TECHNICAL MEMORANDUM

TO: San Pasqual Valley Groundwater Sustainability Agency

PREPARED BY: Will Medlin/W&C, Clayton Marcotte/W&C, Sam Castro/W&C

REVIEWED BY: Sally Johnson/W&C, Nate Brown/Jacobs

DATE: August 22, 2023

RE: Project Management Action (PMA) No. 7: Initial Surface Water Recharge Evaluation, Task 6: Possible Benefits to Potential Groundwater Dependent Ecosystems

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ACRONYMS & ABBREVIATIONS

bgs	below ground surface
CDFW	California Department of Fish and Wildlife
CNDDB	California Natural Diversity Database
CNRA	California Natural Resources Agency
DWR	California Department of Water Resources
EIR	Environmental Impact Report
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	hydrogeological conceptual model
NCCAG	Natural Communities Commonly Associated with Groundwater
PMA	Project and Management Action
Ramona MWD	Ramona Municipal Water District
SPV	San Pasqual Valley
TM	Technical Memorandum
US	United States
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

EXECUTIVE SUMMARY

This technical memorandum (TM) evaluates possible benefits to potential groundwater dependent ecosystems (GDEs) that may result from the implementation of four potential surface water recharge strategies under the San Pasqual Valley (SPV) Groundwater Sustainability Plan (GSP). This TM is part of a broader effort to develop a Preliminary Feasibility Study, comprised of components developed under separate tasks including evaluation criteria and ranking process of recharge strategies (Task 1), streambed investigation (Task 2), potential water sources for recharge (Task 3), potential recharge strategies (Task 4), approach and results of strategy modeling (Task 5), and possible benefits to potential GDEs (which will be addressed in this TM). An updated model, SPV GSP Model v2.0, was used to evaluate the four recharge strategies developed from the Task 4 assessment (City, 2023b) and their impacts to the SPV Groundwater Basin (Basin).

The intent of this Task 6 evaluation is to better understand the potential effects of the recharge strategies on groundwater level as it relates to GDE ability to access groundwater based on average GDE maximum vegetation rooting depth and modeled groundwater levels per year for each of the four strategies. These recharge strategies are as follows:

- Strategy 1B: Enhance Streamflow Infiltration with In-stream Modifications
- Strategy 2A: Augment Santa Ysabel Creek Streamflow with Sutherland Controlled Releases
- Strategy 3A: Augment Santa Ysabel Creek Streamflow with Ramona MWD Deliveries
- Strategy 3D: Injection Wells with Ramona MWD Deliveries

The four recharge strategies would primarily target the Santa Ysabel Creek drainage upstream of Ysabel Creek Road in the eastern portion of the Basin. The eastern portion of the Basin is generally a groundwater recharge area, where the aquifer receives water primarily from streambed infiltration of Santa Ysabel, Guejito, and Santa Maria Creeks. Within the Basin, Santa Ysabel Creek is approximately 50 to 150 feet wide with coarse sandy substrates and mid channel bars vegetated by willow (*Salix* spp.), salt cedar (*Tamarisk ramosissima*), and other riparian shrubs typical for the region. Normal stream flow within the channel of Santa Ysabel Creek is intermittent and primarily results from heavy rainfall runoff during the wettest months of the year. The eastern portion of the Basin is the target recharge area for the proposed strategies based on the potential benefits groundwater recharge would have on the deeper water table in that area of the Basin. Additionally, accessibility to existing infrastructure and roadways, proximity to representative monitoring wells, and minimization of disturbance to nearby agricultural lands make the eastern portion of the Basin ideal for potential long-term groundwater recharge. Typical average groundwater depths in the portion of the Basin east of Ysabel Creek Road range between approximately 65 to 105 feet below ground surface (bgs). Refer to Attachment A: Figures for project location and other mapping of the Basin, existing groundwater monitoring wells, and the four recharge strategies.

Based on the modeled recharge strategy hydrographs, the strategies appear to increase groundwater levels compared to baseline in many of the modeled groundwater wells within the target area in the eastern portion of the Basin. Though the modeled groundwater levels increase, they still remain between 30 and 90 feet below ground surface and therefore may not intersect with the average maximum rooting depths for potential non-GDEs. This would suggest that while the strategies may be good for overall groundwater supply replenishment and potential maintenance of groundwater levels above minimum thresholds, they may not have a direct long-term benefit to GDE vegetation accessing the aquifer. Further, the modeled recharge strategy hydrographs appear to indicate a long-term downward trend for groundwater levels in the target area despite augmenting groundwater and therefore further analysis of potential benefits to GDEs was not completed for future implementation years beyond 2030 – 2032. Refer to Attachment A: Figures for recharge strategies and GDEs, and Attachment C for the recharge strategy groundwater-level hydrographs.

Despite the minimal effect on groundwater levels in relation to GDE rooting depths, it should be noted that augmented stream flows and/or prolonged surface water inundation resulting from recharge strategies 1B, 2A, and 3A would likely still produce benefits to potential non-GDEs and sensitive or special-status species that may exist in the Basin and rely on riparian vegetation and wetland communities for breeding, feeding, and sheltering. Agricultural runoff, wastewater, and man-made surface water retention structures may also have a possible effect on potential GDEs. Shallow groundwater monitoring (e.g. piezometer readings) within 10-ft of ground surface may be used to determine water accessibility to potential GDEs and potential non-GDEs in the Basin. Further study could potentially discern how potential GDEs within the Basin are currently sustained and whether augmented surface flows may provide additional support to potential GDEs and potential non-GDEs.

1. INTRODUCTION

As part of the California Sustainable Groundwater Management Act (SGMA), Groundwater Sustainability Agencies (GSAs) are required to develop a GSP to help ensure that groundwater is available for long-term, reliable water supply uses. SGMA was signed into law in 2014.

The San Pasqual Valley GSA – composed of the City of San Diego (City) and the County of San Diego (County) – adopted the San Pasqual Valley GSP and submitted it to the California Department of Water Resources (DWR) in January 2022 (City and County, 2021). The GSP provides guidance and quantifiable metrics to provide for the continued sustainable management of groundwater resources within the San Pasqual Valley Groundwater Basin (Basin) over the 20-year GSP implementation period. To accomplish this, the GSP includes a hydrogeological conceptual model, monitoring requirements, sustainable management criteria, and several projects and management actions (PMAs). The PMAs included in the GSP provide opportunities to enhance water supply, reduce demands, and otherwise support sustainable groundwater management in the Basin, allowing the GSA to respond to changing conditions and help avoid undesirable results defined in the GSP. The Basin is currently sustainably managed, meaning no undesirable results are being experienced, so no additional PMAs are currently needed to achieve sustainability. However, implementing PMAs could improve resilience against challenging future hydrologic conditions, such as extended droughts.

Consideration of GDEs is a required component of a GSP, and potential non-GDEs were included in the 2021 GSP for the Basin. SGMA defines GDEs as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." Potential GDEs identified in this TM are defined as mapped natural communities commonly associated with groundwater (NCCAG) community polygons where the vegetative community's average maximum rooting depths intersect with measured groundwater. Potential non-GDEs identified in this TM are defined as being mapped NCCAG polygons with average maximum rooting depths that do not intersect groundwater. This TM is the last of six that specifically focuses on PMA No. 7 and how initial surface water recharge strategies could influence potential GDEs and potential non-GDEs identified within the Basin. While not a full GDE study, this TM is part of a broader effort to develop a Preliminary Feasibility Study of potential recharge strategies to augment groundwater within the Basin. Further desktop and field study beyond the scope of this TM may be required to determine the presence, extent, and status of potential GDEs in the Basin to inform the SPV GSP.

2. BASIN ECOLOGICAL SETTING

The Basin is located in southern California, southeast of the City of Escondido, in San Diego County, California. The Basin sits entirely within the Southern California / Northern Baja Coast Environmental Protection Agency (EPA) Level III ecoregion (85). The Southern California / Northern Baja Coast ecoregion is made up of coastal and alluvial plains, marine terraces, and foothills along the coast of Southern California. The ecoregion also extends southward for over 200 miles along the coast of Baja California. Dominant communities of coastal sage shrub and chaparral plants once characterized much of the area; however, large-scale urbanization and agricultural land clearing activities have altered the landscape (Griffith et al. 2016).

Much of the Basin is within the Diegan Coastal Valleys and Hills (85f) EPA Level IV ecoregion, as shown in **Figure 1**. This ecoregion is characterized by terraces and steep foothills. Numerous canyons exist along with a few wide valleys and the geology primarily consists of sedimentary and granitic rocks. Oceanic influence drives and changes the climate in this ecoregion. Soils are typically hot and dry, and the native vegetative communities include coastal scrub, chaparral, grasslands and meadows, and some small areas of coastal oak woodland. The westernmost portions of the Basin are located within the Diegan Western Granitic Foothills (85g) Level IV ecoregion. This ecoregion consists of low, somewhat steep, foothills that are part of the lower Peninsular Ranges. Valleys in the ecoregion vary in width. Marine air does not affect the climate as much as in the neighboring ecoregions to the west, however, soil temperature and moisture regimes and vegetative communities are similar.

The Basin is in a wide valley situated between Highland Valley and Starvation Mountain to the south, and Rockwood Canyon to the north. According to the United States Geological Survey (USGS) 7.5-minute topographic map Escondido, California (1975) and San Pasqual, California (1988) quadrangles, the approximate elevation of the eastern extent of the Basin is approximately 480 feet above mean sea level and the approximate elevation of the western extent of the Basin is 300 feet above mean sea level. Surface drainage within the eastern portion of the San Pasqual Valley is mainly comprised of two streams, Guejito Creek and Santa Ysabel Creek. Guejito Creek flows southward through Rockwood Canyon and into Santa Ysabel Creek, which then flows westward through the valley eventually draining into the San Dieguito River. The San Dieguito River then continues flowing west-southwest through the Basin eventually entering Lake Hodges. Refer to Attachment A: Figures for project location, ecoregion, and other relevant mapping of the Basin.

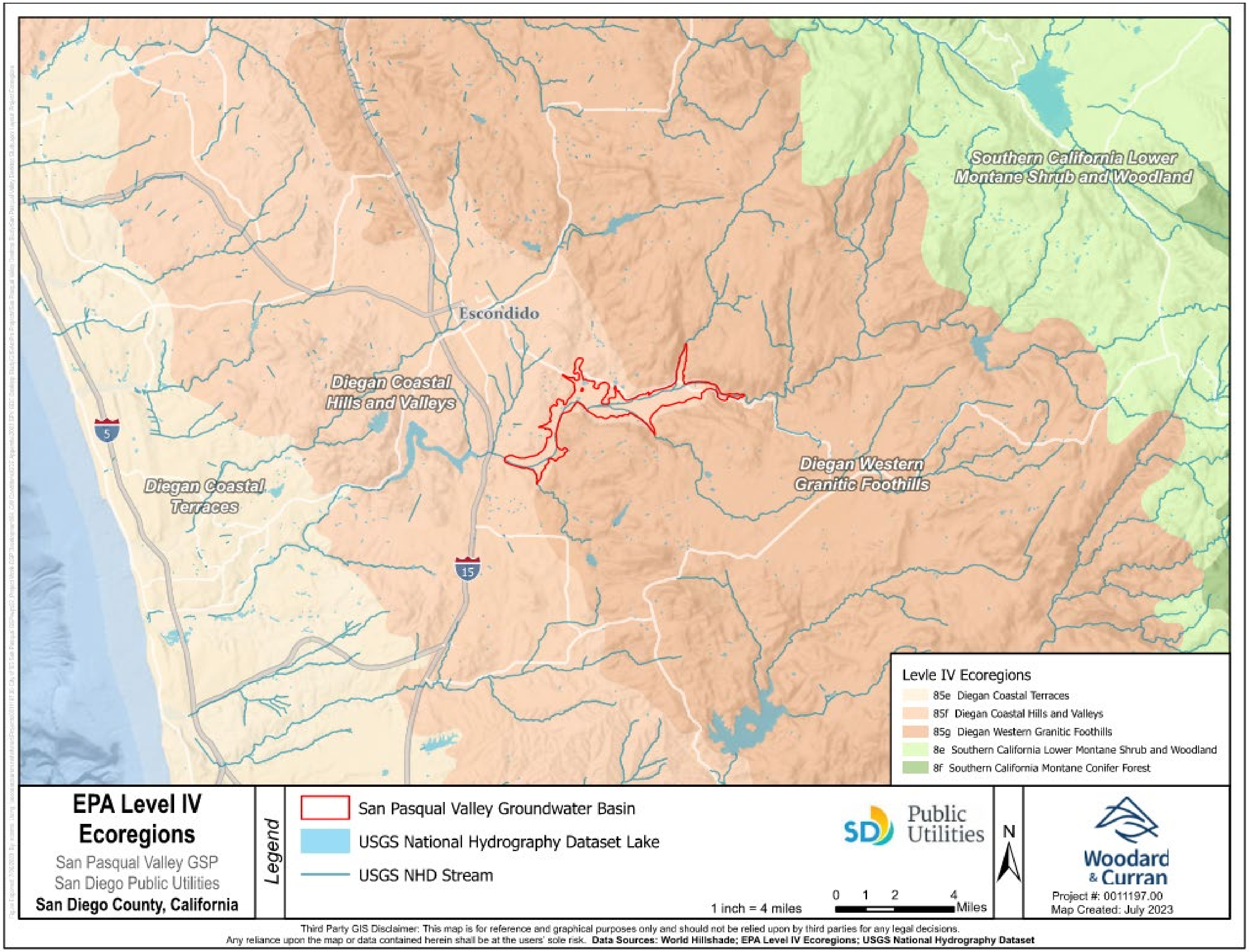


Figure 1: Basin Location in EPA Level IV Ecoregion

3. GROUNDWATER DEPENDENT ECOSYSTEMS AND INTERCONNECTED SURFACE WATERS

GDEs are communities and species that rely on groundwater for all or a portion of their life cycle. Reliance on groundwater varies between GDEs and may be considered direct, such as in the case of deep-rooted phreatophytes accessing groundwater via root systems, or indirect, such as animals that depend on riparian, wetland, or other groundwater-dependent vegetation. GDEs may include upland vegetation communities, springs, seeps, coastal wetlands, and riparian vegetation found along rivers, streams, and lakes (TNC 2020). The NCCAG dataset developed by California DWR was used to develop a Basin map of GDE indicators, shown in **Figure 2**. The NCCAG database includes a set of GIS data for vegetative communities and a separate data set for wetlands.

3.1 Methodology for Assessing GDEs

As documented in the separate TM for Task 5 (City, 2023c), the SPV GSP Model was updated from the version used to support the development of the GSP. The new model, SPV GSP Model V2.0, improved its representation of streams and aquifer characteristics in the Basin. This updated model incorporates more permeable stream channels, a more permeable alluvial aquifer, and more realistic streamflow behavior as compared with the previous version used to support GSP development. The SPV GSP Model v2.0 updates were conducted using information obtained during the Task 2 streambed investigation (City, 2023a) and recalibrated using a combination of daily and monthly stress periods. A stress period is an interval of time during which different values of precipitation, stream inflows at the perimeter of the model, and groundwater pumping are measured and weighed within the model. The model was used to generate predicted future groundwater levels in the Basin both without recharge strategy implementation (Baseline) and with each recharge strategy implemented. These modeled groundwater levels were then compared to the NCCAG-mapped polygons within the Basin to assess the recharge strategy impacts to GDEs.

Within the Basin, there are 72 NCCAG-mapped polygons (19 vegetation and 53 wetland) indicating potential GDEs or potential non-GDEs. The vegetative communities are described in the United States Forest Service (USFS) South Coast and Montane Ecological Province (CALVEG Zone 7) report (2009 USFS) and the wetland communities are described under the Cowardin classification system (1979 USFWS). There are six different vegetative communities mapped within the Basin: *coast live oak alliance, riparian mixed hardwood alliance, riparian mixed shrub alliance, riversidean alluvial scrub alliance, tule-cattail alliance, and willow (shrub) alliance*. The three different freshwater wetland communities mapped within the Basin consist of *palustrine emergent marsh, palustrine scrub-shrub, and palustrine forested systems*. The various vegetative and wetland communities include a number of species designated by California as phreatophytes or “deep-rooting” vegetation that rely on access to groundwater for long-term survival. Though these defined communities may include phreatophytic species, not all representative species within a community are considered phreatophytes. While these communities access shallow soil moisture, surface water, or perched groundwater during periods of drought or other dry conditions, they may also rely on access to the deeper regional aquifer for long-term survivability.

Each of the various vegetative and wetland community types have typical, representative plant species that occur within those habitats according to the 2009 USFS South Coast and Montane Ecological Province report. Those species have corresponding typical maximum rooting depths based on the 2021 Groundwater Resource Hub plant rooting database. Using this information and field observations of plant species within the vegetative and wetland communities from the 2020 GDE study, an average maximum rooting depth for each of the nine community types was calculated and applied to the NCCAG polygons mapped within the Basin. The vegetative and wetland community types and their associated average maximum rooting depths are described in **Table 1**. Potential GDEs identified in this TM are defined as mapped NCCAG community polygons with average maximum rooting depths that intersect groundwater. Potential non-GDEs identified in this TM are defined as being mapped NCCAG polygons with average maximum rooting depths that do not intersect groundwater. The average maximum rooting depths for each NCCAG-mapped community type were then compared against 10 years (2013-2022) of measured average groundwater level data for the Basin. If the average maximum rooting depth was at or below the average annual groundwater level, then the polygon was classified as a potential GDE. If the maximum rooting depth of a NCCAG community polygon was above the average annual groundwater level and did not intersect groundwater, the polygon was considered a potential non-GDE (**Figure 3**). Out of the 72 NCCAG-mapped polygons, only 14 polygons had average maximum rooting depths that intersected with the groundwater level contours, meaning groundwater depth was within the rooting zone's depth, and were therefore classified as potential GDEs. The remaining 58 NCCAG-mapped polygons with average maximum rooting depths that did not intersect groundwater were classified as potential non-GDEs.

Some surface waters may also support potential non-GDEs through their ability to recharge the Basin. Surface waters can generally be classified as interconnected surface waters or disconnected surface waters. SGMA defines interconnected surface waters as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted". Within the Basin, there are several intermittent stream channels that carry surface water at times during the year. The six primary intermittent drainage systems are Santa Ysabel Creek, Guejito Creek, Santa Maria Creek, Cloverdale Creek, Sycamore Creek, and the San Dieguito River. Based on a review of aerial photography, USGS gage station data, and field observations, each of these drainages dries up completely during certain portions of the year (typically Fall). However, groundwater modeling does appear to indicate that Cloverdale Creek, Sycamore Creek, and the San Dieguito River are potentially interconnected surface waters. Guejito Creek, Santa Maria Creek, and Santa Ysabel Creek in the eastern portion of the Basin are designated as disconnected streams because measured groundwater levels in nearby wells and the simulated groundwater levels do not intersect the streambed in these reaches. These streams are considered losing streams and can recharge groundwater when surface flows are available.

Table 1: NCCAG Vegetative and Wetland Community Types Found Within SPV Basin and Corresponding Community Average Maximum Rooting Depths

Community Type	Dominant Species Associated with Community Type (Species Average Maximum Root Depth)	Community Average Maximum Root Depth (feet bgs)	Present within Target Recharge Area
Vegetative Community			
Coast Live Oak Alliance	*Quercus agrifolia* (35 ft)	35	No
Riparian Mixed Hardwood Alliance	*Anemopsis californica* (1 ft), *Baccharis salicifolia* (2 ft), *Eucalyptus globulus* (10 ft), *Populus balsamifera* (4 ft), *Populus fremontii* (7 ft), *Populus trichocarpa* (4 ft), *Quercus agrifolia* (35 ft), *Salix spp.* (3 ft)	8	No
Riparian Mixed Shrub Alliance	*Arundo donax* (16 ft), *Baccharis salicifolia* (2 ft), *Salix spp.* (3 ft), *Tamarix ramosissima* (72 ft)	23	Yes
Riversidean Alluvial Scrub Alliance	*Arundo donax* (16 ft), *Baccharis salicifolia* (2 ft), *Encelia farinose* (2 ft), *Eriogonum fasciculatum* (4 ft), *Salvia apiana* (5 ft), *Tamarix ramosissima* (72 ft), *Yucca whipplei* (2 ft)	15	No
Tule – Cattail Alliance	*Avena fatua* (1 ft)	1	No
Willow (Shrub) Alliance	*Anemopsis californica* (1 ft), *Arundo donax* (16 ft), *Baccharis salicifolia* (2 ft), *Eucalyptus globulus* (10 ft), *Populus fremontii* (7 ft), *Salix spp.* (3 ft) *Tamarix ramosissima* (72 ft), *Typha domingensis* (1 ft)	14	Yes
Wetland Community			
Palustrine Emergent Marsh (PEM)	*Avena fatua* (1 ft)	1	Yes
Palustrine Scrub-Shrub (PSS)	*Arundo donax* (16 ft), *Baccharis salicifolia* (2 ft), *Encelia farinose* (2 ft), *Eriogonum fasciculatum* (4 ft), *Salix spp.* (3 ft), *Salvia apiana* (5 ft), *Tamarix ramosissima* (72 ft), *Yucca whipplei* (2 ft)	13	Yes
Palustrine Forested (PFO)	*Anemopsis californica* (1 ft), *Arundo donax* (16 ft), *Bacchari salicifolia* (2 ft), *Eucalyptus globulus* (10 ft), *Populus balsamifera* (4 ft), *Populus fremontii* (7 ft), *Populus trichocarpa* (4 ft), *Quercus agrifolia* (35 ft), *Salix spp.* (3 ft), *Tamarix ramosissima* (72 ft), *Typha domingensis* (1 ft)	14	No

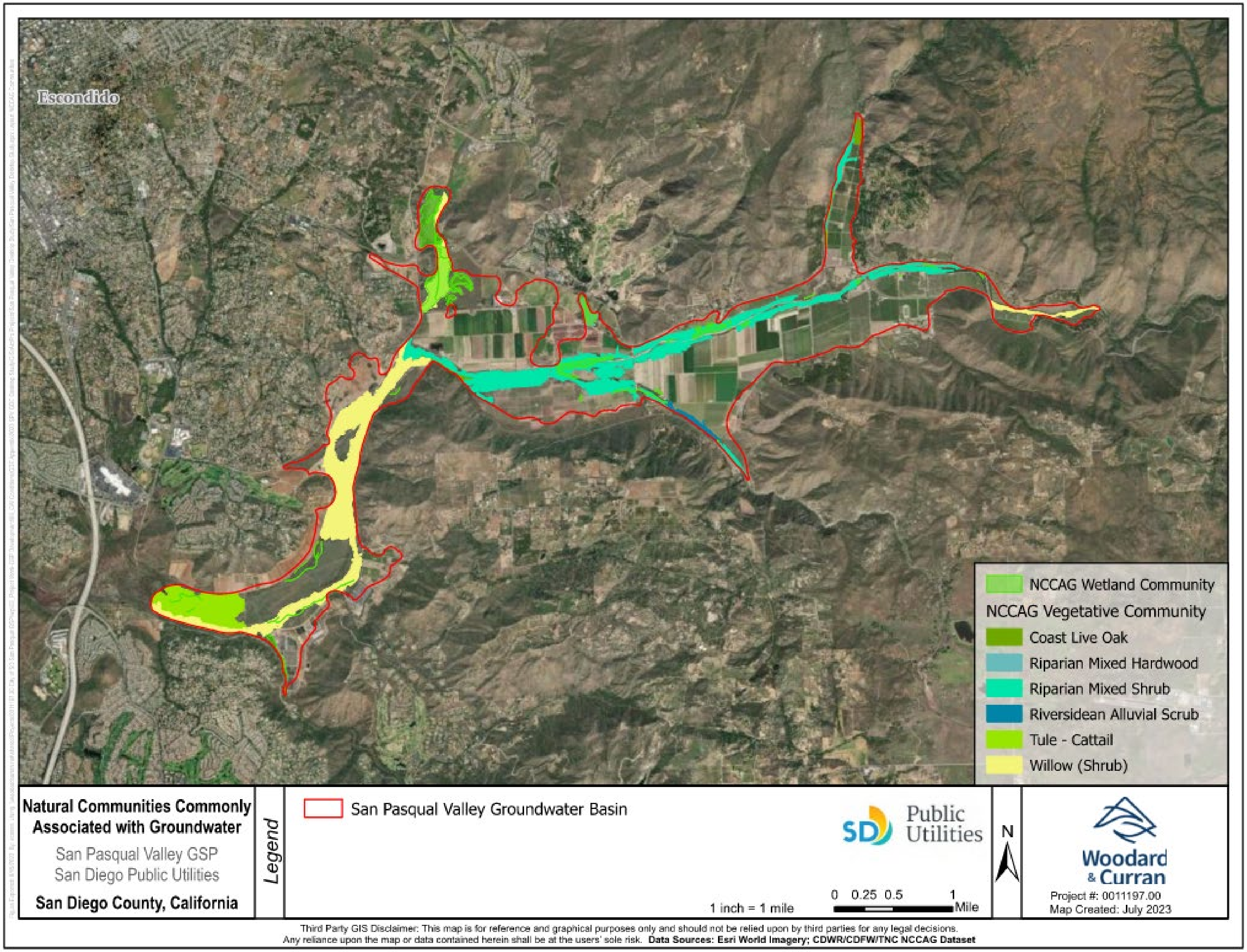


Figure 2: Potential GDEs and Potential Non-GDEs in the San Pasqual Valley Groundwater Basin

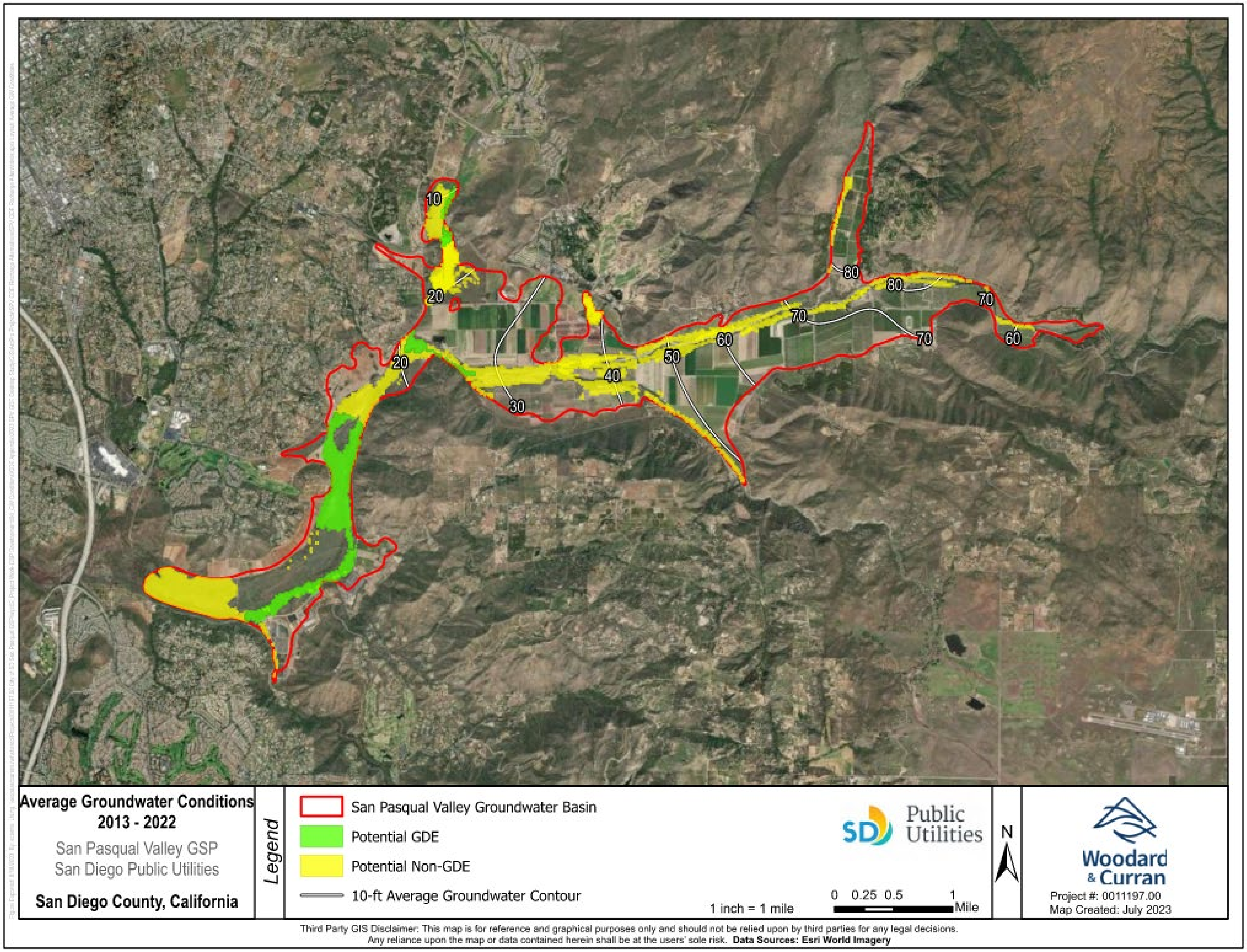


Figure 3: Average Measured Groundwater Levels from 2013-2022 in the San Pasqual Valley Groundwater Basin

4. SURFACE WATER RECHARGE STRATEGIES

The updated SPV GSP Model v2.0 was used to evaluate the four recharge strategies retained from the Task 4 assessment of potential recharge strategies. The intent of the evaluation is to better understand potential benefits of the recharge strategies, should they require implementation as part of adaptive management to avoid undesirable results. Additional discussion on the four recharge strategies and considerations for implementation can be found in TM 5 (City, 2023c). The recharge strategies are shown in **Figure 4** and include:

Strategy 1B: Enhance Streamflow Infiltration with In-stream Modifications; A permanent, channel-spanning, inflatable rubber dam across Santa Ysabel Creek will be installed. The rubber dam would be inflated during selected periods to detain stormwater and increase the opportunity for additional infiltration and groundwater recharge behind the dam and deflated when Santa Ysabel Creek is dry or during higher-streamflow periods to allow stormwater in the creek to flow past the dam. The conditions under which the dam was inflated when modeling this strategy are described in TM 5 (City, 2023c).

