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From: **Glenn Church** <gwchurch@gmail.com>
Date: Thu, Apr 4, 2019 at 12:41 PM
Subject: Public Comment for Chapters 5, Groundwater Conditions, of the draft Valley-Wide Integrated Groundwater Sustainability Plan and the 180-400 Foot Aquifer Subbasin GSP
To: <peterseng@svbgsa.org>

Mr. Petersen,

After reviewing the draft for the 180/400 aquifer, my main concerns rest with the northern section of the aquifer, primarily north of Dolan Rd./Castroville Blvd.

There is a serious lack of data on this section of the aquifer, primarily a lack of data on saltwater intrusion. I find it difficult to imagine that an adequate groundwater sustainability plan can be drafted without having basic scientific information for this area. We know saltwater has advanced considerably since the years following World War II in the Castroville area and continues to advance towards Salinas. The area north of this has traditionally been marshy. Until the early 1900s the Salinas River used to flow past where Moss Landing harbor now is and emptied into the ocean about a mile north of the Elkhorn Slough's opening. Historically, the Elkhorn Slough was a fresh and saltwater mix, depending on the time of year. In the early 1980s, the state of California cut dikes easterly from the Elkhorn Slough towards Elkhorn Rd. This brought saltwater onto lands that had freshwater vegetation growing on them. Many freshwater ponds were turned to saltwater. Besides forever altering the freshwater environments in these locations, the opening of these lands to a saltwater marsh greatly expanded saltwater over what appears to be thousands of acres.

I do not know of any studies that show how the presence of aboveground saltwater has affected groundwater levels. This knowledge is of extreme importance in developing a sustainability plan along the Elkhorn Slough. Many places on the slough, such as Moro Cojo and Parson's Slough are no longer freshwater, but they were just a few years ago. Some wells in these areas have been lost to the introduction of saltwater over the years. The many organizations involved in the Elkhorn Slough have done tremendous work, but they have used saltwater primarily as a means to rehabilitate the lands. While saltwater intrusion in the groundwater in the Castroville area is an unplanned result of water use, the expansion of saltwater in the Elkhorn Slough is a planned action. Future plans will continue to advance the saltwater easterly. This runs counter to the goals of the SVBGSA which is to protect groundwater.

The SVBGSA needs to coordinate with the organizations along the Elkhorn Slough in developing a sustainability plan for this area. There should also be coordination with the Pajaro Valley Water Management Agency handling the GSA there. The boundaries of all three of these interests (SVBGSA, Elkhorn Slough, Pajaro Valley) meet at the Elkhorn Slough and even overlap. The Elkhorn Slough is the largest surface saltwater encroachment on the Central Coast. There is a case to be made that the diversion of the Salinas River a hundred years ago, and the filling of the Elkhorn Slough purely with saltwater are contributors to saltwater intrusion from the current boundaries of the Salinas River to the Elkhorn Slough. Any sustainability plan must take these factors into consideration.

Respectfully,
Glenn Church

--

Gary Petersen

Regional Government Services

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Assignment:

General Manager

Salinas Valley Groundwater Sustainability Agency

SVBGSA.org

Salinas Valley Basin
Groundwater Sustainability Agency

The Nature Conservancy
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11 April 2019

General Manager Gary Petersen
Salinas Valley Basin Groundwater Sustainability Agency
200 Lincoln Avenue
Salinas, CA 93901

Submitted online via email: peterseng@svbgsa.org

Re: Chapter 5 of the 180-400 Foot Aquifer Subbasin Draft GSP and the Salinas Valley Basin Integrated Sustainability Plan Draft GSP

Dear Mr. Gary Petersen,

The Nature Conservancy (TNC) appreciates the opportunity to comment on Chapter 5 for the 180-400 Foot Aquifer Subbasin and Salinas Valley Basin Integrated Sustainability Plan Draft Groundwater Sustainability Plans (GSPs) being prepared under the Sustainable Groundwater Management Act (SGMA).

TNC as a Stakeholder Representative for the Environment

TNC is a global, nonprofit organization dedicated to conserving the lands and waters on which all life depends. We seek to achieve our mission through science-based planning and implementation of conservation strategies. For decades, we have dedicated resources to establishing diverse partnerships and developing foundational science products for achieving positive outcomes for people and nature in California. TNC was part of a stakeholder group formed by the Water Foundation in early 2014 to develop recommendations for groundwater reform and actively worked to shape and pass SGMA.

Our reason for engaging is simple: California's freshwater biodiversity is highly imperiled. We have lost more than 90 percent of our native wetland and river habitats, leading to precipitous declines in native plants and the populations of animals that call these places home. These natural resources are intricately connected to California's economy providing direct benefits through industries such as fisheries, timber and hunting, as well as indirect benefits such as clean water supplies. SGMA must be successful for us to achieve a sustainable future, in which people and nature can thrive within the Salinas Valley and California.

We believe that the success of SGMA depends on bringing the best available science to the table, engaging all stakeholders in robust dialog, providing strong incentives for beneficial outcomes and rigorous enforcement by the State of California.

Given our mission, we are particularly concerned about the inclusion of nature, as required, in GSPs. The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs.

These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Addressing Nature's Water Needs in GSPs

SGMA requires that all beneficial uses and users, including environmental users of groundwater, be considered in the development and implementation of GSPs (Water Code § 10723.2).

The GSP Regulations include specific requirements to identify and consider groundwater dependent ecosystems (23 CCR §354.16(g)) when determining whether groundwater conditions are having potential effects on beneficial uses and users. GSAs must also assess whether sustainable management criteria may cause adverse impacts to beneficial uses, which include environmental uses, such as plants and animals. In addition, monitoring networks should be designed to detect potential adverse impacts to beneficial uses due to groundwater. Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decision, and using data collected through monitoring to revise decisions in the future. Over time, GSPs should improve as data gaps are reduced and uncertainties addressed.

To help ensure that GSPs adequately address nature as required under SGMA, The Nature Conservancy has prepared a checklist (**Attachment A**) for GSAs and their consultants to use. The Nature Conservancy believes the following elements are foundational for 2020 GSP submittals. For detailed guidance on how to address the checklist items, please also see our publication, *GDEs under SGMA: Guidance for Preparing GSPs* (https://groundwaterresourcehub.org/public/uploads/pdfs/GWR_Hub_GDE_Guidance_Doc_2-1-18.pdf).

1. Environmental Representation
SGMA requires that groundwater sustainability agencies (GSAs) consider the interests of all beneficial uses and users of groundwater. To meet this requirement, we recommend actively engaging environmental stakeholders by including environmental representation on the GSA board, technical advisory group, and/or working groups. This could include local staff from state and federal resource agencies, nonprofit organizations and other environmental interests. By engaging these stakeholders, GSAs will benefit from access to additional data and resources, as well as a more robust and inclusive GSP.

2. Basin GDE and ISW Maps
SGMA requires that groundwater dependent ecosystems (GDEs) and interconnected surface waters (ISWs) be identified in the GSP. We recommend using the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) provided online (https://gis.water.ca.gov/app/NCDatasetViewer/) by the Department of Water Resources (DWR) as a starting point for the GDE map. The NC Dataset was developed through a collaboration between DWR, the Department of Fish and Wildlife and TNC.

3. Potential Effects on Environmental Beneficial Users
SGMA requires that potential effects on GDEs and environmental surface water users be described when defining undesirable results. In addition to identifying GDEs in the basin, The Nature Conservancy recommends identifying beneficial users of surface water, which include environmental users. This is a critical step, as it is impossible to define "significant and unreasonable adverse impacts" without knowing *what* is being impacted. For your convenience, we've provided a list of freshwater species within the boundary of the 180-400 Foot Aquifer in **Attachment C**. Our hope is that this information will help your GSA better

evaluate the impacts of groundwater management on environmental beneficial users of surface water. We recommend that after identifying which freshwater species exist in your basin, especially federal and state listed species, that you contact staff at the Department of Fish and Wildlife (DFW), United States Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Services (NMFS) to obtain their input on the groundwater and surface water needs of the organisms on the freshwater species list. Because effects to plants and animals are difficult and sometimes impossible to reverse, we recommend erring on the side of caution to preserve sufficient groundwater conditions to sustain GDEs and ISWs.

4. Biological and Hydrological Monitoring
If sufficient hydrological and biological data in and around GDEs is not available in time for the 2020/2022 plan, data gaps should be identified along with actions to reconcile the gaps in the monitoring network.

Our comments related to Chapter 5 of the 180-400 Foot Aquifer Subbasin Draft GSP and Salinas Valley Integrated Sustainability Plan GSP are provided in detail in **Attachment B** and are in reference to the numbered items in **Attachment A. Attachment D** describes six best practices that GSAs and their consultants can apply when using local groundwater data to confirm a connection to groundwater for DWR's Natural Communities Commonly Associated with Groundwater Dataset (https://gis.water.ca.gov/app/NCDatasetViewer/).

Thank you for fully considering our comments as you develop your GSP.

Best Regards,

Sandi Matsumoto
Associate Director, California Water Program
The Nature Conservancy

Attachment A
Considering Nature under SGMA: A Checklist

The Nature Conservancy is neither dispensing legal advice nor warranting any outcome that could result from the use of this checklist. Following this checklist does not guarantee approval of a GSP or compliance with SGMA, both of which will be determined by DWR and the State Water Resources Control Board. The checklist is available online: https://groundwaterresourcehub.org/public/uploads/pdfs/TNC_GDE_Checklist_for_SGMA_Sept2018.pdf

GSP Plan Element*		GDE Inclusion in GSPs: Identification and Consideration Elements		Item Number
Admin Info	**2.1.5 Notice & Communication** *23 CCR §354.10*	**Description of the types of environmental beneficial uses of groundwater that exist within GDEs and a description of how environmental stakeholders were engaged throughout the development of the GSP.**		1.
Basin Setting	**2.2.2 Current & Historical Groundwater Conditions** *23 CCR §354.16*	**Interconnected surface waters:**		2.
		Interconnected surface water maps for the basin with gaining and losing reaches defined (included as a figure in GSP & submitted as a shapefile on SGMA portal).		3.
		Estimates of current and historical surface water depletions for interconnected surface waters quantified and described by reach, season, and water year type.		4.
		Basin GDE map included (as figure in text & submitted as a shapefile on SGMA Portal).		5.
		If NC Dataset *was* used:	Basin GDE map denotes which polygons were kept, removed, and added from NC Dataset (Worksheet 1, can be attached in GSP section 6.0).	6.
			The basin's GDE shapefile, which is submitted via the SGMA Portal, includes two new fields in its attribute table denoting: 1) which polygons were kept/removed/added, and 2) the change reason (e.g., why polygons were removed).	7.
			GDEs polygons are consolidated into larger units and named for easier identification throughout GSP.	8.
		If NC Dataset *was not* used:	Description of why NC dataset was not used, and how an alternative dataset and/or mapping approach used is best available information.	9.
		Description of GDEs included:		10.
		Historical and current groundwater conditions described in each GDE unit.		11.
		Ecological condition described in each GDE unit.		12.
		Each GDE unit has been characterized as having high, moderate, or low ecological value.		13.
		Inventory of species, habitats, and protected lands for each GDE unit with ecological importance (Worksheet 2, can be attached in GSP section 6.0).		14.

	2.2.3 Water Budget *23 CCR §354.18*	Groundwater inputs and outputs (e.g., evapotranspiration) of native vegetation and managed wetlands are included in the basin's historical and current water budget.		15.
		Potential impacts to groundwater conditions due to land use changes, climate change, and population growth to GDEs and aquatic ecosystems are considered in the projected water budget.		16.
Sustainable Management Criteria	**3.1 Sustainability Goal** *23 CCR §354.24*	**Environmental stakeholders/representatives were consulted.**		17.
		Sustainability goal mentions GDEs or species and habitats that are of particular concern or interest.		18.
		Sustainability goal mentions whether the intention is to address pre-SGMA impacts, maintain or improve conditions within GDEs or species and habitats that are of particular concern or interest.		19.
	3.2 Measurable Objectives *23 CCR §354.30*	**Description of how GDEs were considered and whether the measurable objectives and interim milestones will help achieve the sustainability goal as it pertains to the environment.**		20.
	3.3 Minimum Thresholds *23 CCR §354.28*	**Description of how GDEs and environmental uses of surface water were considered when setting minimum thresholds for relevant sustainability indicators:**		21.
		Will adverse impacts to GDEs and/or aquatic ecosystems dependent on interconnected surface waters (beneficial user of surface water) be avoided with the selected minimum thresholds?		22.
		Are there any differences between the selected minimum threshold and state, federal, or local standards relevant to the species or habitats residing in GDEs or aquatic ecosystems dependent on interconnected surface waters?		23.
	3.4 Undesirable Results *23 CCR §354.26*	**For GDEs, hydrological data are compiled and synthesized for each GDE unit:**		24.
		If hydrological data *are available* within/nearby the GDE	Hydrological datasets are plotted and provided for each GDE unit (Worksheet 3, can be attached in GSP Section 6.0).	25.
			Baseline period in the hydrologic data is defined.	26.
			GDE unit is classified as having high, moderate, or low susceptibility to changes in groundwater.	27.
			Cause-and-effect relationships between groundwater changes and GDEs are explored.	28.
		If hydrological data *are not available* within/nearby the GDE	Data gaps/insufficiencies are described.	29.
			Plans to reconcile data gaps in the monitoring network are stated.	30.
		For GDEs, biological data are compiled and synthesized for each GDE unit:		31.
		Biological datasets are plotted and provided for each GDE unit.		32.
		Data gaps/insufficiencies are described.		33.
		Plans to reconcile data gaps in the monitoring network are stated.		34.
		Description of potential effects on GDEs, land uses and property interests:		35.

		Cause-and-effect relationships between GDE and groundwater conditions are described.	36.
		Impacts to GDEs that are considered to be "significant and unreasonable" are described.	37.
		Known hydrological thresholds or triggers (e.g., instream flow criteria, groundwater depths, water quality parameters) for relevant species or ecological communities are reported.	38.
		Land uses include and consider recreational uses (e.g., fishing/hunting, hiking, boating).	39.
		Property interests include and consider privately and publicly protected conservation lands and opens spaces, including wildlife refuges, parks, and natural preserves.	40.
Sustainable Management Criteria	**3.5 Monitoring Network** *23 CCR §354.34*	Description of whether hydrological data are spatially and temporally sufficient to monitor groundwater conditions for each GDE unit.	41.
		Description of how hydrological data gaps and insufficiencies will be reconciled in the monitoring network.	42.
		Description of how impacts to GDEs and environmental surface water users, as detected by biological responses, will be monitored and which monitoring methods will be used in conjunction with hydrologic data to evaluate cause-and-effect relationships with groundwater conditions.	43.
Projects & Mgmt Actions	**4.0. Projects & Mgmt Actions to Achieve Sustainability Goal** *23 CCR §354.44*	Description of how GDEs will benefit from relevant project or management actions.	44.
		Description of how projects and management actions will be evaluated to assess whether adverse impacts to the GDE will be mitigated or prevented.	45.

