August 24, 2019

Eastern San Joaquin Groundwater Authority
1810 E. Hazelton Avenue
P.O. Box 1810
Stockton, CA 95201

Submitted online via: http://www.esjgroundwater.org/

Re: Eastern San Joaquin Subbasin Groundwater Sustainability Plan Public Draft

Dear Basin Representatives,

The Nature Conservancy (TNC) appreciates the opportunity to comment on the Eastern San Joaquin Subbasin Groundwater Sustainability Plan Public Draft prepared by the Eastern San Joaquin Groundwater Authority under the Sustainable Groundwater Management Act (SGMA) and dated July 2019. TNC provided comments on the Eastern San Joaquin Subbasin Groundwater Sustainability Plan Draft Deliverable 1, which included portions of Chapters 1, 2, 3 and 5, on May 31, 2019. For your convenience, we have included the several attachments (discussed below) to this letter that were also provided in the previous letter.

**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 Eastern San Joaquin Groundwater Authority 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. In addition, monitoring networks should be designed to detect potential adverse impacts to beneficial uses due to groundwater. Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decision, and using data collected through monitoring to revise decisions in the future. Over time, GSPs should improve as data gaps are reduced and uncertainties addressed.

To help ensure that GSPs adequately address nature as required under SGMA, The Nature Conservancy has prepared a checklist (Attachment A) for GSAs and their consultants to use. The attached version of this checklist was revised in July 2019. 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 GSPs1.

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 online2 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.

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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. Since the Public Draft GSP includes the Freshwater Species List for the Subbasin provided in our earlier comment letter as Appendix 1-F of the Public Draft, we did not include it as an attachment to this letter. We recommend that after identifying which freshwater species exist in your basin, especially federal and state-listed species, that you contact staff at the California Department of Fish and Wildlife (CDFW), 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 Eastern San Joaquin Subbasin Draft GSP. We appreciate the work that has gone into the preparation of this plan. However, we consider it to be inadequate under SGMA because the basis for removing the majority of the potential GDEs identified in the NC Dataset from further consideration and management as GDEs is not scientifically supported, and could lead to significant and unreasonable impacts. Based on the available data, the removed polygons should be retained and managed as potential GDEs in the plan. If further analysis were to provide substantial evidence that groundwater level declines would not result in an adverse impact to the species in these ecosystems, then consideration could be given to removing them at that time; however, no such evidence has been presented in the draft GSP.

Our specific comments related to the Eastern San Joaquin Subbasin Groundwater Sustainability Plan, Draft Deliverable 1 of the Draft GSP are provided in detail in Attachment B and are in reference to the numbered items in the revised checklist in Attachment A. Attachment C 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 Dataset². Attachment D 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**  
**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.

### 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.

<table>
<thead>
<tr>
<th>GSP Plan Element*</th>
<th>GDE Inclusion in GSPs: Identification and Consideration Elements</th>
<th>Check Box</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Admin Info</strong></td>
<td></td>
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<tr>
<td>2.1.5 Notice &amp; Communication 23 CCR §354.10</td>
<td>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.</td>
<td>1</td>
</tr>
<tr>
<td><strong>Planning Framework</strong></td>
<td></td>
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<tr>
<td>2.1.2 to 2.1.4 Description of Plan Area 23 CCR §354.8</td>
<td>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.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Description of instream flow requirements, threatened and endangered species habitat, critical habitat, and protected areas.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Summary of process for permitting new or replacement wells for the basin, and how the process incorporates any protection of GDEs</td>
<td>4</td>
</tr>
<tr>
<td><strong>Basin Setting</strong></td>
<td></td>
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<tr>
<td>2.2.1 Hydrogeologic Conceptual Model 23 CCR §354.14</td>
<td>Basin Bottom Boundary: Is the bottom of the basin defined as at least as deep as the deepest groundwater extractions?</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>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?</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Basin cross sections: Do cross-sections illustrate the relationships between GDEs, surface waters and principal aquifers?</td>
<td>7</td>
</tr>
<tr>
<td>2.2.2</td>
<td>Interconnected surface waters:</td>
<td>8</td>
</tr>
<tr>
<td><strong>Current &amp; Historical Groundwater Conditions</strong>&lt;br&gt;<strong>23 CCR §354.16</strong></td>
<td>Interconnected surface water maps for the basin with gaining and losing reaches defined (included as a figure in GSP &amp; submitted as a shapefile on SGMA portal).</td>
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<tr>
<td></td>
<td>Estimates of current and historical surface water depletions for interconnected surface waters quantified and described by reach, season, and water year type.</td>
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</tr>
<tr>
<td><strong>Basin GDE map included</strong>&lt;br&gt;(as figure in text &amp; submitted as a shapefile on SGMA Portal).</td>
<td>Basin GDE map denotes which polygons were kept, removed, and added from NC Dataset (Worksheet 1, can be attached in GSP section 6.0).</td>
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<td></td>
<td>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).</td>
<td></td>
</tr>
<tr>
<td>If NC Dataset was used:</td>
<td>GDEs polygons are consolidated into larger units and named for easier identification throughout GSP.</td>
<td></td>
</tr>
<tr>
<td>If NC Dataset was not used:</td>
<td>Description of why NC dataset was not used, and how an alternative dataset and/or mapping approach used is best available information.</td>
<td></td>
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</tbody>
</table>

**Description of GDEs included:**

- Historical and current groundwater conditions and variability are described in each GDE unit.
- Historical and current ecological conditions and variability are described in each GDE unit.
- Each GDE unit has been characterized as having high, moderate, or low ecological value.
- Inventory of species, habitats, and protected lands for each GDE unit with ecological importance (Worksheet 2, can be attached in GSP section 6.0).

**2.2.3 Water Budget**<br>**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.
- 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.

