GROUNDWATER PROTECTION REPORT FOR L901R & L903R PIPELINES

SANTA BARBARA COUNTY, CA

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## APPENDICES

- Appendix A - Shallow Groundwater Maps
- Appendix B - Geologic and Well Data Maps
- Appendix C - Well Data Summary Table
1.0 INTRODUCTION
This report presents the results of a study of shallow groundwater and/or sensitive aquifers that are potentially within proximity of the Line 901R and Line 903R Pipeline Replacement Project (Project). The purpose for this study is to respond to the Determination of Application Incompleteness issued by Santa Barbara County Planning and Development, Energy and Minerals Division dated September 13, 2017, which requests Plains’ “identify locations where the ROW approaches sensitive aquifers or shallow groundwater. Provide information on potential impact avoidance and/or minimization.”

The report includes identification of areas where the pipelines appear to cross groundwater basins or stream valleys where shallow groundwater may occur and have the potential for domestic or irrigation usage. Upon identification of these potential areas of shallow groundwater occurrence, data has been obtained to evaluate the depth from ground surface to the top of groundwater and the quality of the groundwater. In addition, for each area identified, the characteristics of the Project at that location are discussed along with recommended procedures to avoid or minimize any potential impact to the groundwater.

2.0 PROJECT DESCRIPTION
Proposed Line 901R will consist of a twelve-inch diameter uninsulated steel pipeline installed between the existing Las Flores Pump Station and the existing Gaviota Pump Station, and a sixteen-inch diameter uninsulated steel pipeline installed between the Gaviota Pump Station and the existing Sisquoc Pump Station. Proposed Line 903R will consist of a fourteen-inch uninsulated steel pipeline between the existing Sisquoc Pump Station and the existing Pentland Delivery Point. Existing valve stations will be retrofitted for use with the replacement pipelines. In addition, the new Russell Ranch Pump Station will be constructed in the Cuyama Valley region of San Luis Obispo County, and thirty-one (31) new valve stations will be installed along the pipeline route.

The combined total length of the replacement pipelines will be approximately 123.4 miles. The proposed route will primarily follow the existing Lines 901 and 903, with the exception of three (3) planned deviations. The new pipeline will be rerouted to avoid the densely populated portion of the City of Buellton, and two (2) additional smaller deviations will occur to limit impacts to environmental resources.

The proposed Project spans multiple local, State, and federal jurisdictions as summarized in Tables 1 and 2 below.

<table>
<thead>
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<th>Jurisdiction</th>
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<tr>
<td>San Luis Obispo County</td>
<td>37.1</td>
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<td>Kern County</td>
<td>13.7</td>
</tr>
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<td><strong>Total</strong></td>
<td><strong>123.4</strong></td>
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Table 2- Pipeline Jurisdictional Summary by Agency

<table>
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<tr>
<th>Jurisdiction</th>
<th>Location</th>
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</tr>
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<tr>
<td>California Coastal Zone</td>
<td>--</td>
<td>14.6</td>
</tr>
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<td>California State Parks</td>
<td>Gaviota State Park</td>
<td>4.0</td>
</tr>
<tr>
<td>California Department of Fish and Wildlife</td>
<td>Carrizo Plains Ecological Reserve</td>
<td>4.5</td>
</tr>
<tr>
<td>United States Bureau of Land Management</td>
<td>Carrizo Plain National Monument</td>
<td>3.6</td>
</tr>
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<td>United States Fish and Wildlife Service</td>
<td>Bitter Creek Wildlife Refuge</td>
<td>2.3</td>
</tr>
<tr>
<td>United States Forest Service</td>
<td>Los Padres National Forest</td>
<td>6.3</td>
</tr>
</tbody>
</table>

1. All Coastal Zone jurisdiction is located within Santa Barbara County.
2. All agencies listed in Table 2 are within each of the County jurisdictions in Table 1.

Figure 1 below depicts a cross section of the proposed Temporary Construction Corridor which will be approximately one hundred (100) feet in width with a trench at a minimum depth of seven (7) feet deep to install the replacement pipelines.

Figure 1 – Typical Cross Section of Temporary Construction Corridor

Approximately thirty-five (35) crossings of creeks and other sensitive resources are proposed throughout the 123.4 mile pipeline corridor utilizing Horizontal Directional Drilling (HDD) to avoid surficial impacts. Figure 2 represents a typical crossing utilizing HDD technology. In these areas the pipeline could reach a depth of at least twenty (20) feet below ground surface. Thus various HDD sections likely represent the locations where the pipeline would be the deepest and thus closer to the top of shallow groundwater.

Figure 2 – Typical Cross Section of HDD Crossing
2.1 Defining Shallow Groundwater or Sensitive Aquifers

The County of Santa Barbara’s request included the identification of, “locations where the ROW approaches sensitive aquifers or shallow groundwater.” In this context there is no established legal definition for a “sensitive aquifer” or “shallow groundwater.”

Therefore, “shallow groundwater” was considered groundwater present at a depth that could conservatively come in contact with crude oil subsequent to a pipeline failure. The crude oil transported through the replacement pipeline system is considered “heavy” with an average American Petroleum Institute (API) gravity of 18°. Table 3 below describes the relative difference of crude oil characteristics based on the API gravity. “Heavy” oils are characterized by having a high specific gravity and viscosity and inherently have a greater resistance to flow. In the event of a crude oil release along the pipeline, these properties would greatly increase the likelihood of a successful cleanup before the oil could migrate in significant distance and impact a groundwater supply system.

<table>
<thead>
<tr>
<th>Crude Oil Classification</th>
<th>API Gravity</th>
<th>Common Equivalent Liquids</th>
<th>API Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Crude Oil</td>
<td>&gt;30°</td>
<td>Gasoline</td>
<td>47°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>West Texas Intermediate</td>
<td>39.6°</td>
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<td>Medium Crude Oil</td>
<td>22-30°</td>
<td>Motor Oil</td>
<td>28°</td>
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<tr>
<td>Heavy Crude Oil</td>
<td>22-10°</td>
<td>Water*</td>
<td>10°</td>
</tr>
<tr>
<td>Extra Heavy Crude Oil</td>
<td>&lt;10°</td>
<td>Asphalt</td>
<td>8°</td>
</tr>
</tbody>
</table>

*oil with an API > 10° will float on water

A long-term research project sponsored by the U.S. Geological Survey Toxic Substances Hydrology Program investigated the effects of a 1979 crude oil release that occurred due to a pipeline rupture. This study monitored the migration of oil into the subsurface and subsequently groundwater for 17 years by analyzing groundwater samples of approximately 370 wells. The results of the study indicate that crude oil had only migrated to a depth of approximately six (6) meters (equivalent of approximately 20 feet) below ground surface. 1 This potential oil migration distance combined with the Project’s typical pipeline depth of 5-7 feet, indicates that crude oil releases from the Project would be unlikely to impact groundwater greater than 25-30 feet below ground surface (bgs) for the majority of the replacement pipeline system. However, as noted before, in areas of proposed Jack and Bore or HDD installation the replacement pipeline system could be located in excess of 20-30 foot bgs. In those limited areas, a conservative assumption that crude oil could encounter groundwater at a maximum depth of fifty (50) feet bgs will be assumed. Based on this conclusion, and to further ensure that the results of this study were conservative in nature, “shallow groundwater” was subsequently defined as groundwater within one-hundred (100) feet of the ground surface.

