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21 May 2019

Jim Bennett
County of San Diego Planning & Development Services
5510 Overland Avenue, Suite 310
San Diego, CA 92123

Submitted via email: PDS.LUEGGroundwater@sdcounty.ca.gov

Re: Concerns Regarding Draft Groundwater Sustainability Plan for the Borrego Valley

Dear Mr. Jim Bennett,

The Nature Conservancy (TNC) appreciates the opportunity to comment on the Draft Groundwater Sustainability Plan (GSP) for the Borrego Valley Basin being prepared under the Sustainable Groundwater Management Act (SGMA). We have significant concerns regarding the treatment of environmental beneficial users in the Draft GSP and submit this letter as a guidance to address the deficiencies prior to submission to the State.

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 Borrego Valley Basin 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. The Nature Conservancy has identified each part of the GSP where consideration of beneficial uses and users are required. That list is available here: https://groundwaterresourcehub.org/importance-of-gdes/provisions-related-to-groundwater-dependent-ecosystems-in-the-groundwater-s. Please ensure that environmental beneficial users are addressed accordingly throughout the GSP. 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*[1].

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[2] 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.

[1] GDEs under SGMA: Guidance for Preparing GSPs is available at: https://groundwaterresourcehub.org/public/uploads/pdfs/GWR_Hub_GDE_Guidance_Doc_2-1-18.pdf

[2] The Department of Water Resources' Natural Communities Commonly Associated with Groundwater dataset is available at: *https://gis.water.ca.gov/app/NCDatasetViewer/*

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 Borrego Valley groundwater basin 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 GSA's 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.

The Nature Conservancy has thoroughly reviewed the Borrego Valley Groundwater Basin Draft GSP, and considers it to be inadequate under SGMA for the following main reasons:

1. Environmental beneficial uses and users are not adequately identified and considered
2. The Draft GSP permits groundwater conditions to worsen in this Critically Overdrafted Basin (beyond the 2015 SGMA benchmark date) over the 20-year SGMA timeline.

Our specific comments related to the Borrego Valley Groundwater Basin Draft GSP are provided in detail in **Attachment B** and are in reference to the numbered items in **Attachment A.** **Attachment C** provides a list of the freshwater species located in the Borrego Valley Basin. **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[2]. **Attachment E** provides an overview of a new, free online tool that allows GSAs to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data.

Thank you for fully considering our comments as you finalize 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.

GSP Plan Element*		GDE Inclusion in GSPs: Identification and Consideration Elements		Check Box
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	**2.2.1 Hydrogeologic Conceptual Model** *23 CCR §354.14*	**Basin Bottom Boundary:** Is the bottom of the basin defined as at least as deep as the deepest groundwater extractions?		2
		Principal aquifers and aquitards: Are shallow aquifers adequately described, so that interconnections with surface water and vertical groundwater gradients with other aquifers can be characterized?		3
	2.2.2 Current & Historical Groundwater Conditions *23 CCR §354.16*	**Interconnected surface waters:**		4
		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).		5
		Estimates of current and historical surface water depletions for interconnected surface waters quantified and described by reach, season, and water year type.		6
		Basin GDE map included (as figure in text & submitted as a shapefile on SGMA Portal).		7
		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).	8
			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).	9
			GDEs polygons are consolidated into larger units and named for easier identification throughout GSP.	10
		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.	11
		Description of GDEs included:		12
		Historical and current groundwater conditions described in each GDE unit.		13
		Ecological condition described in each GDE unit.		14

		Each GDE unit has been characterized as having high, moderate, or low ecological value.		15
		Inventory of species, habitats, and protected lands for each GDE unit with ecological importance (Worksheet 2, can be attached in GSP section 6.0).		16
	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.		17
		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.		18
Sustainable Management Criteria	**3.1 Sustainability Goal** *23 CCR §354.24*	**Environmental stakeholders/representatives were consulted.**		19
		Sustainability goal mentions GDEs or species and habitats that are of particular concern or interest.		20
		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.		21
	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.**		22
	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:**		23
		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?		24
		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?		25
	3.4 Undesirable Results *23 CCR §354.26*	**For GDEs, hydrological data are compiled and synthesized for each GDE unit:**		26
		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).	27
			Baseline period in the hydrologic data is defined.	28
			GDE unit is classified as having high, moderate, or low susceptibility to changes in groundwater.	29
			Cause-and-effect relationships between groundwater changes and GDEs are explored.	30
		If hydrological data *are not available* within/nearby the GDE	Data gaps/insufficiencies are described.	31
			Plans to reconcile data gaps in the monitoring network are stated.	32
		For GDEs, biological data are compiled and synthesized for each GDE unit:		33
		Biological datasets are plotted and provided for each GDE unit.		34
		Data gaps/insufficiencies are described.		35

		Plans to reconcile data gaps in the monitoring network are stated.	36
		Description of potential effects on GDEs, land uses and property interests:	37
		Cause-and-effect relationships between GDE and groundwater conditions are described.	38
		Impacts to GDEs that are considered to be "significant and unreasonable" are described.	39
		Known hydrological thresholds or triggers (e.g., instream flow criteria, groundwater depths, water quality parameters) for relevant species or ecological communities are reported.	40
		Land uses include and consider recreational uses (e.g., fishing/hunting, hiking, boating).	41
		Property interests include and consider privately and publicly protected conservation lands and opens spaces, including wildlife refuges, parks, and natural preserves.	42
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.	43
		Description of how hydrological data gaps and insufficiencies will be reconciled in the monitoring network.	44
		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.	45
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.	46
		Description of how projects and management actions will be evaluated to assess whether adverse impacts to the GDE will be mitigated or prevented.	47

* 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 the Borrego Valley Groundwater Basin Draft Groundwater Sustainability Plan

The Nature Conservancy has thoroughly reviewed the Borrego Valley Groundwater Basin Draft GSP, and considers it to be inadequate under SGMA. The deficiencies of the GSP are described in here, along with recommendations on how to reconcile them.

2.1.4 Beneficial Uses and Users of Groundwater (p. 2-26)

[Checklist item #1]: Please identify environmental users of groundwater, such as groundwater dependent ecosystems and other species that depend on interconnected surface water that exist in Borrego Valley Basin, and describe how representatives of these beneficial uses were included in the planning process. If Borrego Valley is asserting that no environmental beneficial users exist, please provide scientific rationale and data to support this claim. Based on science The Nature Conservancy has assembled on the basin, there is a strong case to be made that environmental beneficial users are very likely to exist and the GSP must therefore provide sufficient evidence to rebut this science, which includes starting with the following resources:

- Natural Communities Commonly Associated with Groundwater dataset (NC Dataset) - https://gis.water.ca.gov/app/NCDatasetViewer/
- The list of freshwater species located in the Borrego Valley Groundwater Basin in **Attachment C** of this letter. Please take particular note of the species with protected status.