Strategy 2A: Augment Santa Ysabel Creek Streamflow with Sutherland Controlled Releases; Streamflow in Santa Ysabel Creek would be augmented with controlled releases from Sutherland Reservoir. The timing of recharge strategy implementation would occur based on certain conditions established in the GSP related to current groundwater levels in the target area, future predicted water availability due to precipitation and weather events, availability of water in Sutherland Reservoir, and current streamflow with Santa Ysabel Creek.

Strategy 3A: Augment Santa Ysabel Creek Streamflow with Ramona MWD Deliveries; Santa Ysabel Creek streamflow would be augmented with deliveries of raw water from Ramona MWD. Deliveries of raw water would occur upstream of River Mile 3 near the San Pasqual Valley Road bridge. This location was ultimately determined to maximize the potential for streambed infiltration by conveying water along a realistic hypothetical pipeline route from Ramona MWD's existing untreated water conveyance system to Santa Ysabel Creek and delivering the water in the eastern portion of the Basin.

Strategy 3D: Injection Wells with Ramona MWD Deliveries; Recharge water from Ramona MWD would be injected directly into the Basin aquifer through three injection wells. During the modeled Strategy 3D implementation periods, the monthly volume of water available from Ramona MWD would be conveyed to and evenly distributed across each of the three injection wells.

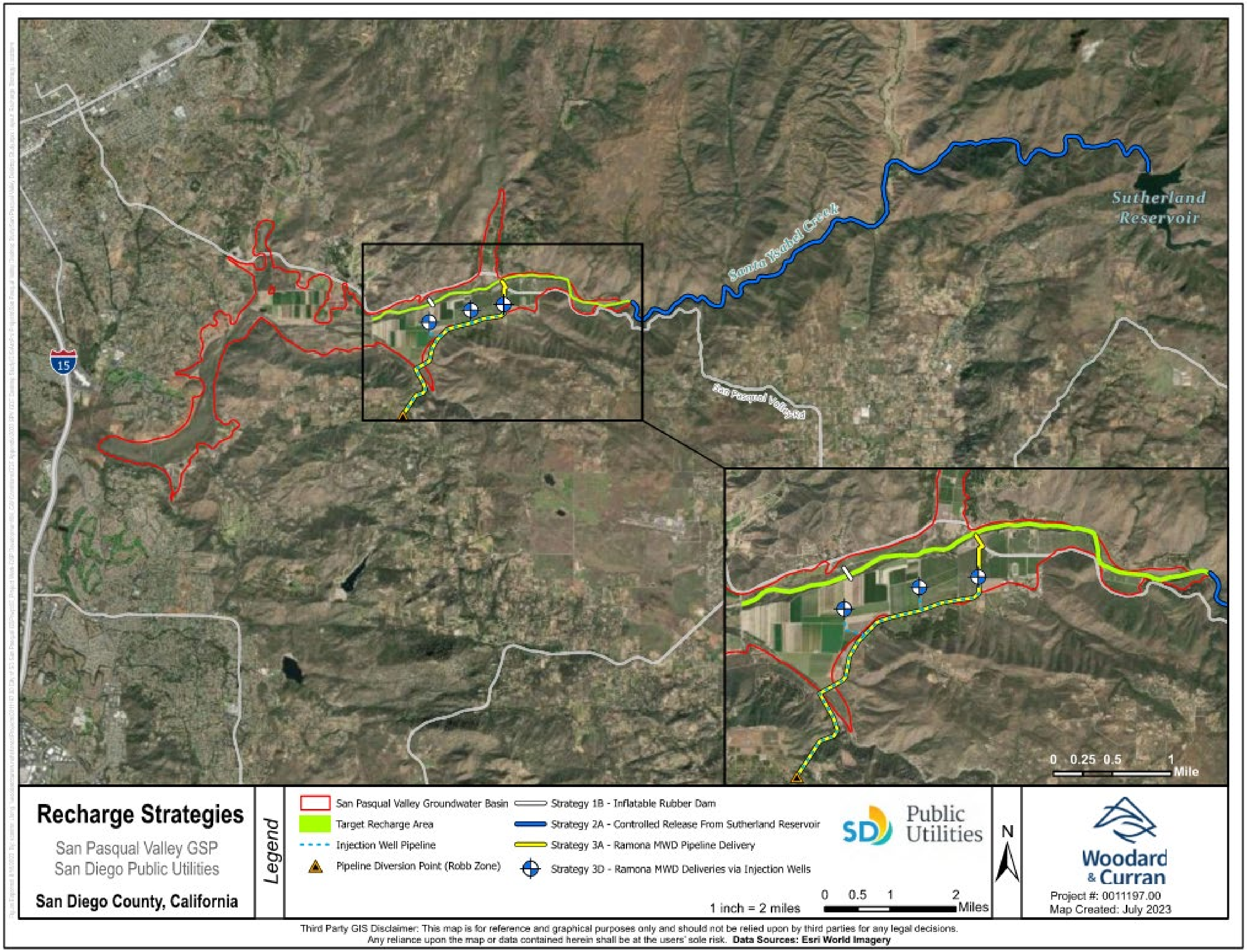


Figure 4: Location of Proposed Recharge Strategies

5. POTENTIAL BENEFITS FOR GDES

When assessing future modeled groundwater levels resulting from the four recharge strategies over the first three years of implementation (2030 – 2032) it appears that the most significant gains in groundwater level would likely be realized in the eastern portion of the Basin. Based on the modeled recharge strategy hydrographs, the strategies do appear to indicate an increase compared to baseline in many of the modeled groundwater wells within the target area in the eastern portion of the Basin, yet the groundwater levels remain between 30 and 90 feet bgs. The recharge strategies may still not be substantially beneficial because the average maximum rooting depth for the various NCCAG-mapped vegetative and wetland communities located in the target recharge area along Santa Ysabel Creek does not extend below 23 feet bgs (riparian mixed shrub alliance). Thus, the maximum average rooting depth and predicted groundwater levels do not intersect within the target recharge area for any of the modeled recharge strategies; suggesting that the recharge strategies offer minimal to no benefit to potential non-GDEs accessing groundwater in the target recharge area.

The average annual groundwater levels are shown in contours, along with the location of potential GDEs and potential non-GDEs for baseline and each of the four strategies for the year 2031 (midpoint of the three-year initial assessment period) are provided in Attachment A: Figures to show an example of the anticipated changes in groundwater levels and potential GDEs resulting from the recharge strategies as modeled. **Table 2** displays the potential GDE area for the baseline, the modeled area east and west of Ysabel Creek Road, and the total potential GDE area for each implementation year and recharge strategy. There is effectively no substantial difference between the baseline and modeled recharge strategies' potential GDE and potential non-GDE area. This would suggest that while the strategies may be good for overall groundwater supply replenishment and potential maintenance of groundwater levels above minimum thresholds, they may not have a direct long-term benefit to GDE vegetation accessing the aquifer.

Further analysis of possible benefits to potential non-GDEs was not completed for future implementation years beyond 2030 – 2032 because the modeled recharge strategy hydrographs appear to indicate an overall long-term downward trend for groundwater levels in the target area that would not come within 23 feet bgs even with the additional water provided by the recharge strategies as modeled. Refer to Attachment C for the recharge strategy groundwater-level hydrographs. Despite the minimal effect on groundwater levels as modeled, it should be noted that augmented stream flows and prolonged surface water inundation resulting from recharge strategies 1B, 2A, and 3A would likely produce benefits to potential GDEs, potential non-GDEs, and sensitive or special-status species that may exist in the Basin and rely on riparian vegetation and wetland communities for breeding, feeding, and sheltering. The additional surface water flows will support potential non-GDEs through near-surface root hydration to further plant growth and development of riparian communities. Also, additional surface water within the stream channel would potentially support birds, reptiles, amphibians, and macroinvertebrates within potential non-GDEs that might not otherwise survive prolonged dry periods. Due to the variability in species' reliance on groundwater, further study of species and habitats local to the Basin may be required to determine the beneficial impacts the recharge strategies may have on shallow groundwater, soil moisture, and surface water and potentially on the communities that rely on these resources.

Table 2: Baseline Potential GDE Area and Modeled Change for the Four Surface Recharge Strategies

Recharge Strategy	Baseline Potential GDE Area (acres)	Modeled Potential GDE Area West of Ysabel Creek Rd/ Percent Change	Modeled Potential GDE Area East of Ysabel Creek Rd/ Percent Change	Total Potential GDE Area (acres)
Implementation Year 2030				
Recharge Strategy 1B	198.45	198.68 / 1.00%	0.00 / 0%	198.68
Recharge Strategy 2A	198.45	199.36 / 1.00%	0.00 / 0%	199.36
Recharge Strategy 3A	198.45	207.55 / 1.05%	0.00 / 0%	207.55
Recharge Strategy 3D	198.45	210.05 / 1.06%	0.00 / 0%	210.05
Implementation Year 2031				
Recharge Strategy 1B	105.14	105.14 / 1.00%	0.00 / 0%	105.14
Recharge Strategy 2A	105.14	106.28 / 1.01%	0.00 / 0%	106.28
Recharge Strategy 3A	105.14	110.15 / 1.05%	0.00 / 0%	110.15
Recharge Strategy 3D	105.14	115.15 / 1.10%	0.00 / 0%	115.15
Implementation Year 2032				
Recharge Strategy 1B	65.54	65.54 / 1.00%	0.00 / 0%	65.54
Recharge Strategy 2A	65.54	68.27 / 1.04%	0.00 / 0%	68.27
Recharge Strategy 3A	65.54	72.60 / 1.11%	0.00 / 0%	72.6
Recharge Strategy 3D	65.54	80.34 / 1.23%	0.00 / 0%	80.34

6. DISCUSSION AND NEXT STEPS

To better understand the current conditions of potential GDEs and potential non-GDEs within the Basin, it is recommended that additional study be conducted to assess the biological communities that currently exist within the Basin, and additional assessment of potential shallow groundwater levels that may persist above the deeper regional aquifer groundwater levels. For consistency and comparative purposes, it may be useful to return to the 16 different 2020 GDE study field assessment locations and establish permanent bio-monitoring stations so that changes over time may be observed. The following studies could be conducted to better understand GDEs and how the recharge strategies might affect them:

- Establish permanent photo stations to monitor community health and landscape-scale disturbances.
- Conduct California Rapid Assessment Method (CRAM) at 2020 GDE study field assessment locations. The CRAM is a scientifically defensible methodology for monitoring and assessing wetlands throughout California.
- Conduct avian point count surveys at 2020 GDE study field assessment locations using the North American Breeding Bird Survey program method.
- Conduct sampling for terrestrial amphibians and reptiles following established scientific methods such as USFS methodology.
- Establish vegetation plots and conduct quantitative sampling for species inventory and monitoring.
- During the wet season while there is water present in the GDEs, conduct environmental DNA (eDNA) sampling to determine what aquatic species have historically or are currently inhabiting these communities.

As modeled, the recharge strategies may not provide meaningful benefits to potential GDEs and potential non-GDEs, however changes to how the recharge strategies are implemented could have different effects on the potential benefits to GDEs, which should be considered as the recharge strategies are further developed.

7. REFERENCES

California Department of Water Resources. 2023. Summary of the "Natural Communities Commonly Associated with Groundwater" GIS Dataset and Online Web Viewer. https://gis.water.ca.gov/app/NCDatasetViewer/

City of San Diego (City) and County of San Diego (County). 2021. *Final San Pasqual Valley Groundwater Basin Groundwater Sustainability Plan*. Prepared by Woodard & Curran. September.

City of San Diego (City). 2023a. *Technical Memorandum. Project Management Action (PMA) No. 7: Initial Surface Water Recharge Evaluation, Task 2: Streambed Investigation*. Prepared by Jacobs. January.

City of San Diego (City). 2023b. *Technical Memorandum. Project Management Action (PMA) No. 7: Initial Surface Water Recharge Evaluation, Task 4: Potential Recharge Strategies*. Prepared by Jacobs and Woodard & Curran. May.

City of San Diego (City). 2023c. *Technical Memorandum. Project Management Action (PMA) No. 7: Initial Surface Water Recharge Evaluation, Task 5: Groundwater and Surface Water Simulations*. Prepared by Jacobs and Woodard & Curran. August.

Cowardin, L. M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of wetlands and deepwater habitats of the United States*. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 131pp.

Groundwater Resource Hub. 2021. Plant Rooting Depth Database 20210525. https://www.groundwaterresourcehub.org/index.php/gde-tools/gde-rooting-depths-database-for-gdes/

Rohde, M. M., Saito L., Smith R. 2020. *Groundwater Thresholds for Ecosystems: A Guide for Practitioners*. Global Groundwater Group, The Nature Conservancy.

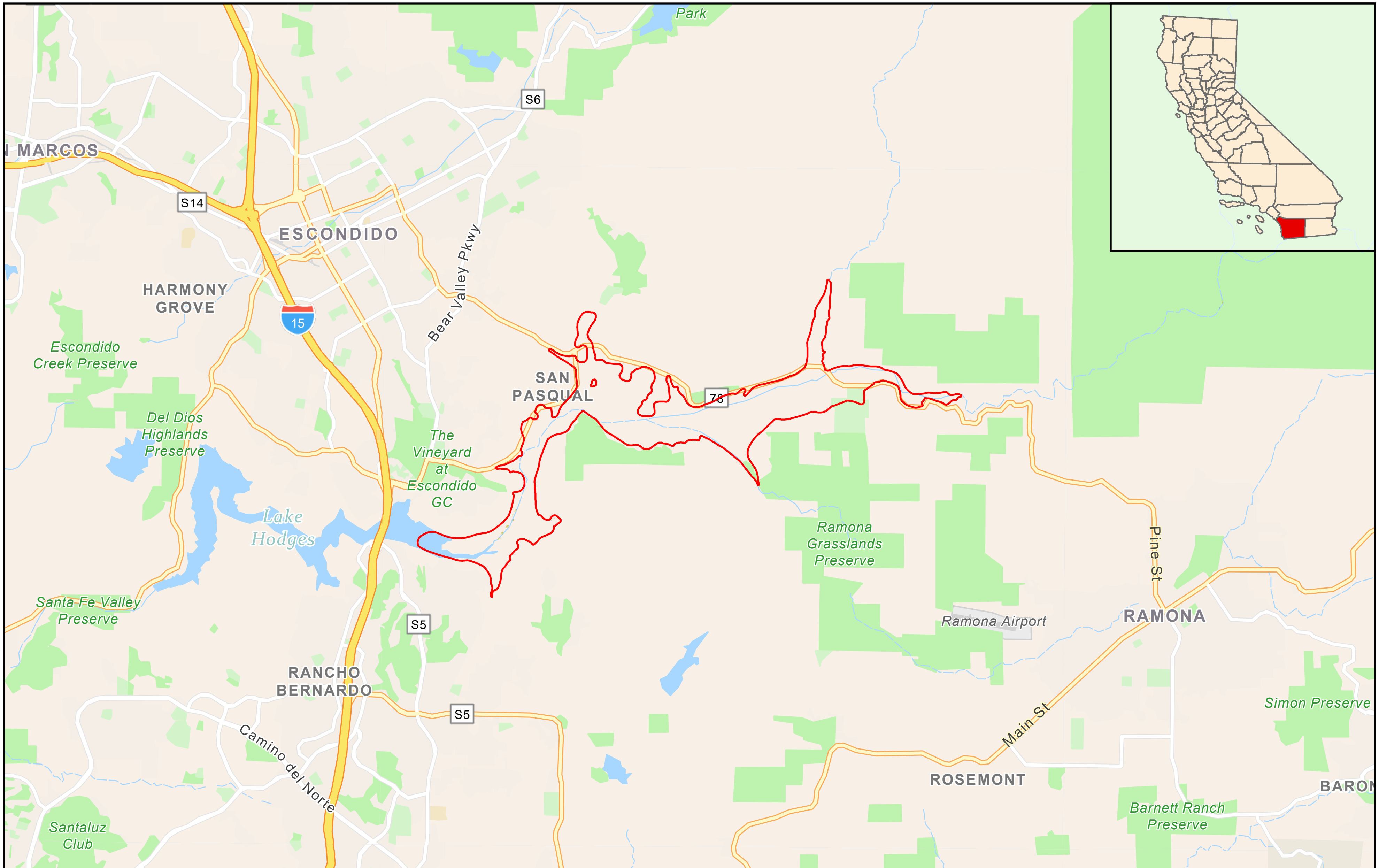
Rohde, M. M., Matsumoto, J. Howard, S. Liu, L. Riege, and E. J. Remson. 2018. *Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans*. The Nature Conservancy, San Francisco, California.

The Nature Conservancy. 2023. GDE Pulse 2.1. GIS Data and Interactive Online Mapper. https://gde.codefornature.org/#/home

United States Environmental Protection Agency (US EPA). 2019. *National Hydrography Dataset Plus version 2 (NHDPlusv2)*. Accessed 2023. https://www.epa.gov/waterdata/nhdplus-california-data-vector-processing-unit-18

United States Forest Service. 2009. *Vegetation Descriptions for South Coast and Montane Ecological Provinces CALVEG Zone 7*.

Attachment A: Figures



Project Location

San Pasqual Valley GSP
San Diego Public Utilities

San Diego County, California

Legend

San Pasqual Valley Groundwater Basin

Public Utilities

Woodard & Curran

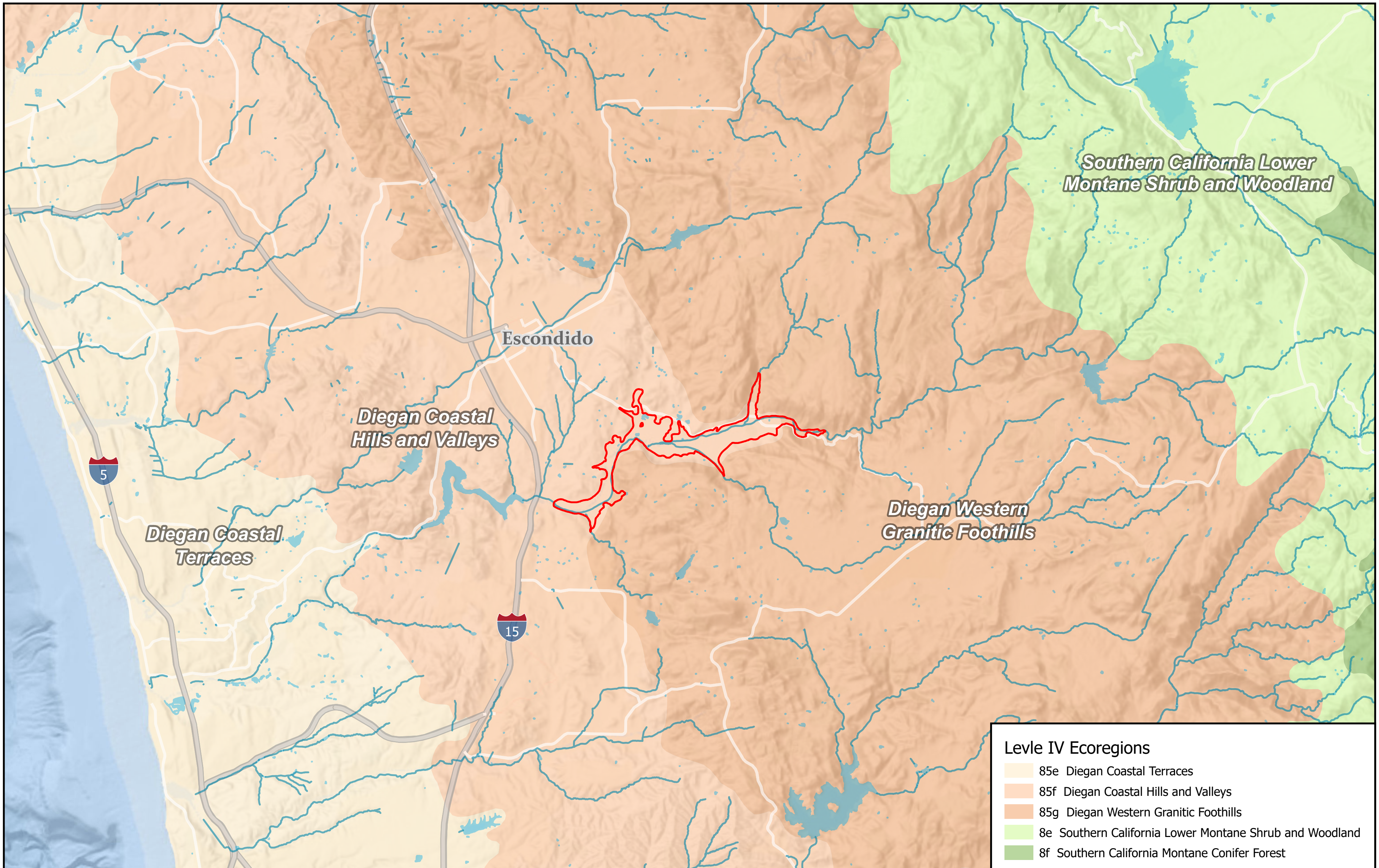
N

0 0.5 1 2 Miles

1 inch = 2 miles

Project #: 0011197.00
Map Created: July 2023

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources: Esri World Navigation Map**



EPA Level IV Ecoregions

San Pasqual Valley GSP
San Diego Public Utilities
San Diego County, California

Legend

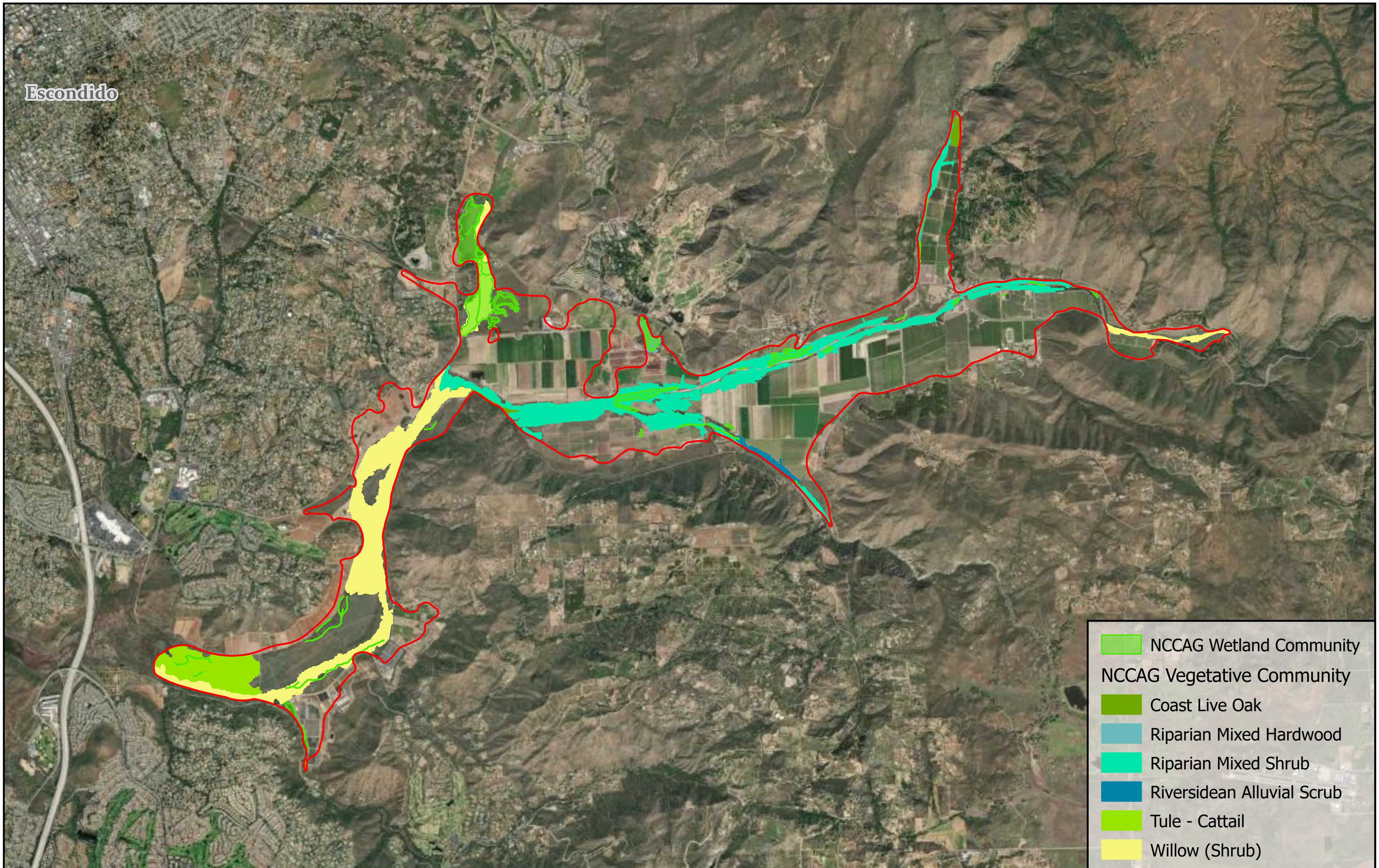
- San Pasqual Valley Groundwater Basin
- USGS National Hydrography Dataset Lake
- USGS NHD Stream