**3.1 Sustainability Goal**<br>**23 CCR §354.24**

- Environmental stakeholders/representatives were consulted.
- Sustainability goal mentions GDEs or species and habitats that are of particular concern or interest.
- 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.

**3.2 Measurable Objectives**<br>**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.

**3.3 Minimum Thresholds**<br>**23 CCR §354.28**

- Description of how GDEs and environmental uses of surface water were considered when setting minimum thresholds for relevant sustainability indicators:
- 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?
### Undesirable Results

**For GDEs, hydrological data are compiled and synthesized for each GDE unit:**

- 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).
  - Baseline period in the hydrologic data is defined.
  - GDE unit is classified as having high, moderate, or low susceptibility to changes in groundwater.
  - Cause-and-effect relationships between groundwater changes and GDEs are explored.

- If hydrological data are not available within/nearby the GDE:
  - Data gaps/insufficiencies are described.
  - Plans to reconcile data gaps in the monitoring network are stated.

**For GDEs, biological data are compiled and synthesized for each GDE unit:**

- Biological datasets are plotted and provided for each GDE unit, and when possible provide baseline conditions for assessment of trends and variability.
- Data gaps/insufficiencies are described.
- Plans to reconcile data gaps in the monitoring network are stated.

**Description of potential effects on GDEs, land uses and property interests:**

- Cause-and-effect relationships between GDE and groundwater conditions are described.
- Impacts to GDEs that are considered to be "significant and unreasonable" are described.
- 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.
- Land uses include and consider recreational uses (e.g., fishing/hunting, hiking, boating).
- Property interests include and consider privately and publicly protected conservation lands and opens spaces, including wildlife refuges, parks, and natural preserves.

### Sustainable Management Criteria

**3.5 Monitoring Network**

- Description of whether hydrological data are spatially and temporally sufficient to monitor groundwater conditions for each GDE unit.
- Description of how hydrological data gaps and insufficiencies will be reconciled in the monitoring network.
- 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.
<table>
<thead>
<tr>
<th>Projects &amp; Mgmt Actions</th>
<th>4.0. Projects &amp; Mgmt Actions to Achieve Sustainability Goal</th>
<th>23 CCR §354.44</th>
<th>Description of how GDEs will benefit from relevant project or management actions.</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td>Description of how projects and management actions will be evaluated to assess whether adverse impacts to the GDE will be mitigated or prevented.</td>
<td>51</td>
</tr>
</tbody>
</table>

* 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](https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GD_GSP_Outline_Final_2016-12-23.pdf)
Attachment B

TNC Evaluation of the Eastern San Joaquin Subbasin Groundwater Sustainability Plan, Public Draft Complete Executive Summary and Main Report

A complete draft of the Eastern San Joaquin GSP has been provided for public review. On May 31, 2019, TNC provided comments on the Eastern San Joaquin Subbasin GSP Draft Deliverable 1, which included portions of Chapters 1, 2, 3 and 5. This attachment summarizes our comments on the complete public draft GSP dated July 2019, and includes any initial review comments from our May 31, 2019 that have not yet been addressed. Since the GSP does not follow the DWR Annotated GSP Outline, we have organized our comments below in accordance with the item numbers in the checklist included as Attachment A.

Checklist Item 1 – Notice & Communication (23 CCR §354.10).

- [Section 1.3.1 Beneficial Uses and Users in the Subbasin (pp. 1-40)] [Checklist item 1]
  - Caswell Memorial State Park is incorrectly referred to as being located outside the Eastern San Joaquin Subbasin. The following additional protected lands are located near surface waters within the Subbasin that may be interconnected with groundwater, and/or may rely at least partly on groundwater to support vegetation and sensitive natural communities. These protected lands represent potential beneficial users of groundwater: Durham Ferry State Recreational Area, a small portion (approximately 200 acres) of San Joaquin River National Wildlife Refuge, Army Corps Park, Vernalis Riparian Habitat (Public Conservation Lands), Seegers Preserve, Cabral Island Preserve, Machado Preserve, Hansen Preserve, Micke Grove Park and Zoo, Oak Grove Regional Park, Nakagawa Preserve, El Rio Farms Preserve, Lodi Lake Nature Area, Woodbridge Regional Park, Woodbridge Ecological Preserve, White Slough WA, Nuss Farms, Beck Preserve, Hilder Preserve, Staten Island Ranch, Burchel Preserve, and Ishizuka Preserve. The authors referred to the San Joaquin County General Plan documents, including background reports, for information regarding these important resources. These potential beneficial groundwater users should be described in the text on pp. 1-18 and shown in Figure 1-11. **Please include a description recognizing all of the protected areas in the Subbasin and their beneficial groundwater uses.**
  - Section 2.2.8 includes a geospatial analysis that removes managed wetlands from consideration as GDEs. **The managed wetlands in the Subbasin should be identified in this section.**

Checklist Item 2 to 4 - Description of general plans and other land use plans relevant to GDEs and their relationship to the GSP (23 CCR §354.8).
[Section 1.2.1 Description of Plan Area (1-10 to 1-21)] Critical habitat is known to exist for protected aquatic species, such as California Tiger Salamander, Steelhead, Delta Smelt, Giant Gartersnake and California Red-Legged Frog in and around the Subbasin (https://fws.maps.arcgis.com/home/webmap/viewer.html?webmap=9d8de5e265ad4fe09893cf75b8dbfb77). There are likely ongoing monitoring programs associated with critical habitat areas and the protected lands. Please include a description of these habitat areas, and associated programs and requirements pertinent to ISWs, GDEs and wetlands. Identify areas where critical habitat exists and overlaps with ISWs and GDEs.

