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August 19, 2019

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101 Montgomery Street | Suite 1850
San Francisco, California 94104

Submitted via Email at mercedsgma@woodardcurran.com

Re: Merced Groundwater Subbasin Groundwater Sustainability Plan

Dear Basin Representatives,

The Nature Conservancy (TNC) appreciates the opportunity to comment on the Merced Subbasin Groundwater Sustainability Plan 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 Merced Subbasin region 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.

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

[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/*

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 Merced Subbasin 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 Merced Subbasin Draft GSP, and considers it to be incomplete under SGMA since beneficial uses and users are not adequately identified and considered.

Our specific comments related to the Merced Subbasin 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 Merced Subbasin. 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 develop your GSP.

Best Regards,

Sandi Matsumoto
Associate Director, California Water Program
The Nature Conservancy

# Attachment A

# Environmental User 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 |
| Planning Framework | 2.1.2 to 2.1.4 Description of Plan Area *23 CCR §354.8* | Description of jurisdictional boundaries, existing land use designations, water use management and monitoring programs; general plans and other land use plans relevant to GDEs and their relationship to the GSP. | 2 |
| | | Description of instream flow requirements, threatened and endangered species habitat, critical habitat, and protected areas. | 3 |
| | | Summary of process for permitting new or replacement wells for the basin, and how the process incorporates any protection of GDEs | 4 |
| Basin Setting | 2.2.1 Hydrogeologic Conceptual Model *23 CCR §354.14* | Basin Bottom Boundary:<br>Is the bottom of the basin defined as at least as deep as the deepest groundwater extractions? | 5 |
| | | Principal aquifers and aquitards:<br>Are shallow aquifers adequately described, so that interconnections with surface water and vertical groundwater gradients with other aquifers can be characterized? | 6 |
| | | Basin cross sections:<br>Do cross-sections illustrate the relationships between GDEs, surface waters and principal aquifers? | 7 |
| | 2.2.2 Current & Historical Groundwater Conditions *23 CCR §354.16* | Interconnected surface waters: | 8 |
| | | 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). | 9 |
| | | Estimates of current and historical surface water depletions for interconnected surface waters quantified and described by reach, season, and water year type. | 10 |
| | | Basin GDE map included (as figure in text & submitted as a shapefile on SGMA Portal). | 11 |

| | | | | |
|---|---|---|---|---|
| | | 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). | 12 |
| | | | 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). | 13 |
| | | | GDEs polygons are consolidated into larger units and named for easier identification throughout GSP. | 14 |
| | | 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. | 15 |
| | | Description of GDEs included: | | 16 |
| | | Historical and current groundwater conditions and variability are described in each GDE unit. | | 17 |
| | | Historical and current ecological conditions and variability are described in each GDE unit. | | 18 |
| | | Each GDE unit has been characterized as having high, moderate, or low ecological value. | | 19 |
| | | Inventory of species, habitats, and protected lands for each GDE unit with ecological importance (Worksheet 2, can be attached in GSP section 6.0). | | 20 |
| | 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. | | 21 |
| | | 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. | | 22 |
| Sustainable Management Criteria | 3.1 Sustainability Goal *23 CCR §354.24* | Environmental stakeholders/representatives were consulted. | | 23 |
| | | Sustainability goal mentions GDEs or species and habitats that are of particular concern or interest. | | 24 |
| | | 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. | | 25 |
| | 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. | | 26 |
| | 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: | | 27 |
| | | 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? | | 28 |
| | | 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? | | 29 |
| | 3.4 Undesirable Results *23 CCR §354.26* | For GDEs, hydrological data are compiled and synthesized for each GDE unit: | | 30 |
| | | 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). | 31 |
| | | | Baseline period in the hydrologic data is defined. | 32 |

| | | | | |
|---|---|---|---|---|
| | | | GDE unit is classified as having high, moderate, or low susceptibility to changes in groundwater. | 33 |
| | | | Cause-and-effect relationships between groundwater changes and GDEs are explored. | 34 |
| | | If hydrological data *are not available* within/nearby the GDE | Data gaps/insufficiencies are described. | 35 |
| | | | Plans to reconcile data gaps in the monitoring network are stated. | 36 |
| | | For GDEs, biological data are compiled and synthesized for each GDE unit: | | 37 |
| | | Biological datasets are plotted and provided for each GDE unit, and when possible provide baseline conditions for assessment of trends and variability. | | 38 |
| | | Data gaps/insufficiencies are described. | | 39 |
| | | Plans to reconcile data gaps in the monitoring network are stated. | | 40 |
| | | Description of potential effects on GDEs, land uses and property interests: | | 41 |
| | | Cause-and-effect relationships between GDE and groundwater conditions are described. | | 42 |
| | | Impacts to GDEs that are considered to be "significant and unreasonable" are described. | | 43 |
| | | Known hydrological thresholds or triggers (e.g., instream flow criteria, groundwater depths, water quality parameters) for significant impacts to relevant species or ecological communities are reported. | | 44 |
| | | Land uses include and consider recreational uses (e.g., fishing/hunting, hiking, boating). | | 45 |
| | | Property interests include and consider privately and publicly protected conservation lands and opens spaces, including wildlife refuges, parks, and natural preserves. | | 46 |
| 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. | | 47 |
| | | Description of how hydrological data gaps and insufficiencies will be reconciled in the monitoring network. | | 48 |
| | | Description of how impacts to GDEs and environmental surface water users, as detected by biological responses, will be monitored and which GDE monitoring methods will be used in conjunction with hydrologic data to evaluate cause-and-effect relationships with groundwater conditions. | | 49 |
| 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. | | 50 |
| | | Description of how projects and management actions will be evaluated to assess whether adverse impacts to the GDE will be mitigated or prevented. | | 51 |

* 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
## Merced Subbasin Groundwater sustainability Plan

A complete draft of the Merced Subbasin GSP has been provided for public review. The following comments are in order of the Checklist given in Attachment A.

Section 1.2.5 Beneficial Uses and Users p. 1-40
(Checklist Item 1)

The environment is listed as one of the beneficial users of groundwater in the Subbasin, but few details are given. The US Fish and Wildlife is listed as operating several wildlife refuges supported by groundwater, as shown in Figure 1-7 (p. 1-20), along with state parks. A statement is made that there are other wetlands and GDEs that exist mostly in the western part of the subbasin, but they are not specified.

The types and locations of environmental uses, species and habitats supported, and the designated beneficial environmental uses of surface waters that may be affected by groundwater extraction in the Subbasin should be specified. To identify environmental users, please refer to the following:

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

The stakeholder outreach process is described, and include outreach to federal, state, and local agencies, but did not appear to engage environmental groups. Please note if any environmental groups were contacted and were enlisted in the GSP development process.

Section 1.2 Plan Areas p. 1-13 through 1-38
(Checklist Item 2)

The jurisdictional boundaries and water use management and existing monitoring programs are adequately described. The land use designations do not show types of crops. Only federal and state parks are shown on Figure 1-7 (p. 1-20). The general and land use plans are adequately described. Surface water gauging is described for the three major creeks; a map showing the locations would be helpful. Habitat Conservation Plans (HCPs) or Natural Community Conservation Plans (NCCPs) within the Subbasin should be added and noted if they are associated with critical, GDE and/or ISW habitats.