SD Public Utilities

0 1 2 4 Miles
1 inch = 4 miles

N

Woodard & Curran
Project #: 0011197.00
Map Created: July 2023



Natural Communities Commonly Associated with Groundwater

San Pasqual Valley GSP
San Diego Public Utilities

San Diego County, California

Legend

San Pasqual Valley Groundwater Basin

SD Public Utilities

N

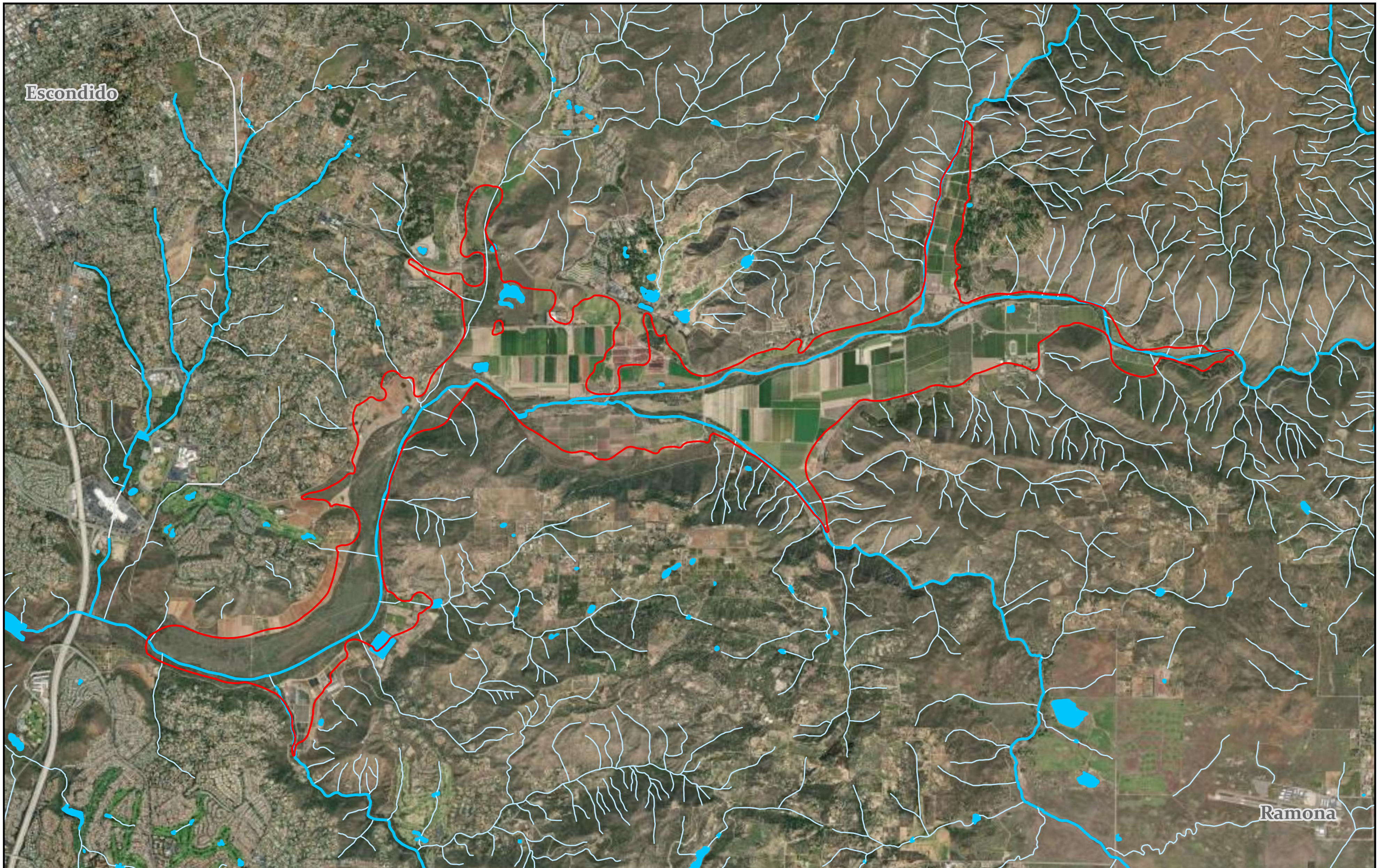
1 inch = 1 mile

0 0.25 0.5 1 Mile

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023

 Data Sources: Esri World Imagery; CDWR/CDFW/TNC NCCAG Dataset



NHD Streams and Other Surface Waterbodies

San Pasqual Valley GSP
San Diego Public Utilities
San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- NHD Waterbody

NHD Stream
- Intermittent
- Ephemeral
- Connector

1 inch = 1 mile

0 0.25 0.5 1 Mile

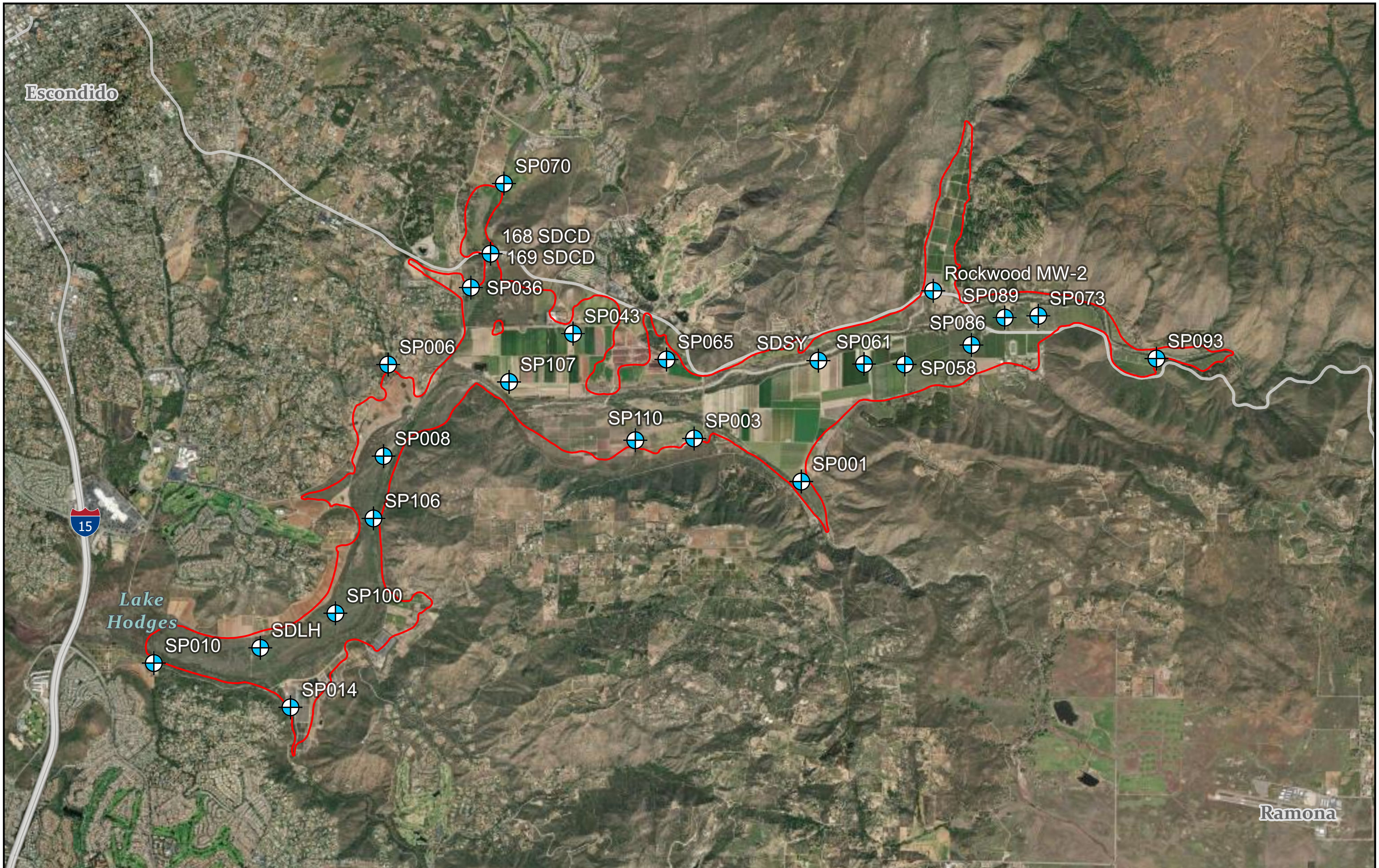
N

SD Public Utilities

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources: Esri World Imagery; USGS National Hydrography Dataset**



Monitoring Wells

San Pasqual Valley GSP
San Diego Public Utilities

San Diego County, California

Legend

San Pasqual Valley Groundwater Basin

Monitoring Wells

SD Public Utilities

N

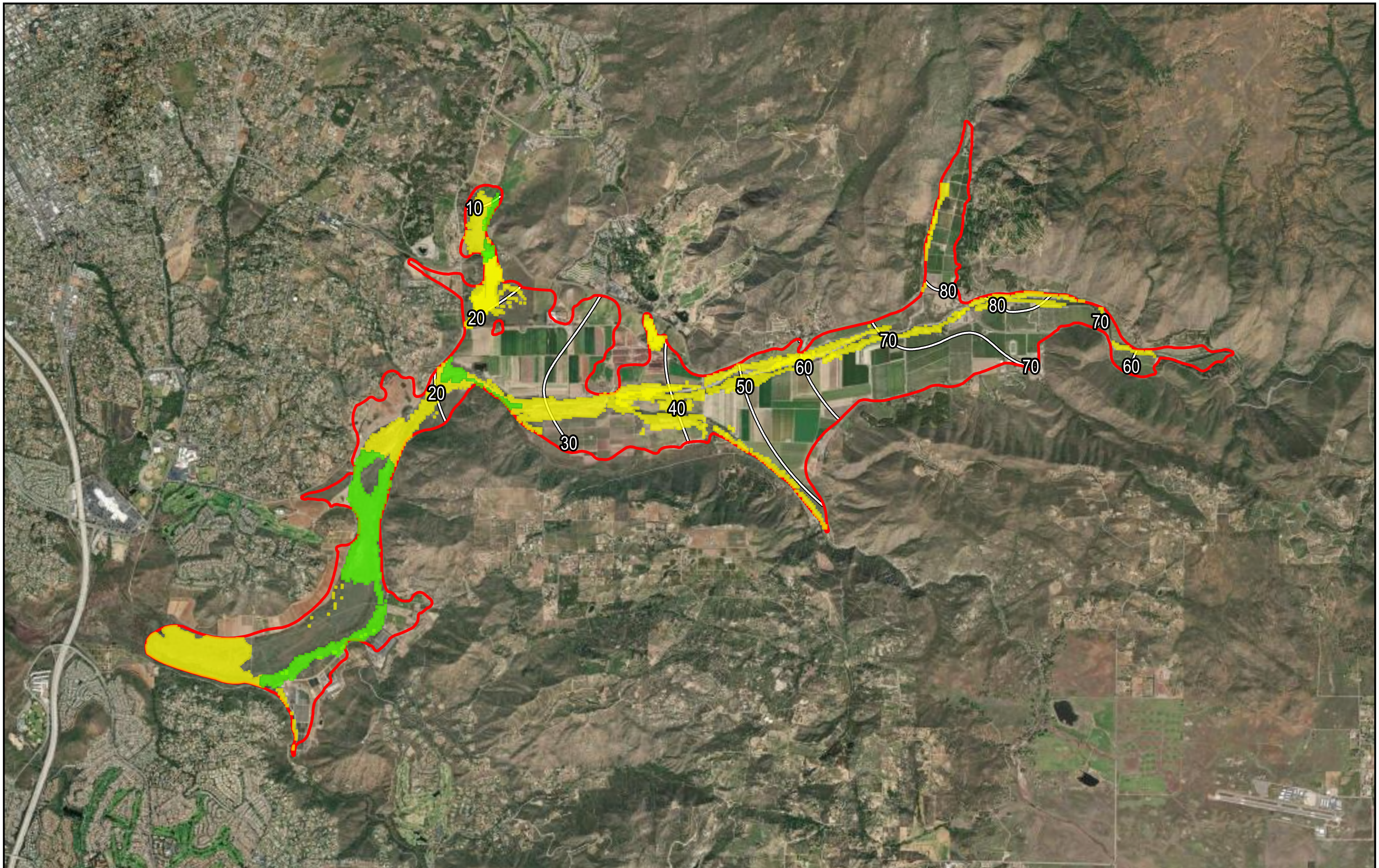
0 0.25 0.5 1 Mile

1 inch = 1 mile

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources: Esri World Imagery**



Average Groundwater Conditions 2013 - 2022

San Pasqual Valley GSP
San Diego Public Utilities

San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- Potential GDE
- Potential Non-GDE
- 10-ft Average Groundwater Contour

1 inch = 1 mile

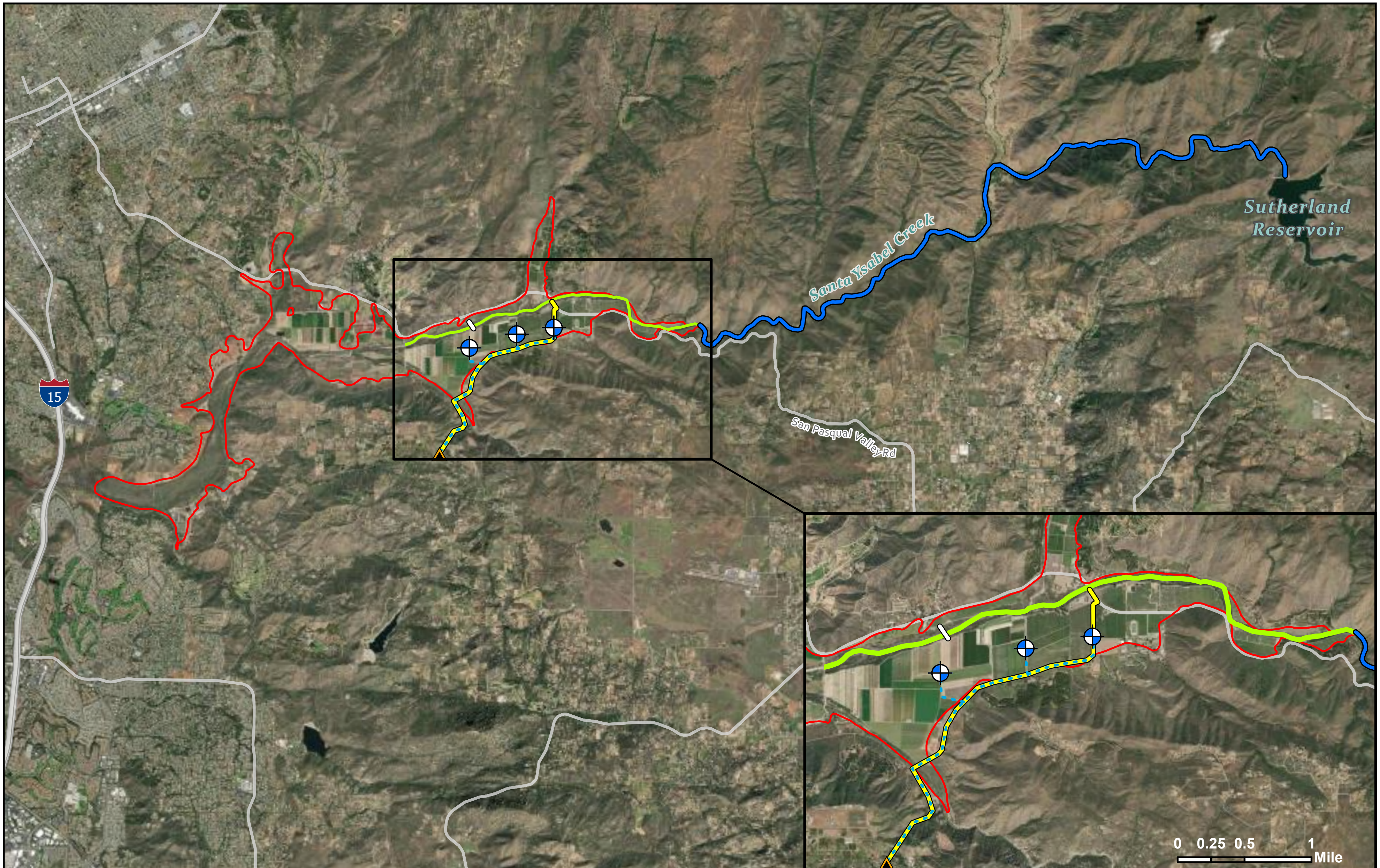
0 0.25 0.5 1 Mile

N

SD Public Utilities

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023



Recharge Strategies

San Pasqual Valley GSP
San Diego Public Utilities

San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- Target Recharge Area
- Injection Well Pipeline
- Pipeline Diversion Point (Robb Zone)
- Strategy 1B - Inflatable Rubber Dam
- Strategy 2A - Controlled Release From Sutherland Reservoir
- Strategy 3A - Ramona MWD Pipeline Delivery
- Strategy 3D - Ramona MWD Deliveries via Injection Wells

1 inch = 2 miles

0 0.5 1 2 Miles

N

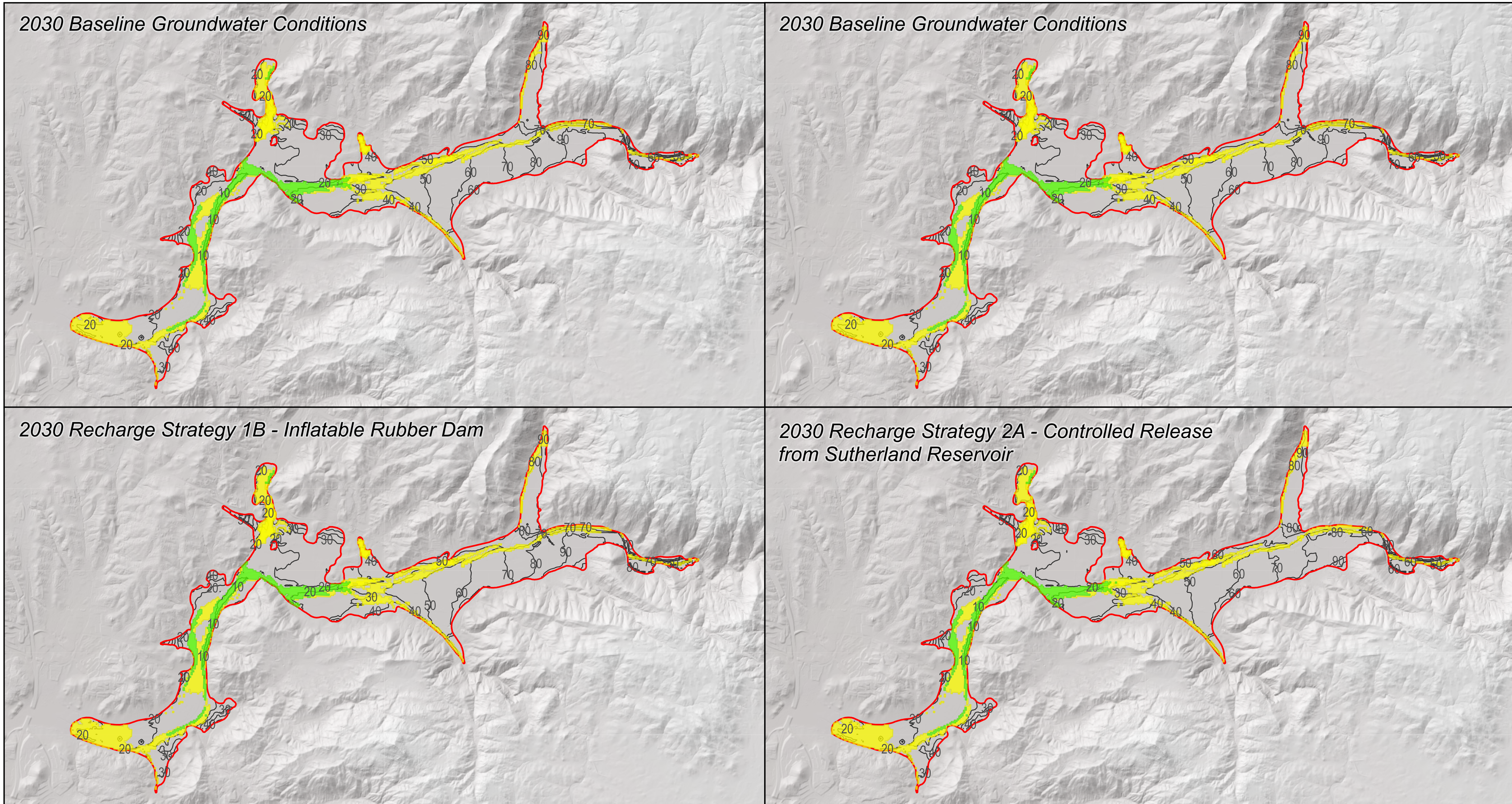
SD Public Utilities

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources: Esri World Imagery**

Figure Exported: 8/15/2023 By: scastro Using: \\woodardcurran.net\shared\Projects\0011197.00 City of SD San Pasqual GSP\wip\02_Project Work-GSP Development\04_GW Conditions\GDE Appendix\2023 SPV GDE Desktop Study\GIS\ArcPro Projects\San Pasqual Valley Desktop Study\San Pasqual Valley Desktop Study.aprx Layout: Recharge Strategy Locations



2030 Recharge Strategies 1B and 2A

San Pasqual Valley GSP
San Diego Public Utilities
San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- Potential GDE
- Potential Non-GDE
- 10-ft Groundwater Contour

1 inch = 1 mile

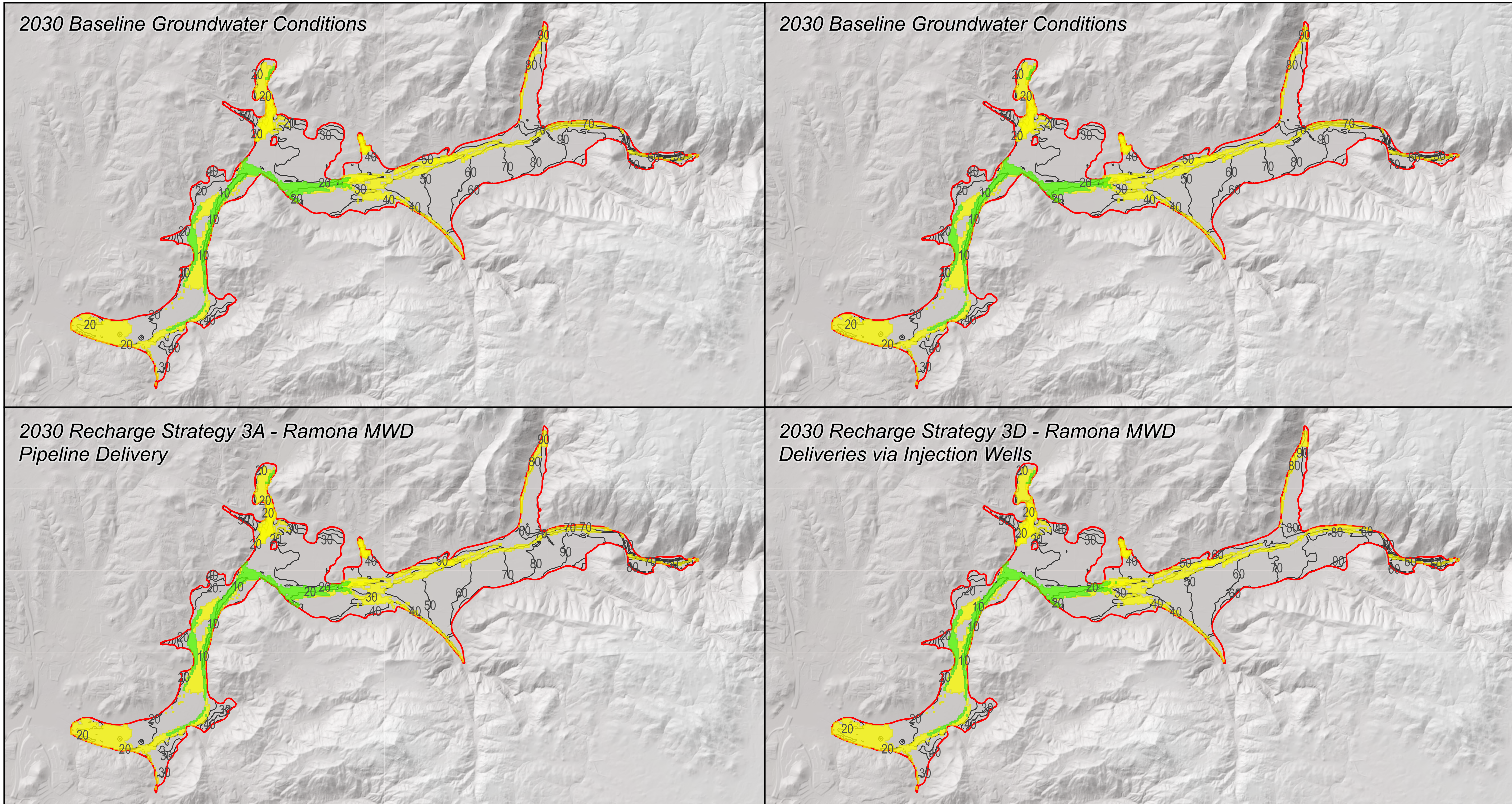
0 0.5 1 2 Miles

N

SD Public Utilities

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023



2030 Recharge Strategies 3A and 3D

San Pasqual Valley GSP
San Diego Public Utilities
San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- Potential GDE
- Potential Non-GDE
- 10-ft Groundwater Contour

1 inch = 1 mile

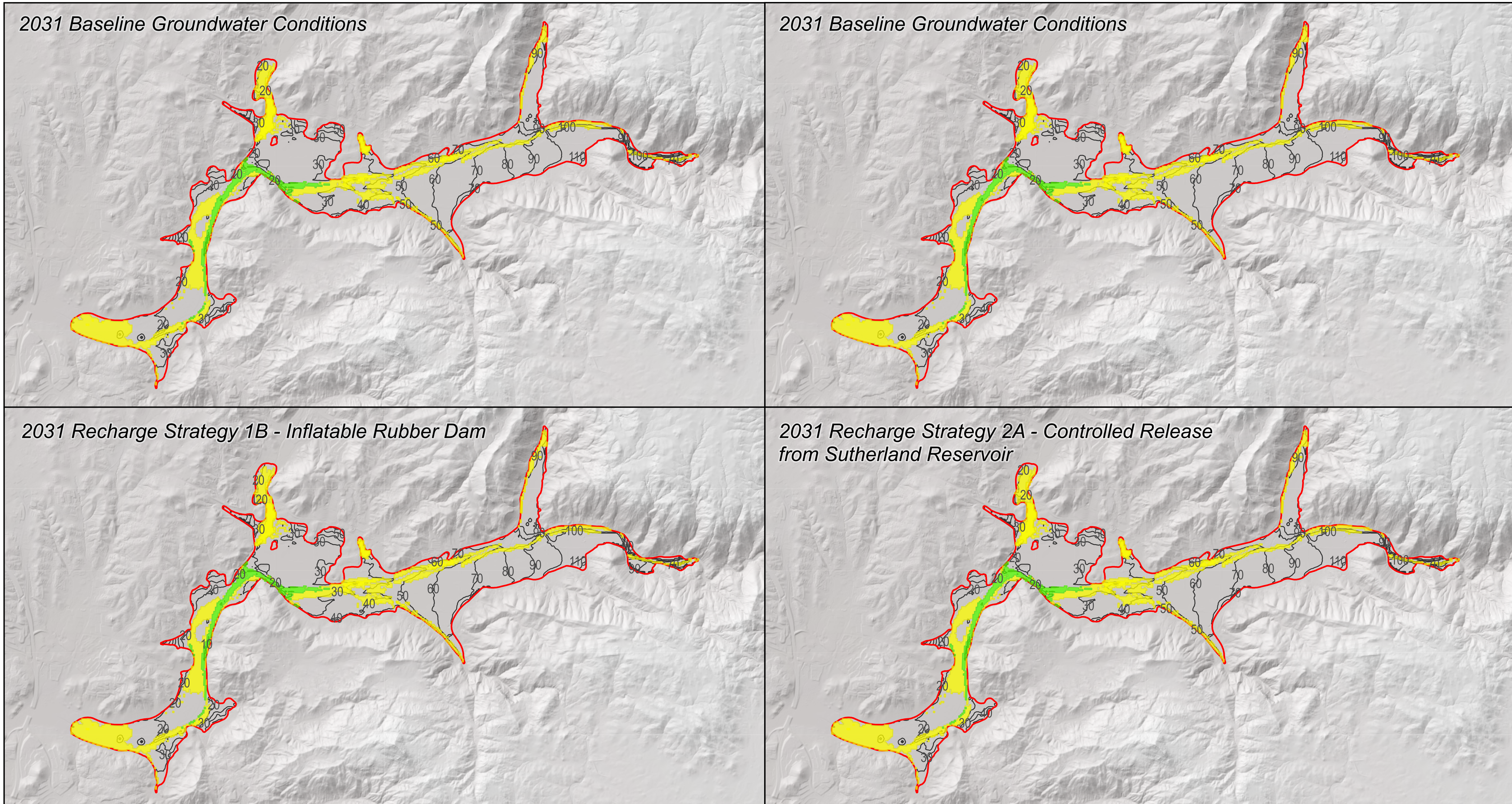
0 0.5 1 2 Miles

N

SD Public Utilities

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023



2031 Recharge Strategies 1B and 2A

San Pasqual Valley GSP
San Diego Public Utilities
San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- Potential GDE
- Potential Non-GDE
- 10-ft Groundwater Contour