[Section 1.2.2 Water Resources Monitoring and Management Programs (pp. 1-21 to 1-32)] Per the GSP Regulations (23 CCR §354.34 (a) and (b)), monitoring must address trends in groundwater and related surface conditions (emphasis added). In order for this section to provide the appropriate context and help assure integration of GSP implementation with other ongoing regulatory programs, this section should describe the following:

- Monitoring activities and responsibilities by State, Federal and local agencies and jurisdictions related to aquatic resources and GDEs that could be affected by groundwater withdrawals should be discussed. Section 1.2.2.6 states that there are no agencies that do monitoring specific to surface-groundwater interconnection. While this may be technically correct insofar as it relates to hydrogeologic monitoring, it ignores ongoing monitoring programs related to the state of aquatic resources and GDEs that could be affected by groundwater withdrawals, and that are a direct indicator of potential undesirable results. For example, there are likely ongoing monitoring programs associated with the protected lands listed in our comments to Section 1.3.1, and other open space or preserve areas that may be monitored by public, private or nonprofit entities. A discussion of monitoring programs related to GDEs and ISWs should be included.

- The lack of existing hydrologic monitoring of surface-groundwater interconnection is a significant data gap as it relates to classification and management of GDEs and should be identified as such and further discussed and addressed in the appropriate subsequent sections of the GSP.

- Monitoring activities and responsibilities related to instream flow and water quality requirements under applicable Federal Energy Regulatory Commission licenses, Biological Opinions and other regulations or programs are relevant and should be identified. Please include a discussion of water flow and quality monitoring requirements pertinent to ISWs.

[Section 1.2.3 Land Use Elements or Topic Categories of Applicable General Plans (pp. 1-33 to 1-36 and Appendix 1-E)]

- This section should include a discussion of General Plan goals and policies related to the protection and management of GDEs and aquatic resources that could be affected by groundwater withdrawals, rather than being limited to goals and policies directly related to groundwater resources alone. Section
1.3.1 correctly identifies environmental uses of groundwater as including “...species and habitat reliant on instream flows, as well as wetlands and GDEs,” and yet Section 1.2.3 and Appendix 1-E do not identify any General Plan policies related to these resources. **Section 1.2.3 should identify if there are any Habitat Conservation Plans (HCPs) or Natural Community Conservation Plans (NCCPs) within the Subbasin and if they are associated with critical, GDE and/or ISW habitats. Appendix 1-E should identify General Plan policies related to wetlands, riparian habitat, streams, aquatic habitat, and related threatened and endangered species. Section 1.2.3.2 should include a discussion of the relationship of GSP implementation to General Plan goals and policies related to GDEs and aquatic habitat; and also address how GSP implementation will coordinate with the goals of any HCPs or NCCPs.**

- [Section 1.2.3.4 Well Permitting (pp. 1-36 to 1-38)] **This section should include a discussion of the following:**
  - Future well permitting must be coordinated with the GSP to assure achievement of the Plan’s sustainability goals.
  - The State Third Appellate District recently found that Counties have a responsibility to consider the potential impacts of groundwater withdrawals on public trust resources when permitting new wells near streams with public trust uses (ELF v. SWRCB and Siskiyou County, No. C083239). The need for well permitting programs to comply with this requirement should be stated.
  - Section 2.3.3.3 discusses potential exemptions from the Stanislaus County Groundwater Ordinance but does not mention the fact that applicants who are not exempt are required to provide substantial evidence that their proposed extraction will not result in undesirable results, including significant and unreasonable impacts to GDEs and surface waters.

Checklist Items 6 and 7 – Hydrogeologic Conceptual Model (23 CCR §354.14)

- [Section 2.1.7 Geologic Cross Sections (pp. 2-35 to 2-37)] **Please clearly state whether localized perched aquifers are present in the basin. Include example near-surface cross section details that depict the conceptual understanding of shallow groundwater and stream interactions at different locations, including perched and regional aquifers.**

- [Section 2.1.8.2 Definable Bottom of the Basin (p. 2-39)] The Bottom of the Basin Boundary was defined by the base of freshwater, which was mapped 45 years ago and pumping since then has very likely resulted in shift in the isohaline contouring in the basin. Defining the bottom of the Subbasin based on geochemical properties is a suitable approach for defining the base of freshwater, however, 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](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 determination of the basin bottom.** This will
prevent the possibility of extractors with wells deeper than the basin boundary from claiming exemption of SGMA due to their well residing outside the vertical extent of the basin boundary. Also, pumping saline groundwater and desalinating it will become increasingly economical under SGMA due to pumping restrictions in the basin.

- [Section 2.1.10 HCM Data Gaps (pp. 2-56 and 2-57)] The Hydrologic Conceptual Model identified several data gaps including the following for groundwater level data:
  - Depth- or zone-specific water levels to assess vertical interconnection, including zones within the Principal Aquifer. **Nested monitoring wells would be helpful near surface water to show how pumping is impacting surface water flows and GDEs.**
  - Additional shallow groundwater data near surface waters and NCCAGs.
  - Additional groundwater level data in the east and northwest areas of the Subbasin.
  - Additional groundwater level data near the Mokelumne River to improve quantification and understanding of subsurface flows.

  Of these, the second data gap is the information that is most critical to identifying GDEs or potential GDEs and understanding their characteristics.