Please also identify lands that are protected as open space preserves, habitat reserves, wildlife refuges, etc. or other lands protected in perpetuity and supported by groundwater or interconnected surface waters should be identified and acknowledged.

2.2.2.6 Groundwater-Surface Water Connections (pp. 2-65 thru 2-68)
[Checklist items #4-6]:

- Please rename the Groundwater-Surface Water Connections section as the "Identification of interconnected surface water systems" to be consistent with DWR's GSP annotated Outline Guidance Document[3].
- On Figure 2.2-17, please add depth-to-groundwater data (derived from contoured groundwater elevation data and ground surface elevation from digital elevation model data; See Best Practice #5 in **Appendix D** of this letter for more specifications) near surface water systems in the Basin.
- The regulations [23 CCR §351(o)] define interconnected surface waters (ISW) 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". "At any point" has both a spatial and temporal component. Even short durations of interconnections of groundwater and surface water can be

[3] DWR's Annotated Outline Guidance Document: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GD_GSP_Outline_Final_2016-12-23.pdf

crucial for surface water flow and supporting environmental users of groundwater and surface water. Thus, only considering perennial portions of streams as ISWs does not meet the SGMA definition. **Please identify interconnected surface waters in the Basin by relying on groundwater elevation and stream gauge data, specifying any data gaps that exist so that they can be resolved in the monitoring network.**

2.2.2.6 Groundwater-Surface Water Connections - Groundwater Dependent Ecosystems (pp. 2-68 thru 2-72)
[Checklist items #7-16]:

- Groundwater Dependent Ecosystems (GDEs) are not only relevant under the Groundwater-Surface Water Connections section, especially in arid environments like the Borrego Valley Basin where GDEs can exist in the absence of ISW. Please create a new subsection (e.g., 2.2.2.7) for the identification of groundwater dependent ecosystems to be consistent with DWR's GSP annotated Outline Guidance Document[3].
- While historical groundwater level declines in the Borrego Valley have inevitably led to pre-SGMA adverse impacts to groundwater dependent ecosystems, please separate the identification of GDEs from the consideration of GDEs. We recommend identifying GDEs (mapping) and describing groundwater conditions in the basin setting section of the GSP (e.g., 2.2.2.7) and evaluating potential adverse impacts due to groundwater levels in the Sustainable Management Criteria section where undesirable results are described (e.g., significant and adverse impacts to beneficial users of groundwater). **Please identify (map) GDEs in the basin that are supported by groundwater, even groundwater from a perched aquifer. Management actions and decisions regarding the prevention of post-2015 adverse impacts are a separate issue and should be addressed when defining undesirable results in the basin.**
- SGMA defines GDEs as "ecological communities and species that depend on *groundwater emerging from aquifers or on groundwater occurring near the ground surface*". **We recommend that depth to groundwater contour maps are used to verify whether a connection to groundwater exists for polygons in the NC Dataset, instead of relying on watershed boundaries (especially for the polygons located on the fringe of the basin)**. **Please refer to Appendix D of this letter for best practices for using groundwater data to verify a connection to groundwater.**
- Please add a map that clearly indicates which NCCAG polygons were kept or removed, as well as specify the rationale for removing each polygon (e.g., groundwater levels too deep). It was hard to follow Appendix D4 of the draft GSP and know which polygons are being identified as GDEs in the Borrego Valley Basin.

GDE Unit 1 – Coyote Creek

- **Please provide information on the depth to groundwater, particularly in the NCCAG mapped areas that do not coincide with perennial surface flows.**

GDE Unit 3 – Mesquite Bosque

- Scientific literature does not support the removal of Mesquite Bosque in Borrego Sink. It appears that Mequite Bosque was not considered a GDE because it was assumed that the ecosystem has become disconnected from groundwater and is in decline. This finding was based on: 1) Estimated evapotranspiration for this area modeled by the USGS in a MODFLOW modeling study that was assumed to be zero; 2) surviving mesquite derive their water from soil moisture and perched groundwater; and 3) the rooting depth for *Prosopis glandulosa* was assumed to be 15.33 feet (Table 13 of the USGS (2015) modelling study, which does not have any references associated with it) and considerably lower than current groundwater levels (~55 feet). However, none of these assumptions were substantiated through field observations. According to TNC's global rooting depth database[4], the max rooting depth for *Prosopis glandulosa* can be as high as 66 feet. And, depending on the subsurface soils and thickness of the capillary fringe, groundwater at depths >66 feet could still be supporting the remaining Mesquite. Similarly, it is known that *P. glandulosa* can have taproots, in the absence of available subsurface water, up to 190 feet according to the United States Forest Service[5]. These reported rooting depth observations for Honey Mesquite are beyond the 55 feet bgs groundwater levels observed in MW-5B, meaning that groundwater is likely still supporting this vegetation at greater depths than originally presented in this GSP. **Unless there is field evidence that demonstrates otherwise, it should be assumed that the remaining mesquite is groundwater-dependent and mapped as GDEs until further data and information can confirm otherwise. In addition, the sustainability criteria should be set to avoid adverse impacts to this species through further (post-SGMA) degradation. At a minimum this should be considered a data gap and the ecosystem needs to be further evaluated.**

3.1.1 Standard for Establishing the Sustainability Goal (p.3-1)
[Checklist items #19-21]:

- According to 23 CCR §354.22, the sustainability goal must "culminate in the absence of undesirable results within 20 years of the applicable statutory deadline." As the GSP is written now, the sustainable management criteria fail to address adverse impacts to beneficial uses in the basin, and permit groundwater conditions in the basin to worsen over the 20 years of GSP implementation. **Please redefine your sustainability goal so that it complies with the intent of SGMA.**

3.2.1. Chronic Lowering of Groundwater Levels – Undesirable Results (p. 3-7)
[Checklist items #26-42]:
While impacts to GDEs have been broadly described in Appendix D4 of the Draft GSP, **please provide more specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs.** The definition of 'significant and unreasonable' is a qualitative statement that is used to describe when undesirable results would occur in the basin, such that a minimum threshold can be quantified. Potential effects on all beneficial users of groundwater in the basin need to be taken into consideration. According to the California Constitution Article X, §2, water resources in California must be "put to beneficial use to the fullest extent of which they are capable". **Please identify appropriate biological indicators that can be used to monitor potential impacts to environmental beneficial users due to groundwater**

[4] TNC's Global Rooting Depth Database is available at: https://groundwaterresourcehub.org/gde-tools/gde-rooting-depths-database-for-gdes/
[5] U.S. Forest Service: https://www.fs.fed.us/database/feis/plants/tree/progla/all.html

conditions. Refer to Appendix E of this letter for an overview of a free, new online tool for monitoring the health of GDEs over time.