* In reference to DWR's GSP annotated outline guidance document, available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GD_GSP_Outline_Final_2016-12-23.pdf

Attachment B

TNC Evaluation of Chapter 5 of the 180-400 Foot Aquifer Subbasin GSP Draft and Salinas Valley Basin Integrated Sustainability Plan (ISP)

Although none of the items on the Environmental User Checklist (Attachment A) were relevant to Section 5.2., we have the following suggestions:

5.5 Interconnected Surface Water (p.39)

- [Paragraph 1] While groundwater in the 180- and 400-foot Aquifers is generally not considered to be hydraulically connected to the Salinas River or its tributaries, the Shallow Aquifer (which resides above the Salinas Valley Aquitard) likely does. In chapter 4, the following aquitards and aquifers have been identified in the 180/400-Foot aquifer and Monterey Subbasins: 1) Shallow Aquifer; 2) Salinas Valley Aquitard; 3) 180-Foot Aquifer; 4) 180/400-Foot Aquitard; 5) 400-Foot Aquifer; 6) 400-Foot/Deep Aquitard; 7) Deep Aquifers (Chapter 4 ISP; p. 19). **We recommend that interconnections of surface water with groundwater in the Shallow Aquifer be evaluated in this section of the GSP, since the Shallow Aquifer is within the 180/400-Foot Aquifer Subbasin.** Groundwater in the shallow aquifer is also likely to be supporting groundwater dependent ecosystems and interacting with the Salinas River in this part of the basin. Basins with a stacked series of aquifers may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, that can support springs, surface water, and groundwater dependent ecosystems. This is because the goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits, and while groundwater pumping may not be currently occurring in a shallow aquifer, it could be in the future.
- [Paragraph 2] The 180-Foot Aquifer and the 400-Foot Aquifers are confined units, thus comparing groundwater levels of <20 feet below the ground surface with wells screened within a confined aquifer is an incorrect approach. This is because the potentiometric surface of a confined aquifer cannot reflect the position of the true water table. **Comparing groundwater levels from the shallow (unconfined) aquifer (that exists above the Salinas Valley Aquitard) with the ground surface is a more appropriate approach for identifying ISW in the basin**.
- [Paragraph 3] **We would like to see groundwater conditions evaluated across the range of seasonal and interannual time frames**. Relying solely on any single point in time (in this case Fall 2013) to characterize groundwater conditions (e.g., depth to groundwater) is inadequate because data from one time point fails to capture the seasonal and interannual variability (i.e., wet, average, dry, and drought years) that is characteristic of California's climate.

Environmental User Checklist (Attachment A) Items 2-4:

Interconnected surface waters (ISW) are defined in the GSP Regulations as "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" [23 CCR §351(o)]. California's Mediterranean-like climate is characterized by large seasonal variations (dry summers and wet winters) and interannual variability in water year types (drought, dry, average, wet years), which can result in the groundwater regime to have varying levels of interconnections with surface water in time and space. For this reason, we highly recommend the following:

- **Mapping ISW locations would be best done using contours of depth to groundwater measured from multiple points in time (different seasons and water year types) rather than only from Fall 2013.** If data gaps exist in groundwater level contour data over time, these data gaps should be discussed in the GSP section 5.5.1 (Salinas Valley Basin ISP) and section 5.5 (180-400 Foot Aquifer GSP Draft) and reconciled in the Monitoring Network section, so that ISW maps can be improved in future GSPs.
- **The use of piezometric head from confined aquifers should be eliminated** from these ISW mapping efforts, since they do not adequately reflect the position of the true water table (see last paragraph on p. 38 of Salinas Valley Basin ISP)
- It is unclear on Figure 5-19 (Salinas Valley Basin ISP) and Figure 5-22 (180-400 Foot Aquifer GSP Draft), whether missing groundwater levels along certain reaches of the Salinas River are due to groundwater levels >20 feet bgs or due to data gaps in groundwater levels. Mapping the position of wells used for the interpolation of groundwater elevation data used to map groundwater level contours near surface water would help provide further clarification.
- **Please elaborate on how depth to groundwater contours were developed** after the first sentence in GSP section 5.5.1 (Salinas Valley Basin ISP) and third paragraph (p.39) of the 180-400 Foot Aquifer GSP Draft section 5.5. More accurate depth to groundwater maps around surface water features can be obtained by first interpolating groundwater elevations around surface water features and then subtracting groundwater elevations from land surface elevation data (obtained via digital elevation maps (DEM)[1]) for more accurate ISW mapping.
- **We recommend mapping the gaining and losing reaches onto Figure 5-19 (**Salinas Valley Basin ISP) using the data from Figure 5-23 (Salinas Valley Basin ISP). If this is not possible due to insufficient data, then as with the first bullet above, we would like the data gaps to be addressed by the Monitoring Network.

Environmental User Checklist (Attachment A) Items 5-14:

- The identification of GDEs is a required element of the Basin Setting Section under the description of Current & Historical Groundwater Conditions (23 CCR §354.16). Recognizing natural points of discharge (seeps & springs) as GDEs is consistent with

[1] Available at: https://catalog.data.gov/dataset/usgs-national-elevation-dataset-ned-1-meter-downloadable-data-collection-from-the-national-map-

the SGMA definition of GDEs[2], however, we recommend **the identification of GDEs (GDE map Figure 4-11; Chapter 4) for the 180-400 Foot Aquifer be moved to Chapter 5: Groundwater Conditions and elaborated upon with a description of current and historical groundwater conditions in the GDE areas**. Chapter 5 is a more appropriate place for the identification of GDEs, since groundwater conditions (e.g., depth to groundwater, interconnected surface water maps, groundwater quality) are necessary local information and data from the GSP in assessing whether polygons in the NC dataset are connected to groundwater in a principal aquifer. Appendix 4A (Page 27, Chapter 4) was referenced as describing methods used to determine the extent and type of potential GDEs, but that document was not available on the SVBGSA website for us to review.

- Decisions to remove, keep, or add polygons from the NC dataset into a basin GDE map should be based on best available science in a manner that promotes transparency and accountability with stakeholders. Any polygons that are removed, added, or kept should be inventoried in the submitted shapefile to DWR, and mapped in the plan. **We recommend revising Figure 4-11 and including it in Chapter 5 to reflect this change.**
- Best practices for identifying GDEs in GSPs are outlined in detail in Step 1 of The Nature Conservancy's Guidance Document[3]. Here are some highlights:
    - The NC dataset is a starting point for GSAs, and needs to be groundtruthed with aerial photography to screen for changes in land use that many not be reflected in the NC dataset (e.g., recent development, cultivated agricultural land, obvious human-made features).
    - Grouping multiple GDE polygons into larger units by location (proximity to each other) and principal aquifer will simplify the process of evaluating potential effects on GDE due to groundwater conditions under GSP Chapter 7: Sustainable Management Criteria.
    - Groundwater conditions within GDEs should be briefly described within the portion of the Basin Setting Section where GDEs are being identified.
    - When using groundwater levels to confirm that a connection to groundwater in a principal aquifer exists.
    - Not all GDEs are created equal. Some GDEs may contain legally protected species or ecologically rich communities, whereas other GDEs may be highly degraded with little conservation value. Including a description of the types of species (protected status, native versus non-native), habitat, and environmental beneficial uses (see Worksheet 2, p.74 of GDE Guidance Document) can be helpful in assigning an ecological value to the GDEs. Identifying an ecological value of each GDE can help prioritize limited resources when considering GDEs as well as prioritizing legally protected species or habitat that may need special consideration when setting sustainable management criteria.
- Are any of the wells from the MCWRA program (described in GSP section 5.1.1 of the Salinas Valley Basin ISP) close enough (<1 km) to GDEs and screened in the shallow portions of the aquifer to characterize historical and current groundwater conditions for each GDE? If data gaps exist, they should be discussed in Chapter 5.

[2] Groundwater dependent ecosystem refer to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. [23 CCR §351 (m)]

[3] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/

Attachment C

Freshwater Species Located in the 180-400 Foot Aquifer

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", Attachment C provides a list of freshwater species located in the 180-400 Foot Aquifer. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the 180-400 Foot Aquifer groundwater basin boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[4]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[5] as well as on The Nature Conservancy's science website[6].

Scientific Name	Common Name	Legally Protected Status		
		Federal	State	Other
BIRD				
Actitis macularius	Spotted Sandpiper			
Aechmophorus clarkii	Clark's Grebe			
Aechmophorus occidentalis	Western Grebe			
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
Aix sponsa	Wood Duck			
Anas acuta	Northern Pintail			
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas crecca	Green-winged Teal			
Anas cyanoptera	Cinnamon Teal			
Anas discors	Blue-winged Teal			
Anas platyrhynchos	Mallard			
Anas strepera	Gadwall			
Anser albifrons	Greater White-fronted Goose			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Aythya affinis	Lesser Scaup			
Aythya americana	Redhead		Special Concern	BSSC - Third priority
Aythya collaris	Ring-necked Duck			

[4] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710
[5] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS
[6] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Aythya marila	Greater Scaup			
Aythya valisineria	Canvasback		Special	
Botaurus lentiginosus	American Bittern			
Bucephala albeola	Bufflehead			
Bucephala clangula	Common Goldeneye			
Butorides virescens	Green Heron			
Calidris alpina	Dunlin			
Calidris mauri	Western Sandpiper			
Calidris minutilla	Least Sandpiper			
Chen caerulescens	Snow Goose			
Chen rossii	Ross's Goose			
Chlidonias niger	Black Tern		Special Concern	BSSC - Second priority
Chroicocephalus philadelphia	Bonaparte's Gull			
Cistothorus palustris palustris	Marsh Wren			
Cygnus columbianus	Tundra Swan			
Egretta thula	Snowy Egret			
Empidonax traillii	Willow Flycatcher	Bird of Conservation Concern	Endangered	
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Geothlypis trichas trichas	Common Yellowthroat			
Grus canadensis	Sandhill Crane			
Haliaeetus leucocephalus	Bald Eagle	Bird of Conservation Concern	Endangered	
Himantopus mexicanus	Black-necked Stilt			
Histrionicus histrionicus	Harlequin Duck		Special Concern	BSSC - Second priority
Icteria virens	Yellow-breasted Chat		Special Concern	BSSC - Third priority
Limnodromus scolopaceus	Long-billed Dowitcher			
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus merganser	Common Merganser			
Mergus serrator	Red-breasted Merganser			
Numenius americanus	Long-billed Curlew			
Numenius phaeopus	Whimbrel			

Nycticorax nycticorax	Black-crowned Night-Heron			
Oxyura jamaicensis	Ruddy Duck			
Pelecanus erythrorhynchos	American White Pelican		Special Concern	BSSC - First priority
Phalacrocorax auritus	Double-crested Cormorant			
Phalaropus tricolor	Wilson's Phalarope			
Plegadis chihi	White-faced Ibis		Watch list	
Pluvialis squatarola	Black-bellied Plover			
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Recurvirostra americana	American Avocet			
Riparia riparia	Bank Swallow		Threatened	
Rynchops niger	Black Skimmer			
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
Tringa melanoleuca	Greater Yellowlegs			
Tringa semipalmata	Willet			
Tringa solitaria	Solitary Sandpiper			
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		Special Concern	BSSC - Third priority
CRUSTACEAN				
Americorophium spp.	Americorophium spp.			
Cambaridae fam.	Cambaridae fam.			
Cyprididae fam.	Cyprididae fam.			
Gammarus spp.	Gammarus spp.			
Gnorimosphaeroma spp.	Gnorimosphaeroma spp.			
Hyalella spp.	Hyalella spp.			
Neomysis mercedis				Not on any status lists
HERP				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Ambystoma californiense californiense	California Tiger Salamander	Threatened	Threatened	ARSSC
Ambystoma macrodactylum	Long-toed salamander			
Ambystoma macrodactylum croceum	Santa Cruz Long-toed Salamander	Endangered	Endangered	

Anaxyrus boreas boreas	Boreal Toad			
Anaxyrus boreas halophilus	California Toad			ARSSC
Pseudacris regilla	Northern Pacific Chorus Frog			
Pseudacris sierra	Sierran Treefrog			
Rana boylii	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Rana draytonii	California Red-legged Frog	Threatened	Special Concern	ARSSC
Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Taricha torosa	Coast Range Newt		Special Concern	ARSSC
Thamnophis elegans elegans	Mountain Gartersnake			Not on any status lists
Thamnophis elegans terrestris	Coast Gartersnake			Not on any status lists
Thamnophis hammondii hammondii	Two-striped Gartersnake		Special Concern	ARSSC
Thamnophis sirtalis infernalis	California Red-sided Gartersnake			Not on any status lists
Thamnophis sirtalis sirtalis	Common Gartersnake			
INSECT & OTHER INVERT				
Abedus spp.	Abedus spp.			
Ablabesmyia spp.	Ablabesmyia spp.			
Acentrella spp.	Acentrella spp.			
Aeshna interrupta interna				
Aeshna palmata	Paddle-tailed Darner			
Aeshnidae fam.	Aeshnidae fam.			
Agabus spp.	Agabus spp.			
Ameletus spp.	Ameletus spp.			
Argia spp.	Argia spp.			
Baetidae fam.	Baetidae fam.			
Baetis spp.	Baetis spp.			
Belostomatidae fam.	Belostomatidae fam.			
Berosus spp.	Berosus spp.			
Bisancora spp.	Bisancora spp.			
Brachycentrus spp.	Brachycentrus spp.			
Brillia spp.	Brillia spp.			

Calineuria californica	Western Stone			
Callibaetis spp.	Callibaetis spp.			
Centroptilum spp.	Centroptilum spp.			
Chaetocladius spp.	Chaetocladius spp.			
Cheumatopsyche spp.	Cheumatopsyche spp.			
Chironomidae fam.	Chironomidae fam.			
Chironomus spp.	Chironomus spp.			
Chloroperlidae fam.	Chloroperlidae fam.			
Choroterpes spp.	Choroterpes spp.			
Cladotanytarsus spp.	Cladotanytarsus spp.			
Coenagrionidae fam.	Coenagrionidae fam.			
Corisella decolor				Not on any status lists
Corisella spp.	Corisella spp.			
Corixidae fam.	Corixidae fam.			
Cricotopus spp.	Cricotopus spp.			
Cryptotendipes spp.	Cryptotendipes spp.			
Cymbiodyta spp.	Cymbiodyta spp.			
Dicrotendipes spp.	Dicrotendipes spp.			
Diphetor hageni	Hagen's Small Minnow Mayfly			
Drunella spp.	Drunella spp.			
Dytiscidae fam.	Dytiscidae fam.			
Enallagma carunculatum	Tule Bluet			
Enallagma spp.	Enallagma spp.			
Epeorus spp.	Epeorus spp.			
Ephydridae fam.	Ephydridae fam.			
Fallceon quilleri	A Mayfly			
Fallceon spp.	Fallceon spp.			
Gomphidae fam.	Gomphidae fam.			
Gumaga spp.	Gumaga spp.			
Gyrinus spp.	Gyrinus spp.			
Heptageniidae fam.	Heptageniidae fam.			
Hydrophilidae fam.	Hydrophilidae fam.			
Hydroporus spp.	Hydroporus spp.			
Hydropsyche spp.	Hydropsyche spp.			
Hydroptila spp.	Hydroptila spp.			
Hydroptilidae fam.	Hydroptilidae fam.			
Ischnura spp.	Ischnura spp.			
Isoperla spp.	Isoperla spp.			
Laccobius spp.	Laccobius spp.			
Laccophilus spp.	Laccophilus spp.			
Lepidostoma spp.	Lepidostoma spp.			
Leptoceridae fam.	Leptoceridae fam.			