Section 2.1.3.3 Surface Water p. 2-9 through 2-12
(Checklist Item 3)

The regulation of surface waters by dams and reservoirs is described for each of the major rivers in Section 2.1.3.3 Surface Waters. Past examples of in-stream flows are given on page 1-40 for the Merced River, by the Merced Irrigation District. In-stream flow requirements in each of the rivers/streams including the amount, time of year when the flow minimum is specified, the duration, the freshwater fish species for which it applies, associated permits that set forth the requirements, and the regulating agency setting forth the compliance requirements. Please provide a list of the current in-stream flow requirements for chinook salmon and other threatened and endangered fish species and other requirements to protect habitat on the Merced and San Joaquin Rivers and the other creeks.

Section 1.2.3.3 Well Permitting p.138
Checklist Item 4

Merced County established a well permitting system for new, replacement, back-up, and De Minimus wells in 2015. It is not clear if this requirement covers monitoring wells, unless they are classified as De Minimus wells. The permit includes property setback distances, which may apply to surface water. The City of Merced also enforces well standards that apply to all new and existing water wells, monitoring wells, cathodic protection wells, test wells and those exploratory holes deeper than twenty feet within the jurisdictional boundaries of the city. The City of Merced directs permittees to DWR standards for wells. Please clarify the permitting requirements for monitoring wells and how they will be coordinated with the GSP.

Section 2.1.6.2 Bottom of the Merced Basin p. 2-39
(Checklist Item #5)

The base of freshwater, defined as specific conductance > 3,000 micromhos/cm, is used as the bottom of the basin. Because the depth varies with location, a map is provided as Figure 2-28 (p. 2-40). The depth of this boundary is provided in some areas of the geologic cross-sections, but not others. As noted on page 9 of DWR's Hydrogeologic Conceptual Model BMP (https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_HCM_Final_2016-12-23.pdf) "the definable bottom of the basin should be at least as deep as the deepest groundwater extractions". Thus, groundwater extraction well depth data should also be included in the definition of the basin bottom. This will prevent the possibility of extractors with wells deeper than the basin boundary (defined by the base of freshwater) from claiming exemption from SGMA due to a well residing outside the vertical extent of the basin boundary. Please check that active wells used for domestic or public water supply or agricultural wells are not deeper than the base of freshwater.

Section 2.2.1.2 Current Groundwater Conditions p. 2-63 through 2-29
(Checklist Item #6)

The number of wells used to describe the groundwater elevations for each aquifer is sparse. For example, there were only eight wells used for the spring 2017 elevation measurements (Figure 2-44 p. 2-64) for the Above the Corcoran Clay aquifer and six for fall 2017 elevation for the Above the Corcoran Clay aquifer (Figure 2-47 p. 2-67). Additional wells have been included in the GSP Monitoring Program, as stated on p. 4-2, "The Merced Subbasin GSP groundwater level monitoring network totals 50 wells from the CASGEM program. This includes 13 wells in the Above Corcoran Clay Principal Aquifer, 16 wells in the Below Corcoran, and 21 wells in the Outside Corcoran. Additional monitoring wells with appropriate screened intervals should be installed and added as the funding allows.

<u>Section 2.1.7.2 Principal Aquifers and Aquitards</u>
(Checklist Item 6)

The three principal aquifers have been combined from the original five designations. The three aquifers are shown in a schematic diagram (Figure 2-36 p. 52) and the general characteristics are discussed (p. 2-52 and 2-53). The shallow aquifers are not described in sufficient detail to show where GDEs are likely and the places with interconnected surface water. Please expand the discussion of shallow groundwater and discuss any information regarding vertical groundwater gradients across the principal aquifers.

<u>Section 2.1.4 Geologic Formations and Stratigraphy</u>
<u>(Checklist Item 7)</u>

The geologic cross-sections, Figures 2-13 through 2-17 and Figure 2-19 through 2-22 (p. 2-24 and 2-27 and 2-29 and 2-32, respectively), show the full depth of the basin and do not highlight the shallow aquifers. Cross-sections along the San Joaquin and Merced Rivers showing the relationship between the rivers and the shallow aquifers would be helpful. The near-surface cross sections should provide details that depict the conceptual understanding of shallow groundwater and stream interactions at different locations, including perched aquifers.

<u>Section 2.2.6 Interconnected Surface Waters p. 108</u>
<u>(Checklist Items 8, 9 and 10)</u>

A map showing gaining and losing streams was provided in Figure 2-9 (p. 2-15) as determined using the Merced Water Resources Model (MercedWRM). The report stated that no field studies had been conducted to confirm the designations and the documentation of the model was not provided in this report (Appendix D). Therefore, no estimates of surface water depletions by water year type were made. Please provide the documentation for the model and how the gaining and losing streams were determined.

<u>Section 2.2.7 GDEs p. 2-109</u>
<u>(Checklist Item 10-15)</u>

SGMA requires that all beneficial uses and users, including GDEs, be considered in the development and implementation of GSPs (Water Code §10723.2). The GSP Regulations include specific requirements to identify (map) GDEs and consider them when determining whether groundwater conditions are having potential effects on beneficial uses and users. SGMA also requires an assessment of whether sustainable management criteria (including minimum thresholds and measurable objectives) may cause adverse impacts to beneficial uses, including GDEs, and that monitoring networks are designed to detect such impacts. Therefore, mapping GDEs is a critical first step for incorporating environmental considerations into GSPs.

- It appears that the preliminary desktop analysis, completed by Woodard & Curran and documented in the draft GSP, resulted an excessive elimination of the NC dataset polygons mapped in the Merced Subbasin. In particular, the methods used to confirm whether or not polygons in the NC Dataset are connected to groundwater in the Merced Subbasin are highly flawed. Here we debunk the scientific insufficiencies in the methodology used:
    1. *Areas with depth to groundwater greater than 30 feet in Spring 2015.*
        a. While depth to groundwater levels within 30 feet are generally accepted as being a proxy for confirming that polygons in the NC dataset are connected to groundwater, it is highly advised that seasonal and interannual groundwater fluctuations in the groundwater regime are taken into consideration. Utilizing groundwater data from one point in time (e.g., Spring 2015) can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Based on a study we recently submitted to Frontiers in Environmental Science Journal, we've observed riparian forests along the Cosumnes River to experience a range in groundwater levels between 1.5 and 75 feet over seasonal and interannual timescales. Seasonal fluctuations in the regional water table can support perched groundwater near an intermittent river that seasonally runs dry due to large seasonal fluctuations in the regional water table. While perched groundwater itself cannot directly be managed due to its position in the vadose zone, the water table position within the regional aquifer (via pumping rate restrictions, restricted pumping at certain depths, restricted pumping around GDEs, well density rules) and its interactions with surface water (e.g., timing and duration) can be managed to prevent adverse impacts to ecosystems due to changes in groundwater quality and quantity under SGMA. We highly recommend using depth to groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. Please refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. 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.
        b. Please confirm that wells screened in the Shallow and Leaky intermittent principal aquifers located above the Corocoran Clay Layer are being used to verify whether NCCAGs are actual GDEs. According to Figure 2-39, the majority of wells in the

area in between Route 140, Route 59, and the San Joaquin River where NCCAGs were not identified as GDEs due to "depth to water" (Figure 2-86); however the wells located in this area are predominantly irrigation and domestic wells screened in the principal aquifers BELOW the Corocoran Clay Layer. Using "depth to groundwater" measurements from confined aquifers is mapping piezometric head of the confined aquifer and not detecting groundwater conditions in the principal aquifers of the unconfined aquifer that are supporting the ecosystem. If there is insufficient groundwater level data in the principal aquifers above the Corocoran Clay layers, then the NCCAGs in these areas should be included as GDEs in the GSP until data gaps are reconciled in the monitoring network.