Lastly, for the purposes of this report, a “sensitive aquifer” is considered an area of groundwater with known or potential use for drinking water, agriculture irrigation, or similar use.

3.0 METHODS

The following methodology was used in determining where shallow groundwater or sensitive aquifers may potentially occur within proximity to the Project:

1. Identify regional groundwater basins that the pipeline corridor overlies.

2. Within the selected groundwater basins, identify any geologic formation that is known to contain groundwater.

3. Identify any additional groundwater bearing geologic formations associated with major rivers and creeks that the pipeline traverses.

4. Of the geologic formations that contain groundwater:
   a. Identify whether or not the replacement pipelines overlie the formation that contains groundwater. Thomas Dibblee geologic quadrangles were plotted in ArcMap Geographic Information Systems (GIS) to further analyze which formations the pipeline corridor overlies.
   b. Review sources such as the California’s Department of Water Resources (DWR) online water data library\(^2\) as well as Santa Barbara County’s well records to verify the existing groundwater level in each water bearing geologic formation.

5. Examine the entire length of the pipeline with Dibblee geologic maps and known groundwater wells to further refine the presence of shallow groundwater in proximity to the pipeline. This step was completed to analyze areas the pipeline traverses that are not associated with a groundwater basin.

6. Digitize the perimeter of all identified geologic formations with a potential groundwater depth of less than one-hundred (100) feet bgs utilizing GIS mapping systems and transect the proposed pipeline corridor with this shallow groundwater extent.

7. Where the pipeline corridor transects potentially shallow groundwater, representative well data was reviewed to verify whether or not the chemical composition of the groundwater is viable for use as drinking water, agricultural irrigation, etc. or verify the current use (drinking water, irrigation, etc.) of the groundwater associated with well records. If records indicate that a groundwater well in a geologic formation is either currently being used to produce water for drinking or irrigation or the chemical composition of the groundwater could satisfy California Drinking Water Standards, the groundwater within that geologic formation was considered a sensitive aquifer.

Geologic maps, groundwater data, and historical reports pertinent to the Line 901R and 903R corridor were examined to determine potential areas of shallow groundwater or sensitive aquifers. For convenience, two (2) sets of map series were created to divide the pipeline into sixteen (16) segments that will allow for easier reference throughout this report (Appendix A). Please refer to Figures 3 and 4 below for overview exhibits of these map series.

\(^2\)http://www.water.ca.gov/waterdatalibrary/
- Historical Groundwater Depth Map Series – Displays historical groundwater depth data obtained from the California Department of Water Resources.
- Geologic Map Series – Displays the pipeline overlain on geologic quadrangles published by Thomas Dibblee.

Figure 3 – Historical Groundwater Depth Map Series

Figure 4 – Geologic Map Series
4.0 POTENTIAL SHALLOW GROUNDWATER & SENSITIVE AQUIFERS

In order to determine the location of shallow groundwater and the potential for sensitive aquifers, groundwater basins were identified with known water depths of less than one hundred (100) feet bgs and the locations of significant river crossings where water depths are significantly closer to ground level.

4.1 Identified Groundwater Basins

The proposed pipeline corridor crosses six (6) groundwater basins as listed below and illustrated in Figure 5:

1. Santa Ynez River Valley
2. San Antonio Creek Valley
3. Santa Maria River
4. Cuyama Valley
5. Carrizo Plain
6. San Joaquin Valley

Figure 5 – Groundwater Basins & Major River/Creek Crossings

These groundwater basins are defined in the California Code of Regulations as an “…aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom…”

3 California’s Groundwater Bulletin 118 Interim Update 2016.
Based on further analysis of geologic formations and known water well data, there are three (3) groundwater basins that contain shallow groundwater in the vicinity of the Project. These basins include the Santa Ynez River Valley, Santa Maria River Valley, and the Cuyama Valley. These groundwater basins of concern and the significant river crossings will be described in further detail below.

4.2 Shallow Groundwater Analysis
The pipeline route was plotted on geology outcrop maps obtained from the Dibblee Foundation (see Appendix B for individual map quadrangles used in this report). The maps were studied to determine the surficial deposits along the pipeline route. For the majority of the route, the pipeline crosses over consolidated or semi-consolidated rock formations that are not water bearing at surface or near surface. However, there are several areas where the pipeline crosses stream/river beds filled with alluvium and where shallow groundwater may be present. Each of these stream or river crossings were further studied to determine if groundwater is present at shallow depths, generally considered to be one-hundred (100) bgs or less. Groundwater wells for each of these areas were located and determinations were made as to the depth of water. Using these methods, five (5) geographical areas along the pipeline route were identified as having shallow groundwater that is used for domestic and/or irrigation purposes. The five (5) pipeline areas of interest from south to north are as follows:

1. Las Flores to Gaviota Canyon
2. Santa Ynez River on the West Side of Buellton
3. Foxen Canyon Creek
4. Santa Maria Valley/Sisquoc River
5. Cuyama River

1. Las Flores to Gaviota Canyon
Between the pump station at Las Flores Canyon and Gaviota Canyon on the west, the pipeline traverses the south slope of the Santa Ynez Mountains. The Project proposes a multitude of HDD locations along the Gaviota stretch to minimize impacts to various riparian areas, major creeks (Gaviota and Refugio), and other environmentally sensitive resources. For most of this west-trending segment, the pipeline crosses over alluvial terraces, and Tertiary Monterey Formation and Vaqueros Sandstone bedrock. Several stream channels or arroyos cut through these rocks that contain various amounts of Recent alluvium overlying the Monterey and Vaqueros bedrock deposits.

Studies conducted along the coastline from the Las Flores area to the Gaviota Canyon have indicated that groundwater is present in the consolidated Tertiary rocks underlying the bluffs and south slopes of the Santa Ynez Mountains, particularly the Monterey, Sespe and Vaqueros rocks, and also in the alluvial sediments that have accumulated along
the stream valley floors. However, the Gaviota coast lacks true aquifers so groundwater resources are a limiting factor to development. Most of the groundwater extracted in this area is too hard for domestic use without treatment, and salinity was found at hazardous concentrations in many wells suggesting seawater intrusion in alluvial areas along the coast.

