive than the Basin sediments, the rate of this flux is not expected to be significant.

Obispo Formation

The Obispo Formation and associated Tertiary volcanics are composed of materials associated with volcanic activity along tectonic plate margins approximately 20 to 25 million years ago. Although fractures in consolidated volcanic rock may yield small quantities of water to wells, the Obispo Formation is not considered to be an aquifer for the purposes of this Study.

Franciscan Assemblage

The Franciscan Assemblage contains the oldest rocks in the Basin area, ranging in age from late Jurassic through Cretaceous (150 to 66 million years ago). The rocks include a heterogeneous collection of basalts, which have been altered through high-pressure metamorphosis associated with subduction of the oceanic crust beneath the North American Plate before the creation of the San Andreas Fault. Although fractures may yield small quantities of water to wells, the Franciscan Assemblage is not considered to be an aquifer for the purposes of this Study.

2.2. Geologic Structure

The primary geologic structures of significance to the hydrogeology of the Basin are the Edna Fault Zone and the adjacent Los Osos Fault Zone, which together form the southwestern boundary of the Basin through the uplift of the Franciscan and Monterey strata southwest of the faults. The Edna Fault is identified as a normal fault, extending from southeast of the Edna Valley to the vicinity of the town of Edna (Figure 2-2). There are some disconnected and unnamed fault splays mapped in the area south of the San Luis Obispo County Regional Airport. The Los Osos Fault Zone is mapped along the southwest edge of the Los Osos Valley. Movement along the Edna and Los Osos Valley Fault Zones has brought the water-bearing sediments of the Basin into contact with the bedrock formations of the San Luis Range. No available water level or other data indicate that the faults have any significant effect on the movement or quality of groundwater in the Basin.

2.3. Lithologic Data

All readily available lithologic data were obtained for the preparation of the Characterization Report (GSI Water Solutions, Inc., 2018) and updated for this TM. Sources of data included Well Completion Reports on file with the County and DWR, boring logs documented in published government reports or private consultant reports, geophysical boring logs, and various other sources. In all, 405 data points with lithologic information were collected for use in the GSP. (The reader is referred to the Characterization Report to evaluate the details of twelve cross sections generated in the Basin, which will not be duplicated herein.) Lithologic data were assigned spatial coordinates based on available mapping, and descriptions of geologic materials were recorded in a database for reference in future Sustainable Groundwater Management Act management activities. Lithologic data point locations are presented in Figure 2-3.

Available lithologic data, cross sections, and land surface elevation data were evaluated to identify probable contacts between geologic formations. Based on these data, GSI developed a map of total thickness of combined Basin sediments (Alluvium, Paso Robles Formation, and Pismo Formation), presented in Figure 2-4. This figure indicates that the Basin sediments are significantly thicker in the Edna Valley than in the San Luis Valley. Lithologic data were reviewed to identify contacts between the Recent Alluvium, Paso Robles Formation, and Pismo Formation. Based on these contacts, twelve cross sections were developed and presented in the Characterization Report (GSI Water Solutions, Inc., 2018); the reader is directed to that report to review details of the cross sections. Based on this data, a 3-D lithologic model of the SLO Basin sediments was developed using the software package Leapfrog©. Leapfrog 3D is a geologic modeling platform that incorporates and processes data from multiple sources including boreholes, GIS, grids, mesh/surface information, and historical cross section data. The Leapfrog model can be used as a basis to develop a numerical groundwater model grid and/or for 3D visualization and presentation purposes (Figure 2-5).

2.4. Hydrogeologic Setting

This section of the TM presents a summary discussion of hydrogeologic conditions in the SLO Basin as they pertain to the integrated model development. These subjects are evaluated in greater detail in the Basin Characterization Report (GSI Water Solutions, Inc., 2018), and the reader is directed to that report for a more comprehensive discussion of relevant topics. This TM will present an overview of the hydrogeology but will not duplicate the level of detail provided in the Characterization Report.

2.4.1. Hydrogeologic Units

Although there are significant intervals of clay evident in boring logs throughout the Basin, the clay lenses are not consistent across large areas. There is no evidence of laterally extensive impermeable strata that vertically isolates the geologic formations from one another. As a result, it appears that in the San Luis Valley, the Recent Alluvium and the Paso Robles Formation function as a single hydrogeologic unit. Work performed for the City indicates that alluvial deposits have a significantly higher hydraulic conductivity than the Paso Robles Formation and the Pismo Formation (Cleath, 2019). It does not appear that wells in the San Luis Valley are screened exclusively in either the Recent Alluvium or the Paso Robles Formation. Similarly, in the Edna Valley, there is no laterally extensive impermeable strata separating the Paso Robles and Pismo Formations. Frequently, the sand of one formation is in contact with the sands of the other formation. Therefore, it appears that in the Edna Valley, the Paso Robles Formation and the Pismo Formation function as a single hydrogeologic unit. Therefore, the modeling approach will be to represent each of the geologic units separately in the model, but no discrete barriers to vertical flow between the units will be simulated.

2.4.2. Recharge

The primary mechanisms for recharge in the Basin occur via infiltration of rainfall, percolation of seasonal streamflow from the alluvial sediments to underlying formations, deep percolation of applied irrigation water, and mountain front recharge. Mountain front recharge has not been specifically discussed or quantified in previous studies.

DWR (Department of Water Resources, 1958) estimated that average recharge to the Basin was 2,250 acre-feet per year (AFY). Working with data from a longer period of record, Boyle (Boyle Engineering Corp., 1991) estimated total recharge to the Basin from 1978-1990 was 3,650 AFY (1,510 acre-feet from irrigation percolation, 1,450 acre-feet from rainfall, 430 acre-feet from stream seepage losses, 300 acre-feet from reclaimed wastewater). In its draft report, DWR (Department of Water Resources , 1997), using a groundwater model approach, estimated combined recharge from precipitation, agriculture return flows, and incidental urban recharge, to average 4,560 AFY and range from 2,300 AFY in a drought year to 9,590 AFY in a wet year (As discussed previously, the groundwater model was never published). It should be noted that DWR (Department of Water Resources , 1997) estimates aquifer recharge from stream seepage only during dry years; in wet years, DWR estimated that the aquifer discharges to streams.

Cleath-Harris Geologists (CHG), a member of the consultant team developing the SLO Basin GSP, is preparing estimates of a historical water budget simultaneously with the development of the Basin numerical model. Estimates for each of the components of recharge discussed herein will be utilized during the calibration of the model.

2.4.3. Groundwater Pumping

Patterns and quantities of groundwater use in the Basin have varied depending on the period of record. The City of San Luis Obispo did not begin using groundwater until the late 1980s. In the 1990s, the City relied on significant groundwater use, particularly during the drought of the early 1990s. Today, by contrast, the City's potable water wells are used only for emergency standby due to groundwater contamination. The City does have plans to utilize groundwater as a drinking water supply in the future.

Agricultural groundwater use in the Edna Valley has changed in recent decades in response to market drivers, with the total irrigated acreage expanding significantly, and the crop types changing. Currently, wine grapes are the dominant crop type. No continuous estimates of groundwater pumpage in the Basin are available. Agricultural wells have not been metered in the past, and methods to estimate agricultural pumpage indirectly may vary. However, various published estimates have been presented in past reports and are briefly discussed below.

DWR (Department of Water Resources, 1958) estimates that 1,900 acre-feet of groundwater was pumped at that time. No details on this estimate are evident in the report text.

Boyle (Boyle Engineering Corp., 1991) reports an estimate of agricultural groundwater pumpage of 5,200 AFY, based on evaluation of irrigated acreage of various crop types, unit water use for each crop type, and irrigation efficiency. It is noteworthy that there is no reported irrigated vineyard acreage reported for their study period (1978-1990). Municipal and industrial pumpage is estimated to average 600 to 800 AFY during that period but was reported to be as high as 2,600 AFY during the drought year of 1990. Resultant total groundwater pumpage estimates for the Basin range from 5,690 to 7,810 AFY.

In its draft report, DWR (Department of Water Resources , 1997) presents some estimates for groundwater pumpage in the Basin. For years ranging from 1970 to 1995, groundwater pumpage estimates for all water user groups from the San Luis Valley range from 1,900 to 3,300 AFY, with the maximum estimate in the drought year of 1990. Pumpage estimates from the Edna Valley range from 2,330 to 4,340 AFY. Resultant total groundwater pumpage estimates for the Basin range from 4,380 to 7,640 AFY.

CHG is developing estimates of historical pumping as part of the water budget analysis. The results of that analysis will be incorporated into the historical calibration of the groundwater model.

2.4.4. Evapotranspiration

Evapotranspiration refers to the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants. This mechanism for outflow from the Basin may be significant in areas where the water table is near the land surface, such as along the stream corridors in the Basin. Transpiration of applied irrigation water to agricultural crops is also a significant process in the hydrology of the Basin. The details of the evapotranspiration processes will be represented in the integrated model.

2.4.5. Surface Water/Groundwater Interaction

Surface water/groundwater interactions represent a significant portion of the water budget of SLO Basin. In the Basin, these interactions occur primarily at streams and lakes.

Laguna Lake is the only lake in the Basin. The downstream outlet of the lake is dammed to artificially impound water to maintain water elevation in the lake to preserve and enhance the wildlife habitat and recreational purposes. The water in the lake is partially supplied by seasonal flow in Prefumo Creek, which flows into Laguna Lake. During dry periods, the lake may remain at least partially full, although it may dry up during extended drought. This appears to indicate that in addition to surface water inflow, the water in the lake is at least partially supplied by subsurface groundwater inflow.

Groundwater interaction with streams in the Basin is not well quantified, but it is recognized as an important component of recharge in the water budget. During the dry season when many streams have no flow, the groundwater elevation is below the streambed. Therefore, it is generally understood that San Luis Obispo Creek discharges to the underlying aquifer, at least in the first part of the wet-weather flow season. If there is constant seasonal surface water flow, it is possible that groundwater elevations may rise to the point that they are higher than the stream elevation, and the creek may become a seasonally gaining stream, but there are no data to corroborate this. It may remain a losing stream throughout most or all years.

The amount of flow in surface water/groundwater interaction is difficult to quantify. Boyle (Boyle Engineering Corp., 1991) assumed that 10 percent of the measured surface water flow coming into the Basin in San Luis Obispo Creek and Stenner Creek was recharged to the aquifer and at an average rate of 430 AFY. In its draft report, DWR (Department of Water Resources , 1997) reports model-generated estimates ranging from streams gaining 2,700 AFY from the aquifer, to streams losing 680 AFY to the aquifer.

The County, through its Water Resources Division coordination with Zone 9 and the City, maintains a network of five stream gages in the San Luis Valley of the Basin to record heights of flow throughout the year for flood warning purposes. The gages were constructed in November 2001 and have periods of record from 2005 to the present. Continuous monitoring of the height of flow at the gages is recorded, but equivalent discharge (e.g. cubic feet per second) is not recorded. Partial rating curves have recently been developed for some of the gages based on field measurements of discharge for observed flows. Additionally, estimated theoretical rating curves for each gage based on hydraulic modeling using HEC-RAS have been developed (Questa Engineering Corp., 2007).

2.4.6. Groundwater Flow Patterns

Groundwater flow in the Basin is predominantly from the Edna Valley toward the San Luis Obispo Creek alluvium, at which point the flow direction leaves the Basin through the alluvium. Groundwater in the northwestern areas of the Basin near the City boundary and Los Osos Valley Road flows southeastward toward the San Luis Obispo Creek alluvium. In the Edna Valley, there are also local areas of flow leaving the Basin along the Corral de Piedras Creek and alluvium of other smaller tributaries, in the southeastern portion of the Basin.

DWR (Department of Water Resources, 1958) published a series of maps depicting groundwater elevation maps for the various parts of its study area, including groundwater elevations in the Basin for Fall 1954. This map displays dominant groundwater flow direction from higher elevations in the Edna Valley (over 280 feet relative to mean sea level [msl]) to lower elevations (less than 110 feet msl) where San Luis Obispo Creek exits the Basin (GSI Water Solutions, Inc., 2018).

Boyle (Boyle Engineering Corp., 1991) presents water level elevation contour maps for the spring of 1986 and 1990. Contours for spring of 1990 display a pattern of groundwater flow in the Basin very similar to that exhibited in the DWR map. Contours for the spring of 1986 are not presented in this report, but 1986 represents wetter conditions than the 1990 map, and it is noted in Boyle (Boyle Engineering Corp., 1991) that there is a difference of approximately 10 feet of elevation between the two maps, representing the variation in water levels that may be observed between wet and dry weather cycles (GSI Water Solutions, Inc., 2018).

In its draft report, DWR (Department of Water Resources , 1997) used a computer groundwater model developed for its study to generate a series of modeled water level maps representing wet, dry, and average conditions. The model results are not re-presented in this Study, but the maps display the same general flow patterns as the DWR (Department of Water Resources, 1958) and Boyle (Boyle Engineering Corp., 1991) maps based on field data. Water level elevations in what DWR defines as the San Luis sub-basin in wet years were approximately 10 to 20 feet higher than in dry years. In what DWR defines as the Edna sub-basin, the difference in groundwater elevations between wet and dry years was approximately 20 to 30 feet.

Recent groundwater level data collected as a part of the District's voluntary monitoring network were obtained and used to generate a water table map to evaluate more recent conditions. Figure 2-6 presents the contours generated from the data for the October 2019 monitoring event. Because there are no significant or extensive aquitards separating the Alluvium, Paso Robles Formation, and Pismo Formation, the water level maps assume that all three formations function as a single hydrogeologic unit. This map confirms the previously estimated primary direction of groundwater flow from the Edna Valley to the San Luis Valley, but several new features are apparent. First, a pronounced mound is evident at the location where Corral de Piedras Creek enters the Basin in Edna Valley, near the corner of Biddle Ranch Road and Orcutt Road. This indicates that this is a groundwater recharge area, and that the recent rains of 2016-2017 have elevated water levels in this area. Secondly, a depression in the water table surface is evident in the area near Edna Road and Biddle Ranch Road, likely due to agricultural pumping in the area in recent years. The southeast and northwest extents of the Basin had no wells monitored during this event to calculate water levels in these areas.