3.2.6 Depletions of Interconnected Surface Water – Undesirable Results (p.3-14) [Checklist items #26-42]:

- **Please provide scientific evidence that supports the following statement on p 3-15: "The honey mesquite [in the Borrego Sink] experienced prolonged adverse impacts including desiccation, inability to regenerate and habitat loss well prior to 2015".** While adverse impacts (e.g., extent of honey mesquite habitat) has been declining for years prior to SGMA, it is unclear of what the current ecological status of the remaining portions.
- There is insufficient evidence to conclude that current groundwater levels are no longer supporting the honey mesquite. The Mesquite polygons in the NC dataset were mapped from 1996, however, 35 years of Landsat imagery[6] (Figure 1) show a slight upward trend in vegetation growth (indicated by Normalized Vegetation Difference Index (NDVI)) and leaf moisture (indicated by Normalized Vegetation Moisture Index (NDMI)), with fluctuations over wet and dry years during this time period. Scientific studies[7,8,9] have found that gradual increases in depth to groundwater within a GDE with historically shallow groundwater levels tends to result in an altered species composition due to the migration of more opportunistic invasive species that have deeper rooting systems and are better adapted to deeper groundwater conditions. **Please conduct field verification to determine whether the polygons in this area are still Mesquite or if the invasive Tamarix (e.g., *Tamarix ramosissima*) is prevalent.** If either are present, it is still very likely that groundwater is currently supporting these phreatophytes. However, the presence of Tamarix and the lack of Mesquite would likely suggest that pre-SGMA adverse impacts are underway, confirming previous observations. If this is the case, conservation efforts (removal of *Tamarix spp*.) could provide water supply benefits for the Borrego springs area and the Mesquite vegetation. Visit TNC's Groundwater Resource Hub for a case study on how the invasive *Arundo donax* is being removed in Ventura County to improve groundwater supply and enhance habitat[10].

[6] TNC's GDE Pulse is described in **Attachment E** of this letter and the web viewer is available at: https://gde.codefornature.org/#/map

[7] Keddy, P.A., and A.A. Reznicek. 1986. Great Lakes vegetation dynamics: The role of fluctuating water levels and buried seeds. *Journal of Great Lakes Research* 12: 25 – 36. DOI:10.1016/S0380-1330(86)71697-3.

[8] Moore, D.R.J., and P.A. Keddy. 1988. Effects of a water-depth gradient on the germination of lakeshore plants. *Canadian Journal of Botany* 66: 548–552. DOI:10.1139/b88-078.

[9] Sommer, B., and R. Froend. 2014. Phreatophytic vegetation responses to groundwater depth in a drying mediterranean-type landscape. *Journal of Vegetation Science* 25: 1045–1055. DOI:10.1111/jvs.12178.

[10] Case Study available at: https://groundwaterresourcehub.org/public/uploads/pdfs/GWR_Hub_Ventura_Co_arundo_case_study.pdf

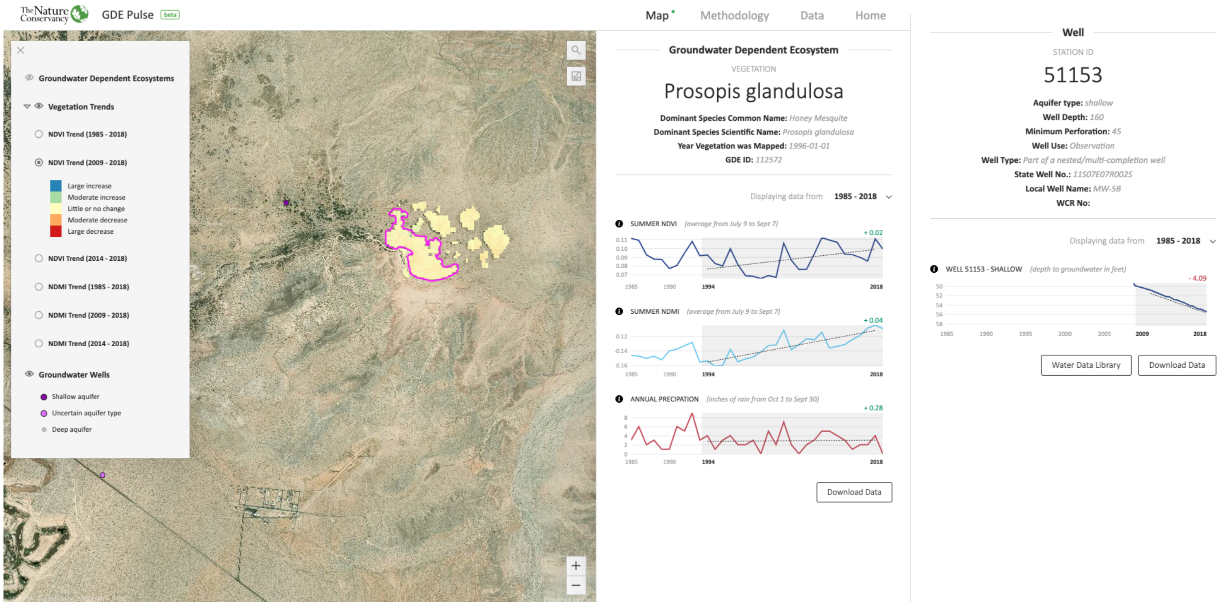


Figure 1. Landsat satellite data from GDE Pulse[5] of the Mesquite (*Prosopis glandulosa*) vegetation mapped within GDE Unit 3, and groundwater levels from nearby MW-5B.