Several groundwater supply wells have been drilled along the coast in this area and in the intervening canyons. Appendix B, Map Series 1, 2, and 3 show well locations for wells with groundwater levels of approximately one hundred (100) feet or less bgs. Research of the well completion data for the shallow-producing wells indicates that most of the wells produce from Monterey fractured shales, Vaqueros sandstone and Sespe sandstone. One of the noted wells was drilled in the coastal strip and appears to be producing from Recent alluvium overlying Monterey rocks. Groundwater levels in these shallow wells range from 10 feet bgs to 32 feet bgs as recorded at the time of drilling. Drill dates range from 1967 to 1986. Most of the wells were drilled for domestic or irrigation purposes and produce low volumes of water. There were no wells found within the DWR databases that indicate more recent groundwater-level monitoring in these or any other wells along this coastline. Table 4 below lists available groundwater well data from Las Flores to the Gaviota Canyon. The “Reference Well ID” corresponds to the wells shown on the Map Series in Appendix B.

**Table 4 – Las Flores to Gaviota Canyon Groundwater Wells**

<table>
<thead>
<tr>
<th>Map Series</th>
<th>Reference Well ID</th>
<th>Groundwater Depth bgs (feet)</th>
<th>Year Recorded</th>
<th>Formation</th>
<th>Geographic Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>21</td>
<td>1969</td>
<td>Landslide Debris</td>
<td>South Coast - Refugio Canyon</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>27</td>
<td>1967</td>
<td>Monterey</td>
<td>South Coast - Refugio Canyon</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>32</td>
<td>1967</td>
<td>Monterey</td>
<td>South Coast - Refugio Canyon</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>NR</td>
<td>1956 Completion</td>
<td>Alluvium</td>
<td>South Coast - Refugio State Beach</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>31</td>
<td>1981</td>
<td>Monterey</td>
<td>South Coast - Tajiguas Canyon</td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>6</td>
<td>20</td>
<td>1980</td>
<td>Monterey</td>
<td>South Coast - Arroyo Quemado</td>
</tr>
</tbody>
</table>

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5 Santa Barbara County Planning and Development, 2016, Gaviota Coast Plan.

6 Santa Barbara County 2011 Groundwater Report.
In the Gaviota Canyon area, the pipeline makes a short turn northward, paralleling Highway 101 on the east side, then turns west again, crossing beneath the creek that flows through the canyon. At this point, the canyon broadens to approximately 1,000 feet to 1,200 feet wide and is alluvial filled. Data for two groundwater wells, Well 12 and 13, was found within the alluvium and to the north where the canyon narrows. Well 12 is present just north of the pipeline crossing and historically has been used to supply water for the Gaviota State Park. Although this well is inactive, Mr. Nathaniel Cox of the California State Parks Service indicated that the well is scheduled to be rehabilitated for Park water supply. Well 13 is located approximately one-quarter mile south of the rest stop on the east side of Highway 101. This well produces from Sespe and Vaqueros sandstone beginning at 160 feet bgs. When this well was drilled in 1985, the depth to the top of water was 31 feet bgs.

Two additional shallow groundwater wells, Well 14 and 15, were drilled on or near the Las Cruces School, approximately 2.5 miles north of the coast at Gaviota Beach. Well 14 was drilled south of the school and completed as a domestic well at a depth of 50 feet bgs in alluvium. The depth to top of groundwater in this well is not known. Well 15 was drilled in 2008 on the west side of the school and completed in Tertiary Gaviota and/or Sacate formations at a depth of 100 to 200 feet bgs. The well was drilled for domestic and irrigation purposes; the depth to the top of groundwater at the time of completion was 36 feet. There is no known groundwater basin in the Las Cruces area. The pipeline crosses an ephemeral stream tributary to the Gaviota Canyon creek approximately one-quarter mile west of the Las Cruces School site.

2. Santa Ynez River on the West Side of Buellton

In the Buellton area, the pipeline will be rerouted from its current location to an alignment west of the developed part of the City. Currently, the pipeline crosses beneath
a residential area which has been developed in the years since the pipeline was constructed. The new route will bypass this more recent development and cross beneath the Santa Ynez River west of the City.

The Santa Ynez River bed at the pipeline crossing (Figure 6) is approximately three hundred (300) feet above sea level. North of the floodplain is a dissected river terrace which rises approximately twenty (20) to one-hundred (100) feet above the river bed and is underlain by sand and gravel floodplain deposits. Extending north of the floodplain, the terrain rises another 200 feet and is comprised of older alluvium overlying Pleistocene Paso Robles Formation. South of the river bed the floodplain rises approximately twenty (20) to forty (40) feet and terminates abruptly against consolidated Tertiary rocks. At the point of the pipeline crossing, the Santa Ynez River bed is approximately 850 feet wide. Approximately 1,725 feet of the pipeline in this area will be bored beneath the riverbed and adjacent floodplain. The point at which the pipeline runs beneath Highway 246 north of the River also will be bored. The remainder of the by-pass pipeline will be trenched (refer to Appendix B, Map Series 5).

Figure 6 – Santa Ynez River Crossing
The pipeline crosses through the Santa Ynez River Valley Groundwater Basin within the Buellton Subarea (Wilson, 1959). In the Buellton Subarea, the alluvial fill of the river floodplain extends to a maximum thickness of ninety-two (92) feet bgs. The area is bounded on the south by consolidated Tertiary rocks and on the north by the water-bearing deposits of the Paso Robles formation and Careaga sand. Underflow from these two formations, along with surface flow and rainfall, comprise the recharge sources to this subarea (Wilson, 1959). Recent monitoring of DWR wells within the area of the crossing has indicated that groundwater in and adjacent to the Santa Ynez River floodplain may be as shallow as thirty-seven (37) feet bgs (refer to Appendix B, Map Series 5). Table 5 below lists available groundwater well data in the vicinity of the Santa Ynez River near Buellton.

Table 5 – Santa Ynez Groundwater Wells

<table>
<thead>
<tr>
<th>Map Series</th>
<th>Reference Well ID</th>
<th>Groundwater Depth bgs (feet)</th>
<th>Year Recorded</th>
<th>Formation</th>
<th>Geographic Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>16</td>
<td>39</td>
<td>2017</td>
<td>Alluvium</td>
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<td>17</td>
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<td>Santa Ynez River</td>
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<td>Alluvium</td>
<td>Santa Ynez River</td>
</tr>
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<td>19</td>
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<td>2008</td>
<td>Alluvium</td>
<td>Santa Ynez River</td>
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<td>5</td>
<td>20</td>
<td>60</td>
<td>2017</td>
<td>Alluvium</td>
<td>Santa Ynez River</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>79</td>
<td>2017</td>
<td>Alluvium</td>
<td>Santa Ynez River</td>
</tr>
</tbody>
</table>

3. **Foxen Canyon Creek**

The pipeline crosses through the Foxen Canyon in the southwest quarter of Section 6, T8N, R31W. At this point, Foxen Canyon is approximately 1,000 feet wide; elevation in the area of the crossing is approximately 880 feet above sea level. Within Foxen Canyon are two (2) creek crossings and the crossing beneath Foxen Canyon Road. Adjacent to Foxen Canyon Road on the north side of the canyon is a tributary to the Sisquoc River named Asphaltum Creek. The crossing of the road and creek will be bored and is estimated at 320 linear feet. On the south side of the canyon is an unnamed tributary to Asphaltum Creek. This crossing also will be bored and is projected to be approximately 200 linear feet. The area between the two creek crossings will be trenched.