Leucrocuta spp.	Leucrocuta spp.			
Limnophyes spp.	Limnophyes spp.			
Liodessus obscurellus				Not on any status lists
Malenka spp.	Malenka spp.			
Micropsectra spp.	Micropsectra spp.			
Microtendipes spp.	Microtendipes spp.			
Mystacides spp.	Mystacides spp.			
Nanocladius spp.	Nanocladius spp.			
Nectopsyche spp.	Nectopsyche spp.			
Ochthebius spp.	Ochthebius spp.			
Onocosmoecus spp.	Onocosmoecus spp.			
Optioservus spp.	Optioservus spp.			
Oreodytes spp.	Oreodytes spp.			
Pantala hymenaea	Spot-winged Glider			
Paracladopelma spp.	Paracladopelma spp.			
Paracymus spp.	Paracymus spp.			
Parakiefferiella spp.	Parakiefferiella spp.			
Paraleptophlebia spp.	Paraleptophlebia spp.			
Paratanytarsus spp.	Paratanytarsus spp.			
Paratendipes spp.	Paratendipes spp.			
Peltodytes spp.	Peltodytes spp.			
Phaenopsectra spp.	Phaenopsectra spp.			
Polypedilum spp.	Polypedilum spp.			
Procladius spp.	Procladius spp.			
Psephenus falli				Not on any status lists
Pseudosmittia spp.	Pseudosmittia spp.			
Psychodidae fam.	Psychodidae fam.			
Rhagovelia distincta				Not on any status lists
Rhagovelia spp.	Rhagovelia spp.			
Rheotanytarsus spp.	Rheotanytarsus spp.			
Rhionaeschna multicolor	Blue-eyed Darner			
Rhionaeshna spp.	Rhionaeshna spp.			
Rhithrogena spp.	Rhithrogena spp.			
Rhyacophila spp.	Rhyacophila spp.			
Serratella spp.	Serratella spp.			
Sigara spp.	Sigara spp.			
Simulium spp.	Simulium spp.			
Sperchon spp.	Sperchon spp.			
Sperchontidae fam.	Sperchontidae fam.			
Stylurus spp.	Stylurus spp.			

Sweltsa spp.	Sweltsa spp.			
Sympetrum corruptum	Variegated Meadowhawk			
Tanytarsus spp.	Tanytarsus spp.			
Tipulidae fam.	Tipulidae fam.			
Trichocorixa calva				Not on any status lists
Trichocorixa spp.	Trichocorixa spp.			
Tricorythodes spp.	Tricorythodes spp.			
Tropisternus spp.	Tropisternus spp.			
Uvarus subtilis				Not on any status lists
Zaitzevia spp.	Zaitzevia spp.			
MAMMAL				
Lontra canadensis canadensis	North American River Otter			Not on any status lists
MOLLUSK				
Anodonta californiensis	California Floater		Special	
Ferrissia rivularis	Creeping Ancylid			CS
Ferrissia spp.	Ferrissia spp.			
Helisoma spp.	Helisoma spp.			
Hydrobiidae fam.	Hydrobiidae fam.			
Lymnaea spp.	Lymnaea spp.			
Menetus opercularis	Button Sprite			CS
Physa spp.	Physa spp.			
Pisidium spp.	Pisidium spp.			
Planorbidae fam.	Planorbidae fam.			
Pomatiopsis spp.	Pomatiopsis spp.			
Sphaeriidae fam.	Sphaeriidae fam.			
PLANT				
Arundo donax	NA			
Azolla filiculoides	NA			
Calochortus uniflorus	Shortstem Mariposa Lily		Special	CRPR - 4.2
Carex densa	Dense Sedge			
Carex harfordii	Harford's Sedge			
Carex obnupta	Slough Sedge			
Cotula coronopifolia	NA			
Eleocharis macrostachya	Creeping Spikerush			
Euthamia occidentalis	Western Fragrant Goldenrod			
Helenium puberulum	Rosilla			
Hypericum anagalloides	Tinker's-penny			
Jaumea carnosa	Fleshy Jaumea			
Juncus effusus pacificus				

Juncus phaeocephalus phaeocephalus	Brown-head Rush			
Juncus xiphioides	Iris-leaf Rush			
Lemna minor	Lesser Duckweed			
Lepidium oxycarpum	Sharp-pod Pepper-grass			
Limonium californicum	California Sea-lavender			
Mimulus guttatus	Common Large Monkeyflower			
Navarretia intertexta	Needleleaf Navarretia			
Oenanthe sarmentosa	Water-parsley			
Perideridia gairdneri gairdneri	Gairdner's Yampah		Special	CRPR - 4.2
Phacelia distans	NA			
Phragmites australis australis	Common Reed			
Plantago elongata elongata	Slender Plantain			
Populus trichocarpa	NA			Not on any status lists
Potentilla anserina pacifica				Not on any status lists
Psilocarphus tenellus	NA			
Rorippa curvisiliqua curvisiliqua	Curve-pod Yellowcress			
Rumex conglomeratus	NA			
Rumex occidentalis				Not on any status lists
Rumex salicifolius salicifolius	Willow Dock			
Rumex stenophyllus	NA			
Salix babylonica	NA			
Salix exigua exigua	Narrowleaf Willow			
Salix laevigata	Polished Willow			
Salix lasiandra lasiandra				Not on any status lists
Salix lasiolepis lasiolepis	Arroyo Willow			
Sequoia sempervirens				
Sparganium eurycarpum eurycarpum				
Stachys ajugoides	Bugle Hedge-nettle			
Stachys chamissonis chamissonis	Coast Hedge-nettle			
Stellaria littoralis	Beach Starwort		Special	CRPR - 4.2
Triglochin maritima	Common Bog Arrow-grass			
Typha latifolia	Broadleaf Cattail			

Veronica anagallis-aquatica	NA			
FISH				
Catostomus occidentalis mnioltiltus	Monterey sucker			Least Concern - Moyle 2013
Cottus aleuticus	Coastrange sculpin			Least Concern - Moyle 2013
Cottus asper ssp. 1	Prickly sculpin			Least Concern - Moyle 2013
Entosphenus tridentata ssp. 1	Pacific lamprey		Special	Near-Threatened - Moyle 2013
Eucyclogobius newberryi	Tidewater goby	Endangered	Special Concern	Vulnerable - Moyle 2013
Gasterosteus aculeatus aculeatus	Coastal threespine stickleback			Least Concern - Moyle 2013
Gasterosteus aculeatus microcephalus	Inland threespine stickleback		Special	Least Concern - Moyle 2013
Lavinia exilicauda harengeus	Monterey hitch		Special	Vulnerable - Moyle 2013
Lavinia symmetricus subditus	Monterey roach		Special Concern	Near-Threatened - Moyle 2013
Oncorhynchus gorbuscha	Pink salmon		Special Concern	Endangered - Moyle 2013
Oncorhynchus mykiss - SCCC	South Central California coast steelhead	Threatened	Special Concern	Vulnerable - Moyle 2013
Oncorhynchus mykiss irideus	Coastal rainbow trout			Least Concern - Moyle 2013
Orthodon microlepidotus	Sacramento blackfish			Least Concern - Moyle 2013
Ptychocheilus grandis	Sacramento pikeminnow			Least Concern - Moyle 2013
Rhinichthys osculus ssp. 1	Sacramento speckled dace			Least Concern - Moyle 2013
Spirinchus thaleichthys	Longfin smelt	Candidate	Threatened	Vulnerable - Moyle 2013

Attachment D

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IDENTIFYING GDEs UNDER SGMA
Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). The California Department of Water Resources (DWR) has provided the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online (https://gis.water.ca.gov/app/NCDatasetViewer/) to help Groundwater Sustainability Agencies (GSAs) identify GDEs within a groundwater basin. The NC Dataset is a compilation of 48 publicly available State and Federal agency datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[7].

The NC Dataset indicates the vegetation and wetland features that are good indicators of a GDE. The NC dataset is a starting point, and it is the responsibility of GSAs to utilize best available science and local knowledge on the hydrology, geology, and groundwater levels to verify its presence or absence, as well as whether a connection to groundwater in an aquifer exists (Figure 1)[8]. Detailed guidance on identifying GDEs within a groundwater basin from the NC dataset is available[9]. This document highlights six best practices that GSAs and their consultants can apply when using local groundwater data to confirm a connection to groundwater for the NC Dataset.

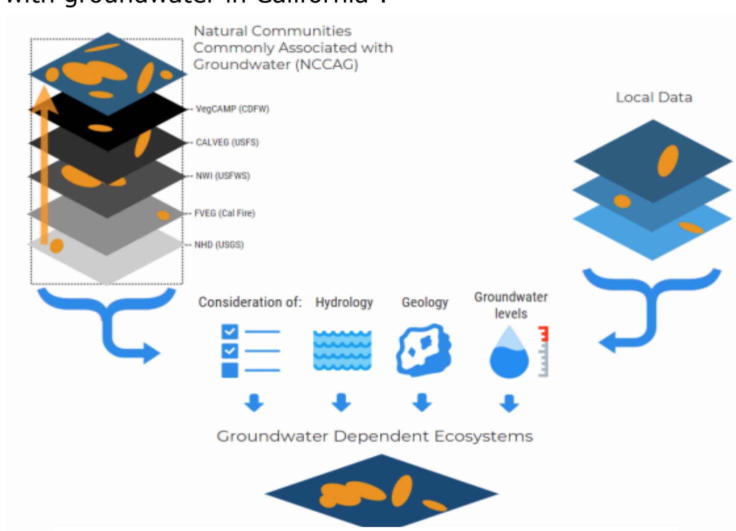

Figure 1. Considerations for GDE identification. Source: DWR[2]

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[7] For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf

[8] *California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf*

[9] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/

BEST PRACTICE #1. Connection to an Aquifer

Groundwater basins can be comprised of one continuous aquifer or multiple aquifers stacked on top of each other. Basins with a stacked series of aquifers may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, and groundwater dependent ecosystems (Figure 2). This is because the goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits, and while groundwater pumping may not be currently occurring in a shallower aquifer, it could be in the future. For example, if a shallow perched aquifer is currently not being pumped due to poor water quality resulting from irrigation return flow, producing this water will become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided and a GSA's legal risk be minimized. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

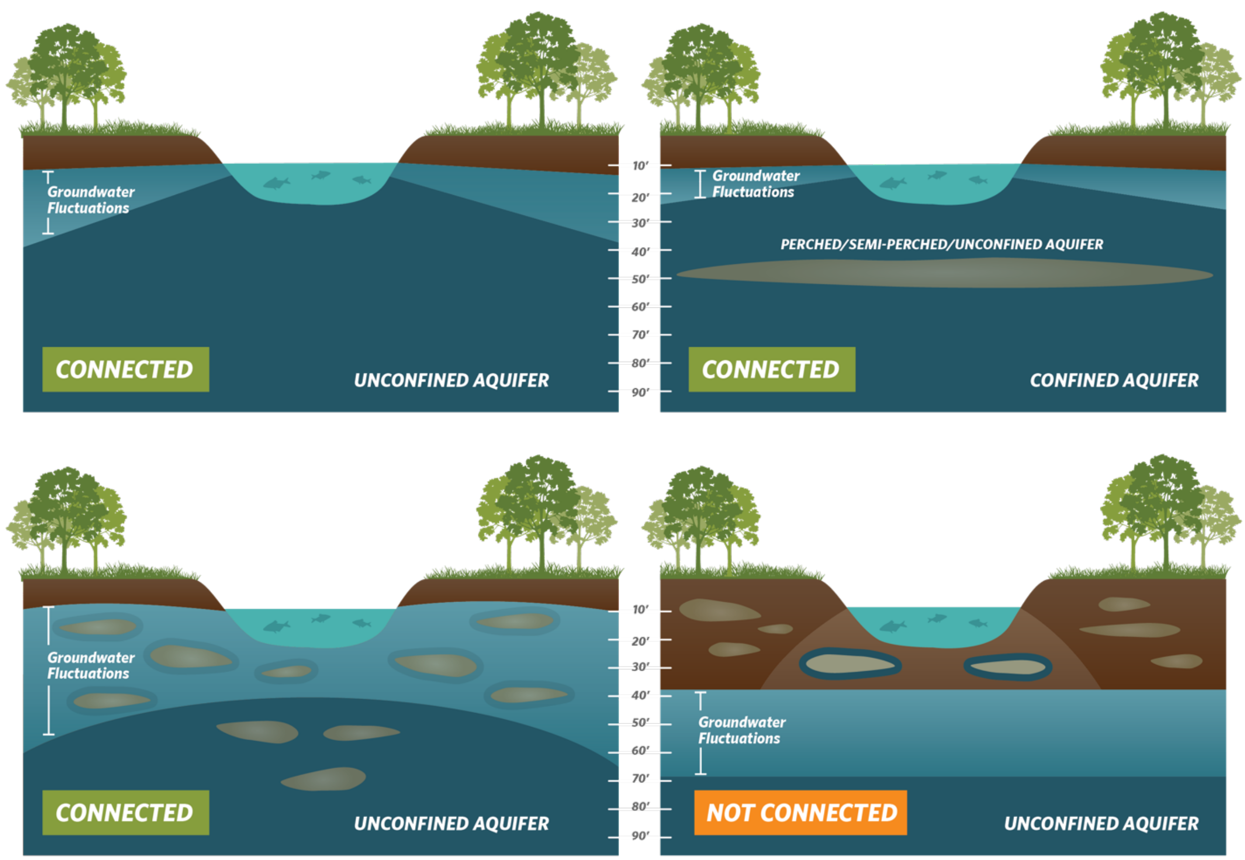


Figure 2. Confirming whether an ecosystem is connected to groundwater in a principal aquifer. Top: (Left) Depth to Groundwater in the aquifer under the ecosystem is an unconfined aquifer with depth to groundwater fluctuating seasonally and interannually within 30 feet from land surface. **(Right)** Depth to Groundwater in the *shallow* aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the *shallow* aquifer. **Bottom: (Left)** Depth to groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystems connection to groundwater. (Right) Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is *due to* direct recharge from precipitation and indirect recharge under surface water feature.

BEST PRACTICE #2. Characterize Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth to groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability (i.e., wet, average, dry, and drought years) that is characteristic of California's climate. DWR's Best Management Practices document on water budgets[10] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[11] could be determined based on data between 2005 and 2015.

GDEs existing on the earth's surface depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[12] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in the GDE guidance document[2], one of the key factors to consider when mapping GDEs is to contour depth to groundwater in the aquifer that is in direct contact with the ecosystem.

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however, if these groundwater conditions are prolonged adverse impacts to GDEs can result. While depth to groundwater levels within 30 feet[2] are generally accepted as being a proxy for confirming that polygons in the NC dataset are connected to groundwater, it is highly advised that fluctuations in the groundwater regime are taken into consideration and to characterize the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[13]. However, if insufficient data are available to describe groundwater conditions within polygons from the NC dataset, it is highly advised that they be included in the GSP <u>until</u> data gaps are reconciled in the monitoring network (See Best Practice #6).

