



Public
Utilities

January 9, 2020 Technical Peer Review
Meeting Handout #3



Groundwater
Sustainability Plan:
Technical Peer Review
Draft Figures for Review and
Discussion

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Public
Utilities

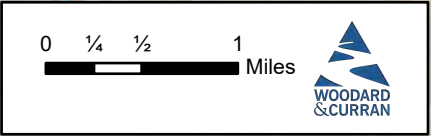
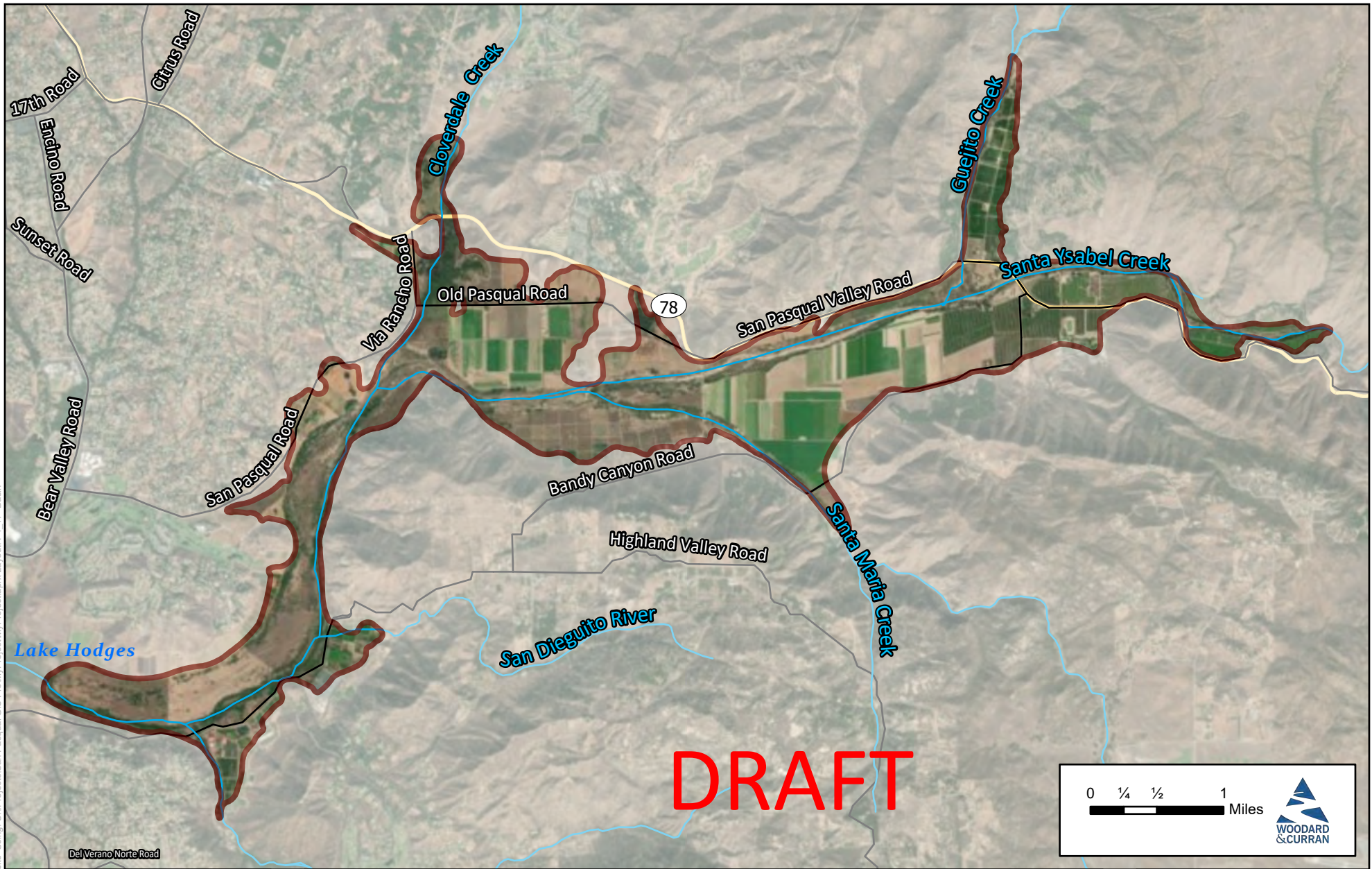
January 9, 2020 Technical Peer Review
Meeting Handout #3



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Figure Exported: 12/5/2019, By: mwick, Using: C:\Projects\San_Pasqual\GIS\Pro\MyProject\MyProject.aprx, Layout: F.1.1 - Basin



Project #: 0011197

Legend


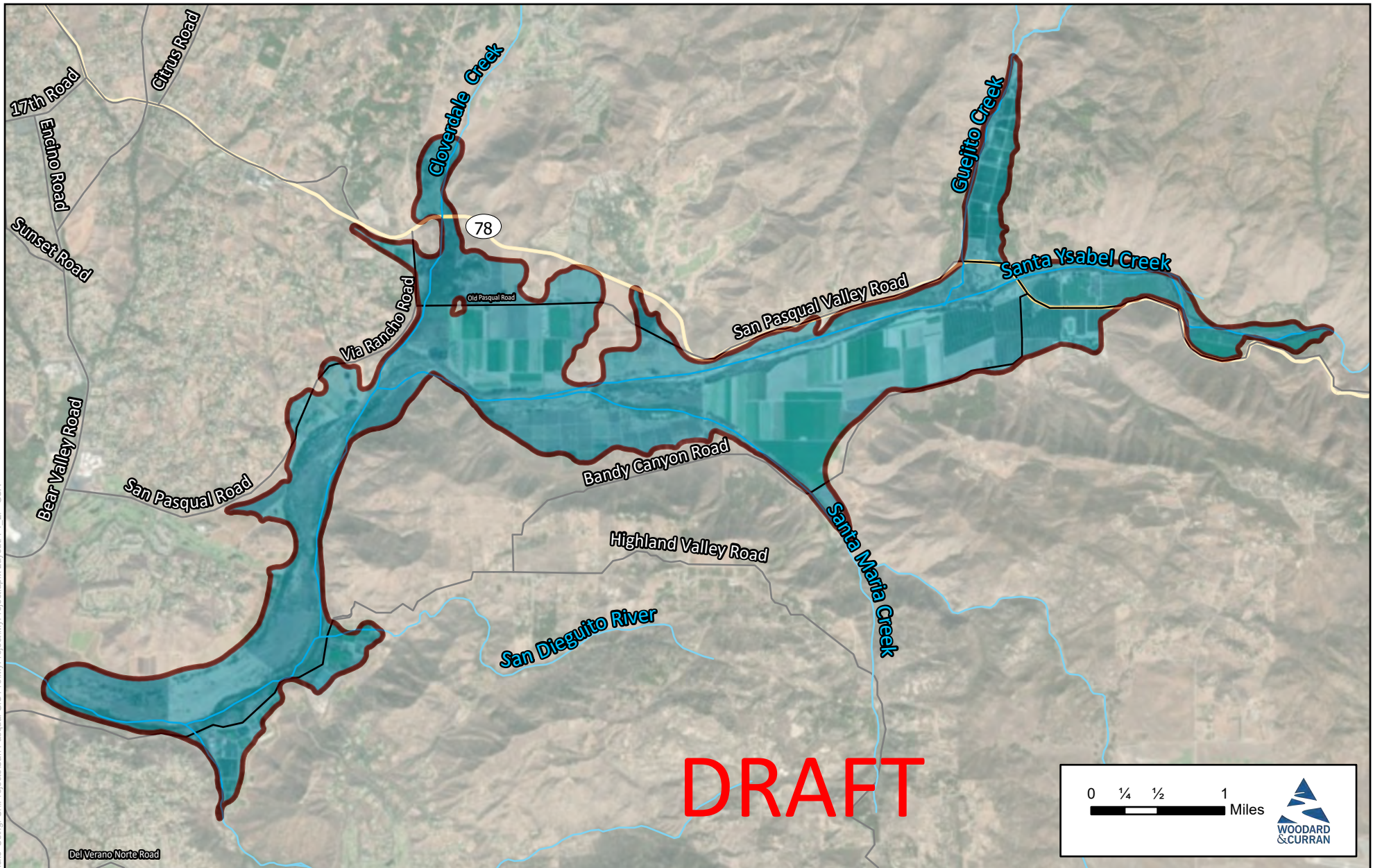
 San Pasqual Valley Basin



Figure 1-1
San Pasqual Valley GSA
San Pasqual Valley Basin Boundary

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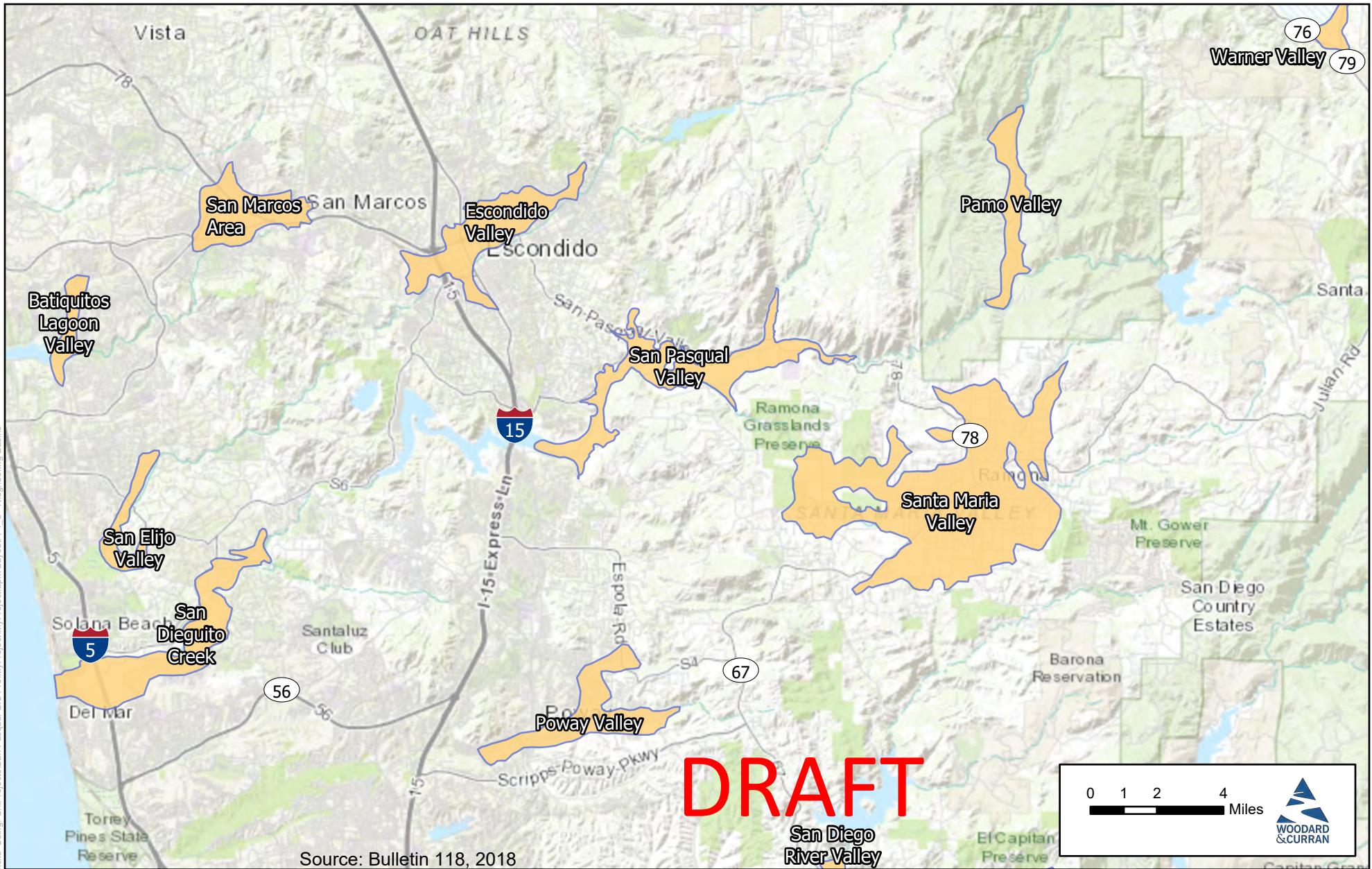
Project #: 0011197

Legend

- San Pasqual Valley Basin
- San Pasqual Valley GSA



Figure 1-2
 San Pasqual Valley GSA
 San Pasqual Valley
 GSA Boundary



Source: Bulletin 118, 2018



Project #: 0011197

Legend


 Bulletin 118 Basins



Figure 1-3
 San Pasqual Valley GSA
San Pasqual Valley
Neighboring Basins

Figure Exported: 11/21/2019, By: mawicks, Using: C:\Projects\San Pasqual\GIS Pro\MyProject\MyProject.aprx Layout, E1_4 - Position in County



Project #: 0011197

Legend

 San Diego County


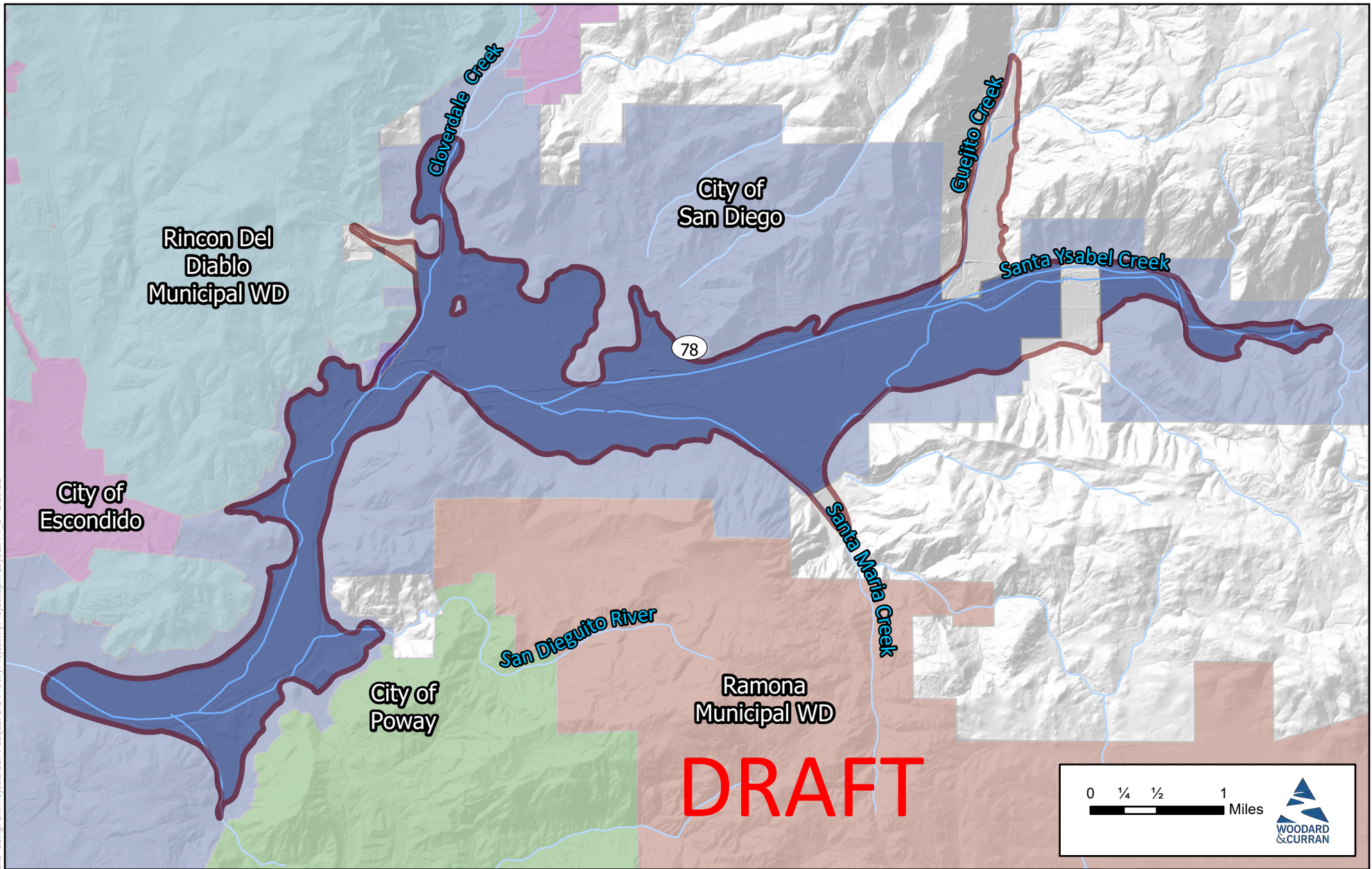
 San Pasqual Valley Basin



Figure 1-4
San Pasqual Valley GSA
San Pasqual Valley
San Diego County

Figure Exported: 12/5/2019, By: meicks, Using: C:\Projects\San_Pasqual_GIS_Pro\W\Project\W\Project.aprx; Layout: F_1_5 - Districts



Project #: 0011197

Legend

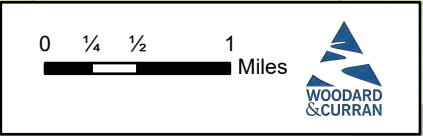
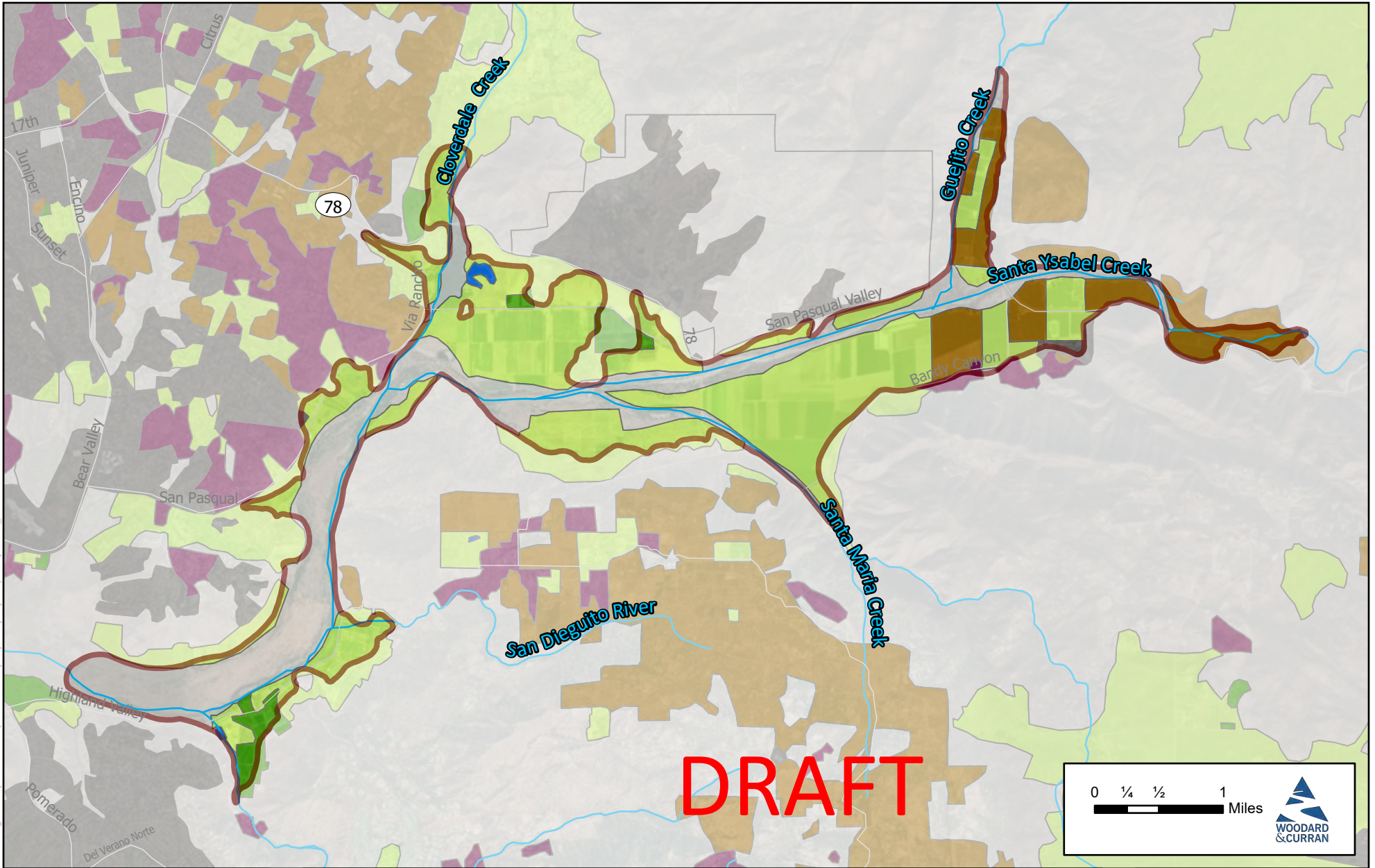
- San Pasqual Valley Basin
- City of Escondido
- City of Poway
- Ramona MWD
- Rincon Del Diablo MWD
- City of San Diego
- San Diego County WA



Figure 1-5
San Pasqual Valley GSA
San Pasqual Valley
Jurisdictional Boundaries

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Figure Exported: 11/15/2019 10:15:00 AM Using: C:\Projects\San Pasqual GIS Pro\MyProject\MyProject.aprx Layout: F1_6_Land Use - 1986



Project #: 0011197

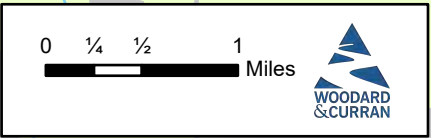
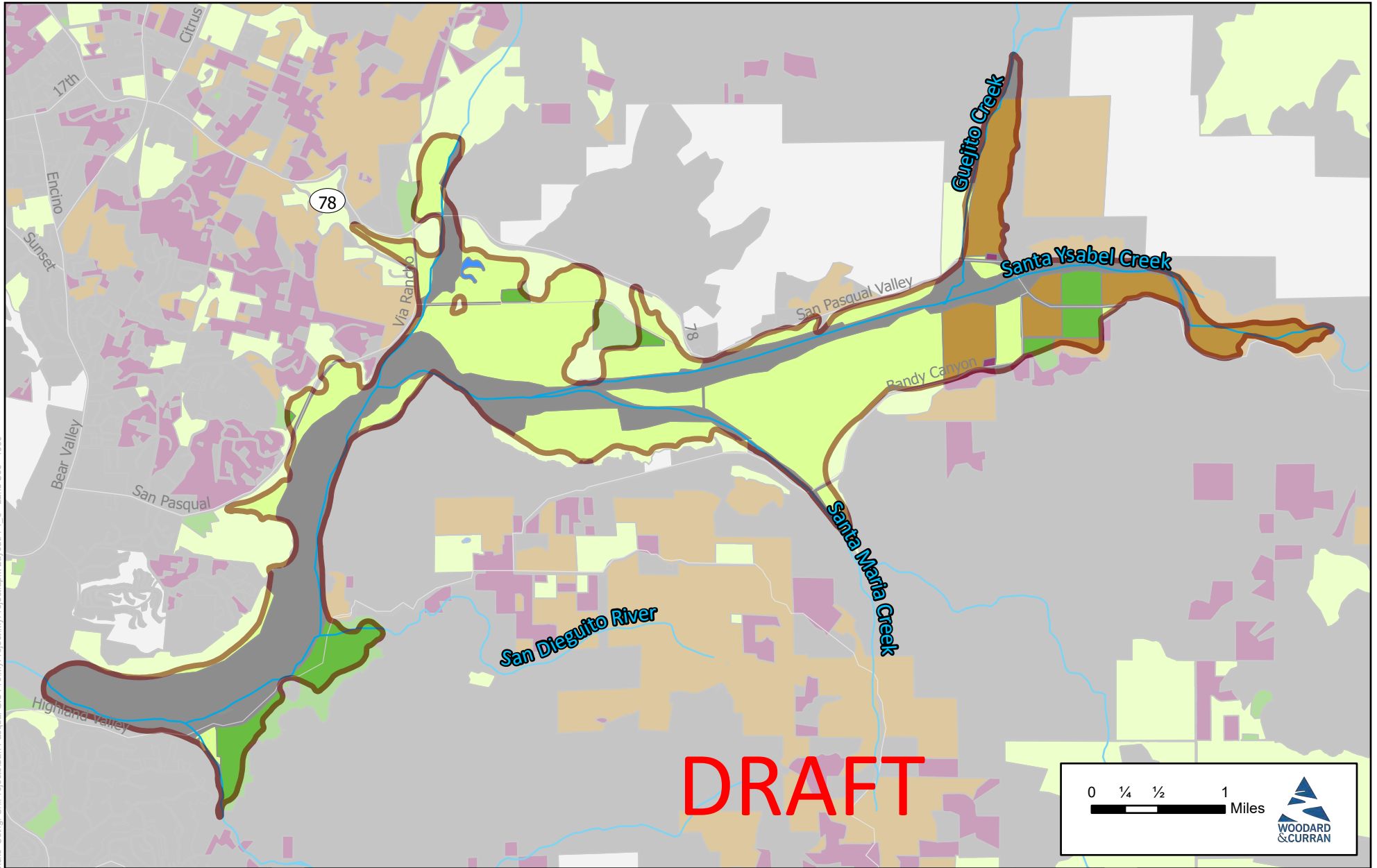
Legend

- San Pasqual Valley Basin
- Field Crops
- Orchard or Vineyard
- Idle
- Rural
- Water
- Intensive Agriculture
- Urban



Figure 1-6
San Pasqual Valley GSA
San Pasqual Valley
1986 Land Use

Figure Exported: 10/21/2019 10:41:00 AM By: mwick Using: C:\Projects\San_Pasqual_GIS\Project\MyProject.aprx Layout: F1_6 - Land Use - 1990