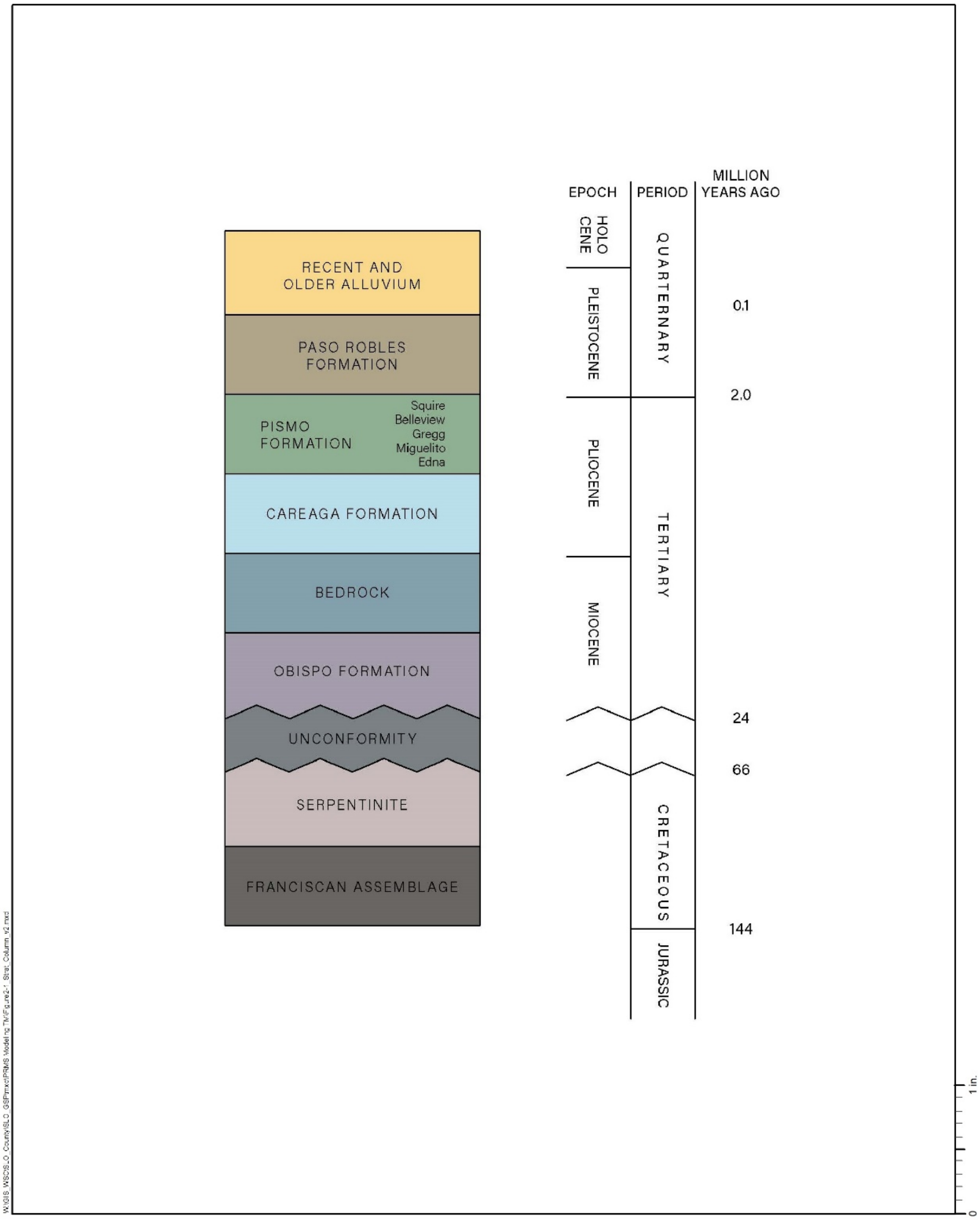
The San Luis Valley and the Edna Valley are characterized by different patterns of groundwater use. In the San Luis Valley, groundwater use has been dominated by municipal and industrial use. In the Edna Valley, groundwater use is dominated by agricultural use. During the past 20 to 25 years, vineyards have supplanted other crop types as the dominant agricultural use. Available water level data were reviewed, and data from wells with the longest period of record are presented here.

Figure 2-7 presents long-term groundwater elevation hydrographs for ten wells throughout the Basin. Three main patterns of water level change are evident in these hydrographs. The hydrographs for the wells in the San Luis Valley indicate that water levels in these wells, although somewhat variable in response to seasonal weather and water use fluctuations and longer-term drought cycles, are essentially stable. There are no long-term trends indicating steadily declining water levels in this area. By contrast, several wells in the Edna Valley display steadily declining water levels during the past 20 to 25 years.

Two wells in close proximity to the groundwater recharge area in Edna Valley where Corral de Piedras Creek enters the Basin display much greater volatility in response to drought cycle fluctuations than the wells in San Luis Valley but appear to rebound to pre-drought levels when the drought cycle ends; water levels in these wells do not display a long-term decline of water levels.

2.4.7. Hydraulic Properties

During the preparation of the Basin Characterization Report (GSI, 2018), all available data on constant rate aquifer tests and specific capacity tests in the Basin were collected, reviewed, and presented in the report. Seventy-seven well locations in the Basin were identified that had an estimate of aquifer hydraulic parameters, indicating reasonable data density in the Basin. Wells screened in the Alluvium and Paso Robles Formation have reported transmissivities ranging from about 5,000 to 158,000 gallons per day per foot (gpd/ft), and averaging over 42,000 gpd/ft. Wells screened in Paso Robles and Pismo Formations have transmissivities ranging from less than 1,000 to about 40,000 gpd/ft, and average about 10,000 gpd/ft. These data are presented in a summary table in Chapter 4 of the GSP.



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Author: EC
Date: 1/13/2020

Notes:
1.
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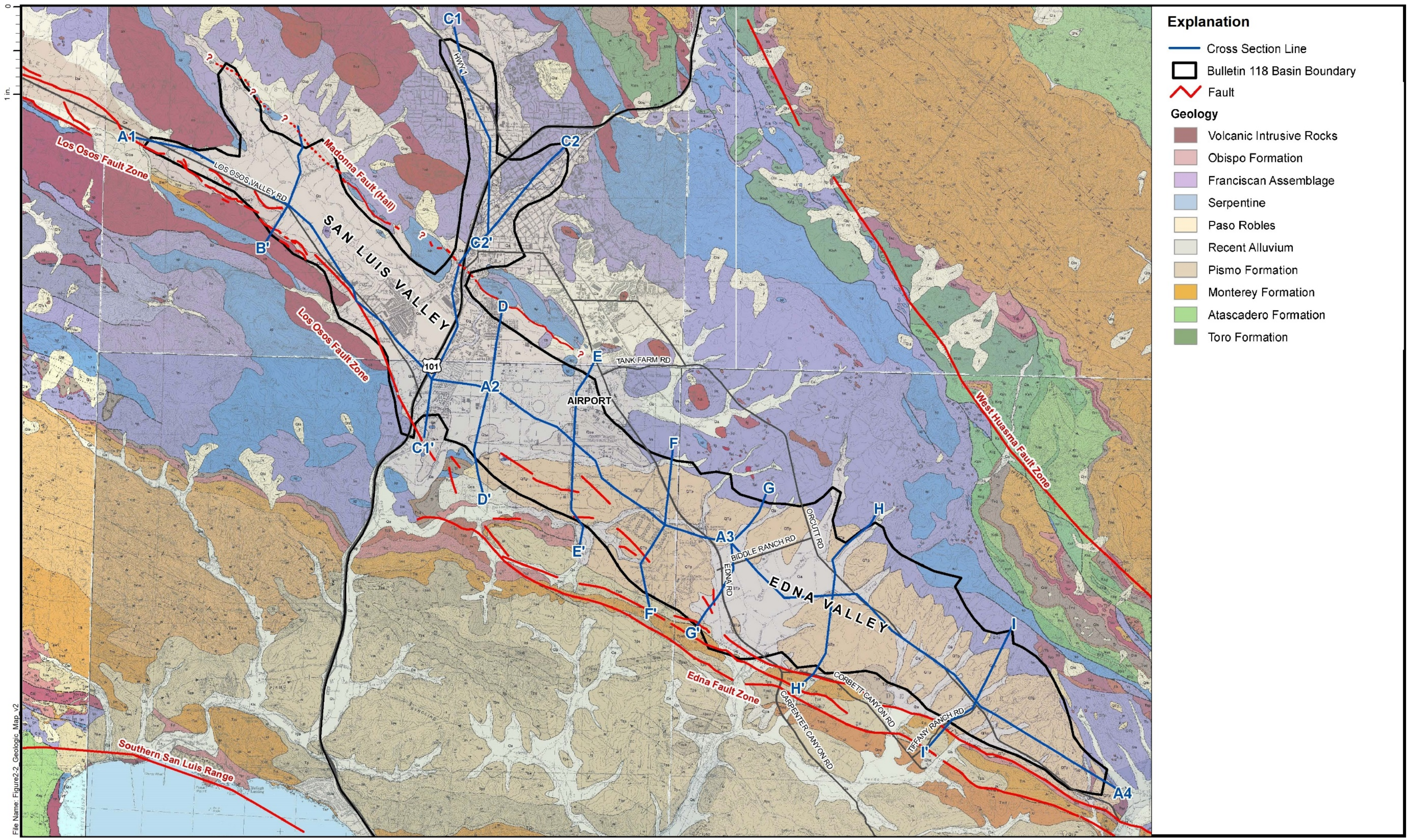
Local Geologic Stratigraphic Column

Figure 2-1



Prepared for:

Author: EC
Date: 1/13/2020

SAN LUIS OBISPO VALLEY BASIN GSP

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1 in : 1.5 mi
0 0.5 1 2 Mi
0 0.75 1.5 3 Km

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
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Notes:
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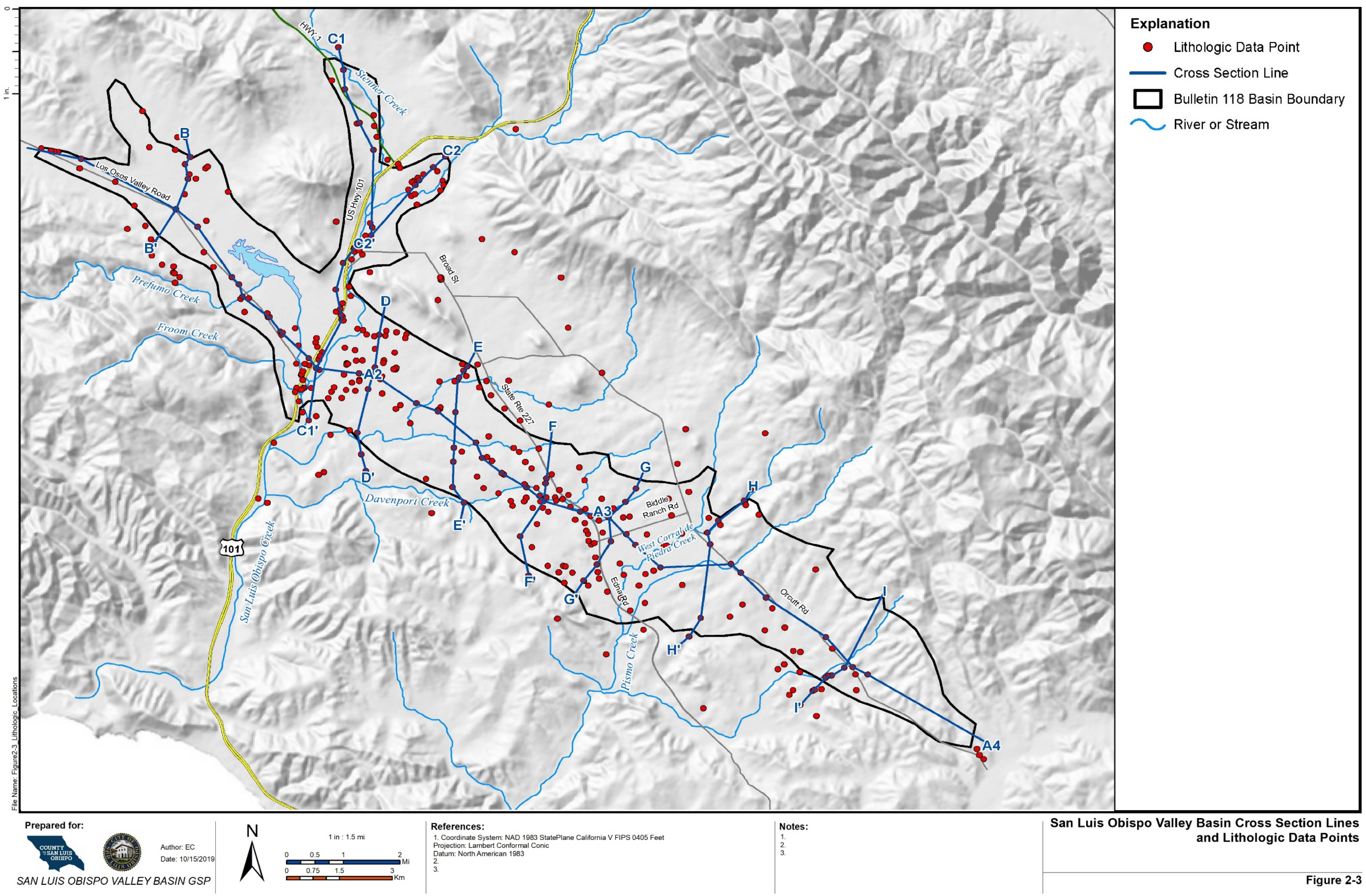
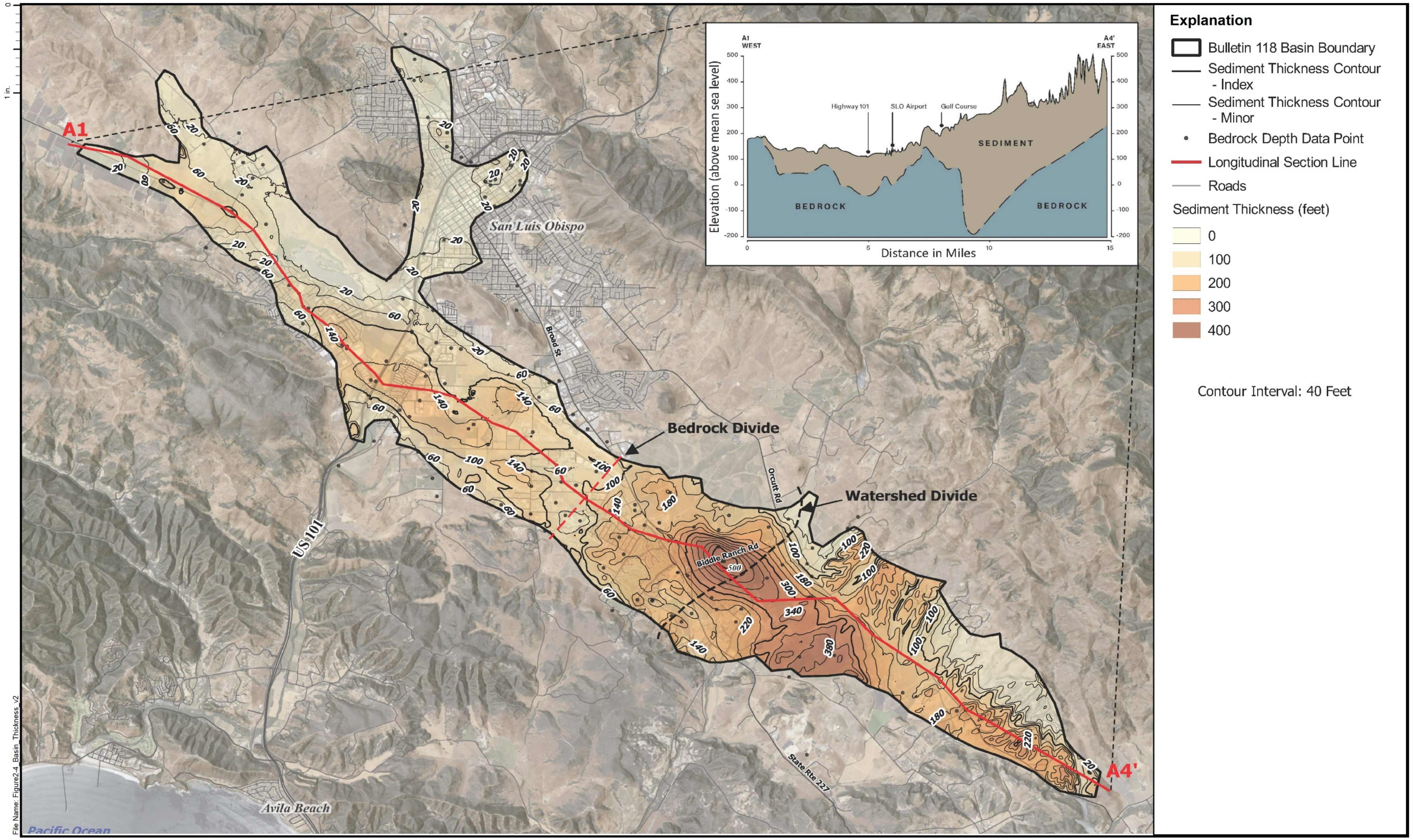
San Luis Obispo Valley Basin Geologic Map