SD Public Utilities

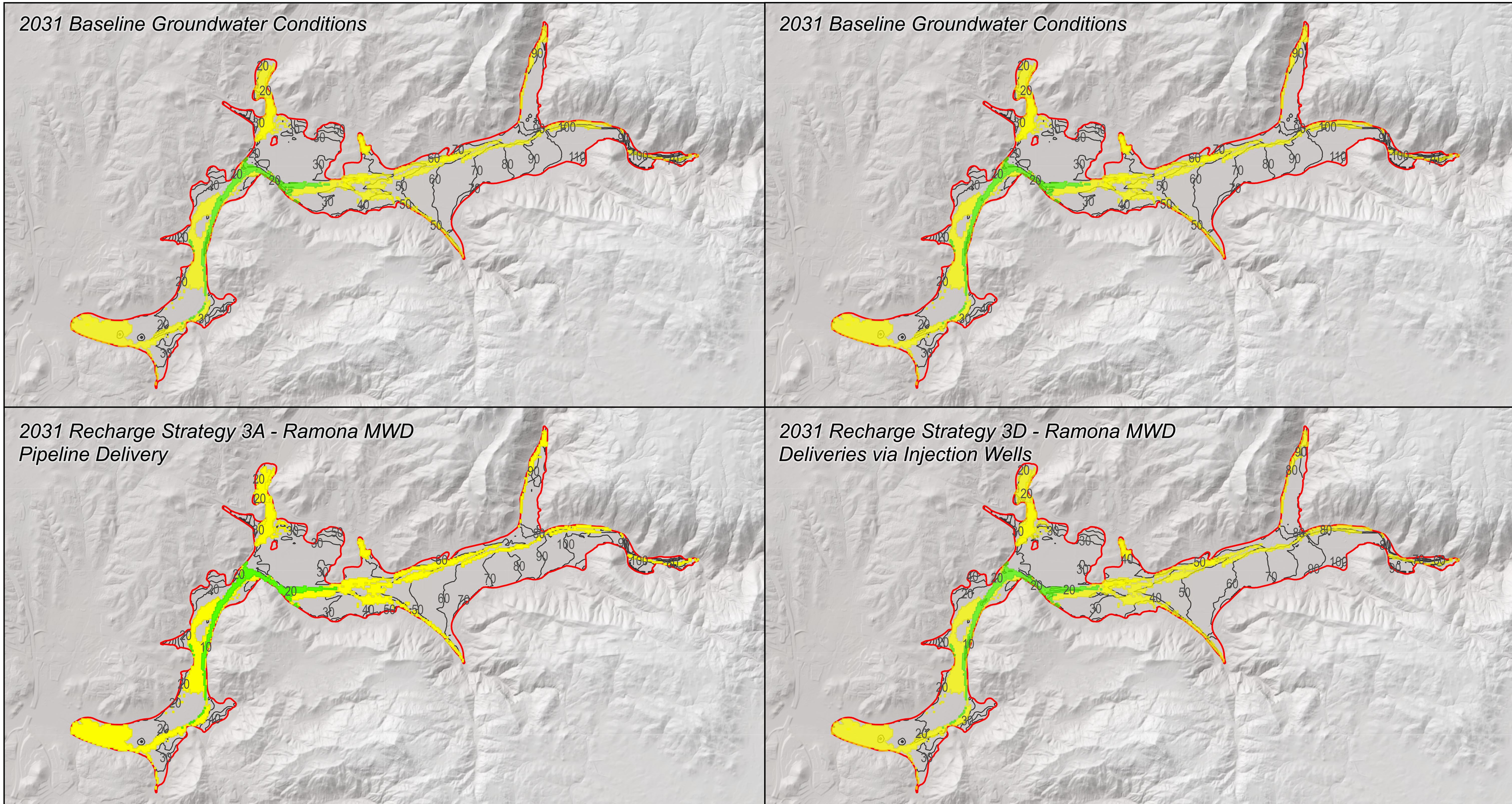
1 inch = 1 mile

0 0.5 1 2 Miles

N

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023



2031 Recharge Strategies 3A and 3D

San Pasqual Valley GSP

San Diego Public Utilities

San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- Potential GDE
- Potential Non-GDE
- 10-ft Groundwater Contour

1 inch = 1 mile

0 0.5 1 2 Miles

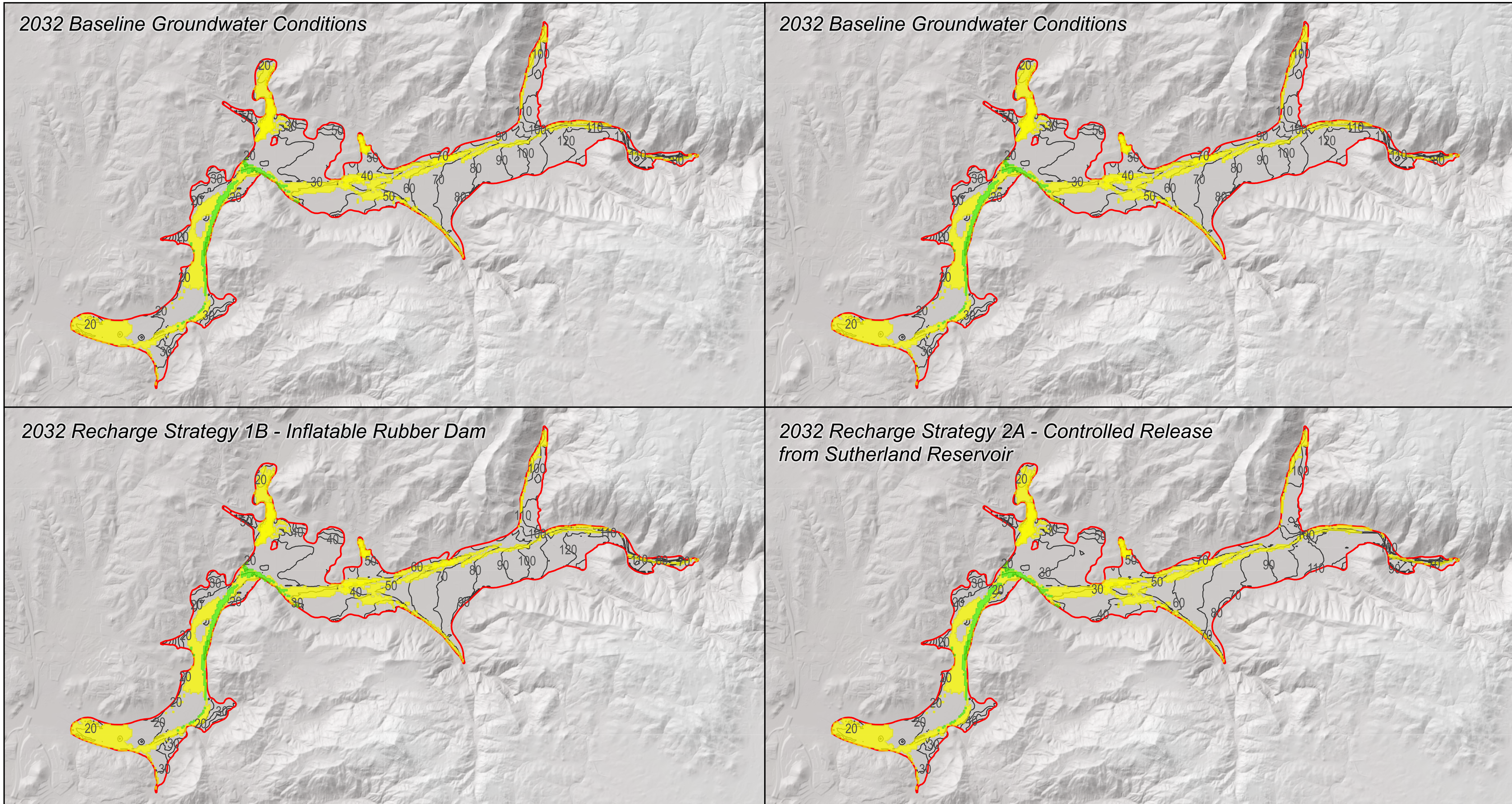
N

SD Public Utilities

Woodard & Curran

Project #: 0011197.00

Map Created: July 2023



2032 Recharge Strategies 1B and 2A

San Pasqual Valley GSP
San Diego Public Utilities
San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- Potential GDE
- Potential Non-GDE
- 10-ft Groundwater Contour

1 inch = 1 mile

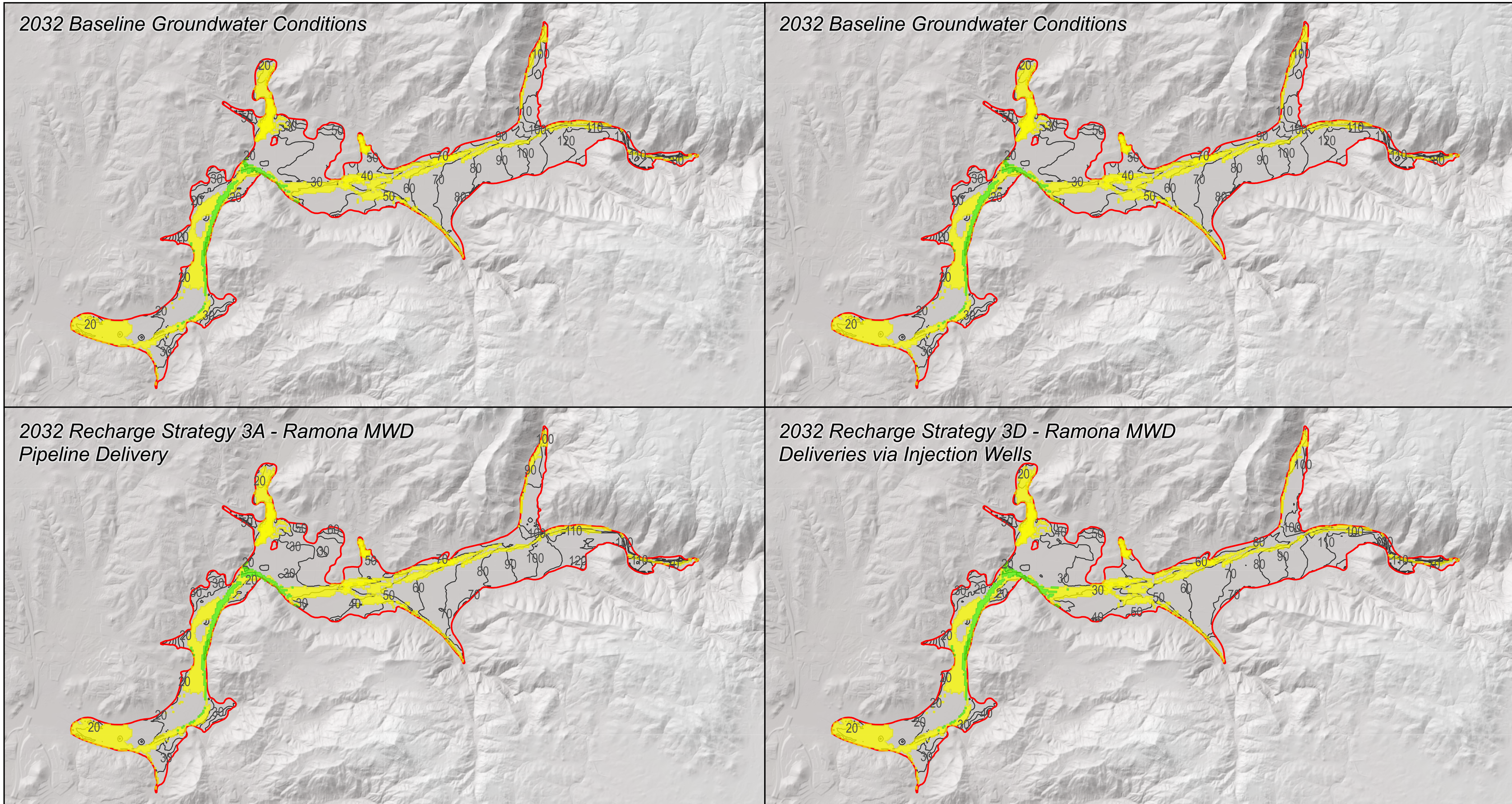
0 0.5 1 2 Miles

N

SD Public Utilities

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023



2032 Recharge Strategies 3A and 3D

San Pasqual Valley GSP
San Diego Public Utilities
San Diego County, California

Legend

- San Pasqual Valley Groundwater Basin
- Potential GDE
- Potential Non-GDE
- 10-ft Groundwater Contour

SD Public Utilities

1 inch = 1 mile

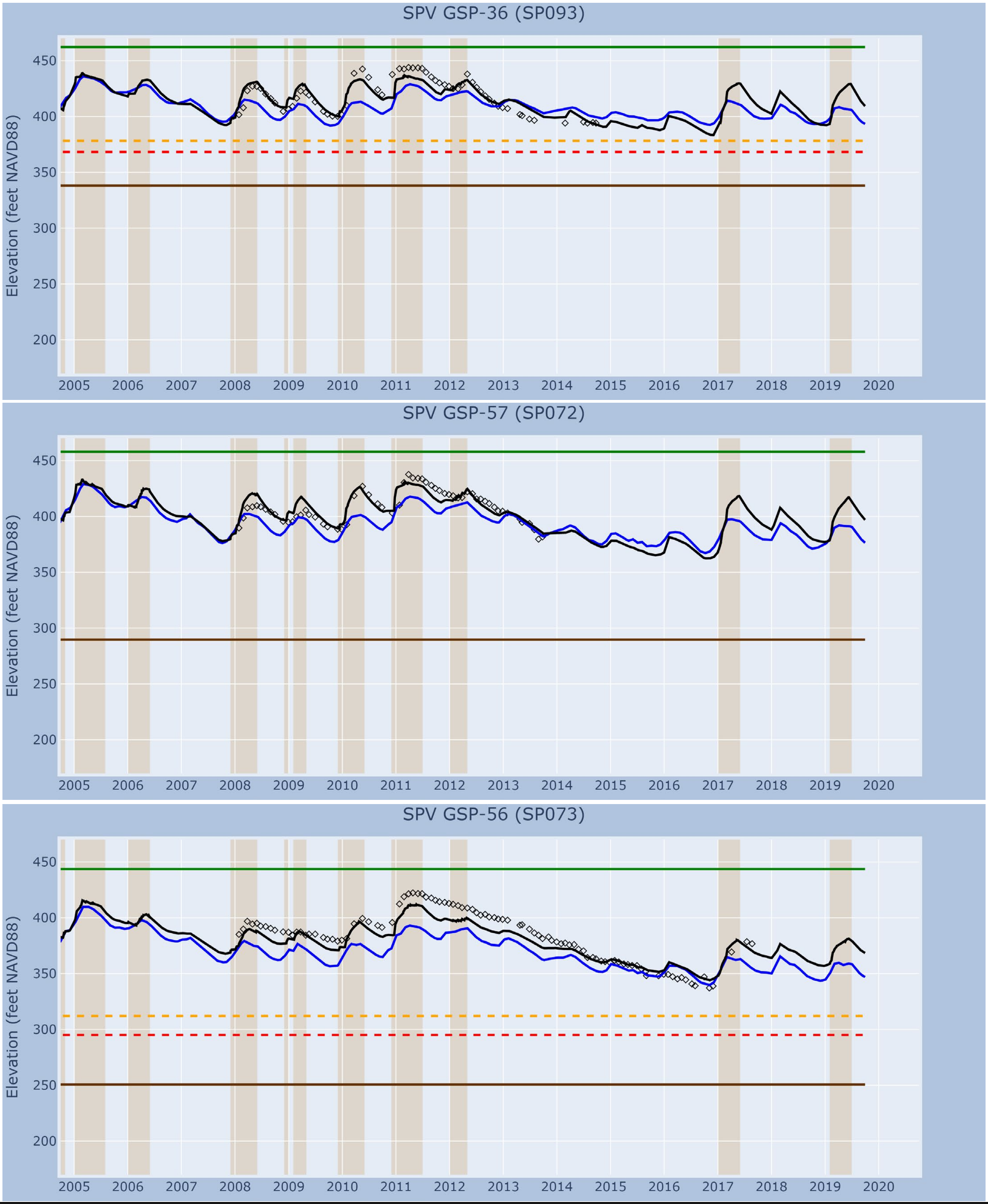
0 0.5 1 2 Miles

N

Woodard & Curran

Project #: 0011197.00
Map Created: July 2023

Attachment B: Historical Groundwater Hydrographs



Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- Measured Groundwater Elevation (feet NAVD88)
- SPV GSP Model v1.0 Head (feet NAVD88)
- SPV GSP Model v2.0 Head (feet NAVD88)
- Daily Stress Period in the SPV GSP Model v2.0 (monthly otherwise)

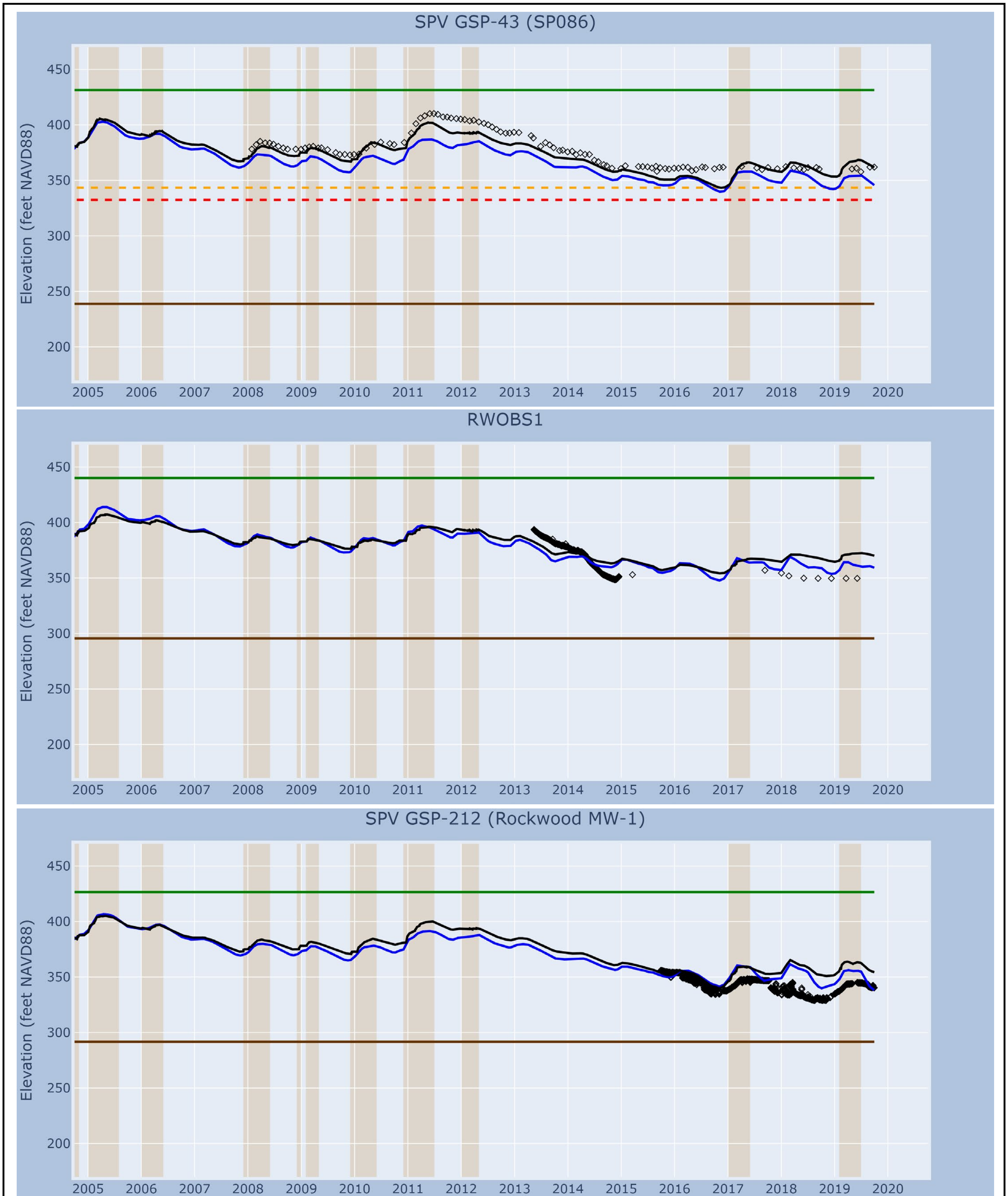
Figure D-1

Modeled Versus Target Groundwater Head Hydrographs

PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater and Surface Water Simulations
San Pasqual Valley, California

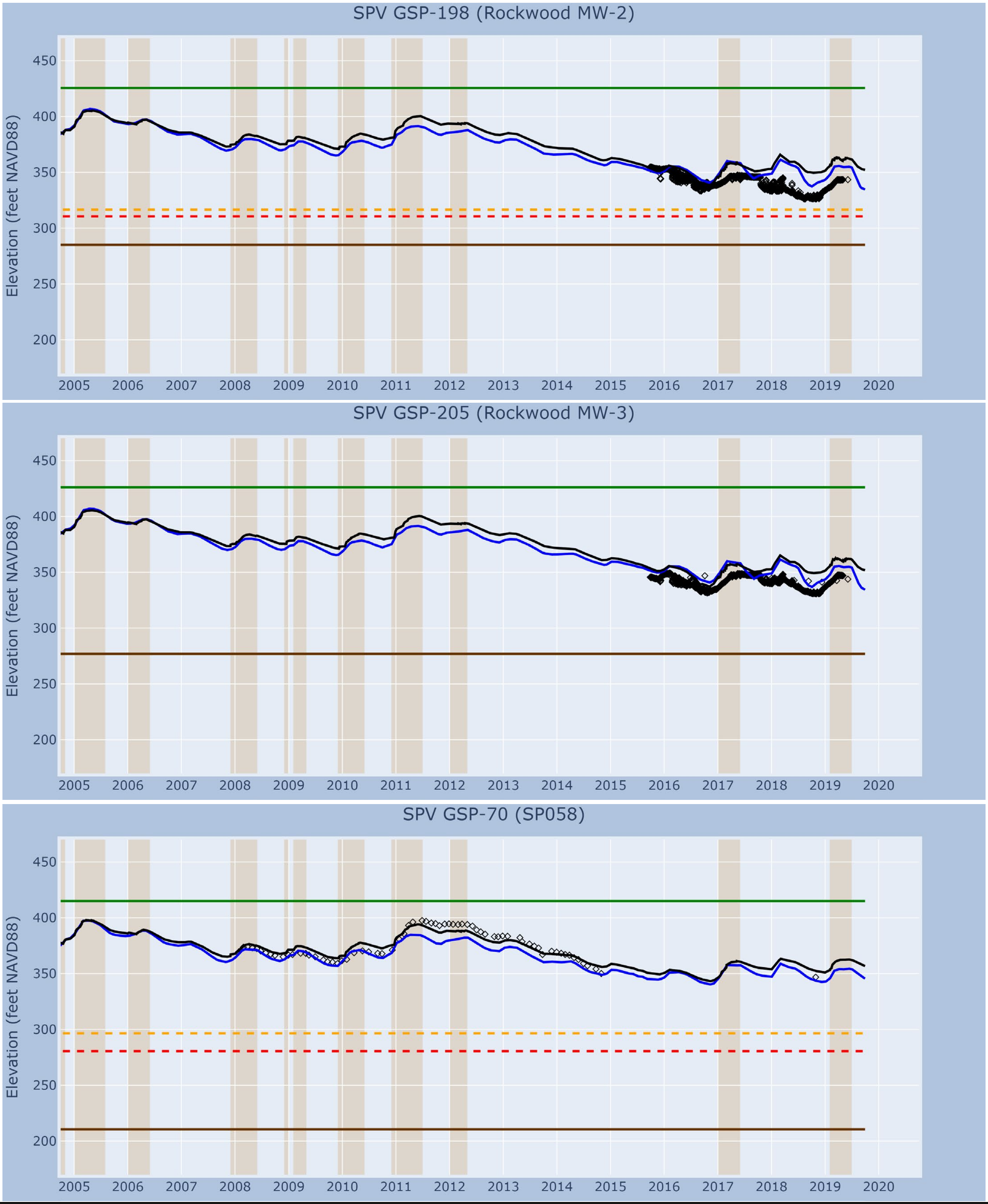
Jacobs

\\odin\proj\SanDiegoCityof\CommonFiles\SGMA\PMA7\Task5\Modeling\Recalibration\PMA7_vs_GSP_Model_Hydrographs\Attachment_D_Calibration_Hydrographs.pptm



Legend
- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- Measured Groundwater Elevation (feet NAVD88)
- SPV GSP Model v1.0 Head (feet NAVD88)
- SPV GSP Model v2.0 Head (feet NAVD88)
- Daily Stress Period in the SPV GSP Model v2.0 (monthly otherwise)

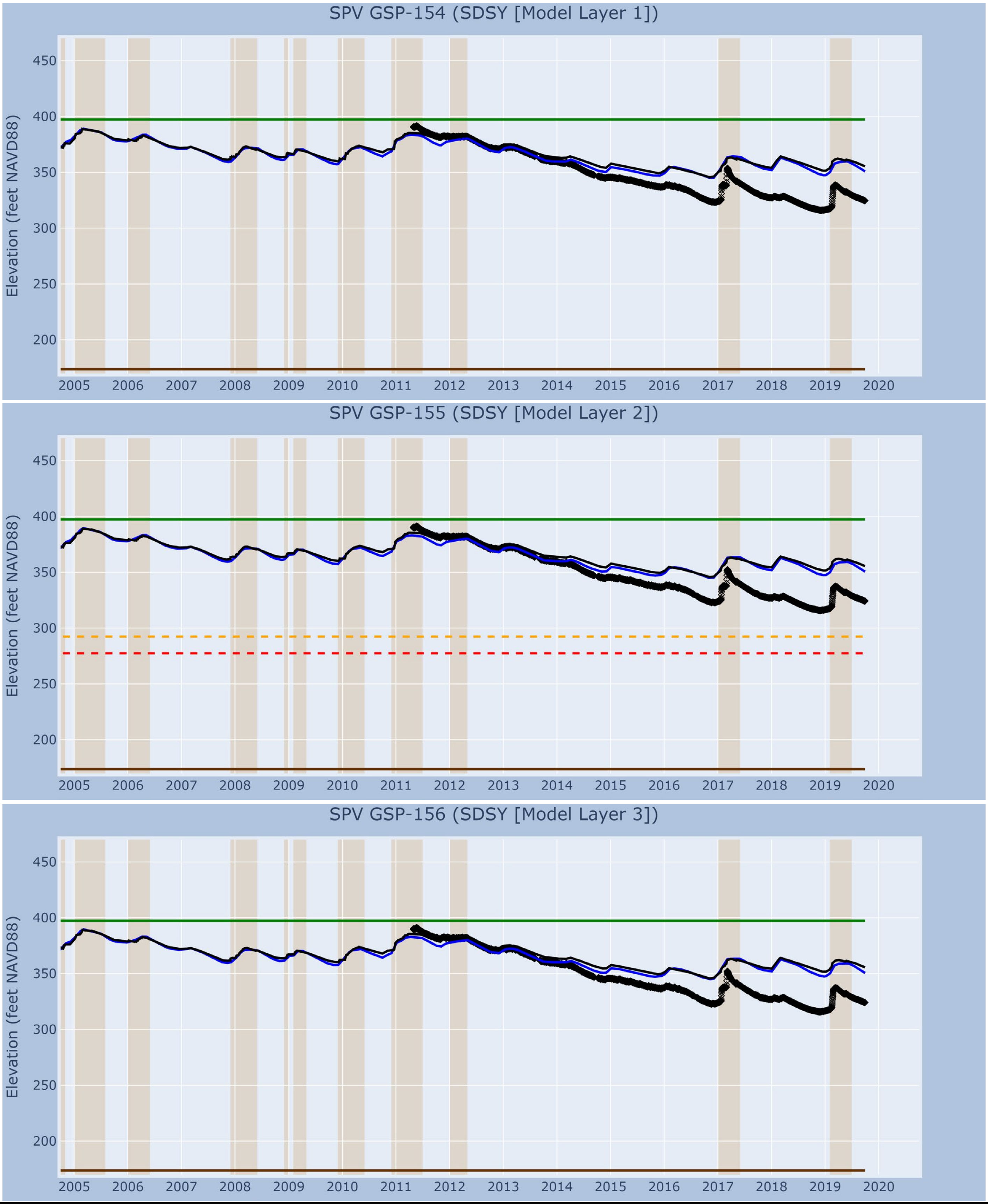
Figure D-2
Modeled Versus Target Groundwater Head Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater and Surface Water Simulations
San Pasqual Valley, California