Project #: 0011197

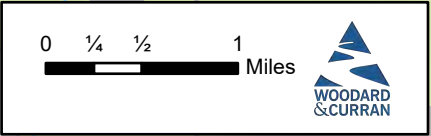
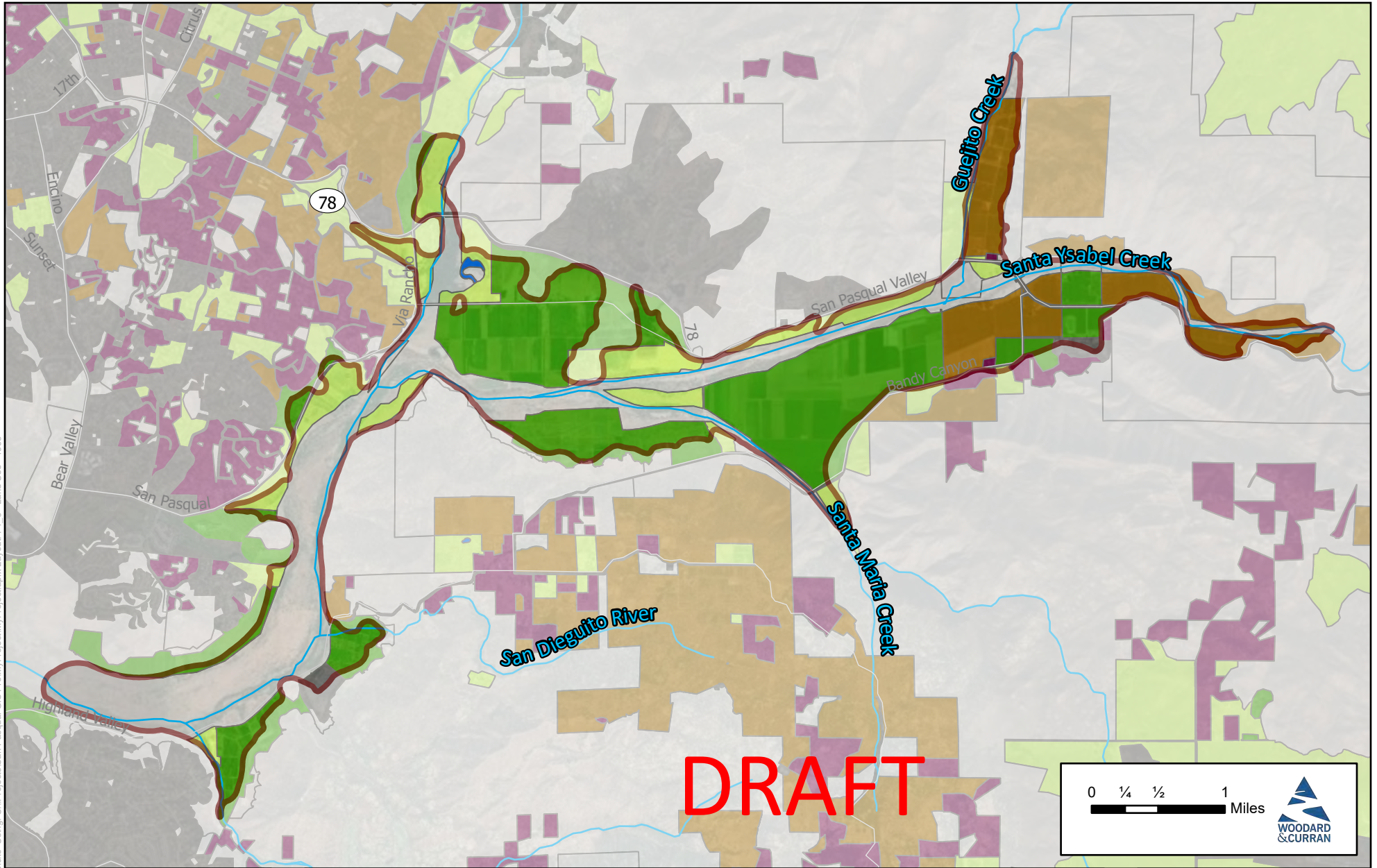
Legend

- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-7
San Pasqual Valley GSA
San Pasqual Valley
1990 Land Use

Figure Exported: 10/21/2019 10:41:00 AM By: mwicks Using: C:\Projects\San_Pasqual_GIS\Project\MyProject.aprx Layout: E1_6 - Land Use - 1995



Project #: 0011197

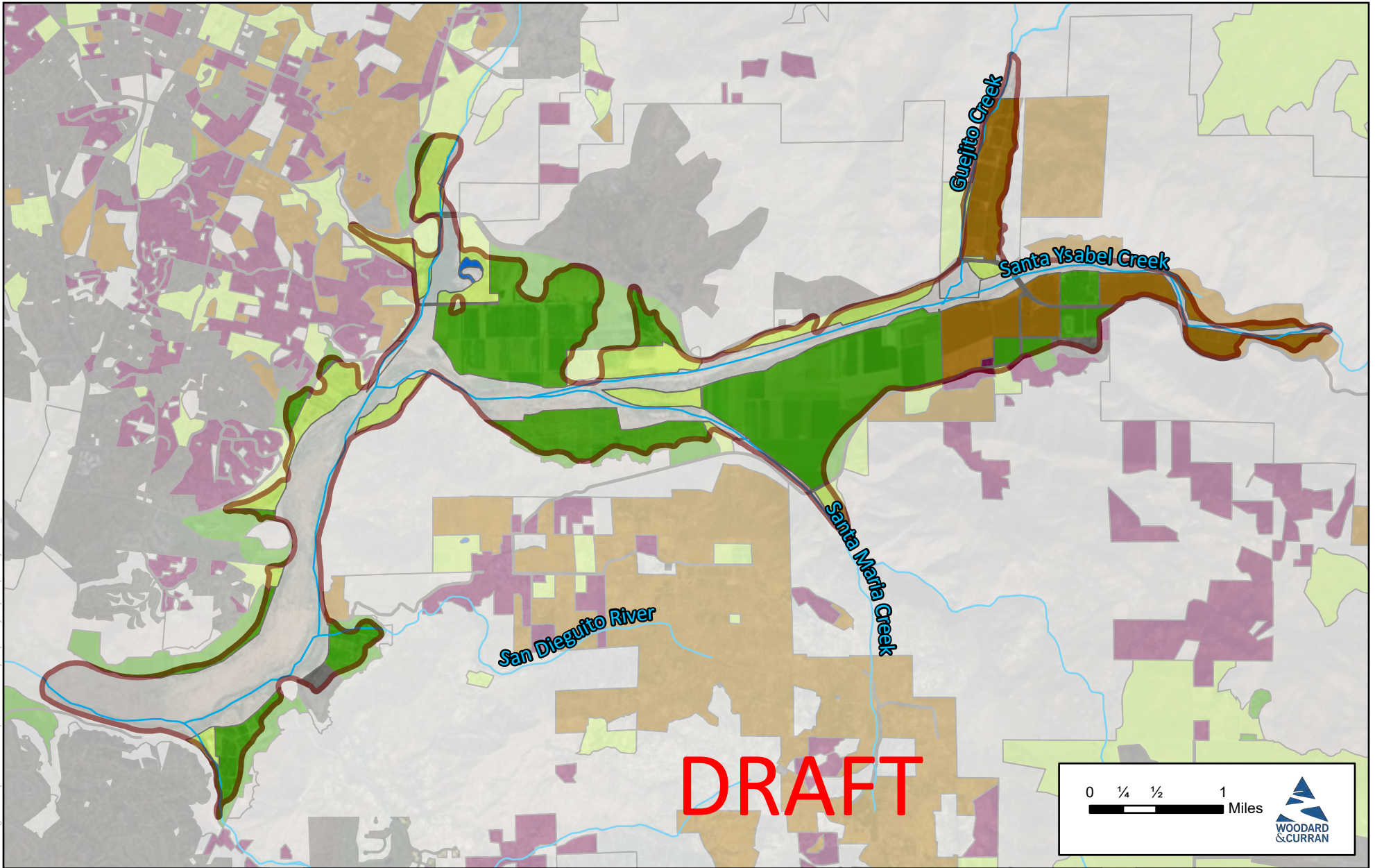
Legend

- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-8
San Pasqual Valley GSA
San Pasqual Valley
1995 Land Use

Figure Exported: 10/21/2019 10:19:11 AM. Using: C:\Projects\San_Pasqual_GIS_Proj\MyProject\MyProject.aprx Layout: F1_8 - Land Use - 2000



Project #: 0011197

Legend

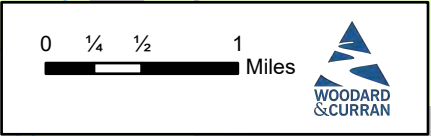
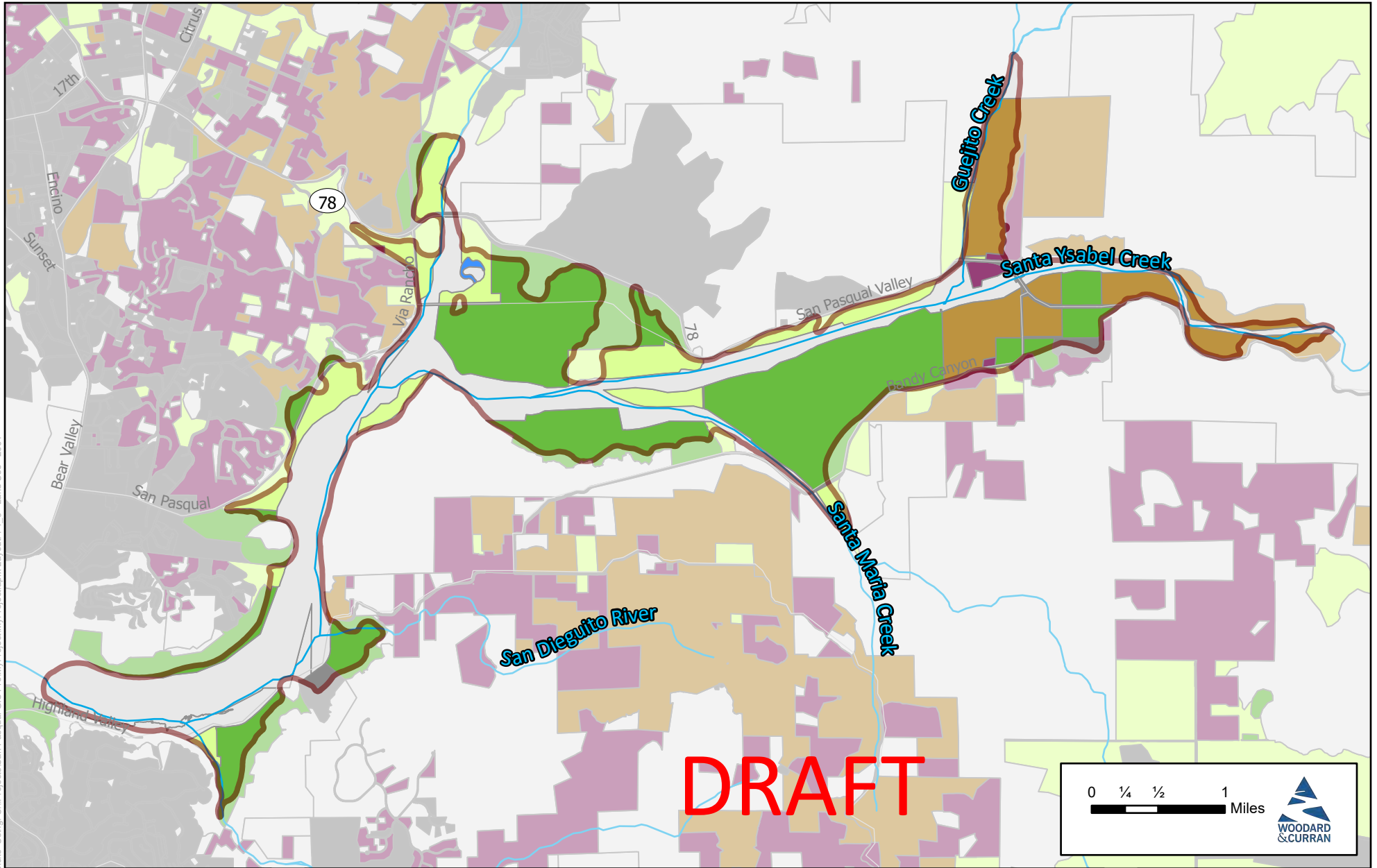
- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-9
San Pasqual Valley GSA
San Pasqual Valley
2000 Land Use

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Figure Exported: 10/21/2019 10:41:00 AM By: mwicks Using: C:\Projects\San_Pasqual_GIS\Project\MyProject.aprx Layout: E1_9 - Land Use - 2004



Project #: 0011197

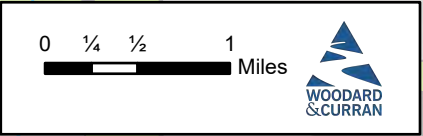
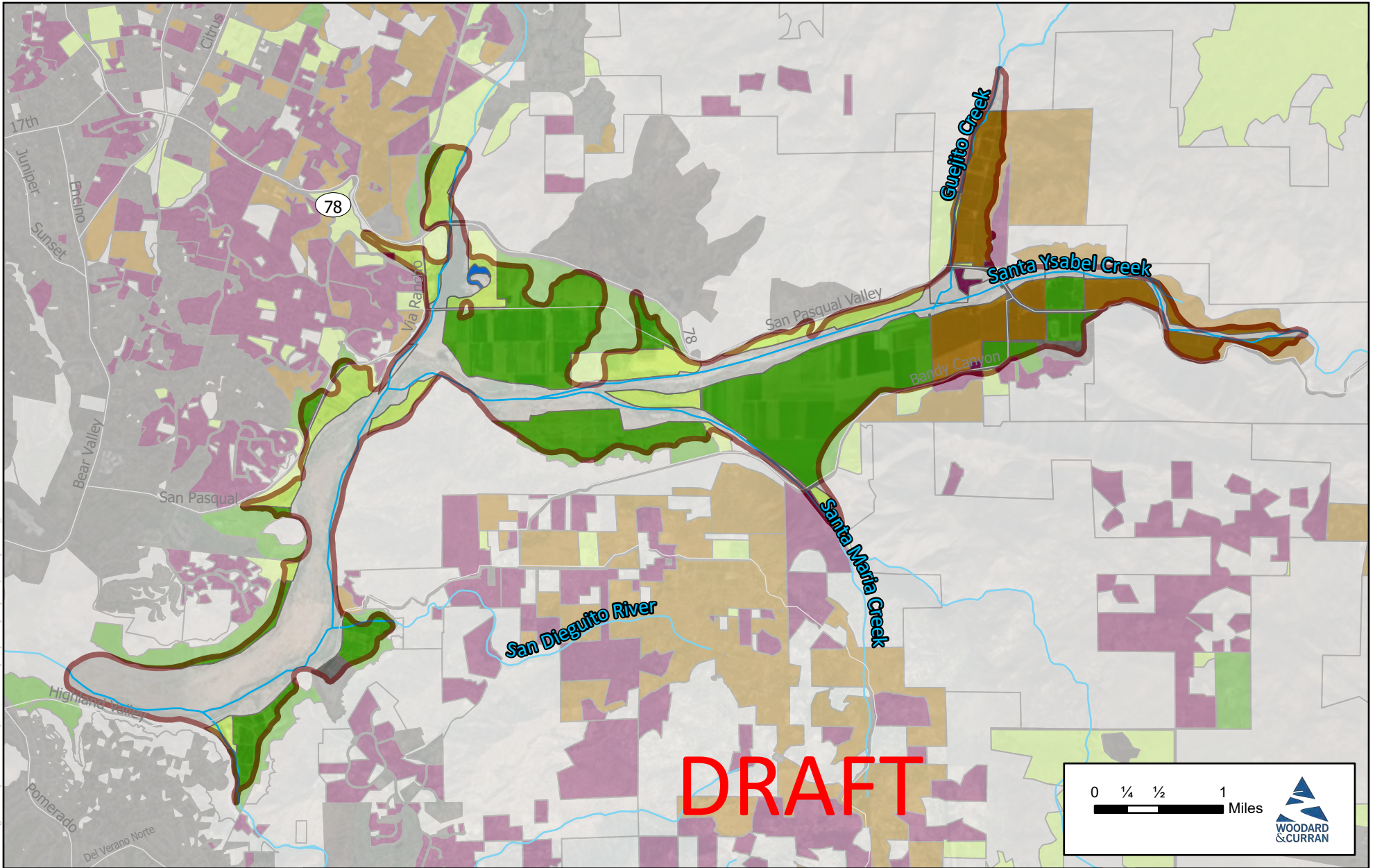
Legend

- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-10
 San Pasqual Valley GSA
San Pasqual Valley
2004 Land Use

Figure Exported: 10/21/2019 10:41:10 AM By: mwick. Using: C:\Projects\San_Pasqual_GIS\Project\MyProject.aprx Layout: F1_10_Land Use - 2008



Project #: 0011197

Legend

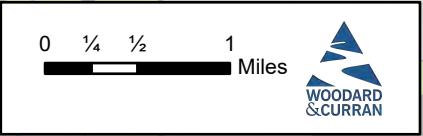
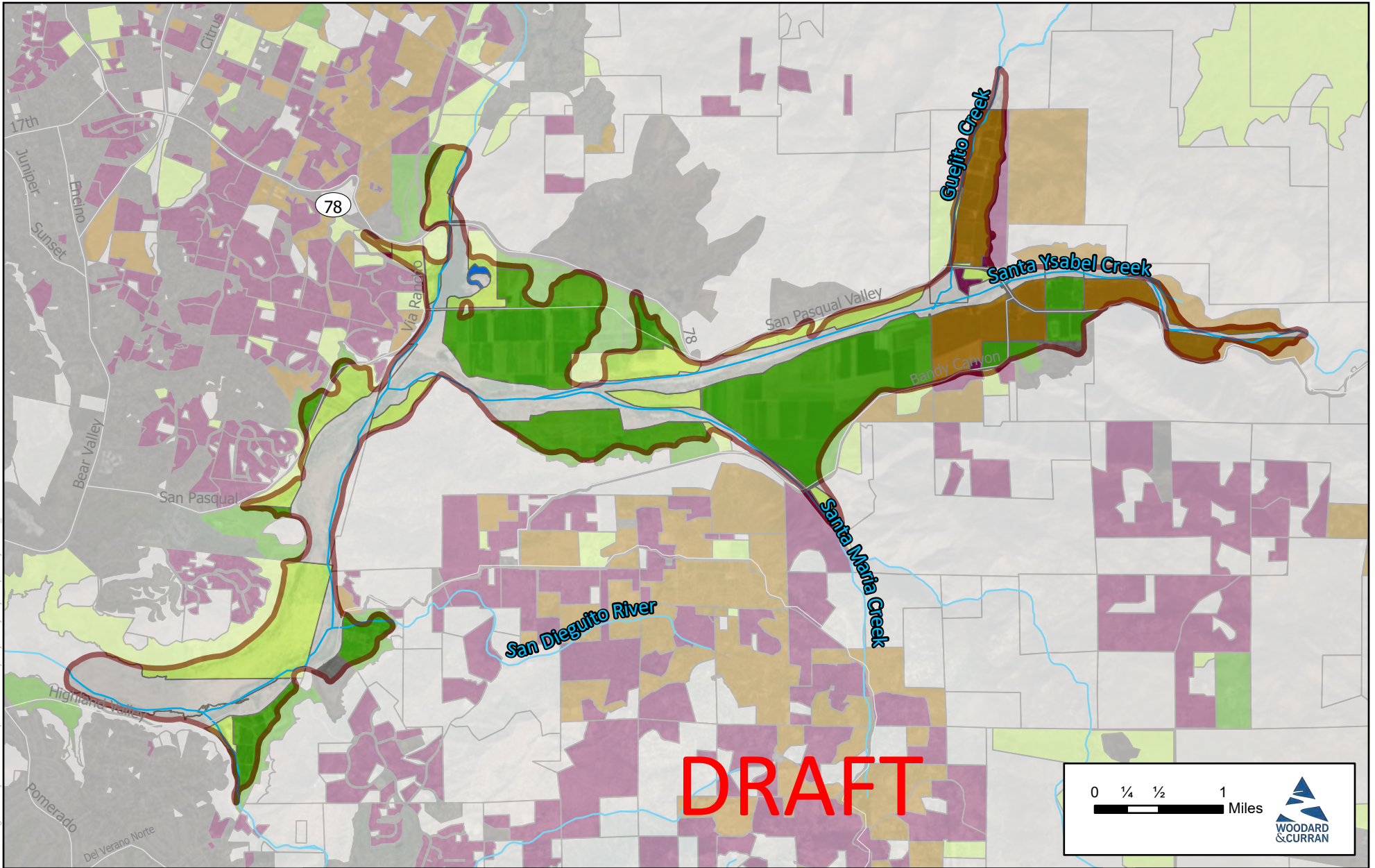
- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-11
San Pasqual Valley GSA
San Pasqual Valley
2008 Land Use

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Figure Exported: 10/22/2019 10:41:11 AM Using: C:\Projects\San_Pasqual_GIS\Project\MyProject.aprx Layout: E1_11_Land Use - 2013



Project #: 0011197

Legend

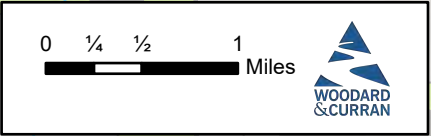
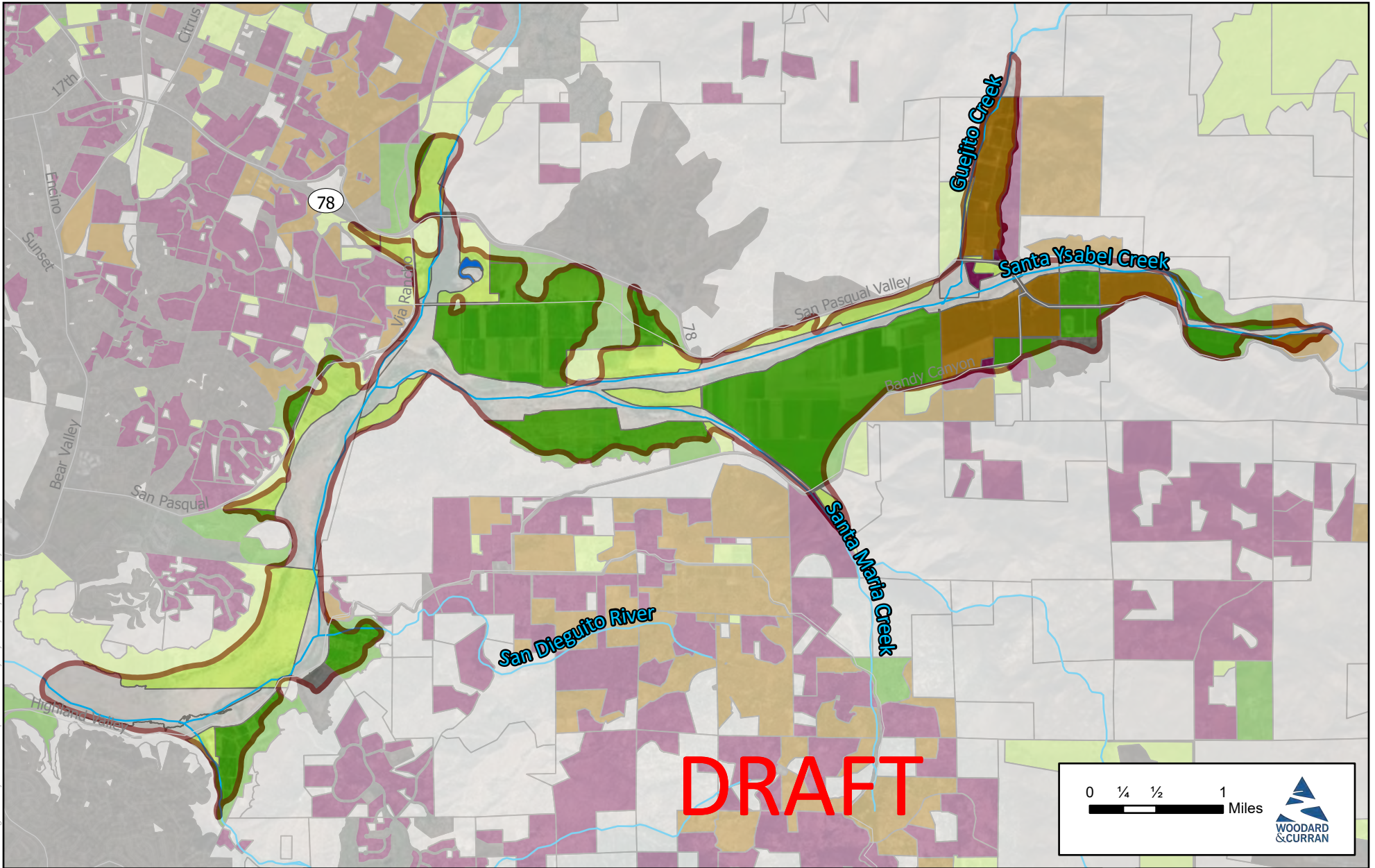
- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-12
 San Pasqual Valley GSA
San Pasqual Valley
2013 Land Use

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Figure Exported: 10/22/2019 10:41:11 AM Using: C:\Projects\San Pasqual GIS\Project\MyProject.aprx Layout: E1_12_Land Use - 2015



Project #: 0011197

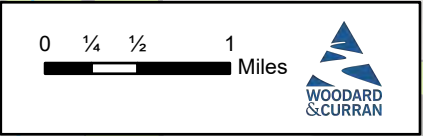
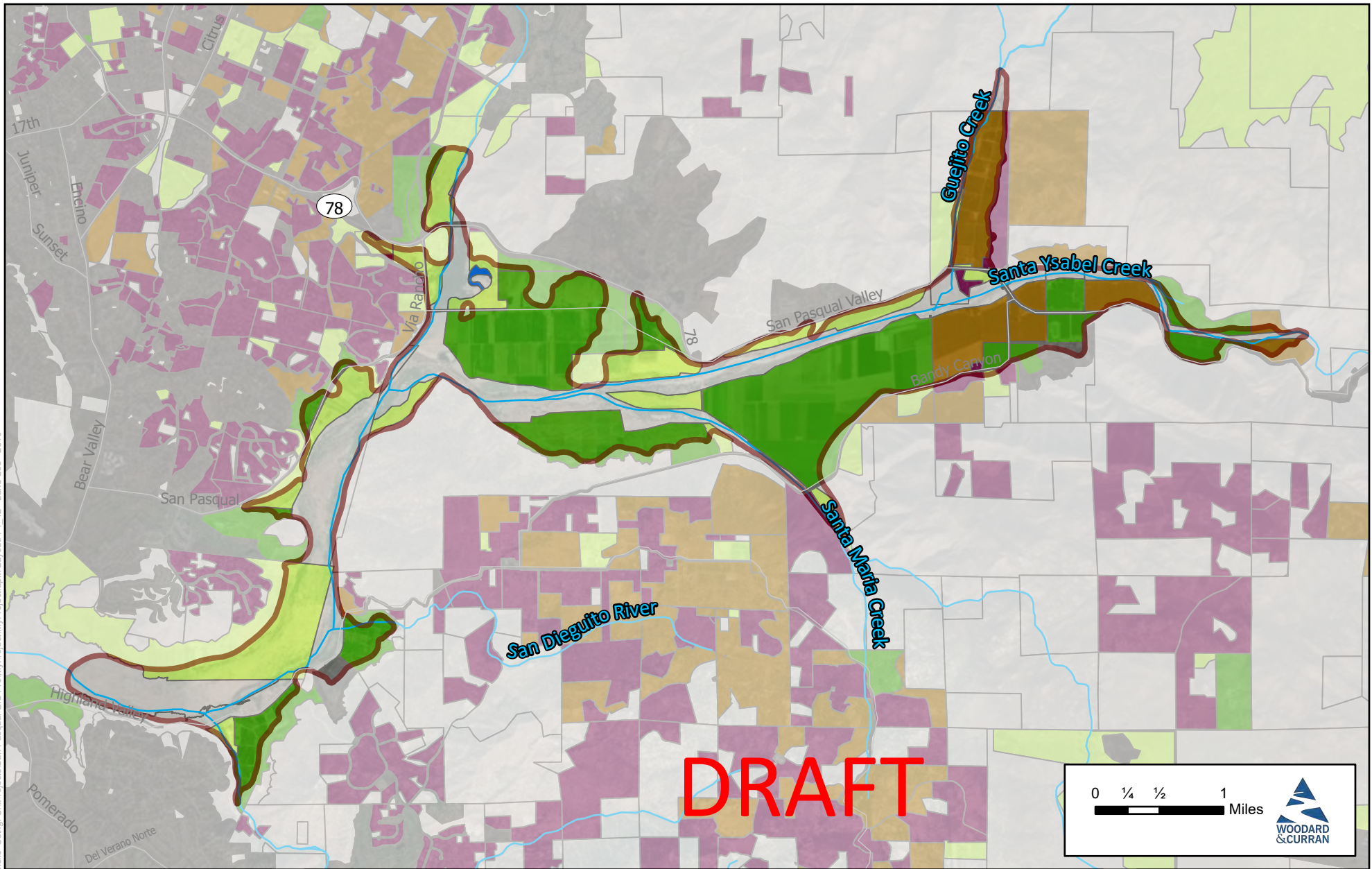
Legend

- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-13
 San Pasqual Valley GSA
San Pasqual Valley
 2015 Land Use

Figure Exported: 10/22/2019 10:41:11 AM By: mwick. Using: C:\Projects\San_Pasqual_GIS\Project\MyProject.aprx Layout: E1_12_Land Use - 2016



Project #: 0011197

Legend

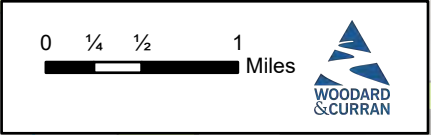
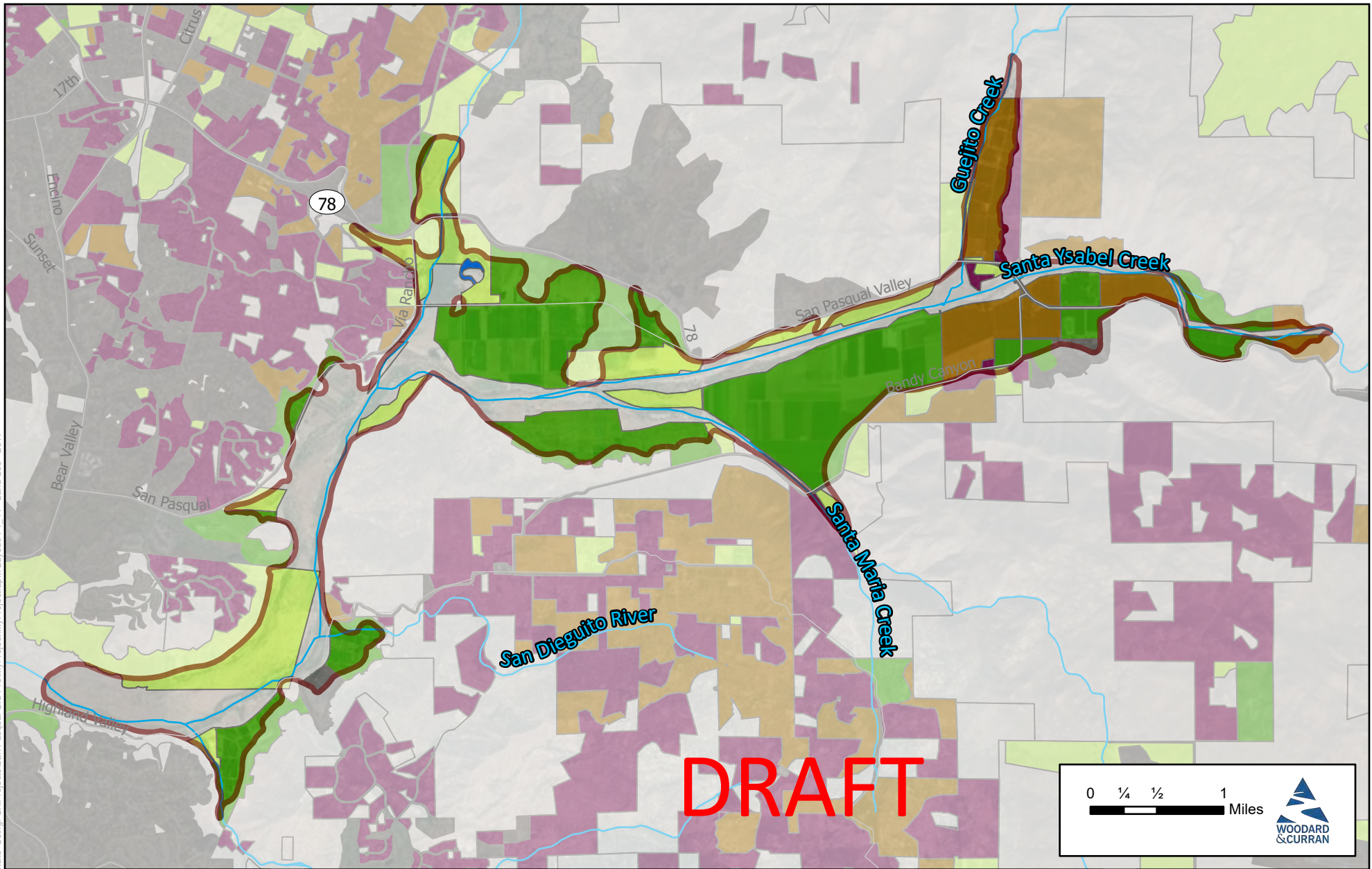
- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-14
San Pasqual Valley GSA
San Pasqual Valley
2016 Land Use

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Figure Exported: 10/22/2019 10:41:10 AM By: mwick Using: C:\Projects\San Pasqual GIS\Project\MyProject.aprx Layout: E1_14_Land Use - 2017



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Legend

- San Pasqual Valley Basin
- Field Crops
- Idle
- Intensive Agriculture
- Water
- Orchard or Vineyard
- Rural
- Urban



Figure 1-15
San Pasqual Valley GSA
San Pasqual Valley
2017 Land Use

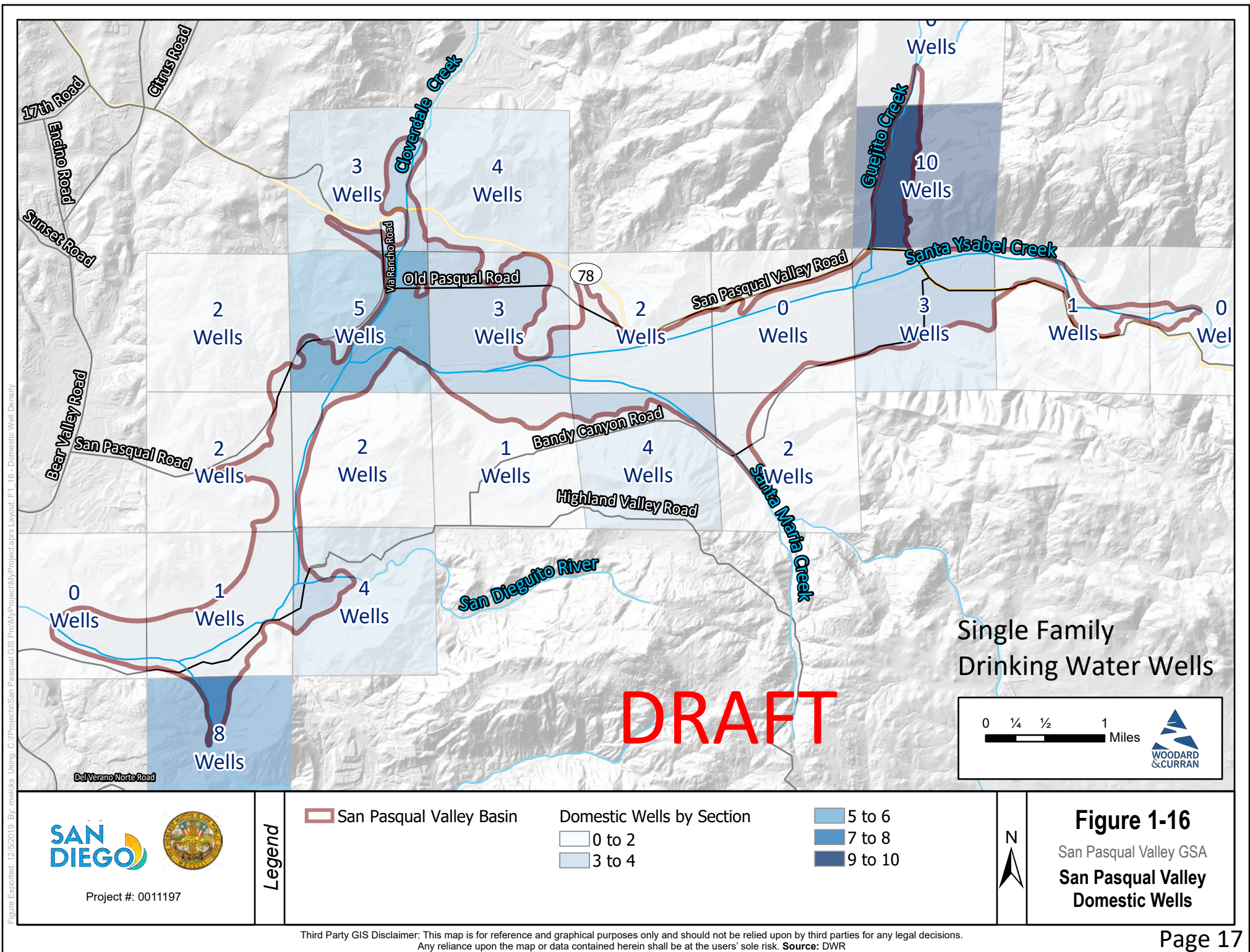
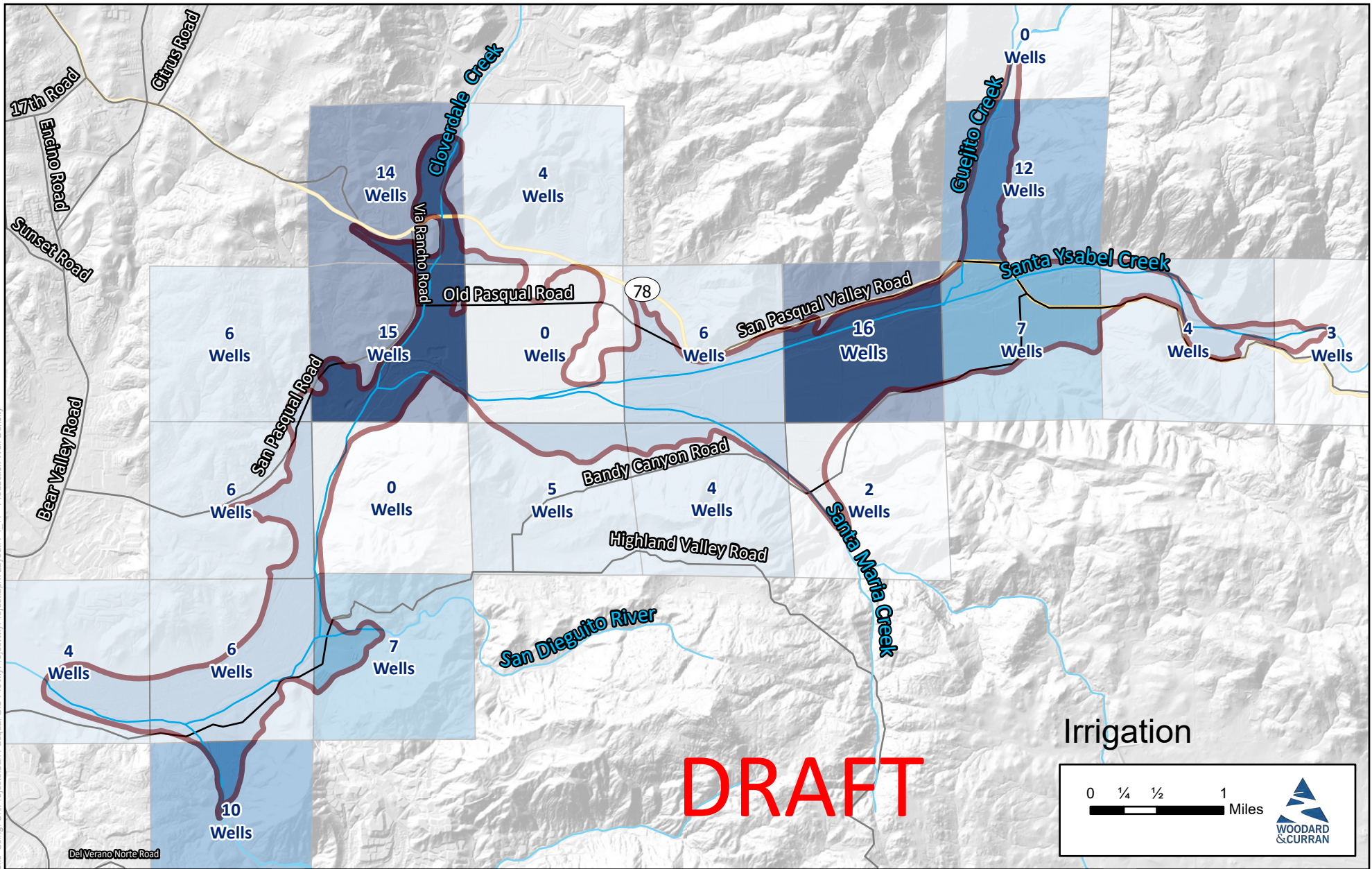


Figure Exported: 12/5/2019 By: mwick Using: C:\Projects\San_Pasqual\GIS\Pro\Map\Project\Map\Project.aprx Layout: F.1_16_Domestic Well Density

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Figure Exported: 12/5/2019, By: mwick, Using: C:\Projects\San_Pasqual\GIS\Pro\Map\Project\Map\Project.aprx; Layout: F.1.17 - Production Well Density



Project #: 0011197

Legend

San Pasqual Valley Basin

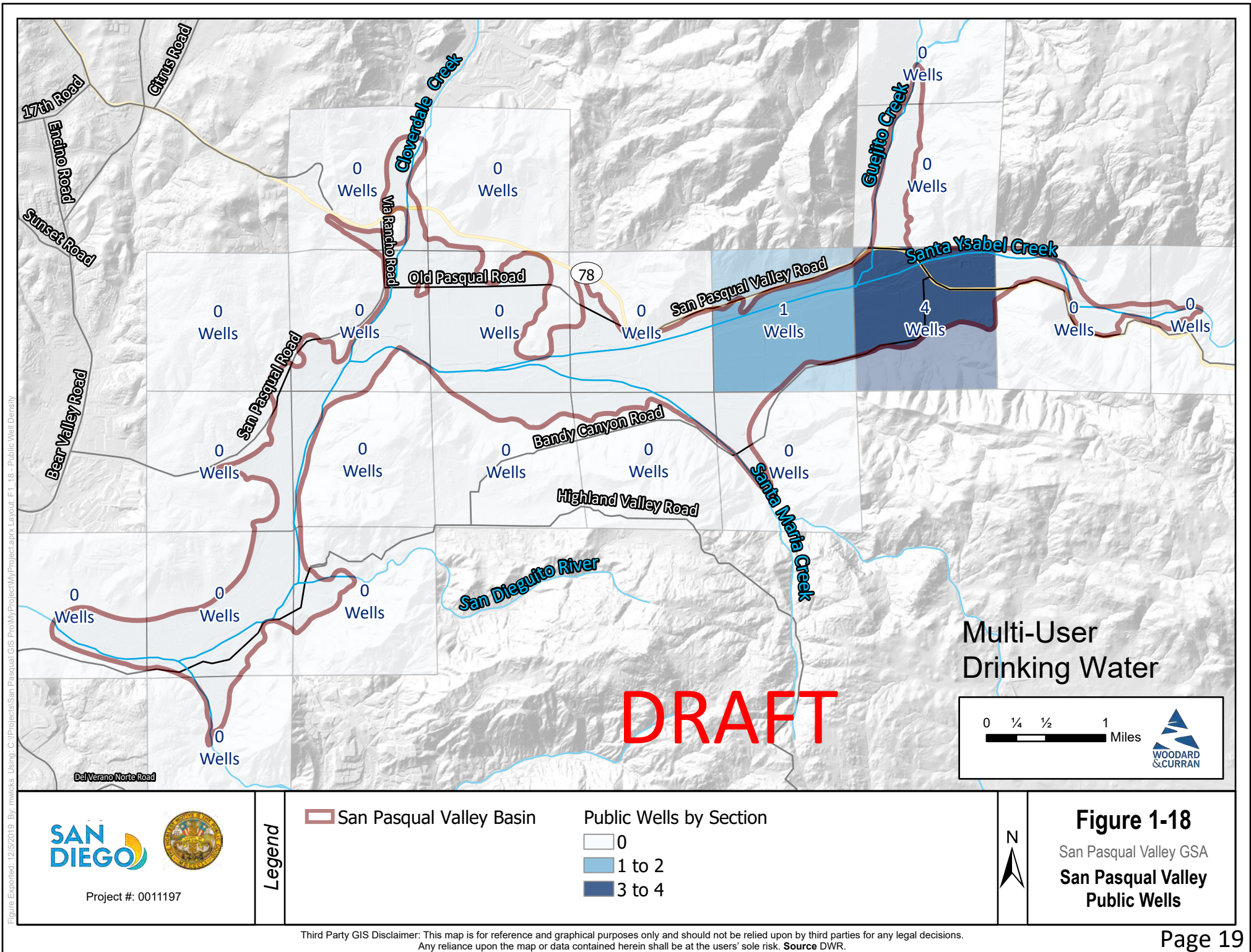
Production Wells by Section

0 to 3
4 to 6

7 to 9
10 to 12
13 to 16



Figure 1-17
San Pasqual Valley GSA
San Pasqual Valley
Production Wells

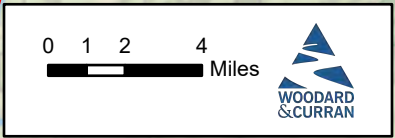


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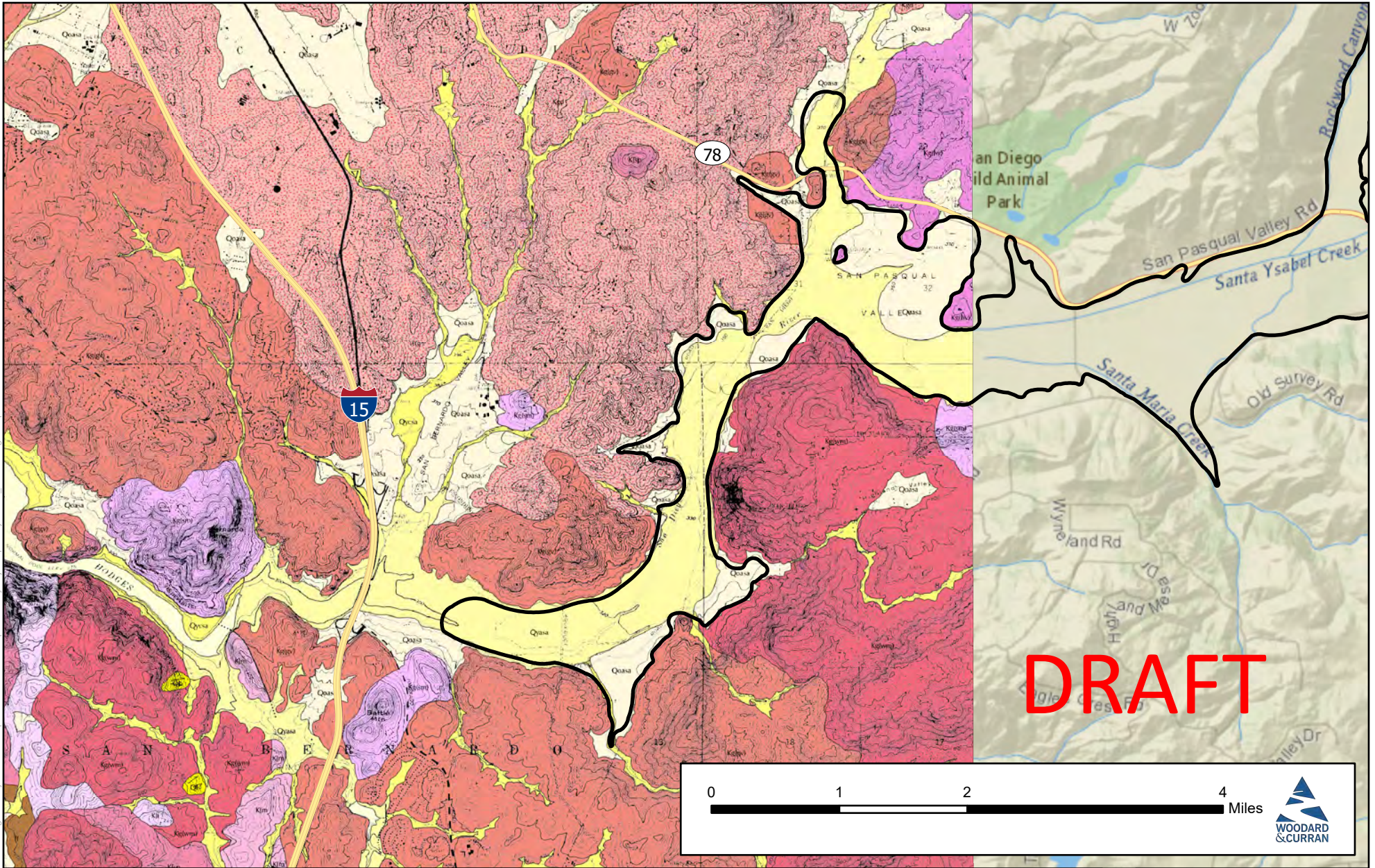
Legend

- Fault
- San Pasqual Valley Basin



Figure 3-1
San Pasqual Valley GSA
Regional Geologic Setting

Figure Exported: 12/12/2019 10:45:11 AM. User: C:\Users\mikek\Documents\Projects\San Pasqual\GIS\Map\Project.aprx; Layout: E3_2.0_Geologic_Map - Escondido



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Legend





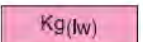

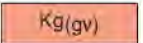

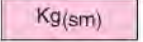
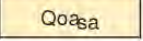





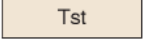



 San Pasqual Valley Basin



Figure 3-2
San Pasqual Valley GSA
Escondido
Geologic Quad

DESCRIPTION OF MAP UNITS

	Active (Holocene) lake (lacustrine) deposits; mostly submerged and manmade; sc = silty clay with sand and gravel.		Woodson Mountain granodiorite: coarse-grained light-colored granodiorite with some finer-grained granodiorites and minor tonalite.
	Younger (Holocene, not active) alluvial flood plain deposit; unconsolidated sediments; sa = silty sand with clay.		Lake Wolford leucogranodiorite: fine-grained light-colored granodiorite with some coarser-grained granodiorite and minor tonalite.
	Younger (Holocene, not active) colluvial (slope wash) and stream deposits; along small drainage courses; sa = silty sand with clay and gravel.		Green Valley tonalite: medium-grained gray tonalite with minor granodiorite, gabbro and other basic igneous rocks.
	Landslide (Pleistocene to Holocene) deposits; subject to renewed slope failure. Querried where existence is questionable.		San Marcos gabbro: fine to coarse-grained rocks ranging from troctolite to quartz norite, with minor tonalite.
	Older (Pleistocene, younger than 500,000 years) alluvial river deposits; moderately consolidated sediments; sa = silty sand with gravel and clay.		Intrusive rocks of the Santiago Peak Volcanics: fine-grained granodiorite and related rocks, with minor amounts of rocks listed under KJsp and KJm.
	Older (Pleistocene, younger than 500,000 years) alluvial fan, debris flow and talus deposits; ag = sandy gravel with silt and clay.		Undifferentiated Santiago Peak Volcanics: mildly metamorphosed volcanic and volcaniclastic rocks. Volcanic rocks range from basalt to rhyolite, but are predominantly andesite. It also contains rocks listed under KJI and KJm.
	Mission Valley Formation (late Eocene) - Friable, light olive gray, fine to medium grained sandstone with interbeds and tongues of dark greenish-gray sandy claystone and cobble conglomerate. The conglomerate represent tongues of the Stadium conglomerate and comprise up to 30 percent of the section in the easternmost exposures but less than 1 percent in the westernmost exposures. Includes the Sweetwater Formation.		Undifferentiated Metasedimentary rocks: quartzite with some mildly metamorphosed rocks (schist, argillite, slate, phyllite, etc.). It also contains rocks listed under KJsp and KJI.
	Stadium Conglomerate (middle-Eocene) - Massive cobble conglomerate with a dark yellowish-brown coarse-grained sandstone matrix.		
	Friars Formation (middle and late Eocene) - Massive, yellowish gray, medium grained, poorly indurated sandstone interlayered with dark greenish-gray sandy claystone.		
	Miscellaneous granodiorite: undifferentiated types of granodiorite with minor tonalite.		
	Escondido Creek leucogranodiorite: fine-grained light-colored rocks ranging from leucogranodiorite to leucotonalite, with minor granodiorite and tonalite.		