Checklist Items 8, 9 and 10 – Interconnected Surface Waters (23 CCR §354.16)

- [Section 2.1.4.2 Major Hydraulic Features (pp. 2-9 to 2-14)] This section should discuss (or reference the sections discussing) the following:
  - Specific ISWs, including the extent of both gaining and losing reaches.
  - In-stream flow requirements in each of the interconnected 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.
  - Areas of critical habitat that exist within rivers and streams.
- [Section 2.1.5 Geologic Formations and Stratigraphy (pp. 2-23 to 2-27)] Table 2-2 states that Holocene Stream Channel Deposits are generally not saturated except by the San Joaquin River. Based on the available data, it would be expected that the stream channel deposits associated with the other ISWs in the Subbasin would be saturated near those streams and rivers.
- [Section 2.1.9.2.2 Regional Historic Groundwater Flow and Surface Water Interaction (p. 2-49)] This section focuses on groundwater flow direction and defers further discussion of groundwater conditions to Section 2.2, which does not provide information on historical groundwater-surface water interaction. **This section should include a discussion of historic groundwater-surface water interaction.**

- Section 2.2.6 Interconnected Surface Water Systems (pp. 2-97 to 2-99)
  - The determination as to whether or not a stream reach is interconnected or disconnected was made based on whether modeling conducted for the GSP
indicated that it is interconnected more than 25 percent of the time. Even if the stream is only connected 25% of the time, it is still connected, and that short period of connectivity may be during critical times for select species or provide a cooling or biogeochemical effect during a critical period. **Please describe the technical basis for selecting a 25 percent interconnection threshold, and how it will adequately protect the environmental beneficial uses of surface water in potentially interconnected surface waters from significant and unreasonable impacts related to groundwater extraction.**

- Shallow groundwater monitoring data near surface waters and NCCAGs are identified as a data gap in Section 2.1.10, and the use of the Eastern San Joaquin Water Resources Model (ESJWRM) to determine the percentage of time that stream reaches are groundwater connected entails inherent uncertainty. The potential presence of shallow or perched aquifers near the rivers is not assessed or discussed in the GSP. Groundwater modeling conducted by the United States Geological Survey (USGS), DWR and others (e.g., JJ&A, 2018) has considered some river reaches shown as disconnected in Figure 2-66 (pp. 2-99) to be groundwater-connected. No data or discussion is presented regarding the potential groundwater connection of other streams associated with significant wetland and riparian resources, including Pixley Slough, Mormon Slough, Littlejohns Creek, Bear Creek, Potter Creek, Duck Creek and Lone Tree Creek. As such, there is considerable uncertainty regarding the designation of interconnected and disconnected surface water resources in Figure 2-66. **The uncertainty regarding the groundwater interconnection of streams in the Subbasin should be identified as a data gap.**

Checklist Items 11 through 20 – Groundwater Dependent Ecosystems (23 CCR §354.16)

- [Section 2.2.7 Groundwater-Dependent Ecosystems (p. 2-100)] This section includes the incorrect statement that SGMA does not require sustainable management criteria to be established for the management of GDEs. Section 1.3.1 of the GSP states that beneficial users of groundwater and ISWs include “environmental users of groundwater, including species and habitat reliant on instream flows, as well as wetlands and GDEs.” Undesirable results under SGMA include chronic lowering of groundwater levels resulting in significant and unreasonable depletion of supply for beneficial groundwater users, including wetlands and GDEs. Undesirable results also include depletion of ISWs resulting in significant and unreasonable adverse impacts on beneficial users of surface water, including wetlands and GDEs. **The incorrect statement that SGMA does not require the establishment of sustainable management criteria for GDEs should be removed.**

- [Section 2.2.8 Methodology for GDE Identification (p. 2-100 to 2-106)] The GSP relies on the NCCAG database developed by TNC for the DWR to identify potential GDEs, and then provides a framework for removing most of these areas from further consideration. **It appears that the preliminary desktop analysis documented in the draft GSP resulted an excessive elimination of the NC dataset**
polygons mapped in the Eastern San Joaquin Subbasin. In particular, the methods used to confirm whether or not polygons in the NC Dataset are connected to groundwater in the Eastern San Joaquin Subbasin are highly flawed. We have the following comments on the proposed approach:

- The GSP takes the approach of removing NCCAGs with "access to alternate water supplies" from consideration as GDEs, and states that in order to be considered GDEs, “there must not be alternate water supplies”. Alternate water supplies are assumed to include potential sources of surface water including managed wetlands, irrigated agricultural fields, perennial surface water sources, and other unspecified sources determined by stakeholders on a case-specific basis. This approach is inappropriate and deficient for several important reasons:
  - There is no hydrologic analysis or empirical data provided as a basis for the proposed buffer zones. The hydrologic connectivity between a GDE and a nearby alternative water source is highly dependent on local conditions and can vary seasonally and by year type. In the case of managed wetlands, no consideration is given to the nature of the wetland and surrounding area, the source and frequency of inundation, the soil types, and other features that would be needed to understand the hydrologic connectivity between the wetland and the surrounding area, or even whether the wetland itself it groundwater dependent for a portion of the year. Similarly, no information is given to the topography and hydrology surrounding irrigated agricultural fields, the soil types involved, irrigation practices, whether irrigation is likely to be curtailed during dry years or during certain crop rotations, and other relevant factors. The hydrologic connectivity of perennial surface water sources cannot be assessed without specific knowledge of the water source, topography and soil conditions. In summary, the adequacy of generic buffer zones to assure GDE access to surface water is unsubstantiated.
  - No information is provided regarding the species residing in the GDEs, their sensitivity to groundwater level declines, or the extent of their reliance on groundwater vs. the proposed “alternate water supplies.”
  - There is no evidence of consultation with the regulatory agencies responsible for the protection and management of these resources in the establishment of the proposed framework. It does not appear that any habitat assessments have been conducted.
  - Ecosystems often rely both on groundwater and surface water to meet their water needs (see Best Management Practice #3 in Attachment C of this letter). The availability of “alternate water supplies” to provide some portion of a GDE’s water demand does not mean all of its water needs can be met through alternate supplies (i.e., without reliance on groundwater).
  - Groundwater pumping depletes ISWs under both gaining or losing conditions, and GDEs may rely on the interactions of surface water to meet their water requirements.
Simply put, the approach proposes to manage GDEs without consideration to understanding the nature and needs of the resource being managed. A strictly binary approach, designating all NCCAGs as either 100 percent reliant on groundwater or 100 percent reliant on alternate water supplies is inconsistent with the available science and is not supportable. A scientific rationale for removing areas with access to assumed alternate water sources has not been provided. The deleted potential GDEs should be retained in the GSP and managed as potential GDEs. If further study and consultation with the appropriate regulatory agencies indicates that some areas would not be affected by groundwater withdrawals, consideration could be given to removing them at that time.