Legend
- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- Measured Groundwater Elevation (feet NAVD88)
- SPV GSP Model v1.0 Head (feet NAVD88)
- SPV GSP Model v2.0 Head (feet NAVD88)
- Daily Stress Period in the SPV GSP Model v2.0 (monthly otherwise)

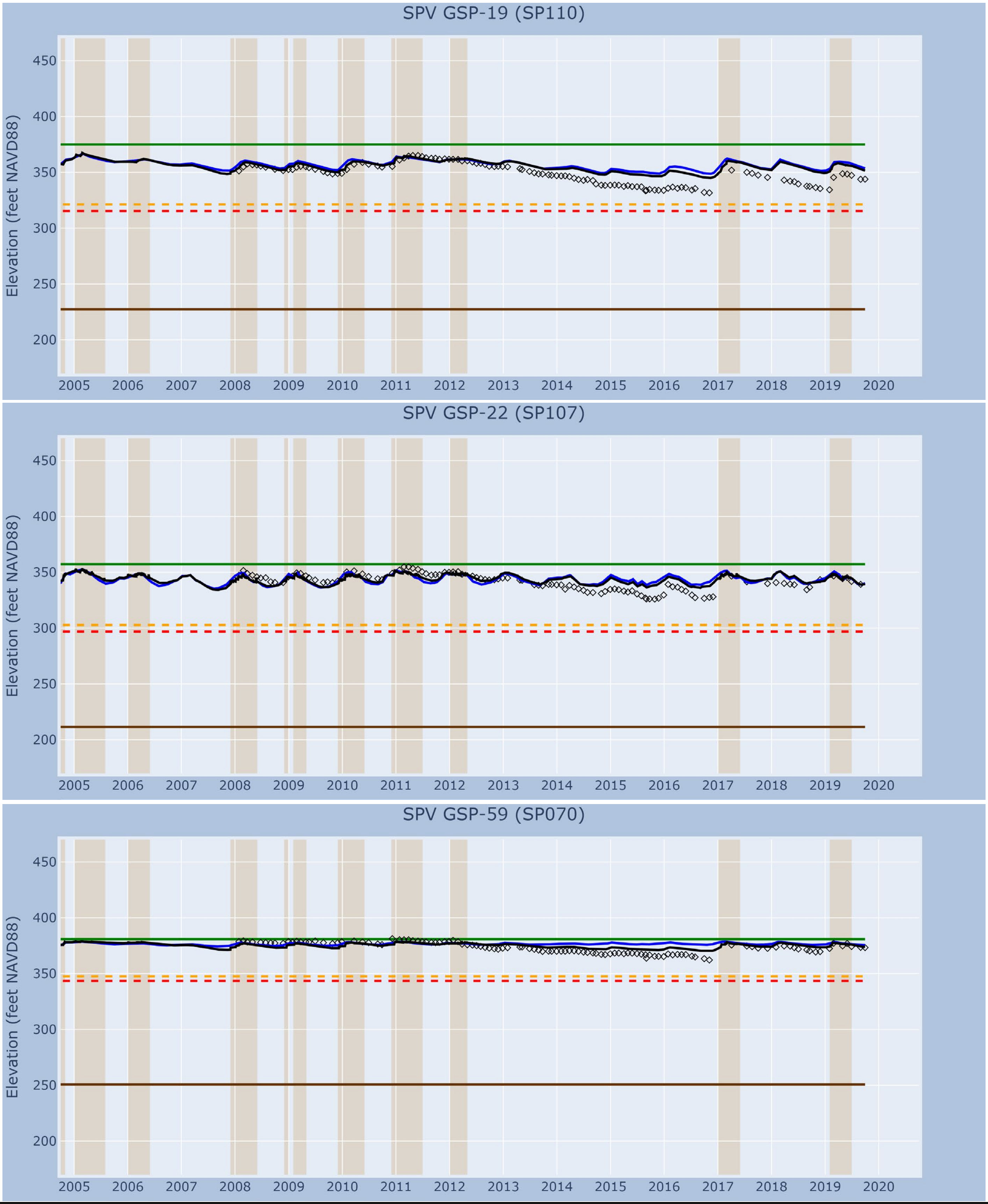
Figure D-3
Modeled Versus Target Groundwater Head Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater and Surface Water Simulations
San Pasqual Valley, California

Jacobs



Legend
- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- Measured Groundwater Elevation (feet NAVD88)
- SPV GSP Model v1.0 Head (feet NAVD88)
- SPV GSP Model v2.0 Head (feet NAVD88)
- Daily Stress Period in the SPV GSP Model v2.0 (monthly otherwise)

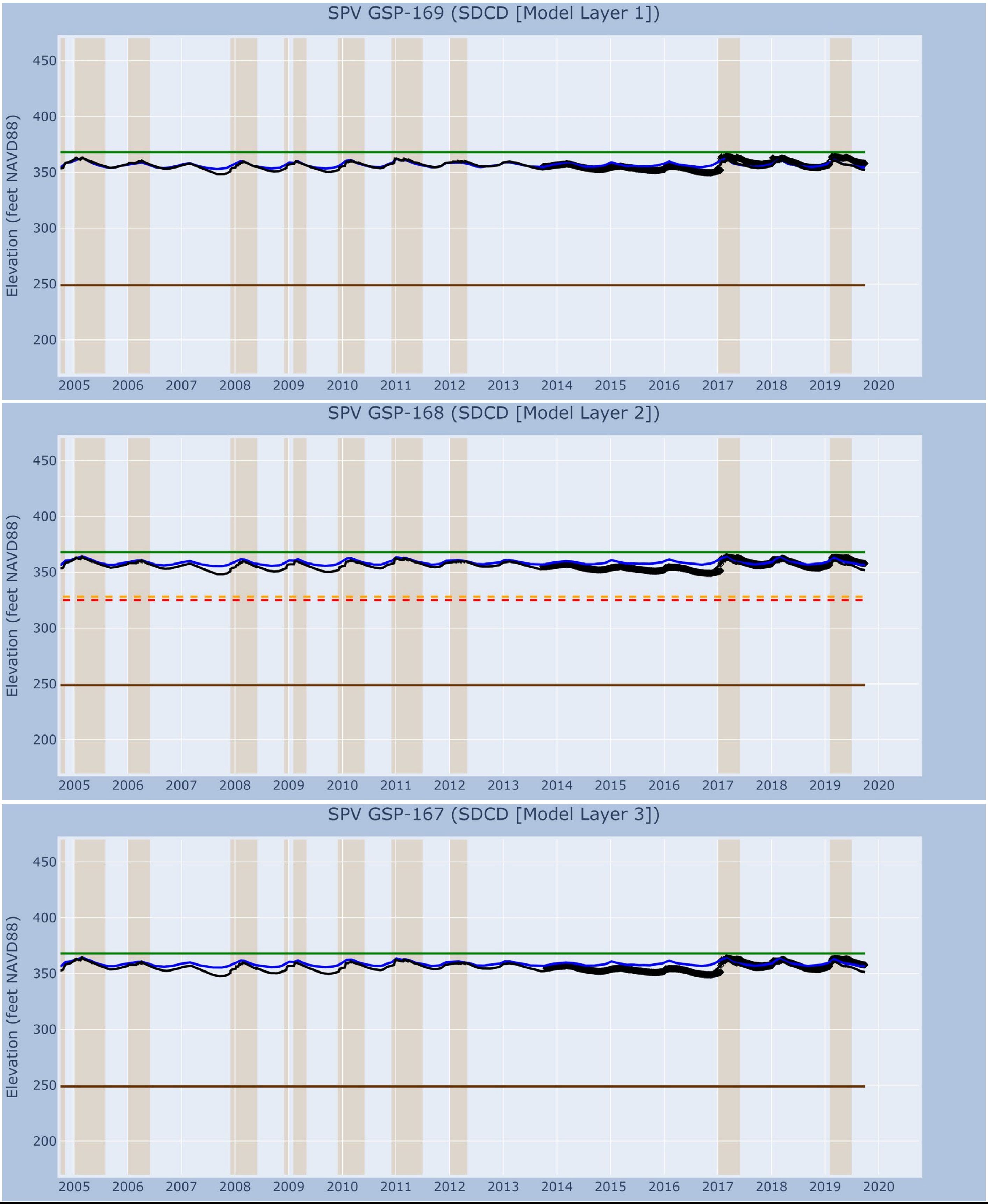
Figure D-4
Modeled Versus Target Groundwater Head Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater and Surface Water Simulations
San Pasqual Valley, California



Legend
- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- Measured Groundwater Elevation (feet NAVD88)
- SPV GSP Model v1.0 Head (feet NAVD88)
- SPV GSP Model v2.0 Head (feet NAVD88)
- Daily Stress Period in the SPV GSP Model v2.0 (monthly otherwise)

Figure D-5
Modeled Versus Target Groundwater Head Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater and Surface Water Simulations
San Pasqual Valley, California

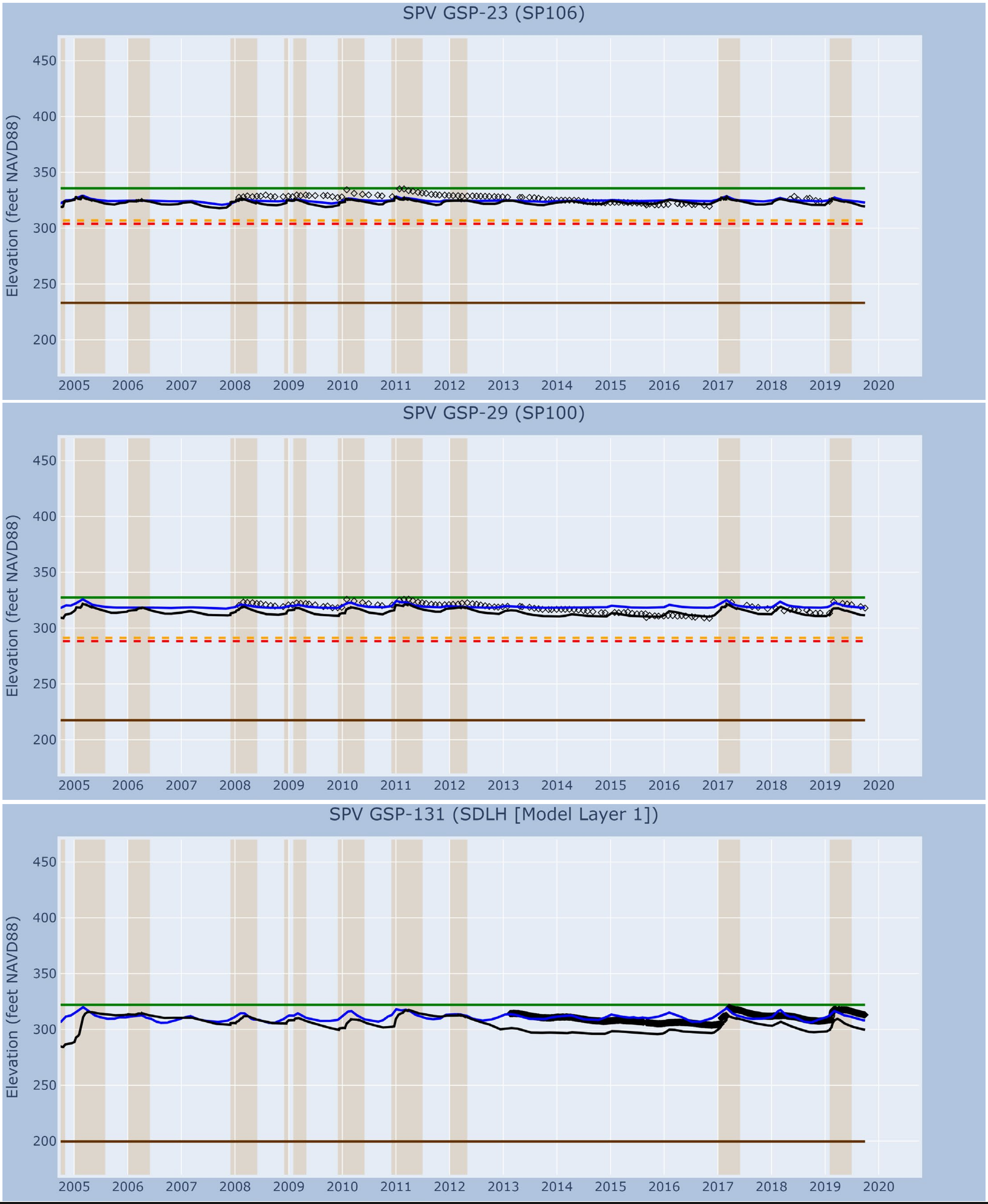
Jacobs



Legend
- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- Measured Groundwater Elevation (feet NAVD88)
- SPV GSP Model v1.0 Head (feet NAVD88)
- SPV GSP Model v2.0 Head (feet NAVD88)
- Daily Stress Period in the SPV GSP Model v2.0 (monthly otherwise)

Figure D-6
Modeled Versus Target Groundwater Head Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater and Surface Water Simulations
San Pasqual Valley, California

Jacobs



Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- Measured Groundwater Elevation (feet NAVD88)
- SPV GSP Model v1.0 Head (feet NAVD88)
- SPV GSP Model v2.0 Head (feet NAVD88)
- Daily Stress Period in the SPV GSP Model v2.0 (monthly otherwise)

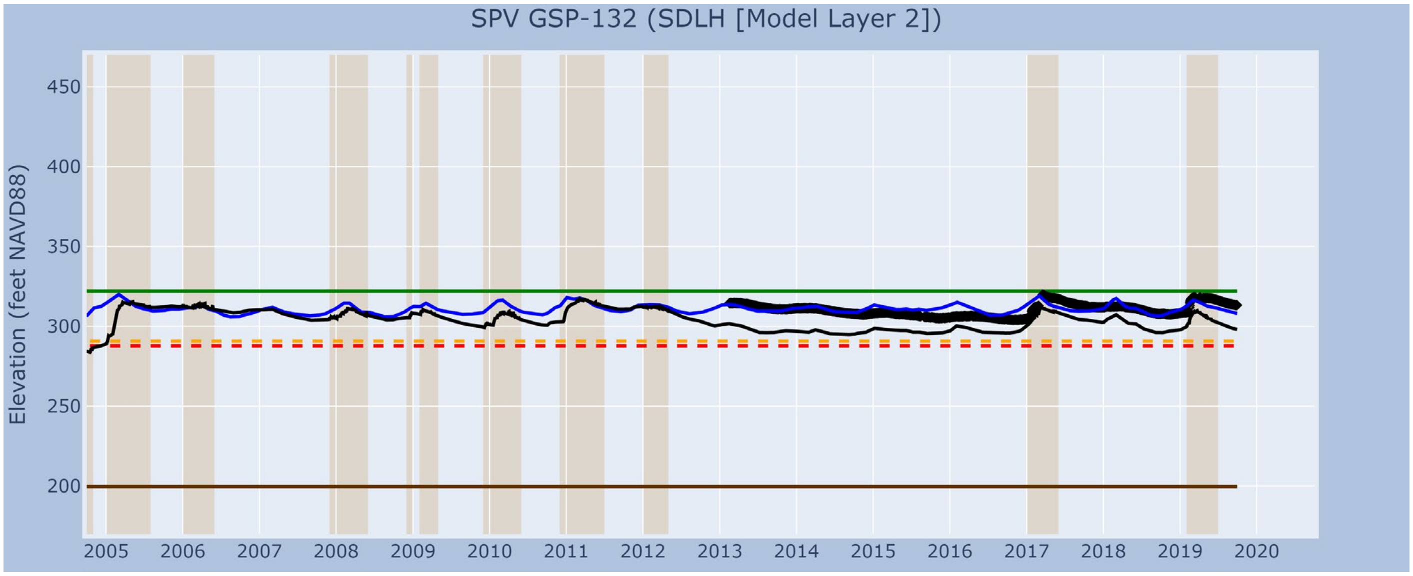
Figure D-7

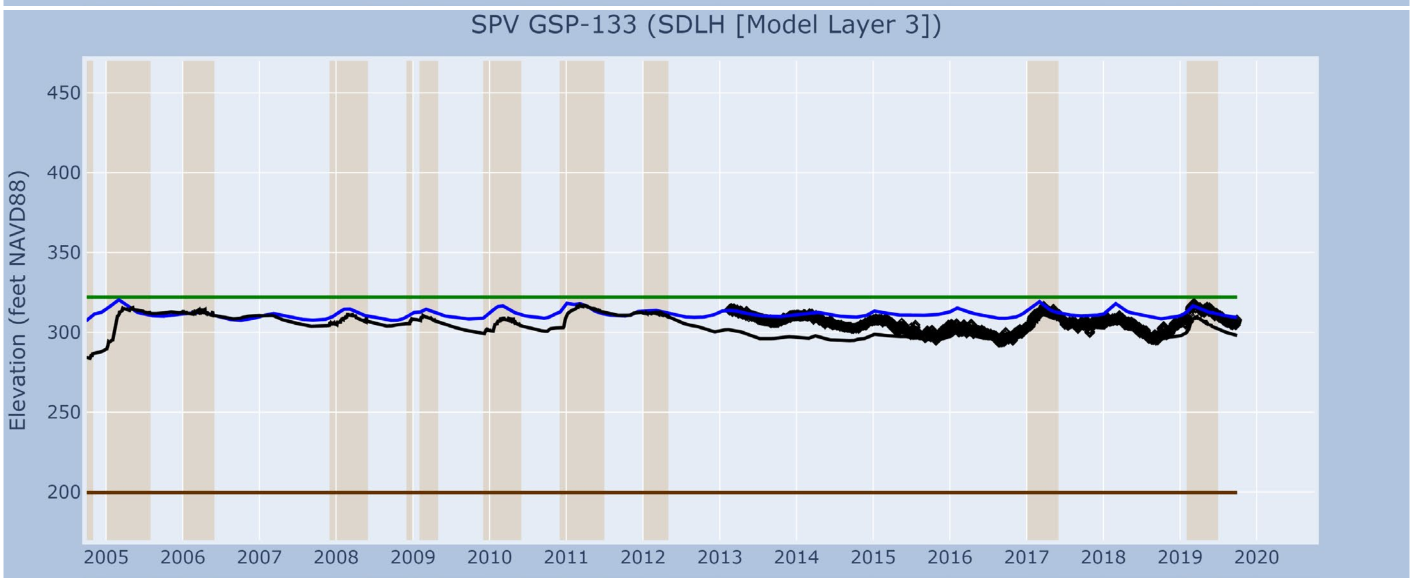
Modeled Versus Target Groundwater Head Hydrographs

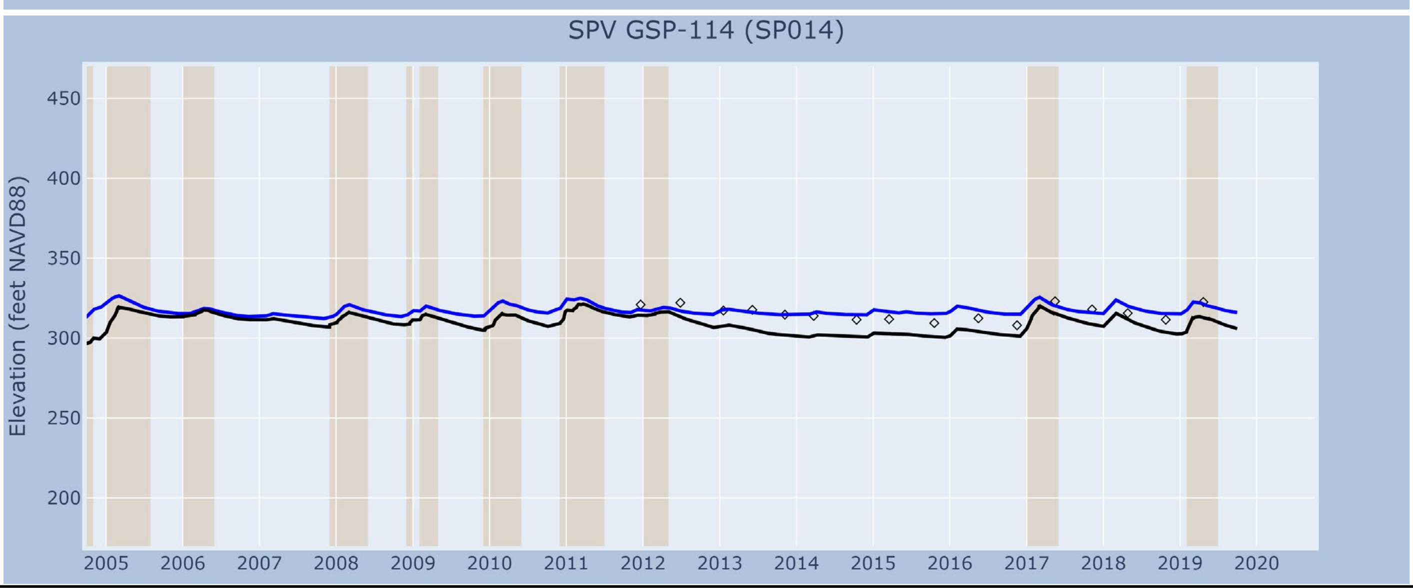
PMA7: Initial Surface Water Recharge Evaluation

Task 5 Groundwater and Surface Water Simulations

San Pasqual Valley, California





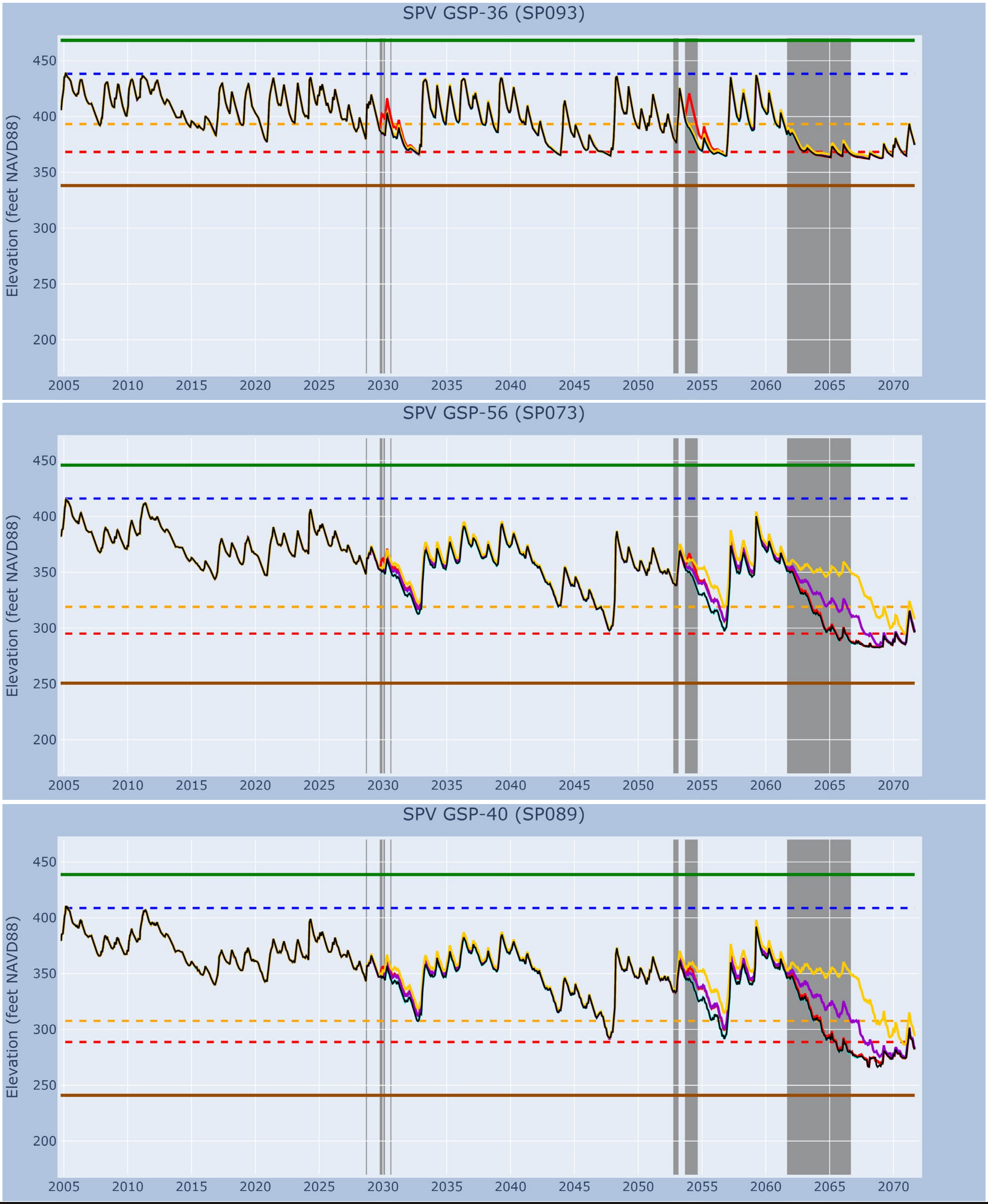


Legend
- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- Measured Groundwater Elevation (feet NAVD88)
- SPV GSP Model v1.0 Head (feet NAVD88)
- SPV GSP Model v2.0 Head (feet NAVD88)
- Daily Stress Period in the SPV GSP Model v2.0 (monthly otherwise)

Figure D-8
Modeled Versus Target Groundwater Head Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater and Surface Water Simulations
San Pasqual Valley, California

Jacobs

Attachment C: Recharge Strategy Groundwater-Level Hydrographs

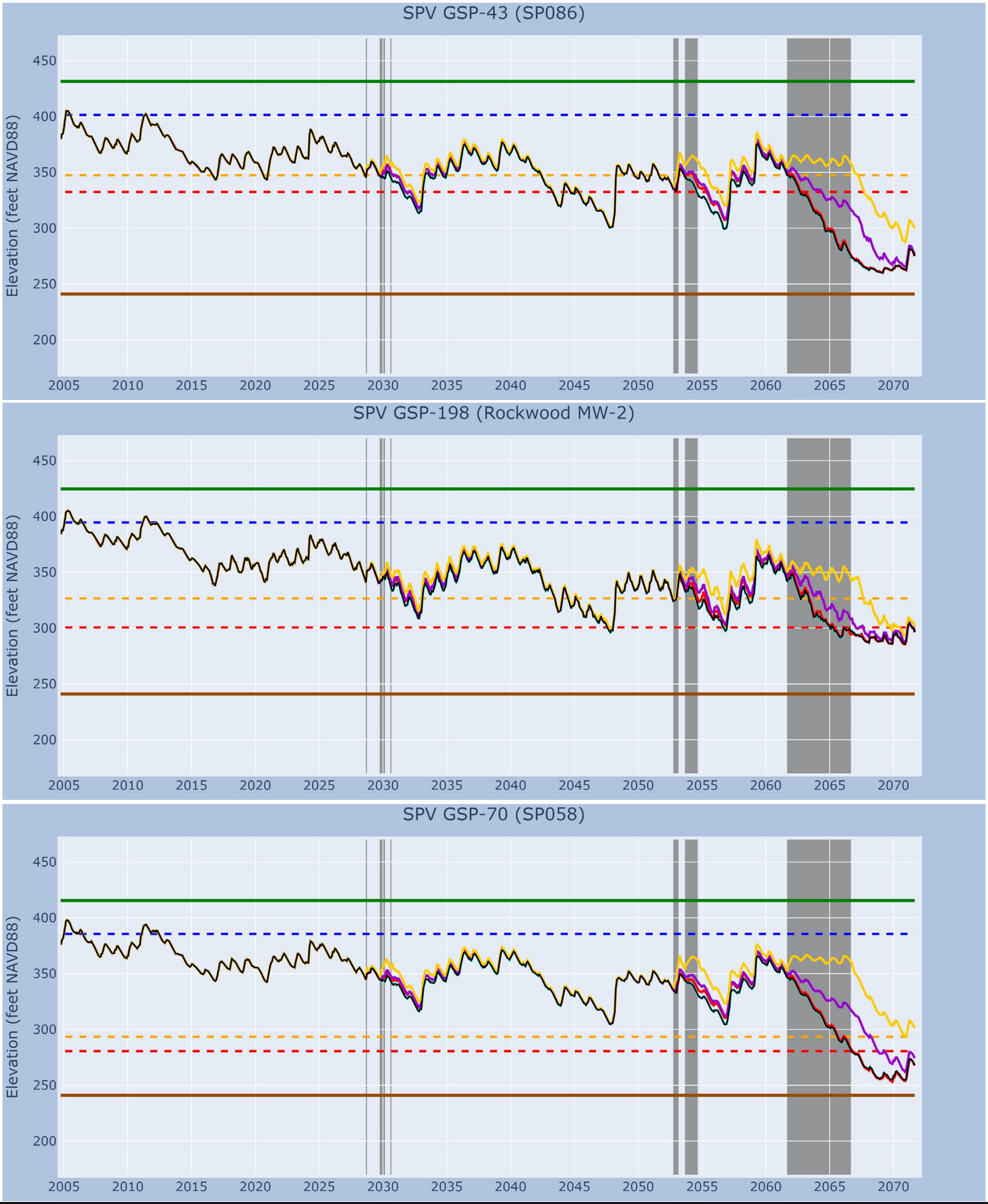


Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- 30-feet below ground surface
- Recharge Implementation Timing (Condition 1 & Condition 2 met)
- Baseline Modeled Head (feet NAVD88)
- Strategy 1B Modeled Head (feet NAVD88)
- Strategy 2A Modeled Head (feet NAVD88)
- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-1
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