Figure 2-2



San Luis Obispo Valley Basin Cross Section Lines and Lithologic Data Points

Figure 2-3



Prepared for:

SAN LUIS OBISPO VALLEY BASIN GSP

Author: EC
Date: 1/13/2020

1 in : 1.5 mi

References:
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Projection: Lambert Conformal Conic
Datum: North American 1983
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Notes:
1. Vertical Exaggeration = 57x for inset cross section
2.
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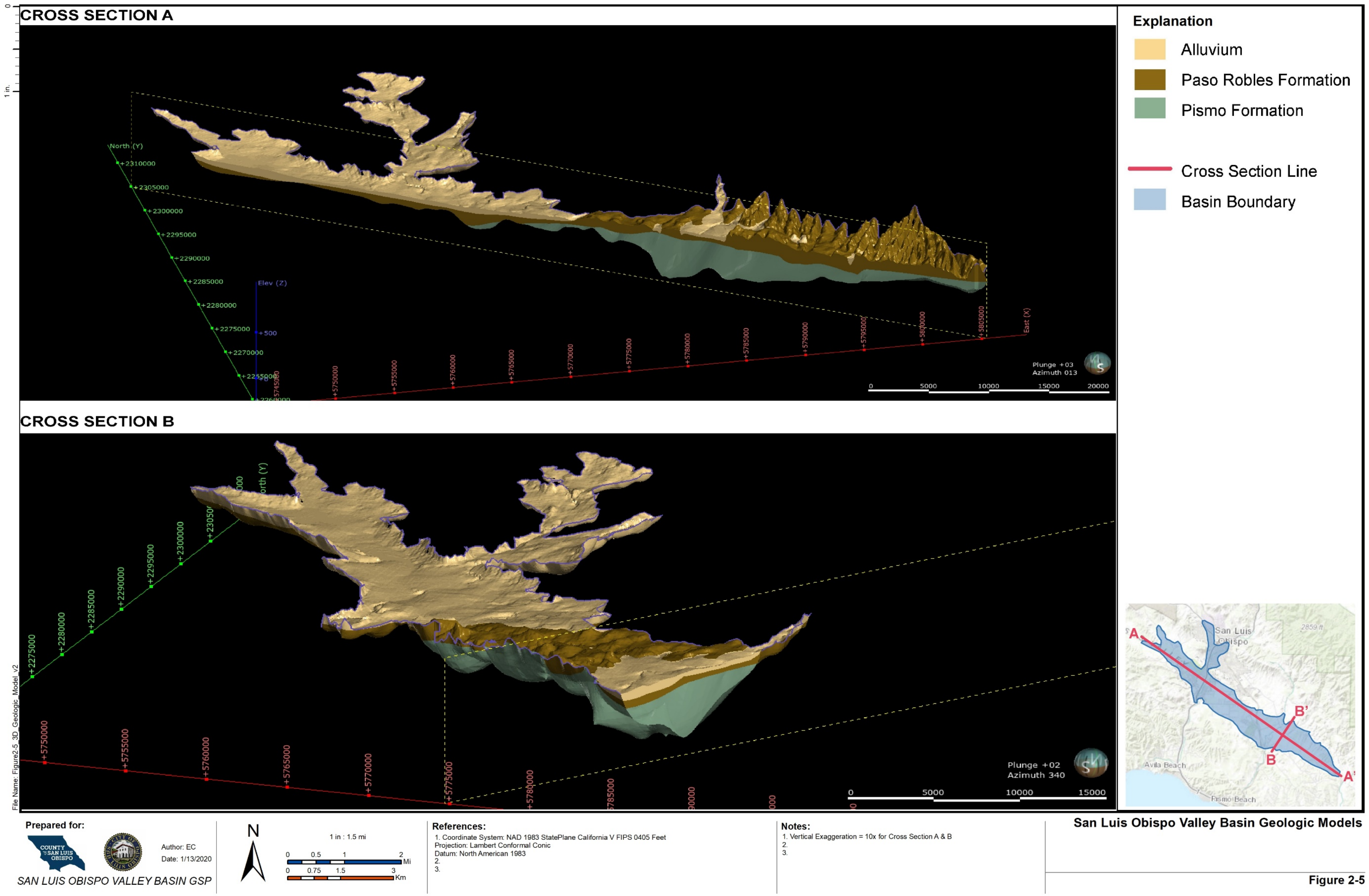
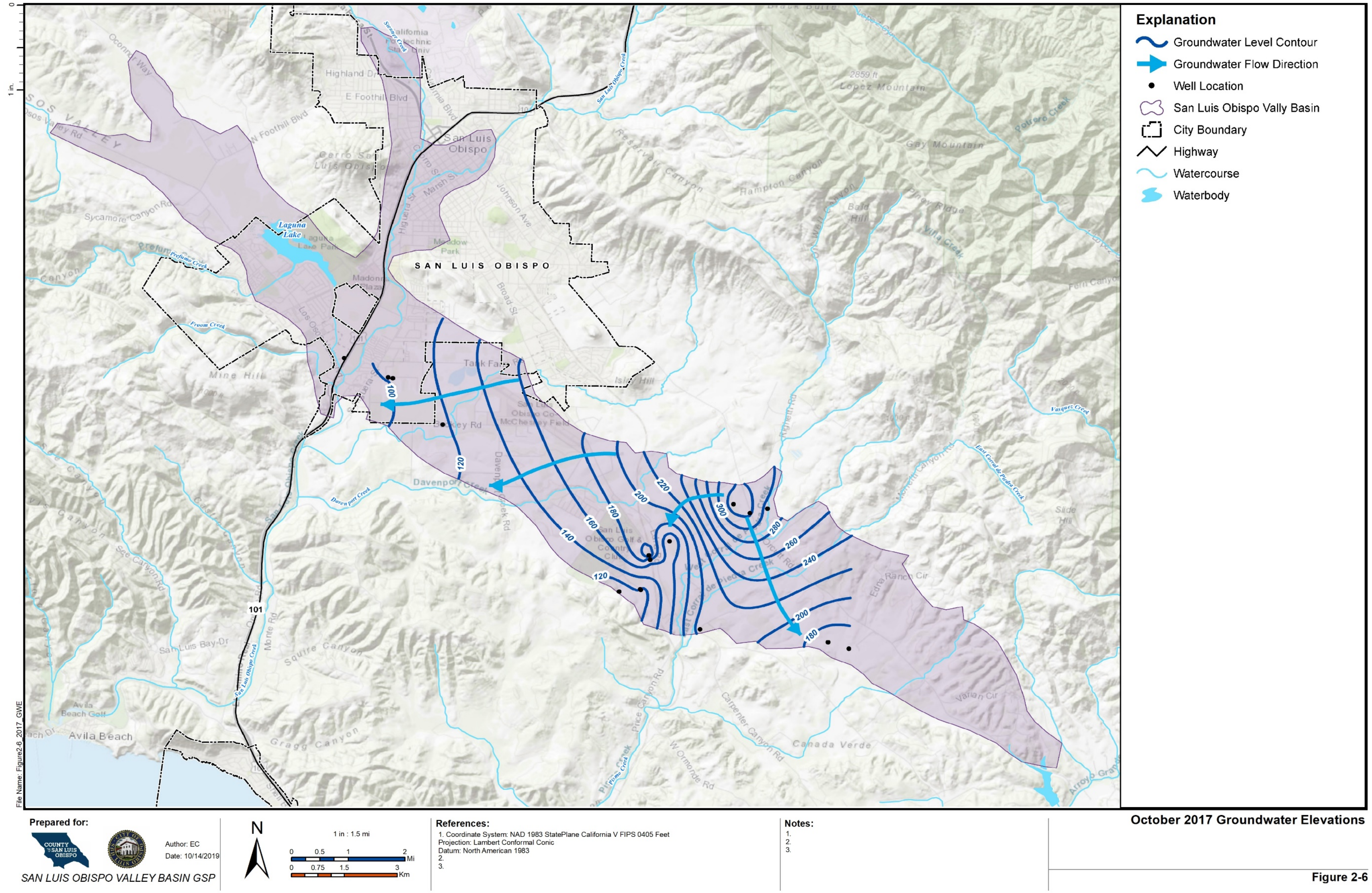
San Luis Obispo Valley Basin Sediment Thickness

Figure 2-4



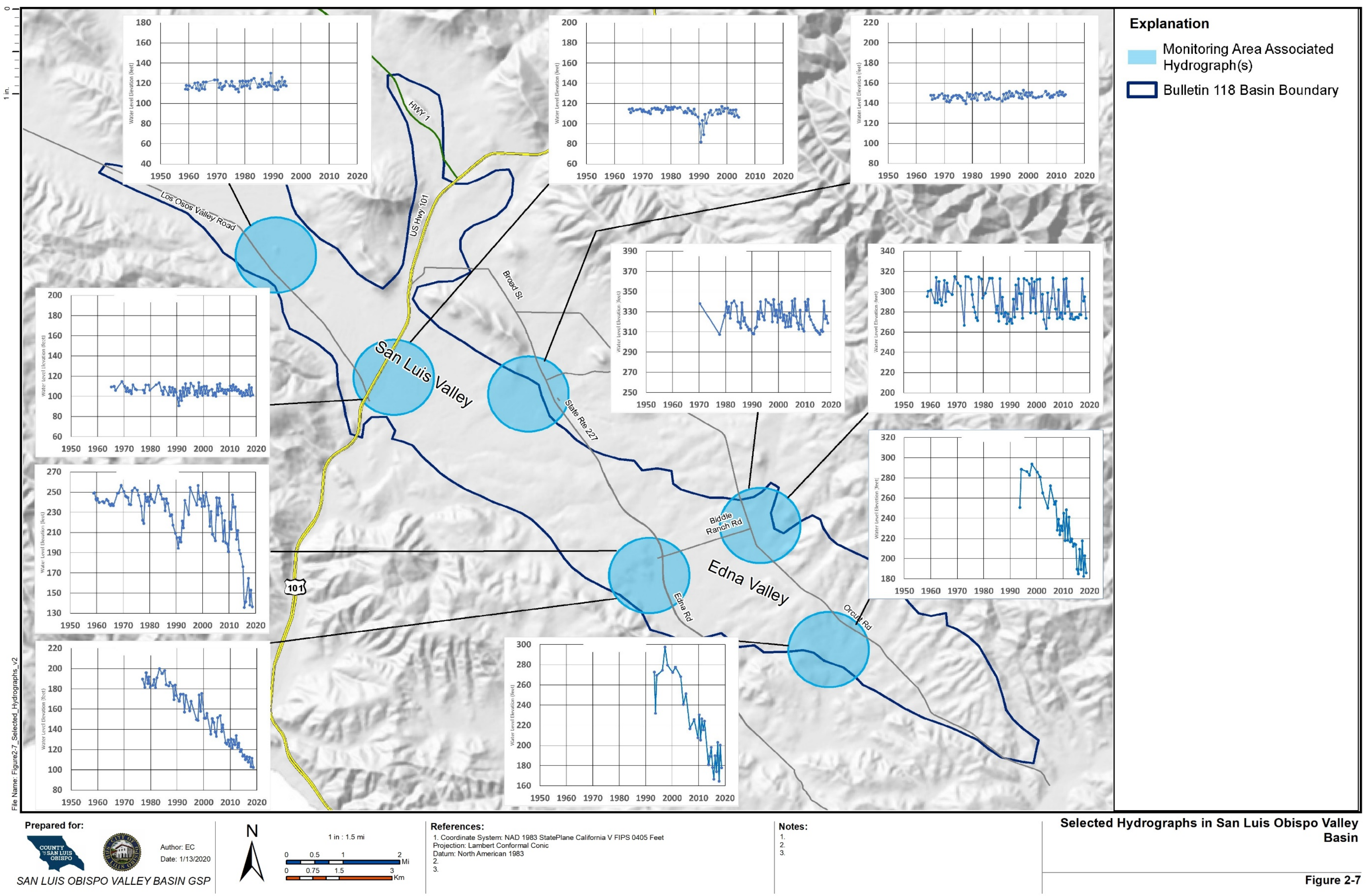
San Luis Obispo Valley Basin Geologic Models