- While the restoration of the honey mesquite GDE map may require groundwater levels to shallow by 30-40 feet to achieve its historic extent, **it is still possible to maintain groundwater levels such that no further adverse impacts occur post-SGMA so that remaining habitat is preserved.** SGMA also gives GSA's the authority to address pre-SGMA impacts by restoring some of the original historic extent of the honey mesquite, if the GSA's choses to do so.
- **Please describe whether there are any legally protected species that rely on the honey mesquite GDE habitat.**

<u>3.3.1 Chronic Lowering of Groundwater Levels - Minimum Thresholds (p.3-17 thru 3-25)</u> [Checklist items #22-25]:

- While maintaining groundwater levels above saturated screen intervals for pre-existing municipal wells during an anticipated multi-year drought circumstance is a suitable approach to establish minimum thresholds that protect some beneficial users of groundwater (i.e., municipal and domestic (*de-minimus*) users), it fails to prevent adverse impacts to GDEs and environmental beneficial users of surface water in interconnected surface waters. **Environmental beneficial users of groundwater are required to be considered when establishing measurable thresholds, measurable objectives, and interim milestones. Please include environmental beneficial users in section 3.3.1.4 of the GSP when describing how the minimum threshold impacts beneficial uses. Refer to Step 2 of *GDEs under SGMA: Guidance for Preparing GSPs*[1] for how this can be accomplished.**
- On page 3-20, the GSP describes that the measurable objectives, interim milestones, and minimum thresholds assume that the historical climate from 1960 through 2010 repeats itself for the 2020 through 2070 period. This has resulted in a linear reduction in pumping (outlined in Table 3-6) from current levels to a target of 5,700 AFY between

2020 and 2070. The sustainable yield target of 5,700 AFY is inadequate for the following reasons:

- The target sustainable yield of 5,700 AFY does <u>not</u> take climate change into consideration, and establishing a target sustainable yield based on historical climate conditions fails to sustainably manage groundwater resources for current and future social, economic, and environmental benefits, thus deviating from the legal intent of SGMA. SGMA was passed at the height of California's historic drought, a period of time that was characterized by adverse impacts to domestic well owners (e.g., dry wells), GDEs (e.g., water stress impacts on growth, reproduction, and even mortality due to lack of groundwater), and surface water users (e.g., lower streamflows). Critically overdrafted basins, such as the Borrego Valley Basin, are more likely to have disproportionately experienced these adverse impacts due to historical groundwater overdraft in the basin.
- As currently written in the GSP, a sustainable yield target of 5,700 AFT results in pumping restrictions that permit groundwater conditions to worsen by ~100,000 AF beyond 2015 conditions (see Figure 2 in this letter). This has resulted in the groundwater level measurable objectives and interim milestones in Table 3-7 to be deeper than they are in 2018. This is highly problematic, given that Borrego Valley has been characterized as a critical status basin nor does it adequately prevent adverse impacts to beneficial users in the basin.

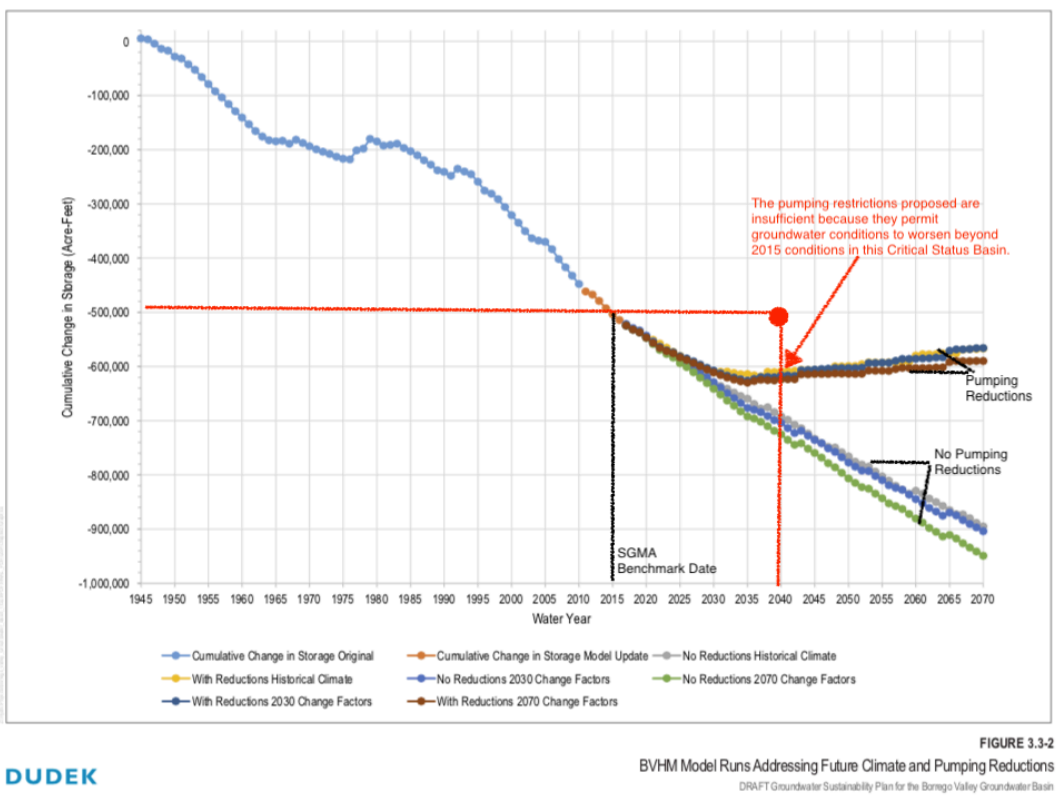


Figure 2. Figure 3.3-2 is annotated to demonstrate how the proposed pumping restrictions permit groundwater conditions to worsen post-2015 in the basin.

