Hazen *Technical Memorandum*

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Palmdale Ditch Conversion Feasibility Study

90 Percent Submittal

Introduction

The Palmdale Water District is looking to replace the existing Palmdale Ditch, a 7.2-mile earthen or concrete-lined ditch that conveys water from Littlerock Dam to Lake Palmdale with a pipeline. Once completed, the project will provide the following benefits:

- Increase flow capacity from 25 cubic feet per second (cfs) to 60 cfs.
- Reduce seepage and evapotranspiration losses.
- Mitigate downstream flooding that occurs when Littlerock Dam is spilling.

The purpose of this feasibility study is as follows:

- Perform hydraulics analysis and pipe sizing to convey 60 cfs from Littlerock Dam to Lake Palmdale.
- Complete a pipe materials evaluation and recommend a material selection.
- Evaluate water loss savings.
- Develop feasibility level cost estimates for construction.
- Prioritize ditch sections for replacement.

Job no

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List of Acronyms

Abbreviation	Definition
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CEQA	California Environmental Quality Act
cfs	Cubic Feet per Second
CMP	Corrugated metal pipe
DI	Ductile Iron
fps	Feet per second
gpm	gallons per minute
HDPE	High-Density Polyethylene
HGL	Hydraulic Gradeline
LF	Linear feet
LRD	Littlerock Dam
MG	Million Gallons
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
OD	Outside diameter
PE	Polyethylene
psi	Pounds per square inch
PVC	Polyvinyl chloride
PWD	Palmdale Water District
RCP	Reinforced Concrete Pipe
USBR	United States Bureau of Reclamation

1. Project Description

1.1 Introduction

The Palmdale Water District (PWD) is evaluating the feasibility of replacing the existing Palmdale Ditch with a pipeline. The ditch was originally constructed in the 1880s and almost 70 percent of its total length remains an unlined earthen ditch. The remaining 30 percent of the ditch is either concrete-lined or enclosed in tunnels or culverts. There is also one remaining steel trestle located west of Pearblossom Highway at approximate station 387+03. The upstream and downstream ends of the ditch have been previously improved by other projects and therefore are not included in the scope of this analysis. In 1995, approximately 1,900 feet of the ditch starting at the debris basin downstream of Littlerock Dam was converted to 54-inch pipe. The new pipe alignment differs slightly from the alignment of the original ditch, which was not demolished. Therefore, a section of the covered concrete channel still exists to the east of the new 54-inch pipe but is no longer in use. In 2010, approximately 3,800 feet of the ditch from Lake Palmdale to Sierra Highway was replaced with a 48-inch diameter reinforced concrete pipeline (RCP). An overview of the ditch with approximate stationing is shown in **Figure 1-1**.The length of the ditch included in the scope of this analysis is shown in white. The upstream and downstream ends of the ditch which have been previously improved, as described above, and are shown in yellow.

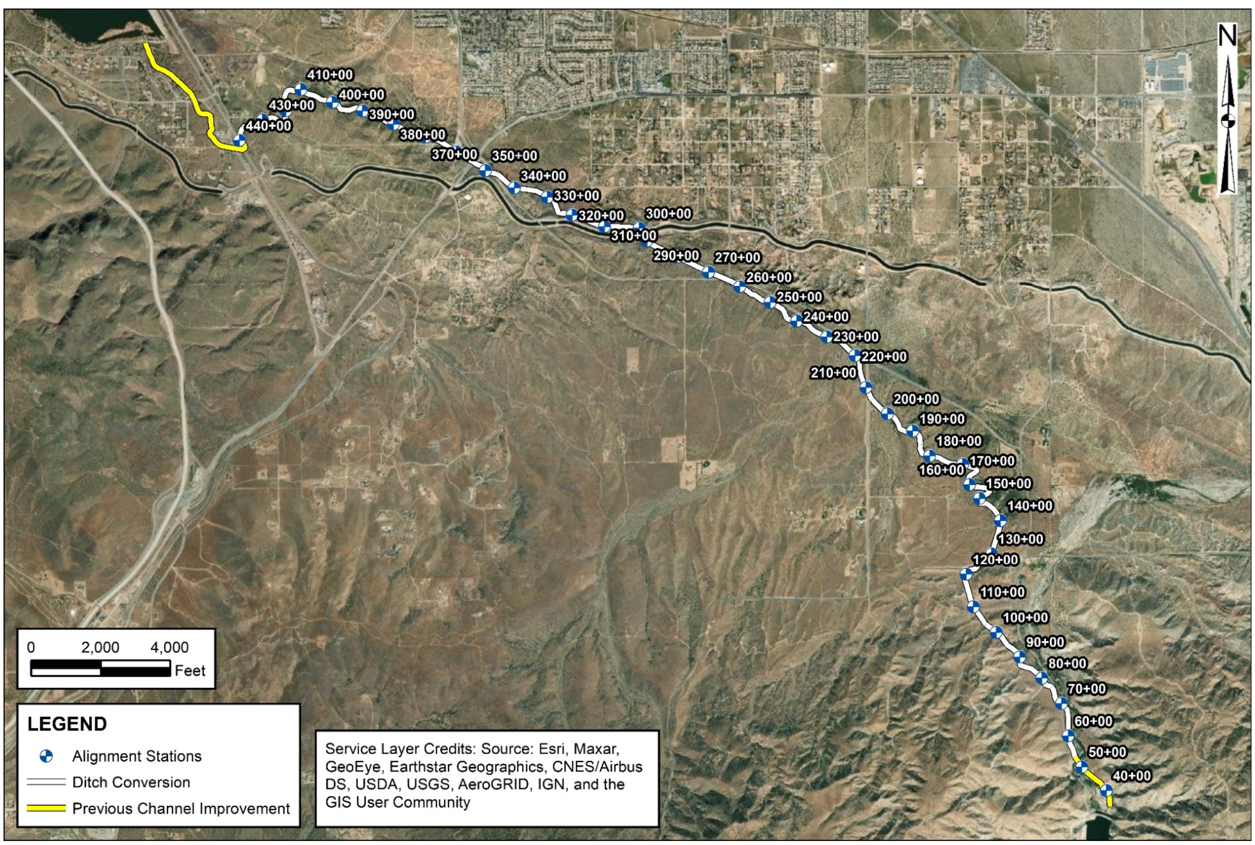

Figure 1-1 Palmdale Ditch Alignment

PWD operates the ditch intermittently to transfer water from the Littlerock Reservoir to Lake Palmdale for treatment and beneficial as potable supply within its service area. The purpose of this study is as follows:

- Perform hydraulics analysis and pipe sizing to convey 60 cubic feet per second (cfs) from Littlerock Dam to Lake Palmdale.
- Complete a pipe materials evaluation and recommend a material selection.
- Evaluate water loss savings.
- Develop feasibility level cost estimates for construction.
- Prioritize ditch sections for replacement.