We have the following additional comments regarding the potential use of buffer zones to exclude NC-Dataset polygons from further consideration as GDEs:

- In the case of managed wetlands, the water sources used by the managed wetlands, the type of managed wetlands, the relationship of the wetlands to groundwater, and the wetland manager should be specified. In addition, these managed wetlands should be identified in Section 1.3.1.
- Please refer to Attachment C of this letter for best practices in using groundwater data to verify whether NCCAGs are GDEs. The GSP identifies monitoring data for shallow groundwater near ISWs as a data gap. Please discuss what temporal and spatial data were used to identify “shallow groundwater,” and identify any data gaps.
- A scientifically defensible rationale and data for applying the proposed buffer zones used to remove NCCAGs areas proximal to alternate water sources from consideration as GDEs has not been provided. In the absence of specific information regarding groundwater levels near these features, which is identified as a data gap in the GSP, it is possible that they are connected to a shallow groundwater table, at least seasonally. This is true of both gaining and losing reaches. Such a connection means they meet the definition of a GDE, regardless of whether the groundwater is replenished by a surface water source (see Best Management Practice #3 in Attachment C of this letter). In addition, the extent of groundwater reliance, and the ability of species to adapt to seasonal and long-term changes in hydrologic conditions, varies from species to species. We acknowledge that proximity to surface water sources and establishment of buffer zones may be an important consideration in GDE management; however, groundwater extraction can still result in drawdown near these areas, especially at the outer fringes of GDEs that are more vulnerable to drawdown. Buffer zones, if used, must be supported by actual hydrologic and habitat assessment data. If such data and assessments are not available, the areas should not be deleted from consideration and management as GDEs. The need for
supporting studies to validate the approach may be identified as a data gap and undertaken in the future.

- The “stakeholder feedback” mechanism for removal of NCCAGs from consideration as GDEs is not explained or documented in the GSP.

Please provide details that support removing potential GDEs based on stakeholder feedback. Stakeholder feedback, in the absence of scientifically supportable data and/or agency consultation, may be insufficient to exclude areas from consideration as GDEs.

- We have the following comments about the proposed use of a 30-foot depth to water criterion to exclude NC-Dataset polygons from further consideration as GDEs:

  - 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, where they can be reliably substantiated, to verify whether a connection to groundwater exists for polygons in the NC Dataset. This is preferable to relying on inferences based on the presence of surface water features in the Basin. However, it is important to note that where depth to water is uncertain in proximity to streams, a depth to water criterion for assessing which polygons are GDEs is inappropriate. Please refer to Appendix C of this letter for best practices for using groundwater data to verify a connection to groundwater.**

  - **Please provide more details on how depth to groundwater contour maps were developed:**
    - Are the wells used for interpolating depth to groundwater sufficiently close (<5km) to NC Dataset polygons to reflect local conditions relevant to ecosystems?
    - Are the wells used for interpolating depth to groundwater screened within the surficial unconfined aquifer and capable of measuring the true water table?
    - 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

\(^3\) 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/
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.

- The 30-foot depth to water criterion used to exclude riparian areas near streams east of the San Joaquin River from further consideration as GDEs is very broadly applied and poorly supported. Based on our understanding of the regional hydrogeology, we would expect riparian vegetation and wetlands near the major surface drainages to be connected to water tables associated with the regional aquifer system from a point where the streams exit the foothill uplands westward, except in areas of significant, pumping-induced drawdown. Shallow groundwater data near streams are identified as a significant data gap, and the available groundwater level data come from wells screened at a variety of depths. The application of a 30-foot depth to water criterion is inadequately supported in light of the identified data gaps, and should not be used exclude potential GDEs from further consideration without additional study.

- 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, the variable needs of plant species and their dependence on seasonal and inter-annual groundwater level fluctuations should be considered when applying this criterion. The GSP cites a maximum rooting depth of 25 feet for oak trees as a basis for the 30-foot criterion, yet studies have found the roots of oaks can extend deeper than 70 feet to extract water from the capillary fringe immediately above the water table during the summer and fall, and that groundwater reserves provide a buffer to rapid changes in their hydroclimate, as long as groundwater reserves are not depleted by drought or human consumption.\(^4\) It is highly advised that seasonal and interannual fluctuations in the groundwater regime are taken into consideration. Utilizing groundwater data from one point in time or contoured with too few shallow monitoring wells 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.

- Very little description is provided regarding the nature and function of the identified GDEs, their potential sensitivity to groundwater and surface water supply changes, their relative habitat value, or the current and historical groundwater conditions and variability near the GDEs. Given that monitoring of groundwater levels near ISWs has been identified as a data gap and limited resources are available to expand monitoring efforts in these areas, additional assessment would be helpful to identify and prioritize potential data gaps. **We recommend that a discussion regarding the nature and characteristics of the identified GDEs be included.**

Checklist Items 21 and 22 – Water Budget (23 CCR §354.18)

- [Section 2.3.5 Water Budget Estimates (pp. 2-115 to 2-133)] The following items related to GDEs, wetlands and riparian areas should be clarified or considered:
  - “Riparian intake from streams” is identified as a stream system water budget component and is defined as the portion of riparian evapotranspiration (ET) met by streamflows. **Please include an explanation of the approach to determining the amount of riparian ET demand met by streamflow vs. groundwater evapotranspiration.**
  - Groundwater outflow to ET does not appear to be identified as a groundwater budget component (for example see Figure 2-74, p. 2-125). In addition, the ET demand of natural vegetation does not appear to be considered in water supply and demand calculations (for example see Table 2-16, p. 2-126). **Since GDEs (including wetlands, riparian vegetation, phreatophytes and other communities) are recognized as beneficial users of groundwater in the Subbasin, it is appropriate to include them in these calculations.**