c. Please provide more details on how depth to groundwater contour maps were developed:
    i. Are the wells used for interpolating depth to groundwater sufficiently close (<5km) to NC Dataset polygons to reflect local conditions relevant to ecosystems?
    ii. Are the wells used for interpolating depth to groundwater screened within the surficial unconfined aquifer and capable of measuring the true water table? (see comment b above)
    iii. Is depth to groundwater contoured using groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape? This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[3] to estimate depth-to-groundwater contours across the landscape. This will provide much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found. Depth to groundwater contours developed from depth to groundwater measurements at wells assumes that the land surface is constant, which is a poor assumption to make. It is better to assume that water surface elevations are constant in between wells, and then calculate depth to groundwater using a DEM of the land surface to contour depth to groundwater.

d. Spring 2015 is after the SGMA benchmark date of January 1, 2015. Please rely on groundwater condition data prior to the SGMA benchmark date.

e. Please use care when considering rooting depths of vegetation. While Valley Oak (*Quercus lobata*) have been observed to have a max rooting depth of ~24 feet (https://groundwaterresourcehub.org/gde-tools/gde-rooting-

[3] 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://iewer.nationalmap.gov/basic/

depths-database-for-gdes/), rooting depths are likely to spatially vary based on the local hydrologic conditions available to the plant. Also, max rooting depths do not take capillary action into consideration, which will vary with soil type and is an important consideration since woody phreatophytes generally do not like to have their roots submerged in groundwater for extended periods of time, and hence can access groundwater at deeper depths. In addition, while it is likely to be true that shallow water availability is necessary to support the recruitment of saplings, hydraulic lift of groundwater to shallow depths has been observed in *Quercus* spp. Research on the symbiotic relationships between species and offspring is still emerging, but the assumption that a groundwater depth of 25 feet is "unlikely to support recruitment of new oak seedlings" is an unsubstantiated claim and falsely considered to be "conservative". This approach is not "conservative" and results in the elimiination of more NC polygons because it negates the fact that there may be mature tree species that are likely connected to groundwater. Regardless of life stage, if any plant or animal species in the NC polygons are connected to groundwater, then it needs to be mapped as a GDE. The evaluation of potential effects on GDEs (e.g., the likelihood that regeneration is not occuring in the GDE due to groundwater levels being to deep for saplings) is to be performed when defining undesirable results in the Sustainable Management Criteria section of GSP, not the Basin Setting section.

2. *Habitat areas with supplemental water*
    a. The application of supplemental water to managed wetlands <u>does not preclude</u> the possibility that NC polygons could be accessing groundwater in addition to the supplied water. In the scientific literature, it is generally acknowledged that GDEs can rely on groundwater for <u>some or all</u> of its requirements. GDEs can rely on multiple water sources simultaneously and at different temporal/spatial scales (e.g., precipitation, river water, reservoir water, soil moisture in the vadose zone, groundwater, applied water, treated wastewater effluent, urban stormwater, irrigated return flow). SGMA defines GDEs as "ecological communities and species that depend on groundwater <u>emerging from aquifers</u> or on groundwater <u>occurring near</u> the ground surface". Hence, we recommend that depth to groundwater contour maps are used to identify whether a connection to groundwater exists for the Managed Wetlands in the Merced Subbasin. Please refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.
3. *Areas adjacent to irrigated fields*
    a. SGMA defines GDEs as "ecological communities and species that depend on groundwater <u>emerging from aquifers</u> or on groundwater

occurring near the ground surface". We recommend that depth to groundwater contour maps are used to identify whether a connection to groundwater exists for the NC Dataset polygons adjacent to irrigated fields in the Merced Subbasin. Please refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.

   b. GDEs can rely on multiple water sources – including shallow groundwater receiving inputs from irrigation return flow from nearby irrigated fields - simultaneously and at different temporal/spatial scales. 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 principal aquifers, that support springs, surface water, and groundwater dependent ecosystems. NC polygons adjacent to irrigated land can still potentially be reliant on shallow groundwater aquifers, thus excluding them based on their proximity to irrigated fields is inadequate.

4. *Areas depending on adjacent losing surface water bodies*
   a. While losing conditions occur when groundwater levels are lower than the stage in the stream, the degree to which losing conditions occur will depend on the groundwater level gradient between them. Losing conditions also vary in time, especially over different seasons. Even if a stream or river reach is losing, the riparian vegetation may still be accessing groundwater, and hence be identified as a GDE. We highly recommend that depth to groundwater levels under the NC polygons be used as the evaluation criteria, since access to groundwater could be be occuring in/near losing reaches. Please refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. If riparian vegetation in losing reaches are 100% of the time using surface water (especially if the groundwater is consistantly deep), it is not a GDE.
   b. Areas within 300 feet of losing streams identified by the model, MERCEDWRM, were eliminated. The distance of 300 feet seems excessive and may have eliminated some areas prematurely. The documentation of the model was not included in the draft report, Appendix D, so this information could not be verified.
5. *Areas of vernal pool complexes*

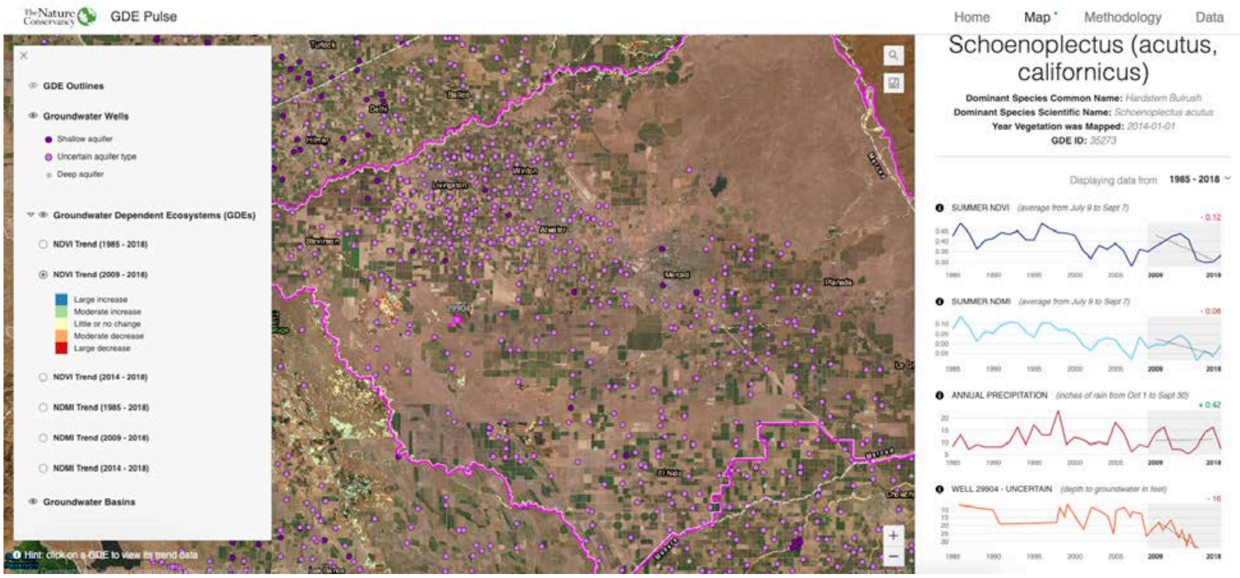
a. While we generally agree that vernal pools are shallow pockets of groundwater that are not directly connected or associated with principal aquifers, please included a short description on whether or not the vernal pool complexes mapped in the DFW 1989-1998 dataset are consistent with information collected in the HCM and groundwater conditions in the surficial aquifers (e.g., shallow and intermittent leaky aquifers above the Corocoran Clay Layer).