During design, an Initial Study (IS) similar to the IS completed for the 1995 and 2010 projects and in compliance with the California Environmental Quality Act (CEQA) will need to be completed to determine if the project will have significant impact on the environment and to determine what type of environmental documentation will be required. Based on the Initial Study prepared as part of the design for the enclosure of the lower portion of the ditch, it is anticipated that that the construction work described in this report will require at a minimum a Mitigated Negative Declaration.

1.2 Background Information

Information provided by PWD to assist with this feasibility includes the following:

- April 1991 survey of the centerline of Palmdale Ditch from Cheseboro Road to approximately 50-feet south of the Peripheral Canal on the south side of Lake Palmdale. (Google Earth images and elevations were used to supplement the survey information South of Cheseboro Road to Littlerock Dam).
- July 2010 Record Drawings for the Palmdale Ditch enclosure (Specification 0602).
- August 1994 Record Drawings for the Littlerock Canal Improvements (Job number 94135).
- Various undated ditch plan and profile drawings for the ditch alignment surveyed in 1991 (Specification 9002)
- Littlerock Dam (LRD) to Lake Palmdale Water Loss Data from 1997 to 2020.
- Geotechnical and Groundwater level data for the area (5 million gallon (MG) Water Storage Tank Report of Compaction Tests and Well No. 18 and 19 Static and Pumping Levels for May 2021).

To evaluate the existing ditch conditions, the above information was used to identify sections of ditch that appeared to be earthen-lined, concrete-lined, or enclosed with pipelines, culverts, trestles or tunnels. This information was used to assist in assessing water loss in the existing ditch and replacement costs. A summary of the existing ditch features is included in **Appendix A**. Based on our evaluation of the 7.2-

mile section of ditch being evaluated, approximately 73% is earthen lined, 17% is concrete-lined and 10% is enclosed in a pipeline or tunnel.

It should be noted that field work and inspections were not included in the scope of this project. All evaluations were desktop studies which used the best available information as summarized herein. All information has been referenced and limitations and assumptions have been stated.

2. Hydraulics Analysis

2.1 Hydraulic Model

Hydraulic modeling was conducted to evaluate the required pipe size to convey 60 cfs from the Littlerock Reservoir to Lake Palmdale. Infoworks ICM software was used to create a steady state model of the ditch alignment capable of modeling both open channel and pressurized gravity flow.

The Infoworks ICM hydraulic model was developed using data provided in the 1991 survey as well as record drawing of improvements at the north and south ends of the project. For the surveyed section, the pipe invert elevation was assumed to be the surveyed ditch invert. The upstream section of the model was replaced with a 54-inch pipeline in 1994. This section was modeled using the as-build drawings of the pipeline. The ditch alignment between Sierra Highway and Lake Palmdale was replaced with a 48-inch pipeline in 2010; this section was also modeled using as-built drawings of the pipeline.

The upstream boundary of the model reach is the open-air concrete debris basin at the foot of the Littlerock Dam, where the flow leaves the reservoir outfall and enters the pipeline. From as-built data, this basin has an invert elevation of 3139.5 ft. Two boundary conditions are considered at this upstream boundary: a constant water surface elevation within the debris basin assuming 1 foot of freeboard, under which the pipeline is continuously surcharged under 10’8” of static head, and a steady flow of 60 cfs leaving the debris basin over a weir and entering the existing 54” pipeline at atmospheric conditions.

The downstream model boundary is the outfall from the 48-inch pipeline to Lake Palmdale. The outfall is modeled as a free-flowing outfall without hydraulic restrictions, as the pipeline discharges to atmosphere into an energy dissipator, which transitions to an earthen lined channel and discharges to the lake surface and without the possibility of submergence.

Based on the material selection presented in **Section 3**, the pipe material is assumed to be RCP. Friction loss is calculated using the Manning’s equation. A pipe roughness value of n = 0.11 has been used simulating an average pipe condition. Minor losses at bends or appurtenances are assumed to be minimal and have not been included.

2.2 Model Results

Both 42- and 48-inch pipelines were modeled. Results show a minimum 48-inch pipe is required to convey the design flow of 60 cfs without surcharging manholes or spilling. For the 42-inch alternative, the hydraulic grade line (HGL) is above ground surface for significant lengths indicating an overflow condition. The HGL for the 48-inch pipe size are shown in **Figure 2-1** and **Figure 2-2**.

Results of this analysis suggest that the existing enclosed 48-inch pipe at the downstream end of the alignment can remain unchanged, therefore this segment is not included in the cost estimate or in the water loss calculations in subsequent sections. Additional model results are included in **Appendix B**.

It should also be noted that because of the steep slopes and drops in the exiting ditch, some reaches have high velocities (exceeding 20 feet per second [fps]). These specific areas should be carefully evaluated during design and slopes flatten as practical or drop structures introduced as necessary to limit velocities to a maximum of 10 fps in accordance with AWWA best practices. Details of these high velocity areas along the profile are included in the Appendix.