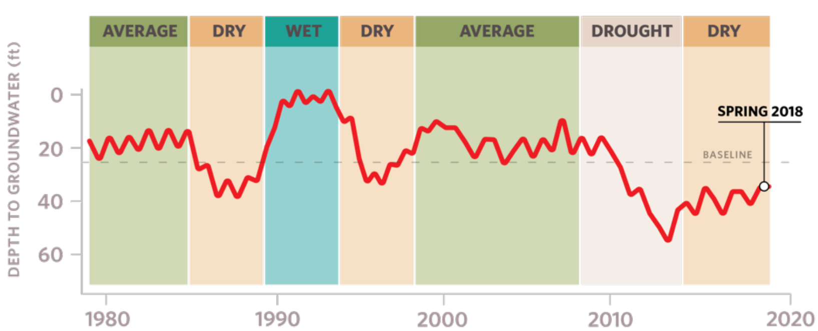


Figure 3. Example seasonality and interannual variability in depth to groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

[10] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf
[11] Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]
[12] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs - link in footnote above).
[13] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

BEST PRACTICE #3. Ecosystems Can Rely on Both Surface and Groundwater

GDEs can rely on groundwater for all or some of its requirements, using multiple water sources simultaneously and at different temporal or spatial scales. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around NC polygons does not preclude the possibility that a connection to groundwater exists. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth to groundwater data should be used to identify whether NC polygons are connected to groundwater and should be considered GDEs.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and would not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

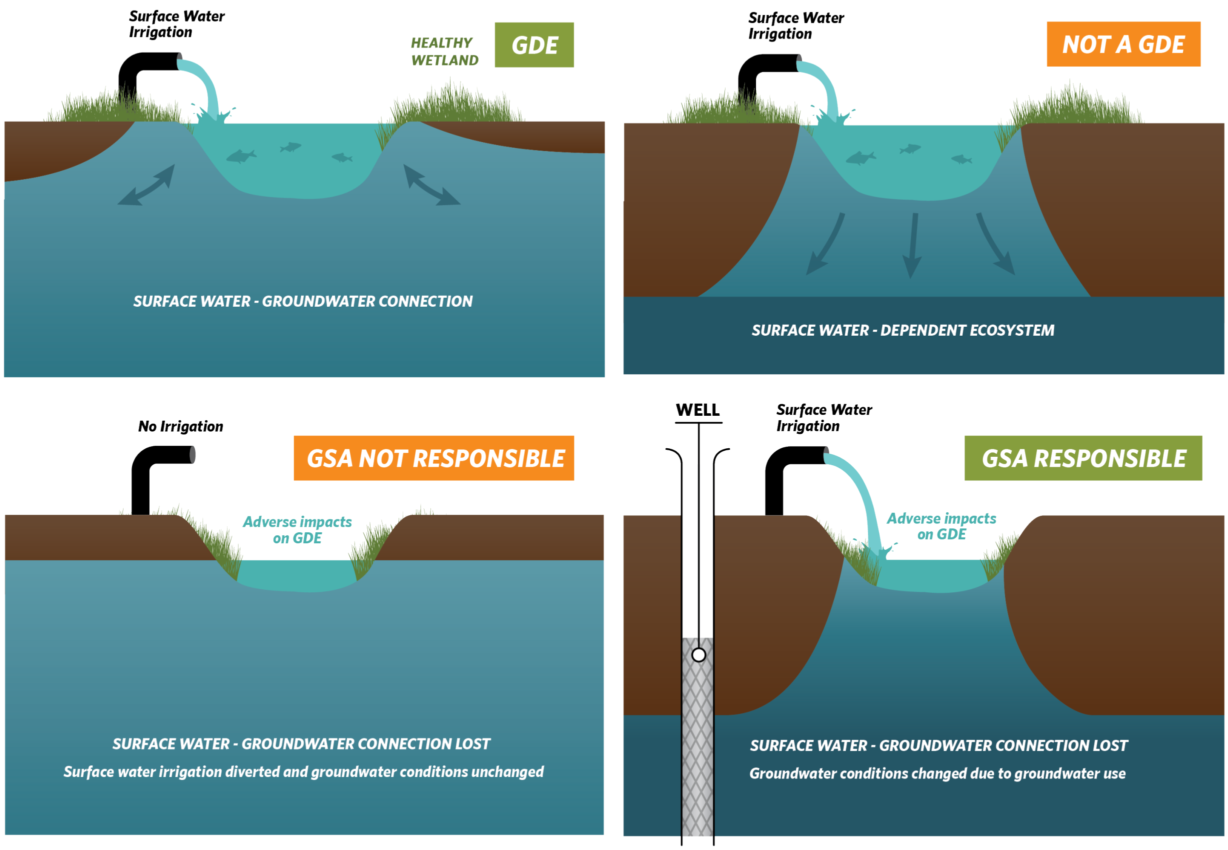


Figure 4. Ecosystems can depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, such that a connection to groundwater exists for the ecosystem. **(Right)** Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. **Bottom: (Left)** An ecosystem that was once dependent on an interconnected surface water and groundwater connection, but then loses this connection due to surface water diversions would not be the GSA's responsibility. **(Right)** Groundwater dependent ecosystems in places where a surface water – groundwater connection existed, but then loose that connection due to groundwater pumping would be the GSA's responsibility.

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin require that groundwater conditions are characterized to confirm whether polygons in the NC dataset are connected to an underlying aquifer. Once an aquifer has been identified, representative groundwater wells are necessary to characterize groundwater conditions (Figure 5). It is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of the NC Dataset polygons, and more likely to reflect the local conditions relevant to the ecosystem. NC dataset polygons that are farther than 5 km from a well should not be excluded because of interpolated groundwater depth conditions, as there is insufficient information to make that determination. Instead, they should be retained as potential GDEs until there is sufficient data to determine whether or not the NC Dataset polygon is connected to groundwater and is a GDE.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient well information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer.

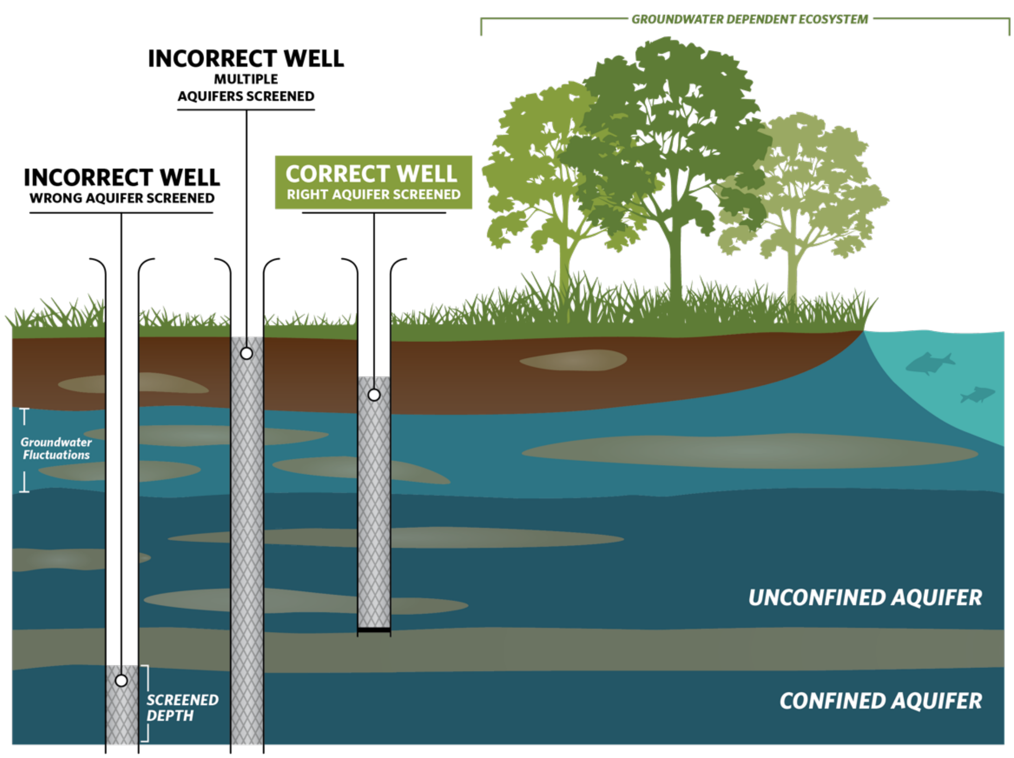


Figure 5. Selecting representative wells to characterize groundwater conditions in the aquifers directly connected with GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

A common, but error prone practice, to contour depth to groundwater over a large area is to interpolate depth to groundwater measurements at monitoring wells. This practice causes errors when the land surface contains features like streams and wetlands depressions because it assumes the land surface is constant across the landscape and depth to groundwater is constant below these low-lying areas (Figure 6). A more accurate approach is to interpolate **groundwater elevations** at monitoring wells to get an estimate of groundwater elevation across the landscape. This layer can then be subtracted from the land surface elevation from a Digital Elevation Model (DEM)[14] to estimate depth to groundwater contours across the landscape (Figure 7). This will provide a much more accurate contours of depth to groundwater along streams and other land surface depressions where GDEs are commonly found.

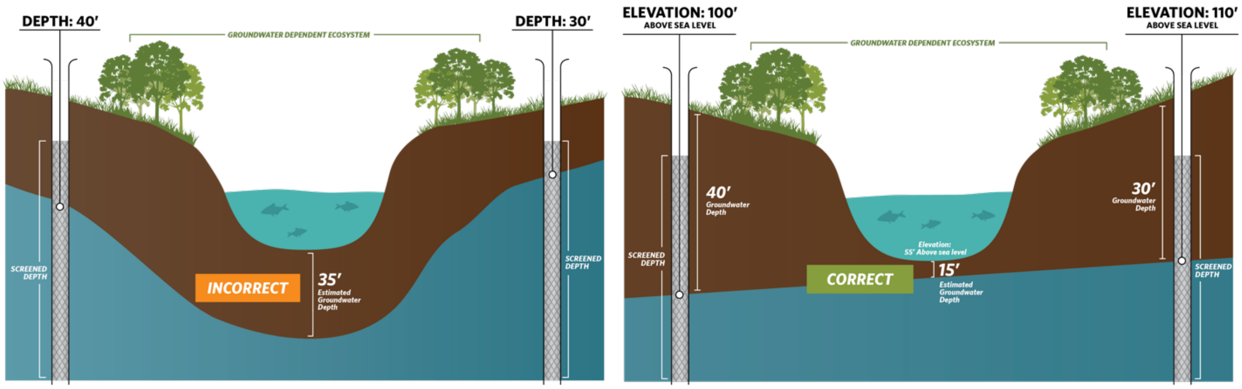


Figure 6. Contouring depth to groundwater around surface water features and GDEs. (Left) Groundwater level interpolation using depth to groundwater data from monitoring wells. **(Right)** Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

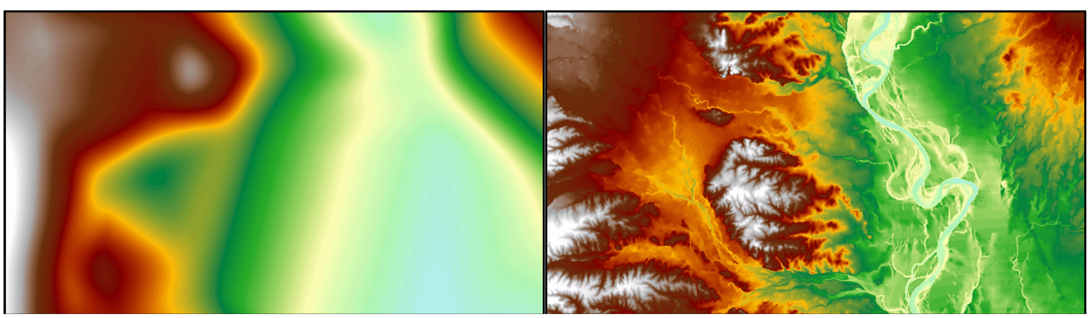


Figure 7. Depth to Groundwater Contours in Northern California. (Left) Contours were interpolated using depth to groundwater measurements determined at each well. **(Right)** Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth to groundwater contours. The image on the right shows a more accurate depth to groundwater estimate because it takes the local topography and elevation changes into account.

[14] *Digital Elevation Model data is available at: https://catalog.data.gov/dataset/usgs-national-elevation-dataset-ned-1-meter-downloadable-data-collection-from-the-national-map-*

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, **The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network.** Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) 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. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

18 April 2019

MEMORANDUM

To: Gary Peterson, Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA)
Derrik Williams, P.G., C.Hg., Montgomery & Associates

From: Keith Van Der Maaten, P.E., Marina Coast Water District (MCWD)
Patrick Breen, MCWD
Vera Nelson, P.E., EKI Environment and Water, Inc. (EKI)
Tina Wang, P.E., EKI

Subject: Preliminary Comments Regarding Salinas Valley Basin Groundwater Sustainability Agency Draft Groundwater Sustainability Plan Chapter 5 (EKI B60094.03)

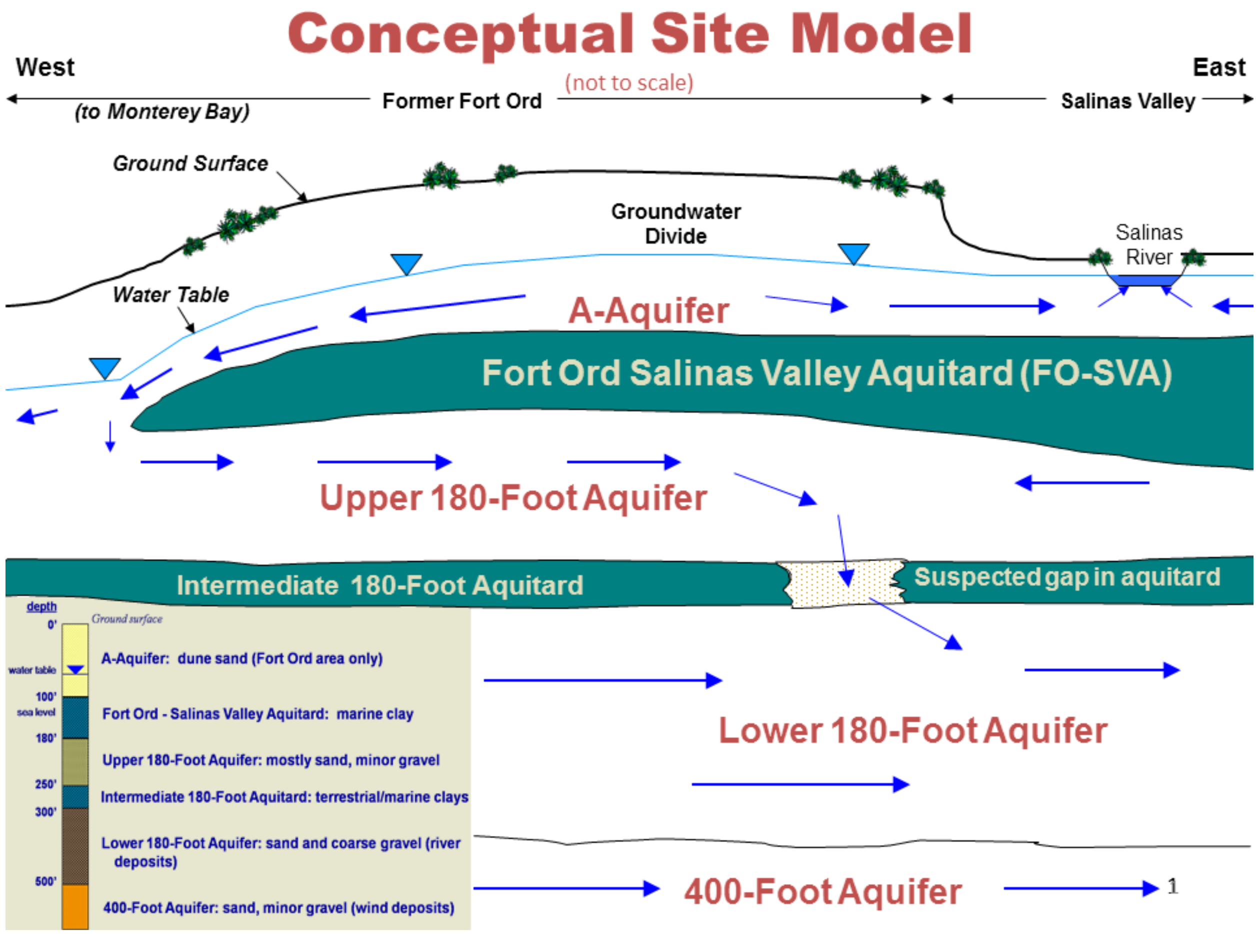
On behalf of the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA), EKI has reviewed and prepared preliminary comments on the SVBGSA draft 180/400 Foot Aquifer Subbasin and Salinas Valley Integrated Groundwater Sustainability Plans (GSPs) Chapter 5, released January 2019 and updated February 2019.

1. General Comment

We understand that SVBGSA has solicitated input during its February 7 Planning Committee regarding the inclusion of the Dune Sand Aquifer in its GSPs. Although the Dune Sand Aquifer exists only south of the river and thus encompasses a small portion of the 180/400 Foot Aquifer Subbasin, we request that the 180/400 Foot Aquifer Subbasin GSP characterize the Dune Sand Aquifer for the following reasons.