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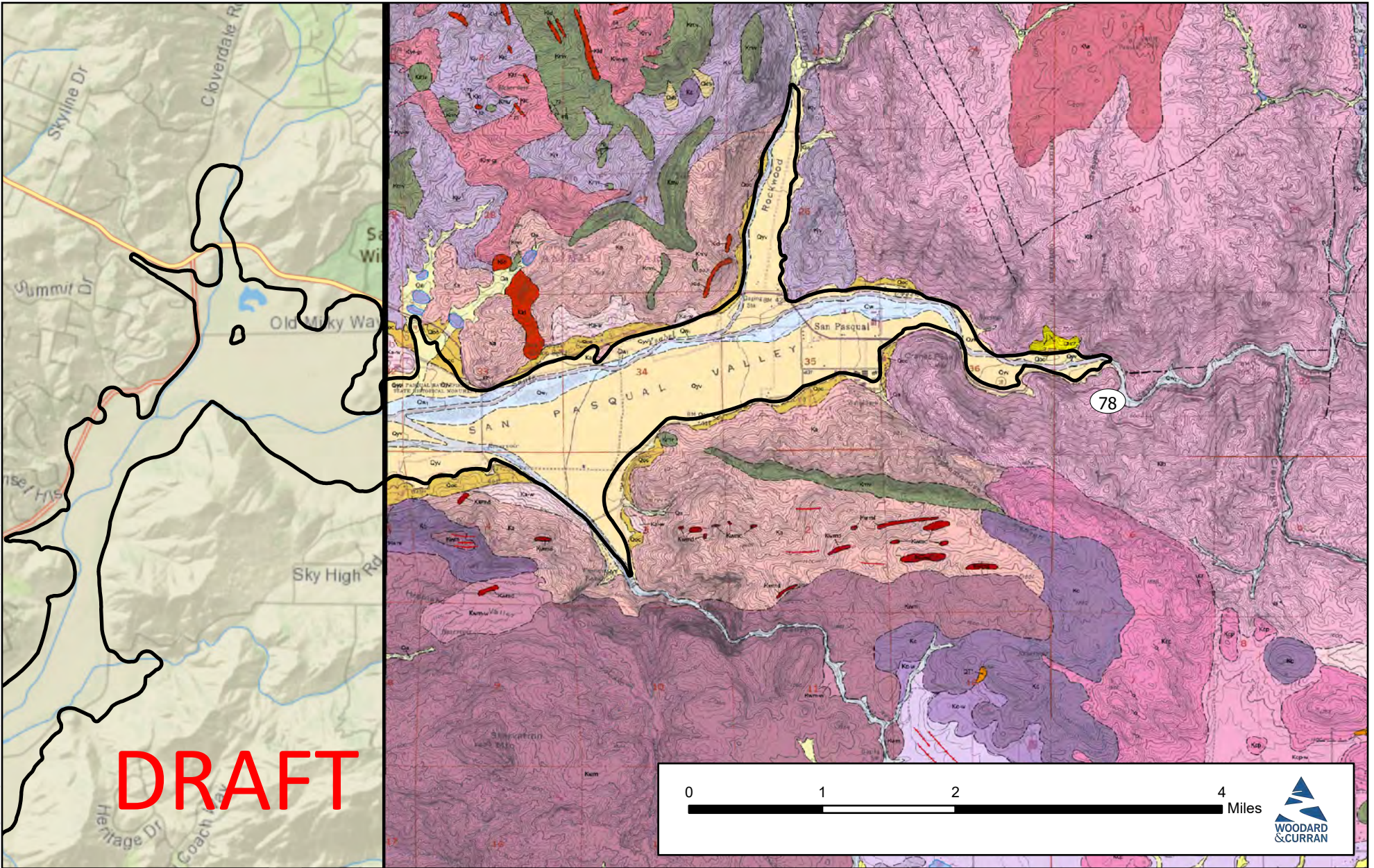


Project #: 0011197

Legend

Figure 3-2.1
San Pasqual Valley GSA
Escondido Geologic
Quad Key

Figure Exported: 12/12/2019 10:45:10 AM. User: C:\Projects\San Pasqual GIS\Map\Project.aprx Layout: F3_3.0_Geologic Map - San Pasqual



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Project #: 0011197

Legend

 San Pasqual Valley Basin



Figure 3-3
San Pasqual Valley GSA
San Pasqual
Geologic Quad

- af** **Artificial fill (late Holocene)** - Includes earth dam structure at Lake Ramona, and engineered fill, asphalt and concrete paving at Ramona Airport airstrip.
- QW₂** **Wash deposits (late Holocene)** - Unconsolidated sand and gravel deposited in active washes. Consists of light brownish-gray (2.5Y 6/2) to grayish-brown (10YR 5/2), fine- to medium-grained sand, silt, and coarse sand to fine gravel. Sand is angular to sub-angular, micaceous, and is primarily derived from local bedrock. Subject to localized reworking and new sediment deposition during winter storms.
- QW₁** **Wash deposits (late Holocene)** - Unconsolidated sand and gravel deposited in intermittently active washes. Consists of light brownish-gray (2.5Y 6/2), fine- to medium-grained sand, silt, and coarse sand to fine gravel. Sand is angular to sub-angular, micaceous, and is primarily derived from local bedrock. Subject to periodic flooding of bordering QW₂ wash deposits.
- Qa** **Axial channel deposits (late Holocene)** - Unconsolidated sand, gravel, silt and clay deposited in active and recently active canyon and valley drainages. Consists of grayish-brown (10YR 5/2) sand, gravel, silt and clay.
- Qls** **Landslide deposits (Holocene to Pleistocene)** - Slope-failure deposits consisting of poorly to moderately consolidated, poorly sorted rock fragments and soil material. May be susceptible to renewed slope movements. Question mark indicates landslide is questionable.
- Qds** **Debris slide deposits (Holocene to Pleistocene)** - Shallow slope-failure deposits consisting of soil material and poorly sorted rock fragments. May be susceptible to renewed slope movements.
- Qya** **Young axial channel deposits (Holocene to late Pleistocene)** - Unconsolidated to slightly consolidated sand and gravel deposited in marginal parts of active washes. Consists of light olive-brown (2.5Y 5/3) to grayish-brown (2.5Y 5/2), fluvial deposits of fine- to coarse-grained sand with minor silt, and minor fine to coarse gravel and cobbles. Gravel and cobbles are sub-rounded to rounded. In most areas, unit is slightly elevated above the active younger wash deposits.
- Qyv** **Young alluvial valley deposits (Holocene to late Pleistocene)** - Unconsolidated to moderately consolidated gently sloping fluvial deposits within broad valleys. Consists of grayish-brown (2.5Y 5/2) to dark grayish-brown (10YR 4/2) fine- to medium-grained sand, silt, and fine gravel.
- Qoc** **Old colluvial deposits (late to middle Pleistocene)** - Unconsolidated to well-consolidated deposits of sediment, rock fragments and soil material deposited by creep and slope wash. Consists of brown (7.5YR 4/3) to (7.5YR 5/4), fine- to coarse-grained sand, clay, silt, and minor fine gravel. Mapped where thick enough to obscure underlying bedrock. Forms aprons along the base of slopes.
- QTF** **Fanglomerate (Quaternary or Tertiary?)** - Moderately to well-indurated, massively bedded, poorly sorted to unsorted, micaceous, silty, fine- to medium-grained, brown (10YR 5/3) arkosic sandstone. Matrix-supported angular (0.5 to 3 cm) clasts of locally derived pegmatitic rock common. Near its base, the deposit contains abundant clasts of angular pegmatitic material as much as 20 cm in maximum dimension; rare broken Poway-type metavolcanic and quartzite cobble clasts up to 25 cm; and rounded, "rotten" granitic boulders. Boulders average 30 cm in diameter and can exceed one meter in maximum dimension. Fossiliferous, fossils consist of root casts and other unidentified casts and debris. Occurs as debris flow and fan deposits at base of slopes and in small drainages. Poorly exposed, usually only observed in roadcuts and gullies. Desiccation cracks common. Queried Tertiary age assignment based on degree of induration, and stratigraphic position above crystalline basement and below deeply weathered, eroded, unindurated colluvium. May include deposits related to the Ballena River system, e.g. cobble lag deposits 1 km south of the Ramona Airport, shown on the map as **QTF-I**.

Klp **Tonalite of La Posta (Cretaceous)** - Rocks tentatively correlated with La Posta-type plutons of the eastern zone of the Peninsular Ranges batholith. Consists of homogeneous, idiomorphic medium- and coarse-grained hornblende-biotite tonalite, trondhjemite (leucotonalite), and leucogranodiorite. The unit is in part equivalent to the La Posta Quartz Diorite of Miller (1935). La Posta rocks contain abundant white-weathering plagioclase and a low color index (C.I.), which together, impart a white color to the low platy outcrops of the unit. Also characteristic are: 1) light-gray quartz grains up to 1+ cm of bipyramidal to ovoid shape, 2) euhedral, barrel-shaped biotite books (0.5 to 1 cm across by 1.5 cm in length), and 3) scattered 2- to 5-cm-long K-feldspar oikocrysts that appear as glassy reflective cleavages on weathered rock surfaces. Commonly visible in hand sample, are grains of pale-yellow euhedral sphene. The La Posta unit consists of plagioclase, quartz, biotite ± hornblende ± K-feldspar; in granodiorite and monzogranite, where K-feldspar equals or exceeds biotite. In the San Pasqual quadrangle, the tonalite of La Posta is mapped along the east central map boundary and the northeast map corner. These small La Posta bodies represent the western portion of the outer pluton of the Ramona ring-dike structure located in the central portion of the Ramona quadrangle immediately to the east. Medium-grained leucotonalite and tonalite/granodiorite of this pluton display idiomorphic texture (due to hornblende and biotite phenocrysts), are quartz-rich, and contain K-feldspar oikocrysts and visible sphene. The Klp pluton in the ring dike structure in the Ramona quadrangle is petrographically similar to the La Posta-type pluton south of the town of Alpine, which is the westernmost exposure of the unit in the El Cajon 1:100,000-scale quadrangle. The Klp pluton of the Ramona ring-dike structure appears to be the origin of numerous large pegmatite dikes that intrude the northeast quarter of the quadrangle.

Kcp **Chiquito Peak Monzogranite (Cretaceous)** - This unit is grayish-white weathering, medium to coarse-grained hornblende-biotite leucomonzogranite and granodiorite, with lesser tonalite, granite, alaskite and pegmatite. Biotite content is greater than hornblende in most outcrops. In thin section, biotite contains opaque oxide rimmed by secondary sphene and is altered to very fine grained sphene. Large euhedral to subhedral plagioclase grains are present along with quartz grains larger than feldspars, and most recrystallized into subgrains. Most K-feldspar is poikilitic, and some perthitic. Texture is generally magmatic with minor subsolidus effects. Chiquito Peak monzogranite has mutually intrusive contacts with the tonalite of Las Bancas. Named Chiquito Peak by Todd (1977), for its location in the northeast part of the Viejas Mountain quadrangle in San Diego County. U-Pb zircon dating of the Chiquito Peak pluton gave an age of about 113 Ma (Todd, 2004). Deeply weathered Kcp unit is shown on the map as **Kcp-w**.

Kc-w **Cuyamaca Gabbro (Cretaceous)** - The Cuyamaca Gabbro (Everhart, 1951), is the name given to large gabbro plutons, smaller gabbro bodies, and gabbroic dikes in central and southern San Diego County. Most of the gabbro in the San Pasqual quadrangle occurs in small discontinuous bodies and dikes within granitic rocks, regionally associated with the Ramona ring-dike structure. These rocks are fine- to coarse-grained and dark grayish-green colored on fresh surfaces, but typically weather to form a reddish soil with sparse outcrop. Textures are magmatic with slight recrystallization, and includes strong foliation due to recrystallized mafic minerals. Most outcrops are foliated and flow banding is present near contact zones. Unit has abundant fine-grained anhedral orthopyroxene with scarce subhedral phenocrysts. Hornblende is poikilitic and intersillial. Plagioclase typically occurs as subhedral laths. A more leucocratic variety of gabbro occurs either interlayered with, or gradational to the more common mafic variety. This rock has less abundant mafic minerals and may have fine-grained interstitial quartz. Conventional K-Ar analysis of hornblende from two gabbro plutons southeast of the San Pasqual quadrangle yielded cooling ages of 108 and 104 Ma (Hoggatt and Todd, unpublished data). An U-Pb zircon age of 107 ± 2 Ma for the gabbro pluton that underlies Poser Mountain in the Viejas Mountain quadrangle is essentially the same as that of the Ka pluton at its nearby type locality (Ortega-Rivera, 2003). Deeply weathered Kc unit is shown on the map as **Kc-w**.

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 Project #: 0011197	Legend		Figure 3-3.1 San Pasqual Valley GSA San Pasqual Geologic Key #1
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Corte Madera Monzogranite (Cretaceous) - Consists of medium- to coarse-grained biotite leucomonzogranite, leucogranodiorite, and syenogranite as well as abundant dikes of leucogranite, alkaskite, pegmatite, and aplite. Outcrops of the unit weather white with a pinkish-orange (peach) hue. Scarce mafic grains in Corte Madera rocks form lenticular aggregates whose wide (0.5 to 2 cm) spacing imparts a distinctive spotted appearance to rock surfaces. Foliation fabrics in Kcm rocks range from weak magmatic to strong symmagmatic or post-magmatic (subsolidus). Monzogranite of the Kcm unit is composed of subequal quartz and plagioclase with lesser K-feldspar and biotite; about half of the petrographic samples contain small relict hornblendes. Granodiorite consists of plagioclase, quartz, K-feldspar, and biotite. Major minerals of the syenogranite phase of the Kcm unit are K-feldspar, quartz, plagioclase, and biotite. Characteristically, quartz in all facies of the unit occurs as subequal to lenticular grains as long as 1 cm; in moderately strained rocks, quartz phenocrysts are partly recrystallized to subgrains, whereas in highly strained rocks, quartz occurs in lenticular multi-grain aggregates and ribbons >1 cm long. Corte Madera plutons typically comprise the most centrally located and latest intrusions in Cretaceous zoned plutonic complexes in the western zone of the Peninsular Ranges batholith (Todd and others, 2003). In the southeastern part of the San Pasqual quadrangle, Kcm forms small bodies and dikes in the Japatul Valley tonalite. An U-Pb zircon age of 111 ± 2 Ma was reported for the central Corte Madera-type pluton that underlies El Cajon Mountain (Ortega-Rivera, 2003). Conventional K-Ar hornblende cooling ages of 105 and 102 Ma were determined for two additional plutons of the unit (Hoggatt and Todd, unpublished data).



Tonalite of Alpine (Cretaceous) - Consists of medium- to coarse-grained biotite-hornblende tonalite, quartz diorite, and minor diorite. In addition to abundant mafic inclusions, Alpine rocks contain 2- to 3-cm-long concentrations of mafic minerals. In thin section, these dark concentrations consist of intergrown, partly recrystallized mafic minerals. Poikilitic biotite and/or hornblende grains, 1- to 2-cm-long, are commonly present. As a result of variably sized mafic constituents, the tonalite of Alpine tends to be heterogeneous in outcrop and hand sample. Foliation is well developed due to parallel alignment of (1) magmatic phenocrysts, (2) recrystallized minerals (subsolidus recrystallization), and (3) mafic aggregates and inclusions. The tonalite of Alpine consists of plagioclase, quartz, subequal hornblende and biotite, and pyroxene. Rarely, rocks contain interstitial K-feldspar, in a few cases enough to produce borderline granodiorite/tonalite compositions. In the San Pasqual quadrangle, the tonalite of Alpine interfingers with, and grades into, the Japatul Valley tonalite in the northwest corner of the map, and is shown as map unit Ka/Kjv. The Alpine and Japatul Valley units are genetically related based on: progressively less mafic compositions of these two tonalite units, abundant mafic inclusions in both, hornblende and biotite as chief mafic minerals, gradational contacts, and similar geochemical characteristics. Todd and others (2003) proposed that both units fractionated from a single mafic parental magma. U-Pb zircon analysis of a sample from the Alpine type locality yielded an age of 108 ± 2 Ma (Ortega-Rivera, 2003). A conventional K-Ar hornblende cooling age of 107 Ma was obtained for tonalite collected near this site; other K-Ar hornblende ages for the Alpine unit range from 102 to 97 Ma (Hoggatt and Todd, unpublished data). Deeply weathered Ka unit is shown on the map as **Ka-w**.



Woodson Mountain Granodiorite (Cretaceous) - Light-tan to pale brownish-gray, medium- to coarse-grained granodiorite. Named for characteristic large boulder outcrops at Mount Woodson, the type locality (Miller, 1937), in the southwest corner of the San Pasqual quadrangle, and is present in many large masses in the southwest map area. Unit locally intrudes Japatul Valley and earlier Cretaceous plutons. Small scale dark, fine-grained inclusions are widespread, but not as numerous as tonalities, with some crude gneissic structure. Typical granodiorite unit is coarse-grained, with more than 30% quartz and 30% plagioclase, with rectangular crystals showing albite twinning. Biotite is approximately 5%, and is chief ferromagnesian, forming well-distributed unoriented flakes, grouped occasionally with primary sphene, and allanite. Hornblende may be absent, to up to 2%. Accessory minerals include sphene, zircon, and apatite. Outcrops form bold ledge-like ridges. Unit weathers to fine- to coarse-grained grus. Deeply weathered Kwmd unit is shown on the map as **Kwm-w**. Woodson Mountain aplite dikes (map symbol **Kwmd**) form resistant small northwest and west-trending outcrops, and intrude both Kjv and Ka/Kjv unit. K-Ar apparent ages on biotite from Mount Woodson location are 104 Ma and 89 Ma near Mount Laguna, in San Diego County (Krummenacher and others, 1975). Also mapped as Kcp - Chiquito Peak monzogranite by Todd (2004) in the El Cajon 1:100,000-scale quadrangle to the south.



Japatul Valley Tonalite (Cretaceous) - Consists of biotite-hornblende tonalite, hornblende-biotite tonalite, and borderline tonalite/granodiorite that grades to granodiorite. Japatul Valley rocks are medium- to coarse-grained, equigranular, and moderately to strongly foliated. Weathered color ranges from light-gray to grayish-white, and the abundant mafic inclusions commonly weather out in relief. The Japatul Valley unit is composed of plagioclase, quartz, biotite, hornblende, and K-feldspar. Plagioclase in tonalite samples is zoned from labradorite cores to sodic oligoclase rims, and in granodiorite, from sodic andesine to sodic oligoclase. Plagioclase has undergone variable degrees of subsolidus strain and recrystallization. Roughly one-half of Japatul Valley samples are strongly foliated, and in these rocks, plagioclase igneous shapes and zoning are almost obliterated. In mylonitic gneiss, plagioclase occurs as porphyroclasts containing solid-state inclusions of hornblende, biotite, epidote, and quartz, and in recrystallized folia. The Japatul Valley tonalite underlies a large portion of the San Pasqual quadrangle, and is one of the Ramona ring-dike units to the east. Japatul Valley tonalite underlies most of the Santa Maria Valley and is extensively exposed in the northwest map area. In the southeastern map area, the tonalite contains Kmv inclusions, and is cut by numerous dikes of the Corte Madera monzogranite (Kcm), many of which are too small to show at map scale. In the west and northern Santa Maria Valley, Japatul Valley rocks are also cut by Woodson Mountain Granodiorite dikes. This area is part of the northern outermost zone of the El Cajon Mountain plutonic complex to the south, in which Kcm dikes that fringe a central Corte Madera pluton intrude Kmv screens and Kjv tonalite (Todd, 2004). The Kjv unit has not been dated by U-Pb method. South of the San Pasqual quadrangle, conventional K-Ar hornblende ages of six samples range from 109 to 94 Ma (Hoggatt and Todd, unpublished data), and ⁴⁰Ar/³⁹Ar minimum emplacement ages of 112 and 104 Ma were also determined (Todd and others, 2003). Deeply weathered Kjv unit is shown on the map as **Kjv-w**.



Lake Wolford Granodiorite (Cretaceous) - Lake Wolford granodiorite is primarily a fine-grained, light-gray leucogranodiorite. It likely comprises several closely related plutons, with some hybrid zones. In the northwest part of the San Pasqual quadrangle, the Lake Wolford granodiorite is exposed as a possible chilled-margin facies with the Kmv unit. Small bodies of fine-grained leucogranite related to the Lake Wolford pluton show a marginal facies (map symbol **Klw-gr**), and may be the source of leucocratic dikes (map symbol **Kld**) that intrude into the Kjv unit and metavolcanic unit, Kmv. Large hybrid areas are formed by streaking and intermixing of granodiorite, quartz monzonite, and metamorphics (chiefly quartzites or feldspathic quartzites) (Miller, 1937). The Lake Wolford unit is distinguished by low percent of dark minerals (Larsen, 1948). Dark fine-grained inclusions are widespread, but not as numerous as tonalites. The Lake Wolford granodiorite is exposed as broad, flat outcrops that are commonly aplitic.

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Legend

Project #: 0011197

Figure 3-3.2
San Pasqual Valley GSA
San Pasqual
Geologic Key #2

Figure Exported: 12/12/2019, By: mwicks Using: C:\Projects\San Pasqual GIS\MyProject.aprx Layout: F3_3.3_Geologic Map - San Pasqual Key.3



Las Bancas Tonalite (Cretaceous) – Las Bancas tonalite is a homogeneous, mafic inclusion-free hypersthene-biotite tonalite with lesser quartz diorite, granodiorite, diorite, and quartz norite. Locally, Las Bancas tonalite is interlayered on a fine scale with gabbro. On fresh surfaces of average Klb, mafic minerals and clear plagioclase grains give the rock a dark-gray to black color. The unit weathers to large subrounded residual boulders with a reddish-gray to tan color. The Las Bancas rock is typically medium-grained, equigranular, and generally has a steep foliation due to the preferred alignment of mineral grains. Plagioclase and mafic minerals of Klb plutons retain euhedral/subhedral grain shapes except near pluton margins where protoclastic textures may be developed. Characteristic of the unit are scattered large (0.5 to 2.5 cm) poikilitic biotite grains (oikocrysts) that enclose early crystallized mafic minerals and appear as reflective cleavages on weathered rock faces. Plagioclase (labradorite to sodic andesine) is the most abundant modal mineral. Although locally recrystallized, the largest plagioclase grains (up to 6 mm long) commonly retain delicate euhedral oscillatory zoning. In the most mafic Las Bancas rocks, which contain abundant hypersthene and less than 10% quartz, plagioclase is labradorite to bytownite. This mafic rock may contain indistinct, 2-cm-thick planar concentrations of felsic and mafic minerals oriented parallel to mineral foliation (cumulate layering). The layered rocks also contain pale-weathering lenticular basaltic inclusions as long as 10 cm. In the San Pasqual quadrangle, the Las Bancas tonalite forms most of the highland areas in the north half of the map area. The Las Bancas-type pluton south of the town of Mount Laguna has an U-Pb zircon age of 104 Ma (L.T. Silver, oral communication to V.R. Todd, 1979) and the pluton south of the town of Descanso (unit type locality) has an age of 109 ± 2 Ma (Ortega-Rivera, 2003). Conventional K-Ar hornblende cooling ages of 107, 101, and 96 Ma were determined for the Las Bancas unit (Hoggatt and Todd, unpublished data). Deeply weathered Klb unit is shown on the map as **Klb-w**.



Western metavolcanic rocks (Cretaceous) - In the southern part of the San Pasqual quadrangle, several small hills are underlain by metamorphosed silicic and intermediate volcanic rocks that are intruded and surrounded by the Japatul Valley tonalite. Minor pelitic schist, feldspathic metaquartzite, and plutonic-cobble metaconglomerate are interlayered with tuff, tuff-breccia, and flows of andesitic, rhyolitic, and basaltic composition. These rocks were metamorphosed to amphibolite facies and based on lithology, have been assigned to the Early Cretaceous-Late Jurassic Santiago Peak Volcanics by most workers. These outcrops are spatially continuous in a north- northwest structural trend across the map area, with similar rocks mapped as Kmv in the El Cajon 1:100,000-scale quadrangle by Todd (2004) to the south where tonalite magma apparently assimilated marginal parts of the metavolcanic inclusions producing a variety of hybrid migmatites.

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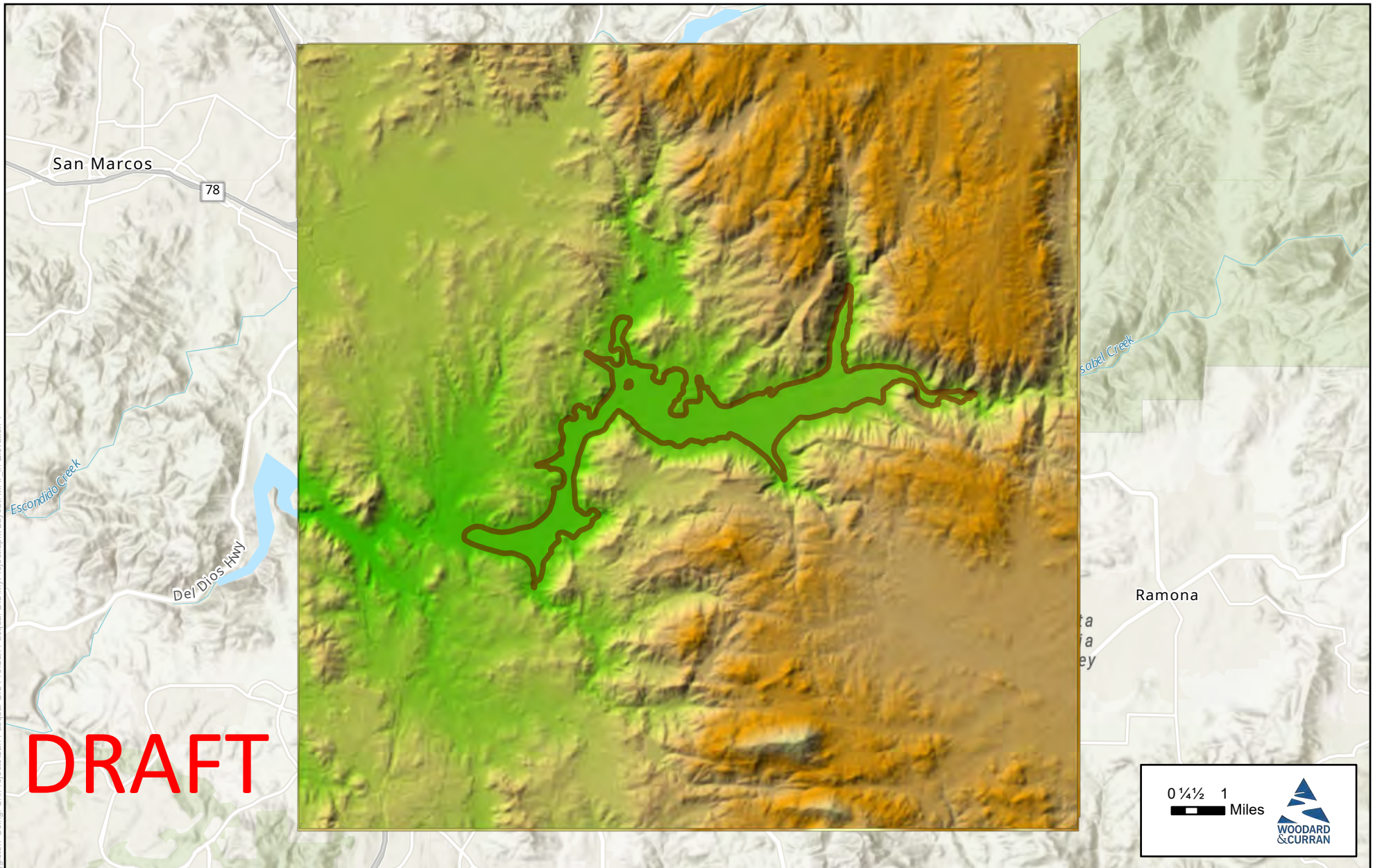