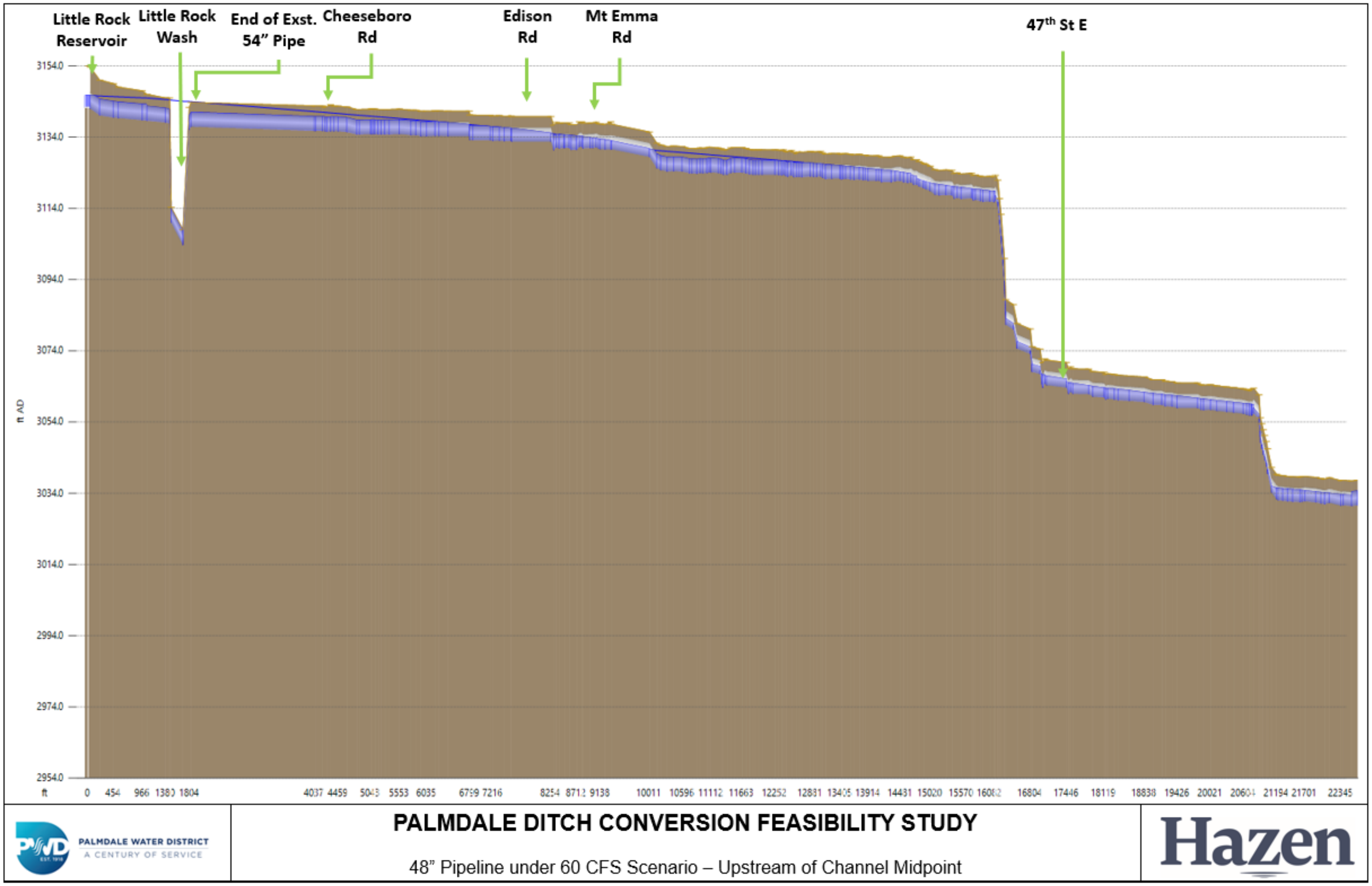

Figure 2-1 48-inch HGL - Upper Portion

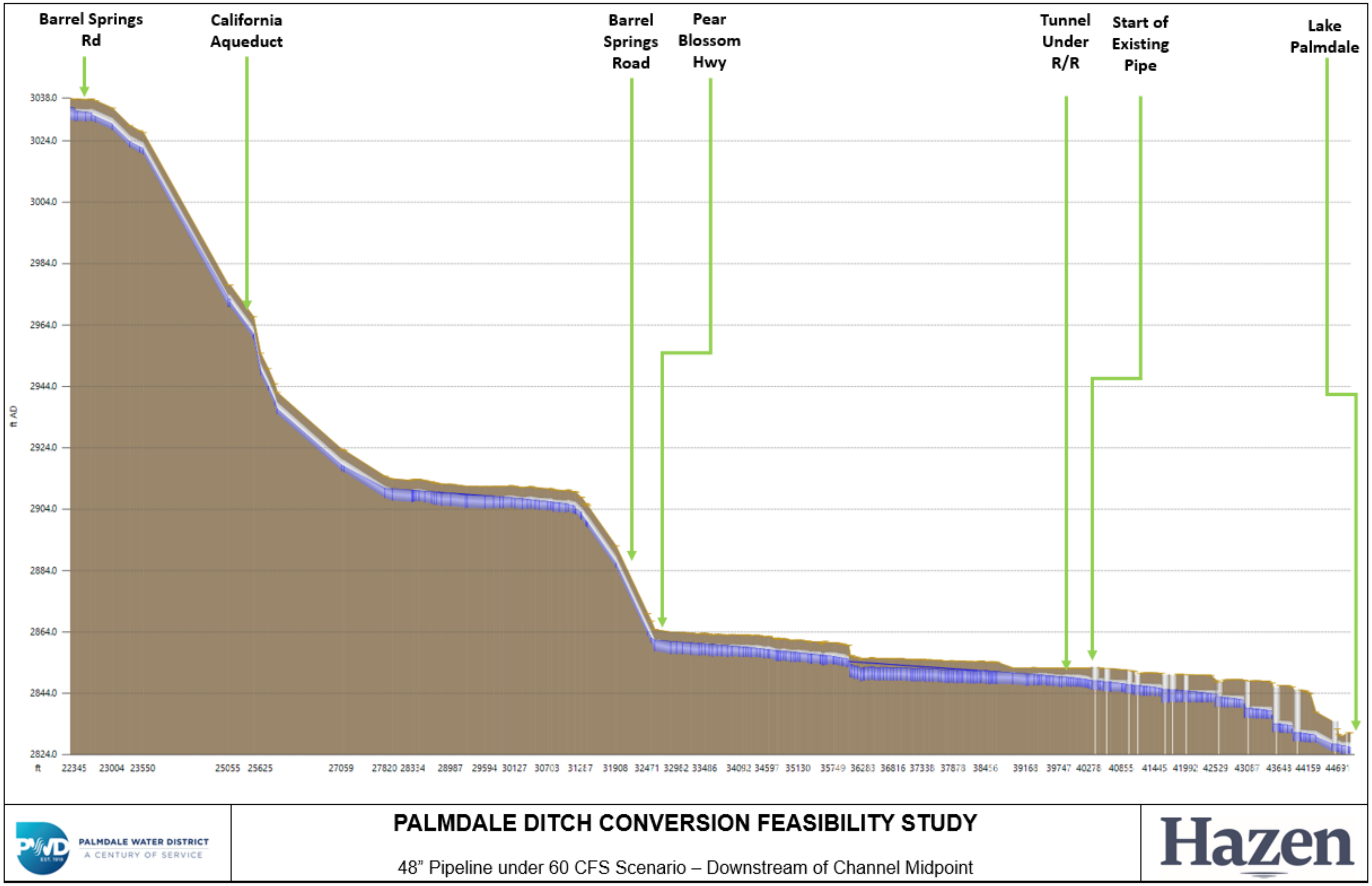

Figure 2-2 48-inch HGL - Lower Portion.