Foxen Canyon is bounded on the south by the Solomon Hills and on the north by the foothills of the San Raphael Mountains. Diatomaceous claystone of the Mio-Pliocene Sisquoc crop out adjacent to the canyon on the south and hard siliceous shales and diatomites of the Miocene Monterey Formation are exposed on the north side (Dibblee, 1994). The floor of Foxen Canyon at the crossing consists of sand and gravel alluvial sediments. Shallow water well data indicates that these sediments extend to approximately eighty (80) feet to one-hundred (100) feet below bgs and overlie Monterey Formation rocks.
A search of the Santa Barbara County water well files found four (4) wells in the area of the pipeline crossing in Foxen Canyon which penetrate and are completed in the Recent alluvium and one (1) well that is completed in the Careaga sand formation. The respective well locations are shown on Map Series 7 in Appendix B. Water pumped from these wells is used for domestic and agricultural purposes. The depth to the top of groundwater in this area may be as shallow as ten (10) feet bgs. Table 6 below lists available groundwater well data in the vicinity of Foxen Canyon.

Table 6 – Foxen Canyon Groundwater Wells

<table>
<thead>
<tr>
<th>Map Series</th>
<th>Reference Well ID</th>
<th>Groundwater Depth bgs (feet)</th>
<th>Year Recorded</th>
<th>Formation</th>
<th>Geographic Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>26</td>
<td>NR</td>
<td>NR</td>
<td>Careaga Sand</td>
<td>Foxen Canyon</td>
</tr>
<tr>
<td>7</td>
<td>27</td>
<td>~50</td>
<td>NR</td>
<td>Alluvium</td>
<td>Foxen Canyon</td>
</tr>
<tr>
<td>7</td>
<td>28</td>
<td>NR</td>
<td>NR</td>
<td>Alluvium</td>
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<td>Foxen Canyon</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td>9</td>
<td>1993</td>
<td>Alluvium</td>
<td>Foxen Canyon</td>
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</tbody>
</table>

4. Santa Maria Valley/Sisquoc River

The pipeline crosses the eastern end of the Santa Maria Valley. It enters the valley east of Foxen Canyon, crossing beneath the Sisquoc River (tributary to the Santa Maria River) and traversing the Santa Maria mesa north of the River in a north-northeast direction (Figure 7). The pipeline will be bored beneath the Sisquoc River bed, projected to be 2,181 linear feet. The floodplain of the River to the north and south will be trenched, as will the older alluvial terrace north of the floodplain. North of the terrace, the Monterey Formation outcrops, and the pipeline will be turned to the west-northwest and trenched through consolidated rock.

A search of the DWR online databases identified three (3) groundwater wells within the Sisquoc River floodplain upstream and downstream of the pipeline crossing as shown in Map Series 8. Recent surveys in these wells indicate a depth to groundwater ranging from thirty-two (32) feet bgs in the upstream well to one-hundred and eight (108) feet bgs in the downstream well. Water from these wells is used for irrigation purposes and is of potable quality. Table 7 below lists available groundwater well data in the Santa Maria Valley and along the Sisquoc River.
5. **Cuyama River**

The pipeline segment that travels through the Cuyama Valley (Line 903R) crosses the Cuyama River between Valves 3-700 and 3-800 and then parallels the river for approximately twenty-five (25) miles (Figure 8 and Map Series 10 through 13). At the River crossing, the pipeline will be bored beneath the Cuyama River bed, projected to be 545 linear feet. The elevation of the Cuyama River at the crossing is approximately 1,300 feet above sea level. Moving east of this river crossing, the pipeline parallels the north side of the Cuyama River and is primarily situated in younger and older alluvium.
A search of the DWR online databases found multiple groundwater wells along the Cuyama River that range from thirty (30) to one-hundred and sixty-five (165) feet bgs. Table 8 below lists available groundwater well data in the Cuyama Valley in proximity to the pipeline.

**Figure 8 – Cuyama River Crossing**

![Cuyama River Crossing Map](image)

**Table 8 – Cuyama Valley Groundwater Wells**

<table>
<thead>
<tr>
<th>Map Series</th>
<th>Reference Well ID</th>
<th>Groundwater Depth bgs (feet)</th>
<th>Year Recorded</th>
<th>Formation</th>
<th>Geographic Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>37</td>
<td>7</td>
<td>2008</td>
<td>Stream Channel</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>12</td>
<td>38</td>
<td>57</td>
<td>1968</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>12</td>
<td>39</td>
<td>30</td>
<td>1966</td>
<td>Stream Channel</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>12</td>
<td>40</td>
<td>39</td>
<td>1968</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>12</td>
<td>41</td>
<td>110</td>
<td>1966</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>12 &amp; 13</td>
<td>42</td>
<td>38</td>
<td>1966</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>13</td>
<td>43</td>
<td>27</td>
<td>1967</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>13</td>
<td>44</td>
<td>235</td>
<td>2017</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>13</td>
<td>45</td>
<td>53</td>
<td>1966</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>13</td>
<td>46</td>
<td>41</td>
<td>1966</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>13 &amp; 14</td>
<td>47</td>
<td>165</td>
<td>2008</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
<tr>
<td>13 &amp; 14</td>
<td>48</td>
<td>46</td>
<td>1966</td>
<td>Alluvium</td>
<td>Cuyama River</td>
</tr>
</tbody>
</table>
**4.3 Sensitive Aquifer Analysis**

As described in Section 2.1 above, for the purposes of this Report it is assumed that any shallow groundwater with the potential to be impacted by future pipeline operations constitutes a sensitive aquifer if there is evidence that it is currently being used for residential water supply, agricultural irrigation, or similar activity; or the groundwater exhibits chemical characteristics that would make it easily treatable for such a beneficial use. To verify this potential for sensitive aquifers, well records of representative wells for each of the five (5) shallow groundwater geographic regions were examined for water quality data. As illustrated in Table 9 below, in situ water quality in these shallow groundwater regions ranged from a low of 675 milligrams per liter (mg/L) of Total Dissolved Solids (TDS) to a high of 1,543 mg/L TDS. California Drinking Water Standards recommend that public water supplies have a TDS of 500 mg/L and require that public water supplies have a TDS lower than 1,000 mg/L. As such, all of the representative shallow aquifer well data indicates that in situ groundwater could be utilized for drinking water with little to no treatment. One well, located at Refugio State Beach, has TDS that exceeds the State standard but such water could be relatively easily and economically treated for potable use. As a result, all shallow groundwater identified in this Report is also considered to be a potentially sensitive aquifer.