Project #: 0011197

Legend

Figure 3-3.3
San Pasqual Valley GSA
**San Pasqual
Geologic Key #3**

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Project #: 0011197

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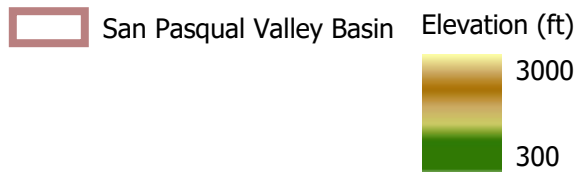
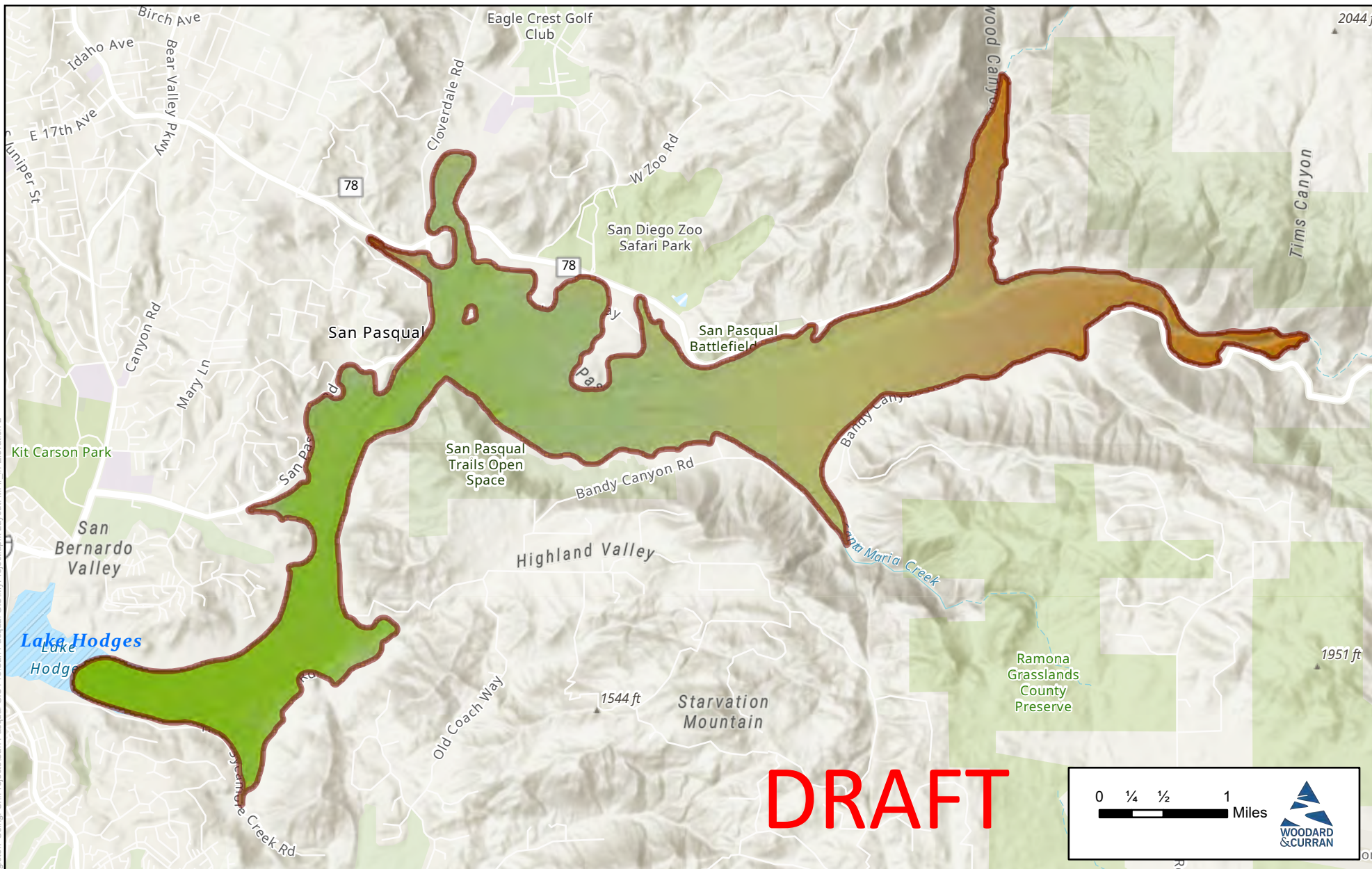
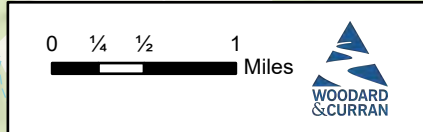


Figure #-#
 San Pasqual Valley GSA
San Pasqual Valley
Regional Topography

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Project #: 0011197

Legend




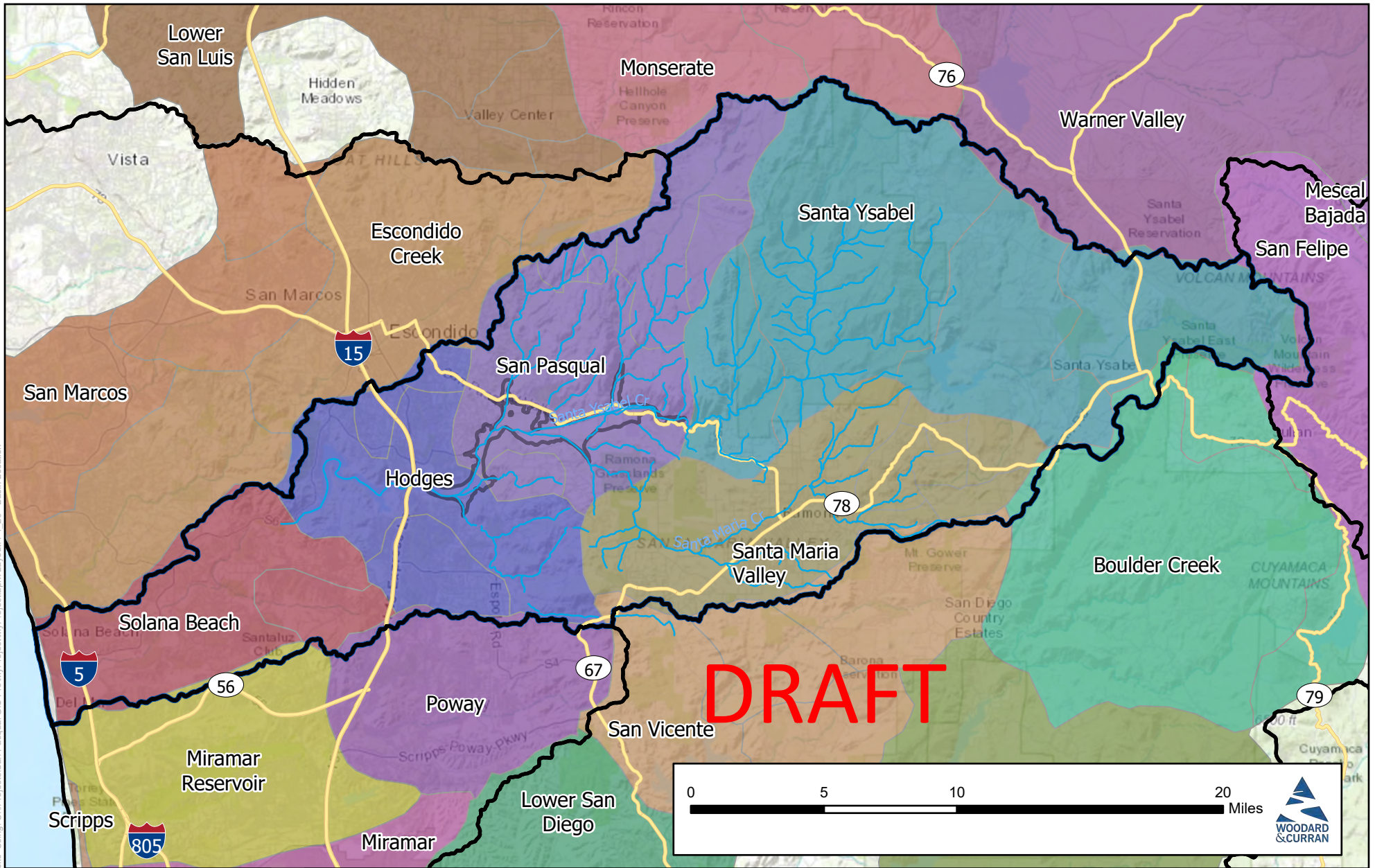
-  San Pasqual Valley Basin
- Elevation (ft)**
-  500
-  300



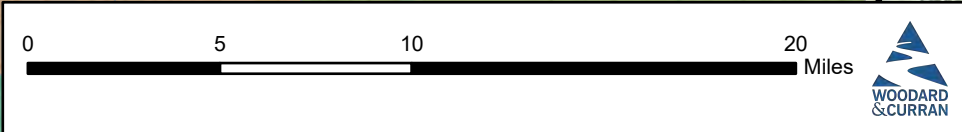
Figure #-#
 San Pasqual Valley GSA
San Pasqual Valley Basin Topography

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Figure Exported: 12/5/2019, By: mwick, Using: C:\Projects\San_Pasqual\GIS\Pro\lyr\Project\Map\Project.aprx, Layout: F:_20_ -Basin_Location



DRAFT



Project #: 0011197

Legend

- San Pasqual Valley Basin
- San Dieguito Drainage Basin
- Hydrologic Basins



Figure 1-X
 San Pasqual Valley GSA
San Pasqual Valley Basin Overview

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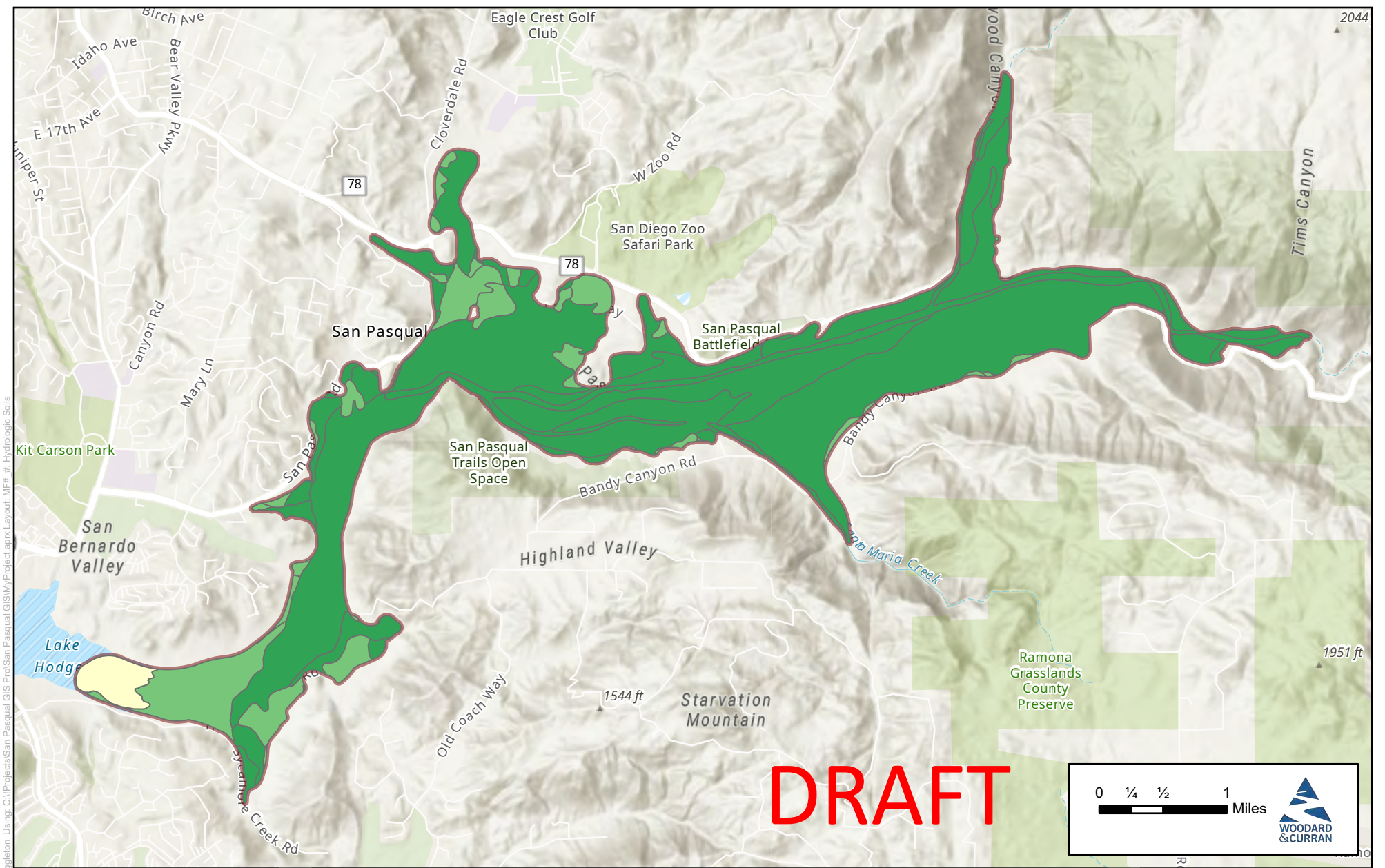


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Project #: 0011197

Legend

- San Pasqual Valley Basin
- Soil Hydrology Rating (um/sec)**
- Very Low: 0-0.01
- Low: 0.01-0.1
- Moderately Low: 0.1-1
- Moderately High: 1-10
- High: 10-100
- Very High: 100+

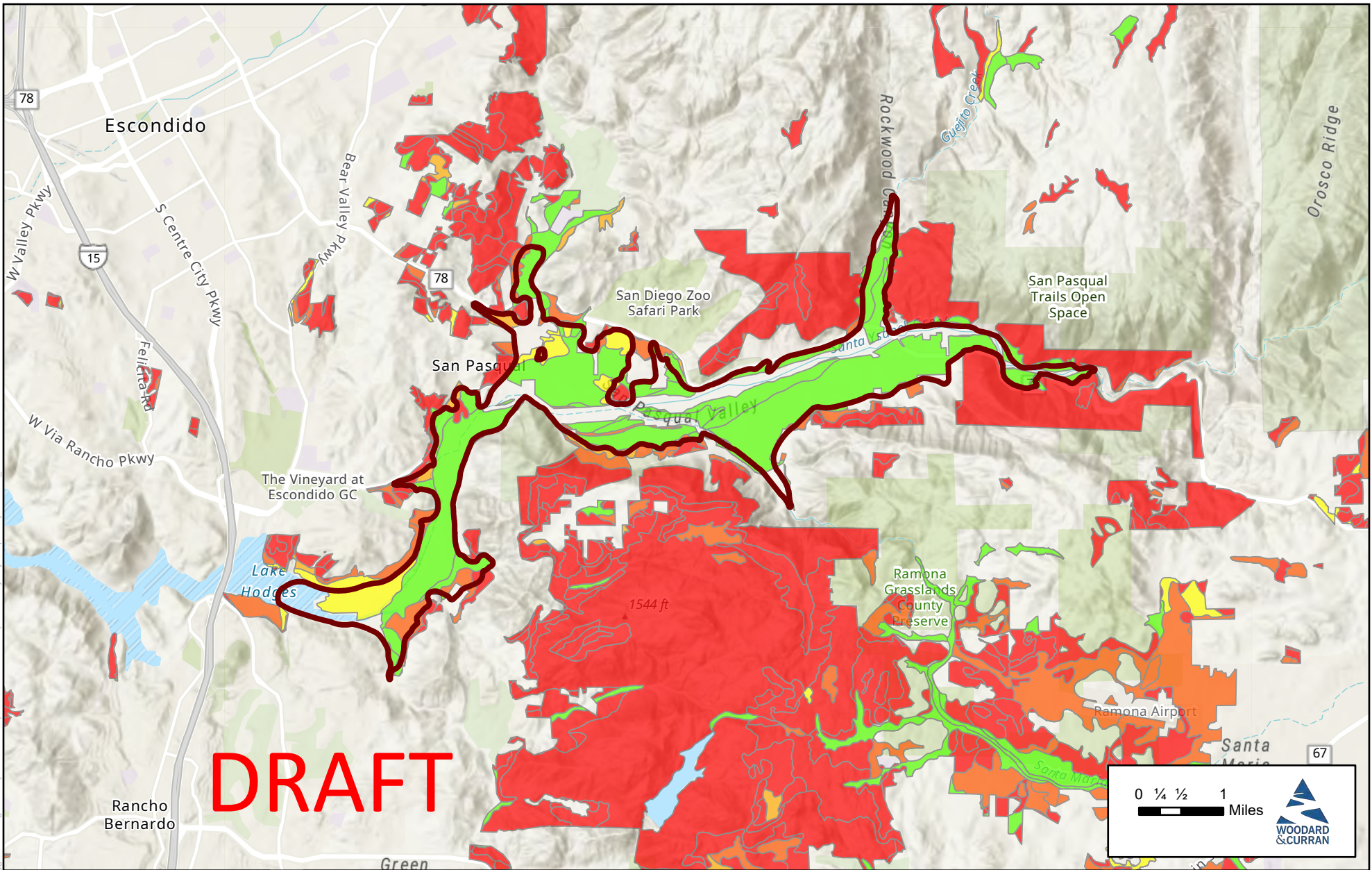
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Figure #-#
 San Pasqual Valley GSA
San Pasqual Valley
Soil Hydrology

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Project #: 0011197

Legend








- | | | |
|--|--|---|
|  San Pasqual Valley Basin |  Excellent |  Moderately Poor |
|  Good |  Poor |  Very Poor |
|  Moderately Good | | |



Figure #-#
 San Pasqual Valley GSA
San Pasqual Valley
SAGBI Classifications

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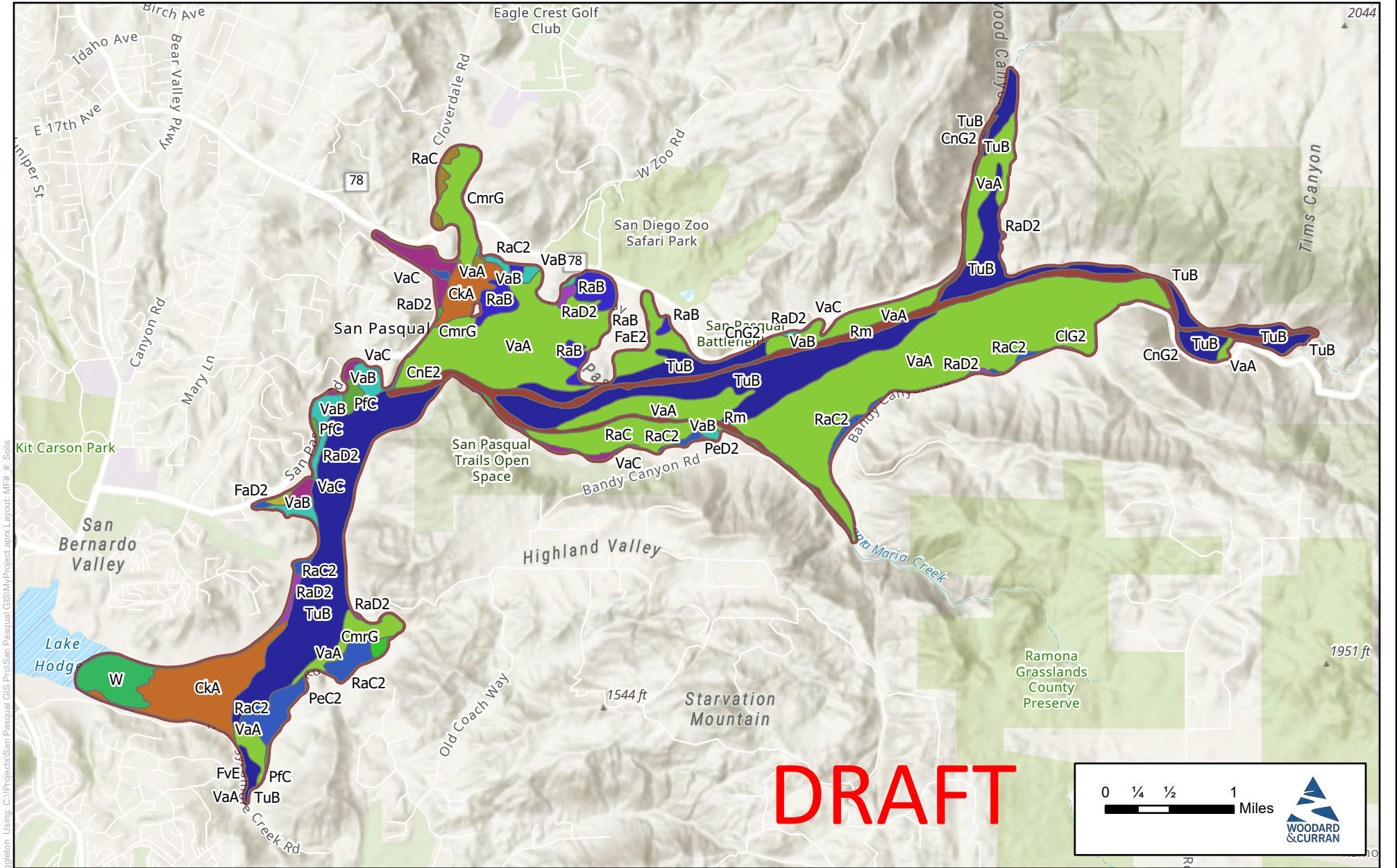


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Project #: 0011197























Legend

San Pasqual Valley Basin



Figure #-#
 San Pasqual Valley GSA
San Pasqual Valley
Soils

SSURGO Soils

-  CkA-Chino silt loam, saline, 0 to 2 percent slopes
-  CmrG-Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes
-  ClG2-Cieneba coarse sandy loam, 30 to 65 percent slopes, eroded
-  CnE2-Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent slopes, eroded
-  CnG2-Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent slopes, eroded
-  FaD2-Fallbrook sandy loam, 9 to 15 percent slopes, eroded
-  FaE2-Fallbrook sandy loam, 15 to 30 percent slopes, eroded
-  FvE-Fallbrook-Vista sandy loams, 15 to 30 percent slopes
-  PeC2-Placentia sandy loam, 5 to 9 percent slopes, eroded
-  PeD2-Placentia sandy loam, 9 to 15 percent slopes, eroded
-  PfC-Placentia sandy loam, thick surface, 2 to 9 percent slopes
-  RaB-Ramona sandy loam, 2 to 5 percent slopes
-  RaC-Ramona sandy loam, 5 to 9 percent slopes
-  RaC2-Ramona sandy loam, 5 to 9 percent slopes, eroded
-  RaD2-Ramona sandy loam, 9 to 15 percent slopes, eroded
-  Rm-Riverwash
-  TuB-Tujunganga sand, 0 to 5 percent slopes
-  VaA-Visalia sandy loam, 0 to 2 percent slopes
-  VaB-Visalia sandy loam, 2 to 5 percent slopes
-  VaC-Visalia sandy loam, 5 to 9 percent slopes
-  VvE-Vista rocky coarse sandy loam, 15 to 30 percent slopes
-  W-Water

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Project #: 0011197

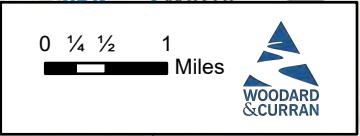
Legend

 San Pasqual Valley Basin



Figure #-#
 San Pasqual Valley GSA
San Pasqual Valley
Soil Key

Figure Exported: 12/18/2019, By: ceceleon, Using: C:\Projects\San Pasqual GIS\Proj\San Pasqual GIS\Proj\San Pasqual GIS\Proj\San Pasqual GIS\Layouts\MEF#. Surface Waters