3. Pipe Material Evaluation

3.1 Material Selection

Four pipe materials were considered for use in the conversion of the ditch from an open channel to an enclosed pipeline. The materials are described below and summarized in **Table 3-1.**

- **RCP per American Society for Testing and Materials (ASTM) C76**: RCP pipe is reinforced concrete product intended for use in the conveyance of sewage and stormwater. RCP is a rigid pipe, available in diameters up to 144-inch diameter and is widely used in the water and wastewater industry as gravity flow pipelines. The pipe is primarily design to for external loading conditions as is not intended for pressure service. Bell and spigot joints are available with O-ring gaskets in accordance with ASTM C443.

- **Ductile Iron Gravity Pipe (DI) per ASTM A746**: DI pipe manufacture under ASTM A746 is identical in pipe manufactured under the American Water Works Association (AWWA) C 150/151 standards. DI is considered a semi-rigid pipe, available up to 64-inch diameter, and suitable for both pressure and gravity applications. The interior of the pipe is provided with a mortar lining to protect against internal corrosion. The exterior is provided with an asphaltic coating and the pipe is typically polyethylene encased in accordance with AWWA C105 to protect against long term external corrosion. Joints are gasketed, typically either O-ring for push-on type or glandular for mechanical type.

- **Polyvinyl chloride (PVC) Gravity Sewer Pipe per ASTM F679:** PVC pipe manufactured under ASTM F697 is intended for use as non-pressurized sanitary sewers. PVC pipe is considered a flexible pipe and therefore its ability to withstand external loading depends on side support from the surrounding soils. The pipe is available in diameters up to 60-inch, however it has a limited history in diameters greater than 24-inch. Joints are O-ring gaskets push on type. PVC is an electrically nonconductive and will not rust or corrode.

- **High-Density Polyethylene Pressure Pipe (HDPE) per AWWA C906*:*** HDPE, also referred to as polyethylene (PE), is typically used in pressure applications and is available in diameters up to 63-inch and pressures up to 254 psi. Joints are fusion welded. Typical installation methods include fusing pipe sections above ground outside the trench, then lowered into the trench. HDPE pipe is considered a flexible pipe and, therefore, its ability to withstand external loading depends on side support from the surrounding soils. HDPE also has a high coefficient of thermal expansion therefore, for installations that experience high temperature variation, thermal expansion and contraction must be accommodated. HDPE is an electrically nonconductive material and is not subject to galvanic action and will not rust or corrode.

Table 3-1 Pipe Material Comparison

Material	Lay Length (ft)	Pipe cost per foot	Service Life	Pros	Cons
RCP	8	$140	75-100 years	• Available up to 144" diameter • Typically used in gravity applications • Generally not susceptible to corrosion unless reinforcing becomes exposed. • Durable product with a long service history • Lowest cost	• Not suitable for pressure applications • Short lay lengths introduce more joints/leakage potential • Lowest construction productivity due to short lay length and weight • Rigid pipe less likely to perform well in seismic event
DIP	20	$330	75-100 years	• Available up to 64" diameter • Typically used in both pressure and gravity applications • Long track record of use	• Metallic and may be susceptible to corrosion if integrity of poly bag is breached. • May require corrosion monitoring in highly corrosive soils. • High costs • Long periods with the ditch out of service and dry will be detrimental to mortar lining in the DI pipe. • Semi-Rigid pipe less likely to perform well in seismic event
PVC	20	$170	50-100 years	• Available up to 60" diameter • Typically used in both pressure and gravity applications • Not susceptible to corrosion • Flexible likely to perform better in seismic event, however, pipe may be subject to cracking with bending.	• Does not have a long history of use in diameters greater than 24-inch. • Successful installation highly dependent on high level of compaction around for side support to carry external soil loads. • Can become brittle in colder temperatures and weaker in high temperature climates
HDPE	50	$230	50-100 years	• Available up to 63" outside diameter. • Not susceptible to corrosion. • Flexible, fused likely to perform better in seismic event, however, pipe may be pullout at expansion joints.	• High thermal coefficient of expansion will require thermal expansion joints. • Repairs in-trench difficult due to need of fusing equipment. • Likely requires 54-inch outside diameter (OD) to meet hydraulic requirements. • Successful installation highly dependent on high level of compaction around for side support to carry external soil loads. • Can become brittle in colder temperatures and weaker in high temperature climates.

Based on the above comparison table, **RCP is recommended for use of this project**.

3.2 Allowable Leakage

Actual leakage from a properly constructed pipeline is negligible. However, allowable leakage criteria have been developed by various agencies and associations to test pipelines to assess proper installation. Section 306-7.8.2.2 of the Standard Specification for Public Work Construction (Greenbook) provides for water exfiltration test of gravity sewers (See Equation 1, below). For the purposes of estimating the maximum volume of water that could be lost due to leakage in a pipeline replacing the ditch, this allowable leakage criterion was used. For this type of pipeline allowable leakage is calculated by the following formula:

Equation 1 Allowable Leakage

$$E = 0.00002\mathrm{LD}\sqrt{H}$$

Where:

E = allowable leakage in gallons per minute (gpm)

L = Length of pipeline tested in feet

D = Internal diameter of pipeline in inches

H = Difference in elevation in feet between the water surface in the upper manhole tested and the invert of the pipe in the lower manhole of the section tested.

To apply this equation to the pipeline, it is assumed that the pipe is operating slightly surcharged with the water surface elevation one foot above the crown of the pipe. This is a conservative assumption since the hydraulics show the pipe flowing in an open channel condition at the maximum flowrate of 60 cfs.

Inputs to the calculation are as follows:

L = 38,200 feet based on google earth measurements
D = 48-inch
H = 5 feet (invert of the pipe to one foot above the crown)

Based on the above equation and assumptions, **the maximum allowable leakage for the entire pipeline is approximately 82 gpm or approximately 0.36-acre feet per day**.

4. Ditch Losses

4.1 Seepage Losses

To estimate seepage losses in the existing ditch, a desktop study was performed to evaluate the varying conditions along the alignment to attempt to determine and delineate the most susceptible segments/regions where considerable infiltration should be anticipated. There are many variables that impact water loss along this route, i.e., time of year of releases, rainfall preceding releases impacting soil saturation, degree of saturation achieved during releases, evaporation caused by temperature, evaporation caused by wind, vegetation and organic cover on the unlined areas restricting infiltration, inline structures causing changes in velocity/ponding which impacts wetted perimeter/head, ditch geometry, ditch profile, discharge rate, condition/integrity of partial/total lined sections, and soil types/properties. Due to this list of channel variables, estimates of seepage losses presented in this section should be considered approximate and are intended to be used for comparative purposes. More detailed field investigations involving full-scale in-situ ponding test, and/or geotechnical drilling, installation of numerous observation/monitoring wells and pump-in water tests to determine subsurface conditions, restrictive layers, in-situ rate of infiltration, soil saturation and hydraulic conductivity would be needed to allow further refinement of this evaluation.