**Table 9 – Representative Water Quality & Use Data**

<table>
<thead>
<tr>
<th>Region</th>
<th>Sub-Region</th>
<th>Station Name</th>
<th>Date Recorded</th>
<th>TDS (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Coast</td>
<td>Refugio State Beach</td>
<td>05N30W31N002S</td>
<td>1965</td>
<td>1,543</td>
</tr>
<tr>
<td></td>
<td>Gaviota Canyon</td>
<td>05N32W33H001S</td>
<td>1959</td>
<td>675</td>
</tr>
<tr>
<td>Santa Ynez River</td>
<td>n/a</td>
<td>06N31W17L001S</td>
<td>1973</td>
<td>782</td>
</tr>
<tr>
<td>Foxen Canyon</td>
<td>n/a</td>
<td>unknown</td>
<td>1993</td>
<td>876</td>
</tr>
<tr>
<td>Sisquoc River</td>
<td>n/a</td>
<td>09N32W17F003S</td>
<td>1963</td>
<td>900</td>
</tr>
<tr>
<td>Cuyama River</td>
<td>n/a</td>
<td>10N27W03L001S</td>
<td>1966</td>
<td>748</td>
</tr>
</tbody>
</table>
5.0 CONCLUSIONS AND MITIGATION MEASURES

Through this analysis, SCS identified six (6) groundwater basins the pipeline overlies. Of the six (6) groundwater basins, three (3) were identified to have potentially shallow groundwater; the Santa Ynez River Valley, the Santa Maria River, and the Cuyama Valley.

5.1 Shallow Groundwater & Sensitive Aquifer Conclusions

After examining the pipeline route using Dibblee Geologic Maps as well as groundwater well data obtained from the DWR and the County of Santa Barbara well records, it was determined that the pipeline transects five (5) geographic areas that have potential to contain shallow groundwater as summarized in Table 10 below. All such shallow groundwater has the potential for residential or agricultural use and thus is also considered a sensitive aquifer for the purposes of this report.

Within the five (5) geographic regions, the pipeline corridor potentially transects an approximate maximum of 40.2 linear miles of shallow groundwater which could be less than one-hundred (100) feet bgs. This represents approximately one-third, or 32.5%, of the total pipeline corridor. The vast majority of the pipeline corridor that overlies potentially shallow groundwater is located within the Cuyama Valley (approximately 32.4 miles, or 91% of the 40.2 linear miles of shallow groundwater). This is an extremely conservative assumption based upon an entire geologic formation maintaining a relatively shallow depth only found in a portion of each basin’s respective wells. For instance, research indicated that groundwater can be found as shallow as seven (7) feet bgs in Cuyama Valley, however the average depth of groundwater throughout the region is approximately eighty-five (85) feet bgs. Therefore, throughout most of this 40.2 mile extent, the typical depth of the pipeline (5-7 feet) would limit the pipeline’s exposure to groundwater where average depth in these shallow groundwater varies from 29.75 to 110.83 feet bgs. Where boring or HDD would take the pipeline to a greater depth, the relative risk to shallow groundwater would increase. The total length of boring and HDD installation in shallow groundwater areas is limited to approximately 2.87 miles (2%) of the total 123.4 mile replacement pipeline system. Figure 9 below illustrates locations where the pipeline intersects with the identified potentially shallow groundwater and/or sensitive aquifers. Refer to Appendix A for further mapping detail of pipeline locations within shallow groundwater areas.
<table>
<thead>
<tr>
<th>Geographic Area/Shallow Aquifer</th>
<th>Shallowest Water Depth (Feet BGS)</th>
<th>Deepest Water Depth (Feet BGS)</th>
<th>Average Water Depth (Feet BGS)</th>
<th>Approximate TDS (mg/L)</th>
<th>Miles of Pipeline in Shallow Aquifer</th>
<th># of Bores that Intersect Shallow Groundwater</th>
<th>Total Linear Feet of Boring in Shallow Groundwater</th>
<th>Total Linear Miles of Boring in Shallow Groundwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Flores to Gaviota</td>
<td>10</td>
<td>105</td>
<td>29.75</td>
<td>600-1500</td>
<td>3.13</td>
<td>12</td>
<td>5,013</td>
<td>0.95</td>
</tr>
<tr>
<td>Santa Ynez River</td>
<td>39</td>
<td>79</td>
<td>48.83</td>
<td>800</td>
<td>2.41</td>
<td>3</td>
<td>2,062</td>
<td>0.39</td>
</tr>
<tr>
<td>Foxen Canyon</td>
<td>9</td>
<td>50</td>
<td>29.5</td>
<td>850</td>
<td>0.33</td>
<td>2</td>
<td>521</td>
<td>0.1</td>
</tr>
<tr>
<td>SM Valley/Sisquoc River</td>
<td>32</td>
<td>175</td>
<td>110.83</td>
<td>900</td>
<td>1.17</td>
<td>2</td>
<td>2,278</td>
<td>0.43</td>
</tr>
<tr>
<td>Cuyama Valley</td>
<td>7</td>
<td>235</td>
<td>85.61</td>
<td>750</td>
<td>33.16</td>
<td>14</td>
<td>5,256</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40.2</strong></td>
<td><strong>33</strong></td>
<td><strong>15,130</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 9 – Pipeline Intersection with Sensitive Aquifers
5.2 Release Prevention Measures

Although the proposed pipeline route overlies areas where potentially shallow aquifers/groundwater exist, avoiding releases of crude oil is the primary method that these aquifers can be protected. The following measures should be utilized to limit the likelihood of crude oil releases and subsequent groundwater impacts:

1. Operation of a SCADA system including pressure alarms to prevent major releases and flow monitoring/mass balance meters to detect slow/minor releases.
2. Conduct regular pig runs to identify pipeline weakness and repair/replace pipeline sections promptly.
3. Install cathodic protection throughout the pipeline corridor.
4. Construct the pipelines without insulation, to limit moisture and external corrosion.
5. Provide adequate sized secondary containment around Sisquoc Crude Oil Break-out Tank.
6. Install additional control valves, in conformance with the EFRD, to increase shut-down capacity of pipeline and decrease maximum release volumes.
7. Conduct visual monitoring of the pipeline route including aerial and ground surveys.

5.3 Post Release Procedures

In the unlikely instance that a release of crude oil occurs, the following procedures are recommended to protect and remediate shallow groundwater.