Project #: 0011197

Legend

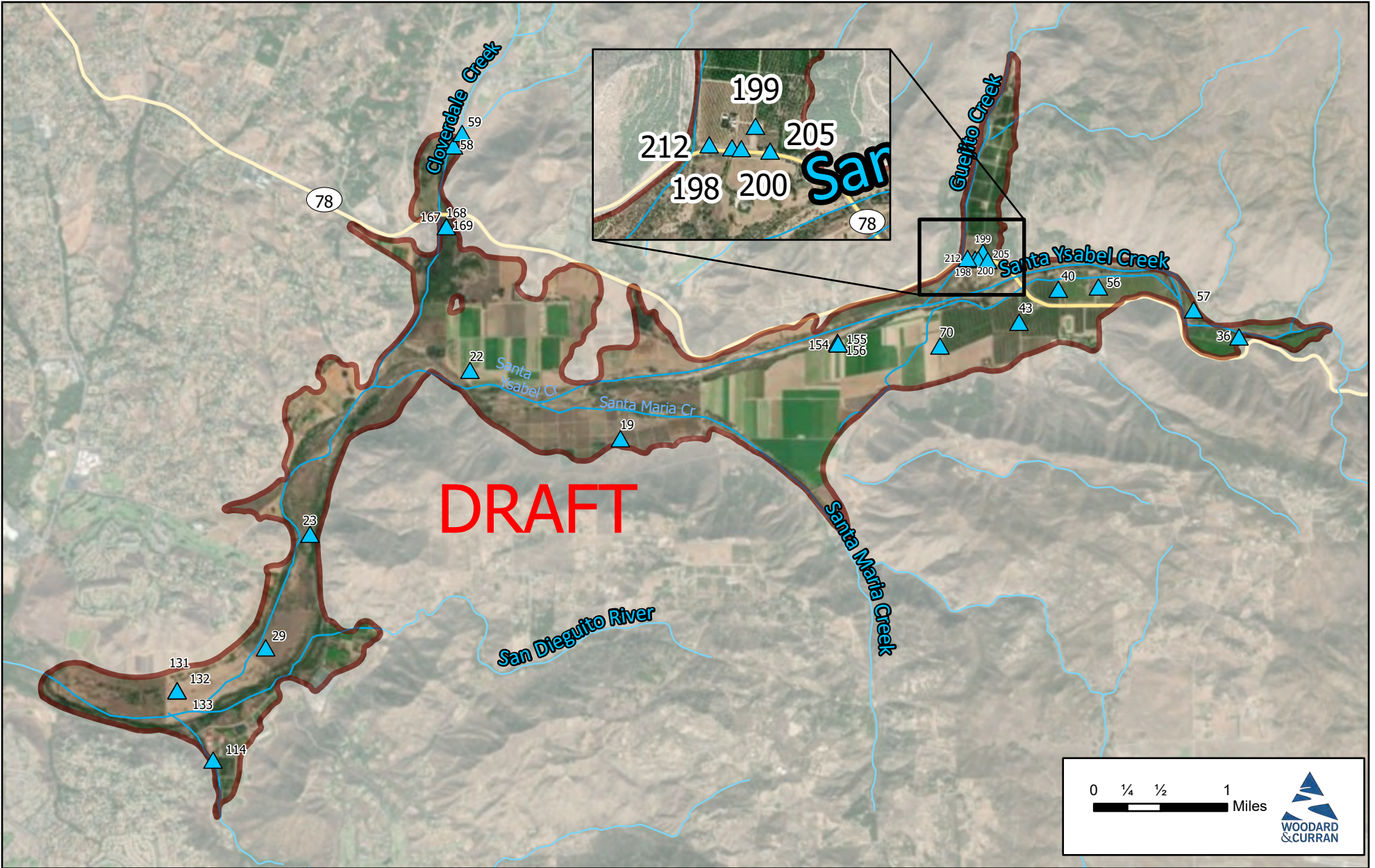
 San Pasqual Valley Basin  Streams



Figure #-#
 San Pasqual Valley GSA
San Pasqual Valley
Surface Waters

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Project #: 0011197

Legend

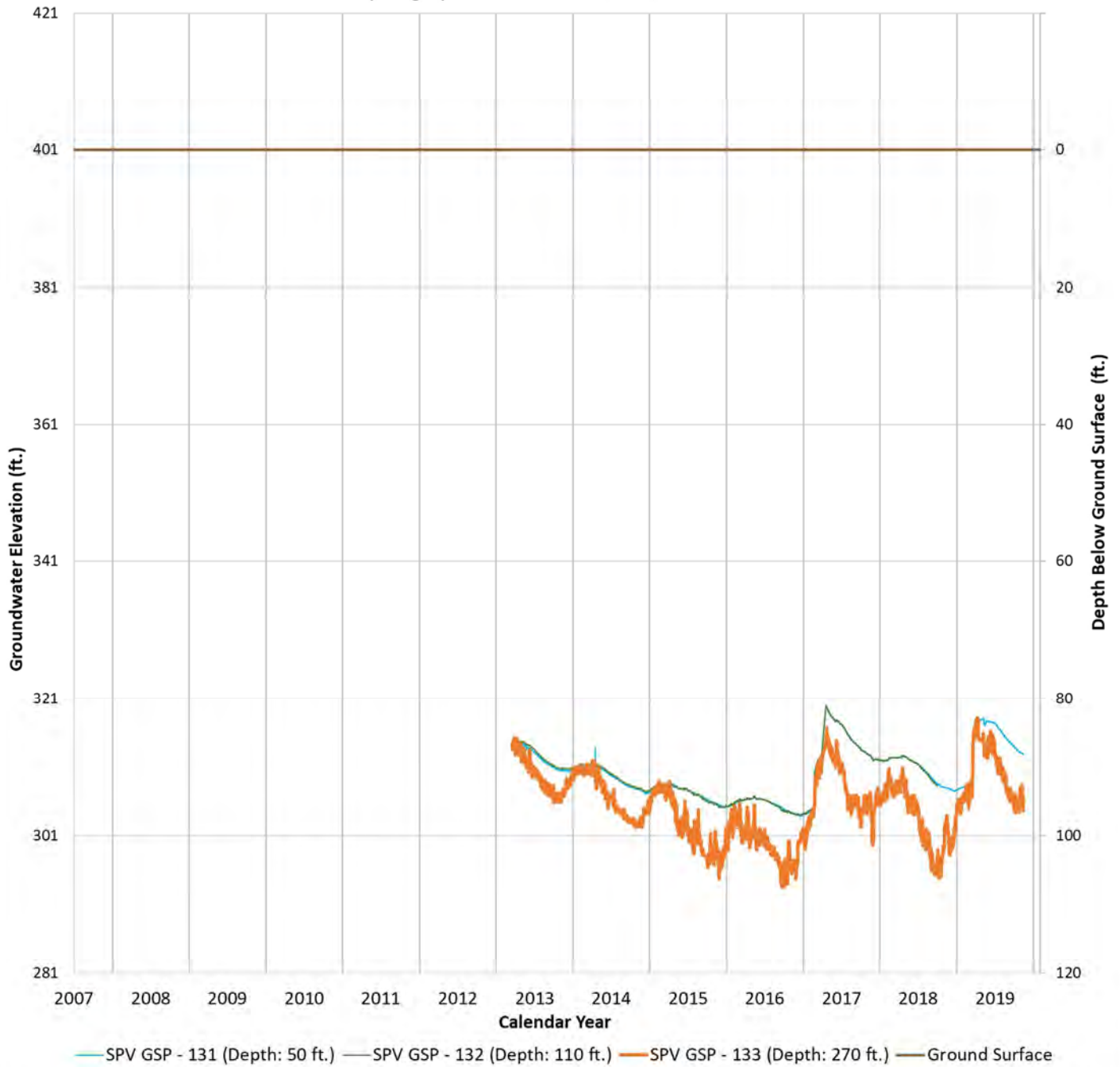
San Pasqual Valley Basin

Monitoring Wells



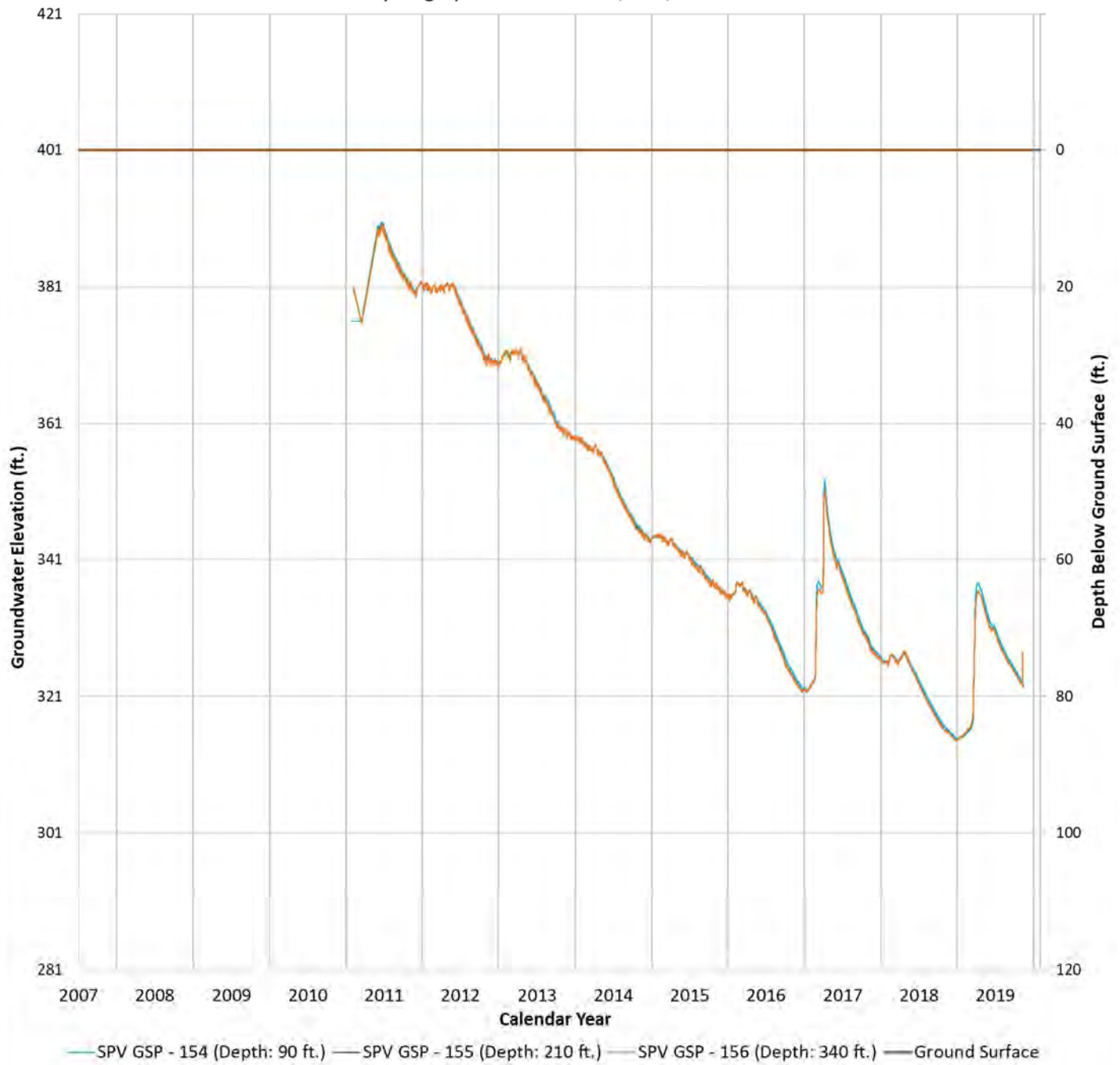
Figure WF-7
 San Pasqual Valley GSA
San Pasqual Valley
Monitoring Well Locations

Hydrograph SPV GSP - 131, 132, and 133



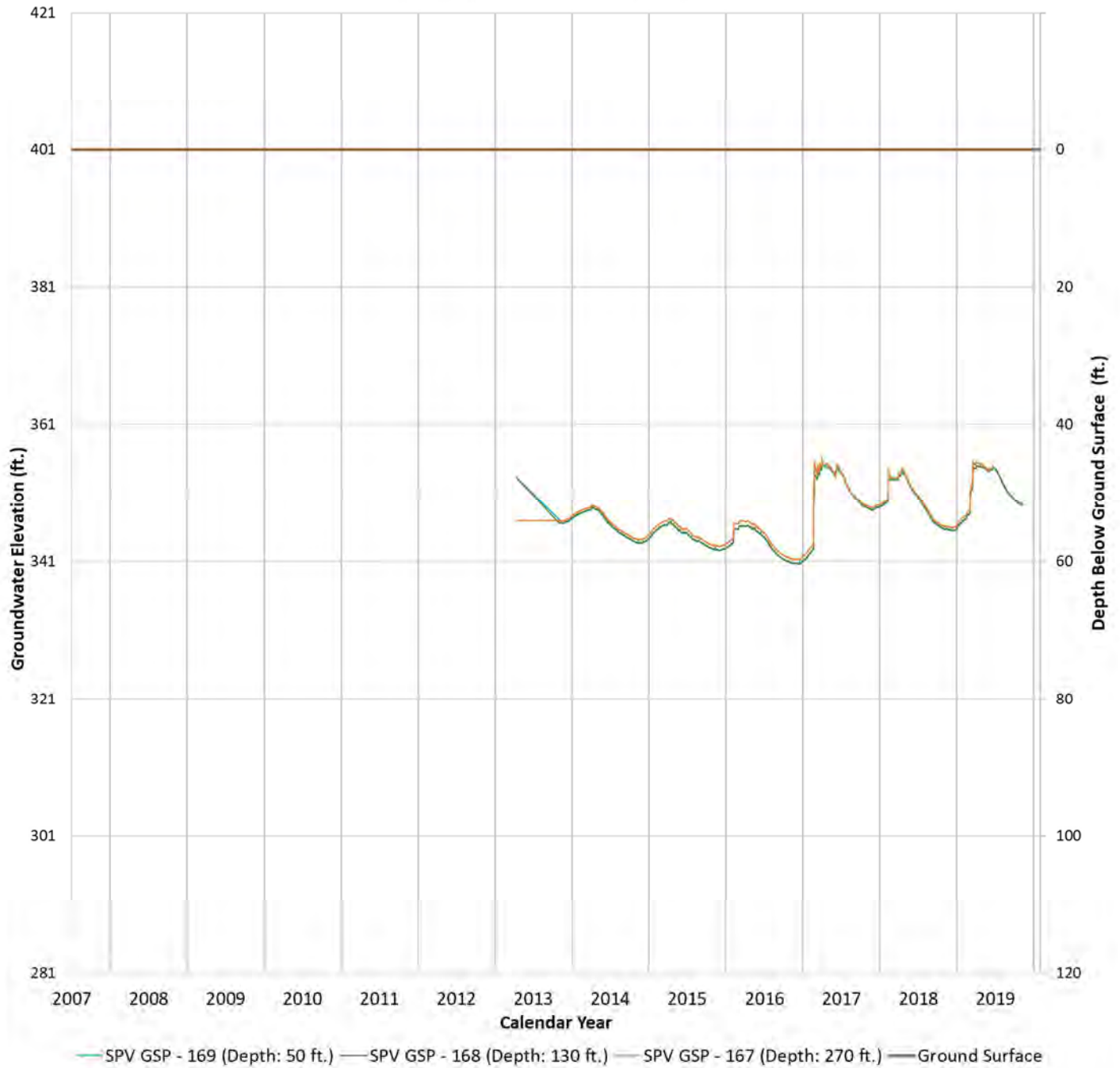
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Hydrograph SPV GSP - 154, 155, and 156

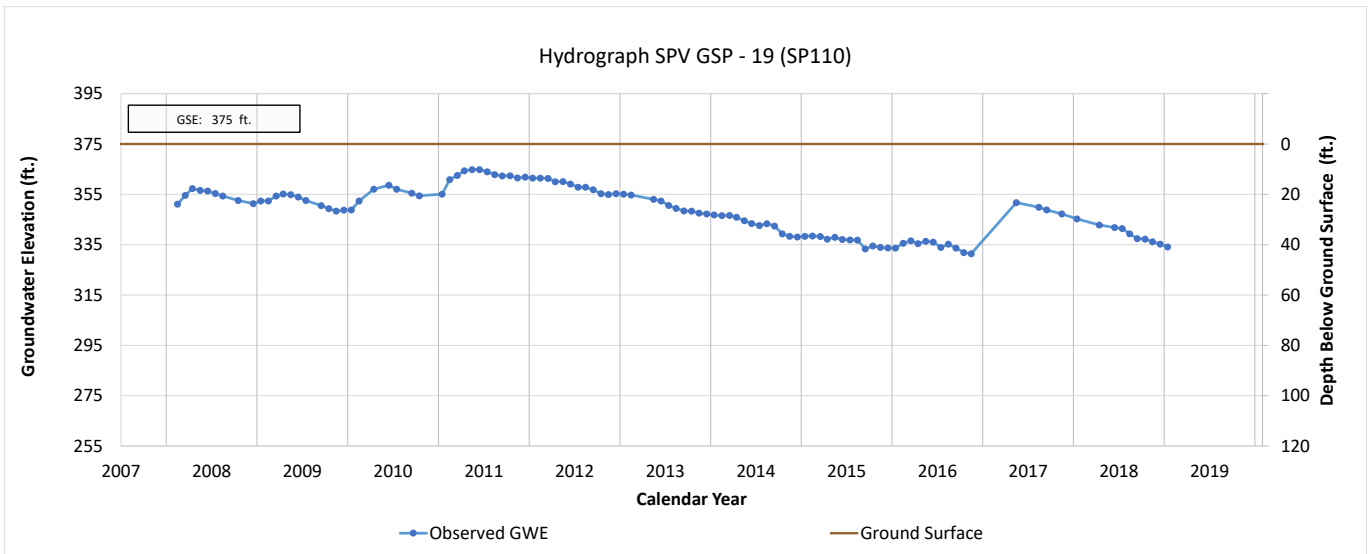


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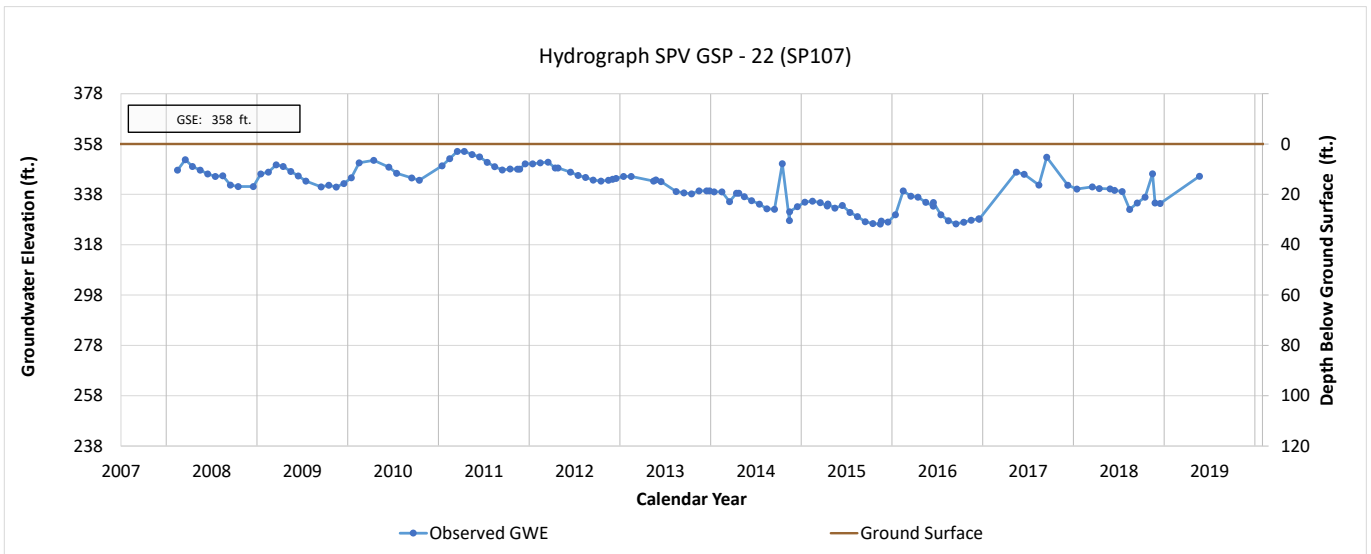
Hydrograph SPV GSP - 167, 168, and 169