- The minimum thresholds outlined in Table 3-5 (p.3-22) are inadequate for the following reasons:
    - The SGMA benchmark date is Jan 1, 2015 not 2018. Any adverse impacts that have been accrued in the current period (2015-2019) need to be corrected.
    - The scientific rationale behind the maximum allowable decline in groundwater levels through 2040 are not explained well. Also, the maximum allowable decline needs to be compared to the SGMA benchmark date, not the beginning of GSP implementation. **Please provide an explanation of how the maximum allowable decline in groundwater levels through 2040 will prevent adverse impacts to beneficial users of groundwater in the basin.**
    - As noted on p.3-21: "The GSA will adjust the rate of pumping reduction, revisit minimum thresholds, and/or evaluate additional PMAs if the minimum thresholds in Table 3-4 or Table 3-5 are exceeded or if the interim milestones in Table 3-7 are not being achieved." While adaptive management is certainly a foundational principle of SGMA, this statement fails to comply with SGMA by operating the basin with enough operational flexibility so that groundwater conditions are away from minimum thresholds. **Please revise the minimum thresholds so that they prevent post-2015 adverse impacts to beneficial users of groundwater in the basin.**
  - Please describe whether there are any legally protected species that exist in GDE or ISW areas in the basin and rely on groundwater. **Please describe any differences between the selected minimum threshold and state, federal, or local standards relevant to the species or habitats residing in GDEs, as required [23 CCR §354.28 (b)(5)].**

<u>3.4.1 Chronic Lowering of Groundwater Levels – Measurable Objectives (p. 3-32)</u>
[Checklist item #22]:

- The GSA should be managing the basin towards a measurable objective that is in a better state than Jan 1, 2015. As the measurable objectives are written now (in Table 3-7, page 3-33), the groundwater level goals for 2040 are actually deeper than 2018 observed levels. January 1, 2015 was at the height of California's historic drought, a period of time that was characterized by adverse impacts to domestic well owners (e.g., dry wells), GDEs (e.g., water stress impacts on growth, reproduction, and even mortality due to lack of groundwater), and surface water users (e.g., lower streamflows). **The onus is on the GSAs to determine whether groundwater conditions (due to groundwater pumping) exacerbated impacts to these beneficial users. And if so, to recognize these impacts and establish thresholds and measurable objectives that can avoid adverse impacts to beneficial users caused by groundwater in all water year types.**

3.4.6 Depletions of Interconnected Surface Water – Measurable Objectives (p.3-36) [Checklist item #22]:

The honey mesquite bosque located in the vicinity of the Borrego Sink appear to be supported by current groundwater level (~55 feet), given the max rooting depths known for honey mesquite (see description above in section 2.2.2.6). In order to prevent adverse impacts post-SGMA, minimum thresholds around the SGMA benchmark date need to be established, at the very least. According to MW-5B, depth to groundwater ranged between ~50-56 feet over the past 10 years (2008-2018) (see Figure 1 in this letter). The average depth to groundwater measured at this well over this period (~53 feet), and would be a reasonable minimum threshold to consider for this honey mesquite GDE. SGMA empowers GSAs to address pre-SGMA impacts, and as demonstrated by TNC's Ventura County Case Study[10], conservation projects that remove invasive tamarisk could benefit groundwater conditions for the honey mesquite and the Borrego sink vicinity. **Please consider these suggestions when establishing sustainable management criteria**.

Chapter 3.5 Monitoring Network (pp. 2-68 through 2-72 and Appendix D) [Checklist items 43-45]:

- The potential GDE Unit 3 - Borrego Sink (Mesquite Bosque) is one of the areas targeted for future monitoring. The well MW-5B is located about 1.2 miles northeast of the Borrego sink and is 480 feet deep. The well is a multi-completion well that includes MW-5B, screened from 45 to 155 feet, and MW-5A, screened from 200 to 340 feet. Similar groundwater levels were found and suggest potentially unconfined conditions in the Borrego Valley Subbasin. The following remark is made at page 2-71 in the GSP: "However, it is uncertain whether a good well seal was obtained during installation of the multi-completion monitoring well." Therefore, monitoring is suggested at a new well located near well MW5B that is screened from a depth of 45 ft bgs to 100 ft bgs focused on the shallower part of the aquifer. Monitoring in this new well would provide data for the groundwater levels screened in a region of interest to the GDE.

- Coyote Creek is one of the potential GDEs, Unit 1. This GDE is described as a losing stream reach based on limited visual observations in the creek. Additional streamflow measurements are needed to improve the understanding of streamflow contribution and stream leakage. Installation of recording streamflow gauges at the former USGS measuring locations is suggested instead of manual/visual measurements. This method would be more likely to monitor conditions that represent when the creek is losing or gaining as well as the infrequent and flashy flows from the watershed.

4.0 Projects and Management Actions

[Checklist items: 46 & 47]:

- For more case studies on how to incorporate environmental benefits into groundwater projects, please visit our website: https://groundwaterresourcehub.org/case-studies/recharge-case-studies/

Attachment C

Freshwater Species Located in the Borrego Valley Basin

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 Borrego Valley Basin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the GSA's 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[11]. 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[12] as well as on The Nature Conservancy's science website[13].

Scientific Name	Common Name	Legal Protected Status		
		Federal	**State**	**Other**
BIRDS				
Actitis macularius	Spotted Sandpiper			
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			
Aythya valisineria	Canvasback		Special	

[11] 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

[12] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS

[13] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Botaurus lentiginosus	American Bittern			
Bucephala albeola	Bufflehead			
Butorides virescens	Green Heron			
Calidris mauri	Western Sandpiper			
Calidris minutilla	Least Sandpiper			
Chen caerulescens	Snow Goose			
Chen rossii	Ross's Goose			
Chroicocephalus philadelphia	Bonaparte's Gull			
Cistothorus palustris palustris	Marsh Wren			
Egretta thula	Snowy Egret			
Empidonax traillii	Willow Flycatcher	Bird of Conservation Concern	Endangered	
Empidonax traillii brewsteri	Willow Flycatcher	Bird of Conservation Concern	Endangered	
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Himantopus mexicanus	Black-necked Stilt			
Icteria virens	Yellow-breasted Chat		Special Concern	BSSC - Third priority
Limnodromus scolopaceus	Long-billed Dowitcher			
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus serrator	Red-breasted Merganser			
Nycticorax nycticorax	Black-crowned Night-Heron			
Oreothlypis luciae	Lucy's Warbler		Special Concern	BSSC - Third priority
Oxyura jamaicensis	Ruddy Duck			
Pelecanus erythrorhynchos	American White Pelican		Special Concern	BSSC - First priority
Phalacrocorax auritus	Double-crested Cormorant			
Piranga rubra	Summer Tanager		Special Concern	BSSC - First priority
Plegadis chihi	White-faced Ibis		Watch list	
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Setophaga petechia	Yellow Warbler			BSSC - Second priority