- The NC dataset is a starting point for GSAs to identify GDEs in their basin. Please map the original NC dataset on Figures 2-86, 2-87, and 2-88 (p. 2-111, 2-112, and 2-113) and document which polygons were added (and what local sources were used to identify them), removed (and the removal reason), and kept (from the original NC dataset). The basin's GDE shapefile, which is submitted via the SGMA Portal, should also include 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).

Section 3.37 GDE p. 2-109 through 2-112

Checklist Items 16-20)

- No information was given on the historical or current groundwater conditions in the GDEs or the ecological conditions present. Please provide groundwater data for historical and current conditions near the GDEs or identify as a data gap. Refer to GDE Pulse (https://gde.codefornature.org; See Attachment E of this letter for more details) or any other locally available data to describe depth to groundwater trends in and around GDE areas, as well as trends in plant growth (e.g., NDVI) and plant moisture (e.g., NDMI). Below is a screenshot example of data available in GDE Pulse for NC dataset polygons found in Merced Subbasin:




- The vegetation species were not ranked as having a high, moderate or low value and no inventory of the vegetation types or habitat types were provided. Please identify whether any endangered or threatened freshwater species of animals and plants or areas with critical habitat were found in any of the GDEs. The list of freshwater species located in the Merced Subbasin in Attachment C of this letter.

<u>Section 2.3 Water Budget Information p. 2-113</u>
<u>(Checklist Item 21-22)</u>

The water budget for the surface water components did not include an explicit evapotranspiration term, but the following footnote was included as an explanation to Table 2-14 (p. 2-121 to 2-122). "Other flows is a closure term that captures the stream and canal system include gains and losses not directly measured or simulated within IWFM. Some of these features include but may not be limited to direct precipitation, evaporation, unmeasured riparian diversions and return flow, temporary storage in local lakes and regulating reservoirs, and inflow discrepancies resulting from simulating impaired flows." Riparian uptake from streams and evapotranspiration was included in the Land System Budget Table 2-15 (p. 2-123 to 2-124). The groundwater budget (Table 2-16 p. 2-125 and 2-126) did not include an explicit evapotranspiration term but included the following footnote "Other flows within the groundwater system including temporary storage in the vadose zone, and root water uptake from the aquifer system." The water budgets were calculated by the model, MercedWRM, and without the documentation the water budget is uncertain. Please provide a more complete description of the budget and the full model documentation in Appendix D.

<u>Section 3.1 Sustainability Goal p, 3-1</u>
<u>(checklist Items 23-25)</u>

The sustainability goal is stated as "Achieve sustainable groundwater management on a long-term average basis by increasing recharge and / or reducing groundwater pumping, while avoiding undesirable results" (p. 3-1). The report does not provide details on stakeholders involved in the goal selection process. The statement refers to "undesirable results" but does not mention GDEs, specifically. The goal appears to be directed toward reducing the groundwater overdraft and reducing the chance of wells going dry. The goal does not make a distinction between the pre-SGMA period and later years. Please clarify the sustainability goal and expand it to pertain to protection of GDE, ISWs and critical habitats.

Section 3.3.3 Measurable Objectives and Interim Milestones p, 3-4
(Checklist Item 26)

The measurable objectives addressed only the representative monitoring wells and was set at 25 feet above the minimum threshold. GDEs were not considered. Please expand the Measurable Objectives to include protection of the environmental health of GDEs and ISWs.

Section 3.3.2 Minimum Thresholds p. 3-4
(Checklist Item 27-29)

The minimum threshold was set at each of the representative monitoring wells. The level was defined as "The minimum threshold for groundwater levels was defined as the construction depth of the shallowest domestic well within a 2-mile radius." p. 3-5 Thus, GDEs were not considered. Please explain whether any adverse impacts to GDEs are expected and if changes to the minimum threshold should be made.

Chronic lowering of groundwater was considered by proxy only for the Merced River and San Joaquin River, not for the other creeks in the Merced Subbasin. Please identify areas on rivers or creeks where depletions are expected and if the minimum threshold should be changed.

Section 3.3.1 Undesirable Results p. 3-3
(Checklist Items (30-46)

- Undesirable results are defined as follows: "For the Merced Subbasin, an undesirable result for declining groundwater levels is considered to occur during GSP implementation when November groundwater levels at greater than 25% of representative monitoring wells (at least 7 of 25) fall below their minimum thresholds for two consecutive years where both years are categorized hydrologically as below normal, above normal, or wet" (p.3-3). GDEs are not specifically addressed. No hydrologic or biological data are compiled for the GDEs and data gaps are not described. Potential impacts on the GDEs are not described. For existing GDEs, please provide hydrologic and biological data for current conditions and describe how susceptible they are to future impacts.
- 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 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.

Section 4.5.6 Data Gaps p. 4-13
(Checklist Item #47)

Three regions where monitoring wells are missing or scarce are shown in Figure 4-6 (p. 4-14). These areas include:

"1. Data Gap #1: Located northwest of Merced and northeast of Atwater, this area contains relatively fewer existing wells, which often have limited construction information, and the wells are generally privately owned and require coordination with well owners to obtain permission and data.
2. Data Gap #2: Located along the western edge of the Subbasin, this area has virtually no known wells; overall well coverage needs to be enhanced through outreach to well owners to identify wells that can be used for monitoring purposes.
3. Data Gap #3: Located along the southern portion of the Subbasin just east of Data Gap #2, there are known potential wells to monitor but acquiring data from these wells is associated with technical or funding issues. These wells are primarily located within a federal wildlife refuge."

Aside from these areas, there are limited wells close to the Merced and San Joaquin Rivers to track conditions near potential GDEs. Greater effort should be directed toward obtaining full well construction information in all areas, but especially in the areas with GDEs and then selecting appropriate wells for monitoring.

Section 4.10 Depletions of Interconnected Surface Water Monitoring Network p, 4-30
(Checklist Item 48)

The stream gauges used to support interconnected stream monitoring are listed in Table 4-10 and shown in Figure 4-9 (p. 4-32 and 4-33, respectively). The GSP states on page 4-35 that "The understanding of depletions of interconnected surface water could be improved through additional depth-discrete groundwater elevation data near some rivers and streams and some NCCAGs." The addition of clusters of multi-depth wells near the known interconnected surface waters should be given a high priority.

Section 4.1 Monitoring Network Objectives p, 4-1
(Checklist Item 49)

One of the stated objectives of the monitoring program is "Monitoring impacts to the beneficial uses or users of groundwater." (p. 4-1) There is no reference to use of biological data for monitoring potential impacts to the GDEs or to the combined use of hydrologic and biological data. Hydrologic and biological data should be obtained around existing GDEs. Remote imaging can provide a useful tool for monitoring ecosystem health of GDEs and ISWs. Please clarify the potential use of imagery as a monitoring tool and expand it to monitoring surface indicators of ISW and GDE ecosystem health. Please describe how GDEs will be monitored to avoid or minimize impacts from both a hydrologic and biological standpoint.

Section 6.3 Projects p. 6.6
(Checklist Item #50-51)

A process was conducted by the three GSAs and stakeholders to select 12 projects. The projects are listed in Table 6-3. Only a general way of evaluating each project is given. Up to 50 future potential projects, listed in Table 6-6 Projects Running List for Reference, and may be implemented as priorities and funding change. None of the 12 selected projects are expected to directly benefit GDEs. Please explain how the groundwater recharge projects (Project #1, #4, and #10) could benefit GDEs or a location near the GDEs and how the projects will be evaluated.