(1) The Dune Sand Aquifer is an important source of freshwater and recharge to deeper aquifers south of the Salinas River.

- Groundwater level data and groundwater quality data obtained from Fort Ord indicate that groundwater with low TDS concentrations from the Dune Sand Aquifer seeps down into the upper portion of the 180-Foot Aquifer, upgradient of the coast and then “U-turns” and flows back into the basin. This process is illustrated in figures presented on Fort Ord’s website:



Source: http://fortordcleanup.com/programs/groundwater

- Recent airborne electromagnetic (AEM) data collected in the northern Salinas Valley (see Attachment A) has confirmed that freshwater exists in the Dune Sand Aquifer and underlying portions of the Upper 180-Foot Aquifer in 180/400-Foot Aquifer Subbasin.

(2) The Dune Sand Aquifer is likely a water source for shallow wells in the Corral de Tierra area in the adjacent Monterey Subbasin, which should be further confirmed by SVBGSA in its preparation of GSP components of the Corral de Tierra area.

(3) Chemical impacts exist within the Dune Sand Aquifer, which could impact other underlying aquifers.

- Volatile organic compounds (VOCs) and other constituents have been detected in groundwater within the Dune Sand Aquifer at the Monterey Peninsula Landfill (Geotracker ID L10005501051).

- Groundwater quality data obtained from Monterey Peninsula Water Supply Project (MPWSP) shallow monitoring wells suggest that nitrate impacts may exist in the Dune Sand Aquifer.

(4) Multiple Projects have been proposed within the Dune Sand Aquifer in the 180/400-Foot Aquifer Subbasin.
- Several studies have been completed by MCWD and Fort Ord Reuse Authority (FORA) to evaluate the potential infiltration and storage of Advanced Treated wastewater or excess surface water from the Salinas River within the Dune Sand Aquifer at Armstrong Ranch.
- MPWSP slant wells are screened across and will draw water from the Dune Sand Aquifer.

Therefore, the 180/400 Foot Aquifer Subbasin GSP should characterize the Dune Sand Aquifer and develop a plan to manage current as well as planned groundwater activities in the Dune Sand Aquifer. Moreover, MCWD will coordinate with SVBGSA to develop Sustainable Management Criteria (SMCs) for Dune Sand Aquifer in the Monterey Subbasin GSP, given the Dune Sand Aquifer's importance in water source and groundwater recharge. It is important that the Dune Sand Aquifer is properly characterized in both the 180/400 Foot Aquifer Subbasin GSP and the Monterey Subbasin GSP, so that a coordinated set of SMCs are developed for the Dune Sand Aquifer in both GSPs.

2. <u>Section 5.1 – Groundwater Elevations</u>

Draft chapter 5 of the 180/400 Foot Aquifer Subbasin GSP states that "Insufficient data currently exist to map flow directions and groundwater elevations in the deep aquifer" (Page 17) and "Hydrographs are not available for wells completed in the Deep Aquifer" (Page 18). However, MCWRA's 2017 *Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin* states that there are 32 active productions wells and eight monitoring wells screened in the deep aquifers, and that MCWRA monitors groundwater levels at thirteen locations in the Deep Aquifers "with varying frequency", a majority of which are located in the 180/400 Foot Aquifer Subbasin. Figure 21 of the document showed average groundwater level changes in the deep aquifers from 1986 to 2016. We suggest that the SVBGSA obtain this information from MCWRA and provide groundwater elevation and/or elevation trend information in the Deep Aquifer.

3. <u>Section 5.2 – Seawater Intrusion</u>

Per GSP Regulations Section 354.16 (c), a GSP should provide "seawater intrusion conditions in the basin, including maps and cross sections of the seawater intrusion front for each principal aquifer". The GSPs should address this requirement and provide cross-sections. AEM data collected by MCWD should be incorporated into these cross-sections[1].

Attachments

Attachment A. Selected Figures from Gottschalk et al. Interpretation of Hydrostratigraphy and Water Quality from AEM Data Collected in the Northern Salinas Valley, CA, dated 15 March 2018.

[1] Gottschalk et al. Interpretation of Hydrostratigraphy and Water Quality from AEM Data Collected in the Northern Salinas Valley, CA, dated 15 March 2018.

Attachment A

Selected Figures from Gottschalk et al. Interpretation of Hydrostratigraphy and Water Quality from AEM Data Collected in the Northern Salinas Valley, CA, dated 15 March 2018.

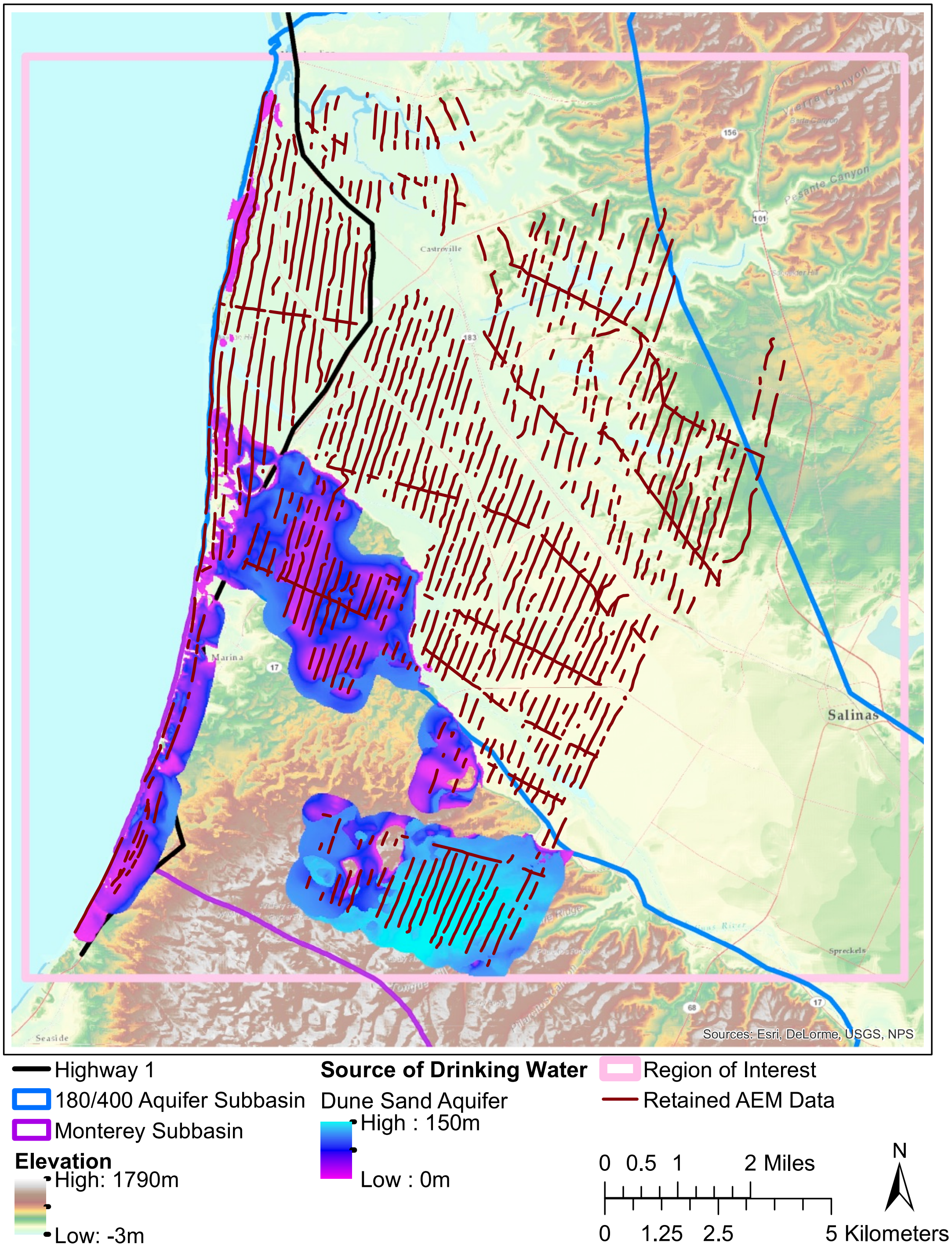


Figure 22: Interpreted thickness of the subsurface containing sources of drinking water within the Dune Sand Aquifer in the region of interest, shown in a color scale ranging from purple to light blue, representing 0 m to 150 integrated meters of the source drinking water, respectively. Overlaying the thickness of sources of drinking water are the locations where AEM data were collected and retained for processing, shown as red lines. The Dune Sand Aquifer lies south of the Salinas River, aside from the dune sand deposits along the coast within the Salinas Valley basin, which are also treated as part of the Dune Sand Aquifer here. The boundaries used in calculating the regions containing sources of drinking water, Highway 1, the 180/400 Aquifer Subbasin, and the Monterey Subbasin, are shown as black, blue, and purple lines, respectively.

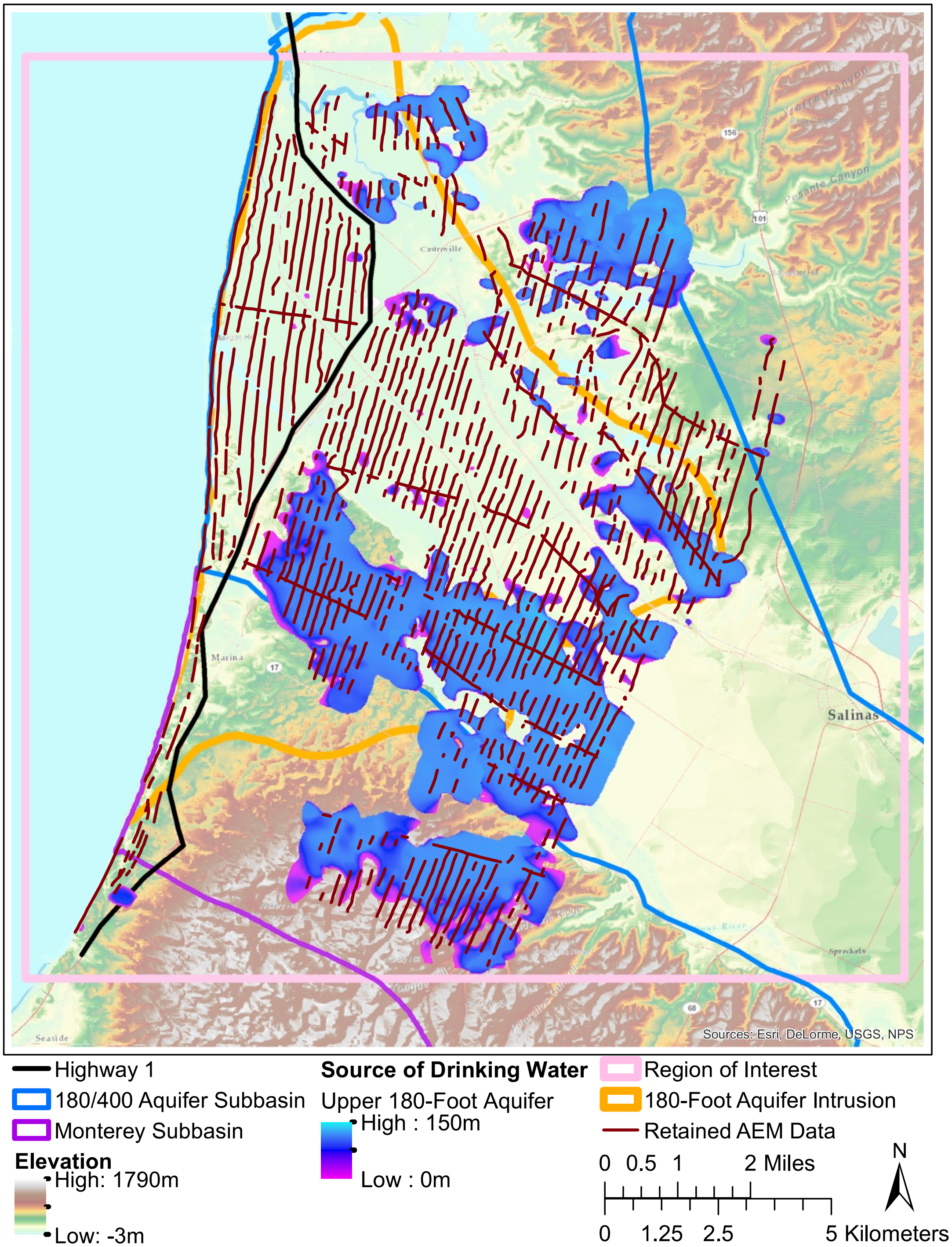


Figure 23: Interpreted thickness of the subsurface containing sources of drinking water within the Upper 180-Foot Aquifer in the region of interest, shown in a color scale ranging from purple to light blue, representing 0 m to 150 integrated meters of the source of drinking water, respectively. Overlaying the thickness of sources of drinking water are the locations where AEM data were collected and retained for processing, shown as red lines. The extent of saltwater intrusion in the 400-Foot Aquifer, as measured by the Monterey County Water Resources Agency, is shown as an orange line. The boundaries used in calculating the regions containing sources of drinking water, Highway 1, the 180/400 Aquifer Subbasin, and the Monterey Subbasin, are shown as black, blue, and purple lines, respectively.

April 12, 2019

Gary Petersen
General Manager
Salinas Valley Basin Groundwater Sustainability Agency
petersen@svbgsa.org

Dear Mr. Petersen:

CENTRAL COAST WATER BOARD COMMENTS ON THE SALINAS VALLEY BASIN INTEGRATED GROUNDWATER SUSTAINABILITY PLAN DRAFT: CHAPTER 5, GROUNDWATER CONDITIONS

The Central Coast Regional Water Quality Control Board (Central Coast Water Board) is a state agency that implements state and federal water quality laws within the Central Coast region. The Salinas Valley groundwater basin falls within the jurisdictional area of the Central Coast region and as such, the Central Coast Water Board has an interest in monitoring, preserving, and restoring water quality within the basin. The Central Coast Water Board has reviewed the draft Chapter 5 of the Salinas Valley Basin Integrated Groundwater Sustainability Plan (GSP) on *Groundwater Conditions* and would like to provide comments on the groundwater quality-related portions of this draft chapter.

Nitrate
Item 8 in our May 2018 Central Coast Water Board Meeting agenda package included a staff report[1] that summarized nitrate concentrations throughout the Central Coast Region, including the Salinas Valley. This staff report includes more recent data (2008 – 2018) and data from a greater number of wells (2,235 wells) in the Salinas Valley than the 2015 Central Coast Groundwater Coalition report that is referenced in your Chapter 5. Our May 2018 staff report provides summary statistics for each of the subbasins within the Salinas Valley. Central Coast Water Board staff recommends that this report be utilized as an additional source for assessing current groundwater conditions. In addition, the staff report includes analysis of nitrate concentration trends through time in individual wells, which provides information on the rates at which groundwater is being degraded by nitrate in the Salinas Valley. This supports characterization of groundwater conditions and potentially informs development of the

[1] Central Coast Water Board staff report on groundwater quality conditions in Central Coast Groundwater basins: https://www.waterboards.ca.gov/centralcoast/board_info/agendas/2018/may/item8/item8_stfrpt.pdf

monitoring network that will be evaluating groundwater quality trends. We recommend this additional information be included in the groundwater conditions chapter.

The extent and rate of nitrate migration into the deeper parts of the Salinas Valley basin is a data gap that is not acknowledged by this draft chapter. Because nitrate pollution in the Salinas Valley basin is among the worst in the state[2], the Central Coast Water Board recommends establishing current groundwater quality conditions for different depth-discrete zones in the subbasins of the Salinas Valley. Establishing this "baseline" will allow the Salinas Valley Basin Groundwater Sustainability Agency (GSA) to assess vertical nitrate migration through time and the rate at which that migration is occurring. In addition, characterizing baseline vertical water quality conditions will be useful for assessing if the substantial pumping-induced vertical hydraulic gradients in the Salinas Valley subbasins contribute to water quality degradation. This information would be useful for implementing GSA management decisions (i.e., groundwater pumping scenarios) that accommodate sustainable water resources without negatively impacting water quality.