Figure 2-5



October 2017 Groundwater Elevations

Figure 2-6



Selected Hydrographs in San Luis Obispo Valley Basin

Figure 2-7

Section 3. Modeling Approach

The GSA expressed a preference for an integrated surface water-groundwater model to be used to support the GSP, rather than a traditional groundwater model limited to the extents of the Basin. An integrated model simulates surface water processes in the contributing watershed as well as groundwater flow within the basin and incorporates results of the surface water simulation as input into the groundwater flow model. There are numerous approaches and available modeling codes capable of achieving this objective. GSI and WSC evaluated four options for development of an integrated numerical model and documented the results in a TM prepared for GSA staff (GSI Water Solutions, Inc., 2019), and presented the results to the GSC in a public meeting. The four options considered were:

- MODFLOW + HSPF (coupled model)
- MODFLOW-One Water (OWHM)
- IWFM – DWR Integrated Flow Model
- GSFLOW

For reasons documented in the supporting TM (GSI Water Solutions, Inc., 2019), the decision was made to use GSFLOW as a platform for the integrated model.

GSFLOW is a fully integrated watershed-groundwater model (Markstrom et al., 2008) that has been used throughout the United States by the USGS and other hydrologic professionals to model surface water and groundwater conditions in various geologic settings. GSFLOW is a coupled groundwater and watershed flow model based on integration of the USGS watershed model PRMS and groundwater model MODFLOW. The PRMS and MODFLOW models can be developed separately, with initial parameter estimation performed in the two models separately, before integrating the two component models. Then the integrated model is calibrated and run using GSFLOW to complete the model development process.

GSFLOW was developed to simulate coupled groundwater – surface water flow in one or more watersheds by simultaneously simulating flow across the land surface, within subsurface saturated and unsaturated materials, and within streams and lakes (Markstrom et al., 2008). GSFLOW uses physically based processes and empirical methods with user inputs of air temperature and precipitation (i.e., snow/rain) to simulate the distribution of precipitation into runoff, evapotranspiration, infiltration, groundwater flow, and surface-water flow.

Details of the modeling approach for PRMS and MODFLOW are presented in the following sections.

Section 4. PRMS: Surface Water-Component Model

The modeling software that will be used to simulate the watershed-scale surface water component of the integrated model is PRMS version 5.0.0. PRMS is a deterministic, distributed-parameter, physical-process hydrologic model used to simulate and evaluate the watershed response of various combinations of climate and land use (Markstrom, et al., PRMS-IV, the Precipitation-Runoff Modeling System, Version 4, 2015).

In the PRMS model, climate data, including precipitation and temperature, are applied to simulate hydrologic water budgets based on spatially defined watershed-component model parameters such as plant canopy and soil zone properties. Surface and subsurface flow is calculated through the cascading of rain-generated runoff. When run in PRMS-only simulations, runoff that infiltrates into the soil zone is distributed to the subsurface reservoir and groundwater reservoir where it can interflow to streams or lakes. When run in a coupled GSFLOW simulation, groundwater flow routing is simulated in MODFLOW rather than PRMS. Initial parameter estimation of the PRMS model will be performed in PRMS-only mode prior to integration into GSFLOW and final calibration of the integrated model.

4.1. Model Discretization

Model discretization is performed using Gsflow-Arcpy (Gardner, Morton, Huntington, Niswonger, & Henson, 2018), a toolkit of ArcGIS Python codes. Gsflow-Arcpy consists of a series of python scripts that, when run in succession, produce model-ready PRMS parameter files and a parameter shapefile for visual representation of all inputs.

Prior to performing the model discretization, the watershed boundary, or model domain, for PRMS and GSLFOW was delineated. The model domain was defined by all land area that drains surface runoff into the San Luis Obispo Valley Groundwater Basin. The two primary watersheds that make up this area are the San Luis Obispo Creek and Pismo Creek watersheds. The two pre-delineated watersheds were trimmed at the south-west boundary of the Basin. A topographic analysis was then performed along the south-west boundary to capture all sub-watersheds that drain to the Basin, including the Prefumo Creek and Froom Creek sub-watersheds. Figure 4-1 presents the PRMS model domain.

4.1.1. Hydrologic Response Unit Discretization

The first step in preparation of the PRMS model is the spatial discretization of the watershed into individual hydrologic response units (HRU). This is performed to allow for spatial variability in model inputs (elevation, slope, vegetation type, etc.) and reporting of the simulation results, as a water balance and energy balance are computed at each timestep at each HRU. A grid-based approach, which entails the delineation of the watershed into square grid-cell HRUs, was selected for both the PRMS and MODFLOW models. Various grid cell sizes were evaluated, ranging from 250-foot (ft) to 1,000-ft. Sample grids at differing cell sizes were overlaid onto aerials and base maps to evaluate grid cell density. GSI and WSC performed a brief literature review to assess what grid cell size has been used in comparison to the entire modeled area for other GSFLOW modeling studies documented in the state. The ratios of cell size to watershed size were assessed in comparison to other GSFLOW models, including the Santa Rosa Plain Model (Woolfenden & Nishikawa, 2014) and the Santa Cruz Mid-County Basin Model prepared by HydroMetrics Water Resources, Inc. (Huntington, King, & Tana, 2016). This comparison indicated that 500-foot grid cells for the model yielded a grid cell to model area ratio within the bounds of those from other documented GSFLOW modeling studies. Therefore, a uniform grid cell size of 500 ft x 500 ft, totaling 21,462 cells, was adopted for the initial model development.

The delineation of the watershed into HRUs for the PRMS model was performed using the Gsflow-Arcpy toolkit. Limitations of the ArcInfo grid format is that it will only perform raster-based calculations on vertical-horizontal oriented grid cells (Environmental Systems Research Institute (ESRI), 2013). Additionally, GSFLOW requires that the grid cells in PRMS output files match those in the MODFLOW files or if the PRMS and MODFLOW grid cells orientation and total model extents differ, HRU's assigned in PRMS and their associated gravity reservoirs are reassigned proportionally to each MODFLOW grid cell. To resolve this limitation, the vertical oriented PRMS grid and its populated input data fields will be used for PRMS calibration. Once PRMS and MODFLOW have been initially run separately, PRMS HRU's and their associated gravity reservoirs will be reassigned to the MODFLOW grid. This combined grid will create the final grid to be used for GSFLOW calibration and multiple model runs assessing various scenarios. This approach will maintain the integrity of the developed PRMS input files and allows for simplified integration between PRMS and MODFLOW into GSFLOW that does not require custom code integration and use of additional data files.

Once the HRU grid cells are generated, the next step in the discretization is the designation of cells as one of four types: land, lake, swale, or inactive. Two water bodies within the watershed, Laguna Lake and the Righetti Reservoir, were designated in the model input. Swales, which represent a sink without an outlet, were not identified within the watershed and therefore were excluded from the designation in the model input. Inactive cells represent those outside the watershed boundary that are not included in the model simulation.

The last step to the HRU discretization is the designation of sub-basins. Sub-basins were delineated based on the locations of the various stream gages (see Section 4.2.2), the outlet of Righetti Reservoir, and the model outlet points. Figure 4-1 presents the results of HRU discretization and Figure 4-2 presents the locations of model sub-basin points and model outlet points.

4.1.2. Stream Segments

Another spatial unit that is defined as part of the model discretization is the delineation of stream segments throughout the watershed. In PRMS, lateral flows, inflow and outflow are calculated at each stream segment. Delineation of the stream segments began with first assigning mean surface elevations to each HRU grid cell within the watershed using a 10-meter resolution digital elevation model (DEM) from the National Elevation Dataset (National Elevation Dataset, 2019). The mean elevations are then used by the Gsflow-Arcpy script to designate the stream segments locations by creating continuously down-sloping HRUs. Generated stream segments were viewed in comparison to USGS National Hydrography Dataset (NHD) streams in ArcMap (National Hydrography Dataset, 2002 - 2016) and recent satellite imagery from Google Earth to evaluate the accuracy of the stream delineation. Stream segment alignments were iteratively adjusted by manually altering the mean elevation of HRUs and rerunning the Gsflow-Arcpy script. The level of detail with regards to stream order was optimized to be representative of the main branches and the primary tributaries. Figure 4-3 presents the stream segments generated for the PRMS model.

4.2. Model Inputs and Calibration Data

Like the model discretization, Gsflow-Arcpy (Gardner, Morton, Huntington, Niswonger, & Henson, 2018) was used to assign input parameters to the HRUs such that they are formatted and structured for direct use by the PRMS model software.

4.2.1. Climate Input

PRMS requires a variety of climatic data for use throughout the various stages of modeling, including pre-processing of input data (mean monthly precipitation, maximum temperature, and minimum temperature), simulation runs (daily precipitation, maximum temperature, and minimum temperature), and calibration (solar radiation and evapotranspiration). Climatic data, dating back to 1870, was obtained from the Cal Poly Weather Station through the help of the Irrigation Training & Research Center (ITRC). The Cal Poly Weather Station houses not only the ITRC owned gages but also the California Irrigation Management Information System (CIMIS) and National Oceanic and Atmospheric Administration (NOAA) weather stations. While there are other County and privately-owned climate stations throughout the watershed, the Cal Poly Weather Station is the only station that has extensive records spanning the duration of the anticipated calibration period. Furthermore, the ITRC has performed thorough quality control reviews on the data collected from the Cal Poly Weather Station.

As part of the pre-processing and generation of input data, mean monthly precipitation was spatially distributed to each HRU within the model domain using 30-year normal baseline datasets, spanning from 1981 to 2010, from the Parameter-Regression on Independent Slopes Model (PRISM) (NACSE, 2019). Monthly precipitation scaling factors, that act as multipliers to account for changes in elevation, were then calculated for each HRU based on a ratio between the PRISM data and 1870-2018 mean monthly observed precipitation data from the Cal Poly Weather Station. Figure 4-4 and Figure 4-5 show the mean annual precipitation PRISM dataset and mean annual precipitation scaling factors derived from the PRISM and the Cal Poly Weather Station datasets. During PRMS simulations, the HRU precipitation scaling factors will be multiplied by the daily precipitation measurements from the Cal Poly Weather Station to calculate daily precipitation at each HRU. This will be performed using the precip_1sta module, as discussed further in Section 4.3. The accuracy of the precipitation scaling factors will be assessed by comparing the measured precipitation at the three County rain gages (SLO Portal, SLO Reservoir, and The Gas Company) to the modeled rainfall at each respective HRU.

Mean monthly minimum and maximum temperature values were assigned to each HRU using the 30-year normal PRISM dataset, as done with precipitation. Daily minimum and maximum temperature will be calculated at each HRU during PRMS simulations using daily observed maximum and minimum temperature data from the Cal Poly Weather Station and monthly PRISM data assigned to each HRU. PRMS simulations will use the temp_sta module to perform temperature calculations, as discussed further in Section 4.3. The accuracy of the modeled temperature will be assessed by comparing the modeled minimum and maximum temperatures to the measured values at the two nearby weather stations (PG&E Black Butte and SLO County Farm Bureau) with data available on Weather Element (Weather Element, 2014).

4.2.2. Streamflow Data

The County of San Luis Obispo owns and operates five real-time data monitoring stream gages along San Luis Obispo Creek, within the model domain. Each gage station records creek stage (depth) on fifteen-minute intervals. Available stage data at each station dates to 2005. Of the five County stream gages, three have stage-discharge relationships, or rating curves, that were approximated by Central Coast Salmon Enhancement (CCSE) based on recorded stage data and measured flows between 2017 and 2019. These stream gages include the Andrews Street Bridge, Stenner Creek at Nipomo, and Elks Lane (Figure 1-1). The rating curves generated for these gauge stations are considered the best available information for use in converting stage data to flow rate, and therefore are anticipated to be the primary datasets for use in calibrating the PRMS model. As previously mentioned, Questa Engineering Corps also estimated theoretical rating curves for each of the five County gages using a HEC-RAS model (Questa Engineering Corp., 2007). However, preliminary application of these rating curves to the stream gage data resulted in abnormal daily mean hydrographs in comparison to the hydrographs generated using the CCSE rating curves. The Questa rating curves may be used as a secondary dataset for comparison of modeled to observed flows at the Jesperesen and Madonna Road gage stations, where no CCSE rating curves exist.