# Attachment C

## Freshwater Species Located in the Merced Subbasin

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 Merced Subbasin. 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[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 | mmon Name | Legally Protected Species | | |
|---|---|---|---|---|
| | | Federal | State | Other |
| Birds | | | | |
| Haliaeetus leucocephalus | Bald Eagle | Bird of Conservation Concern | Endangered | |
| Himantopus mexicanus | Black-necked Stilt | | | |
| Icteria virens | Yellow-breasted Chat | | Special Concern | BSSC - Third priority |
| Ixobrychus exilis hesperis | Western Least Bittern | | Special Concern | BSSC - Second 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 | | | |
| Pandion haliaetus | Osprey | | Watch list | |
| Pelecanus erythrorhynchos | American White Pelican | | Special Concern | BSSC - First priority |

[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

| | | | | |
|---|---|---|---|---|
| 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 | |
| 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 | | | |
| Xanthocephalus xanthocephalus | Yellow-headed Blackbird | | Special Concern | BSSC - Third priority |
| **Crustaceans** | | | | |
| Branchinecta conservatio | Conservancy Fairy Shrimp | Endangered | Special | IUCN - Endangered |
| Branchinecta lindahli | Versatile Fairy Shrimp | | | |
| Branchinecta longiantenna | Longhorn Fairy Shrimp | Endangered | Special | IUCN - Endangered |
| Branchinecta lynchi | Vernal Pool Fairy Shrimp | Threatened | Special | IUCN - Vulnerable |
| Branchinecta mesovallensis | Midvalley Fairy Shrimp | | Special | |
| Cyzicus californicus | California Clam Shrimp | | | |
| Lepidurus packardi | Vernal Pool Tadpole Shrimp | Endangered | Special | IUCN - Endangered |
| Linderiella occidentalis | California Fairy Shrimp | | Special | IUCN - Near Threatened |
| **Fishes** | | | | |
| Mylopharodon conocephalus | Hardhead | | Special Concern | Near-Threatened - Moyle 2013 |
| Oncorhynchus mykiss - CV | Central Valley steelhead | Threatened | Special | Vulnerable - Moyle 2013 |
| Oncorhynchus mykiss irideus | Coastal rainbow trout | | | Least Concern - Moyle 2013 |
| Acipenser medirostris ssp. 1 | Southern green sturgeon | Threatened | Special Concern | Endangered - Moyle 2013 |
| Acipenser transmontanus | White sturgeon | | Special | Vulnerable - Moyle 2013 |

| | | | | |
|---|---|---|---|---|
| Catostomus occidentalis occidentalis | Sacramento sucker | | | Least Concern - Moyle 2013 |
| Cottus asper ssp. 1 | Prickly sculpin | | | Least Concern - Moyle 2013 |
| Cottus gulosus | Riffle sculpin | | Special | Near-Threatened - Moyle 2013 |
| Entosphenus tridentata ssp. 1 | Pacific lamprey | | Special | Near-Threatened - Moyle 2013 |
| Gasterosteus aculeatus microcephalus | Inland threespine stickleback | | Special | Least Concern - Moyle 2013 |
| Lampetra hubbsi | Kern brook lamprey | | Special Concern | Vulnerable - Moyle 2013 |
| Lavinia exilicauda exilicauda | Sacramento hitch | | Special | Near-Threatened - Moyle 2013 |
| Lavinia symmetricus symmetricus | Central California roach | | Special Concern | Near-Threatened - Moyle 2013 |
| Mylopharodon conocephalus | Hardhead | | Special Concern | Near-Threatened - Moyle 2013 |
| Oncorhynchus mykiss - CV | Central Valley steelhead | Threatened | Special | Vulnerable - Moyle 2013 |
| Oncorhynchus mykiss irideus | Coastal rainbow trout | | | Least Concern - Moyle 2013 |
| Oncorhynchus tshawytscha - CV fall | Central Valley fall Chinook salmon | Species of Special Concern | Special Concern | Vulnerable - Moyle 2013 |
| Oncorhynchus tshawytscha - CV late fall | Central Valley late fall Chinook salmon | Species of Special Concern | | Endangered - Moyle 2013 |
| Orthodon microlepidotus | Sacramento blackfish | | | Least Concern - Moyle 2013 |
| Pogonichthys macrolepidotus | Sacramento splittail | | Special Concern | Vulnerable - Moyle 2013 |
| Ptychocheilus grandis | Sacramento pikeminnow | | | Least Concern - Moyle 2013 |
| **Herps** | | | | |
| Actinemys marmorata marmorata | Western Pond Turtle | | Special Concern | ARSSC |
| Ambystoma californiense californiense | California Tiger Salamander | Threatened | Threatened | ARSSC |
| Anaxyrus boreas boreas | Boreal Toad | | | |
| Pseudacris regilla | Northern Pacific Chorus Frog | | | |
| Rana draytonii | California Red-legged Frog | Threatened | Special Concern | ARSSC |

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|---|---|---|---|---|
| Spea hammondii | Western Spadefoot | Under Review in the Candidate or Petition Process | Special Concern | ARSSC |
| Thamnophis gigas | Giant Gartersnake | Threatened | Threatened | |
| Thamnophis sirtalis sirtalis | Common Gartersnake | | | |
| **Insects and Other Invertebrates** | | | | |
| Ablabesmyia spp. | Ablabesmyia spp. | | | |
| Berosus spp. | Berosus spp. | | | |
| Centroptilum spp. | Centroptilum spp. | | | |
| Cladotanytarsus spp. | Cladotanytarsus spp. | | | |
| Corixidae fam. | Corixidae fam. | | | |
| Cricotopus spp. | Cricotopus spp. | | | |
| Cryptochironomus spp. | Cryptochironomus spp. | | | |
| Enallagma carunculatum | Tule Bluet | | | |
| Microtendipes spp. | Microtendipes spp. | | | |
| Mideopsis spp. | Mideopsis spp. | | | |
| Nanocladius spp. | Nanocladius spp. | | | |
| Phaenopsectra spp. | Phaenopsectra spp. | | | |
| Polypedilum spp. | Polypedilum spp. | | | |
| Procladius spp. | Procladius spp. | | | |
| Psychodidae fam. | Psychodidae fam. | | | |
| Sigara spp. | Sigara spp. | | | |
| Stylurus olivaceus | Olive Clubtail | | | |
| Tanytarsus spp. | Tanytarsus spp. | | | |
| Trichocorixa spp. | Trichocorixa spp. | | | |
| **Mammals** | | | | |
| Castor canadensis | American Beaver | | | Not on any status lists |
| Lontra canadensis canadensis | North American River Otter | | | Not on any status lists |
| Neovison vison | American Mink | | | Not on any status lists |
| Ondatra zibethicus | Common Muskrat | | | Not on any status lists |
| **Mollusks** | | | | |
| Anodonta californiensis | California Floater | | Special | |
| Ferrissia spp. | Ferrissia spp. | | | |
| Helisoma anceps | Two-ridge Rams-horn | | | CS |
| Margaritifera falcata | Western Pearlshell | | Special | |
| Menetus opercularis | Button Sprite | | | CS |
| Physa spp. | Physa spp. | | | |