On page 60 of the draft report, it says that Luhdorf and Scalmanini Engineers (LSCE) mapped nitrate distributions using 758 domestic wells in the Salinas Valley. The 758 wells were not necessarily domestic wells; they were any type of well less than 400 feet deep. The Central Coast Water Board therefore recommends removing the *domestic* qualifier from this sentence and making it clear than all well types were included.

Salinity

The draft chapter has little discussion of salinity problems unrelated to seawater intrusion in the Salinas Valley. Mean total dissolved solids (TDS) concentrations in the Salinas Valley Upper Valley, East Side, and Forebay subbasins, where seawater intrusion is not occurring, exceed levels at which salt-sensitive crops begin to experience a decrease in yield. The Central Coast Water Board recommends including a discussion and characterization of groundwater salinity that is unrelated to seawater intrusion in the draft chapter, as it affects numerous users of groundwater, including agricultural and domestic needs. Staff at the Central Coast Water Board can provide further consultation or data on this issue if needed.

Hexavalent Chromium

Page 63 of the draft chapter says that hexavalent chromium does not pose a health risk and is only an aesthetic concern. On the contrary, numerous studies have demonstrated that hexavalent chromium poses a health risk. The San Francisco Bay Water Board's Environmental Screening Level (ESL) for hexavalent chromium is 0.02 micrograms per liter (µg/L) and based on the human health risk it poses. The Central Coast Water Board recommends removing all language that indicates that hexavalent chromium poses "only aesthetic concerns."

---

[2] Harter et al., 2012. Addressing nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater. http://groundwaternitrate.ucdavis.edu/files/138956.pdf

Major Dissolved Ions

The Central Coast Water Board recommends that analysis of major dissolved ions be added to the GSP or its implementation. Major dissolved cation and anion composition in groundwater reflects the source of recharge water, lithological and hydrological properties of the aquifer, groundwater residence time, and chemical processes within the aquifer. As such, major dissolved ions are valuable for identifying different groundwater types (via Piper or Stiff diagrams) and for "fingerprinting" source water from individual wells. In addition, ionic charge balance provides quality assurance that all the major ions are included in the analysis and that TDS concentrations are accurate. These considerations are important to developing a hydrogeologic conceptual model and describing groundwater conditions.

Groundwater Quality Monitoring Constituents

Regional groundwater quality monitoring is currently being discussed with the Board, and to the extent practicable, the Central Coast Water Board staff would like to coordinate agriculture-related monitoring with SGMA monitoring requirements in order to minimize duplication, maximize resources, and provide mutually beneficial data. This will benefit everyone within the Salinas Valley basin, particularly agricultural operators. The Central Coast Water Board would like to provide comments on the draft sections outlining monitoring program details and is happy to share information during preparation of those sections to help coordinate monitoring programs.

The Central Coast Water Board thanks the GSA for the work being done to sustainably manage groundwater resources in the Salinas Valley and appreciates this opportunity to provide comments. If you have questions or would like to discuss these comments in greater detail, please feel free to reach out to James Bishop, Daniel Pelikan, or Diane Kukol at the Central Coast Water Board:

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Sincerely,

for John M. Robertson
Executive Officer

cc:

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TODD GROUNDWATER

April 8, 2019

MEMORANDUM

To: Curtis Weeks, Arroyo Seco Groundwater Management Agency

From: Gus Yates, Senior Hydrologist

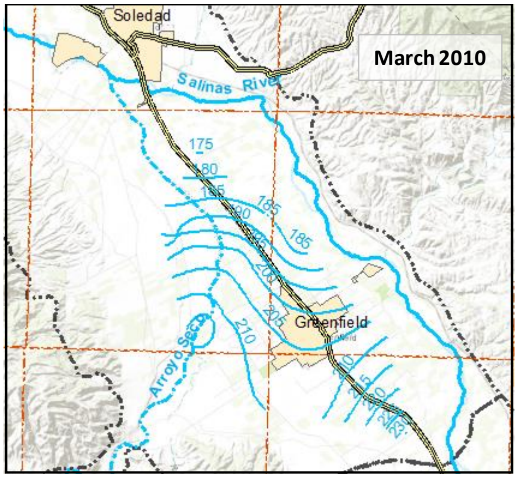
Re: Comments on SVBGSA's draft Chapter 5 "Groundwater Conditions" of Salinas Valley Integrated Water Management Plan

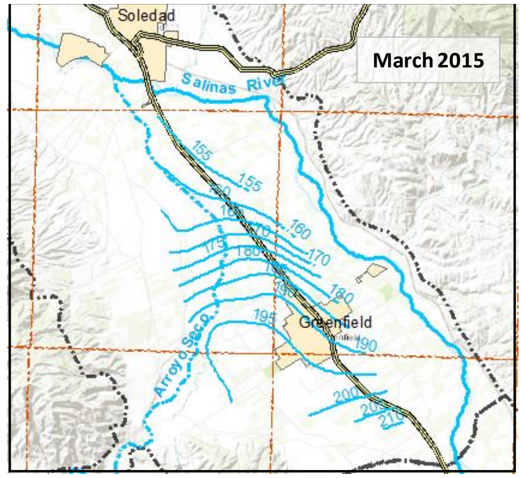
I have reviewed the draft of Chapter 5 "Groundwater Conditions" of the Salinas Valley Integrated Water Management Plan released by the Salinas Valley Basin Groundwater Sustainability Agency on March 14, 2019. Overall, the chapter is a good start toward characterizing groundwater conditions. In a number of instances, important local variations to the generalized patterns described in the chapter are overlooked. In other cases, the information presented is misleading or not correct, or editorial changes would improve the presentation. And finally, two important topics are not included in the chapter.

The specific comments below identify areas where improvements are needed. They are organized from beginning to end of the chapter. They are followed by a few comments on topics that were not covered in the report but should be.

COMMENTS ON ITEMS IN CHAPTER 5

Page 9 and Figure 5-4. December 1995 groundwater contours. How was 1995 selected to represent the full spectrum of historical groundwater contours? Especially considering the last 24 years and the variation in climate we have seen over that period. These climate changes will affect the future sustainability planning of the groundwater basin in the Salinas Valley. At a minimum, high and low conditions for wet and dry years, respectively, should be shown, and also seasonal high and low water levels. Seasonal variations are important because they reveal sources of recharge that are not apparent in the December water levels. Shown below, for example, are contours of March water levels in 2010 and 2015 in the southern half of the Forebay Subbasin.

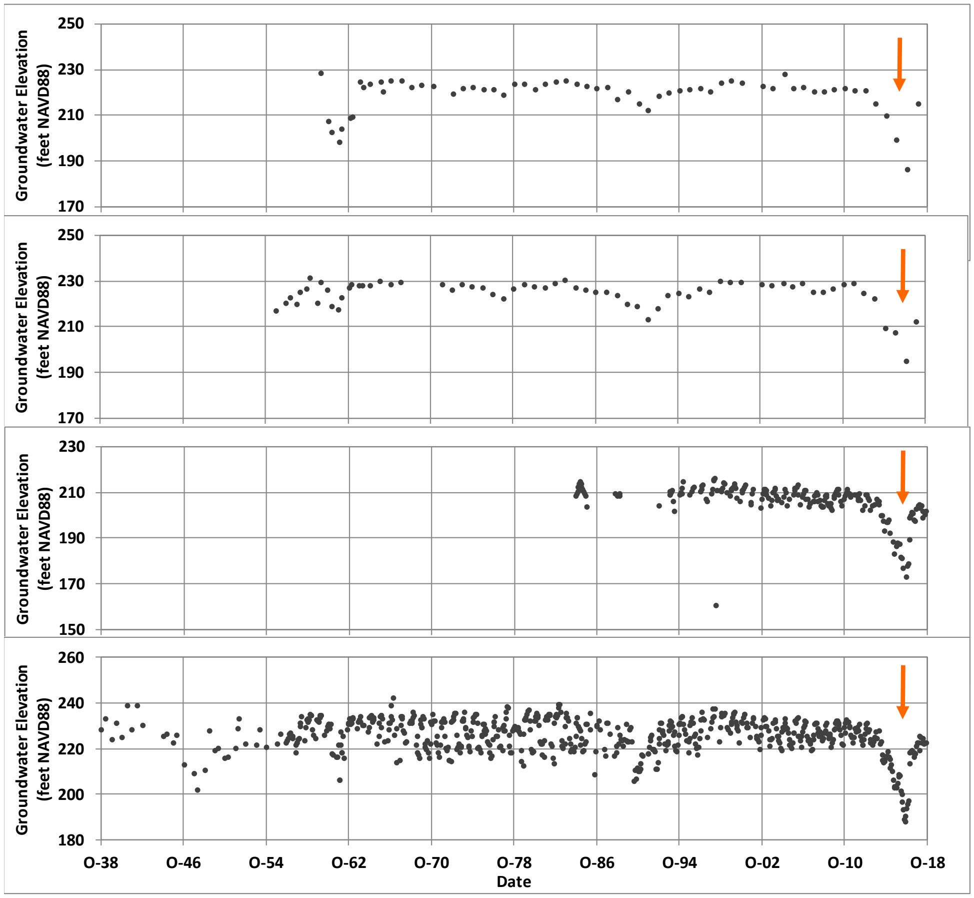




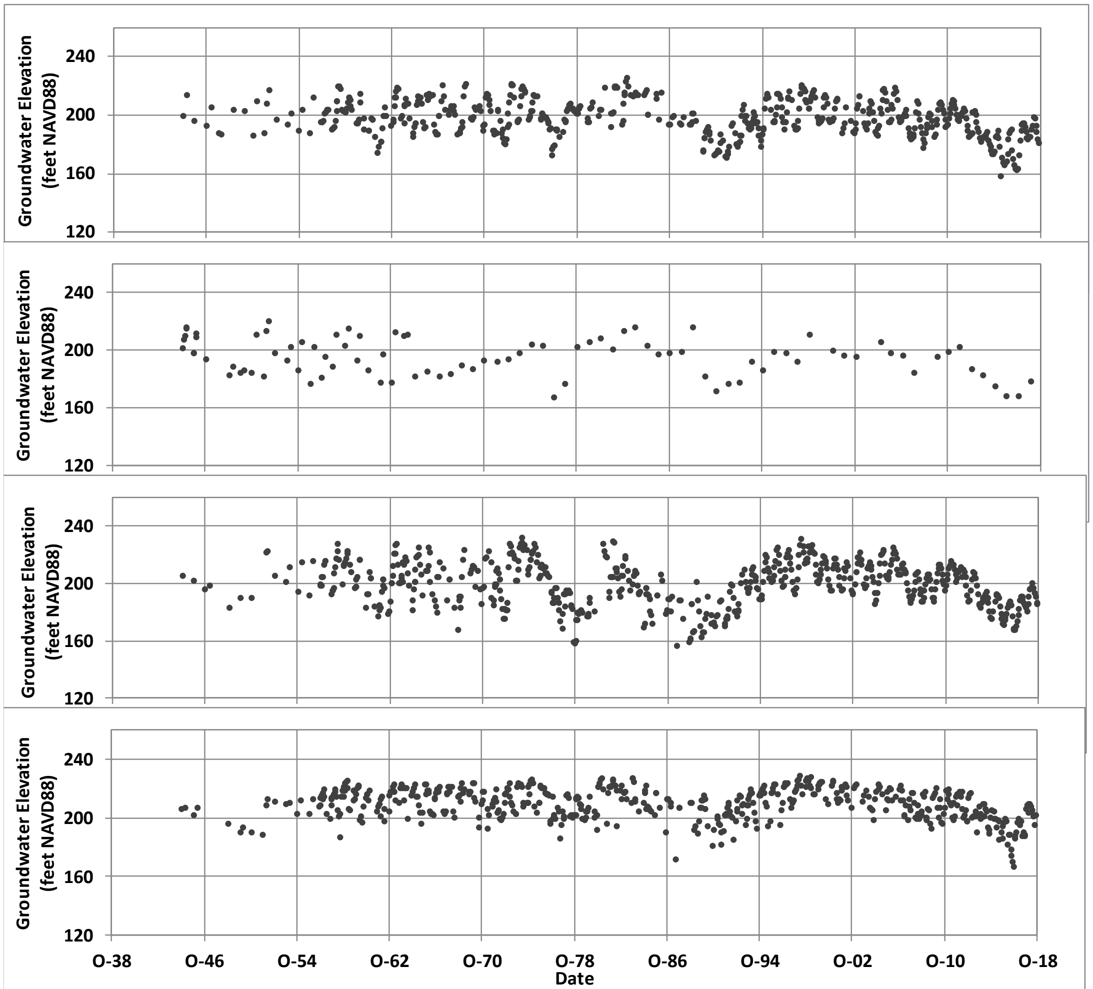
In these spring contours, the effect of Arroyo Seco recharge is prominent. This is particularly noteworthy in spring 2015 when Nacimiento and San Antonio Reservoir releases had been withheld for over two years and Arroyo Seco recharge was critical to sustaining local beneficial uses of groundwater.

Page 14, Figure 5-6, Figure 5-11 and Appendix 5A: hydrograph confidentiality.
Confidentiality does not preclude presenting hydrographs in reports, provided the well is not exactly identified. By limiting the presentation of data and discussion to only eight wells (Figure 5-6) or 55 wells (Figure 5-11 and Appendix 5-A) out of the 760 locations where MCWRA has collected water levels is unnecessarily selective excluding the data. In particular, the Forebay and Upper Valley Subbasins are underrepresented in the figures and discussion. Groundwater conditions in the Forebay Subbasin cannot be represented by a single hydrograph, as Figure 5-6 implies. By selectively excluding the data, the report fails to identify and disclose local variations in hydrograph patterns that provide important understanding of the relative influence of various recharge sources and, hence, which variables are important for groundwater management. In general terms, the report does not provide adequate granularity of data analysis, and hence may not correctly reflect groundwater conditions in these subbasins.