Tachycineta bicolor	Tree Swallow			
Tringa melanoleuca	Greater Yellowlegs			
Tringa semipalmata	Willet			
Tringa solitaria	Solitary Sandpiper			
Vireo bellii	Bell's Vireo			
Vireo bellii arizonae	Arizona Bell's Vireo	Bird of Conservation Concern	Endangered	
Vireo bellii pusillus	Least Bell's Vireo	Endangered	Endangered	
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		Special Concern	BSSC - Third priority
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		Special Concern	BSSC - Third priority
FISH				
Cyprinodon macularius	Desert pupfish	Endangered	Endangered	Endangered - Moyle 2013
Cyprinodon macularius	Desert pupfish	Endangered	Endangered	Endangered - Moyle 2013
Cyprinodon macularius	Desert pupfish	Endangered	Endangered	Endangered - Moyle 2013
HERPS				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Anaxyrus boreas halophilus	California Toad			ARSSC
Anaxyrus californicus	Arroyo Toad	Endangered	Special Concern	ARSSC
Anaxyrus punctatus	Red-spotted Toad			
Pseudacris cadaverina	California Treefrog			ARSSC
Pseudacris regilla	Northern Pacific Chorus Frog			
Thamnophis hammondii hammondii	Two-striped Gartersnake		Special Concern	ARSSC
Anaxyrus punctatus	Red-spotted Toad			
Pseudacris cadaverina	California Treefrog			ARSSC
Thamnophis hammondii hammondii	Two-striped Gartersnake		Special Concern	ARSSC
INSECTS & OTHER INVERTS				
Abedus spp.	Abedus spp.			
Anax junius	Common Green Darner			
Argia nahuana	Aztec Dancer			
Argia spp.	Argia spp.			

Argia vivida	Vivid Dancer			
Baetis adonis	A Mayfly			
Baetis spp.	Baetis spp.			
Belostomatidae fam.	Belostomatidae fam.			
Callibaetis spp.	Callibaetis spp.			
Chaetarthria pallida				Not on any status lists
Chironomidae fam.	Chironomidae fam.			
Coenagrionidae fam.	Coenagrionidae fam.			
Cricotopus spp.	Cricotopus spp.			
Cryptochironomus spp.	Cryptochironomus spp.			
Enallagma civile	Familiar Bluet			
Erpetogomphus compositus	White-belted Ringtail			
Erpetogomphus spp.	Erpetogomphus spp.			
Erythemis collocata	Western Pondhawk			
Eucorethra underwoodi				Not on any status lists
Eukiefferiella spp.	Eukiefferiella spp.			
Fallceon quilleri	A Mayfly			
Fallceon spp.	Fallceon spp.			
Gomphidae fam.	Gomphidae fam.			
Helichus spp.	Helichus spp.			
Helicopsyche spp.	Helicopsyche spp.			
Hetaerina americana	American Rubyspot			
Heterelmis obesa				Not on any status lists
Heterotrissocladius spp.	Heterotrissocladius spp.			
Hydropsyche spp.	Hydropsyche spp.			
Hydropsychidae fam.	Hydropsychidae fam.			
Hydroptila spp.	Hydroptila spp.			
Hydroptilidae fam.	Hydroptilidae fam.			
Laccobius spp.	Laccobius spp.			
Larsia spp.	Larsia spp.			
Lauterborniella spp.	Lauterborniella spp.			
Lethocerus americanus				Not on any status lists
Libellula croceipennis	Neon Skimmer			
Libellula saturata	Flame Skimmer			
Libellulidae fam.	Libellulidae fam.			

Macrodiplax balteata	Marl Pennant			
Meropelopia spp.	Meropelopia spp.			
Nilotanypus spp.	Nilotanypus spp.			
Ochrotrichia spp.	Ochrotrichia spp.			
Ophiogomphus spp.	Ophiogomphus spp.			
Orthemis ferruginea	Roseate Skimmer			
Pachydiplax longipennis	Blue Dasher			
Paltothemis lineatipes	Red Rock Skimmer			
Pantala flavescens	Wandering Glider			
Paracladopelma spp.	Paracladopelma spp.			
Parametriocnemus spp.	Parametriocnemus spp.			
Paratendipes spp.	Paratendipes spp.			
Peltodytes spp.	Peltodytes spp.			
Pentaneura spp.	Pentaneura spp.			
Perithemis intensa	Mexican Amberwing			
Phaenopsectra spp.	Phaenopsectra spp.			
Polypedilum spp.	Polypedilum spp.			
Postelichus spp.	Postelichus spp.			
Pseudochironomus spp.	Pseudochironomus spp.			
Radotanypus spp.	Radotanypus spp.			
Rhagovelia spp.	Rhagovelia spp.			
Rheotanytarsus spp.	Rheotanytarsus spp.			
Rhionaeschna multicolor	Blue-eyed Darner			
Sanfilippodytes spp.	Sanfilippodytes spp.			
Simulium spp.	Simulium spp.			
Sperchon spp.	Sperchon spp.			
Stictotarsus striatellus				Not on any status lists
Sympetrum corruptum	Variegated Meadowhawk			
Sympetrum spp.	Sympetrum spp.			
Tanytarsus spp.	Tanytarsus spp.			
Tinodes spp.	Tinodes spp.			
MAMMALS				
Castor canadensis	American Beaver			Not on any status lists
MOLLUSKS				
Physa spp.	Physa spp.			
PLANTS				

Baccharis salicina				Not on any status lists
Castilleja minor minor	Alkali Indian-paintbrush			
Castilleja minor spiralis	Large-flower Annual Indian-paintbrush			
Datisca glomerata	Durango Root			
Juncus dubius	Mariposa Rush			
Juncus rugulosus	Wrinkled Rush			
Juncus xiphioides	Iris-leaf Rush			
Lythrum californicum	California Loosestrife			
Mimulus guttatus	Common Large Monkeyflower			
Phacelia distans	NA			
Platanus racemosa	California Sycamore			
Pluchea sericea	Arrow-weed			
Salix exigua exigua	Narrowleaf Willow			
Salix gooddingii	Goodding's Willow			
Salix laevigata	Polished Willow			
Schoenoplectus americanus	Three-square Bulrush			
Typha domingensis	Southern Cattail			
Veronica anagallis-aquatica	NA			
Phacelia distans	NA			

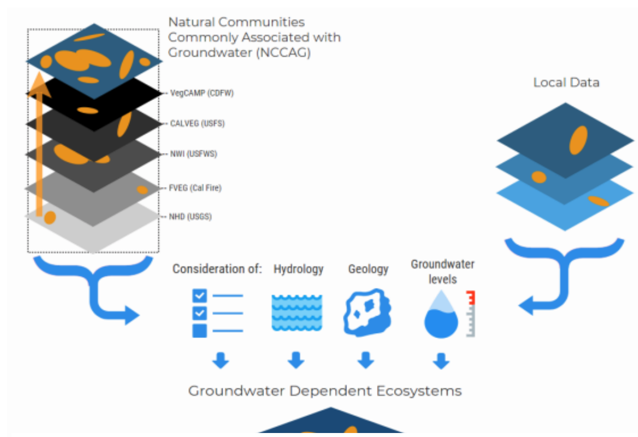
Attachment D

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). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[14] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[15]. This document highlights six best practices for using local groundwater data to confirm whether a potential GDE identified in the NC dataset is supported to groundwater.