There are several conditions that exist along the ditch route between Littlerock Reservoir and Lake Palmdale, ranging from earthen and concrete bottom tunnels, unlined earth, and partial/total lined concrete channels of varying dimensions, vertical and slope sided (trapezoidal shape) channels, single and double 48-inch diameter corrugated metal pipe (CMP)/ and RCP segments, and varying vertical profiles. Additionally, a mitigation loss exists between the Littlerock Dam and the Littlerock Creek crossing which consists of a 4-inch open pipe to supply water to the abandoned concrete box which was previously part of the ditch which is now inhabited by a bat colony. It was assumed that these losses were insignificant compared to the overall losses and is not accounted for as part of this analysis.

A simplified summary of these features is presented in **Appendix A**. In addition to the different noted structures and elevations, it is understood the physical condition of these features varies.

The anticipated seepage losses also vary with the condition of the ditch improvements. Improved sections with fully lined concrete channels and CMP/RCP in good condition should be expected to have minimal to no seepage losses, while the same sections experiencing varying degrees of deterioration could experience considerable losses, especially if these poorer quality areas exist in the more gradual sloped conveyance profiles. Once the water is allowed to exit these improved structures, the ditch profile and the underlying bedding materials and soil conditions begin to control the rate of infiltration, water transmission, soil saturation and seepage losses. No information is known about the bedding materials underlying the improved sections, but it has been assumed that these materials, when used, would be more permeable than the underlying soils.

Based on sparse and widespread water well data for the area, it is understood that seasonal groundwater levels range from about 20 feet to in excess of 40 feet below the ground surface. As such, soils underlying and along the conveyance route would generally be considered unsaturated to partially saturated depending on seasonal and climatic conditions.

The online Web Soil Survey developed and maintained by the Natural Resource Conservation Service (NRCS) was used as a reference to develop an understanding of the different soil types along the alignment. The specific soil information and engineering properties developed by the NRCS and used during this desktop study are summarized in **Table 4-1**. The soil types intersecting the alignment with stationing and approximate lined sections of the channel are shown in **Figure 4-1** and **Figure 4-2** respectively. Additional NRCS reference information is included in **Appendix C**.

Table 4-1 NRCS Soil Classification and Selected Engineering Properties Along Ditch

Soil Series Name	Soil Series Designation	Hydrologic Group	% Slope	% Sand	Depth to Restrictive Layer (cm)	Saturated Hydraulic Conductivity-Ksat (ft/day)
Riverwash	#21	Not Rated	N/A	94	>200	26.1
Triago family, dry-Lithic Xerorthents (Mountains/Residuum weathered from Granodiorite rock)	#711	B	50-80	66	>200	8.6
Amargosa, rocky coarse sandy loam	AmF2	D	9-55	67	46	7.2
Chino loam	Co	C/D		24	>200	1.3
Gaviota, rocky sandy loam	GaE2	D	15-30	67	36	7.2
Greenfield, sandy loam	GsC	A	2-9	67	>200	8.6
Greenfield, sandy loam	GsD2	A	9-15	67	>200	8.6
Hanford, coarse sandy loam	HbC	A	2-9	76	>200	8.6
Hanford, sandy loam	HcC	A	2-9	71	>200	8.6
Ramona, gravelly sandy loam	ReC	C	2-9	59	>200	2.2
Ramona, gravelly sandy loam	ReE	C	9-30	59	>200	2.2
Terrace escarpments	TsF	Not Rated	Not Rated	Not Rated	>200	Not Rated
Wyman, gravelly loam	WgC	B	2-9	37	>200	2.6