The most effective method of protecting groundwater is to contain a crude oil release as quickly and effectively as possible. The less crude oil on the ground/water surface, the less crude oil will penetrate the shallow groundwater supply. To minimize the effects in the unlikely event of a crude oil release that reaches groundwater, the following measures are recommended:

1. Prior to pipeline operation:
   a. Develop and maintain plans for monitoring and early detection of groundwater contamination, including aerial and ground surveys, pipeline pressure monitoring, and water sampling of strategic groundwater wells, if appropriate;
   b. Develop and maintain plans for notification of affected groundwater users, and the Emergency Services Coordinator, in the event of a crude oil release;
   c. Develop and maintain plans regarding containment, clean-up response, habitat restoration, and methods to determine and correct the contamination source including the installation of recovery wells and interceptor trenches; and
2. In the event of a crude oil release which has the potential to cause any groundwater contamination:
   a. The pipeline operator will notify the likely affected groundwater/well users. The pipeline operator will also begin monitoring of those wells immediately adjacent
to the release locations on a daily basis until the surface spill is cleaned-up, on a
weekly basis for the first two (2) months after a spill, and on a quarterly basis for
one (1) year.

b. If well contamination from the release is detected, the pipeline operator will
expand monitoring to wells located further from the release site.
c. All monitoring of potentially affects wells will be conducted in conformance with
oversight by the California Water Quality Control Board and/or pertinent local
agencies.
d. In the event that groundwater and/or well contamination has occurred, develop
and execute a Remedial Action Plan or equivalent as directed by the California
Water Quality Control Board and/or pertinent local agencies.

APPENDICES
Appendix A- Shallow Groundwater Maps
Appendix B- Geology & Well Data Maps
Appendix C- Well Data Summary Table
DIBBLEE MAPS REFERENCED


Dibblee, Thomas W., Jr., 1988, Geologic Map of the Solvang and Gaviota Quadrangles: Dibblee Geological Foundation Map #DF-16.

Dibblee, Thomas W., Jr., 1988, Geologic Map of the Santa Rosa Hills and Sacate Quadrangles: Dibblee Geological Foundation Map #DF-17.


Dibblee, Thomas W., Jr., 1994, Geologic Map of the Foxen Canyon Quadrangle: Dibblee Geological Foundation Map #DF-54.


Dibblee, Thomas W., Jr., 1994, Geologic Map of the Santa Maria & Twitchell Dam Quadrangles: Dibblee Geological Foundation Map #DF-51.


Appendix A- Shallow Groundwater Maps
SANTA YNEZ RIVER VALLEY

PREPARED BY SCS ENGINEERS
NOVEMBER 2017

LEGEND
- Pipeline - Groundwater Intersect
- Line 901R - Las Flores to Sisquoc
- Formations with Shallow Groundwater
  - Qa - Quaternary Alluvium
  - Og - Stream Channel
  - Qls - Landslide Deposits
  - Tml - Monterey Formation
  - Tsp - Sespe Formation
  - Tvq - Vaqueros Sandstone

Basin Name
- SANTA YNEZ RIVER VALLEY

Map Vignette (Number)
- SANTA YNEZ RIVER VALLEY

Scale
- Miles

Groundwater Protection Report
Geologic Formations with Shallow Groundwater within 150 Feet of Line 901R & 903R

Las Flores to Gaviota
Map 1 of 3
LEGEND
- Pipeline - Groundwater Intersect
- Line 901R - Las Flores to Sisquoc
- Formations with Shallow Groundwater
- Qa - Quaternary Alluvium

Basin Name
- SANTA YNEZ RIVER VALLEY

Map Vignette (Number)

0 0.5 1 1.5 2 Miles
0 1,000 2,000 Feet

Groundwater Protection Report
Geologic Formations with Shallow Groundwater within 150 Feet of Line 901R & 903R

LEGEND
- Pipeline - Groundwater Intersect
- Line 901R - Las Flores to Sisquoc
- Formations with Shallow Groundwater
- Qa - Quaternary Alluvium

Basin Name
- SANTA YNEZ RIVER VALLEY

Map Vignette (Number)
**Groundwater Protection Report**

Geologic Formations with Shallow Groundwater within 150 Feet of Line 901R & 903R

**Legend**
- Pipeline - Groundwater Intersect
- Line 901R - Las Flores to Sisquoc
- Qa - Quaternary Alluvium
- Qg - Stream Channel

**Basin Name**
- SANTA YNEZ RIVER VALLEY

**Map 1 of 1**

Pipeline intersecting formations with shallow groundwater, indicating specific areas of concern within the Santa Ynez River Valley.

**Scale**
- 0 0.5 1 1.5 2 Miles
- 0 1,000 2,000 Feet
Groundwater Protection Report
Geologic Formations with Shallow Groundwater within 150 Feet of Line 901R & 903R

LEGEND
- Pipeline - Groundwater Intersect
- Line 903R - Sisquoc to Pentland Formations with Shallow Groundwater
- Qa - Quaternary Alluvium

Basin Name
- CARRIZO PLAIN
- CUYAMA VALLEY
- SAN JOAQUIN VALLEY
- SANTA MARIA

Legend:
- Pipeline - Groundwater Intersect
- Line 903R - Sisquoc to Pentland Formations with Shallow Groundwater
- Qa - Quaternary Alluvium

Map 3 of 5

CUYAMA VALLEY
3-13

CARRIZO PLAIN
3-19

SAN JOAQUIN VALLEY
5-22

SANTA MARIA
3-12

BIG SPRING AREA
3-47

Cuyama River

Scale:
0 2,000 4,000 Feet

North

0 1 2 3 4 Miles

PREPARED BY SCS ENGINEERS
NOVEMBER 2017
GCS, NAD 83

Plains2017SBC-1_0003478
Appendix B- Geology & Well Data Maps
Map Series 1

Groundwater Basin: None designated

Potential Water Bearing Formations: Alluvium, Monterey Formation

Recharge Sources: Precipitation

Areas of potential shallow groundwater: Venadito Canyon, Refugio Canyon, Tajiguas Canyon, Arroyo Quemado

Known groundwater depths: 10’ to 32’
Map Series 2

Groundwater Basin: None designated

Potential Water Bearing Formations: Monterey Formation

Recharge Sources: Infiltration of precipitation, stream flows

Areas of potential shallow groundwater: Arroyo Quemedo

Known groundwater depths: 10' to 20'
Map Series 3

Groundwater Basin: None designated

Potential Water Bearing Formations: Alluvial fill in stream beds, Vaqueros Sandstone, Sespe Formation and Alegria Formation.

Recharge Sources: Infiltration of precipitation, stream flows.