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[16]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[17] on the Groundwater Resource Hub, a website dedicated to GDEs[18].



[14] NC Dataset Online Viewer is available at: https://gis.water.ca.gov/app/NCDatasetViewer/

[15] 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

[16] 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

[17] "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/

[18] The Groundwater Resource Hub is available at: www.GroundwaterResourceHub.org

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2A) or multiple aquifers stacked on top of each other (Figure 2B). In unconfined aquifers (Figure 2A), using the depth to groundwater and the rooting depth of the vegetation is a reasonable method to determine groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2D). However, it is important to consider local conditions (soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2C). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2B) 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, domestic wells, and groundwater dependent ecosystems (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may 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. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

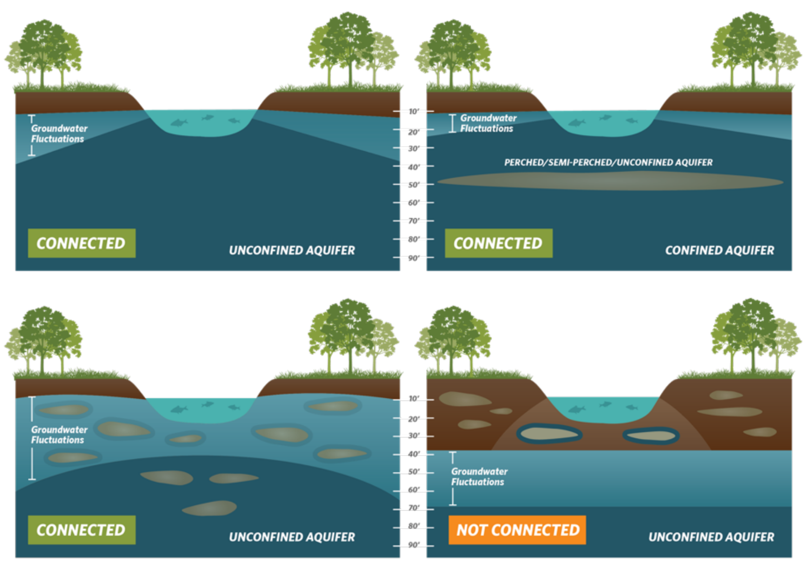


Figure 2. Confirming whether an ecosystem is connected to groundwater in a principal aquifer. Top: (Left) Depth to Groundwater in the aquifer under the ecosystem is an unconfined aquifer with depth to groundwater fluctuating seasonally and interannually within 30 feet from land surface. **(Right)** Depth 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 ecosystem's 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. These areas typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual 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 typical of California's climate. DWR's Best Management Practices document on water budgets[19] 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[20] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs 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[21] 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 TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (See Best Practice #5).

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[4] are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand 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[22]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (See Best Practice #6).

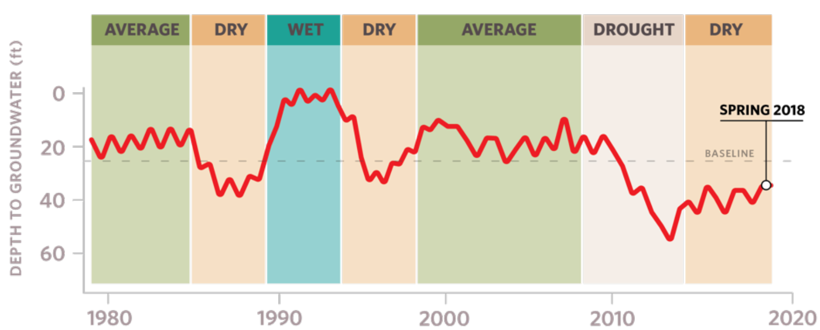


Figure 3. Example seasonality and interannual variability in depth to groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so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

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[19] 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

[20] *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)]*

[21] 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).

[22] *SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer*

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

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. 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 supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[23], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

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 may 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).

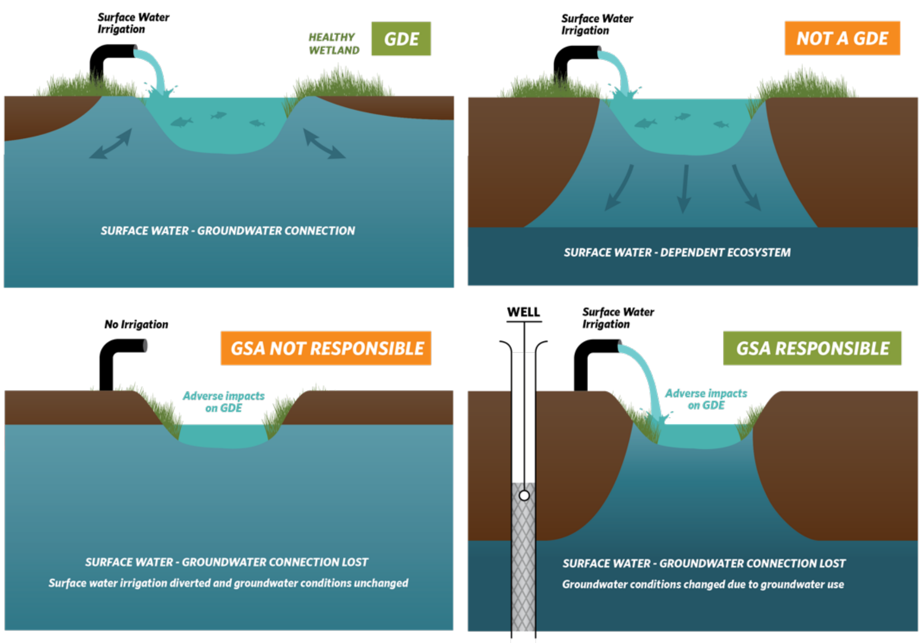

Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. **(Right)** Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. **Bottom: (Left)** An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. **(Right)** Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