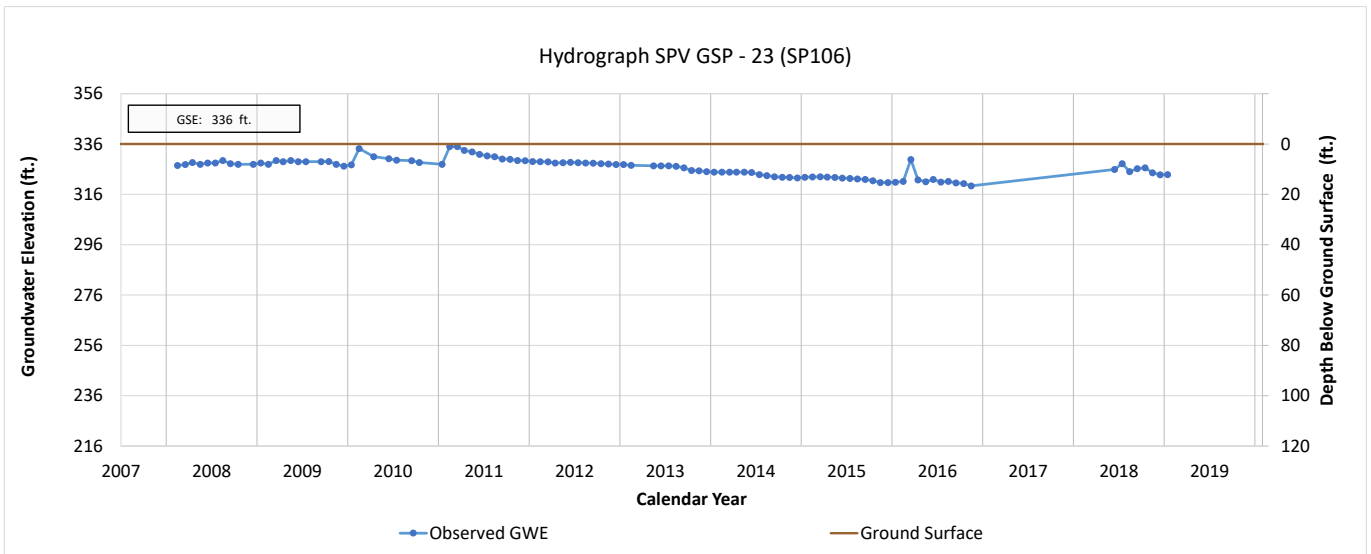
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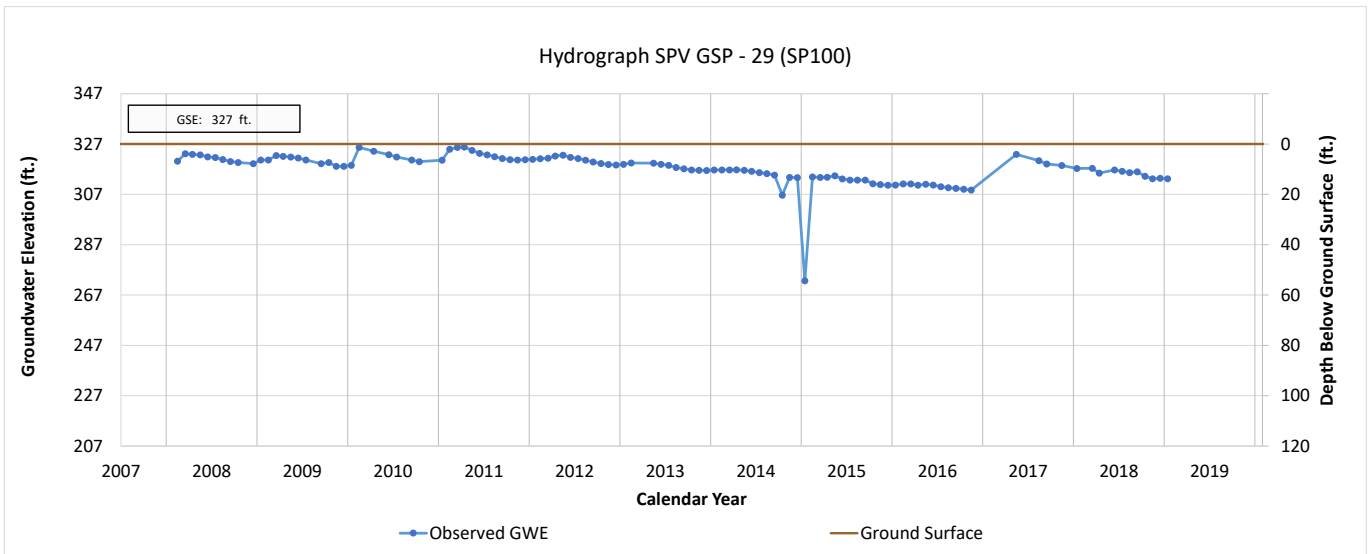
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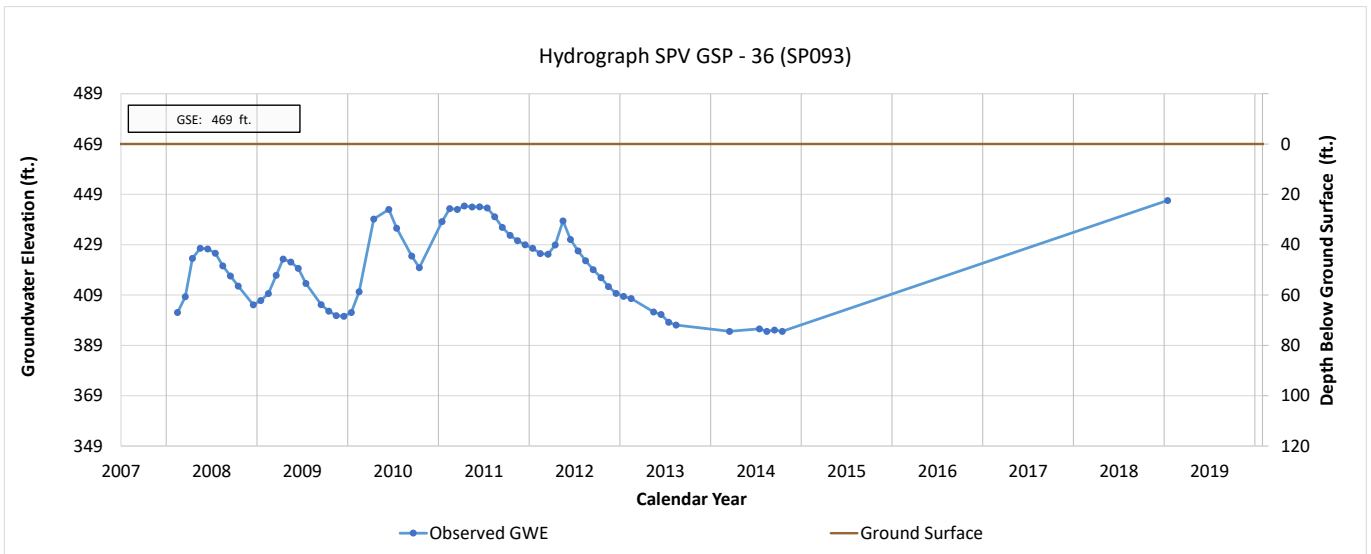
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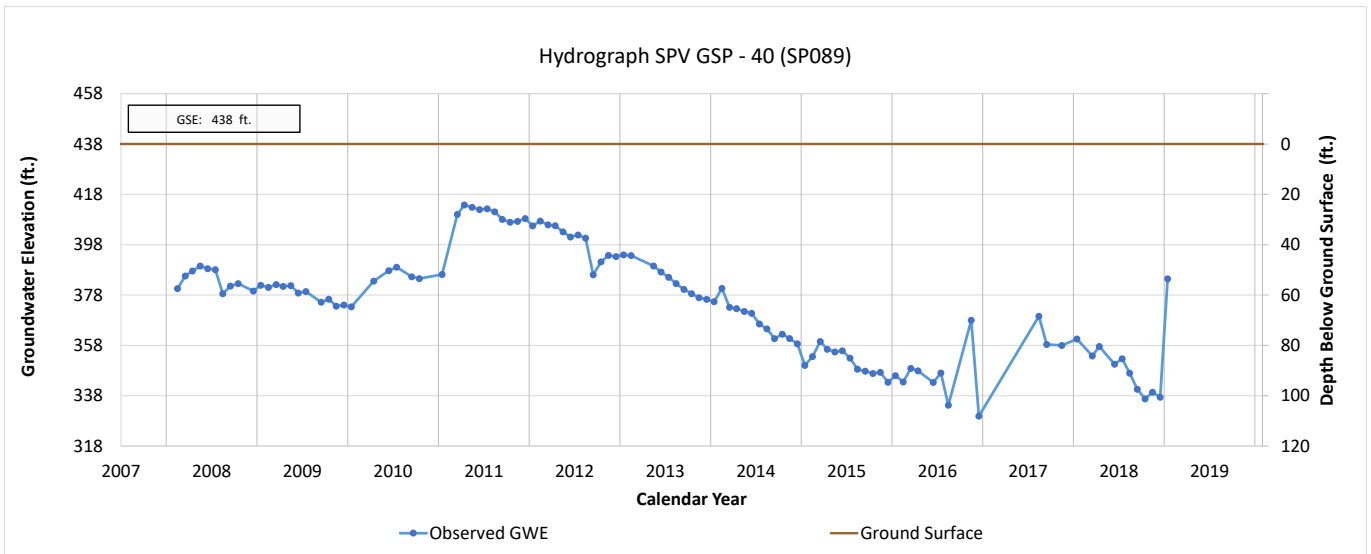
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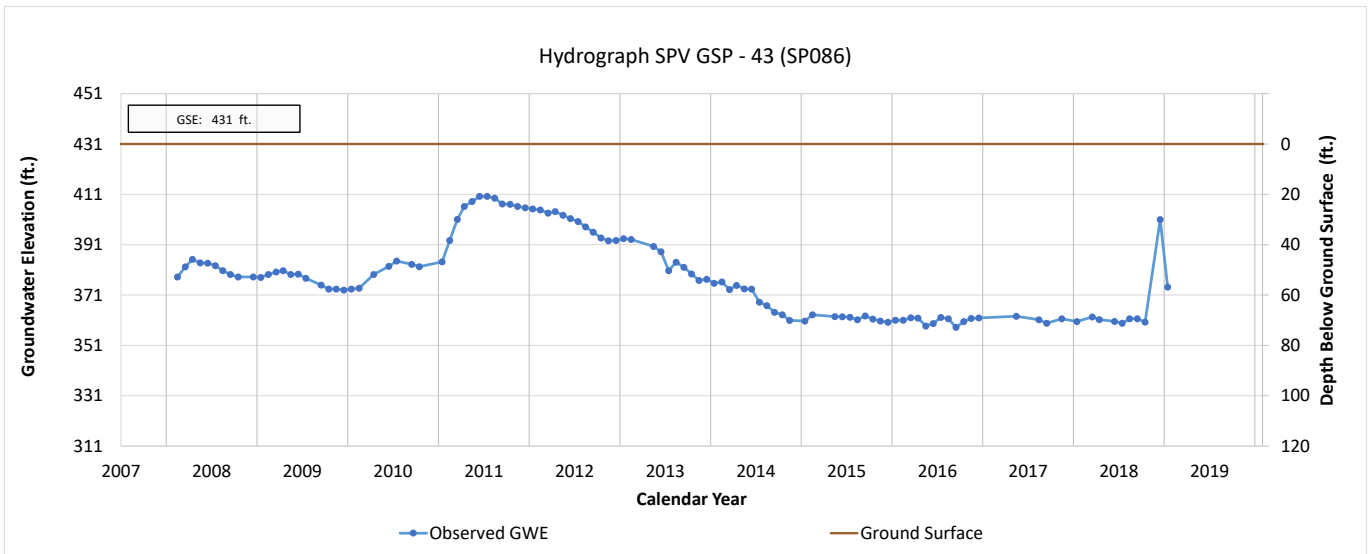
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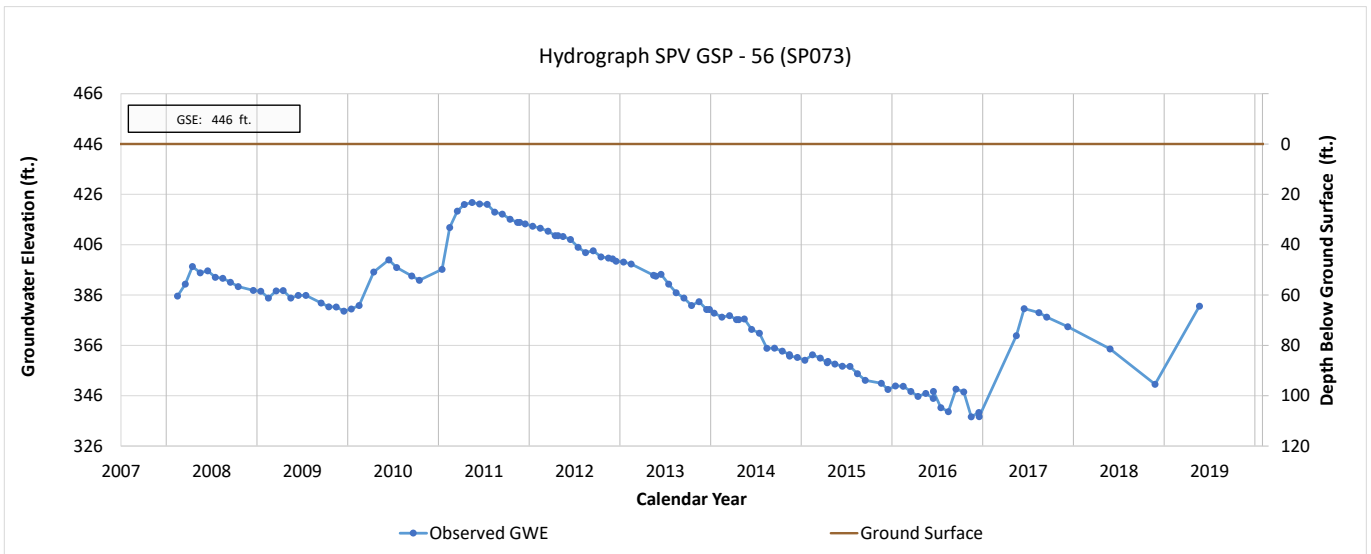
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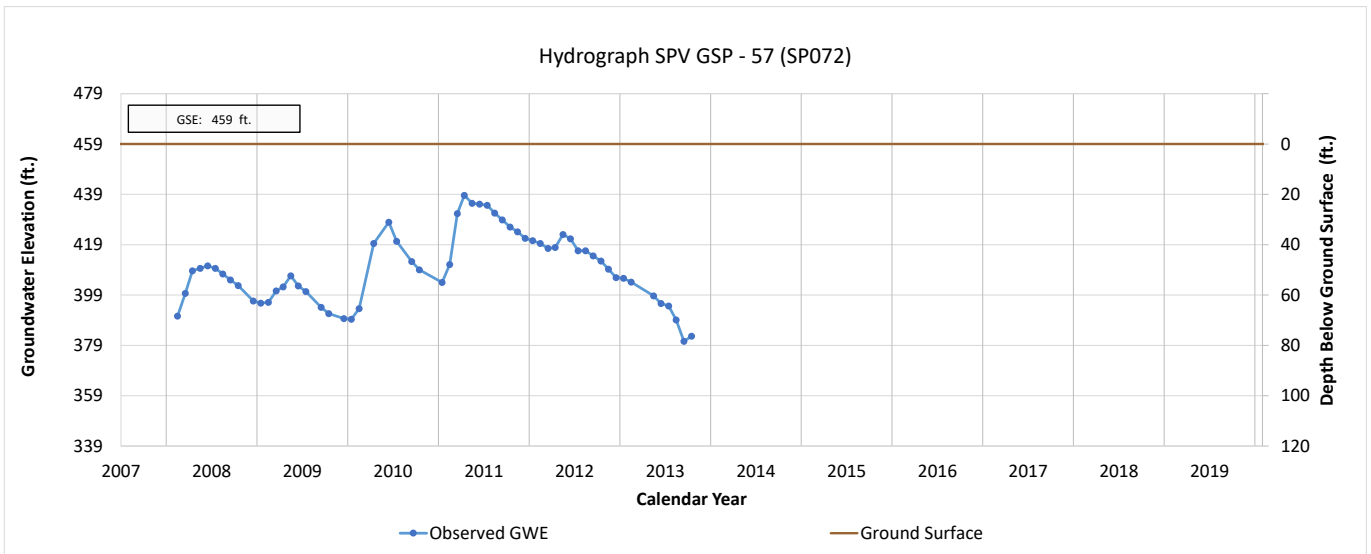
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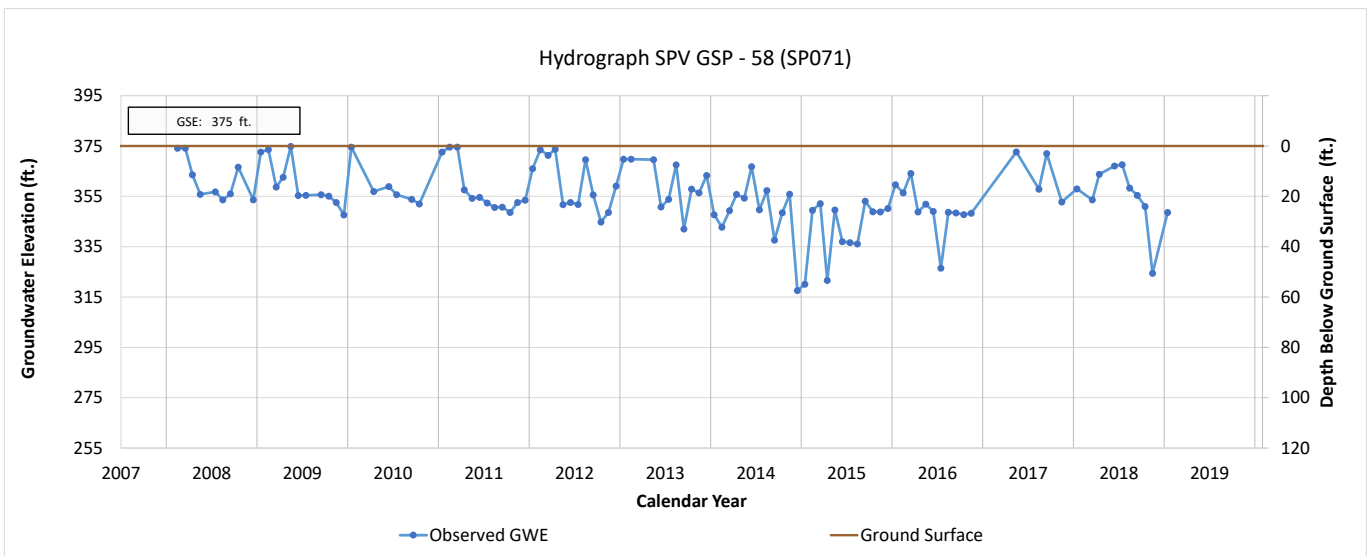
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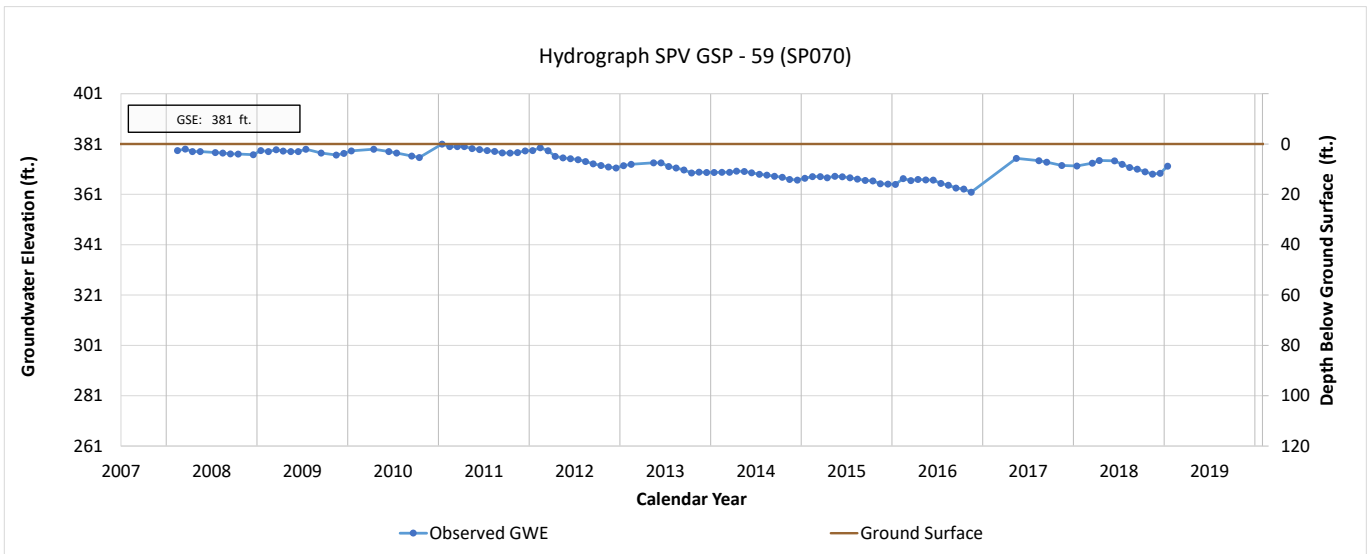
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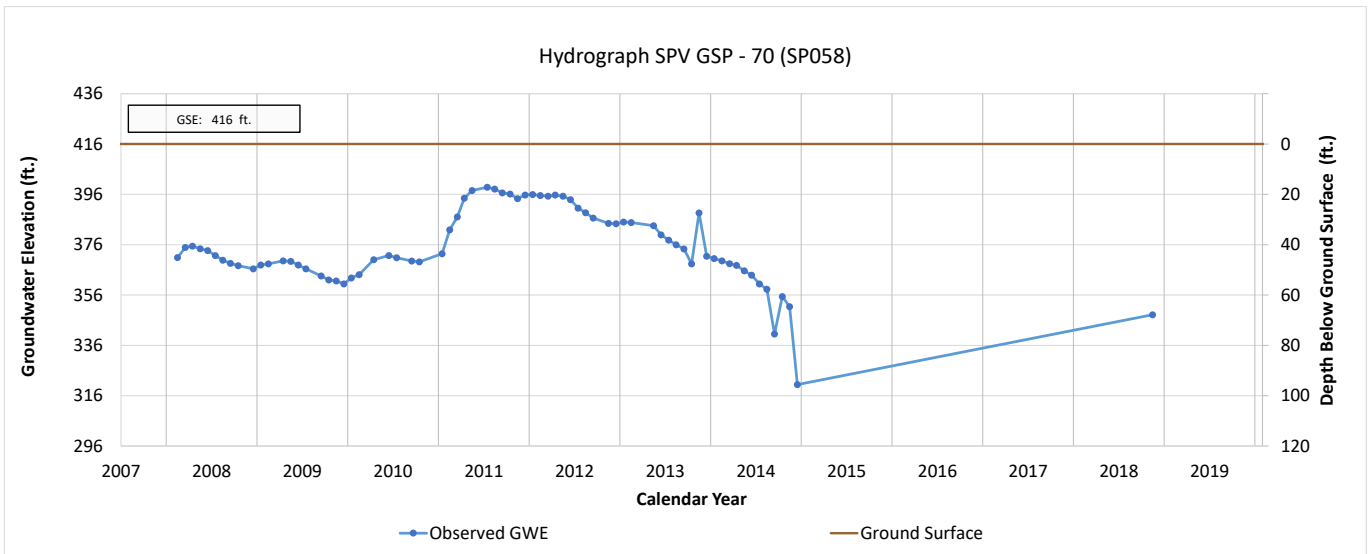
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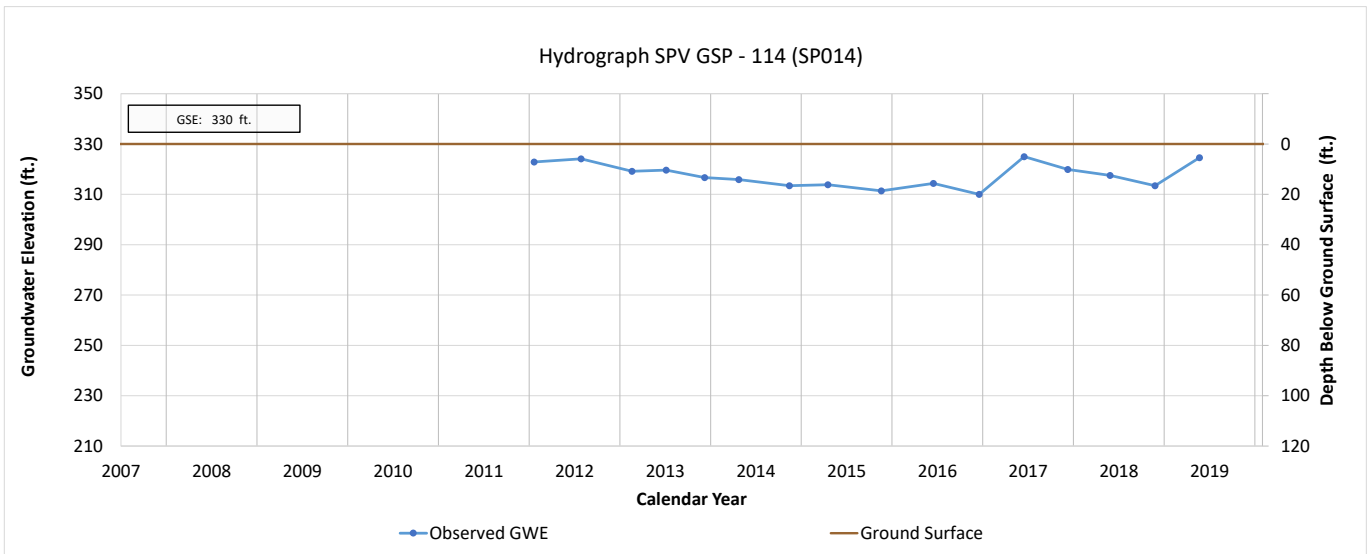
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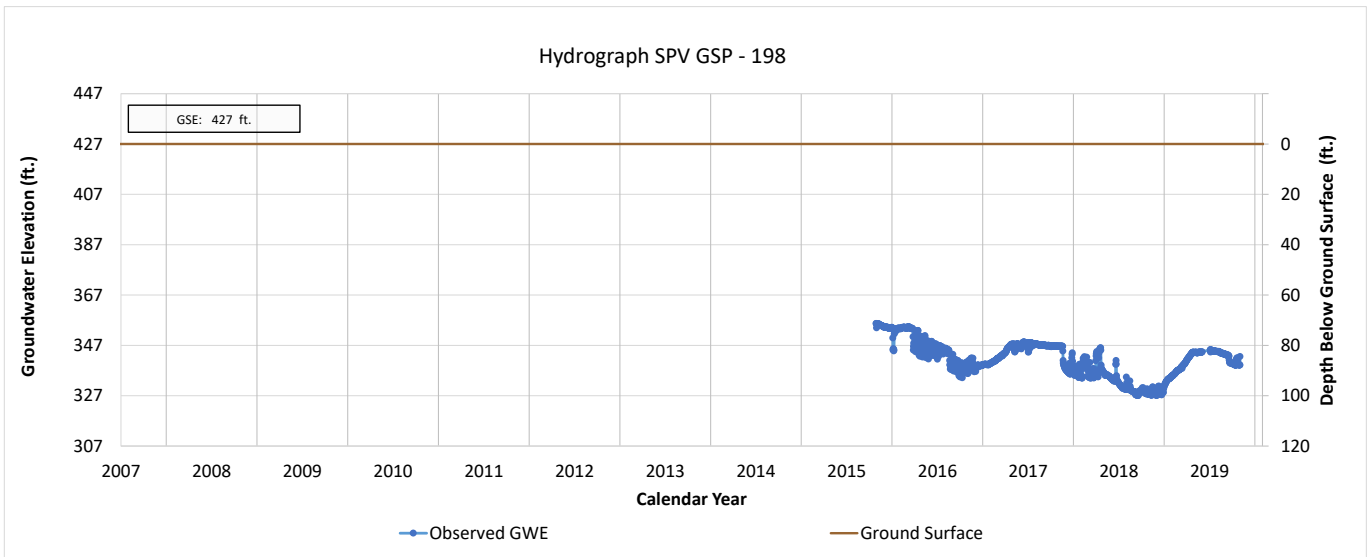
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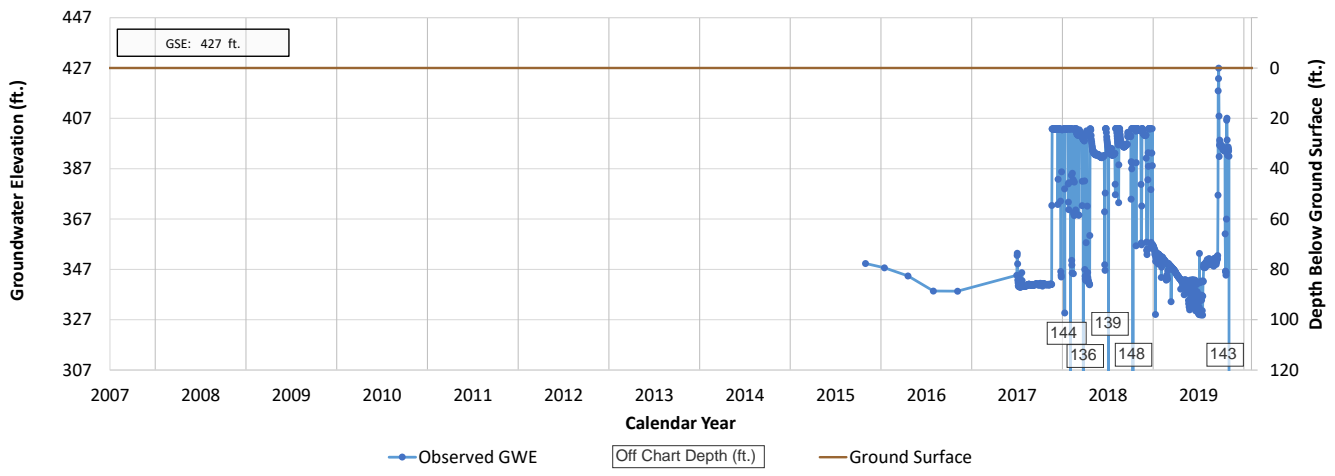


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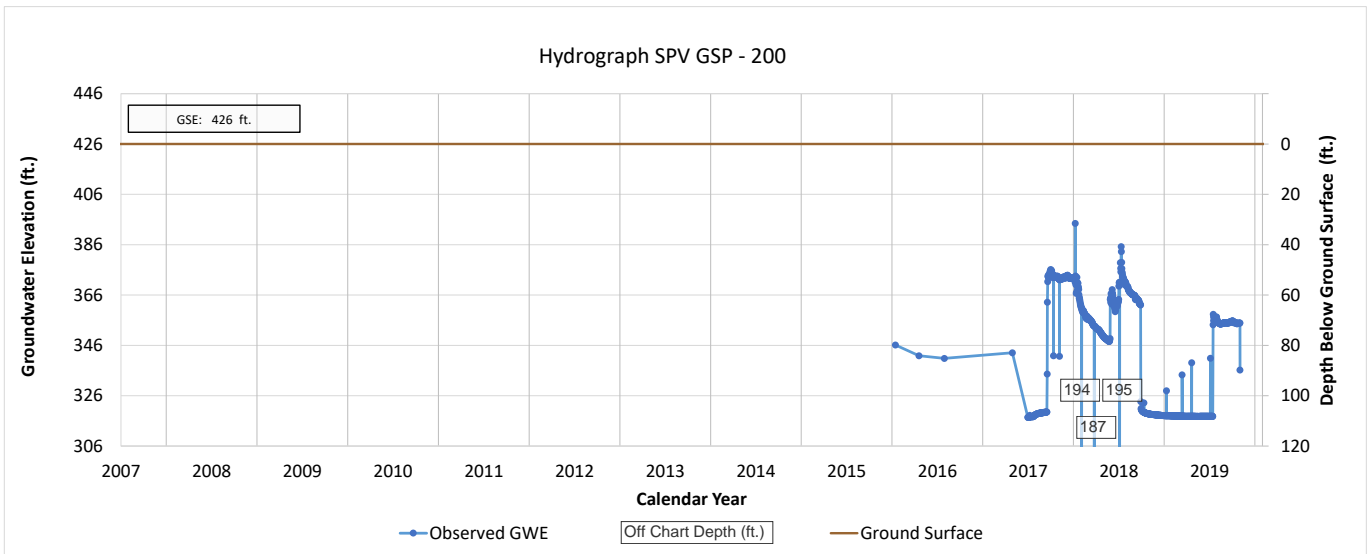


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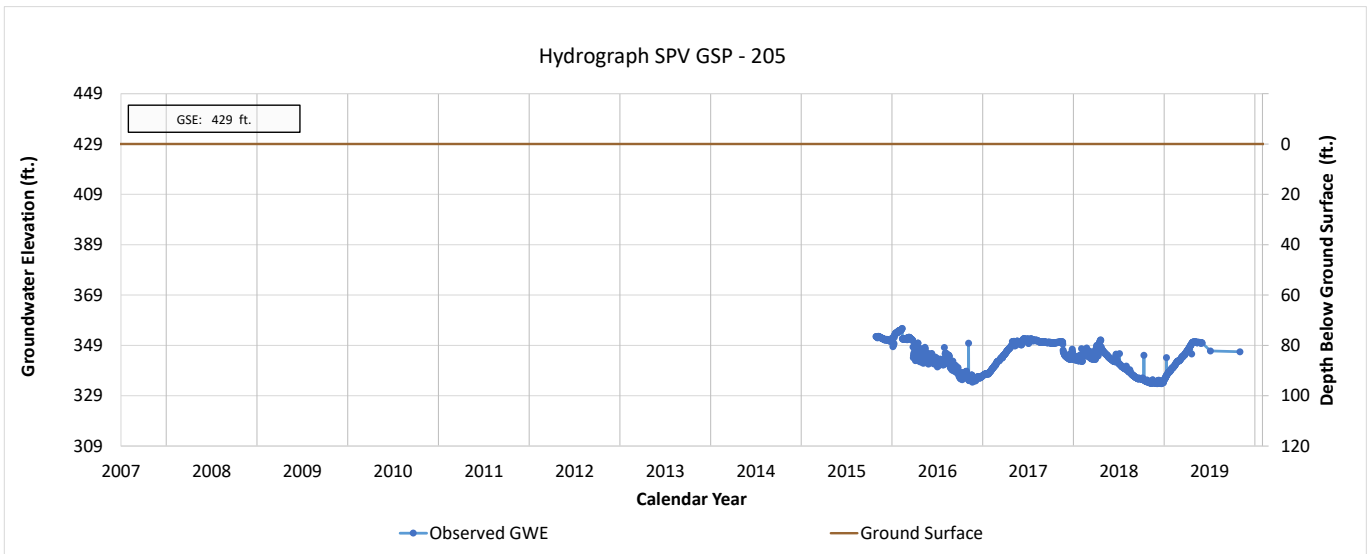
Hydrograph SPV GSP - 199



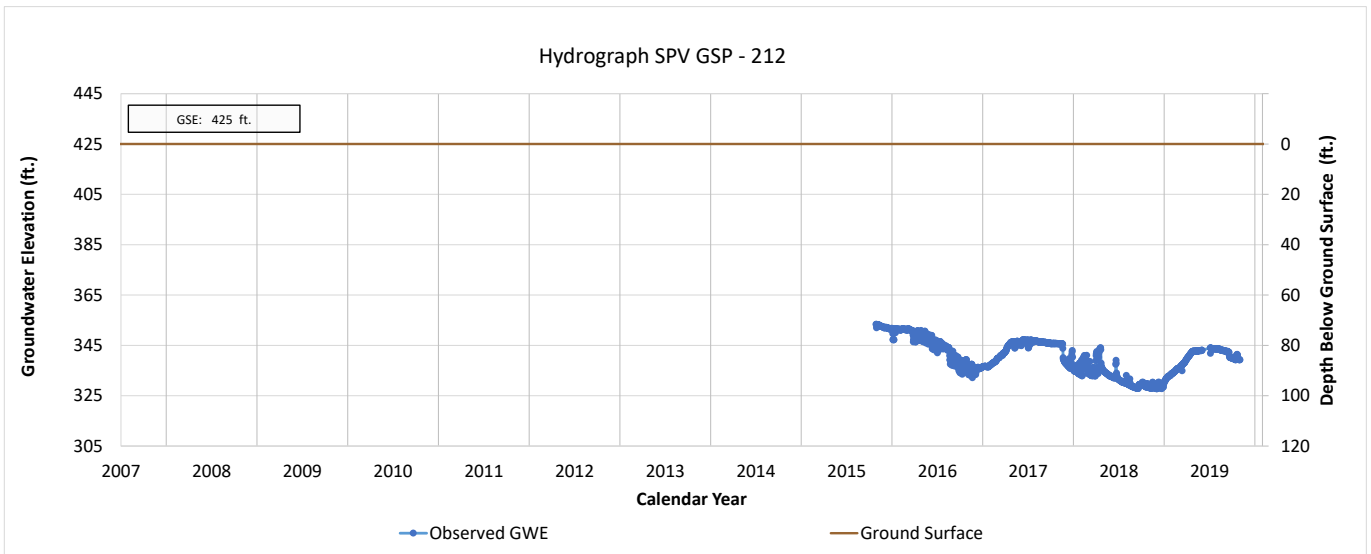
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Monitoring Locations and Measurements for Spring and Fall Months