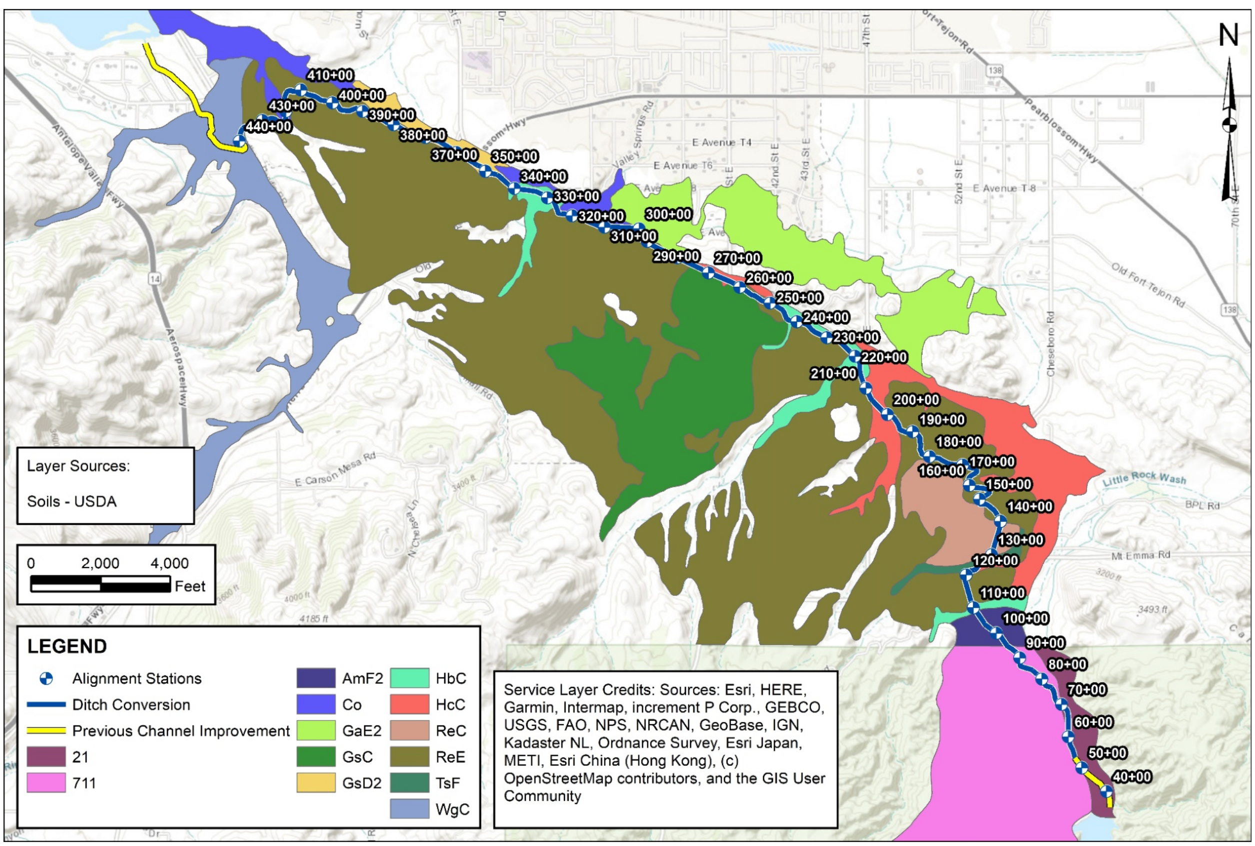

Figure 4-1 NRCS Soil Classification Along Alignment with Approximate Stationing

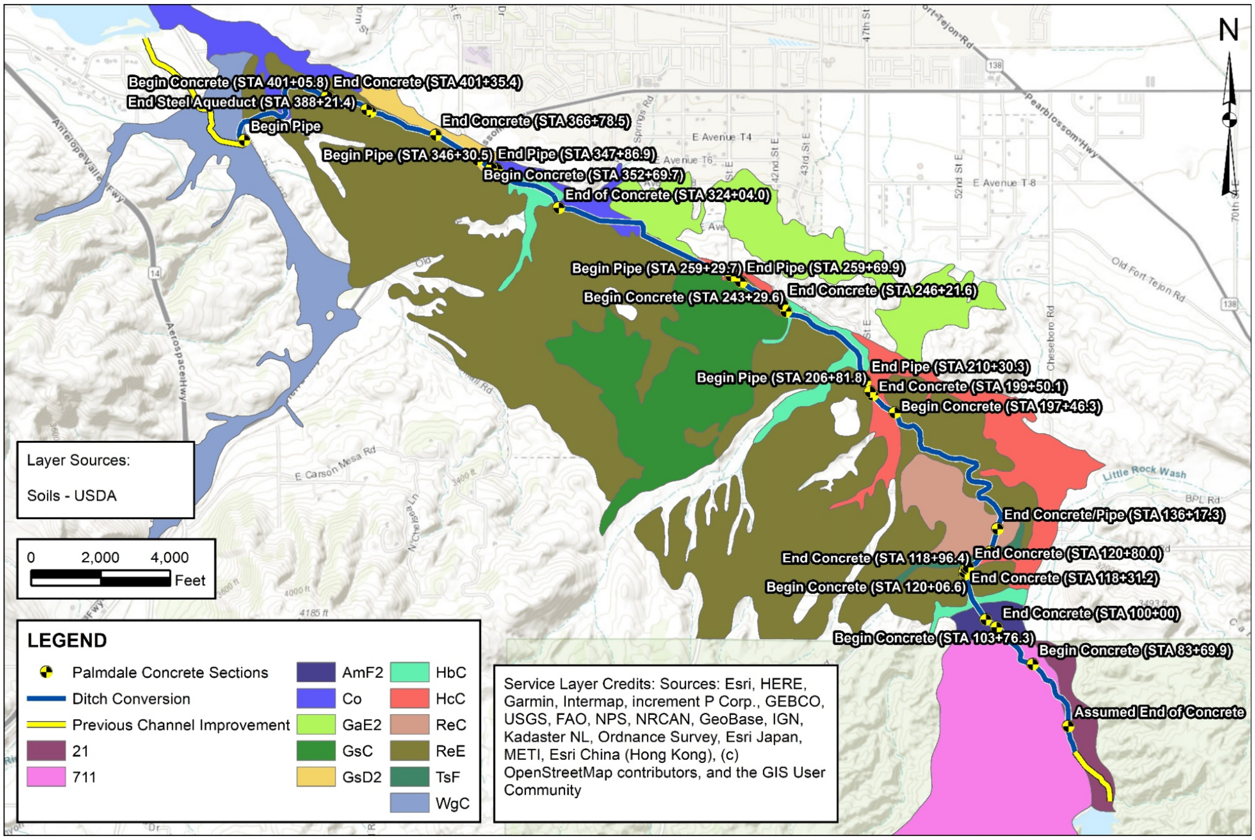

Figure 4-2 USDA Soil Types with Concrete Sections

The engineering properties of the soils indicate considerable variability along the ditch alignment. This variability, along with other factors including slope/gradient, saturation, development of hydraulic gradients; restrictive layers such as shallow rock and other fine-grained soils; and soil gradation/permeability will all have some impact on rate of infiltration. In addition, this does not include impacts due to any manmade changes along the alignment. In the absence of much of this information and without significant field studies, the Hydrologic Groups and to a lesser degree the Saturated Hydraulic Conductivity/Permeability values are considered the best available indicators to develop an understanding of the shallow soils present along the conveyance route and their ability to accept and convey surface and subsurface water (water transmission).

4.1.1 Hydrologic Groups

The NRCS places the various Soil Series into differing Hydrologic Soil Groups based on their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting and when the soil is not frozen. These properties include depth to a seasonal high-water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained, or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high-water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Based on the above information, Hydrologic Soil Groups A and B exhibit moderate to high infiltration and water transmission rate when thoroughly wet (saturated soil conditions). It should be noted that infiltration rates for unsaturated to partially saturated soils conditions are less predictable and can vary up 3 to 5 orders of magnitude difference from saturated conditions. It is hypothesized that soils within Groups A and B are the most likely suspects of allowing significant infiltration and water transmission, especially if these type soils exist in the flatter unlined/partially lined segments of the conveyance route. The Group A soils identified are within the Greenfield Series (GsC and GsD2) and Hanford Series (HbC and HcC) representing approximately 10,360 linear feet (LF), or 27% of the route length. The Group B soils identified are within the Triago family (#711) and Wyman Series (WgC). The Triago family soils, located generally downstream of Cheseboro Road, represents approximately 2,900 feet, or 8% of the route length. The Wyman Series (WgC) represents approximately 590 feet, or 2% of the route length. It is our opinion, the slope of the terrain ranging from 50%-80% and the presence of a restrictive layer at relatively shallow depth, further limits surface infiltration into the Triago family soils; however, NRCS lists these soils as having moderate infiltration capability and will be considered as such for this study.

The "Riverwash" soils are "not rated" and therefore do not fall within any Hydrologic Soil Group. These soils by nature are considered outwash (alluvial) deposits, which primarily occur between the dam and Cheseboro Road within the original Littlerock Wash, which generally diverges from the ditch alignment just upstream of Cheseboro Road. These soils represent a length of ditch that could have a very significant impact on infiltration and seepage losses due to the nature of the depositions and presence of potential preferential seepage paths with open graded gravels. Based on the available mapping, it is anticipated that the “Riverwash” area is underlain by residual materials like those represented by Soil Series #711. The depth of scour/erosion and deposition is unknown. The “Riverwash” represents approximately 1,090 linear feet, or 3% of the route length.