Areas of potential shallow groundwater: Lion Canyon, Gaviota Beach State Park

Known groundwater depths: 12' to 105'
LEGEND

- Groundwater BGS (Feet)
  - # 0-50 (# = Reference Well Id)
  - ø 50-100
  - *100-500
  - (Year Sampled)
- *Locations Approximate based on metes and bounds

- Existing Valve Station
- New Valve Station
- Line 901R - Las Flores to Sisquoc
- Map Series
- Bore Limits

Map Series 3

Groundwater Study
Historical Groundwater Depths

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Plains2017SBC-1_0003491
Groundwater Basin: None designated

Potential Water Bearing Formations: Alluvium and Sacate Formation

Recharge Sources: Infiltration of precipitation, stream flows.

Areas of potential shallow groundwater: Gaviota Canyon located on the north side of Gaviota State Park

Known groundwater depths: 36’
Groundwater Study
Historical Groundwater Depths

LEGEND
Groundwater BGS (Feet)
- # 0-50 (# = Reference Well Id)
- New Valve Station
- Line 901R - Las Flores to Sisquoc
- Map Series
- Bore Limits

Completion Depth 30 - 50’
'86

MOV
2-700

CHECK
2-600

36’
'08

Gaviota Canyon

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Scale
0 0.25 0.5 0.75 1 Miles

Groundwater BGS (Feet)
- 0-50 (## = Reference Well Id)
- New Valve Station
- Line 901R - Las Flores to Sisquoc
- Map Series
- Bore Limits

Legend

North

Gaviota Canyon

MOV
2-500

Bore Limits

Completion Depth 30 - 50’
'86

Line 901R - Las Flores to Sisquoc

New Valve Station

Groundwater Study
Historical Groundwater Depths

Map Series 4

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater BGS (Feet)
- 0-50 (## = Reference Well Id)
- New Valve Station
- Line 901R - Las Flores to Sisquoc
- Map Series
- Bore Limits

Legend

North

Gaviota Canyon

MOV
2-500

Bore Limits

Completion Depth 30 - 50’
'86

Line 901R - Las Flores to Sisquoc

New Valve Station

Groundwater Study
Historical Groundwater Depths

Map Series 4

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater BGS (Feet)
- 0-50 (## = Reference Well Id)
- New Valve Station
- Line 901R - Las Flores to Sisquoc
- Map Series
- Bore Limits

Legend

North

Gaviota Canyon

MOV
2-500

Bore Limits

Completion Depth 30 - 50’
'86

Line 901R - Las Flores to Sisquoc

New Valve Station

Groundwater Study
Historical Groundwater Depths

Map Series 4

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater BGS (Feet)
- 0-50 (## = Reference Well Id)
- New Valve Station
- Line 901R - Las Flores to Sisquoc
- Map Series
- Bore Limits

Legend

North

Gaviota Canyon

MOV
2-500

Bore Limits

Completion Depth 30 - 50’
'86

Line 901R - Las Flores to Sisquoc

New Valve Station

Groundwater Study
Historical Groundwater Depths

Map Series 4

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OCTOBER 2017
GCS, NAD 83

Groundwater BGS (Feet)
- 0-50 (## = Reference Well Id)
- New Valve Station
- Line 901R - Las Flores to Sisquoc
- Map Series
- Bore Limits

Legend

North

Gaviota Canyon

MOV
2-500

Bore Limits

Completion Depth 30 - 50’
'86

Line 901R - Las Flores to Sisquoc

New Valve Station

Groundwater Study
Historical Groundwater Depths

Map Series 4

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater BGS (Feet)
- 0-50 (## = Reference Well Id)
- New Valve Station
- Line 901R - Las Flores to Sisquoc
- Map Series
- Bore Limits

Legend

North
**Map Series 5**

**Groundwater Basin:**  Santa Ynez Valley

**Potential Water Bearing Formations:**  Santa Ynez stream channel and unconsolidated alluvial and terrace deposits.

**Recharge Sources:**  Infiltration of precipitation, stream flows, and percolation of irrigation water and wastewater effluent

**Areas of potential shallow groundwater:**  Santa Ynez River Floodplain and terraces on the north side of the floodplain

**Known groundwater depths:**  33' to 79'

---

LEGEND

- Existing Valve Station
- New Valve Station
- Bore Limits
- Line 901R - Las Flores to Sisquoc
- Map Series

Boring Location

MOV 2-1000

CHECK 2-900

MOV 2-800
Map Series 6

Groundwater Basin: San Antonio Creek Valley

Potential Water Bearing Formations: Alluvium, dune sand, terrace deposits, and the Orcutt, Paso Robles, and Careaga Formations within the San Antonio Creek Valley, however no local groundwater in this section of the Groundwater Basin.

Recharge Sources: Infiltration of rain falling on the valley floor\(^2\) and seepage from streams\(^3\).

Areas of potential shallow groundwater: None known within the area of interest.

Known groundwater depths: None

---


LEGEND

+ New Valve Station
- Bore Limits
--- Line 901R - Las Flores to Sisquoc

Map Series

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater Study - Geologic Map
Zaca Creek Quadrangles
Dibblee 1993
Map Series 7

Groundwater Basin: San Antonio Creek


Recharge Sources: Infiltration of rain falling on the valley floor and seepage from streams.

Areas of potential shallow groundwater: Foxen Canyon and Sisquoc River crossing.

Known groundwater depths: 100 and 140 feet bgs located in Alisos Canyon. ~50 to 100 feet in Foxen Canyon bgs near valve 2-1300.

---


LEGEND
DWR - Groundwater BGS (Feet)
- 0-50
- 50-100
- 100-500
(Year Sampled)
+ New Valve Station
- Line 901R - Las Flores to Sisquoc

GW Basin Name
- SAN ANTONIO CREEK VALLEY
- SANTA MARIA
- SANTA YNEZ RIVER VALLEY

Bore Limits

Map Series

North
Scale
0 0.25 0.5 0.75 1 Miles

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater Study
Historical Groundwater Depths
Groundwater Basin: Santa Maria River Valley

Potential Water Bearing Formations: Alluvium.

Recharge Sources: Percolation of flow in Santa Maria River, controlled in part by releases from the Twitchell Dam, provides recharge for the Santa Maria Valley portion of the basin.

Areas of potential shallow groundwater: Sisquoc River crossing in Quaternary Alluvium.

Known groundwater depths: 32 to 108 feet.

---

LEGEND

- Existing Valve Station
- Bore Limits
- Line 903R - Sisquoc to Pentland
- Line 901R - Las Flores to Sisquoc
- Map Series

Groundwater Study - Geologic Map
Foxen Canyon
Dibblee 1994

Map Series 8
Map Series 9

Groundwater Basin: Santa Maria River in southwest corner

Potential Water Bearing Formations: Alluvium.

Recharge Sources: Percolation of flow in Santa Maria River, controlled in part by releases from the Twitchell Dam, provides recharge for the Santa Maria Valley portion of the basin.

Areas of potential shallow groundwater: Creek crossings.