Jacobs

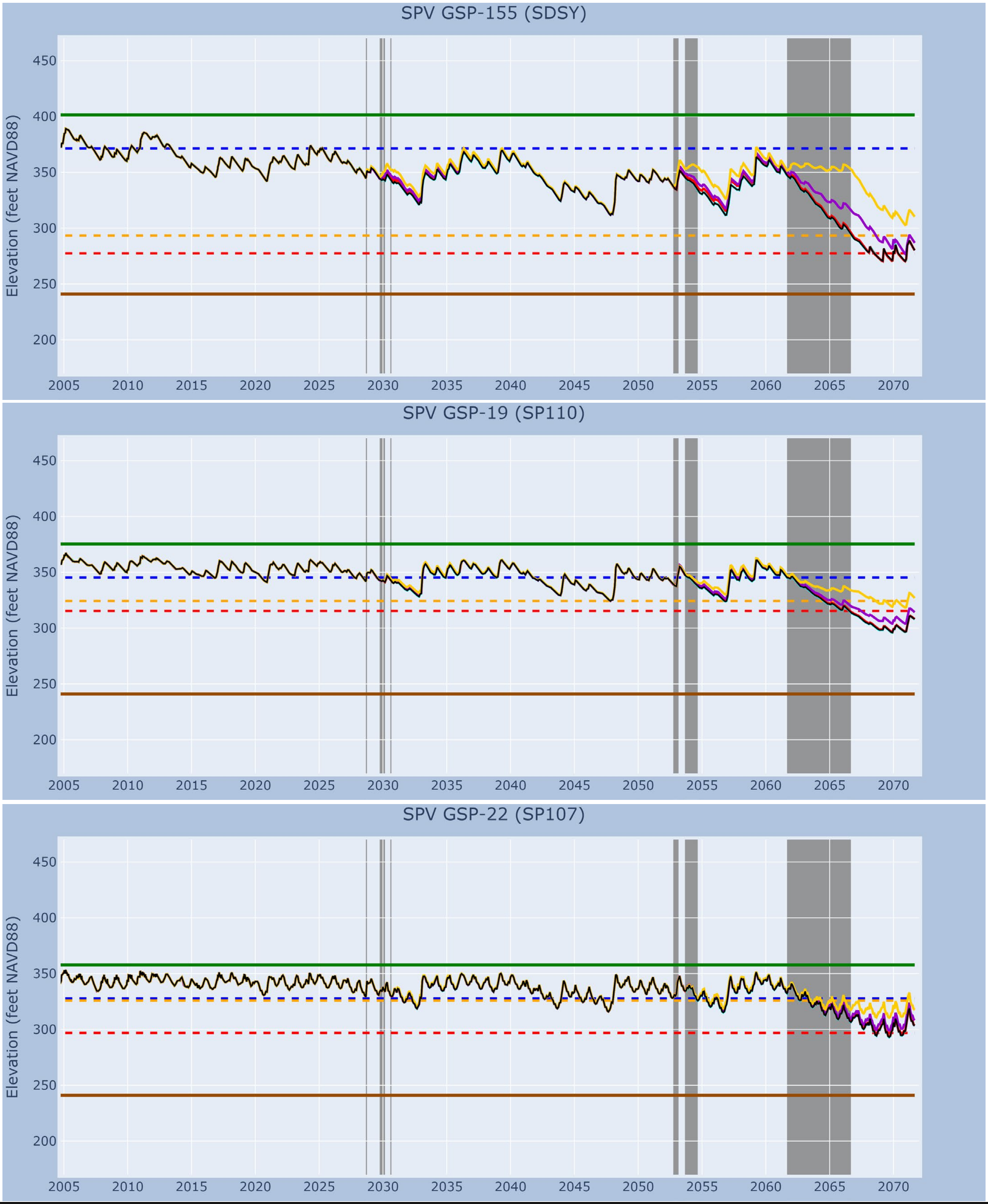


Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- 30-feet below ground surface
- Recharge Implementation Timing (Condition 1 & Condition 2 met)
- Baseline Modeled Head (feet NAVD88)
- Strategy 1B Modeled Head (feet NAVD88)
- Strategy 2A Modeled Head (feet NAVD88)
- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-2
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

Jacobs

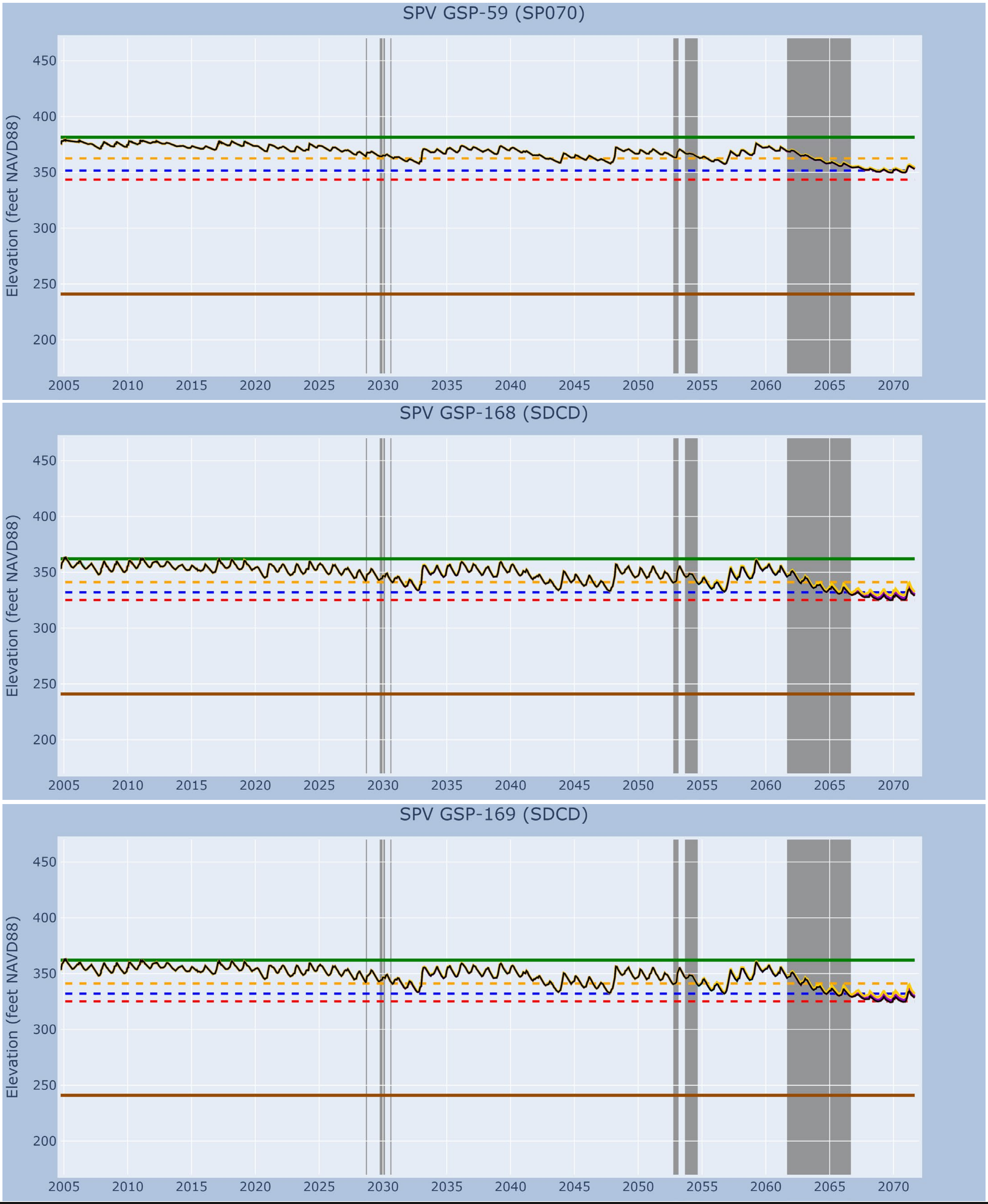


Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- 30-feet below ground surface
- Recharge Implementation Timing (Condition 1 & Condition 2 met)
- Baseline Modeled Head (feet NAVD88)
- Strategy 1B Modeled Head (feet NAVD88)
- Strategy 2A Modeled Head (feet NAVD88)
- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-3
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

Jacobs

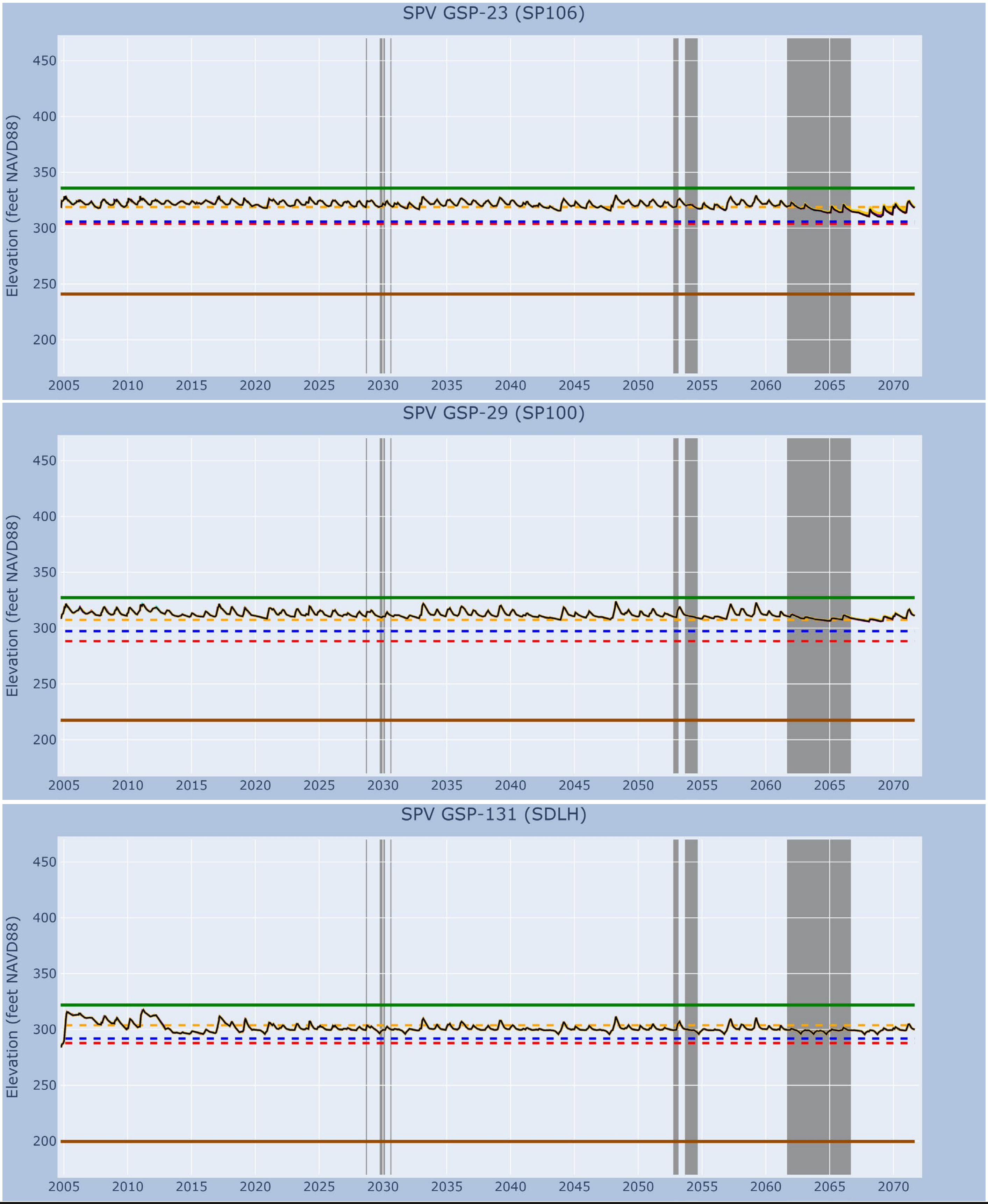


Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- 30-feet below ground surface
- Recharge Implementation Timing (Condition 1 & Condition 2 met)
- Baseline Modeled Head (feet NAVD88)
- Strategy 1B Modeled Head (feet NAVD88)
- Strategy 2A Modeled Head (feet NAVD88)
- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-4
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

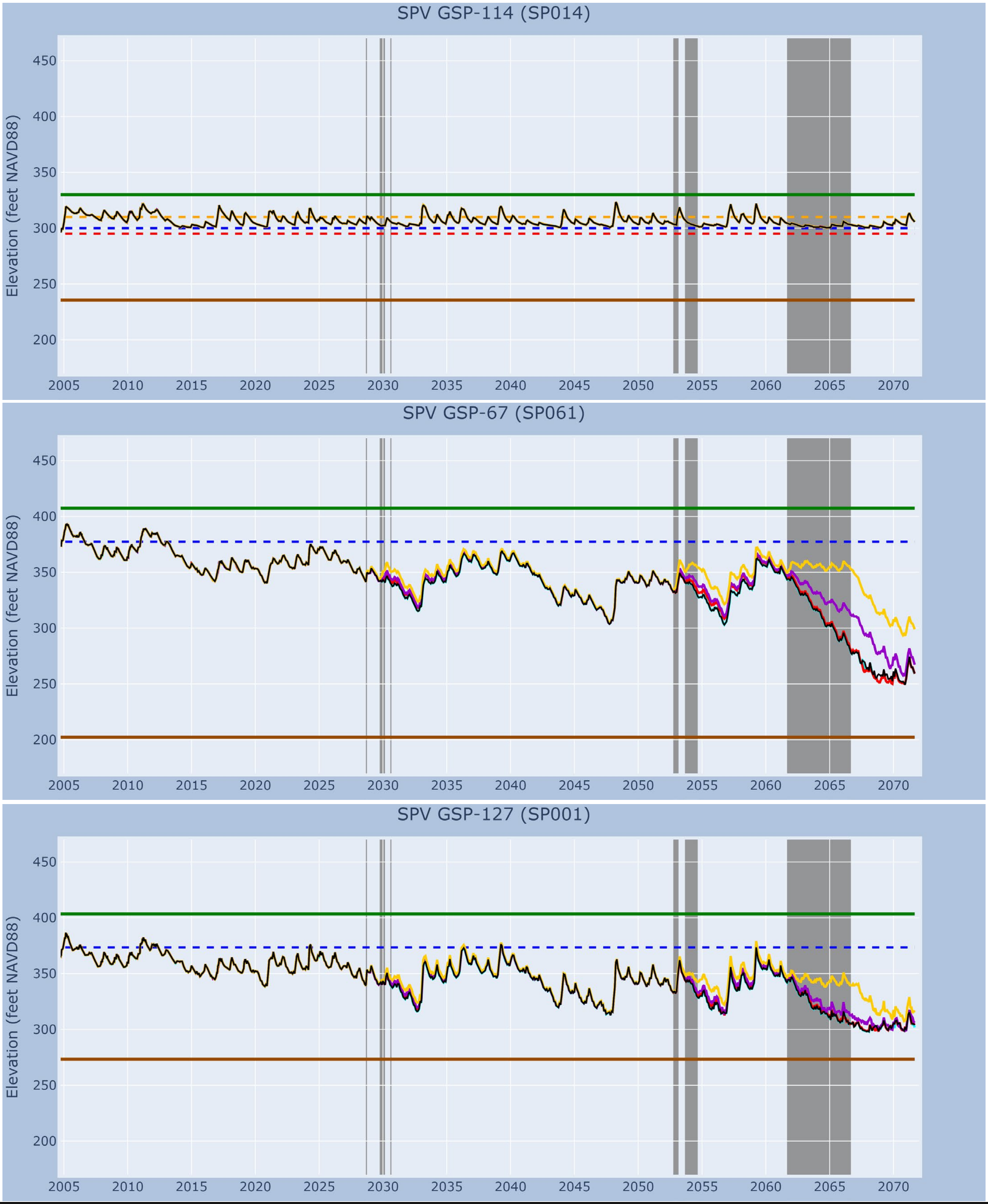
Jacobs



Legend
- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- 30-feet below ground surface
- Recharge Implementation Timing (Condition 1 & Condition 2 met)
- Baseline Modeled Head (feet NAVD88)
- Strategy 1B Modeled Head (feet NAVD88)
- Strategy 2A Modeled Head (feet NAVD88)
- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-5
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

Jacobs

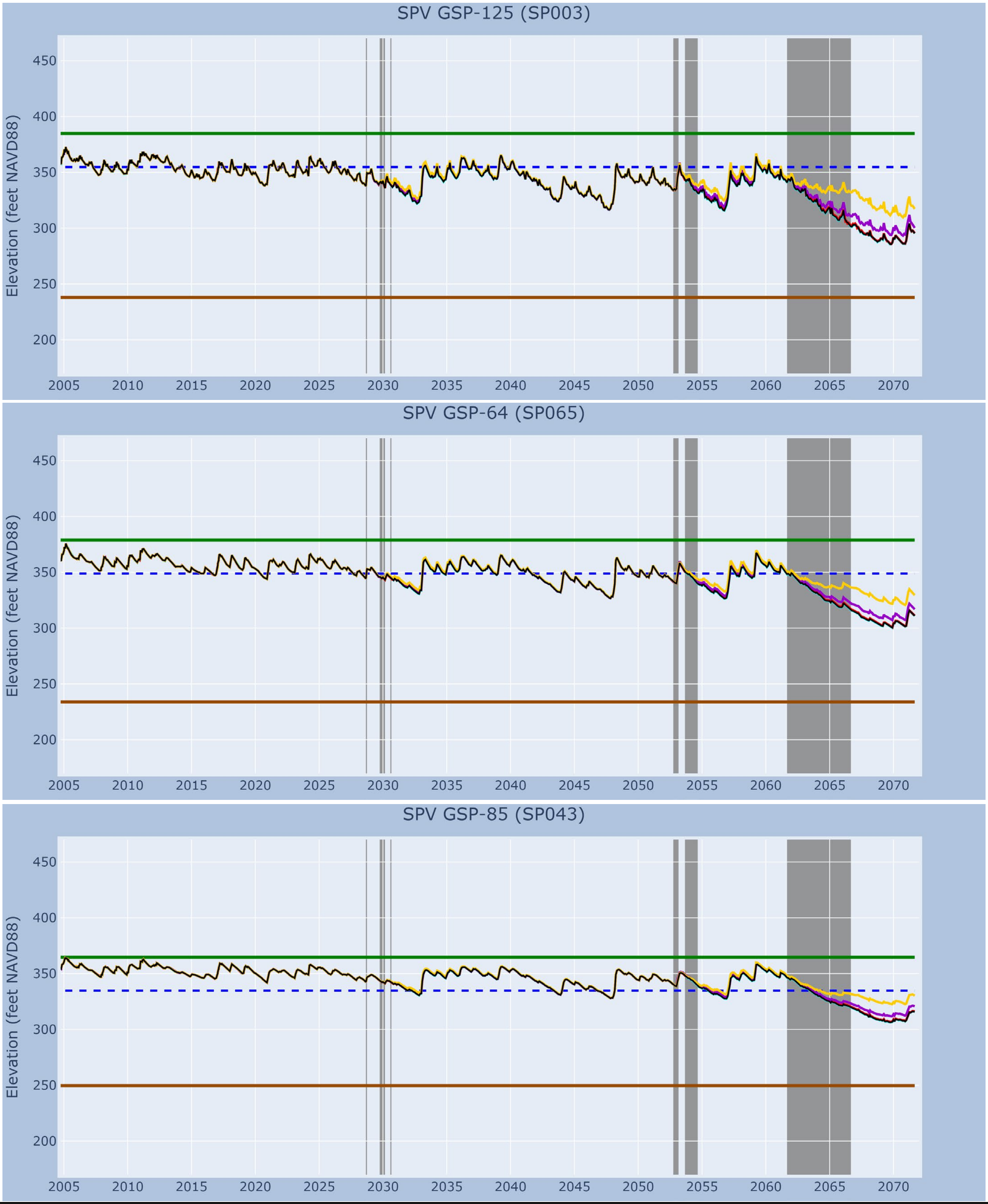


Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- 30-feet below ground surface
- Recharge Implementation Timing (Condition 1 & Condition 2 met)
- Baseline Modeled Head (feet NAVD88)
- Strategy 1B Modeled Head (feet NAVD88)
- Strategy 2A Modeled Head (feet NAVD88)
- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-6
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

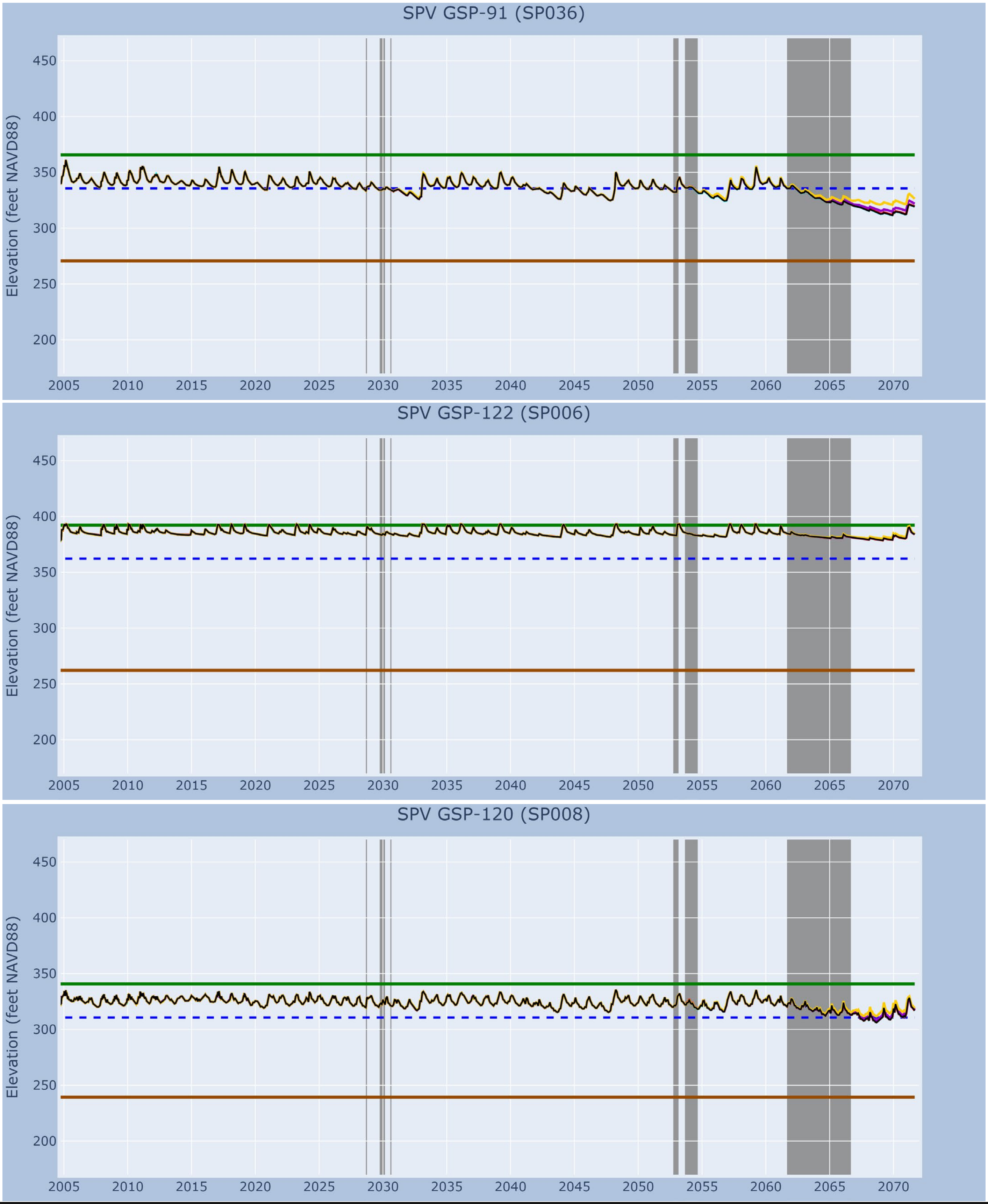
Jacobs



Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- 30-feet below ground surface
- Recharge Implementation Timing (Condition 1 & Condition 2 met)
- Baseline Modeled Head (feet NAVD88)
- Strategy 1B Modeled Head (feet NAVD88)
- Strategy 2A Modeled Head (feet NAVD88)
- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-7
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

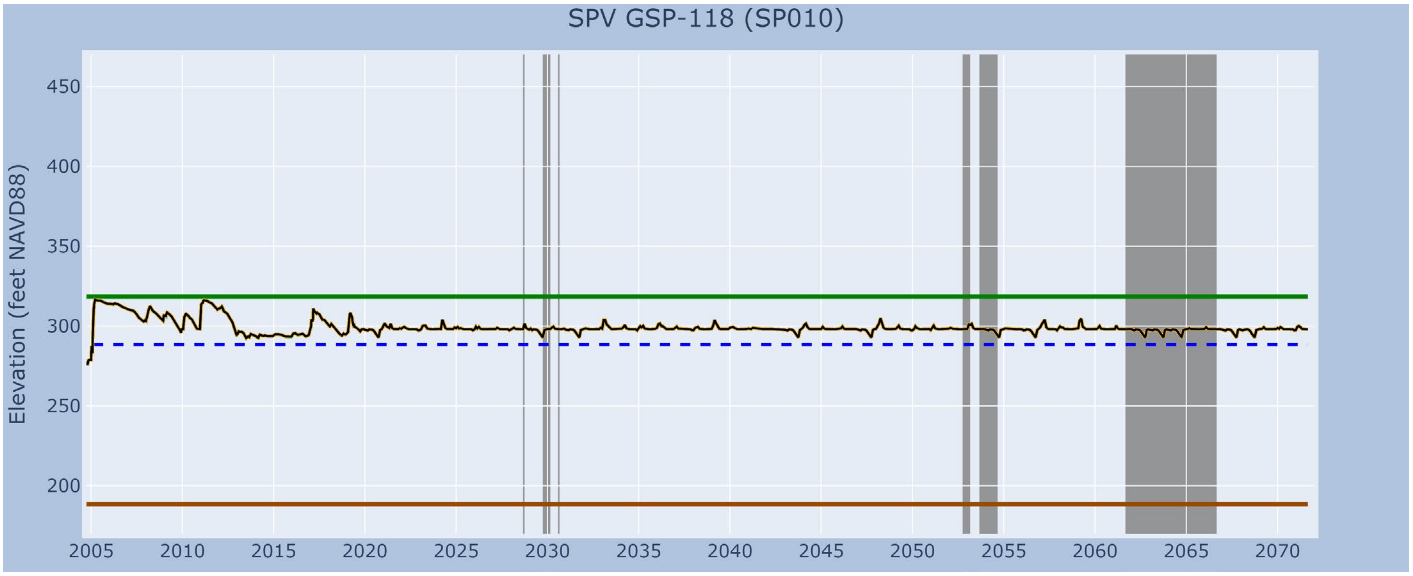


Legend

- Ground Surface Elevation (feet NAVD88)
- Modeled Basin Bottom Elevation (feet NAVD88)
- Minimum Threshold (feet NAVD88)
- Planning Threshold (feet NAVD88)
- 30-feet below ground surface
- Recharge Implementation Timing (Condition 1 & Condition 2 met)
- Baseline Modeled Head (feet NAVD88)
- Strategy 1B Modeled Head (feet NAVD88)
- Strategy 2A Modeled Head (feet NAVD88)
- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-8
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

Jacobs



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- Strategy 3A Modeled Head (feet NAVD88)
- Strategy 3D Modeled Head (feet NAVD88)

Figure E-9
Recharge Strategy Groundwater Level Hydrographs
PMA7: Initial Surface Water Recharge Evaluation
Task 5 Groundwater & Surface Water Simulations
San Pasqual Valley, California

Jacobs

Attachment D: 2020 GDE Study for the San Pasqual Valley Groundwater Basin

Groundwater-Dependent Ecosystems Study for the San Pasqual Valley Groundwater Basin

Prepared for:

SD Public Utilities

Prepared by:

WOODARD & CURRAN

September 2020

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Attachment 1 Photographic Log of GDE Field Assessment Sites

Acronyms and Abbreviations

Term	Abbreviation
CDFW	California Department of Fish and Wildlife
CNDDB	California Natural Diversity Database
DWR	California Department of Water Resources
GDE	Groundwater Dependent Ecosystem
GIS	geographic information systems
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	hydrogeologic conceptual model
NCCAG	Natural Communities Commonly Associated with Groundwater
TM	Technical Memorandum
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

SECTION 1. INTRODUCTION AND REGULATORY FRAMEWORK

As part of the California Sustainable Groundwater Management Act (SGMA), Groundwater Sustainability Agencies (GSAs) are required to develop a Groundwater Sustainability Plan (GSP) to help ensure that groundwater is available for long-term, reliable water supply uses. SGMA was signed into law in 2014.