Groundwater conditions in the Forebay Subbasin are not homogeneous, as the draft chapter implies. Wells close to the Salinas River have hydrographs with pronounced declines during 2013-2016, as illustrated by these four hydrographs:



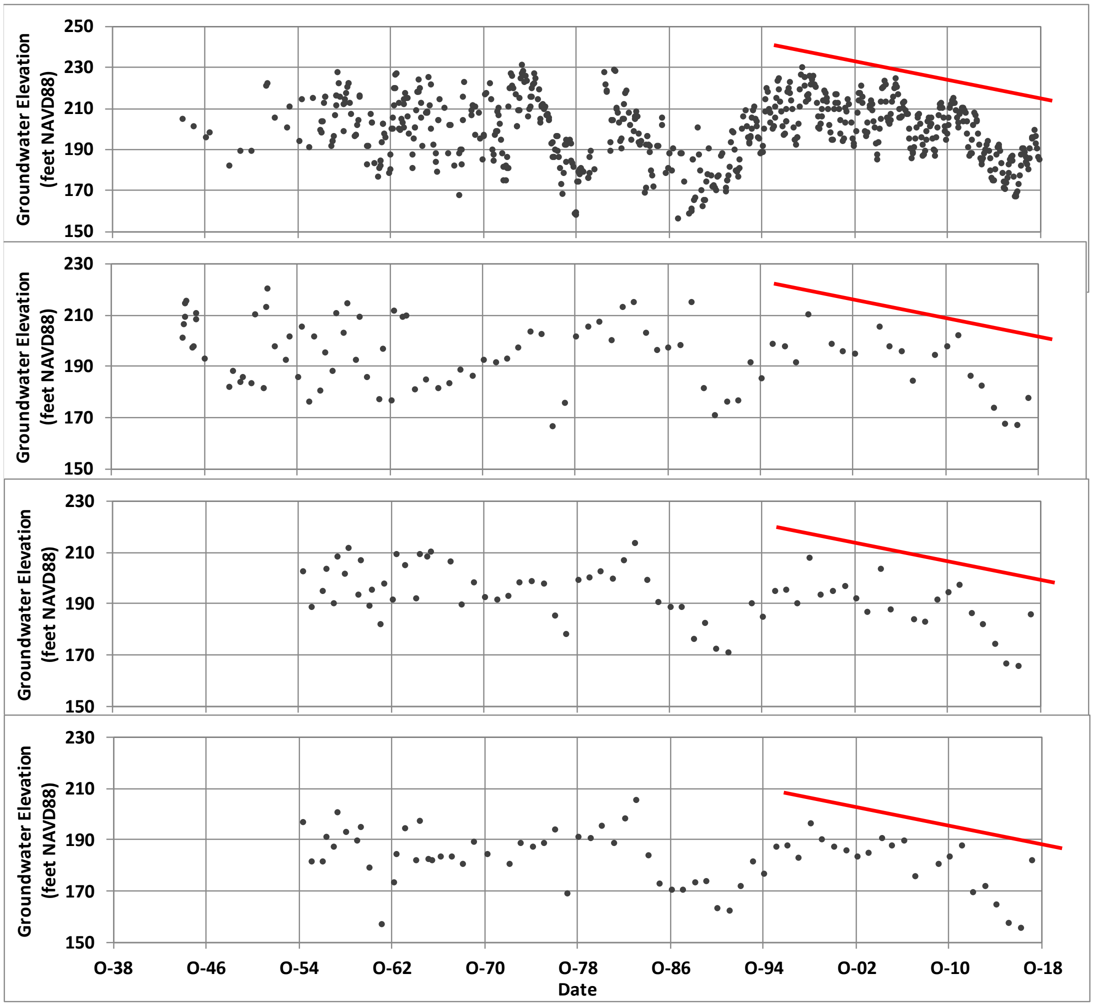
In contrast, water levels in the following set of four wells higher up on the Arroyo Seco Cone show greater seasonal variability but little cumulative decline during 2013-2016:



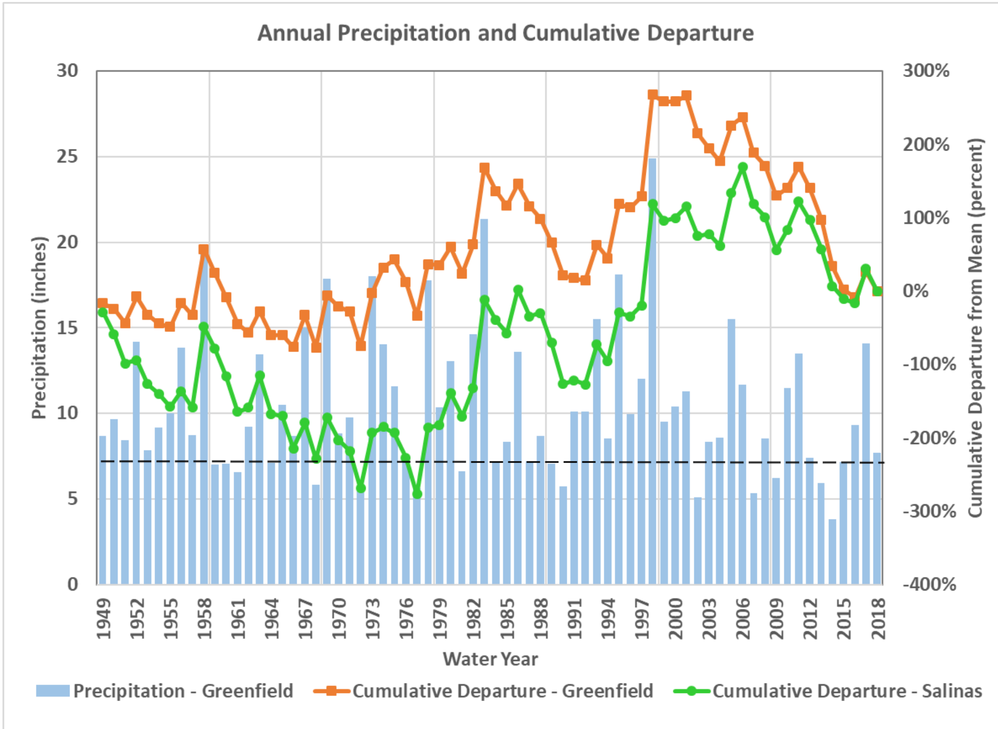
Finally, several wells on the northwestern flank of the Arroyo Seco Cone have declining trends since 1990 that are probably related to intensified local pumping to supply new vineyards in the hills to the west where well yields are poor (see hydrographs, below).

These details matter. The broad brush presentation of water levels in the draft chapter conceals local variability that is relevant to sustainability and management actions.

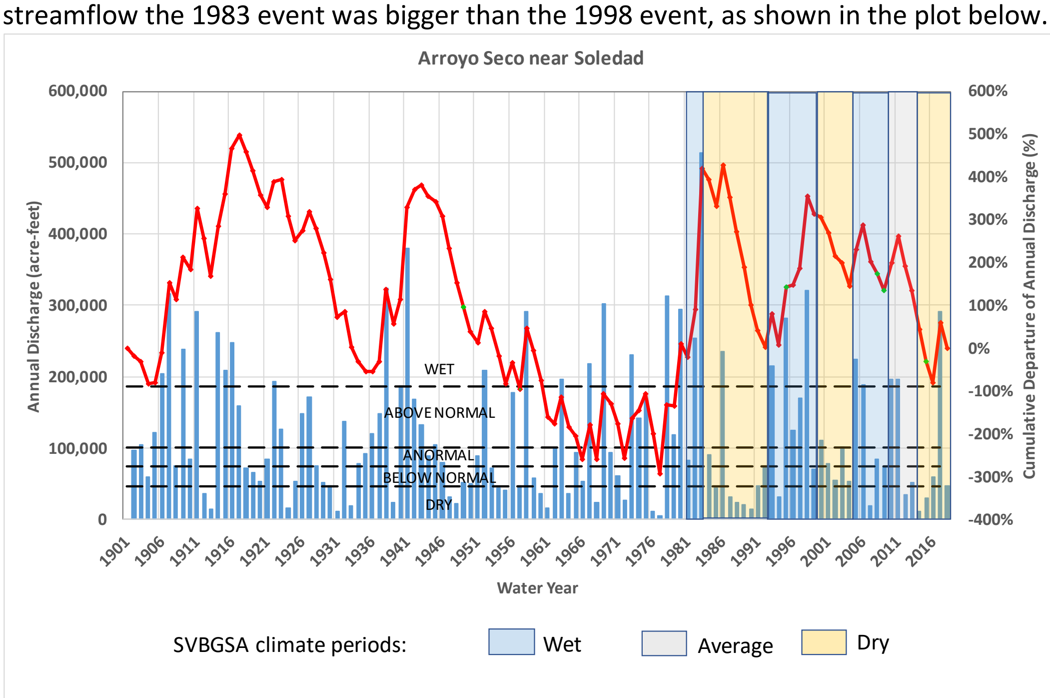
Figures 5-8 through 5-10. Hydrographs of selected wells. These hydrographs are duplicates of the ones shown on Figure 5-6. The repetition is unnecessary.



Page 21, 1st paragraph. Water year types. The water year types shown as background in Figures 5-7 through 5-10 are based on a Standardized Precipitation Index methodology that this report does not document but that is described in the 180/400 Foot Aquifer and Paso Robles Subbasin draft GSPs. The SPI method using a 5-year backward average of annual precipitation does not adequately represent wet and dry periods related to groundwater for two reasons. First, groundwater levels correlate more closely with runoff than with rainfall. The standard practice for hydrologic analysis in California is to identify wet and dry periods on the basis of cumulative departure plots. The SPI method is seldom, if ever, used. For example, cumulative departure of annual rainfall at Greenfield and Salinas are shown in the graph below. For both stations, missing data were filled by correlation with nearby gauges to ensure a complete record. Both stations show that the wet period culminating in 1998 was a larger event than the wet period culminating in 1983.



However, groundwater levels in almost all Forebay wells were higher in 1983 than in 1998. This suggests that recharge was greater during the earlier event. A cumulative departure of annual discharge in Arroyo Seco—which is unregulated—reveals that with respect to streamflow the 1983 event was bigger than the 1998 event, as shown in the plot below.



The stronger correlation between runoff and groundwater levels means that cumulative departure of annual Arroyo Seco discharge represents climatic periods better than cumulative departure of rainfall and should therefore be preferred for use in groundwater analysis and planning.

The second weakness of the SPI method is that the 5-year averaging method misses the correct starting and ending years of wet and dry periods. To illustrate, the wet, dry and average (or fluctuating) periods shown in Figures 5-7 through 5-10 of draft Chapter 5 are transcribed onto the cumulative departure of Arroyo Seco discharge, above. The 1984-1992 dry period starts two years too early (1987 was the first dry year of that drought). Similarly, the first two years and the last year of 1993-1999 were not wet. The wet period would more accurately be identified as 1995-1998. 2005 and 2006 were wet, but they did not amount to a large wet period. It might be more useful to simply classify 2005-2011 as variable. The Arroyo Seco cumulative departure plot shows the recent drought as comprised of 2012-2016. The SPI approach adds 2011 and omits 2014-2016 from that sequence, thereby significantly underrepresenting the actual duration and severity of dry conditions.

Page 21, 2nd bullet. Forebay water-level declines. The statement "Since 1983, groundwater levels in the Forebay have slowly declined, punctuated by two significant declines during the 1989 to 1991 drought and the 2012 to 2016 drought" over-generalizes hydrograph trends in the Forebay Subbasin and needs to be revised. Many hydrographs in the southern half of the Forebay Subbasin (in and near the ASGSA area) do not exhibit a declining trend. In one small area identified above, declining trends can specifically be linked to an increase in local pumping (see third set of hydrographs, above). At the northern end of the Forebay Subbasin, wells would also likely exhibit declines due to the spread of declining trends in the adjacent 180/400 Foot Aquifer and East Side Subbasins. Finally, there is an optical illusion in many hydrographs related to the "since 1983" period, because that period began at the peak of one of the wettest periods on record and ended shortly after a major drought. Thus, the apparent decline from 1983 water levels to 2017 water levels does not represent average annual conditions. Looking at net change from, say, 1986 to 2011 would be more representative of long-term average conditions. During that period, almost no wells in the southern part of the Forebay Subbasin show signs of a declining trend.

Page 22, 1st bullet. 180/400 and East Side drought declines. Smaller storage coefficients due to confined conditions would also tend to increase water-level declines during droughts. Some analysis would be needed to differentiate the effects of recharge and storage coefficient on the magnitude and duration of drought declines.

Figure 5-14. Vertical gradients. The well pair at the southern end of the Upper Valley area is not representative of the generally unconfined conditions in that area. The text acknowledges that the very large gradient is "unusual". While there may be some value in illustrating local variability, it would be better to show a more typical gradient for the purpose of this summary figure.

Page 27, Section 5.2, 1st paragraph. Seawater intrusion. Describing seawater intrusion as a "threat" suggests that it hasn't yet occurred. Rewording such as: "Although those actions have managed to slow the advance of intrusion and reduce its impacts, seawater intrusion continues to advance" would better characterize reality.

Page 28 and Figure 5-15. Closed contour. The description of the figure states that the closed contour at the inland edge of the intruded area in the 180 Foot Aquifer is a local pumping trough. As labeled in the figure (-20 ft msl), it is a local mound, not a trough. Please check whether that is actually a -30 foot contour. Otherwise, the mechanism of repulsion might be due to mounding rather than a trough.

Page 33, 3rd paragraph. Intrusion and pumping depressions. The text states that intrusion will slow down and stop when it reaches a pumping depression. This presumes that the well owners will continue to pump when saltwater arrives. Given that as little as 10 percent seawater in a well will render it unusable for irrigation, it is unlikely that the wells that created the water-level depression will continue to operate.

Figure 5-19 and page 37, 2nd bullet. Forebay storage trends. Please see the above comments regarding the discussion of water level trends on page 21, 2nd bullet. The same issue is repeated here in the discussion of storage. First, the large declines during the 2012-2016 drought occurred primarily at wells near the Salinas River. Wells on the Arroyo Seco Cone showed much smaller declines. Second, the supposed declining trend from 1983-2017 may be an illusory result of selecting a period that began very wet and ended very dry. A more representative period should be selected for trend analysis. Finally, the storage declines during 1944-1950 were likely due in part to the exceptionally dry runoff conditions that prevailed during those years (see Arroyo Seco cumulative departure graph, above) rather than to the presence or absence of reservoirs.

Page 38, 3rd sub-bullet. Storage declines 1998-2017. Again, the selection of an analysis period that starts very wet and ends just after a major drought exaggerates the amount of storage decline. The estimate of 460,000 AF of storage decline is not representative of current average annual conditions.

Page 39, Section 5.4, 1st sentence. Subsidence monitoring. Stating that subsidence "is not closely monitored" conflicts with the subsequent material describing two ongoing monitoring programs: InSar and UNAVCO. The former provides detailed spatial coverage (although it excludes the 180/400 Foot Aquifer area and most of the East Side Area—which can be viewed as a data gap), and the UNAVCO stations provide detailed temporal coverage. The two sources of information are being combined to evaluate subsidence in the southern part of the Forebay Subbasin for the ASGSA GSP.

Also, the subsidence discussion would be improved by differentiating elastic subsidence—which is very evident in the UNAVCO data—from inelastic subsidence, because only the latter is of significant concern.

Page 43, 1st paragraph. Recharge through the Salinas Valley Aquiclude. The text perpetuates the out-of-date and oversimplified hypothesis that no recharge to the 180-Foot Aquifer occurs from percolation through the Salinas Valley Aquiclude. More recent evidence from hydrostratigraphy, geochemistry and groundwater modeling have de-bunked that myth. The following analysis of those data were presented in a technical memorandum to support environmental analysis of percolation from the Salinas Industrial Wastewater Treatment Facility (Todd Groundwater, February 2015; accessible on-line as Appendix N in Volume 2 of the Pure Water Monterey Consolidated Final EIR at http://purewatermonterey.org/reports-docs/cfeir/):

> "To reach the 180-Foot aquifer, groundwater in the shallow aquifer must flow downward through the Salinas Valley Aquitard (SVA). The SVA is a shallow fine-grained layer that has traditionally been viewed as an extensive, continuous, impermeable clay cap that restricts direct downward recharge to the 180-Foot aquifer. Water levels in the 180-Foot aquifer are much lower than shallow groundwater levels, which suggests that overall vertical permeability is low but not necessarily zero. In 2011, groundwater elevation in the 180-Foot aquifer near Salinas Treatment Facility was -18 ft (i.e., below sea level), while water levels in shallow wells near the ponds were 12-33 ft above sea level. This substantial downward gradient will induce downward flow if permeable pathways are present.
>
> Evidence that recharge occurs through the SVA comes from detailed stratigraphic analyses and groundwater model calibration. One of the most detailed evaluations of aquifer stratigraphy in the vicinity of the Salinas Treatment Facility focused on the area encompassed by Alisal Slough, Highway 68 and the Salinas River, which includes the Salinas Treatment Facility (Heard, 1992). Texture descriptions from 117 cable-tool driller's logs were classified into coarse and fine categories and mapped at 20-foot depth intervals from the ground surface down to 340 feet. Overlaying these maps reveals vertical continuity of coarse deposits through all but one of the top seven layers (a total vertical interval of 140 feet) in several locations, each covering about 1 square mile:
>
> - Near the Salinas Treatment Facility across South Davis Road
> - Near the intersection of Blanco Road and Highway 68, about 2.5 miles east of the Salinas Treatment Facility
> - Along Davis Road between Blanco Road and Castroville Road, about 2.5 miles northeast of the Salinas Treatment Facility
>
> A small amount of horizontal flow within the remaining depth interval would allow groundwater flow to link up gaps between clay lenses and continue moving downward.
>
> Heard also evaluated groundwater quality patterns and discovered that groundwater in the 180-Foot aquifer in the study area was slightly enriched in sulfur relative to other dissolved minerals. The only geochemically plausible source of the enrichment was determined to be gypsum, which is commonly applied to heavy soils in the area to maintain soil texture. To arrive

at the 180-Foot aquifer, the dissolved gypsum would have had to percolate downward through the SVA. Nitrate is also elevated in some 180-Foot aquifer wells in the area and also derives from fertilizers applied at the land surface.