Known groundwater depths: 175 feet to groundwater located approximately 2 miles west of pipeline near the Sisquoc River. 7 feet to groundwater depth located approximately 2.25 miles of the pipeline near the Cuyama River.

---

LEGEND

DWR - Groundwater BGS (Feet)
- 0-50  (# = Reference Well Id)
- 100-500  (Year Sampled)
- Existing Valve Station
- New Valve Station
- Line 903R - Sisquoc to Pentland
- Line 901R - Las Flores to Sisquoc

GW Basin Name
- SANTA MARIA

Map Series 9

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater Study
Historical Groundwater Depths

SANTA MARIA
3-12

Sisquoc River
Cuyama River

Plains2017SBC-1_0003509

North

Scale

0 0.5 1 1.5 2
Miles

-2.25 miles

~2.25 miles

GW Basin Name
- SANTA MARIA

Map Series 9
Map Series 10

Groundwater Basin: Cuyama Valley in northeast corner of map series.

Potential Water Bearing Formations: Alluvium.

Recharge Sources: Cuyama River

Areas of potential shallow groundwater: Creek crossings and Cuyama River crossing. The pipeline runs parallel to the Cuyama River in the northeast corner of the map series.

Known groundwater depths: No known groundwater depth data.
Map Series 10

(No Available Groundwater Data)

LEGEND

+ Existing Valve Station
+ New Valve Station

GW Basin Name

- CUYAMA VALLEY

Line 903R - Sisquoc to Pentland

Bore Limits

Map Series

Map Series 10

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater Study
Historical Groundwater Depths
Map Series 11

Groundwater Basin: Cuyama Valley

Potential Water Bearing Formations: Alluvium

Recharge Sources: Cuyama River

Areas of potential shallow groundwater: Creek crossings in Quaternary Alluvium that feed into Cuyama River. The pipeline also runs parallel to the Cuyama River, which could be a potential for shallow groundwater.

Known groundwater depths: No known groundwater depth data.
No Available Groundwater Data

LEGEND
- Existing Valve Station
- New Valve Station
- Line 903R - Sisquoc to Pentland
- CUYAMA VALLEY
- GW Basin Name
- Bore Limits
- Map Series

Scale
0 0.3 0.6 0.9 1.2 Miles

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Map Series 11

Groundwater Study
Historical Groundwater Depths
Map Series 12

Groundwater Basin: Cuyama Valley

Potential Water Bearing Formations: Alluvium and Stream Channel deposits

Recharge Sources: Cuyama River

Areas of potential shallow groundwater: The pipeline runs parallel to the Cuyama River for the entire map series (approximately 10 miles).

Known groundwater depths: Groundwater depths range between 30 and 110 feet bgs adjacent to the Cuyama River that were recorded in the 1960’s.
Map Series 13

Groundwater Basin: Cuyama Valley

Potential Water Bearing Formations: Alluvium and Stream Channel deposits

Recharge Sources: Cuyama River

Areas of potential shallow groundwater: The pipeline runs parallel to the Cuyama River for approximately five (5) miles.

Known groundwater depths: Groundwater depths range between 27 and 53 feet bgs adjacent to the Cuyama River that were recorded in the 1960’s. A well in 2008 recorded the groundwater depth at 165 feet bgs adjacent to the river.
LEGEND

- New Valve Station
- Bore Limits
- Line 903R - Sisquoc to Pentland
- Map Series

North
0 0.35 0.7 1.05 1.4 Miles

PREPARED BY SCS ENGINEERS
OCTOBER 2017
GCS, NAD 83

Groundwater Study - Geologic Map
New Cuyama Quadrangle
Dibblee 2005

Map Series 13
Map Series 14

Groundwater Basin: Cuyama Valley

Potential Water Bearing Formations: Alluvium and Stream Channel deposits

Recharge Sources: Cuyama River

Areas of potential shallow groundwater: Creek crossing approximately 2 miles west of valve 4-500.

Known groundwater depths: Two (2) wells recorded groundwater levels lower than 100 feet below ground surface. 46 feet bgs near the creek crossing recorded in 1966 and 87 feet bgs near valve 4-600.
LEGEND
DWR - Groundwater BGS (Feet)
¬ 0-50  (# = Reference Well Id)
○ 50-100
○ 100-500
○ 500-1000
(Years Sampled)
+ New Valve Station

GW Basin Name
- CARRIZO PLAIN
- CUYAMA VALLEY

Legend:
- Bore Limits
- Map Series

Map Series 14

Cuyama River

Cuyama Valley
3-13

Check 4-500

Check 4-700

Prepared by SCS Engineers
October 2017
GCS, NAD 83

Groundwater Study
Historical Groundwater Depths

Dimensions:
792.0 x 612.0

Scale:
0 0.3 0.6 0.9 1.2 Miles

North
Groundwater Basin: Cuyama Valley

Potential Water Bearing Formations: Holocene age alluvium and older terrestrial deposits including the Pliocene age Cuyama or Morales formation.

Recharge Sources: Cuyama River

Areas of potential shallow groundwater: Groundwater was recorded at a depth of 97 feet below surface approximately one (1) mile southwest of valve 4-800.

Known groundwater depths: Three (3) wells within one (1) mile of the pipeline near Highway 166 on the eastern edge of the Cuyama Groundwater Basin recorded groundwater depths less than 100 feet.
**Map Series 16**

**Groundwater Basin:** San Joaquin Valley

**Potential Water Bearing Formations:** Continental deposits of Tertiary and Quaternary age including flood-basin deposits, younger alluvium, older alluvium, the Tulare Formation, and continental deposits undifferentiated. No groundwater shallower than 100 feet in the vicinity.

**Recharge Sources:** Stream recharge and from deep percolation of applied irrigation water

**Areas of potential shallow groundwater:** No potential shallow groundwater in the vicinity. The nearest groundwater wells are approximately 2.5 miles north of the pipeline and have consistently recorded depths greater than 200 feet. As the pipeline transects the hills to the southwest in map series 16, the geologic formations are comprised of marine rocks which act as a barrier to ground water flow.

**Known groundwater depths:** Greater than 200 feet bgs approximately 2.5 miles north of the Pentland Delivery Station.

---

**Legend**
- New Valve Station
- Line 903R - Sisquoc to Pentland
- Map Series

**Map Series 16**

**Groundwater Study - Geologic Map**
Maricopa and Pentland Quadrangles
Dibblee 2005

**PREPARED BY SCS ENGINEERS**
OCTOBER 2017
GCS, NAD 83
Appendix C- Well Data Summary Table
<table>
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<tr>
<th>Map Series</th>
<th>Reference Well Id</th>
<th>Groundwater Depth Below Ground Surface (feet)</th>
<th>Year Recorded</th>
<th>Formation</th>
<th>Geographic Reference</th>
<th>Notes</th>
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