Checklist Items 23 and 25 – Sustainability Goal (23 CCR §354.24)

- [Section 3.1 Sustainability Goal (p. 3-1)] The Sustainability Goal is defined as being “... to maintain an economically-viable groundwater resource for the beneficial use of the people of the Eastern San Joaquin Subbasin ...”. **Since GDEs, are recognized as beneficial users of groundwater in the Subbasin, they should be mentioned in the Sustainability Goal.**

Checklist Item 26 – Measurable Objectives (23 CCR §354.30) and Checklist Items 30 to 33 – Undesirable Results (23 CCR §354.26)
• [Section 3.2.1.1.1 Description of Undesirable Results (for chronic lowering of groundwater levels (p. 3-3)] This section only describes undesirable results relating to human beneficial uses of groundwater and neglects environmental beneficial uses that could be adversely affected by chronic groundwater level decline. On page 3-5 in Section 3.2.1.2, impacts to GDEs are correctly identified as an undesirable result potentially associated with chronic groundwater level decline. Please add “potential adverse impacts to GDEs” to the list of potential undesirable results presented in Section 3.2.1.1.1.

• [Section 3.2.3.1.1 Description of Undesirable Results (for degraded water quality (p. 3-11)] This section only describes undesirable results in terms of total dissolved solids concentrations and related impacts. The section should be modified to state that overpumping and dewatering of aquifers has been identified as a potential source of elevated arsenic concentrations above drinking water standards in San Joaquin Valley aquifers. The following is a link to a paper by Smith, Knight and Fendorf (2018) titled “Overpumping leads to California groundwater arsenic threat”: (https://www.nature.com/articles/s41467-018-04475-3).

• [Section 3.2.6.1.1 Description of Undesirable Results (for ISWs (p. 3-11)] This section states that undesirable results related to surface water depletion were defined and evaluated only for major streams and rivers including the Calaveras River, Dry Creek, Mokelumne River, San Joaquin River, and Stanislaus River. The section goes on to state that many of the smaller creeks and streams are solely used for the conveyance of irrigation water and these systems have not been considered in the analysis of depletions. Contrary to these statements, surface water resources in these creeks support significant recognized aquatic habitat, wetlands and riparian zones that represent potential environmental beneficial uses and users of groundwater. A number of these streams are associated with designated protected lands. The analysis for potential depletion of ISWs in Section 3.2.6 should include all beneficial users of surface water that could be affected by groundwater withdrawals, including environmental beneficial users along creeks, even if the creeks are interconnected less than 75% of the time.

• [Section 3.2.6.1.2 Identification of Undesirable Results (for ISWs (p. 3-12)] The section states that “undesirable results would occur if groundwater extractions depleted interconnected streams and there was not sufficient surface water to supply … fish and wildlife demands.” This definition of undesirable results is overly narrow and recognizes only a limited subset of the environmental beneficial users of ISWs. A more complete definition would be that undesirable results would occur if groundwater extraction resulted in a depletion of surface water that caused significant impacts to aquatic species or wildlife, or degradation of GDEs. Please expand the definition of undesirable results to include all of the environmental beneficial uses and users of ISWs, and expand the analysis in Section 3.2.6, as appropriate.

• [Section 3.2.6.1.3 Potential Effects of Undesirable Results (for ISWs (p. 3-12)] The potential effects of undesirable results on environmental beneficial users are not described. Please expand the section to describe the potential effects of
undesirable results on all beneficial uses and users of ISWs, including environmental uses and users.

- The **GDE Pulse** web application developed by The Nature Conservancy provides easy access to 35 years of satellite data to view trends of vegetation metrics, groundwater depth (where available), and precipitation data. This satellite imagery can be used to observe trends for NC dataset polygons within the Subbasin. Over the past 10 years (2009-2018), some NC dataset vegetation polygons have experienced adverse impacts to vegetation growth and moisture in the western portion of the Subbasin. An example screen shot from the GDE Pulse tool is presented below. **Please review these spatial patterns and, where possible, correlate them with water level trends. Any indications of adverse trends and any data gaps should be identified.**

![GDE Pulse screenshot]

- Checklist Items 27 to 29 – Minimum Thresholds (23 CCR §354.28).

  - [Section 3.2.6.2 Minimum Thresholds (for ISWs (pp. 3-19 and 3-20))] The GSP proposes to use the Minimum Thresholds and Measurable Objectives associated with Chronic Decline in Groundwater Levels as a proxy for management of depletion of ISWs, and concludes that these criteria will be protective of the depletion of ISWs and prevent significant and unreasonable impacts to beneficial surface water uses and users. This conclusion is not adequately supported by data and/or consultation with the agencies that are responsible for the regulation of GDE habitats. We have the following comments:
    - The section states that current or historical issues associated with depletion of ISWs were not indicated to be significant and unreasonable based on discussions at GWA Board, Advisory Committee, and Workgroup meetings and
through input from GSA staff, and that it was therefore assumed that
historical conditions are protective of beneficial uses. It does not appear that
any consultation occurred with the Federal, State and local agencies
responsible for management and regulation of environmental beneficial uses
of ISWs, or with the private parties, agencies and NGOs involved in managing
the protected lands listed in our response to Section 1.3.1. In addition, no
reference is made to the review of supporting documents for General Plan
Conservation or Land Use Elements, or to the review of environmental
management studies and documents such as Biological Assessments,
Biological Opinions, HCPs or other studies regarding the current and historical
conditions of the beneficial uses being evaluated. **Please provide a more
thorough explanation of the basis for the assumption that current and
historical groundwater level conditions are protective of beneficial
uses related to ISWs. Data gaps should be acknowledged.**