In addition to the County owned gages, the City of San Luis Obispo collects weekly measurements of stage and flow within San Luis Obispo Creek at the outfall of the Water Resources Recovery Facility (WRRF) during the months of April to September as part of the National Pollutant Discharge Elimination System (NPDES) permitting program. It is not anticipated that this data will be used for calibration purposes given the apparent daily and monthly data gaps.

Lastly, monthly diversion data, dating back to 2010, is available for the 500-acre-foot Righetti Reservoir located along West Corral De Piedra Creek. A sub-basin, or sub-watershed, was designated at this reservoir in the model so that simulated flows can potentially be calibrated to observed monthly data. The efficacy of calibration at this location will be dependent on the capabilities of the PRMS routing modules and the limited information available on the day-to-day operations of the reservoir. At the very least, the Righetti Reservoir diversion data may be used to incorporate future diversion flows into modeling scenarios.

4.2.3. Additional Parameters

Vegetation, soil, and impervious land cover surfaces play important roles in routing and distributing runoff throughout PRMS. Vegetation is used by relating vegetation type to root depth and evapotranspiration to model water balances within the soil zone, and vegetation's various roles in runoff processes. Vegetation data was retrieved from the LANDFIRE datasets available through the United States Department of Agriculture, Forest Service (LANDFIRE, 2019). The vegetation parameters are calculated and populated before the soil parameters in order to establish root depths for each vegetation type. Soil data from SSURGO and STATSGO (Soil Survey Staff, 2019) are used to extract available water content (AWC), saturated hydraulic conductivity (Ksat), soil type, and percentages of sand, silt, and clay values throughout the watershed. These values are then assigned to various soil parameters used in PRMS to model flux's between vegetation and the soil-root zone. Impervious land cover surfaces are used to model surface runoff in areas that have no infiltration or in areas with different infiltration rates then can be expected from certain vegetated areas or soil types. The National Land Cover Database (Homer, Fry, & Barnes, 2012) data is used to derive these areas within each HRU grid cell represented as percentages. Figure 4-6 shows the National Land Cover Database data showing land cover types in the Basin derived from the impervious Arcpy script.

4.3. PRMS Modules

PRMS simulates the hydrologic cycle through various processes, each with one or more modules available for use. Table 4-1 presents the modules that have been selected for use in this model.

Table 4-1. PRMS Modules to Be Used

Module Name	Process	Description[1]
basin	Basin Definition	Defines shared watershed wide and HRU physical parameters and variables.
cascade	Cascading Flow	Determines computational order of the HRUs and groundwater reservoirs for routing flow downslope.
soltab	Solar Table	Computes potential solar radiation and sunlight hours for each HRU for each day of the year.
obs	Time Series Data	Reads and stores observed data from all specified measurement stations.
temp_sta	Temperature Distribution	Distributes maximum and minimum temperatures to each HRU by using temperature data measured at one station.
precip_1sta	Precipitation Distribution	Determines the form of precipitation and distributes it from one or more station to each HRU by using monthly correction factors to account for differences in altitude, spatial variation, topography, topography, and measurement gage efficiency.
ddsolrad	Solar Radiation Distribution	Distributes solar radiation to each HRU and estimates missing solar radiation data using a maximum temperature per degree-day relation.
transp_tindex	Transpiration Period	Determines whether the current time step is in a period of active transpiration by the temperature index method.
potent_jh	Potential Evapotranspiration	Computes the potential evapotranspiration by using the Jensen-Haise formulation (Jensen & Haise, 1963)
intcp	Canopy Interception	Computes volume of intercepted precipitation, evaporation from intercepted precipitation, and throughfall that reaches the soil.
srunoff_smidx	Surface Runoff	Computes surface runoff and infiltration for each HRU by using a nonlinear variable-source-area method allowing for cascading flow.
soilzone	Soil-Zone	Computes inflows to and outflows from soil zone of each HRU and includes inflows from infiltration, groundwater, and upslope HRUs, and outflows to gravity drainage, interflow, and surface runoff to down-slope HRUs.
gwflow	Groundwater	Sums inflow to and outflow from PRMS groundwater reservoirs. Used in the PRMS-only model, not the integrated GSFLOW model.
strmflow	Streamflow	Computes flow in the stream network using the Muskingum routing method and flow and storage in on-channel lake using several methods. Used in the PRMS-only model, not the integrated GSFLOW model.

[1] (Markstrom, et al., PRMS-IV, the Precipitation -Runoff Modeling System, Version 4: Updated Tables from Version 4.0.3 to Version 5.0.0, 2019; Markstrom, Niswonger, Regan, Prudic, & Barlow, 2008)

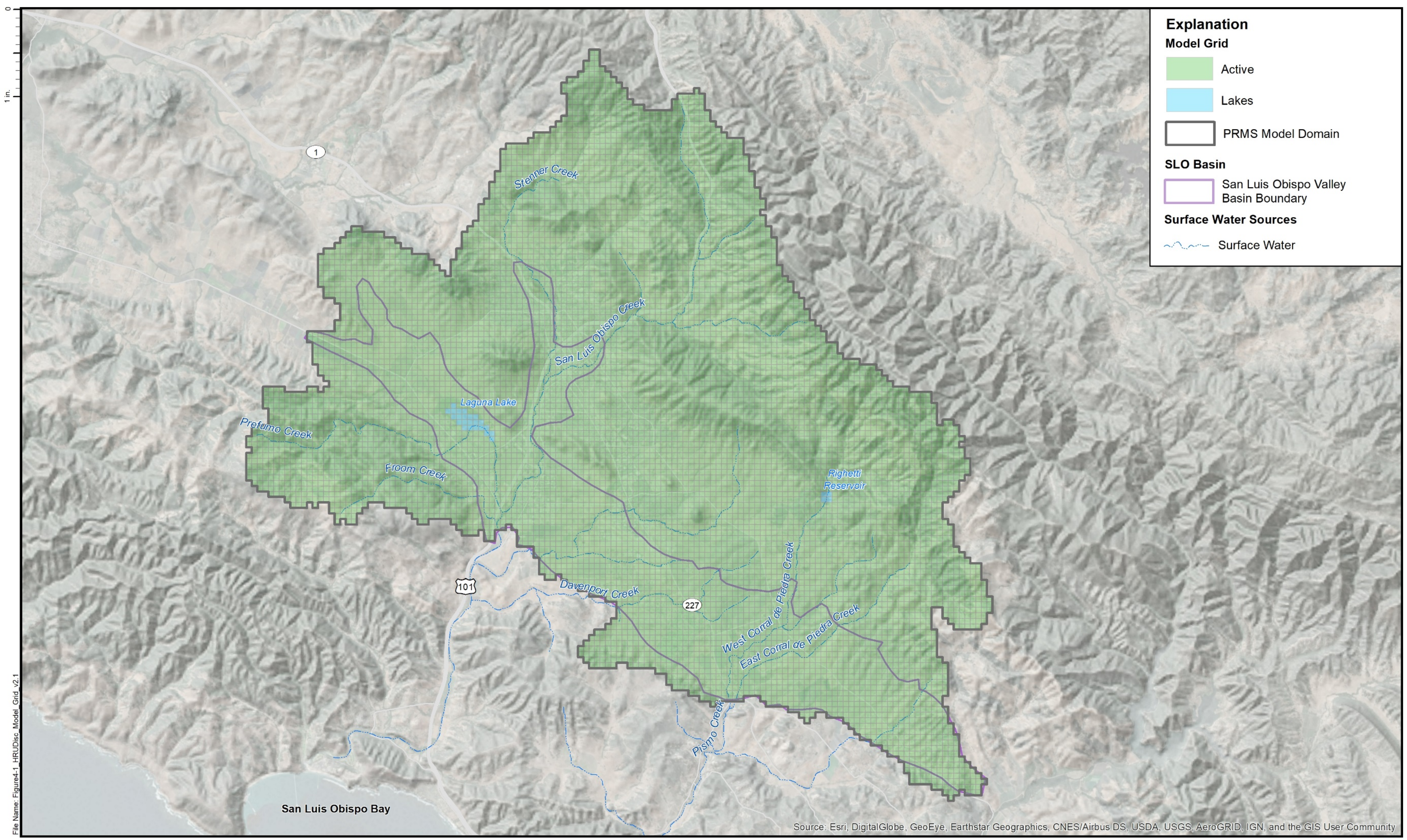
4.4. Calibration Approach

The PRMS model will be calibrated using the USGS Luca software (Hay & Umemoto, 2007) and a step-wise approach that includes the optimization of the following data sets: mean monthly solar radiation, mean monthly potential evapotranspiration, streamflow volume (annual mean, mean monthly, and monthly mean), and streamflow timing (daily and monthly mean). Simulated values and model outputs will be compared to calibration data sets generated from measured data. Data sets for solar radiation and potential evapotranspiration will be derived from measurements recorded at the Cal Poly CIMIS Weather Station 52. Calibration data sets for streamflow volume and timing will be derived from the CCSE and Questa Engineering Corps rating curves and measured stage data at the five County stream gages, as discussed in Section 4.2.2. The Madonna Road stream gage will be used for calibration of the integrated GSFLOW model but not for initial calibration of the PRMS model, as it is located downstream of Laguna Lake which will be modeled in MODFLOW using the Lake Package. The PRMS calibration simulation period will be based on the available stream gage data, which spans from July 2006 to August 2019.

Modeled and measured streamflow will be evaluated in the integrated model via comparison of daily and mean monthly hydrographs as well as using goodness-of-fit statistics. Goodness-of-fit statistics that will be considered for use include the percent-average-estimation-error (PAEE), the absolute-average-estimation-error (AAEE), and the Nash-Sutcliffe model efficiency (NSME). Table 4-2 presents the range of goodness-of-fit criteria as outlined for the Santa Rosa Plain Model (Woolfenden & Nishikawa, 2014). The optimal goal is to achieve calibration results within the “Very Good” or “Excellent” range, however, this may not be feasible at each stream gage location due to limitations associated with the accuracy of the rating curves and stream gage stage data.

Table 4-2. Goodness-of-fit Statistics

Goodness-of-fit Category	PAEE (%)	AAEE (%)	NSME
Excellent	-5 to 5	≤0.5	≥0.95
Very Good	-10 to -5 or 5 to 10	0.5 to 1.0	0.85 to 0.94
Good	-10 to -5 or 5 to 10	10 to 15	0.75 to 0.84
Fair	-10 to -5 or 5 to 10	15 to 25	0.6 to 0.74



Prepared for:

SAN LUIS OBISPO VALLEY BASIN GSP

Author: EC
Date: 12/18/2019

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1 in : 1.5 mi

References:
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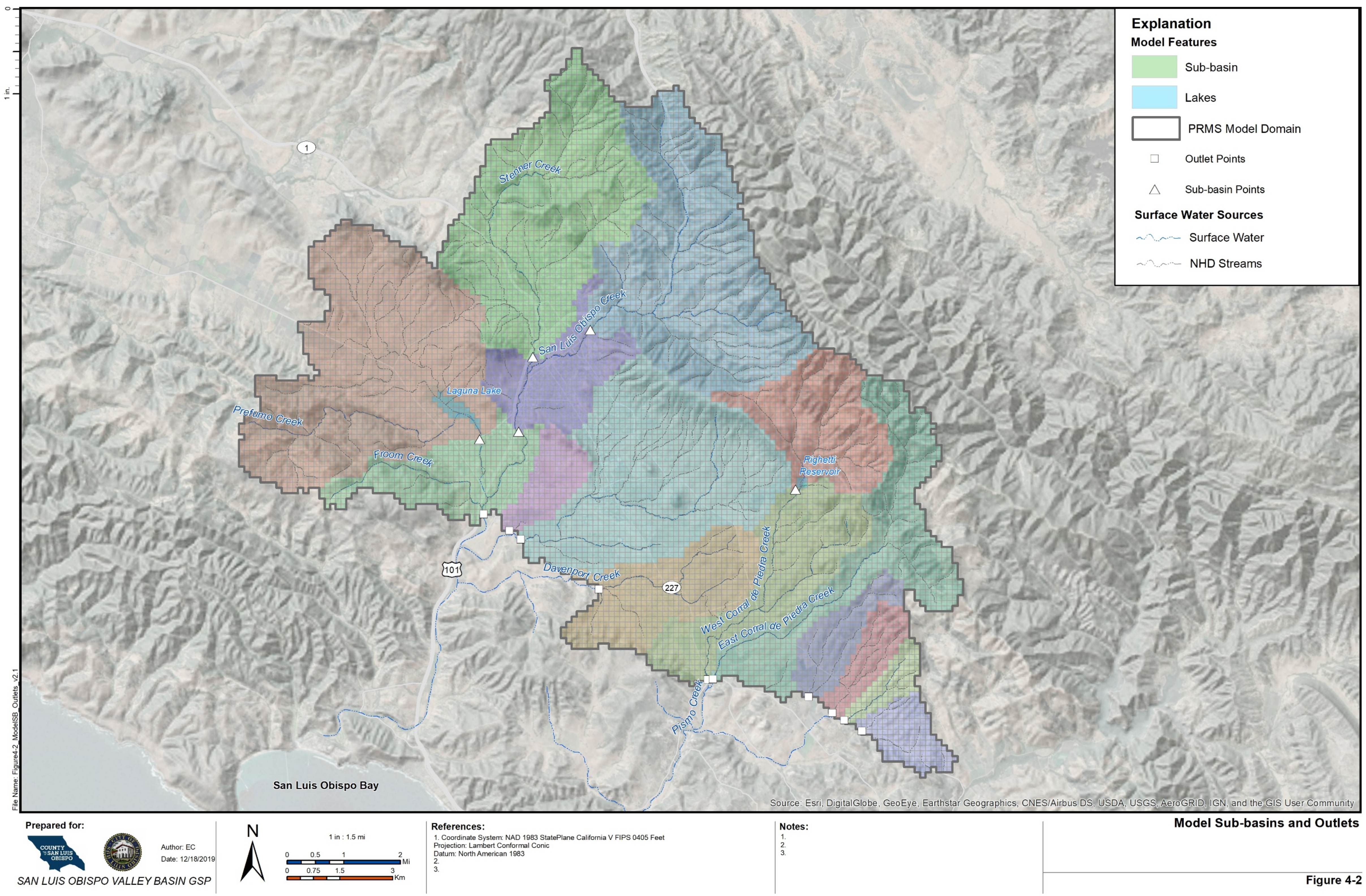
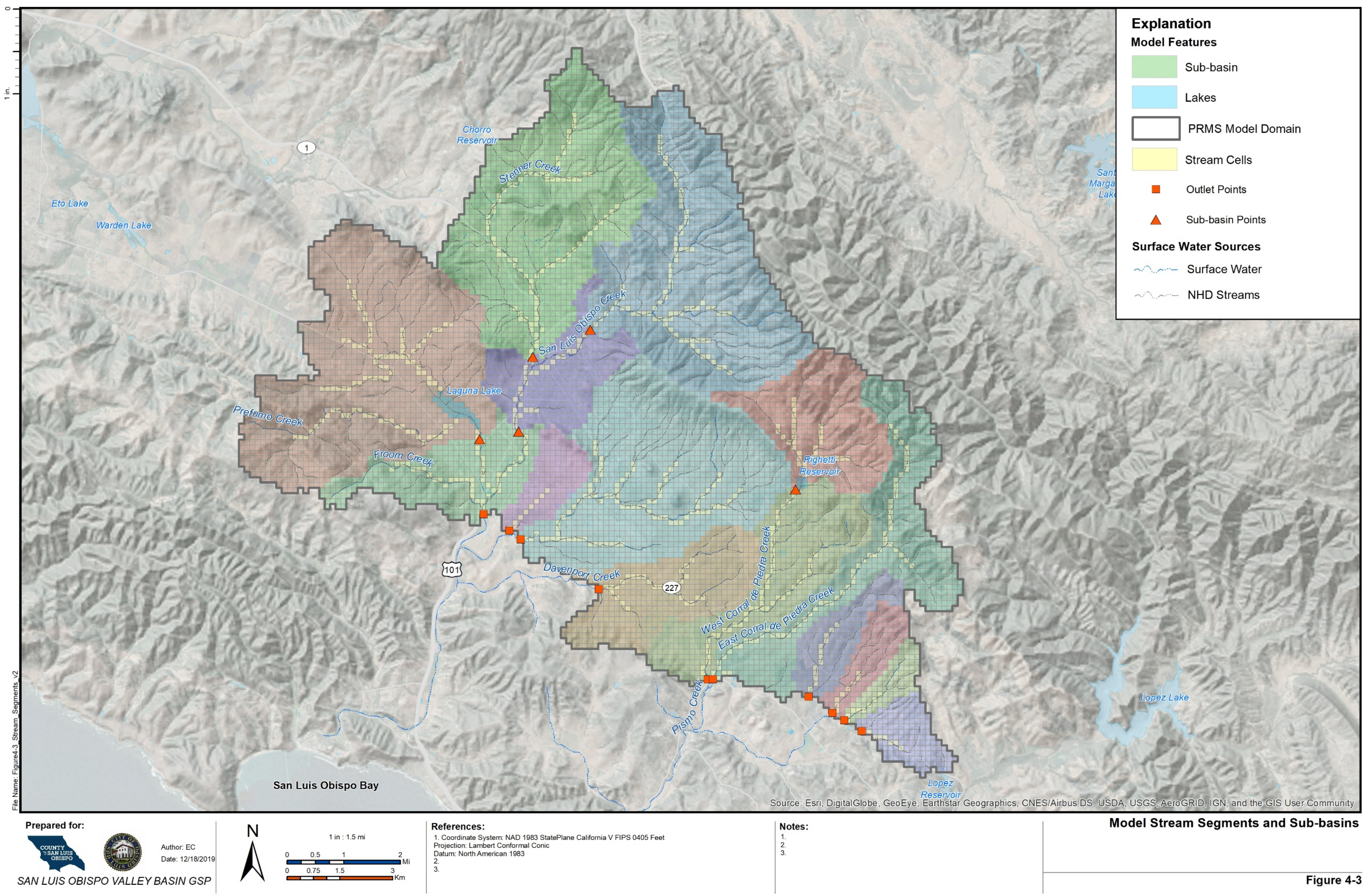
HRU Discretization of Model Grid

Figure 4-1



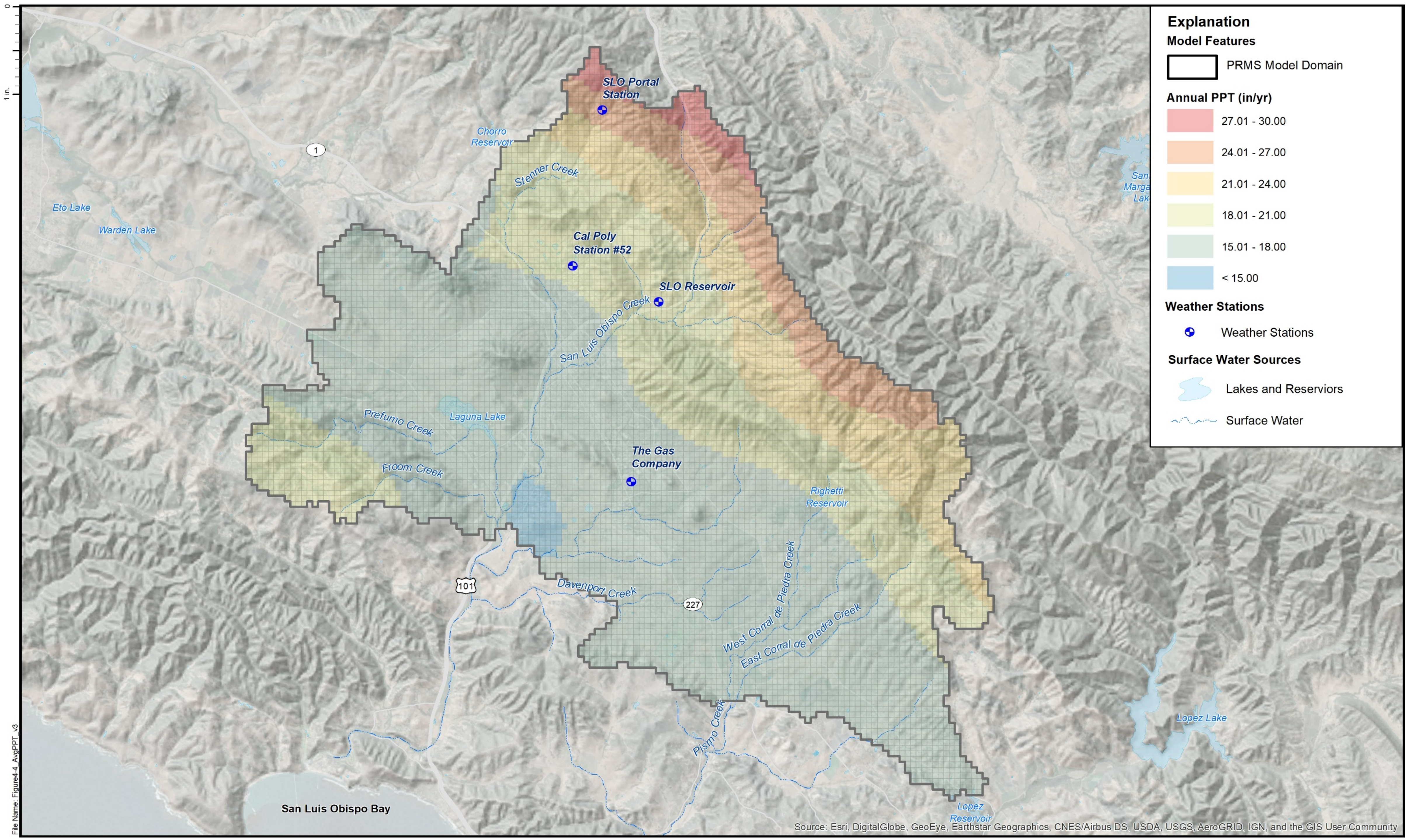
Model Sub-basins and Outlets

Figure 4-2



Model Stream Segments and Sub-basins

Figure 4-3



Prepared for:

SAN LUIS OBISPO VALLEY BASIN GSP

Author: EC
Date: 12/18/2019

1 in : 1.5 mi

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
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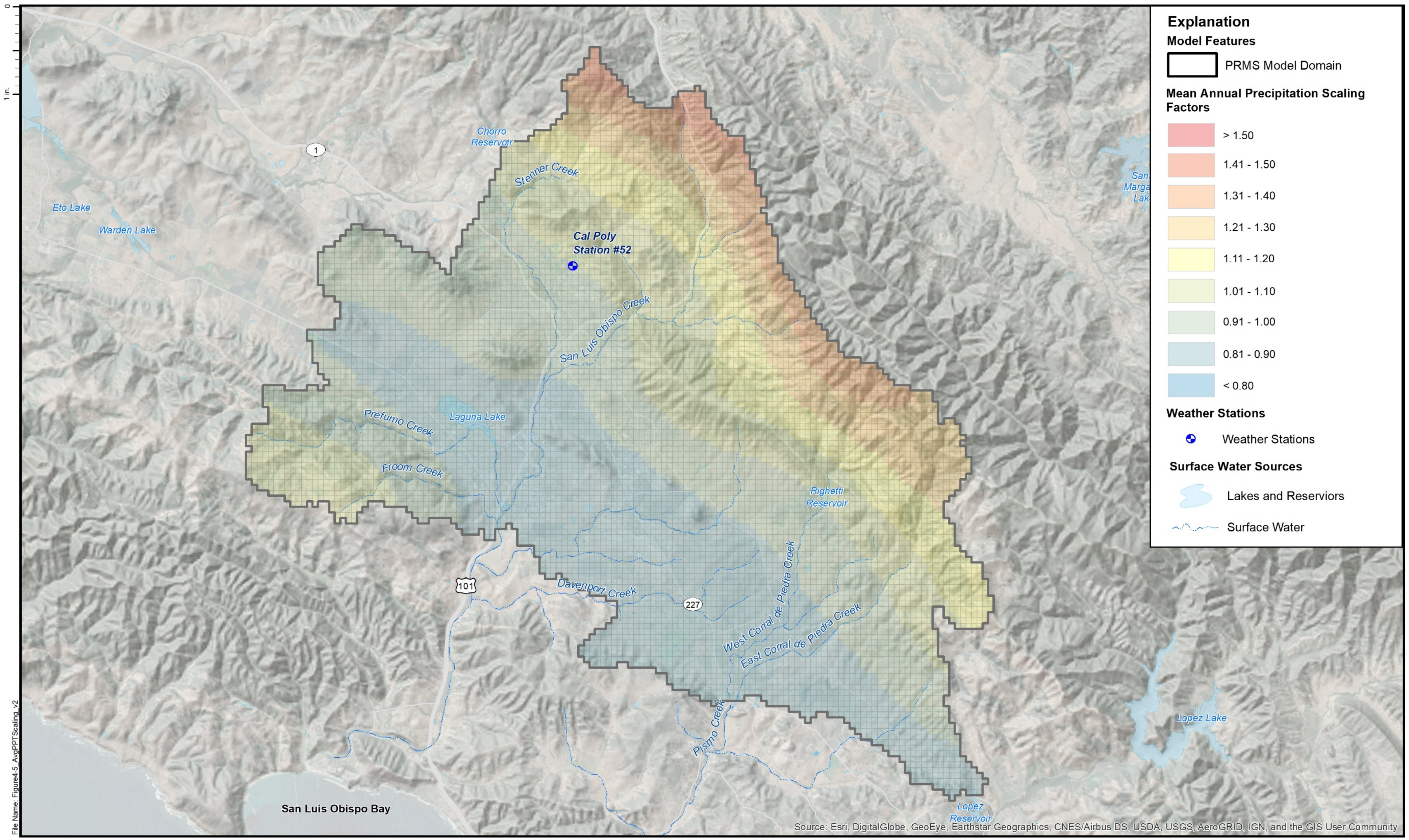
Mean Annual (1980 - 2010) PRISM Precipitation

Figure 4-4



Prepared for:

SAN LUIS OBISPO VALLEY BASIN GSP

Author: EC
Date: 10/10/2019

N

1 in : 1.5 mi
0 0.5 1 2 Mi
0 0.75 1.5 3 Km

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
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Notes:
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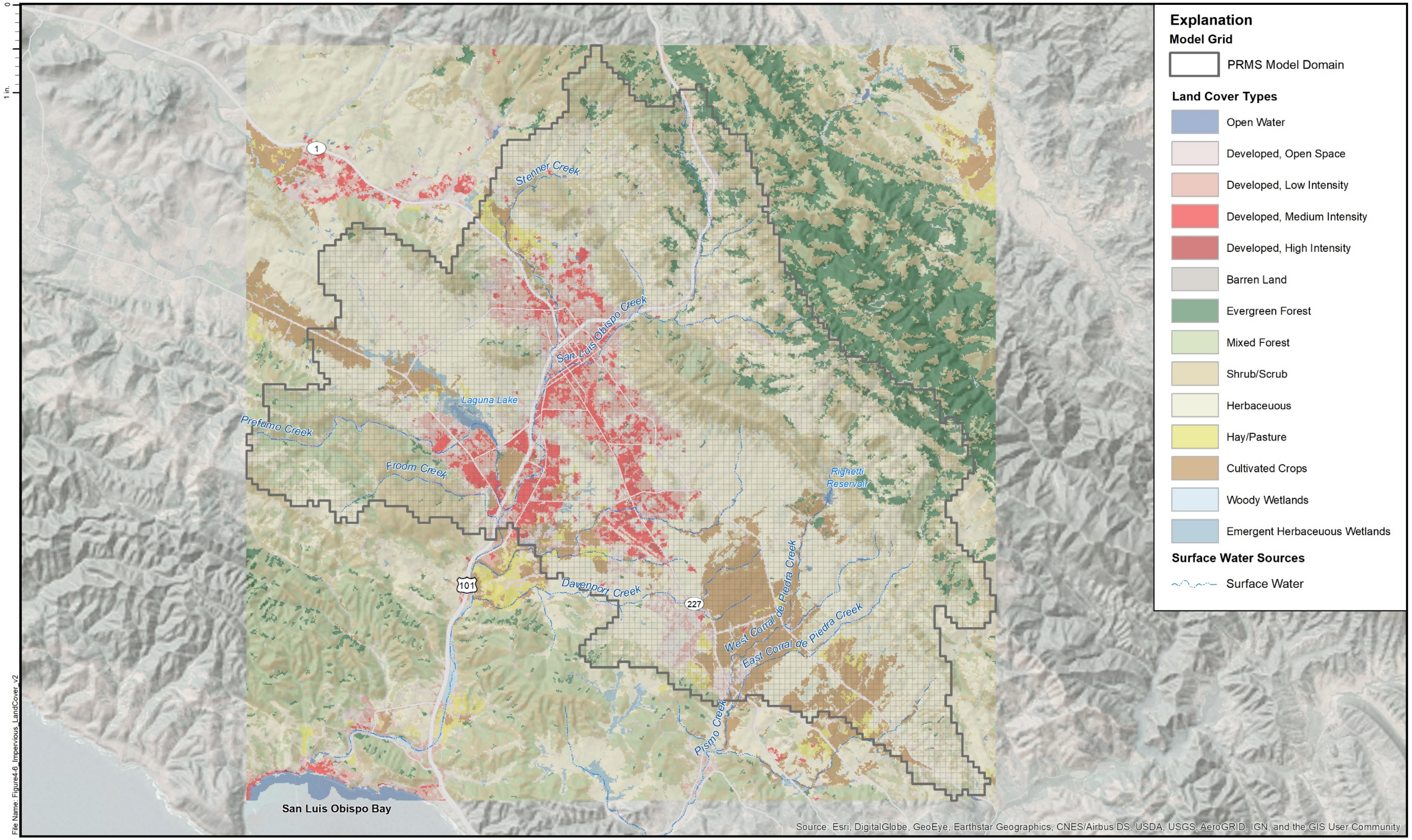
Mean Annual Precipitation Scaling Factors

Figure 4-5



Prepared for:

SAN LUIS OBISPO VALLEY BASIN GSP

Author: EC
Date: 12/18/2019

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1 in : 1.5 mi
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0 0.75 1.5 3 Km

References:
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
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Notes:
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Land Cover Types

Figure 4-6

Section 5. MODFLOW: Groundwater Flow Model

MODFLOW is a publicly available groundwater modeling code developed by the USGS. It is the most used groundwater modeling code in the world and is considered an industry standard. MODFLOW-NWT is the most recent version of MODFLOW that is compatible with GSFLOW; this is the version of MODFLOW that is being implemented. This section of the TM summarizes the modeling approach for the MODFLOW portion of the GSFLOW model.

5.1. Model Discretization

Model grid discretization for the areas represented by both PRMS and MODFLOW were discussed in the previous discussion of PRMS model approach. A uniform grid cell size of 500 feet by 500 feet was adopted for model development.

Vertical discretization of the model (i.e., model layering) will be implemented based on the dominant geologic formations in the Basin (Figure 5-1). One layer each will be assigned to the Recent Alluvium, Paso Robles Formation, and Pismo Formation. In addition, because there are wells identified within the Basin that draw from both the Basin sediments and the underlying Monterey Formation bedrock, a fourth model layer will be added to represent undifferentiated bedrock (i.e., both Franciscan and Monterey Formation represented with a single layer) beneath the Basin, and extending up to the watershed boundaries.

5.1.1. Lateral Boundaries

Groundwater elevations at the northwest extent of the Basin where it bounds with the Los Osos Valley Basin, and at the southeast extent of the Basin where it bounds with the Arroyo Grande sub-basin, are assumed to be coincident with divides in the groundwater surface between the adjacent basins. These lateral boundaries of the Basin will be represented with Constant Head Boundaries (CHBs) with elevations assigned using the most accurate estimate of groundwater elevations in these areas that can be developed from available data.

5.1.2. Mountain Front Recharge

Groundwater elevations in the bedrock formations of the mountains surrounding the Basin are higher than the groundwater elevations within the Basin. Since groundwater flows from areas of higher head to areas with lower head, it is assumed that some amount of inflow to the Basin sediments occurs through the mechanism of mountain front recharge. Subsurface inflow to the Basin through mountain front recharge will be estimated as part of CHG's water budget analysis. It is not expected that this will comprise a significant portion of the Basin water budget. The estimates that will be generated for this component of inflow to the Basin will be represented using General Head Boundaries (GHBs) along the lateral boundaries of the Basin.

5.1.3. Recharge

In a traditional MODFLOW model, various components of recharge to the aquifer such as infiltration of precipitation, irrigation and municipal return flow, etc., are estimated and implemented into the model via the MODFLOW Recharge Package. With the integrated modeling approach provided by GSFLOW, these components of recharge are explicitly simulated using the physically-based processes simulated in PRMS, and the results are transmitted for use by MODFLOW in the groundwater flow simulations. Initial estimates of these recharge components will be made based on water budget analysis and calibration of the MODFLOW model to observed historical water levels. Refinement and revision of these estimates will occur during the combined calibration process using both PRMS and MODFLOW.

5.1.4. Infiltration of Streamflow

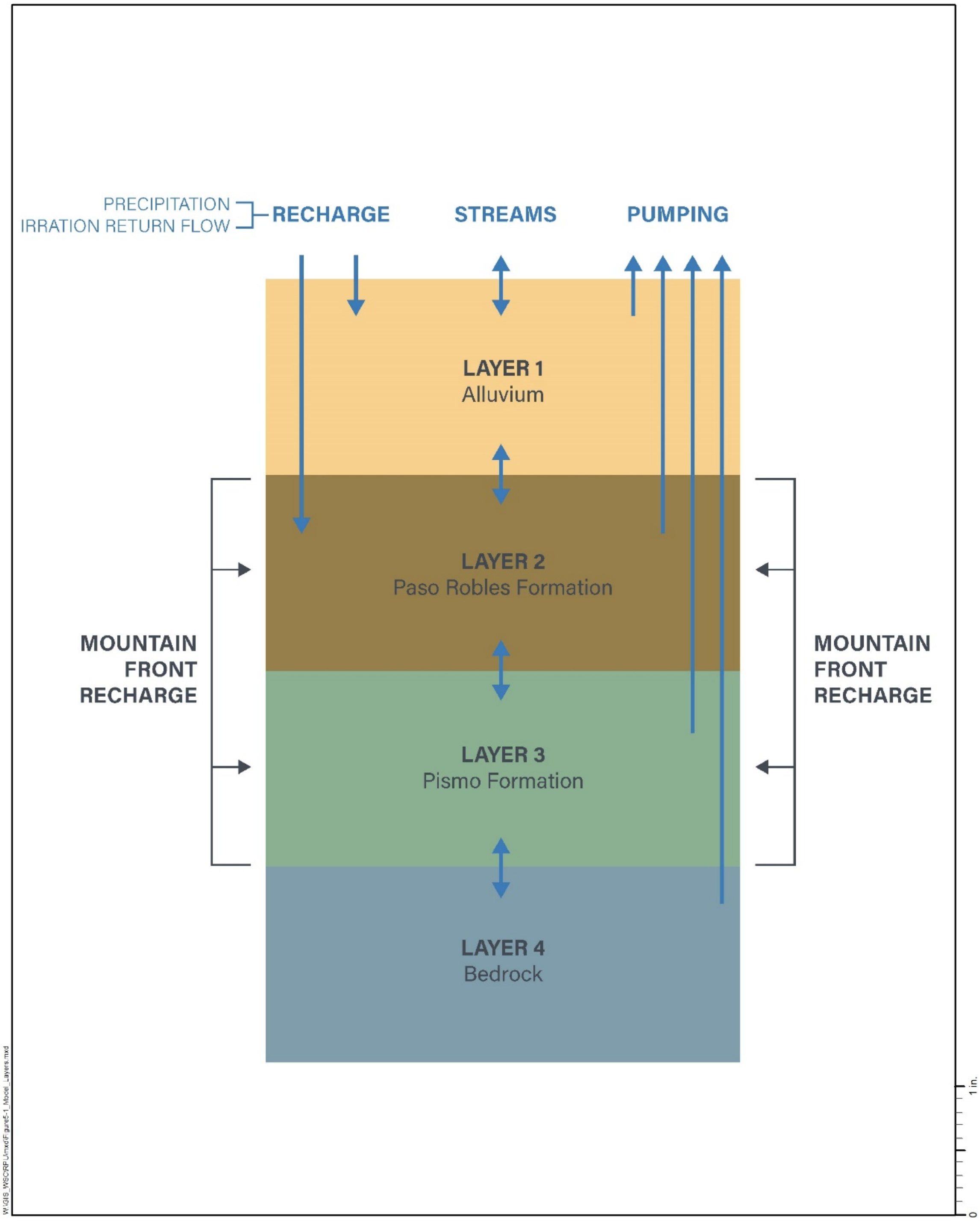
As discussed previously, seasonal infiltration of streamflow to the underlying aquifers is a significant component of the Basin water budget. Streamflow processes within the Basin will be represented using the Streamflow Routing packages available in MODFLOW (SFR and SFR2). Estimates of streamflow infiltration into the underlying aquifers in the Basin provided by the CHG water budget analysis and by previous studies will be used as general guides during historical calibration. Parameters of the SFR package will be adjusted until the quantities of flux between the streams and the aquifers are consistent with the available data.

5.1.5. Well Pumpage

CHG estimates of historical well pumpage developed for the water budget analysis will be incorporated into the historical calibration of the groundwater model. Municipal pumpage by the City will be represented in the specific wells owned and operated by the City. For representation of agricultural pumpage in MODFLOW, there is often not adequate information on well location or pumpage amounts to attempt to explicitly represent pumpage from individual wells. A common approach is to spread estimated agricultural pumping amounts over the entire area of irrigated fields. GSI anticipates that given the amount of data available on well locations in the irrigated areas of the Basin and estimates of historical agricultural pumpage generated by CHG's water budget analysis, it may be feasible to apply irrigation pumpage to specific wells located within the irrigated field areas. Pumpage from de minimis well owners will be estimated based on County data and spread across the areas where the wells are located; no effort to identify specific de minimis wells will be made.

5.2. Calibration Approach

As discussed previously, PRMS and MODFLOW may be run separately during the early stages of model development. It is anticipated that GSI will conduct initial parameter estimation using a long-term historical simulation in MODFLOW-only mode, prior to and separate from the PRMS initial calibration. Because PRMS must be run using daily time steps, it is not necessarily the most efficient tool to perform a long-term simulation to generate initial parameter estimates. Evaluation of the hydrographs in Figure 2-7 indicate that water levels were in approximate equilibrium prior to 1980. The drought of the late 1980s and early 1990s is clear in the hydrographs of some of these wells. In addition, water level declines in Edna Valley wells beginning in the 1990s is evident. In order to capture these significant trends in water levels over the years, the initial parameter estimation of the MODFLOW model will be performed to simulate the 40-year period from 1980 to 2019 using quarterly or monthly stress periods, before the MODFLOW and PRMS models are combined for the integrated model. Annual values provided by the CHG water budget analysis will be used to guide model inputs for such model parameters as pumping and recharge. Aquifer hydraulic properties such as transmissivity and storativity will be varied within ranges indicated by available data (GSI 2018). After the initial parameter estimates of the groundwater flow model are complete, the MODFLOW model will be combined with the PRMS model to perform a joint calibration in which the points of contact between the surface water model and the groundwater flow model are adjusted over the calibration period. All the hydrographs displayed in Figure 2-7 will be used as calibration targets for the MODFLOW model. A commonly referenced metric for groundwater model calibration is to achieve a scaled root mean square error less than 10% for water level calibration targets. GSI and WSC will attempt to meet this calibration standard for modeled groundwater elevations.



Prepared for:

Author: EC
Date: 10/15/2019

SAN LUIS OBISPO VALLEY BASIN GSP

Notes:
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Model Layering and Hydrologic Conceptual Model

Figure 5-1

Section 6. Summary and Next Steps

This TM has presented the data summary, HCM, and anticipated modeling approach for the development of an integrated surface water-groundwater model of the SLO Basin and its contributing watersheds. After approval by the GSA staff, the next step is to perform calibration of the model, discussed in Section 5.2. After separate initial runs of PRMS and MODFLOW are completed, the two models will be joined in GSFLOW, and a combined calibration will be implemented in which parameters of both models will be adjusted to achieve a good fit between observed and modeled water levels, stream flow, and other water budget components.

After calibration of the integrated model is completed, a sensitivity analysis will be performed. The purpose of a sensitivity analysis to identify parameters or boundary conditions to which model forecasts are particularly sensitive. Sensitivity analysis provides a measure of the influence of parameter uncertainty on model predictions. During the sensitivity analysis, key model input parameters and boundaries (such as pumping, recharge, transmissivity, etc.) are systematically varied on the calibrated model simulation, and the resulting impact on the modeled heads are quantified. Calibration and sensitivity analyses will be documented in a separate Technical Memo.

After the completion of the sensitivity analysis, if the model is judged to be adequate for the purposes of the GSP, it will be used to run predictive scenarios simulating projects and management actions to be specified by the GSAs. When the predictive scenarios are complete, an uncertainty analysis will be performed. The purpose of the uncertainty analysis is to identify the impact of parameter uncertainty on the use of the model's ability to effectively support management decisions. This can inform the interpretation of the model results to identify high priority locations for recharge projects, expansion of monitoring networks, and other management actions. The uncertainty analysis is like the sensitivity analysis in that key model parameters are systematically varied and resultant impacts on modeled heads are quantified. However, the uncertainty analysis is performed on the predictive scenario runs rather than the calibration simulation.