Local Name	Well Number	First GWL Date	Last GWL Date	March 2010	September 2010	February 2011	September 2011	March 2012	October 2010	January 2013	November 2013	March 2014	September 2014
				DTW	DTW	DTW	DTW	DTW	DTW	DTW	DTW	DTW	DTW
SP110	SPV GSP - 19	2008-01	2019-12	18.0	20.6	12.5	12.6	15.0	20.1	20.3	27.8	29.1	35.7
SP107	SPV GSP - 22	2008-01	2019-12	6.5	14.4	2.9	9.9	9.5	14.4	12.9	18.6	19.5	7.8
SP106	SPV GSP - 23	2008-01	2019-12	5.0	7.3	1.0	6.1	7.5	7.9	8.4	11.0	11.1	13.2
SP100	SPV GSP - 29	2008-01	2019-12	2.8	7.0	1.3	6.2	4.8	8.1	7.5	10.5	10.2	20.3
SP093	SPV GSP - 36	2008-01	2019-12	29.8	49.1	26.0	36.3	40.1	56.6	61.4	-	-	74.4
SP089	SPV GSP - 40	2008-01	2019-12	54.4	53.4	27.9	31.0	32.4	44.2	44.3	61.7	65.4	75.5
SP086	SPV GSP - 43	2008-01	2019-12	51.8	48.7	29.9	23.9	26.8	38.4	37.9	53.7	56.2	67.8
SP073	SPV GSP - 56	2008-01	2019-12	50.9	54.2	26.7	29.9	36.4	45.3	47.7	65.8	69.8	82.3
SP072	SPV GSP - 57	2008-01	2019-12	39.5	50.0	27.7	33.0	41.1	49.7	54.9	-	-	-
SP071	SPV GSP - 58	2008-01	2019-12	18.1	23.0	0.4	26.4	1.3	26.4	5.2	11.7	19.2	26.5
SP070	SPV GSP - 59	2008-01	2019-12	2.1	5.4	1.0	3.6	4.9	9.1	8.1	11.3	10.8	13.2
SP058	SPV GSP - 70	2008-01	2019-12	46.0	46.8	29.0	19.8	20.3	31.5	31.2	44.6	48.2	60.6
SP014	SPV GSP - 114	2011-12	2019-04	-	-	-	-	-	-	10.8	13.4	14.2	-
13S002W12M003S	SPV GSP - 131	2013-02	2019-10	-	-	-	-	-	-	-	11.6	10.9	14.2
13S002W12M002S	SPV GSP - 132	2013-02	2018-08	-	-	-	-	-	-	-	11.3	10.6	14.1
13S002W12M001S	SPV GSP - 133	2013-02	2019-10	-	-	-	-	-	-	-	13.9	10.9	19.4
12S001W34L004S	SPV GSP - 154	2010-12	2019-10	-	-	25.0	19.6	19.8	30.2	29.5	41.5	43.5	55.2
12S001W34L003S	SPV GSP - 155	2011-01	2019-10	-	-	25.3	19.8	19.8	30.3	29.5	41.3	43.5	55.5
12S001W34L002S	SPV GSP - 156	2011-01	2019-10	-	-	25.4	19.9	19.7	30.4	29.4	41.3	43.4	55.3
12S001W30J003S	SPV GSP - 167	2013-03	2019-10	-	-	-	-	-	-	-	15.3	13.4	18.3
12S001W30J004S	SPV GSP - 168	2013-03	2019-10	-	-	-	-	-	-	-	15.2	13.3	18.2
12S001W30J005S	SPV GSP - 169	2013-03	2019-05	-	-	-	-	-	-	-	15.0	13.0	17.8
LWELL000839	SPV GSP - 198	2015-09	2019-10	-	-	-	-	-	-	-	-	-	-
LWELL-000731	SPV GSP - 199	2015-09	2019-10	-	-	-	-	-	-	-	-	-	-
RC-9	SPV GSP - 200	2015-12	2019-10	-	-	-	-	-	-	-	-	-	-
LWELL000839	SPV GSP - 205	2015-09	2019-10	-	-	-	-	-	-	-	-	-	-
LWELL000839	SPV GSP - 212	2015-09	2019-10	-	-	-	-	-	-	-	-	-	-
RW Hillbrecht Domestic Well	SPV GSP - 239	2013-05	2019-10	-	-	-	-	-	-	-	3.7	0.1	0.1

Count of Wells with Measurements by Year and Month

	Spring 2010 DTW	Fall 2010 DTW	Spring 2011 DTW	Fall 2011 DTW	Spring 2012 DTW	Fall 2012 DTW	Spring 2013 DTW	Fall 2013 DTW	Spring 2014 DTW	Fall 2014 DTW
	January	9	9	13	13	15	15	16	16	20
February	0	0	15	15	15	15	6	6	21	21
March	12	12	12	12	15	15	9	9	21	21
September	12	12	15	15	14	14	20	20	21	21
October	0	0	15	15	15	15	20	20	21	21
November	0	0	15	15	15	15	21	21	19	19

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Monitoring Locations and Measurements for Spring and Fall Months

Local Name	Well Number	First GWL Date	Last GWL Date	March 2015 DTW	September 2015 DTW	March 2016 DTW	October 2016 DTW	March 2017 DTW	October 2017 DTW	March 2018 DTW	October 2018 DTW	March 2019 DTW	October 2019 DTW
SP110	SPV GSP - 19	2008-01	2019-12	37.8	40.5	39.6	43.6	-	27.8	32.2	38.9	-	-
SP107	SPV GSP - 22	2008-01	2019-12	24.6	31.6	21.1	30.3	-	-	17.7	11.8	-	-
SP106	SPV GSP - 23	2008-01	2019-12	13.1	14.6	14.2	16.6	-	-	-	11.4	-	-
SP100	SPV GSP - 29	2008-01	2019-12	13.2	15.8	16.4	18.3	-	8.5	11.5	13.8	-	-
SP093	SPV GSP - 36	2008-01	2019-12	-	-	-	-	-	-	-	-	-	-
SP089	SPV GSP - 40	2008-01	2019-12	81.5	91.1	90.1	70.0	-	80.0	80.4	98.6	-	-
SP086	SPV GSP - 43	2008-01	2019-12	-	69.5	69.2	69.3	-	69.4	69.7	-	-	-
SP073	SPV GSP - 56	2008-01	2019-12	86.9	-	100.3	108.4	-	-	-	95.5	-	-
SP072	SPV GSP - 57	2008-01	2019-12	-	-	-	-	-	-	-	-	-	-
SP071	SPV GSP - 58	2008-01	2019-12	53.4	26.1	26.2	26.7	-	22.2	11.2	50.6	-	-
SP070	SPV GSP - 59	2008-01	2019-12	13.4	14.7	14.1	19.1	-	8.5	6.6	12.0	-	-
SP058	SPV GSP - 70	2008-01	2019-12	-	-	-	-	-	-	-	67.8	-	-
SP014	SPV GSP - 114	2011-12	2019-04	16.2	-	-	-	-	-	-	16.6	-	-
13S002W12M003S	SPV GSP - 131	2013-02	2019-10	13.7	16.2	15.8	17.6	2.1	9.1	9.7	14.0	4.2	8.9
13S002W12M002S	SPV GSP - 132	2013-02	2018-08	13.4	16.4	15.8	17.7	2.1	9.1	9.6	-	-	-
13S002W12M001S	SPV GSP - 133	2013-02	2019-10	14.7	24.7	20.3	25.5	7.7	17.0	13.4	22.8	5.8	14.8
12S001W34L004S	SPV GSP - 154	2010-12	2019-10	57.2	63.8	64.7	76.2	59.5	71.3	74.7	84.4	64.4	77.5
12S001W34L003S	SPV GSP - 155	2011-01	2019-10	57.2	64.2	65.0	76.8	60.5	71.7	74.7	84.8	65.8	77.8
12S001W34L002S	SPV GSP - 156	2011-01	2019-10	57.1	64.1	65.0	77.0	60.6	71.8	74.5	85.0	65.9	77.9
12S001W30J003S	SPV GSP - 167	2013-03	2019-10	15.6	19.3	16.0	21.3	6.6	13.2	8.5	16.3	7.5	12.6
12S001W30J004S	SPV GSP - 168	2013-03	2019-10	15.6	19.2	15.9	21.2	6.6	13.2	8.5	16.3	7.4	12.6
12S001W30J005S	SPV GSP - 169	2013-03	2019-05	15.0	18.7	15.3	20.6	6.2	12.9	8.1	15.9	6.9	-
LWELL000839	SPV GSP - 198	2015-09	2019-10	-	71.4	76.4	88.5	82.8	80.4	86.0	99.4	86.0	87.7
LWELL-000731	SPV GSP - 199	2015-09	2019-10	-	77.7	82.6	88.6	-	86.0	80.0	24.3	81.2	32.9
RC-9	SPV GSP - 200	2015-12	2019-10	-	-	84.1	-	83.0	53.1	72.9	107.2	108.2	71.1
LWELL000839	SPV GSP - 205	2015-09	2019-10	-	76.6	81.5	91.9	83.2	78.8	82.5	94.8	82.6	82.5
LWELL000839	SPV GSP - 212	2015-09	2019-10	-	71.8	75.3	87.8	82.5	79.3	86.0	96.8	85.5	85.7
RW Hillbrecht Domestic Well	SPV GSP - 239	2013-05	2019-10	69.9	74.5	80.9	93.1	85.2	53.9	46.1	-	48.0	47.7

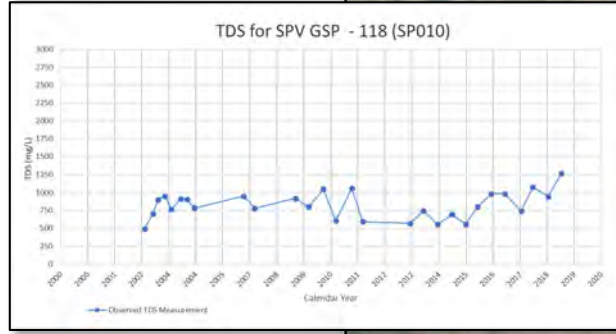
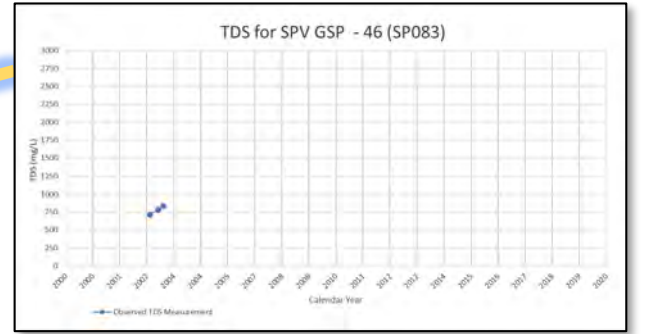
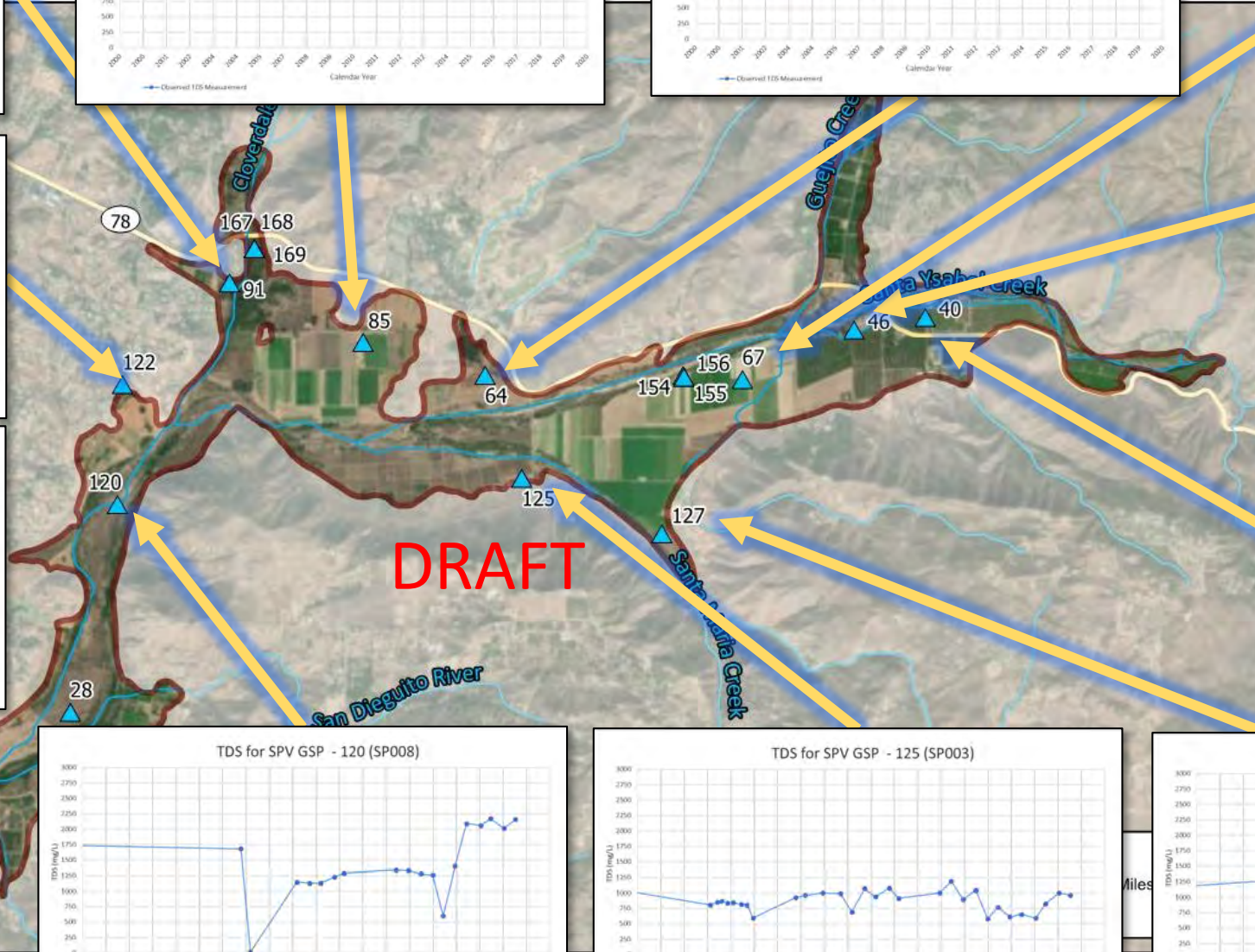
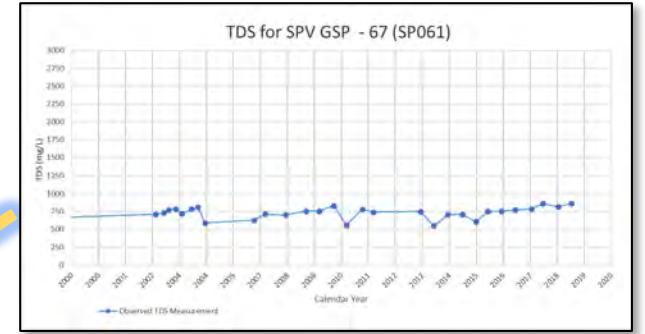
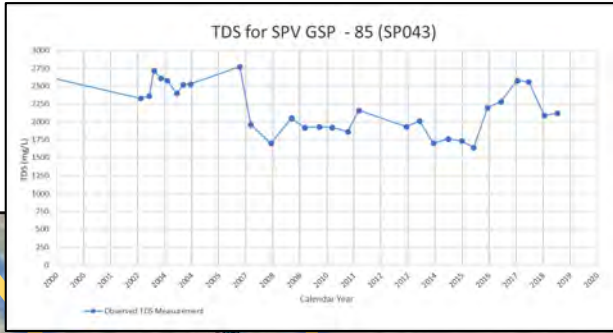
Count of Wells with Measurements in Year and Month

	Spring 2015 DTW	Fall 2015 DTW	Spring 2016 DTW	Fall 2016 DTW	Spring 2017 DTW	Fall 2017 DTW	Spring 2018 DTW	Fall 2018 DTW	Spring 2019 DTW	Fall 2019 DTW
	January	19	19	21	21	12	12	15	15	14
February	18	18	21	21	12	12	21	21	14	14
March	19	19	24	24	14	14	22	22	14	14
September	22	22	20	20	15	15	22	22	12	12
October	22	22	23	23	21	21	23	23	13	13
November	21	21	17	17	18	18	20	20	0	0

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Groundwater Conditions Total Dissolved Solids





Groundwater Conditions Total Dissolved Solids

- Total Dissolved Solids
- From 2015 State of the Basin Report

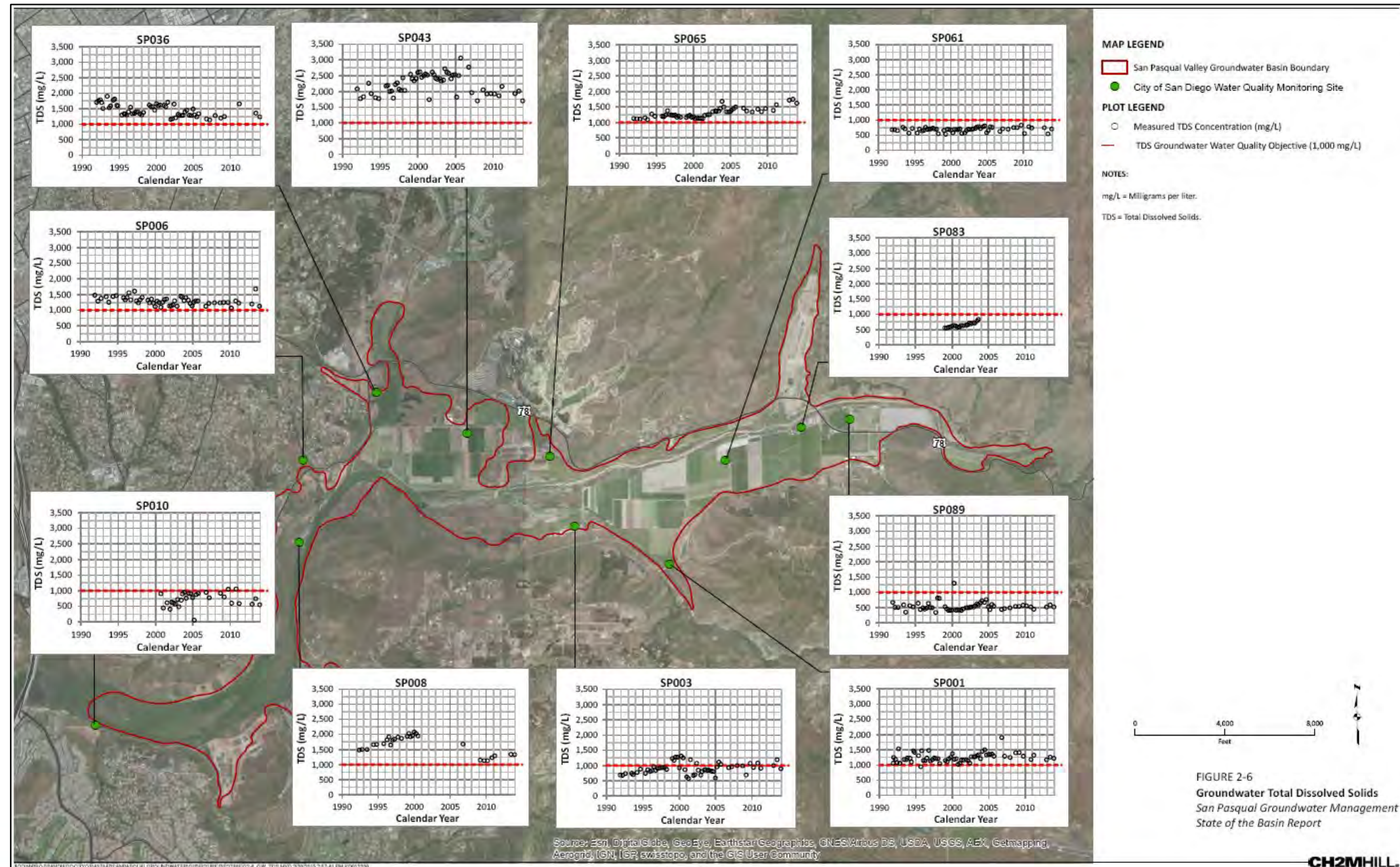
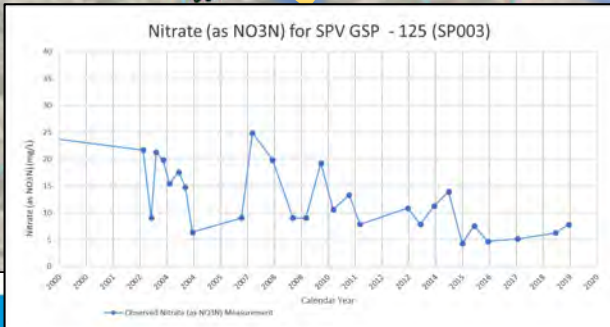
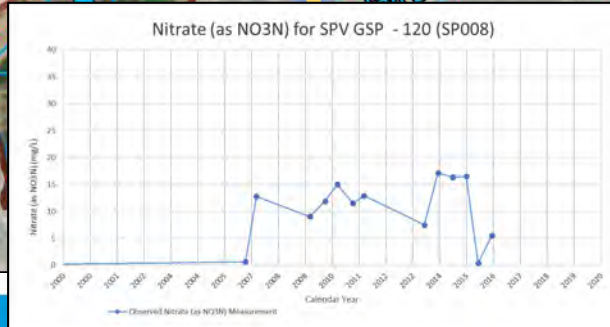
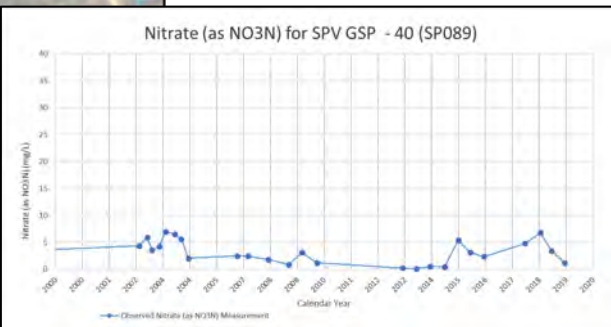
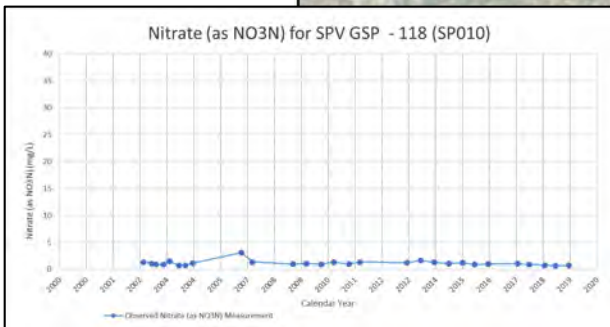
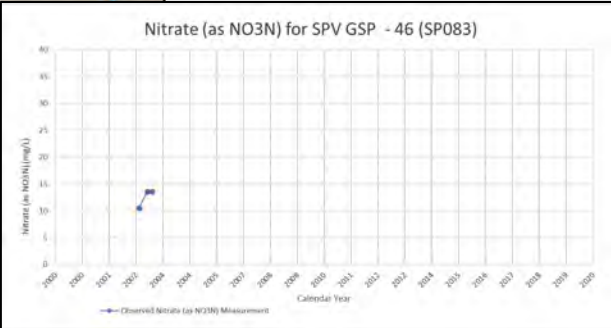
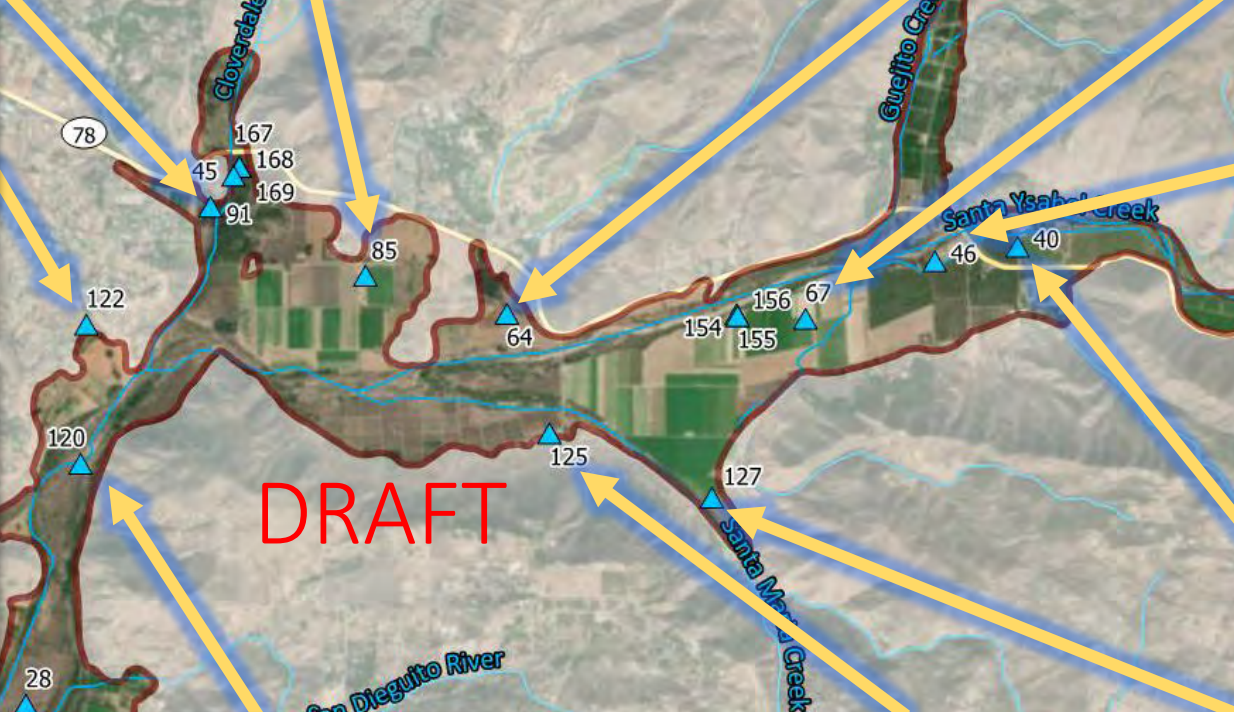
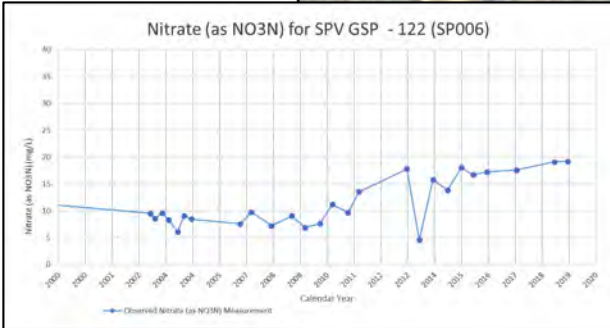
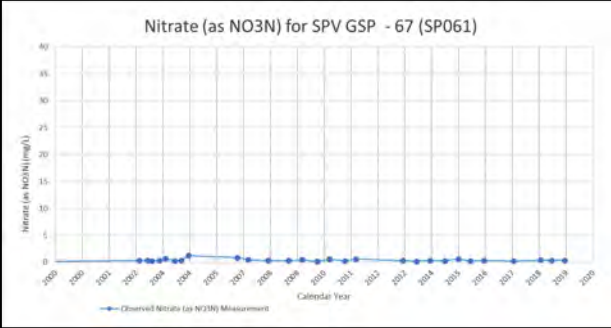
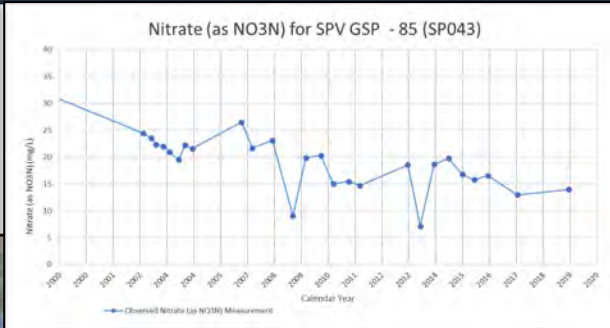
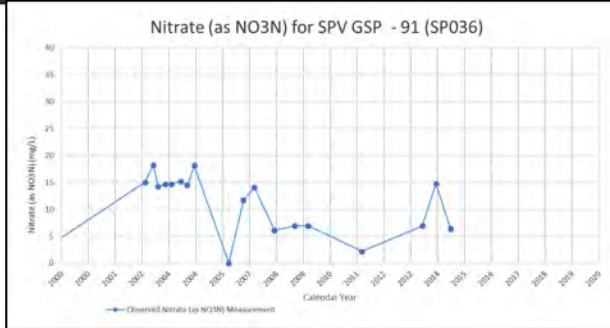


FIGURE 2-6
Groundwater Total Dissolved Solids
San Pasqual Groundwater Management
State of the Basin Report

CH2MHILL



- Nitrate
- From 2015 State of the Basin Report