| Plants | | | | |
|---|---|---|---|---|
| Alopecurus saccatus | Pacific Foxtail | | | |
| Ammannia coccinea | Scarlet Ammannia | | | |
| Arundo donax | NA | | | |
| Azolla filiculoides | NA | | | |
| Bacopa eisenii | Gila River Water-hyssop | | | |
| Bacopa rotundifolia | NA | | | |
| Brodiaea nana | | | | Not on any status lists |
| Callitriche longipedunculata | Longstock Water-starwort | | | |
| Callitriche marginata | Winged Water-starwort | | | |
| Castilleja campestris succulenta | Fleshy Owl's-clover | Threatened | Endangered | CRPR - 1B.2 |
| Cephalanthus occidentalis | Common Buttonbush | | | |
| Cicendia quadrangularis | Oregon Microcala | | | |
| Crassula aquatica | Water Pygmyweed | | | |
| Cyperus erythrorhizos | Red-root Flatsedge | | | |
| Cyperus squarrosus | Awned Cyperus | | | |
| Damasonium californicum | | | | Not on any status lists |
| Downingia bella | Hoover's Downingia | | | |
| Downingia cuspidata | Toothed Calicoflower | | | |
| Downingia pulchella | Flat-face Downingia | | | |
| Downingia pusilla | Dwarf Downingia | | Special | CRPR - 2B.2 |
| Elatine brachysperma | Shortseed Waterwort | | | |
| Elatine californica | California Waterwort | | | |
| Eleocharis acicularis acicularis | Least Spikerush | | | |
| Eleocharis macrostachya | Creeping Spikerush | | | |
| Eleocharis quadrangulata | NA | | | |
| Elodea canadensis | Broad Waterweed | | | |
| Epilobium campestre | NA | | | Not on any status lists |
| Epilobium cleistogamum | Cleistogamous Spike-primrose | | | |
| Eryngium castrense | Great Valley Eryngo | | | |
| Eryngium racemosum | Delta Coyote-thistle | | Endangered | CRPR - 1B.1 |
| Eryngium spinosepalum | Spiny Sepaled Coyote-thistle | | Special | CRPR - 1B.2 |

| | | | | |
|---|---|---|---|---|
| Eryngium vaseyi vaseyi | Vasey's Coyote-thistle | | | Not on any status lists |
| Euthamia occidentalis | Western Fragrant Goldenrod | | | |
| Gratiola ebracteata | Bractless Hedge-hyssop | | | |
| Gratiola heterosepala | Boggs Lake Hedge-hyssop | | Endangered | CRPR - 1B.2 |
| Hydrocotyle ranunculoides | Floating Marsh-pennywort | | | |
| Isoetes howellii | NA | | | |
| Isoetes nuttallii | NA | | | |
| Isoetes orcuttii | NA | | | |
| Juncus exiguus | | | | Not on any status lists |
| Juncus uncialis | Inch-high Rush | | | |
| Juncus usitatus | NA | | | Not on any status lists |
| Lasthenia ferrisiae | Ferris' Goldfields | | Special | CRPR - 4.2 |
| Lasthenia fremontii | Fremont's Goldfields | | | |
| Lemna gibba | Inflated Duckweed | | | |
| Lemna minuta | Least Duckweed | | | |
| Limnanthes douglasii nivea | Douglas' Meadowfoam | | | |
| Limnanthes douglasii rosea | Douglas' Meadowfoam | | | |
| Ludwigia peploides peploides | NA | | | Not on any status lists |
| Lycopus americanus | American Bugleweed | | | |
| Marsilea vestita vestita | NA | | | Not on any status lists |
| Mimulus guttatus | Common Large Monkeyflower | | | |
| Mimulus latidens | Broad-tooth Monkeyflower | | | |
| Mimulus tricolor | Tricolor Monkeyflower | | | |
| Myosurus minimus | NA | | | |
| Myosurus sessilis | Sessile Mousetail | | | |
| Myriophyllum aquaticum | NA | | | |
| Navarretia leucocephala leucocephala | White-flower Navarretia | | | |
| Navarretia myersii myersii | Pincushion Navarretia | | Special | CRPR - 1B.1 |
| Navarretia prostrata | Prostrate Navarretia | | Special | CRPR - 1B.1 |
| Neostapfia colusana | Colusa Grass | Threatened | Endangered | CRPR - 1B.1 |

| | | | | |
|---|---|---|---|---|
| Orcuttia inaequalis | San Joaquin Valley Orcutt Grass | Threatened | Endangered | CRPR - 1B.1 |
| Orcuttia pilosa | Hairy Orcutt Grass | Endangered | Endangered | CRPR - 1B.1 |
| Panicum dichotomiflorum | NA | | | |
| Paspalum distichum | Joint Paspalum | | | |
| Persicaria amphibia | | | | Not on any status lists |
| Persicaria hydropiper | NA | | | Not on any status lists |
| Persicaria hydropiperoides | | | | Not on any status lists |
| Persicaria lapathifolia | | | | Not on any status lists |
| Persicaria maculosa | NA | | | Not on any status lists |
| Phyla nodiflora | Common Frog-fruit | | | |
| Pilularia americana | NA | | | |
| Plagiobothrys acanthocarpus | Adobe Popcorn-flower | | | |
| Plagiobothrys austiniae | Austin's Popcorn-flower | | | |
| Plagiobothrys distantiflorus | California Popcorn-flower | | | |
| Plagiobothrys greenei | Greene's Popcorn-flower | | | |
| Plagiobothrys humistratus | Dwarf Popcorn-flower | | | |
| Plagiobothrys leptocladus | Alkali Popcorn-flower | | | |
| Plagiobothrys undulatus | NA | | | Not on any status lists |
| Plantago elongata elongata | Slender Plantain | | | |
| Pogogyne douglasii | NA | | | |
| Pogogyne zizyphoroides | | | | Not on any status lists |
| Potamogeton nodosus | Longleaf Pondweed | | | |
| Potamogeton pusillus pusillus | Slender Pondweed | | | |
| Psilocarphus brevissimus brevissimus | Dwarf Woolly-heads | | | |
| Psilocarphus oregonus | Oregon Woolly-heads | | | |
| Psilocarphus tenellus | NA | | | |
| Ranunculus aquatilis aquatilis | White Water Buttercup | | | |
| Ranunculus bonariensis | NA | | | |
| Ranunculus sceleratus | NA | | | |

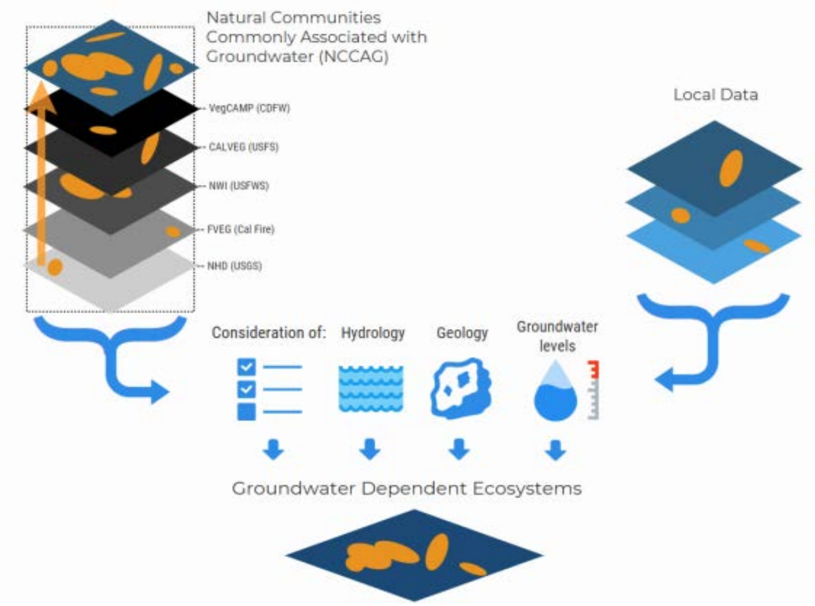
| | | | | |
|---|---|---|---|---|
| Rorippa curvisiliqua curvisiliqua | Curve-pod Yellowcress | | | |
| Rorippa palustris palustris | Bog Yellowcress | | | |
| Rumex stenophyllus | NA | | | |
| Sagittaria sanfordii | Sanford's Arrowhead | | Special | CRPR - 1B.2 |
| Salix exigua exigua | Narrowleaf Willow | | | |
| Salix gooddingii | Goodding's Willow | | | |
| Salix laevigata | Polished Willow | | | |
| Schoenoplectus acutus occidentalis | Hardstem Bulrush | | | |
| Schoenoplectus californicus | California Bulrush | | | |
| Sidalcea calycosa calycosa | Annual Checker-mallow | | | |
| Sidalcea hirsuta | Hairy Checker-mallow | | | |
| Sparganium eurycarpum eurycarpum | | | | |
| Spirodela polyrhiza | NA | | | |
| Stachys albens | White-stem Hedge-nettle | | | |
| Stuckenia striata | | | | Not on any status lists |
| Triglochin scilloides | NA | | | Not on any status lists |
| Tuctoria greenei | Green's Awnless Orcutt Grass | Endangered | Rare | CRPR - 1B.1 |
| Typha domingensis | Southern Cattail | | | |
| Zannichellia palustris | Horned Pondweed | | | |