- The **GDE Pulse** web application developed by The Nature Conservancy
  provides easy access to 35 years of satellite data to view trends of vegetation
  metrics, groundwater depth (where available), and precipitation data. This
  satellite imagery can be used to observe trends for NC dataset polygons
  within the Subbasin. Over the past 10 years (2009-2018), some NC dataset
  vegetation polygons have experienced adverse impacts to vegetation growth
  and moisture in the western portion of the Subbasin. **Please review these
  spatial patterns and, where possible, correlate them with water level
trends. Any indications of adverse trends and any data gaps should be
defined.**

- The section discusses future use scenarios, associated groundwater level
declines and ISW depletions on a broad level. The potential effects of these
declines on environmental beneficial uses, including GDEs, are not discussed.
In addition to discussion of potential adverse effects at a general level, a
conclusion that significant adverse impacts are unlikely generally requires
more site- and resource-specific analysis. **Please include a discussion of
the potential for adverse effects of surface water depletions on
environmental resources, as well as a reasoned analysis of the
likelihood of their occurrence under future scenarios. The lack of
site-specific data to draw conclusions about specific environmental
beneficial users should be recognized as a data gap.**

- Please expand the analysis of potential undesirable results to include
all environmental beneficial uses and users, including those
associated with more local streams and creeks.

- The statement that an additional depletion of the surface water due to
groundwater pumping of 50,000 acre-feet per year is not significant and
unreasonable needs to be further analyzed. The conclusion is based on
analyzing the estimated depletion as a percentage of total surface water
discharge. The significance of such a depletion relative to specific beneficial
uses and users will depend on its distribution throughout the surface water
system. Even a modest amount of depletion may have a significant local
adverse effect. **The limitations of broad conclusions regarding basin-**
wide surface water flow depletions should be recognized and any data gaps identified.

Checklist Items 47, 48 and 49 – Monitoring Network (23 CCR §354.34)

- [Section 4.1 Monitoring Network for Chronic Groundwater Level Decline (pp. 4-1 to 4-8) and Section 4.6 Monitoring Network for Depletion of Interconnected Surface Water (p. 4-14)] The GSP proposes to use groundwater level monitoring for chronic groundwater level decline as a surrogate for monitoring the depletion of ISWs. We have the following comments.
  - The areas identified as potential GDEs in the GSP are located near the western boundary of the Subbasin. Only one of the representative monitoring wells appears to be located near those areas (Figure 4-1 on p. 4-5). Very few of the remaining monitoring wells are located near potential ISWs and GDEs. **Specific monitoring should be described to further evaluate, monitor, manage and protect areas with ISWs and GDEs.**
  - Per the GSP Regulations (23 CCR §354.34 (a) and (b)), monitoring must address trends in groundwater and related surface conditions (emphasis added). Groundwater level monitoring alone may be insufficient to establish a linkage between groundwater extraction and potentially resulting impacts to environmental resources associated with GDEs and ISWs. The cause-effect relationship between groundwater levels and the biological responses that could result in significant and unreasonable impacts to ISWs and GDEs depends on a number of complicated factors, and this relationship is not characterized or discussed. As such, it is not possible to determine whether the proposed monitoring, minimum thresholds and measurable objectives are sufficiently protective to ensure significant and unreasonable impacts to GDEs and ISWs will be prevented. The GDE Pulse interactive mapping application provides an example of a linkage between groundwater level data and GDE health that could be used to incorporate remote sensing into an efficient and incisive monitoring program. **Please provide an explanation how groundwater levels will specifically be used to assess adverse impacts to GDEs and ISWs, and identify any data gaps and how they will be addressed.**

- [Section 4.7 Data Gaps (pp. 4-14 to 4-17)] Twelve new monitoring wells are proposed to measure groundwater levels and quality in critical areas where data are sparse. These include increased coverage near streams, Subbasin boundaries, and in the central area of groundwater depression. We have the following comments.
  - Locations should be prioritized near high value or sensitive resources that are vulnerable to significant and unreasonable impacts, such as near the protected lands identified in our comments on Section 1.3.1 or the GDEs identified in the Subbasin. In addition to the major streams and rivers in the subbasin, impacts to smaller creeks and wetland areas should be considered, as these may be the most vulnerable resources. **Please discuss the results of a resource assessment or consultations with resource managers that demonstrates a sufficient number of wells is proposed to address data gaps near GDEs and ISWs, and that they are being sited where**
they will provide the most benefit. Alternatively, please outline the process by which this will be accomplished.

- As discussed in our comments above, please address how the need to link and correlate groundwater level declines to biological responses, and significant and adverse impacts to GDEs and ISWs will be addressed.

- Well sites near ISWs should be selected at varying distances from streams and completed as vertically-nested clusters to capture the lateral and vertical gradients between the pumped depths in the aquifer system and the shallow groundwater aquifers that are in communication with ISWs or GDEs. **There is a need to enhance monitoring of stream flow and vertical groundwater gradients by installing more stream gauges and clustered/nested wells near streams, rivers or wetlands.** Ideally, co-locating stream gauges with clustered wells would enhance understanding about where ISWs exist in the basin and whether pumping is causing depletions of surface water or impacts on beneficial users of surface water and groundwater.