The remaining Soil Series fall with Hydrologic Groups C and D and include the Chino loam (Co), Ramona gravelly sandy loam (ReC and ReE), Amargosa rocky coarse sandy loam (AmF2 with rock outcrops), and the Gaviota rocky sandy loam (GaE2). These soils are considered to have lesser impact to the overall infiltration and seepage losses along the conveyance route. These soils represent approximately 23,200 linear feet, or approximately 62% of the route length.

4.1.2 Saturated Hydraulic Conductivity (Permeability)

Saturated hydraulic conductivity (Ksat) is a measure of how easily a saturated soil can transmit water. However, the strict use of saturated coefficients of permeability K(sat) values for evaluation of seepage losses in this arid area is not very reliable as most of the soils within the zone of influence likely do not achieve full (essentially 100%) saturation. Based on the available water well data, the normal groundwater table within the area west of Cheseboro Road is likely at least 20 feet, and very possibly >40 feet, below the ground surface during an annual cycle. Historical research indicates that the unsaturated hydraulic conductivity K(unsaturated) could differ from saturated by an order of magnitude of as much as 3 to 5, generally exhibiting higher permeability/infiltration until soils become fully saturated. Therefore, the initial water losses could be substantially higher than predicted using the K(sat) values, but with longer duration releases, the water loss may decrease somewhat as the soil conditions vary between unsaturated and saturated conditions. Therefore, it is recommended to only use the Ksat values for a general qualitative order of magnitude comparison of potential seepage losses for the various Soil Series, in lieu of attempting to estimate partially saturated hydraulic conductivity values.

For example, the Soil Series #21 (Riverwash) exhibits the highest estimated Ksat of 26.1 feet/day, or approximately 3 to 4 times more permeable than the Group A Greenfield and Hanford Series soils. The Group A Greenfield and Hanford Series soils exhibit a Ksat value of approximately 8.6 feet/day, or approximately 4 times more permeable than the Group C Ramona Series soils.

4.1.3 Approximation of Seepage Losses Per Soil Series/Group

As discussed previously, it is difficult with any degree of accuracy to predict the segments/regions where significant seepage losses are occurring due to the considerable number of physical, subsurface, and environmental variables that may exist along the conveyance route. For a general comparison of seepage losses, while limiting variables, we have used the United States Bureau of Reclamation (USBR) (1978) channel seepage formula for free drainage conditions which considers only ditch geometry, depth of water/head and soil permeability. The Ksat values determined from NRCS have been applied, but with the realization that unsaturated to partially saturated K values exists, and soil conditions could be much more permeable than predicted, especially during initial releases following prolonged delays between releases. This is a simplified method that does not consider the conveyance profile, channel improvements/conditions of improvements, vegetation cover or other head losses that could result in slower velocity flows and increased infiltration/water transmission opportunity.

Equation 2 USBR Channel Seepage

$$q_s = \frac{K(B + 2H)}{3.5}$$

Where:

q_s = the seepage rate, cubic feet per linear foot of channel per day

K = the hydraulic conductivity adjacent to the channel, feet per day

B = the width of water in the channel, feet

H = the depth of water in the channel, feet

3.5 is the factor used by USBR to adjust hydraulic conductivity test values to seepage losses due to ponding.

A uniform width of water = 10 feet and depth of water = 2 feet was assumed.

Using calculated Ksat values determined from data provided by NRCS, we estimate the following seepage loss information:

Table 4-2 Estimated Ditch Seepage Loss by Soil Type

Soil Series Groups	Hydrologic Group Designation	Average Ksat (ft/day)	Overall Length of Impacted Conveyance (lf)	q_s (cf/lf per day	Percent Unlined Channel (No Improvements)	Total Seepage Losses (acre-ft/year) *
GsC, GsD2, HbC, HcC	A	8.6	10,360	34.4	66%	568
#21(Riverwash)	N/A	26.1	1,090	104.4	77%	212
#711 (Triago)	B	8.6	2,900	34.4	45%	108
WgC	B	2.6	590	10.4	97%	14
ReC, ReE	C	2.2	19,590	8.8	77%	322
GaE2	D	7.2	590	28.8	31%	12
AmF2	D	7.2	1,380	28.8	6%	5
Co	C/D	1.3	1,600	5.2	36%	7
					Total	1,250

* Losses per year are calculated based on a 5-year average transfer duration of 105 days.

As shown above, the #21-Riverwash followed by Group A Greenfield (GsC and GsD2) Hanford (HbC and HcC) and Group B #711 Series soils exhibit soil/physical properties most receptive to significant water infiltration and transmission during releases from Littlerock Reservoir and have considerable lengths of unlined conveyance.

For the concrete lined sections of ditch, reference seepage values were used to approximate water losses. The USBR suggests that acceptable seepage rates for good quality canals could range between 0.03 to 0.10 cf/day per linear foot of wetted perimeter, with seepage rates up to 0.50 cf/day per linear foot of wetted perimeter or more for poorly lined canals. The same area assumptions that were used to calculate the soil seepage were used to calculate the losses for the lined canal. The results for the varying concrete conditions are presented in **Table 4-3.**

Since the concrete condition is unknown and the survey data shows that the lining is 30+ years old, it is assumed that the lining is in poor condition as a conservative assumption. As a result, the 7 cf/lf/day value was used in the water savings analysis.

Table 4-3 Seepage Losses Lined Canals

Assumed Condition	Seepage Rate (cf/day per linear foot of wetted perimeter)	Calculated Seepage Rate (cf/lf/day)
Good Quality Lining	0.05	0.7
Moderate Quality Lining	0.2	2.8
Poor Quality Lining	0.5	7.0

4.2 Evaporation Losses

Evaporation losses were estimated using evaporation data from the National Oceanic and Atmospheric Administration (NOAA) Technical Report 34 (TR34), Mean Monthly, Seasonal and Actual Pan Evaporation for the United States document. No data specific to Palmdale was available therefore the evaporation rates for the Mojave Desert were used for this analysis.

The duration and timing of the water releases vary from year to year as indicated by the release data provide by PWD. The average release duration over the past five years (2021 to is 105 days or approximately three and a half months. The release data also indicated that the four consecutive months with the highest frequency of release events were April to July, which are the months with the highest evaporation rates aside from August (which has the second highest evaporation rate). TR34 indicates that evaporation from a shallow water body, or other moist natural surfaces is roughly 70 percent of evaporation of a Class A Pan, therefore the assumed evaporation rates for the ditch as shown in **Table 4-4** were taken as 70 percent of the values provided in TR34.