# Attachment D

July 2019

## 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[7] 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)[8]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.




[7] *NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/*

[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

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[9]. 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[10] on the Groundwater Resource Hub[11], a website dedicated to GDEs.

### 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 infer 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 (e.g., 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 GDEs (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*.

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[9] *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*

[10] "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/

[11] *The Groundwater Resource Hub: www.GroundwaterResourceHub.org*

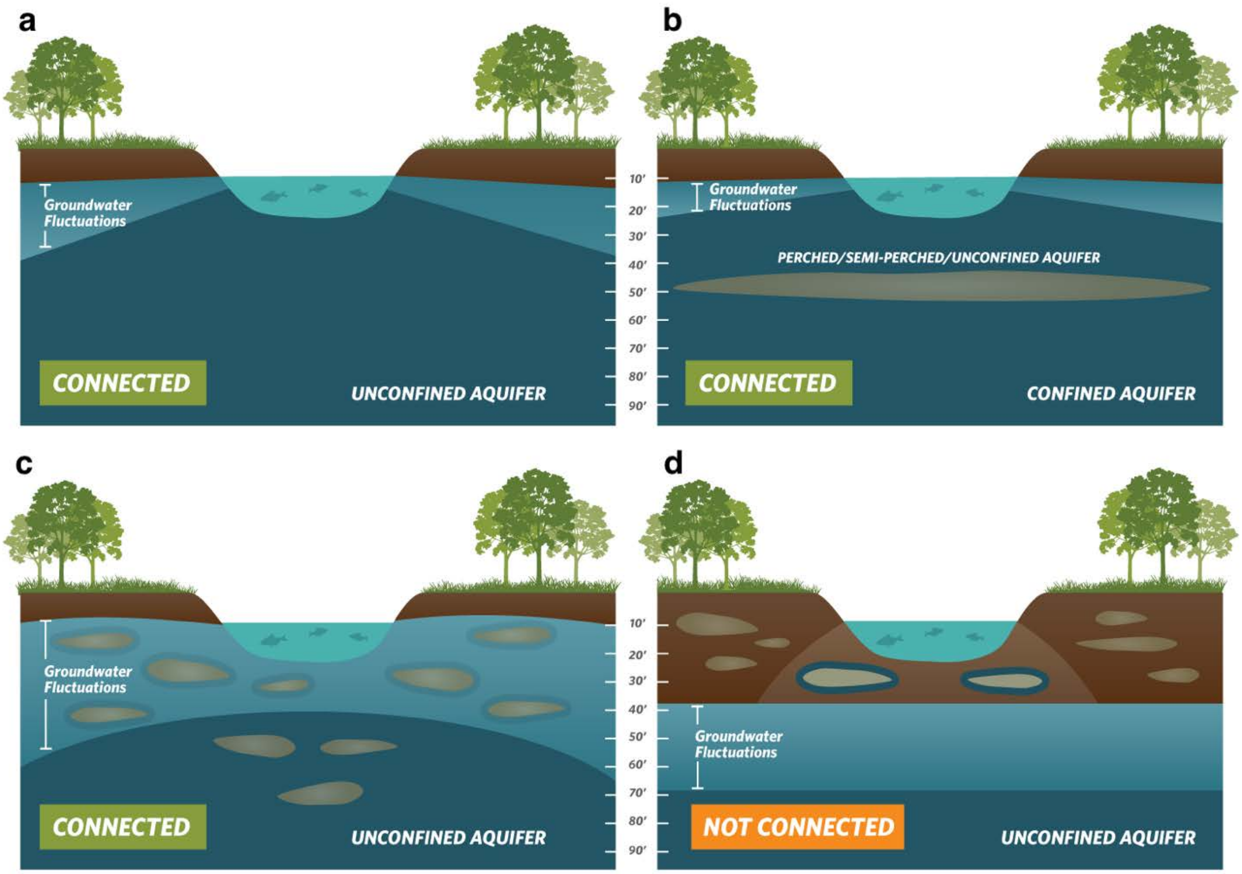


Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. (b) Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. Bottom: (c) Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. (d) 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 the surface water feature. These areas are not connected to groundwater and 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[12] 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[13] 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[14] 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] of the land surface 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[15]. 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).

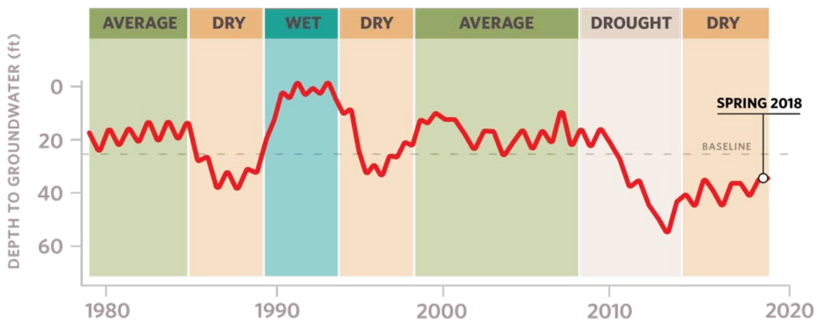


Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so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

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[12] 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

[13] *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)]*

[14] 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[4]).

[15] *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 a GDE does not preclude the possibility that it is supported by groundwater, too. 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[16], 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).