Another detailed stratigraphic study of the region between Spreckels and the coast included cross sections showing the SVA missing at various locations (Kennedy/Jenks Consultants, 2004). The cross sections were developed from geologic logs prepared by well drillers, and most of the logs were from irrigation wells. Although often close to other wells where the SVA is present, wells that show gaps in the SVA include several near the Salinas Treatment Facility in the region between Salinas and the Salinas River (at wells APN-414021010, 15S/03E-04T50, 15S/03E-17B3, and 15S/03E-17M1). The description of SVA hydrogeology in the Monterey County Groundwater Management Plan reiterates the concept of local discontinuity (MCWRA 2006).

A groundwater flow model of the Salinas Valley, called the Salinas Valley Integrated Surface and Groundwater Model (SVISGM), has been used extensively by Monterey County Water Resources Agency (MCWRA) for water planning studies over nearly 20 years. The calibrated model includes recharge from the ground surface to the 180-Foot aquifer. The 180-Foot aquifer is present only in the Pressure Area, which occupies the southwestern half of Salinas Valley between Gonzales and Monterey Bay. In most parts of the Pressure Area, recharge to the 180-Foot aquifer from the ground surface would have to pass through the SVA (MWH, 1997). The shallow aquifer and SVA are not explicitly represented in the model, but their effects are reflected in the amount of downward recharge that accrues to the 180-Foot aquifer. During the 1970-1994 calibration period, there was an average of 54,000 AFY of recharge to the 180-Foot aquifer in the Pressure Area from deep percolation of rainfall and applied irrigation water and 60,000 AFY of recharge from Salinas River infiltration, some of which must also pass through the SVA. Together, these recharge sources accounted for 79% of total recharge to the 180-Foot aquifer in the Pressure Area. However, much of the downward recharge to the 180-Foot aquifer in the model could have been in the southern part of the Pressure Area (between Gonzales and Chualar), where the SVA is known to be discontinuous or absent.

The above lines of evidence lead to a conclusion that Salinas Treatment Facility percolation that does not seep into the river very likely becomes recharge to the 180-Foot aquifer. During 2013, this recharge amounted to 550 AF, or 20% of total Salinas Treatment Facility percolation."

Page 43, 1st paragraph. SFEI reference. The list of references at the end of the chapter does not include the 2009 San Francisco Estuary Institute report.

Page 43, 4th paragraph. GW/SW hydraulic connection. Mapping places where groundwater levels in wells are within 20 feet of the land surface is a reasonable first-cut screening tool for identifying locations where surface water and groundwater might be hydraulically coupled, but a depth to water of 20 feet is insufficient to demonstrate that coupling is present. Unless groundwater levels are **above** the river elevation—in which case coupling is very likely—the presence of coupling depends on the amount of mounding of the water table beneath the river and on vertical gradients within the aquifer system between the well screen and the true water table. In addition, few of MCWRA's water-level monitoring wells are next to the Salinas River channel, so there is additional uncertainty related to horizontal gradients between the well location and the river. This uncertainty in the local three-dimensional head pattern must be treated as a data gap that needs to be filled by measuring water levels in shallow piezometers in or adjacent to the river channel.

Two studies by Martin Feeney in 1994 specifically address water table mounding and surface water/groundwater hydraulic coupling (Feeney, 1994a and 1994b). The first study focused on the Arroyo Seco and found that in the relatively coarse-grained sediments beneath the river channel the water table beneath the river was 4-5 feet higher than the water level in wells 2,000 feet away during periods of active river recharge. At that location (Hudson Road), the seasonal high water table was still 20 feet below the river bed and there was no hydraulic coupling. The second study attempted to confirm and measure hydraulic connection between the Salinas River and groundwater at a location downstream of the Arroyo Seco confluence by means of an aquifer test. Interpretation of the data proved to be more difficult than expected. The report concluded "insufficient data currently exist documenting the nature of the hydraulic connection between the river and aquifer system….Water level data will be required to assess the nature of the hydraulic connection of the river and aquifer, both seasonally and areally….. Water level data near the river are considered essential for understanding the interaction between the river and aquifer."

Based on those studies, the mere presence of water levels in wells somewhat close to the Salinas River that are 20 feet below the river bed is insufficient evidence to conclude that hydraulic connection is present. Furthermore, flow losses simulated by groundwater models are also not confirmation of hydraulic connection. The surface water routing packages in those models (MODFLOW, IGSM, FEMFLOW3D) simulate percolation as coupled or uncoupled, depending on whether the groundwater level at the river node is above or below the river bed elevation, but none of the models had data to confirm whether unsaturated decoupling is present nor the fine-scale vertical and horizontal discretization that would be needed to accurately simulated the local mounding and vertical gradients involved. The models could have obtained good results for simulated stream flow losses and groundwater levels with coupled or decoupled river percolation.

The lack of shallow water level data along rivers is an important data gap, as Feeney emphasized back in 1994. The presence or absence of hydraulic connection has significant implications for groundwater management and protection of riparian and aquatic habitats. If river percolation becomes decoupled as groundwater levels decline, for example, then further decreases in groundwater levels have no additional impact on percolation losses, and the habitats are then almost entirely dependent on surface flow supplied by reservoir releases.

Page 43-44. Recharge to 180 Foot Aquifer through SVA. Please see the previous comment on this topic. The statement that the A aquifer above the Salinas Valley Aquiclude "is not an important water-supply source" incorrectly characterizes the situation, and dismissing that source of recharge from further discussion is unjustified.

Page 44, 1st full paragraph. Vertical water level differences. The differences in water levels between wells and an overlying river does not necessarily prove hydraulic decoupling. In coarse-grained materials (such as described along the Arroyo Seco in a previous comment), a well water level 20 feet below the river might be associated with decoupling. In fine-grained sediments that are more common near the coast, a water-level difference that was uncoupled at the Arroyo Seco might be accommodated within a fully saturated flow system. For example, the fall 2017 water levels in the 180 Foot Aquifer as contoured by MCWRA (see Figure 5-2) are at lowest 10 feet below sea level. The Salinas River bed elevation at the same location is perhaps 20 feet above sea level. Dividing this water level difference of 30 feet into a vertical distance of 180 feet produces a gradient of 0.17, which is easily plausible for a fully saturated system (gradients of up to 1.00 can be present under saturated conditions). Large vertical gradients certainly demonstrate resistance to vertical flow, but do not necessarily demonstrate decoupling.

Figure 5-23 and page 43 Section 5.5.1 1st paragraph. Depth to water contours. The detail shown in this figure is misleading. Depth to water was not measured at that level of detail, as the text implies. Instead, high-resolution ground elevation data were combined with very poor depth to water data (interpolated between sparse wells far from the river using measurements that are not the true water table). This limitation needs to be communicated in the text.

Page 47, Section 5.5.2. "Surface Water Depletion Rates". The word "depletion" in the heading should be replaced with "percolation". The stream flow data presented in the discussion do not demonstrate hydraulic connection, which is a prerequisite for active depletion of surface water by pumping from a nearby well. All of the observed losses could have occurred under decoupled conditions. The report needs to be accurate and precise in all discussions of river percolation and state whether we know for certain that it is coupled or decoupled. That difference has important implications for the potential impacts of pumping on groundwater dependent ecosystems.

Page 51, 4th bullet. Vertical recharge to 180/400 Foot Aquifer. The wording here is much better than in prior passages on this topic. Stating that "the presence of aquitards restricts the vertical migration of groundwater downward into the more productive 180/400 Foot Aquifers" describes the situation well.

Page 53, Table 5-4. River infiltration losses. It seems counterintuitive that the average flow loss for Salinas River flows of 5,000-10,000 cfs is larger than the average loss when flows are 10,000 – 100,000 cfs. Please explain.

Page 53, 2nd bullet. Arundo donax ET. Arundo is an aggressive invader, but studies of its ET rate have produced highly variable results. It may or may not be greater than cottonwood/willow ET. A study of Mojave River riparian vegetation found that cottonwood/willow consistently had highr ET rates than Arundo, saltcedar and several other vegetation categories (Mojave Water Agency, 2011). However, a recently released review of scientific literature on Arundo water use by The Nature Conservancy (2019) found widely disparate results (1 ft/yr to 48 ft/yr of ET) that correlated strongly with the method used for measurement.

Figure 5-27. Salinas River flow loss. Is the lower bound of the Y axis clipped in this plot, or are all data points visible? This graph shows that the net change in flow along the Salinas River is sometimes positive and sometimes negative. However, its usefulness is greatly limited by the lack of data on tributary inflows other than from the Arroyo Seco. Are flow gains up to 500 cfs from groundwater discharge realistic?

Figure 5-28 and Table 5-5. Active cleanup sites. The list of sites should be pared down to include only ones where groundwater has been contaminated. Geotracker lists many sites where only soil is contaminated and the likelihood of subsequent groundwater contamination is negligible. For example, the site in Greenfield identified as "Reconstrution of Mary Chapa and El Camino Real School Sites" involves slight soil contamination from old land uses (more than 25 years ago). The contamination may be an issue with respect to direct exposure of school children to the soil, but not with respect to groundwater.

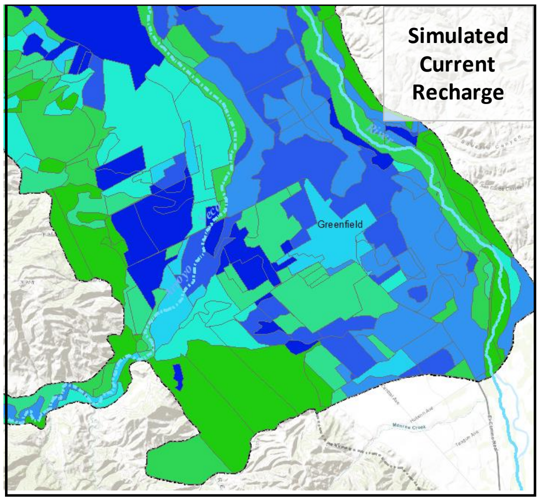
Figure 5-30. Historical nitrate maps. These maps are great but quite grainy. Is it possible to obtain higher-quality images?

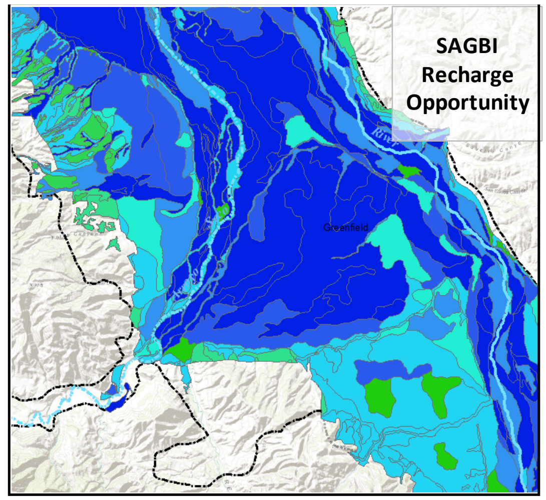
Page 65, Section 5.6.3. List of monitoring constituents. Iron, manganese molybdenum, NDMA, sulfate and TDS are all listed twice.

COMMENTS ON TOPICS THAT SHOULD BE INCLUDED IN CHAPTER 5

Locations of Recharge. GSPs are required to include maps of recharge locations, and such a map should also be included in the Valleywide Plan. Based on draft materials for the Paso Robles and 180/400 Foot Aquifer GSPs (prepared by the same consultant team), it is likely that the SAGBI map of recharge opportunity would be used for that purpose. However, the SAGBI map is not a map of where recharge currently occurs. It is a map of favorable locations for percolating water at high rates through the soil zone only. The two are not the same. Dispersed recharge through soils typically occurs at rates well below soil permeability and is determined more by the water balance of the root zone than by permeability. If infiltration of rainfall or applied irrigation water raise the water content in the root zone to above its storage capacity (root depth x available water capacity), then excess water will percolate downward and eventually reach the water table. Thus, dispersed recharge occurs wherever rainfall or irrigation occur, which is essentially the entire land surface overlying the Basin. The maps below compare current recharge in the southern part of the Forebay Subbasin simulated using a recharge-runoff-rainfall model (continuous, daily soil moisture budget simulation averaged over 1997-2008) with the SAGBI recharge opportunity map.

Both maps are color scaled so that green is low and dark blue is high. The simulation of current conditions shows the large differences between non-irrigated vegetation, truck crops, vineyards and urban areas. The SAGBI map reflects primarily soil characteristics. The two are very different.





Role of Reservoir Operation on Groundwater Conditions. The Valleywide Plan must include a thorough discussion of the conjunctive linkage between reservoir operation and groundwater conditions. Any effort to manage groundwater must start with that knowledge. The most important aspect of the system is that Nacimiento and San Antonio Reservoirs delay the impacts of groundwater pumping to droughts. Under current operation, conservation releases from the reservoirs are managed primarily to achieve a target flow at the Salinas River Diversion Facility near the downstream end of the Valley. Releases are adjusted to overcome whatever percolation losses occur en route. If groundwater pumping goes up and induces additional percolation, the release rate is increased to overcome the additional losses. By the same token, the river percolation prevents groundwater levels from declining in spite of the increased pumping. However, the compensatory increase in release rate depletes reservoir storage at a faster rate and hastens the date at which storage is so depleted that conservation releases simply cannot be made. Releases are then curtailed until the next wet year arrives to replenish reservoir storage. Curtailment of releases—particularly for multiple years in a row—causes sharp declines in groundwater levels and mortality of riparian vegetation.

Current reservoir operating rules do not appear to manage carry-over storage as a means of delaying and possibly shortening periods of curtailed releases. The February 2018 Nacimiento Dam Operation Policy expresses an intent to develop a Drought Contingency Plan (which would presumably address carry-over storage needs), but 60 years after the reservoir was built there still is no such plan.

The accumulation of groundwater pumping effects in reservoir storage can also be viewed as an indirect "depletion of surface water". Even if percolation along the river were hydraulically decoupled, the amount of depleted groundwater storage space that needs to be filled would depend on the amount of prior groundwater pumping. Thus, the reservoirs can serve to shift the depletion to a later date.

The impacts of reservoir flow curtailment are not just on groundwater levels, but also on riparian vegetation. In normal and wet years, the Salinas River channel functions as an irrigation furrow supplying water to riparian vegetation nearly continuously throughout the dry season. The vegetation thrives regardless of groundwater levels. When releases are curtailed, groundwater levels also drop and vegetation loses access to both sources of water. There was widespread mortality of mature cottonwood trees along the river as a result of the 3-year flow curtailment during 2013-2015, for example. The relative importance of surface flow and water table depth for survival of the vegetation is unknown and is a notable data gap.

These aspects of interrelationship between groundwater conditions and reservoir operation should be included in Chapter 5.

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