Identifying groundwater-dependent ecosystems (GDEs) is a required component of a GSP. SGMA defines GDEs as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." This Technical Memorandum (TM) specifically focuses on GDEs identified in the San Pasqual Valley Groundwater Basin (Basin).

SECTION 2. SAN PASQUAL VALLEY GROUNDWATER BASIN ECOLOGICAL SETTING

An ecoregion is an area with generally similar ecosystems with similar quantity, quality, and type of environmental resources. Ecoregions are an important geospatial mapping system that are used by many local, state, and federal regulatory agencies and non-governmental organizations as a frame of reference for assessment and management of ecosystems across the United States. In the context of GDEs, it is important to consider the ecoregion where the GDEs are being assessed because biotic and abiotic processes may vary widely between localities.

The Basin is located in Southern California southeast of the City of Escondido, in San Diego County, California. The Basin sits entirely within the Southern California/Northern Baja Coast Level III ecoregion (85). The Southern California/Northern Baja Coast ecoregion is made up of coastal and alluvial plains, marine terraces, and foothills along the coast of Southern California. The ecoregion also extends southward for over 200 miles along the coast of Baja California. Dominant communities of coastal sage shrub and chaparral plants once characterized much of the area; however, large-scale urbanization and agricultural land clearing activities have altered the landscape (Griffith et al. 2016).

Much of the Basin is within the Diegan Coastal Valleys and Hills (85f) Level IV ecoregion. This ecoregion is characterized by terraces and some steep foothills. Numerous canyons exist along with a few wide valleys and the geology primarily consists of sedimentary and granitic rocks. Oceanic influence drives and changes the climate in this ecoregion. Soils are typically hot and dry, and the native vegetative communities include coastal scrub, chaparral, grasslands and meadows, and some small areas of coastal oak woodland.

The westernmost extents of the Basin are located within the Diegan Western Granitic Foothills (85g) Level IV ecoregion. This ecoregion consists of low, somewhat steep, foothills that are part of the lower Peninsular Ranges. Valleys in the ecoregion vary in width. Marine air does not affect the climate as much as in the neighboring ecoregions to the west, however, soil temperature and moisture regimes and vegetative communities are similar. Refer to Figure 1 at the end of this TM for more information about the project location and the Level IV ecoregion.

The Basin is in a wide valley situated between Highland Valley and Starvation Mountain to the south, and Rockwood Canyon to the north. According to U.S. Geological Survey (USGS) 7.5-minute topographic map Escondido, California (1975) and San Pasqual, California (1988) quadrangles, the approximate elevation of the eastern extent of the Basin is approximately 480 feet above mean sea level and the approximate elevation of the western extent of the Basin is 300 feet above mean sea level. Surface drainage in the eastern portion of San Pasqual Valley is mainly comprised of Guejito and Santa Ysabel Creeks. Guejito Creek flows southward through Rockwood Canyon and into Santa

Ysabel Creek which then flows westward through the valley eventually draining into the San Dieguito River. The San Dieguito River then continues flowing west-southwest through the Basin, eventually entering Hodges Reservoir. Refer to Figure 2 at the end of this TM for USGS 7.5-minute topography in the Basin's vicinity.

SECTION 3. THREATENED AND ENDANGERED SPECIES IN SAN PASQUAL VALLEY

As part of GDE assessment, Woodard & Curran conducted a preliminary review of special-status species in the Basin. Study for this TM focused on state- and federally listed species designated as threatened and/or endangered by the California Department of Fish and Wildlife (CDFW) or the U.S. Fish and Wildlife Service (USFWS). Other listed or otherwise unlisted special-status species were excluded from the evaluation. The purpose of this review was to support the determination of ecological value for GDEs in the Basin.

The San Pasqual Valley is covered by the City of San Diego Multiple Species Conservation Program (MSCP) Planning Area (City of San Diego, 1997). The MSCP is designed to conserve regional sensitive ecological habitat by coordinating project impacts and compensatory mitigation through the issuance of take permits for special-status species. The conservation area, or preserve, is known as the Multi-Habitat Planning Area (MHPA). Significant portions of the San Pasqual Valley are located within the MHPA.

Woodard & Curran conducted a literature review of the latest versions of the California Natural Diversity Database (CNDDB) (CDFW, 2020), and the California Native Plant Society (CNPS) Electronic Inventory of Rare and Endangered Plants (CNPS, 2020) for the USGS Topographic Quadrangles covering the San Pasqual Valley. Additionally, Woodard & Curran reviewed the USFWS Critical Habitat Mapper and Information, Planning and Consultation (IPaC) database for the area covering San Pasqual Valley.

A Woodard & Curran senior field biologist surveyed 15 representative locations in the field to document the Basin's vegetative community and general habitat conditions from March 2 through 4, 2020. Field survey locations were selected during the preliminary desktop assessment of GDEs for the Basin. The senior field biologist observed and documented plant and wildlife species during the field visit(s), and took representative photographs. Protocol-level or presence-absence surveys were not conducted as part of this project; they were not in the scope of work. Refer to Figure 3 for a map of state and federal protected species potentially occurring in the Basin. Table 1 below describes state- and federally listed threatened and endangered species in the Basin.

Table 1. State and Federally Threatened and Endangered Species in the San Pasqual Valley Groundwater Basin

Common Name/ Scientific Name	Status	Habitat	Potential to Occur Within the Project Area	Reliance on Groundwater	Individual(s) Observed
Fauna					
Stephen's kangaroo rat *Dipodomys stephensi*	USFWS: Endangered CDFW: Threatened MSCP Coverage: No	Annual grassland and coastal sage scrub with sparse cover.	Presumed absent based on CNDDB (2020) data. However, potential habitat exists within the project area.	No	No
Swainson's hawk *Buteo swainsoni*	USFWS: None CDFW: Threatened MSCP Coverage: Yes	Open grasslands and cultivated areas; deserts, savannas, and pine-oak woodlands.	Presumed extant based on CNDDB (2020) data. Potential habitat exists within the project area.	Indirect. Species relies on GDE vegetation in riparian woodlands for nesting.	No
tricolored blackbird *Agelaius tricolor*	USFWS: None CDFW: Threatened MSCP Coverage: Yes	Grasslands and other open cultivated areas; freshwater marshes.	Presumed extant based on CNDDB (2020) data. Potential habitat exists within the project area.	Direct. Species relies on GDE vegetation for breeding and roosting, especially emergent marsh wetlands.	No
southwestern willow flycatcher *Empidonax traillii extimus*	USFWS: Endangered CDFW: Endangered MSCP Coverage: Yes	Riparian and wetland thickets.	Presumed extant based on CNDDB (2020) data. Potential habitat exists within the project area.	Indirect. Species relies on GDE riparian vegetation.	No
coastal California gnatcatcher *Polioptila californica californica*	USFWS: Threatened CDFW: None MSCP Coverage: Yes	Coastal sage scrub; dry slopes, washes, mesas.	Presumed extant based on CNDDB (2020) data. Potential habitat exists within the project area.	No	No
least Bell's vireo *Vireo bellii pusillus*	USFWS: Endangered CDFW: Endangered MSCP Coverage: Yes	Willow-cottonwood forest, streamside thickets, and scrub oak.	Presumed extant based on CNDDB (2020) data. Potential habitat exists within the project area.	Indirect. Species relies on GDE vegetation in riparian areas for breeding.	No

Table 1. State and Federally Threatened and Endangered Species in the San Pasqual Valley Groundwater Basin

Common Name/ Scientific Name	Status	Habitat	Potential to Occur Within the Project Area	Reliance on Groundwater	Individual(s) Observed
arroyo toad *Anaxyrus californicus*	USFWS: Endangered CDFW: None MSCP Coverage: Yes	Washes, streams, arroyos, and adjacent riparian uplands; shallow gravelly pools.	Presumed absent based on CNDDB (2020) data. Potential habitat exists within the project area. USFWS critical habitat designated in project area.	Direct and indirect. Species relies on groundwater for breeding and on GDE vegetation for foraging.	No
quino checkerspot *Euphydryas editha quino*	USFWS: Endangered CDFW: None MSCP Coverage: No	Chaparral; coastal sage scrub with Plantago spp.	Presumed absent based on CNDDB (2020) data. However, potential habitat exists within the project area.	N/A*	No
Riverside fairy shrimp *Streptocephalus woottoni*	USFWS: Endangered CDFW: None MSCP Coverage: Yes	Vernal pool complexes in patches of grassland or coastal sage scrub that are hydrologically connected.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
Branchinecta sandiegonensis San Diego fairy shrimp	USFWS: Endangered CDFW: None MSCP Coverage: Yes	Vernal pools and ephemeral wetlands that are hydrologically connected.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
Flora					
San Diego thornmint *Acanthomintha ilicifolia*	USFWS: Threatened CDFW: Endangered MSCP Coverage: Yes	Heavy clay soils in coastal sage scrub and chaparral; often in open depressions or vernal pools.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
San Diego ragweed *Ambrosia pumila*	USFWS: Endangered CDFW: None MSCP Coverage: Yes	Coastal scrub, grasslands, floodplains, and low valleys; persists in disturbed soils.	Presumed absent based on CNDDB (2020) data. However, potential habitat exists within the project area.	N/A*	No

Table 1. State and Federally Threatened and Endangered Species in the San Pasqual Valley Groundwater Basin

Common Name/ Scientific Name	Status	Habitat	Potential to Occur Within the Project Area	Reliance on Groundwater	Individual(s) Observed
coastal dunes milk-vetch *Astragalus tener var. titi*	USFWS: Endangered CDFW: Endangered MSCP Coverage: Yes	Sand/dunes; shallow swales on coastal terraces.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
Encinitas baccharis *Baccharis vanessae*	USFWS: Threatened CDFW: Endangered MSCP Coverage: Yes	Shrubland, chaparral; typically found on steep slopes.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
threadleaf brodiaea *Brodiaea filifolia*	USFWS: Threatened CDFW: Endangered MSCP Coverage: Yes	Grasslands, floodplains; vernal pools.	Presumed extant based on CNDDB (2020) data. Potential habitat exists within the project area.	N/A*	No
salt-marsh bird's beak *Cordylanthus maritimum spp. Maritimum*	USFWS: None CDFW: Endangered MSCP Coverage: Yes	Coastal salt marshes.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
Orcutt's spineflower *Chorizanthe orcuttiana*	USFWS: Endangered CDFW: Endangered MSCP Coverage: No	Open areas within coastal, maritime shrubland/chaparral.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
San Diego button-celery *Eryngium aristulatum var. parishii*	USFWS: Endangered CDFW: Endangered MSCP Coverage: Yes	Vernal pools.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
spreading navarretia *Navarretia fossalis*	USFWS: Threatened CDFW: None MSCP Coverage: Yes	Vernal pools, alkali playas and sinks; may be found in man-made ditches/depressions with clay soils.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No

Table 1. State and Federally Threatened and Endangered Species in the San Pasqual Valley Groundwater Basin

Common Name/ Scientific Name	Status	Habitat	Potential to Occur Within the Project Area	Reliance on Groundwater	Individual(s) Observed
willowy monardella *Monardella viminea*	USFWS: Endangered CDFW: Endangered MSCP Coverage: Yes	Rocky coastal drainages; sandy benches along streambeds.	Presumed absent based on CNDDB (2020) data. However, potential habitat exists within the project area.	N/A*	No
California Orcutt grass *Orcuttia californica*	USFWS: Endangered CDFW: Endangered MSCP Coverage: Yes	Grasslands and chaparral; often found in dried beds of vernal pools.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
San Diego mesa mint *Pogogyne abramsii*	USFWS: Endangered CDFW: Endangered MSCP Coverage: Yes	Vernal pools on coastal mesas/terraces.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No
Otay mesa mint *Pogogyne nudiuscula*	USFWS: Endangered CDFW: Endangered MSCP Coverage: Yes	Vernal pools; chaparral and coastal sage scrub.	Presumed absent based on CNDDB (2020) data. Habitat was not observed within the project area.	N/A*	No

Notes:
N/A = Reliance on groundwater unknown or otherwise not fully understood based on species omission from the Critical Species LookBook (2019).*
Source: California Natural Diversity Database (CDFW, 2020); California Native Plant Society Inventory Results (2020); IPaC Trust Resources List (USFWS, 2020).

SECTION 4. GROUNDWATER DEPENDENT ECOSYSTEM ASSESSMENT

4.1 Preliminary Desktop Assessment

Using a geographic information system (GIS), Woodard & Curran completed a preliminary desktop analysis of the California Department of Water Resources' (DWR's) Natural Communities Commonly Associated with Groundwater (NCCAG) database for the Basin. The NCCAG database includes a set of GIS data for vegetative communities and a separate dataset for wetlands. Additional relevant environmental and hydrogeological GIS datasets were also reviewed as part of the desktop assessment. Woodard & Current developed a Basin using these publicly available statewide and regional data layers to understand the extent of the NCCAG dataset within the Basin. Refer to Figure 4 for a map of GDE indicators in Basin. Once the Basin map of GDE indicators was developed, Woodard & Curran then reviewed the Basin and attempted to identify NCCAG polygons that appeared to be probable GDEs based on the following criteria:

- Presence of a USGS-mapped stream, spring, seep, or other waterbody
- Presence of USFWS National Wetlands Inventory (NWI) mapped wetlands
- Inundation visible on aerial imagery
- Saturation visible on aerial imagery
- Dense riparian and/or wetland vegetation visible on aerial imagery
- CNDDB and/or CNPS vegetative community data indicating a concentration of phreatophytes
- California Protected Areas and/or Areas of Conservation Emphasis

If an NCCAG polygon, or a portion of a polygon, included one or multiple of the above characteristics, then it was tentatively marked as a probable GDE for further evaluation and validation as part of the field study. NCCAG polygons that did not appear to exhibit the above criteria (or similar) were considered probable non-GDEs for the purposes of the desktop study, and were subject to further review as part of the field study.

4.2 GDE Field Assessment and Validation

Woodard & Curran completed a GDE field assessment and validation study at representative locations throughout the Basin. Woodard & Curran originally selected 16 representative locations based on geographic position in the Basin, vegetative community/habitat type, land use, topography, and other environmental factors determined via remote sensing. Prior to field work, Woodard & Curran coordinated with the City of San Diego Public Utilities Department to review the selected GDE field assessment sites and property lease information as well as physical access to the sites. Survey permissions were obtained from the appropriate stakeholders prior to mobilization for the field effort.

The field study was conducted from March 2 to 4, 2020. Woodard & Curran Senior Biologist Will Medlin and City of San Diego Public Utilities Department Civil Engineer Michael Bolouri worked together to complete the field study. GDE field assessment Sites 1 through 14 and 16 were visited during the field study. Site 15 was not accessible at time of field deployment and was eliminated from assessment.

Field observations were made at NCCAG-mapped seeps, springs, wetlands, and other riparian habitats to document plant communities, aquatic or semi-aquatic wildlife, indicators of surface and subsurface hydrology, soil-based evidence of a high water table, and other relevant ecological and hydrological data. Soils were sampled to an approximate depth of between 12 and 20 inches depending on restrictive layer to determine moisture content and texture. The soil profile was assessed and classified based on color using a Munsell soil color chart. Photographs were taken in the four cardinal directions (i.e., north, east, south, west) at each GDE field assessment site to document general habitat conditions. Field notes and additional photographs were taken of plant species, wildlife, and other relevant ecological data to support the GDE assessment at each site. Global positioning system (GPS) data points were also collected using a submeter Trimble Geo 7x GPS unit at each GDE field assessment site. Refer to Figure 5 at the end of this TM for GDE field assessment site locations.

Upon completion of the GDE field assessment, Woodard & Curran refined the preliminary desktop GDE assessment data and revised the mapping for probable GDEs and probable non-GDEs based on field observations and further research.

SECTION 5. RESULTS AND DISCUSSION

Out of 72 NCCAG-mapped polygons (i.e., 53 GDE wetland polygons and 19 GDE vegetation polygons), the combined desktop and field assessment yielded 64 potential GDEs and eight potential non-GDEs. In addition, during the desktop assessment, 1,062 individual locations were viewed and a determination of potential GDE status was made for a point on the landscape. Out of 1,062 assessment locations, 285 points were determined to be probable GDEs, 197 points were determined to be probable non-GDEs, and 580 points were determined to be wetland and/or riparian communities. Probable GDEs largely consisted of dense riparian and wetland communities along mapped drainage systems where monitoring well data showed the depth to groundwater at 30 feet or less relative to the ground surface. Probable non-GDEs largely consisted of dry upland areas dominated by shallow-rooted grasses and/or invasive species. Areas that consisted of wetland and/or riparian phreatophytes (i.e., deep-rooted plant species) along drainageways where depth to groundwater was greater than 30 feet were classified as wetland and riparian communities. Refer to Figure 6 at the end of this TM for the draft GDE assessment map.

For the field study, 15 representative locations were assessed for GDE indicators, functions, and values. Of the 15 sites reviewed in the field, one appeared to be a non-GDE, nine appeared to be GDEs, and five appeared to be wetland/riparian communities but not GDEs. The 14 GDE and wetland/riparian community sites had deep-rooted woody riparian or wetland species growing there. Further, five sites (i.e., Sites 5, 7, 9, 10 and 16) had either standing or flowing water observed at the surface. The one potential non-GDE location was Site 1, which did not have any deep-rooted woody riparian or wetland species and was dominated by grasses and other non-native herbaceous species. Table 2 below describes each of the field assessment sites in more detail.

Table 2. Woodard & Curran GDE Field Assessment Sites in the San Pasqual Valley Groundwater Basin

GDE Field Assessment Site	Latitude/ Longitude	NCCAG-Mapped Polygon?	NCCAG Vegetation/ Wetland Type[a]	Dominant Plant Species Observed	Field Assessment Notes
1	33.056556 N/ 117.054057 W	Yes	Vegetation—Tule-Cattail Wetland—Palustrine, emergent, persistent, seasonally flooded	• *Avena fatua* • *Conium maculatum* • *Rumex crispus* • *Bromus carinatus*	Site is an upland terrace within the floodplain of the San Dieguito River. Soils at data point are low-chroma yet dry and somewhat friable. Site appears to be dominated by non-native grasses and other invasive herbaceous plants. This location does not appear to be a GDE.
2	33.052368 N/ 117.049115 W	Yes	Vegetation—Willow (Shrub)	• *Salix laevigata* • *Tamarisk ramosissima* • *Baccharis salicifolia* • *Schoenoplectus californicus* • *Urtica dioica*	Site is a forested riparian corridor with many large willows. Soils at data point are low-chroma with some organic content. Multiple songbirds were observed/heard at this site. This location appears to be a GDE.
3	33.046929 N 117.042083 W	Yes	Wetland—Palustrine, scrub-shrub, forested, seasonally flooded	• *Eucalyptus globulus* • *Baccharis salicifolia* • *Salix laevigata* • *Eriogonum sp.* • *Conium maculatum* • *Carex sp.*	Site is a forested drainage with a small intermittent/ephemeral stream channel; sediment is deposited throughout the floodplain; soils are low-chroma. Multiple songbirds were observed/heard at this site. This location appears to be a GDE.
4	33.053996 N/ 117.039712 W	Yes	Wetland - Palustrine, emergent, persistent, seasonally flooded	• *Salix laevigata* • *Baccharis salicifolia* • *Rumex crispus*	Site is a dense willow thicket with little herbaceous vegetation; soils are low-chroma with some organic content. This location appears to be a GDE.
5	33.069208N/ 117.031547W	Yes	Vegetation—Willow (Shrub)	• *Salix lasiolepis* • *Salix laevigata* • *Urtica dioica* • *Typha domingensis* • *Schoenoplectus californicus*	Site is a riparian willow thicket. Soils are saturated at the surface by what appears to be groundwater; high organic content observed. Surface water, drainage patterns, drift deposits, and iron-oxidizing bacteria observed. This location appears to be a GDE.

Table 2. Woodard & Curran GDE Field Assessment Sites in the San Pasqual Valley Groundwater Basin

GDE Field Assessment Site	Latitude/ Longitude	NCCAG-Mapped Polygon?	NCCAG Vegetation/ Wetland Type[a]	Dominant Plant Species Observed	Field Assessment Notes
6	33.081393 N/ 117.028357 W	No	N/A	• *Salix lasiolepis* • *Baccharis salicifolia* • *Schoenoplectus californicus* • *Rumex crispus*	Site is an emergent marsh adjacent to an excavated pond/basin that is holding water. Soils are saturated and low-chroma. Dense wetland vegetation. Several waterfowl observed in the open water. This location appears to be a GDE.
7	33.081120 N/ 117.013124 W	Yes	Vegetation—Riparian mixed shrub	• *Tamarisk ramosissima* • *Polygonum sp.* • *Rumex crispus* • *Silybum marianum* • *Plantago sp.*	Site is within what appears to be an excavated pond/basin. Soils are saturated and low-chroma. Standing water observed in western portion of basin. Vegetation favors disturbed sites. Multiple songbirds heard/observed. This location appears to be a GDE.
8	33.091726 N 117.019165 W	Yes	Vegetation—Willow (shrub) Wetland—Palustrine, forested, seasonally flooded	• *Washingtonia filifera* • *Salix laevigata* • *Baccharis salicifolia* • *Urtica dioica* • *Anemopsis californica*	Site is a forested floodplain with a dense understory. Soils are low-chroma through the profile with some organic content. Multiple songbirds heard/observed as well as small mammal. This location appears to be a GDE.
9	33.093791 N/ 117.016029 W	Yes	Wetland—Palustrine, forested, seasonally flooded	• *Salix laevigata* • *Baccharis salicifolia* • *Urtica dioica* • *Schoenoplectus californicus*	Site is an inundated pond/basin with thick scrub-shrub wetland vegetation surrounding and extending into deeper, open water areas. Significant waterfowl and other songbirds heard/observed. This location appears to be a GDE.

Table 2. Woodard & Curran GDE Field Assessment Sites in the San Pasqual Valley Groundwater Basin					
GDE Field Assessment Site	**Latitude/ Longitude**	**NCCAG-Mapped Polygon?**	**NCCAG Vegetation/ Wetland Type[a]**	**Dominant Plant Species Observed**	**Field Assessment Notes**
10	33.099183 N/ 117.019179 W	Yes	Wetland—Palustrine, emergent, persistent, seasonally saturated	• *Salix laevigata* • *Tamarisk ramosissima* • *Nasturtium officinale* • *Eleocharis palustris* • *Lobelia sp.* • *Rumex crispus* • *Schoenoplectus californicus*	Site is a wet meadow in a pasture adjacent to a perennial drainage feature. Soils are low-chroma and have a dense upper clay layer that appears to help pond surface water. Surface water is approximately 4-6 inches deep. Algae and macroinvertebrates observed in standing water. This location appears to be a GDE.
11	33.089156 N/ 116.995885 W	Yes	Vegetation—Riparian mixed hardwood Wetland—Palustrine, emergent, persistent, seasonally flooded	• *Washingtonia filifera* • *Salix laevigata* • *Eucalyptus globulus* • *Baccharis salicifolia* • *Urtica dioica* • *Anemopsis californica*	Site is a mature riparian forest. A small intermittent stream was observed just west of the data point and was flowing at time of field survey. Soils are low-chroma in the upper part but become high-chroma below. Soils are very sandy and appear to be well drained. Songbirds heard/observed. This location appears to be a wetland/riparian community, but not a GDE.
12	33.083919 N/ 116.995362 W	Yes	Vegetation—Riparian mixed shrub Wetland—Palustrine, emergent, persistent, seasonally flooded	• *Tamarisk ramosissima* • *Salix lasiolepis* • *Baccharis salicifolia* • *Arundo donax* • *Xanthium strumarium* • *Conium maculatum* • *Madia exigua*	Site is a dry creek bed and adjacent riparian zone. Some vegetated mid-channel bars are present. No evidence of recent flow. Soils are very dry, friable sands. Butterflies and a lizard were observed. This location appears to be a wetland/riparian community, but not a GDE.

Table 2. Woodard & Curran GDE Field Assessment Sites in the San Pasqual Valley Groundwater Basin

GDE Field Assessment Site	Latitude/ Longitude	NCCAG-Mapped Polygon?	NCCAG Vegetation/ Wetland Type[a]	Dominant Plant Species Observed	Field Assessment Notes
13	33.073991 N/ 116.977904 W	Yes	Vegetation—Riversidean alluvial scrub	• *Tamarisk ramosissima* • *Sambucus nigra spp.* • *Caerulea* • *Salix lasiolepis* • *Baccharis salicifolia* • *Xanthium strumarium* • *Arundo donax*	Site is a dry creek bed just downstream from a roadway bridge. Lots of shrubby vegetation growing in channel and wrack lines are present from past flooding events. Soils are low-chroma and moist in the upper part, but quickly become dry sand below. Bees and songbirds heard/observed; swallow nests were observed under bridge. This location appears to be a wetland/riparian community, but not a GDE.
14	33.092898 N/ 116.956288 W	Yes	Vegetation—Riparian mixed shrub Wetland—Palustrine, scrub-shrub, seasonally flooded	• *Tamarisk ramosissima* • *Sambucus nigra spp.* • *Caerulea* • *Baccharis salicifolia* • *Conium maculatum* • *Galium aparine* • *Xanthium strumarium* • *Madia exigua* • *Bromus diandrus*	Site is a riparian scrub-shrub upland along Santa Ysabel Creek. Streambed is dry and banks are steep and eroded. Soils are somewhat low-chroma, but dry throughout profile. This location appears to be a wetland/riparian community, but not a GDE.

Table 2. Woodard & Curran GDE Field Assessment Sites in the San Pasqual Valley Groundwater Basin

GDE Field Assessment Site	Latitude/ Longitude	NCCAG-Mapped Polygon?	NCCAG Vegetation/ Wetland Type[a]	Dominant Plant Species Observed	Field Assessment Notes
16	33.088564 N/ 116.923676 W	Yes	Vegetation—Willow (shrub)	• *Populus fremontii* • *Platanus racemose* • *Tamarisk ramosissima* • *Salix lasiolepis* • *Salix laevigata, Eucalyptus globulus* • *Baccharis salicifolia* • *Arundo donax* • *Xanthium strumarium* • *Ricinus communis* • *Mirabilis laevis var. crassifolia*	Site is the streambed of Santa Ysabel Creek with adjacent riparian scrub-shrub and forest. Stream was flowing at time of field survey. Aquatic macroinvertebrates were observed in stream. Soils were moist coarse sands. Wild turkey, wading birds, and songbirds heard/observed. This location appears to be a wetland/riparian community, but not a GDE.