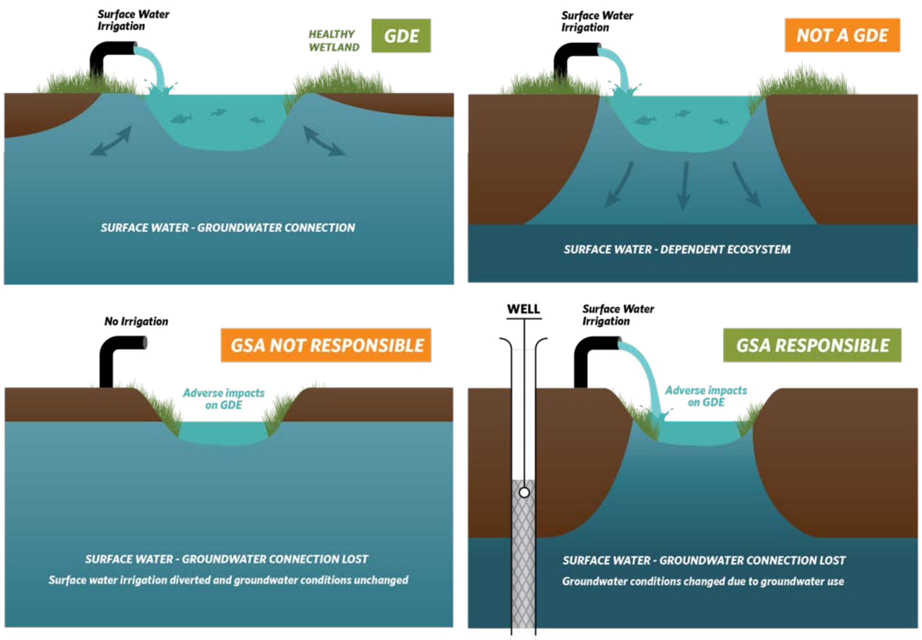



Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. (Right) Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. Bottom: (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.

[16] *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.

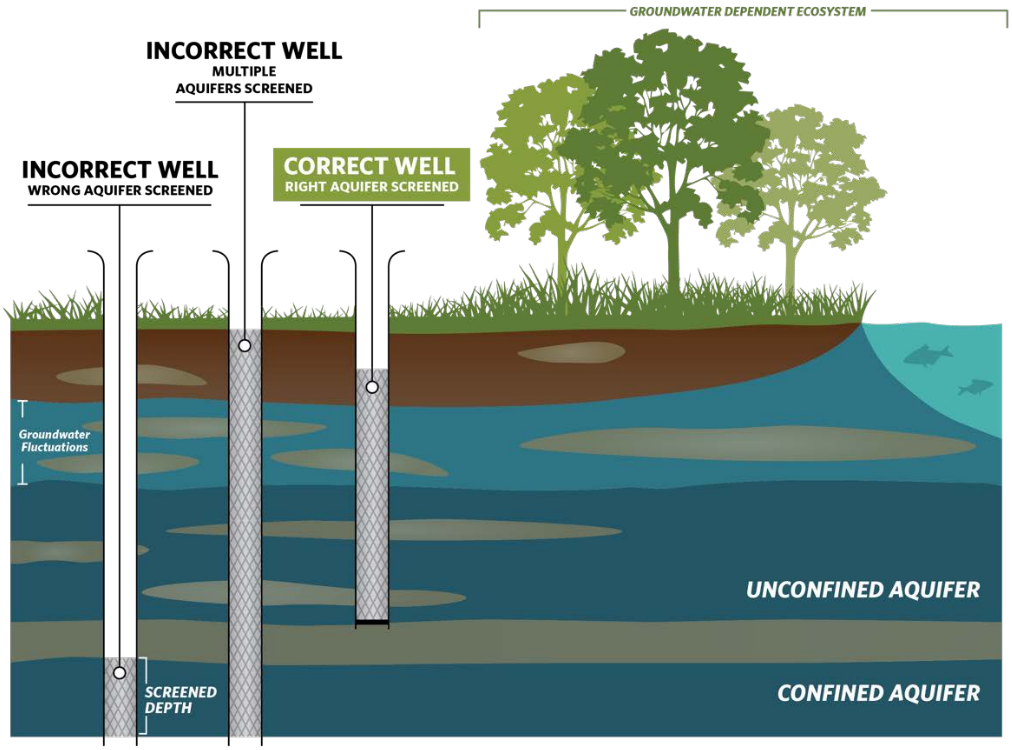



Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

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 stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[17] to estimate depth-to-groundwater contours across the landscape (Figure b; 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.

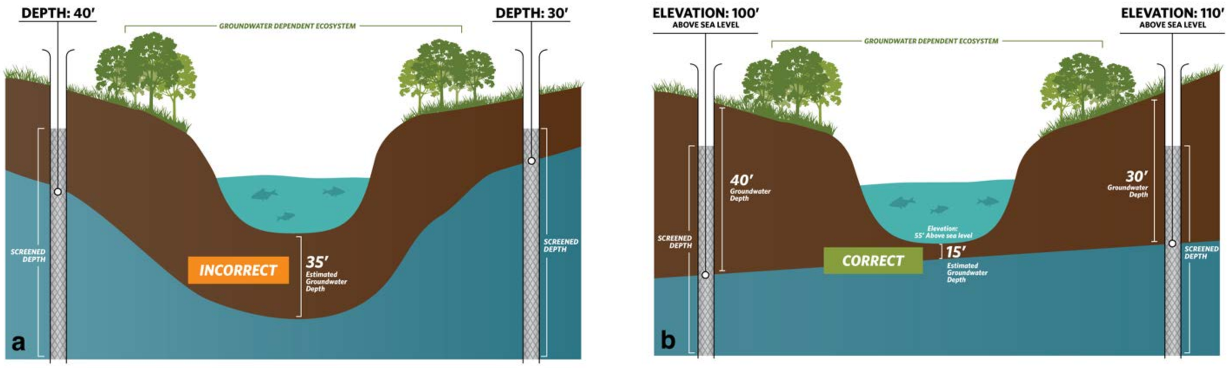



Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. (b) Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

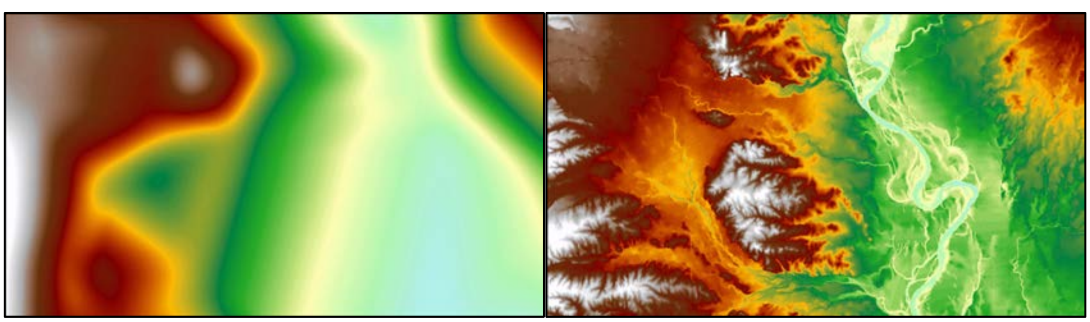


Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. (Right) Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation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

[17] 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://iewer.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 programs 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.

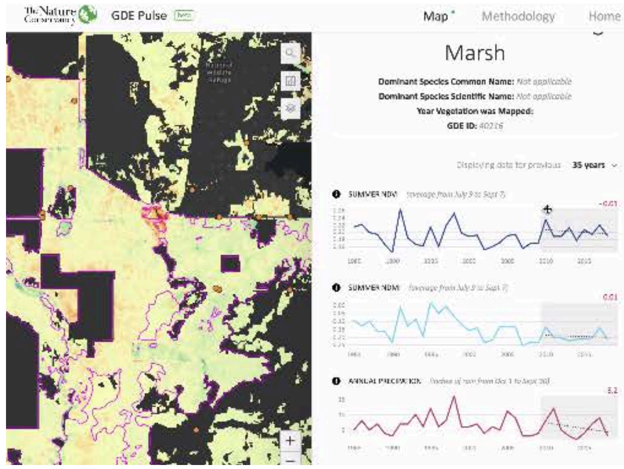
# Attachment E

## 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/](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[18]. 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[19]. 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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[18] *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/#](https://gis.water.ca.gov/app/NCDatasetViewer/#)*

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