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GROUNDWATER SUSTAINABILITY COMMISSION
for the San Luis Obispo Valley Groundwater Basin
March 11, 2020

Agenda Item 10 – A Preview of What's Next?
(Presentation Item)

Recommendation
a) Receive a preview of upcoming SGMA activities and provide direction as necessary

Prepared by
Michael Cruikshank, Water Systems Consulting, Inc.
Tiffany Meyer, Water Systems Consulting, Inc.

Discussion
The WSC Team, has been tasked with the preparation of the Groundwater Sustainability Plan (GSP) for the SLO Basin to meet the requirements of SGMA. The WSC Team will present the near term SGMA activities related to outreach and future GSP Chapter releases and review. Volume 4 of the Quarterly Newsletter Update of the SLO Basin GSP Development will be released in April 2020 via SLOWaterBasin.com. The Newsletter will provide recent meeting summaries, project milestones, opportunities to participate, a project timeline, and a table of key terms. Chapter 6 of the GSP, Water Budget, will be released at the June 11, 2020 Groundwater Sustainability Commission (GSC) meeting.

Workshop #2, titled Sustainable Goal Setting, will be held on April 8, 2020 from 6:00 pm to 8:00 PM at the Ludwick Community Center. The project team will provide an educational grounding of the Basin setting that both predicts future groundwater demand and describes the unique makeup and challenges associated with groundwater management in the SLO Basin. The team will then introduce the concept of management areas, representative wells, and create groundwater sustainability goals, per the requirements of SGMA. The team will gather workshop participants' perspective and input on the topics covered.

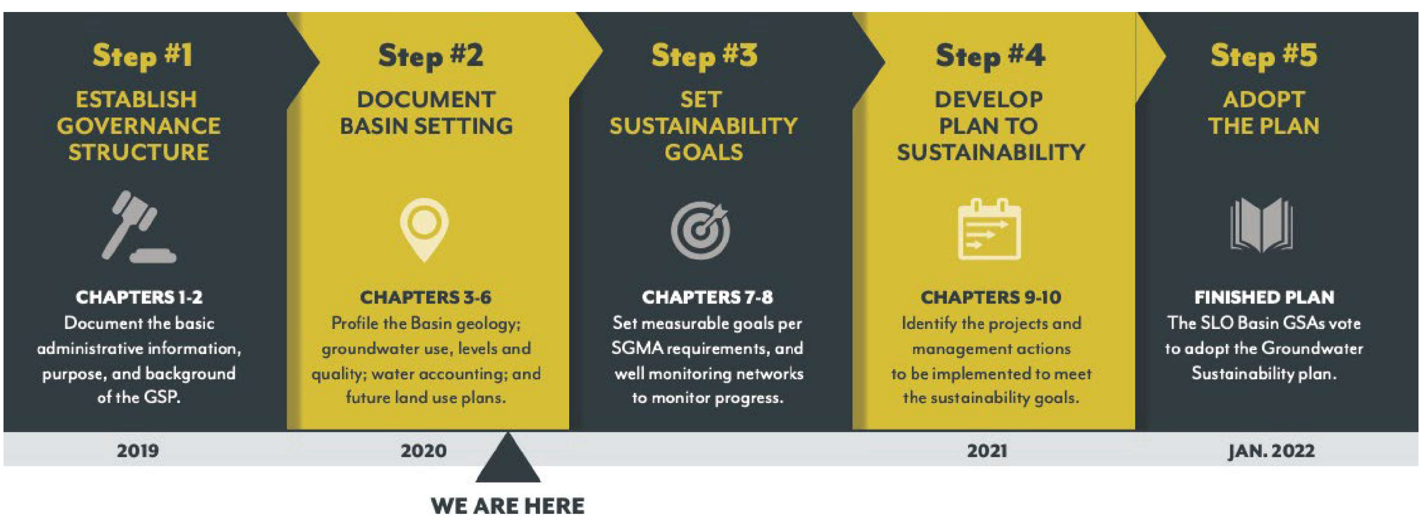
Attachments:
1. Presentation

A PREVIEW OF WHAT'S NEXT

Michael Cruikshank, WSC

Tiffany Meyer, WSC

PROJECT TIMELINE



GSP CHAPTER SCHEDULE

GSP Chapters	2019									2020												2021												2022			
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
Executive Summary																																		GSP Due - January 31, 2022			
Chapter 1: Introduction																																					
Chapter 2: Agency Information (§ 354.6)																																					
Chapter 3: Description of Plan Area (§ 354.8)																																					
Chapter 4: Basin Setting (§ 354.14)																																					
Chapter 5: Groundwater Conditions (§ 354.16)																																					
Chapter 6: Water Budget (§ 354.18)																																					
Chapter 7: Sustainable Management Criteria (§ 354.22-30)																																					
Chapter 8: Monitoring Networks (§ 354.34)																																					
Chapter 9: Projects and Management Actions (§ 354.44)																																					
Chapter 10: Implementation Plan																																					
Chapter 11: Notice and Communications (§ 354.10)																																					
Chapter 12 : Interagency Agreements (§ 357.2-4)																																					
Chapter 13: Reference List																																					
Data Management Plan TM																																					
Integrated Model TM																																					
Appendices																																					
Draft GSP																									AD		PD										
Final GSP																													F			A					

WE ARE HERE

SUSTAINABLE GOAL SETTING WORKSHOP

Weds, Apr. 8, 2020 • 6:00pm-8:00pm

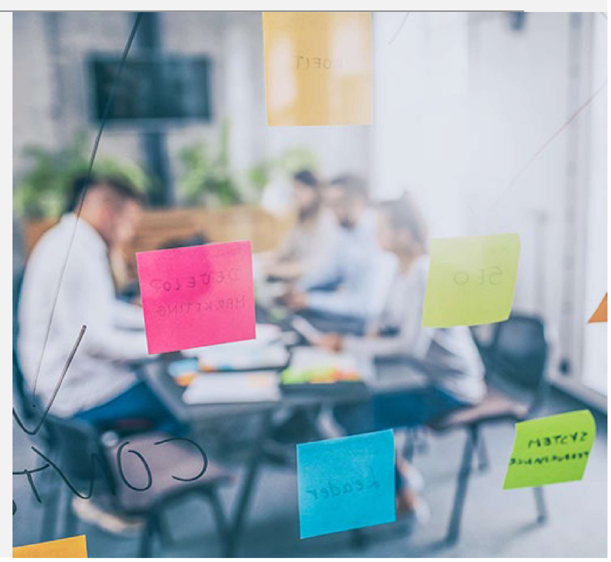
Ludwick Community Center, 864 Santa Rosa Street, San Luis Obispo, CA

EDUCATIONAL OVERVIEW OF:

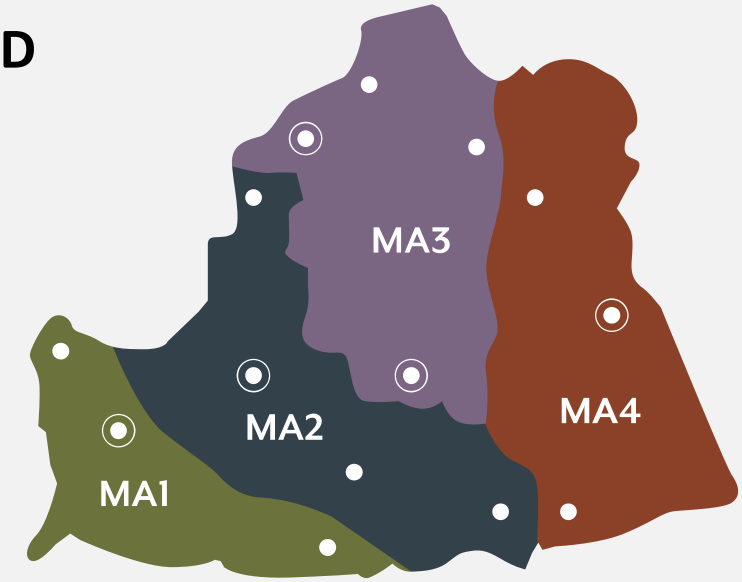
- The setting of the SLO Basin
- Potential management areas (and how they were determined)
- Potential representative wells (and how they were determined)
- Sustainable management criteria (SMCs)
- What goes into setting SGMA compliant sustainability goals

GATHER PARTICIPANT PERSPECTIVE ON:

- Participants will surface unforeseen negative impacts, inequities, and/or costs of the proposed management areas and representative wells.
- If needed, explore alternate management area options (including an estimate of their costs/benefits) will be explored.



WORKSHOP PREVIEW:
MANAGEMENT AREAS AND REPRESENTATIVE WELLS



SAMPLE MANAGEMENT AREA AND REPRESENTATIVE WELLS
Department of Water Resources (GSP Emergency Regulations Guide , 2016)

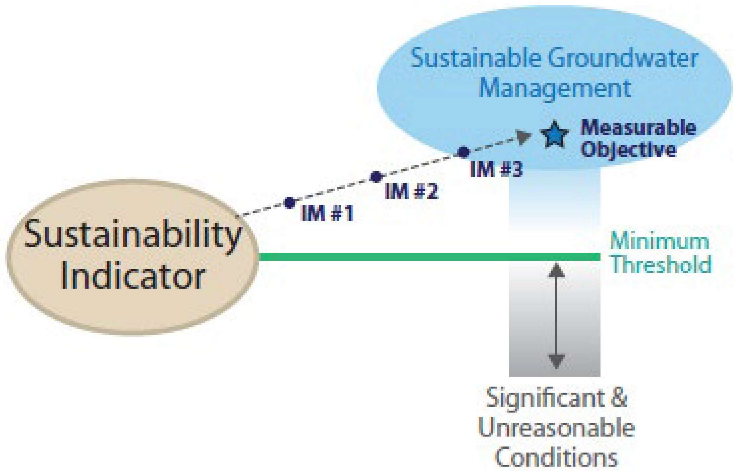
6 | SLO GSC Meeting • March 11, 2020

WORKSHOP PREVIEW:
SUSTAINABLE MANAGEMENT CRITERIA

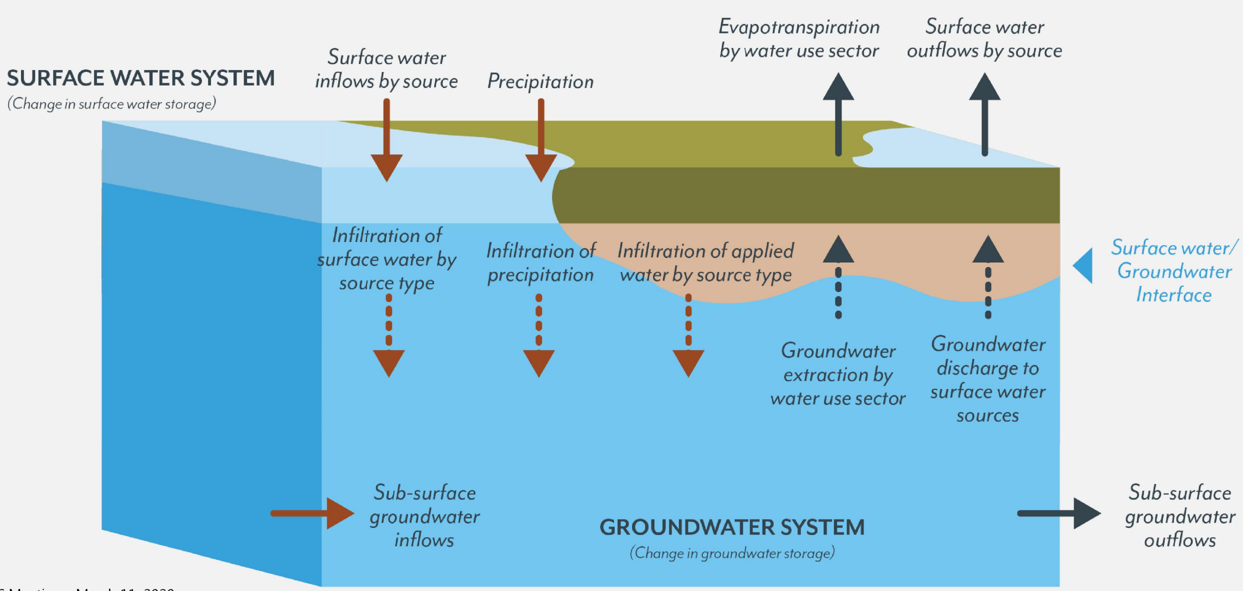
- Chronic Lowering of Groundwater Levels
- Water Quality Degradation
- Reduction of Groundwater Storage
- Interconnected Surface Water Depletions
- Land Subsidence
- Seawater Intrusion

7 | SLO GSC Meeting • March 11, 2020

WORKSHOP PREVIEW:
SUSTAINABLE MANAGEMENT CRITERIA



UPCOMING GSP CHAPTERS:
CHAPTER 6: THE WATER BUDGET



UPCOMING GSP CHAPTERS:
CHAPTER 6: THE WATER BUDGET

Chapter 6 of the GSP describes the historical and current groundwater budget for the SLO Basin including water coming in (inflows), water pumping and discharging (outflows), and changes in storage. It will also quantify the current overdraft in the Basin and estimate the Basin's sustainable yield.

OPPORTUNITIES TO PARTICIPATE

GSC MEETINGS: 06/10/2020

WORKSHOP: 04/08/2020

REVIEW AND COMMENT: Released upon GSC approval at the 06/10/2020 GSC Meeting; comment period is anticipated to close 30 days or more following the GSC meeting.

QUARTERLY NEWSLETTER • APRIL 2020

- Meeting Summaries
- Project Milestones
- Opportunities to Participate
- Project Timeline
- Key Terms