GDEs are present in the Basin as indicated in Table 2. Groundwater monitoring well data from 2015 for depth to water ranges from 8 feet below surface along Cloverdale Creek in the northwestern portion of the Basin to greater than 80 feet below surface along Santa Ysabel Creek near the eastern extent of the Basin. Surface water base flow was observed in the field at five of the GDE assessment sites in March 2020, including in Santa Ysabel Creek near the eastern extent of the Basin. This may suggest that there is a separate shallow, perched groundwater table that was discharging at the time of the field study. This shallow water-bearing zone may be comprised of a type of rock that allows groundwater to exist within interstitial pore spaces and discharge to localized receiving streams prior to connecting to the regional groundwater table or aquifer. Additionally, some GDEs and wetland/riparian communities may be supported by surface waters resulting from storm flows and (possibly) flowing springs outside the Basin boundary.

The major drainages in the San Pasqual Valley have significant riparian or wetland vegetative communities with an abundance of woody phreatophytes such as willows (*Salix* spp.), salt cedar (*Tamarisk ramosissima*), Fremont cottonwood (*Populus fremontii*), California sycamore (*Platanus racemosa*) and California fan palm (*Washingtonia filifera*). These drainageways and their associated riparian communities provide valuable ecological habitat for many species to shelter, feed, and breed. They also provide wildlife corridors for movement and migration through the large agricultural fields and orchards located on the adjacent valley floor.

GDEs in the Basin may also provide habitat for certain state and federal protected species. Of the 23 state- or federally listed threatened and endangered species that have the potential to occur in the Basin, six species (i.e., Swainson's hawk, tricolored blackbird, southwestern willow flycatcher, coastal California gnatcatcher, least Bell's vireo, and threadleaf brodiaea) are presumed extant based on CNDDB (2020) data. Additionally, potential suitable habitat was observed for 11 species (i.e., Stephen's kangaroo rat, Swainson's hawk, tricolored blackbird, southwestern willow flycatcher, coastal California gnatcatcher, least Bell's vireo, arroyo toad, quino checkerspot, San Diego ragweed, threadleaf brodiaea, and willowy monardella) during the field study. Many of these special-status species rely on the riparian scrub-shrub found along drainageways and other wetland ecosystems present in the valley for all or part of their life cycle.

5.1 Conclusion

GDEs and wetland/riparian communities present in the Basin do not appear to depend solely on the regional groundwater table. Many of the GDEs and wetland/riparian communities observed rely on surface flows and stormwater runoff to influence soil moisture requirements for vegetative communities. Further study is recommended to understand if and where a shallow, perched groundwater table exists and if there is an aquitard or other rock layer in the subsurface geology that would influence groundwater discharge at the surface. Also, additional work is recommended to refine and revise the extents of the NCCAG datasets, as this may yield a more realistic map of GDEs for the Basin. Special attention should be given to human-made excavated basins that have naturalized into semi-permanently inundated wetlands and/or open waters where waterfowl and other wetland-dependent species are present. These ecosystems may or may not have a direct connection to groundwater and that should be confirmed.

SECTION 6. REFERENCES

Calflora. 2020. Information on Wild California Plants. Available: https://www.calflora.org/

California Native Plant Society (CNPS). 2020. *A Manual of California Vegetation Online*. Available: http://vegetation.cnps.org/

City of San Diego. 1997. *Multiple Species Conservation Program: City of San Diego MSCP Subbarea Plan*. Available: https://www.sandiego.gov/sites/default/files/legacy/planning/programs/mscp/pdf/subareafullversion.pdf

Griffith, G.E., J.M. Omernik, D.W. Smith, T.D. Cook, E. Tallyn, K. Moseley, and C.B. Johnson. 2016. Ecoregions of California (poster): U.S. Geological Survey Open-File Report 2016–1021, with map, scale 1:1,100,000, http://dx.doi.org/10.3133/ofr20161021.

California's Threatened and Endangered Species for Sustainable Groundwater Management. The Nature Conservancy, San Francisco, California.

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FIGURES

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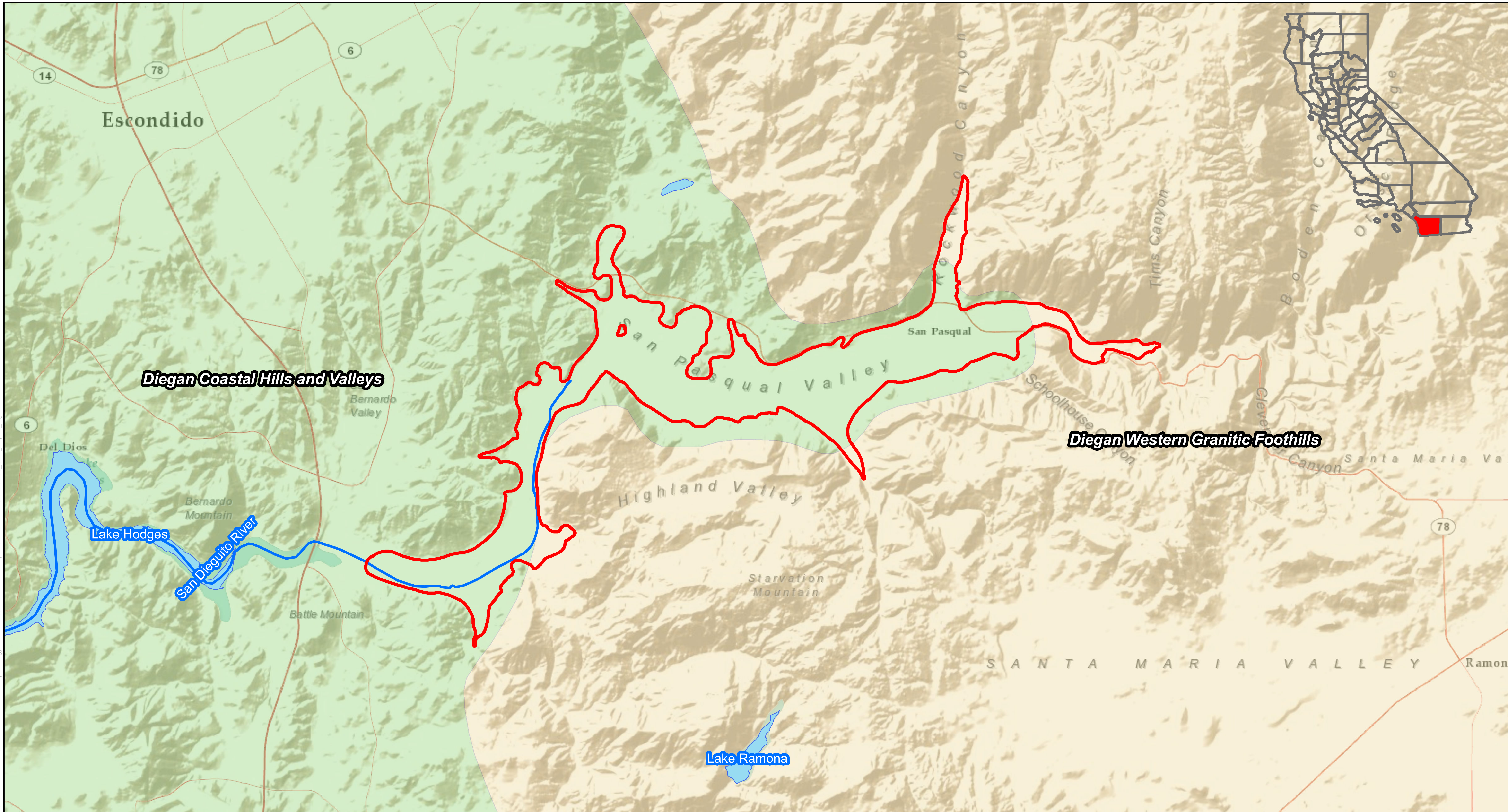

Figure 1
Project Location and Ecoregions

San Pasqual Valley Groundwater Basin
San Diego Public Utilities
San Diego County, CA

Legend

- San Pasqual Valley Groundwater Basin
- USGS National Hydrography Data
- CA DWR Lakes Data

Ecoregion

- Diegan Coastal Hills and Valleys
- Diegan Western Granitic Foothills

SD Public Utilities

1 inch = 6,000 feet

0 3,000 6,000 12,000 Feet

N

WOODARD & CURRAN

Project #: 0011197.00
Map Created: May 2020

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions.
Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources: ESRI World Terrain Basemap; USEPA Level III Ecorgegions; USGS NHD Hydrography; CA DWR Lakes.**

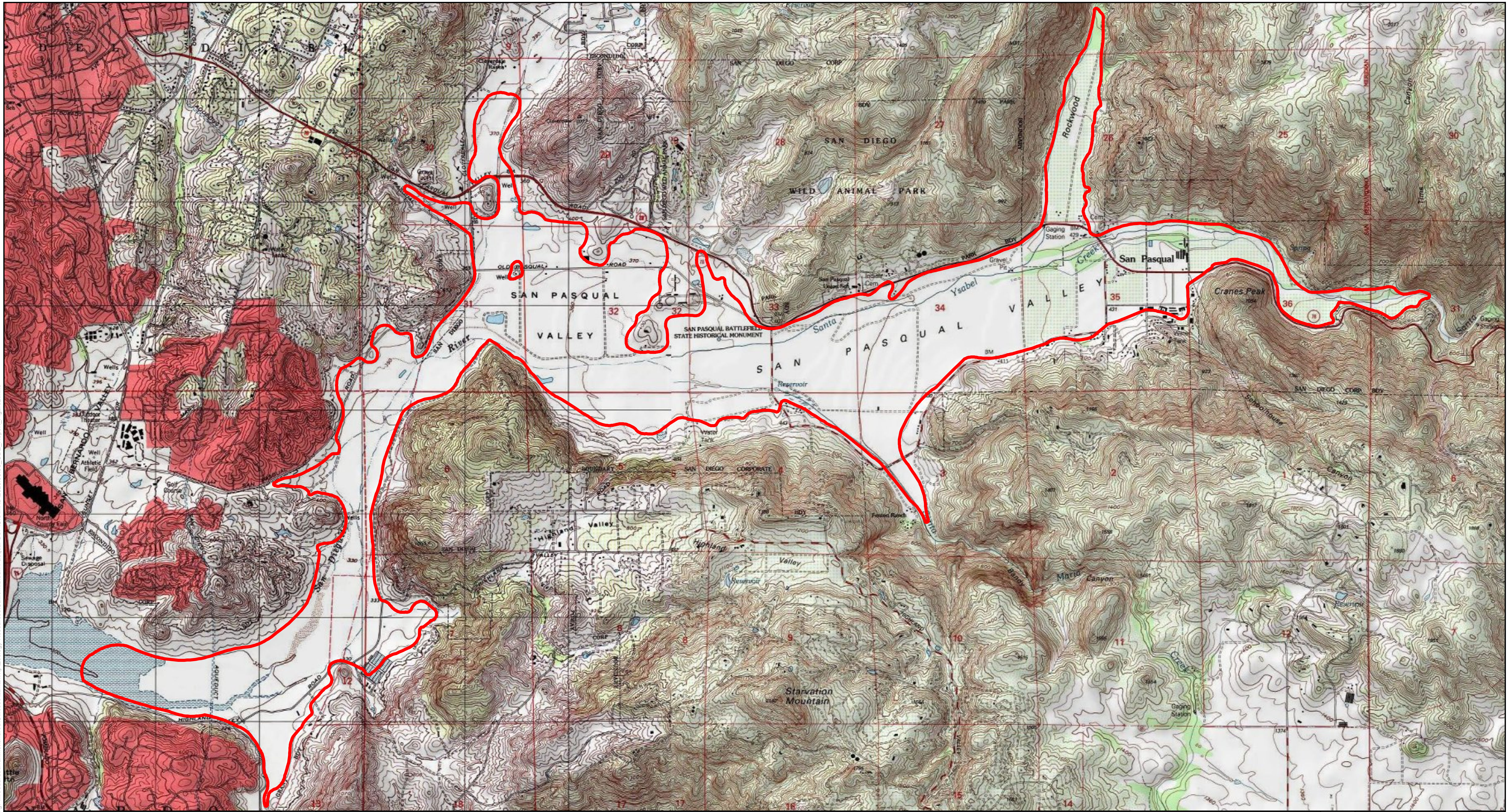

Figure 2
USGS Topography
San Pasqual Valley Groundwater Basin
San Diego Public Utilities
San Diego County, CA

Legend

San Pasqual Valley Groundwater Basin

SD Public Utilities

1 inch = 3,500 feet

0 1,750 3,500 7,000 Feet

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WOODARD & CURRAN

Project #: 0011197.00
Map Created: May 2020

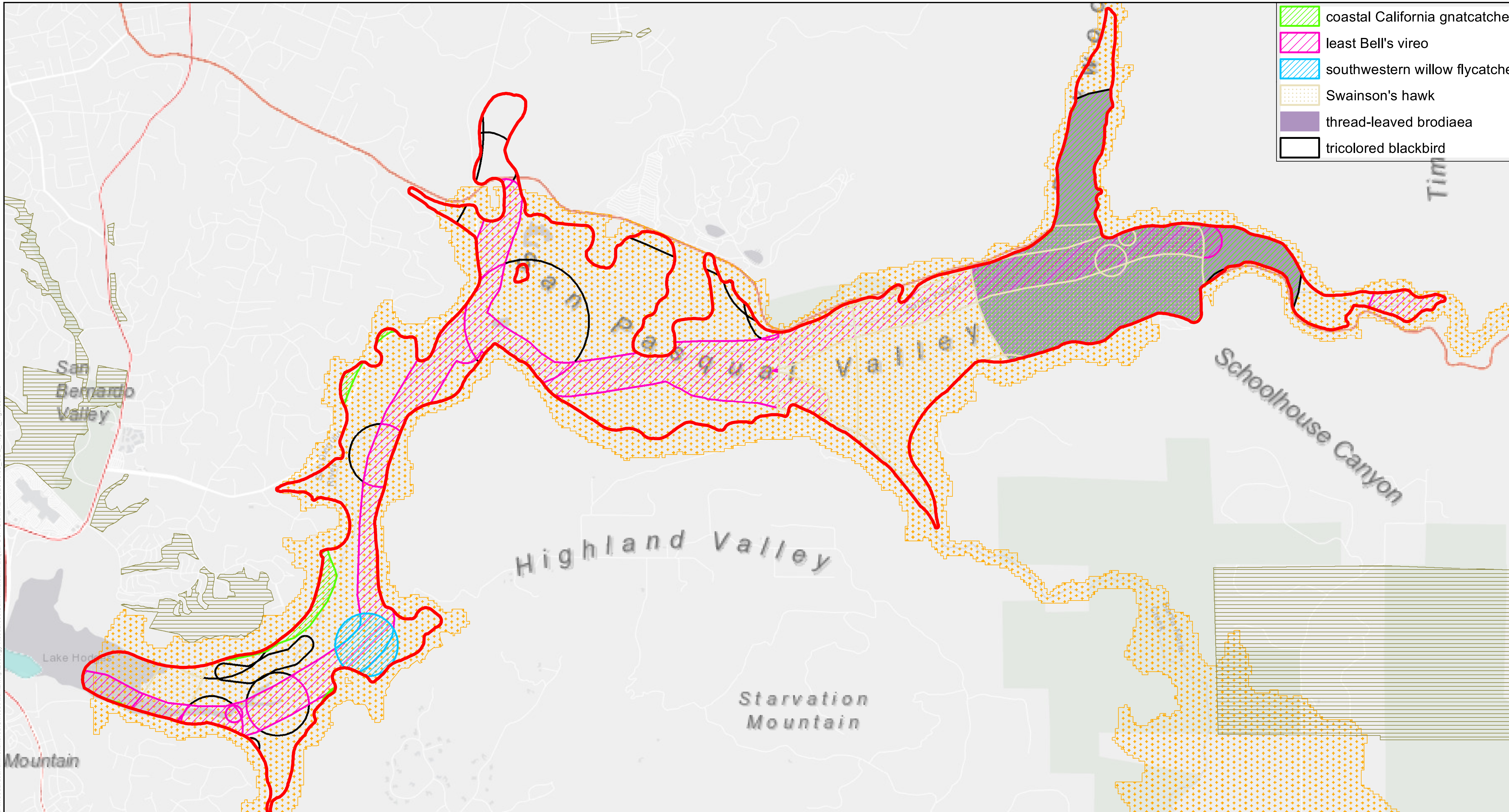

Figure 3
State and Federal Protected Species
San Pasqual Valley Groundwater Basin
San Diego Public Utilities
San Diego County, CA

Legend

- San Pasqual Valley Groundwater Basin
- USFWS Critical Habitat (Arroyo Toad)
- USFWS Critical Habitat (California Gnatcatcher)

SD Public Utilities

1 inch = 3,500 feet

0 1,750 3,500 7,000 Feet

N

WOODARD & CURRAN

Project #: 0011197.00
Map Created: May 2020

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources: ESRI World Light Gray Canvas Base; CA Natural Diversity Database 2020; USFWS Critical Habitat.**

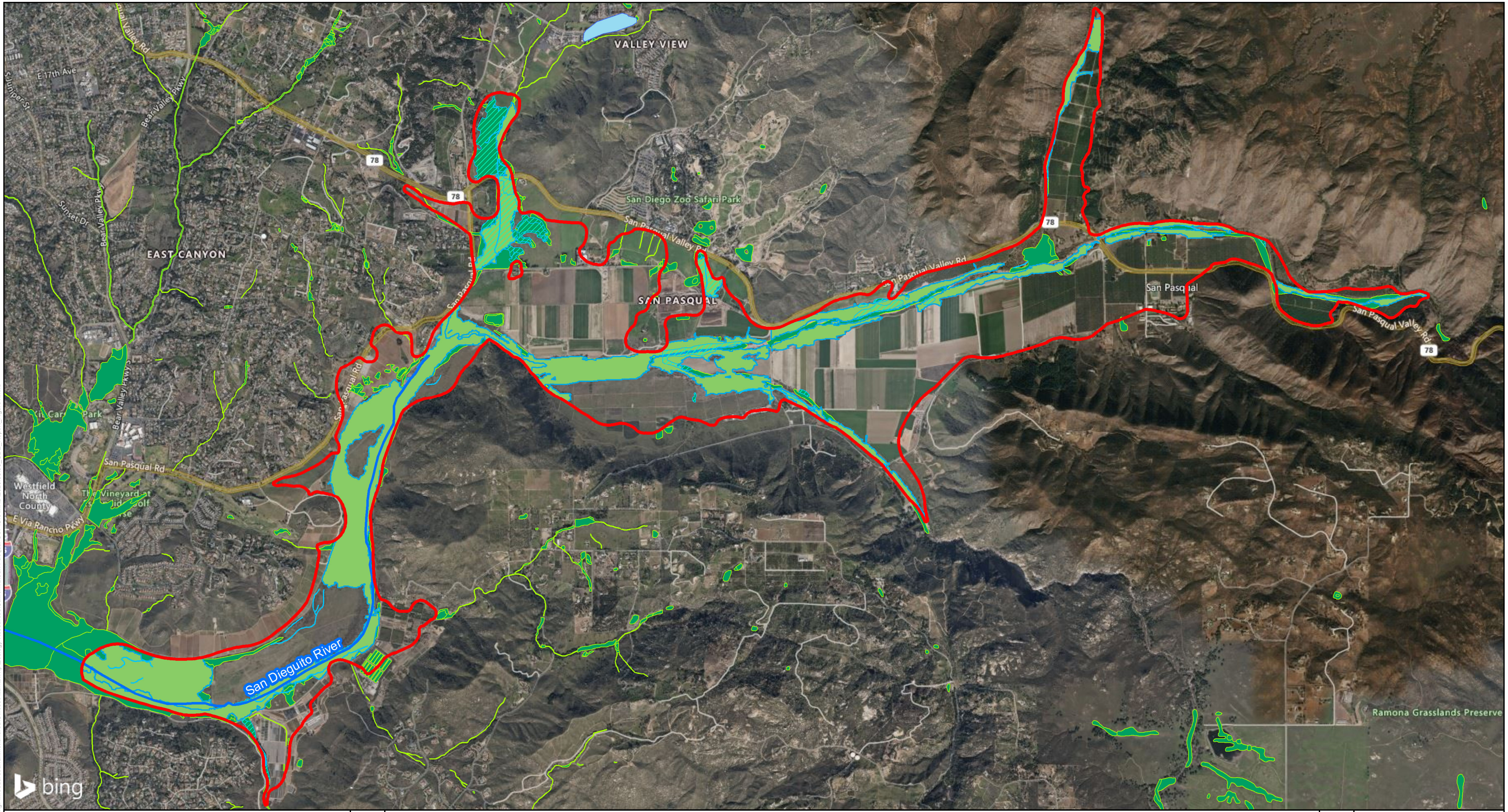

Figure 4
Groundwater Dependent Ecosystem (GDE) Indicators
San Pasqual Valley Groundwater Basin
San Diego Public Utilities
San Diego County, CA

Legend

- San Pasqual Valley Groundwater Basin
- USGS National Hydrography Data
- CA DWR Lakes Data
- NCCAG Wetlands (San Pasqual Valley)
- NCCAG Vegetation (San Pasqual Valley)
- USFWS National Wetlands Inventory

SD Public Utilities

1 inch = 3,500 feet

0 1,750 3,500 7,000 Feet

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WOODARD & CURRAN

Project #: 0011197.00
Map Created: May 2020

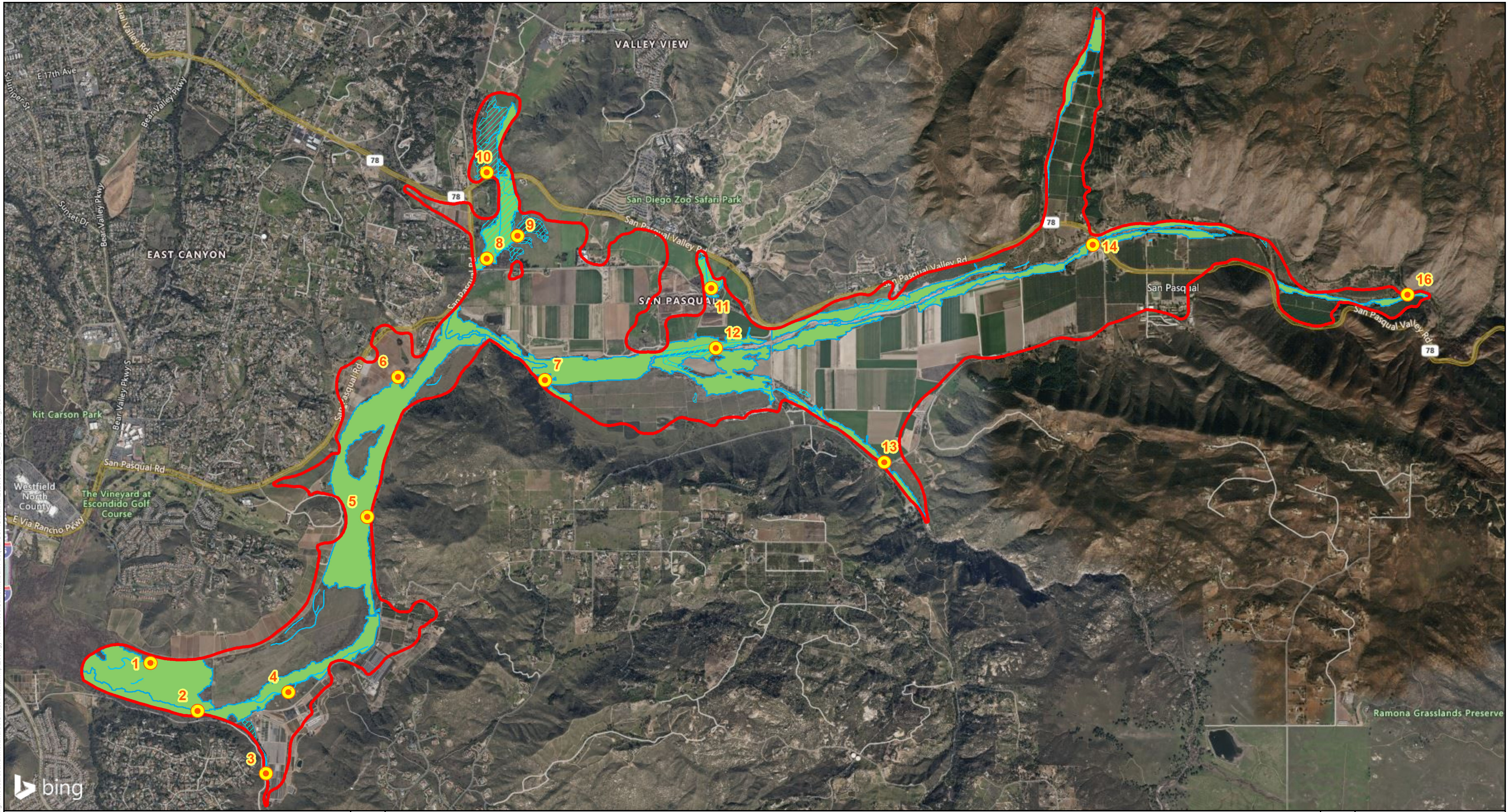

Figure 5
Completed GDE Field Assessments

San Pasqual Valley Groundwater Basin
San Diego Public Utilities

San Diego County, CA

Legend

- San Pasqual Valley Groundwater Basin
- NCCAG Wetlands (San Pasqual Valley)
- NCCAG Vegetation (San Pasqual Valley)
- Completed GDE Field Assessment

SD Public Utilities

1 inch = 3,500 feet

0 1,750 3,500 7,000 Feet

N

WOODARD & CURRAN

Project #: 0011197.00
Map Created: May 2020

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions.
Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources: Bing Maps Hybrid; USGS CA DWR Natural Communities Commonly Associated with Groundwater.**

Figure 6
GDE Assessment
San Pasqual Valley Groundwater Basin
San Diego Public Utilities
San Diego County, CA

Legend

- San Pasqual Valley Groundwater Basin
- NCCAG Wetlands (San Pasqual Valley)
- NCCAG Vegetation (San Pasqual Valley)
- Groundwater Contours
- Probable GDE
- Probable Non-GDE
- Wetland & Riparian Vegetation

SD Public Utilities

1 inch = 3,500 feet
0 1,750 3,500 7,000 Feet

N

WOODARD & CURRAN
Project #: 0011197.00
Map Created: August 2020

Attachment 1
Photographic Log of GDE Field Assessment Sites

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Photo Number: 1 | **View Direction:** West | **Date:** March 2, 2020

Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 2.

Photo Number: 2 | **View Direction:** South | **Date:** March 2, 2020

Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 3.

Photo Number: 3 | **View Direction:** West | **Date:** October 23, 2018

Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 4.

Photo Number: 4 | **View Direction:** West | **Date:** March 2, 2020

Description: Representative photograph taken of potential incorrectly mapped groundwater dependent ecosystem (NCCAG 2020). Photo taken GDE field assessment site 1.

Photo Number: 5 | **View Direction:** North | **Date:** March 2, 2020
Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken GDE field assessment site 5.

Photo Number: 6 | **View Direction:** North | **Date:** March 2, 2020
Description: Representative photograph taken of unmapped potential groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 6.

Photo Number: 7 | **View Direction:** South | **Date:** March 2, 2020
Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 10.

Photo Number: 8 | **View Direction:** West | **Date:** March 3, 2020
Description: Representative photograph taken of confirmed wetland and riparian vegetation . Photo taken at GDE field assessment site 11.

Photo Number: 9 | **View Direction:** West | **Date:** March 3, 2020
Description: Representative photograph taken of confirmed wetland and riparian vegetation.
Photo taken at GDE field assessment site 12.

Photo Number: 10 | **View Direction:** South | **Date:** March 3, 2020
Description: Representative photograph taken of confirmed wetland and riparian vegetation.
Photo taken at GDE field assessment site 13.

Photo Number: 11 | **View Direction:** West | **Date:** March 3, 2020

Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 7.

Photo Number: 12 | **View Direction:** West | **Date:** March 3, 2020

Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 14.

Photo Number: 13 | **View Direction:** North | **Date:** March 4, 2020
Description: Representative photograph taken of confirmed wetland and riparian vegetation. Photo taken at GDE field assessment site 16.

Photo Number: 14 | **View Direction:** South | **Date:** March 4, 2020
Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 8.

Photo Number: 15 | **View Direction:** West | **Date:** March 4, 2020

Description: Representative photograph taken of confirmed probable groundwater dependent ecosystem (NCCAG 2020). Photo taken at GDE field assessment site 9.