- Addressing data gaps is typically iterative and it is not reasonable to expect it will be a one-time process. **Please describe the process by which data gaps will be identified and addressed on an ongoing basis.**

- [Section 5.3 Data Included in the Management System (pp. 5-6 to 5-8)] Table 5.3 indicates that data regarding streamflow and GDEs is not currently included in the proposed Data Management System. Per the GSP Regulations (23 CCR §354.34 (a) and (b)), monitoring must address trends in groundwater and related surface conditions (emphasis added). You cannot manage what you do not measure. **Please discuss which monitoring data for “related surface conditions” will be gathered and incorporated in the DMS to assess potential significant and unreasonable impacts to environmental beneficial uses and users.**

- [Section 7.3.1 Monitoring (p. 7-5)] This section lists the key components involved in implementation of the monitoring network. Groundwater levels and monitoring will occur semi-annually, but no other information is given. Section 6.3 states that “additional management activities are discussed in Chapter 7: Plan Implementation”, and would include monitoring groundwater use through use of satellite imagery. However, Chapter 7 does not discuss using imagery or any remote sensing, which is a great 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.**

- [Section 7.3.2.2 Basin Conditions (pp. 7-5 and 7-6)] This section describes what current groundwater conditions and monitoring results will be included in the annual monitoring report. **Please specifically address ecosystem health of GDEs and ISWs as a surface indicator to subsurface conditions.** This can be done using GDE Pulse, remote sensing, imagery or other feasible methods.

Checklist Items 50 and 51 – Project and Management Actions (23 CCR §354.44)

- [Section 6.2.1 Project Identification (p. 6-1)] The Subbasin includes many GDEs and ISWs which represent beneficial uses and users of groundwater, and which include potentially sensitive resources and protected lands. **Environmental resource**
protection needs should be considered in establishing project priorities. In addition, consistent with existing grant and funding guidelines for SGMA-related work, priority should be given to multi-benefit projects that can address water quantity as well as providing environmental benefits or benefits to disadvantaged communities. **Please include environmental benefits and multiple benefits as criteria for assessing project priorities.**

- Table 6-1 (pp. 6-2 to 6-7) lists potential projects and the Measurable Objective that is expected to benefit. Only water level benefits are listed, but maintenance or recovery of groundwater levels, or construction of recharge facilities, also will have environmental benefits in many cases. From the table, it is not possible to distinguish the full range of project benefits or how the projects will be prioritized. **It would be advantageous to demonstrate multiple benefits from a funding and prioritization perspective.**

  - [Section 6.2.4 Planned Projects (pp. 6-8 to 6-33)]
    - For the projects already identified, please consider stating how ISWs and GDEs will benefit or be protected, or what other environmental benefits will accrue.
    - If ISWs will not be adequately protected by those listed, **please include and describe additional management actions and projects targeted for protecting ISWs.**
    - Recharge ponds, reservoirs and facilities for managed stormwater recharge can be designed to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. In some cases, such facilities have been incorporated into local HCPs, more fully recognizing the value of the habitat that they provide and the species they support. For projects that will be constructing recharge ponds, **please consider identifying if there will be habitat value incorporated into the design and how the recharge ponds will be managed to benefit environmental users.**

  - Specific examples of how project descriptions may be refined to incorporate environmental benefits include the following:
    - Project 21: Winery Recycled Water will recycle winery wastewater and reuse it for irrigation and in-lieu recharge, or the water will be put into ponds. **Please consider identifying what proportion of water will be put into ponds for direct recharge that could also provide a benefit for wildlife and aquatic species.**
    - Project 23: SSJID Stormwater Reuse will capture stormwater for reuse and recharge. Project 18: Farmington Dam Repurpose Project proposes to more than double storage in Farmington Basin for water supply. **Please consider assessing ways in which these projects could also provide enhanced wildlife and aquatic species benefits.**
    - For examples of case studies on how to incorporate environmental benefits into groundwater projects, please visit our website: [https://groundwaterresourcehub.org/case-studies/recharge-case-studies/](https://groundwaterresourcehub.org/case-studies/recharge-case-studies/)

  - [Section 6.3 Management Actions (p. 6-34)] This section lists only administrative actions the GSA will undertake to implement the GSP, and does not identify the management actions to be taken if to assure SGMA compliance if monitoring data
indicate that measurable objectives or interim milestones are not being achieved. An adaptive management approach, where monitoring data are used to assess results and inform refinement of the management approach is typically specified. Please identify what management actions will be taken if monitoring data indicate that Measurable Objectives or Interim Milestones are not being achieved, or undesirable results are imminent.
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\(^5\) 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)\(^6\). This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by 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,

\(^5\) NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/

springs, and seeps commonly associated with groundwater in California\textsuperscript{7}. 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\textsuperscript{8} on the Groundwater Resource Hub\textsuperscript{9}, 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.*


\textsuperscript{8} "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/

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\(^\text{10}\) recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline\(^\text{11}\) 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\(^\text{12}\) for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC’s GDE guidance document\(^\text{4}\), 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\(^\text{4}\) 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\(^\text{13}\). 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.](image)

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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\(^\text{10}\) DWR. 2016. Water Budget Best Management Practice. Available at: [https://water.ca.gov/LegacyFiles/groundwater/som/odfs/BMP_Water_Budget_Final_2016-12-23.pdf](https://water.ca.gov/LegacyFiles/groundwater/som/odfs/BMP_Water_Budget_Final_2016-12-23.pdf)

\(^\text{11}\) Baseline is defined under the GSP regulations as “historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin.” [23 CCR §351(e)]

\(^\text{12}\) Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs).

\(^\text{13}\) SGMA Data Viewer: [https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer](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\textsuperscript{14}, 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).

![Diagram of Ecosystems and Water Connections](Image)

**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.**

\textsuperscript{14} For a list of environmental beneficial users of surface water by basin, visit: [https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/](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)\(^\text{15}\) 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.

\(^{15}\) USGS Digital Elevation Model data products are described at: [https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services](https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services) and can be downloaded at: [https://iewer.nationalmap.gov/basic/](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 D

**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.

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. 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 NDMI 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. 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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16 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/#)

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