[23] *For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/*

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, 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 each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- 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 information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

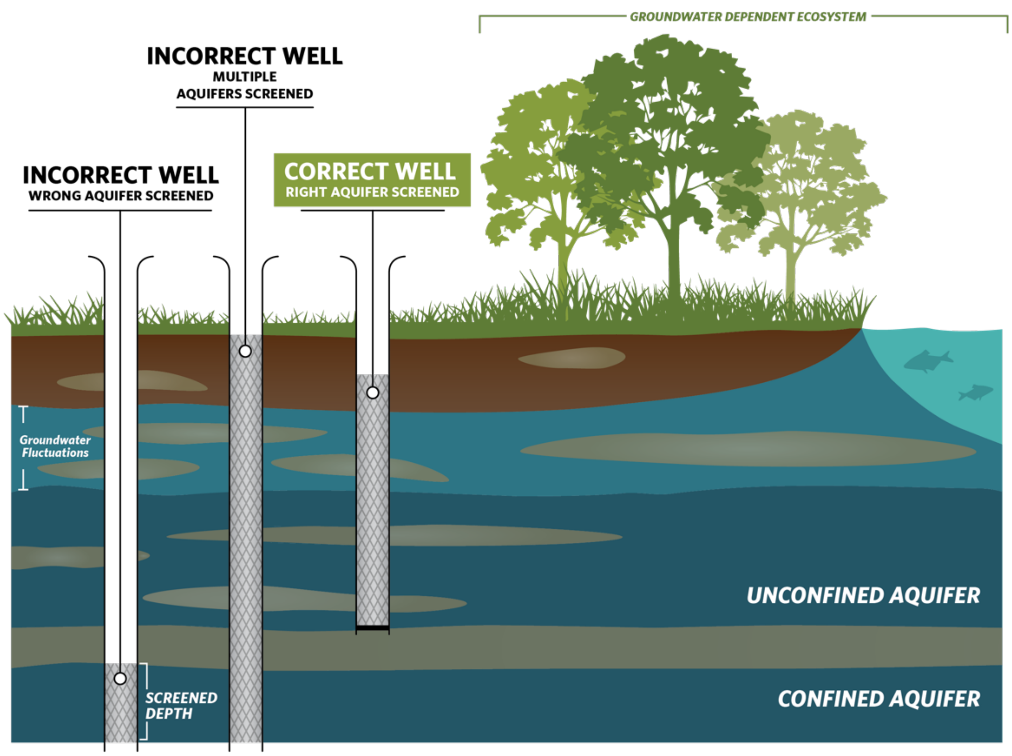

Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. 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 - left panel). 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)[24] to estimate depth to groundwater contours across the landscape (Figure 6 – right panel; 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.

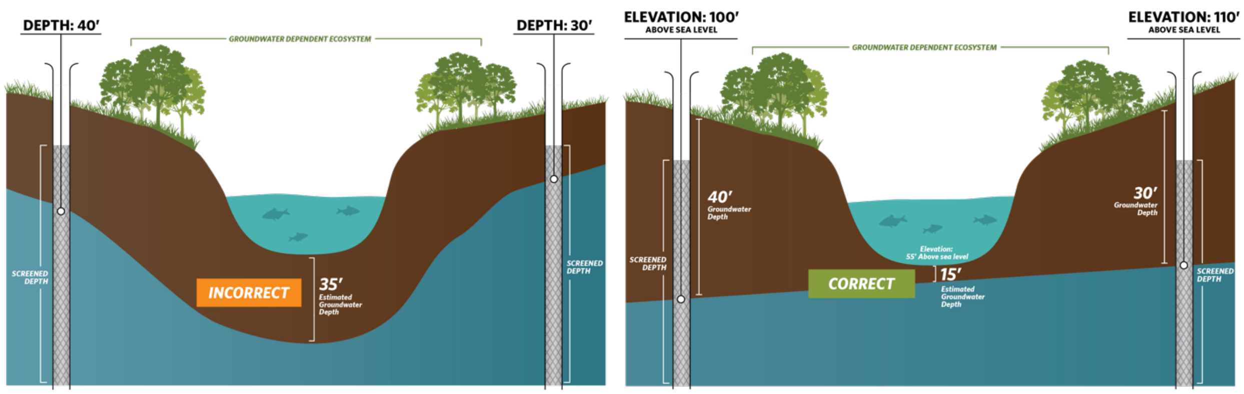

Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (Left) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. **(Right)** Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

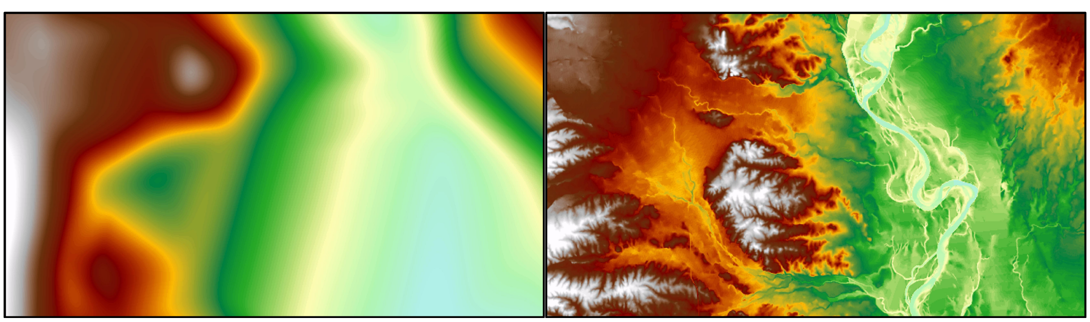

Figure 7. Depth to Groundwater Contours in Northern California. (Left) Contours were interpolated using depth to groundwater measurements determined at each well. **(Right)** Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation 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.

[24] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://viewer.nationalmap.gov/basic/

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.

Attachment E

GDE Pulse

A new, free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data.

The Nature Conservancy
Protecting nature. Preserving life.

Visit
https://gde.codefornature.org/

Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset[25]. The following datasets are included:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset[26]. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

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[25] *The Natural Communities Commonly Associated with Groundwater Dataset is hosted on the California Department of Water Resources' website: https://gis.water.ca.gov/app/NCDatasetViewer/#*

[26] The PRISM dataset is hosted on Oregon State University's website: http://www.prism.oregonstate.edu/