Table 4-4 Mean Evaporation Rates for Release Months

Month	Mean Pan Evaporation (inches/month, TR34)	Assumed Evaporation, Ev (in)
April	10.00	7.00
May	13.86	9.70
June	15.91	11.14
July	17.6	12.32
Total (in)	**40.16**	
Total (ft)	**3.35**	
Loss Rate (ft/day)	**0.027**	

Similar to the seepage analysis, the water width in the channel was assumed to be 10 ft. To calculate the total water loss, only the open area portion of the channels were used to calculate surface area applicable to evaporation. With all tunnels, culverts and pipes excluded the total distance of open channel was assumed to be 34,600 ft. **This produces a total evaporation loss of 22.85 acre-ft per year** for a typical release event assuming the average duration for the last 5 years.

5. Water Savings

The results of the analyses presented in Sections 3 and 4 were used to calculate the approximate water savings by converting the current alignment to a 48-inch diameter RCP with the same segments used for the cost analysis. The potential water savings are calculated by summing up the existing losses for each segment (seepage losses and evaporation losses) and subtracting the allowable pipe leakage.

The calculated seepage losses for each soil cover by segment are shown in **Table 5-1**. The seepage losses per year are summarized for the various soil types along the alignment and the lined sections, assuming a release duration of 105 days (the average of the release data from 2017 to 2021). Analysis of the survey data and Google Maps imagery were used to estimate stationing of the lined, unlined and enclosed (tunnels and pipes) portions of the ditch. Geospatial analysis was used to distinguish the approximate stationing of each soil type boundary. This data was used to distinguish the unlined lengths of each soil type along each segment. The lined lengths for all soil type were summed for each segment. These lengths were then multiplied by the unit seepage values presented in **Section 4.1.3** and summed to get the total seepage values for each segment.

Table 5-1 Segment Seepage Losses by Soil Type

Segment	STA Start	STA End	Length (ft)	Seepage losses (cf/day)										Seepage Loss Total (Ac-ft/yr)
				GsC, GsD2, HbC, HcC	#21	#711	WgC	ReC, ReE	GaE2	AmF2	Co	Lined	Total	
Unit Seepage Rate (cf/lf/day)				34.4	104.4	34.4	10.4	8.8	28.8	28.8	5.2	7.0		
1	55+00	108+70	5,370	-	88,114	45,002	-	-	-	2,206	-	21,988	157,310	379
2	108+70	140+10	3,140	35,298	-	-	-	4,526	-	-	-	11,200	51,024	123
3	140+10	198+40	5,830	-	-	-	-	50,437	-	-	-	692	51,130	123
4	198+40	243+20	4,480	63,900	-	-	-	13,392	-	-	-	7,705	84,996	205
5	243+20	310+70	6,250	42,271	-	-	-	11,169	5,184	-	-	25,004	83,628	202
6	310+70	369+30	5,860	95,453	-	-	-	1,637	-	-	-	20,294	117,384	283
7	369+30	424+00	5,470	-	-	-	-	41,564	-	-	2,964	1,238	45,766	110
8	424+00	442+10	1,810	-	-	-	5,962	10,736	-	-	-	117	16,815	41
Total			38,210	236,921	88,114	45,002	5,962	92,763	5,184	2,206	2,964	88,238	608,052	1,466

Table 5-2 presents a summary of the total water savings by segment, these values are presented in total savings and unit savings (per linear foot). The seepage values vary depending on the percentage of lined ditch and soil type along the alignment, segments with a higher percentage of the concrete lining will have lower seepage losses. The evaporation losses for each segment are dependent on the percentage of the alignment which is covered. The evaporation rate is assumed to be linear along the uncovered sections of ditch, while evaporation along section in pipes or tunnels is assumed to be zero. The pipe leakage is assumed to be distributed equally along the new pipe; therefore, it will have no comparative impact along the water savings per linear foot.

Comparing the unit seepage rates presented in **Table 5-1** to the unit water loss rates presented in **Table 5-2** shows that even the lowest unit seepage rate is over ten-fold that of the water loss rates, meaning the impact of lining (concrete or soil type) will have a larger impact on water loss than the evaporation and pipe leakage.

Table 5-2 Water Savings Summary

Segment	STA Start	STA End	Length (ft)	Total Seepage Loss (cf/day)	Evap. Losses (cf/day)	Pipe Leakage (cf/day)	Water Savings	
					0.28 (cf/lf/day)	0.42 (cf/lf/day)	Ac-ft/year	cf/lf/day
1	55+00	108+70	5,370	157,310	1,274	2,204	377	29.1
2	108+70	140+10	3,140	51,024	464	1,289	121	16.0
3	140+10	198+40	5,830	51,130	1,599	2,393	121	8.6
4	198+40	243+20	4,480	84,996	1,125	1,839	203	18.8
5	243+20	310+70	6,250	83,628	1,456	2,565	199	13.2
6	310+70	369+30	5,860	117,384	1,536	2,405	281	19.9
7	369+30	424+00	5,470	45,766	1,500	2,245	109	8.2
8	424+00	442+10	1,810	16,815	492	743	40	9.2
Total Estimated Savings							1,450	123

The segment with the highest estimated water savings is Segment 1. This is due to the significant length of unlined ditch along the Riverwash (#21) soil type, which has a seepage loss rate of 104.4 cy/lf/day. Inspection of available data suggests that lining the approximately 840 ft of the unlined river wash portion of the alignment (approximate station 61+60 to 70+30) could save over two acre-ft per day of water from seepage losses alone.

The next segment with the best unit water savings is Segment 6, which has a high percentage of unlined channel falling within permeable soils. The entire length of Segment 3 falls within an unlined portion of the channel, however these soils are anticipated to have a relatively low permeability.

As previously mentioned, the volume of water loss per release is dependent on a number of variables. Due to the limitations of this study, many assumptions were made to predict the water loss per segment.

These assumptions were consistent for each segment and, therefore, the values are appropriate to compare the losses and potential water savings between one and other. A brief comparative analysis was performed to compare historical data to the results presented in **Table 5-2.** A summary of this data is presented in **Table 5-3.**

The historical volume losses were normalized for a typical release event (105 days) in order to perform an apples-to-apples comparison between the total water savings presented in **Table 5-2.** Results showed that predicted water savings is approximately 115 % of the average normalized water loss for the past 5 years**.**

The calculated volume loss per day for each year shows considerable variation between each year changing from 0.3 acre-ft to 33 acre-ft per day. Years 2018 and 2020 show low percent losses and could be considered outliers because they can be attributed to the release months occurring during the wet season. When analyzing the average normalized volume loss for the past five years with these years excluded, the predicted water savings is 93% of this total value.

In conclusion, the potential water savings resulting from this analysis appear to be within acceptable range when compared to the normalized volume loss for a release of similar duration.

Table 5-3 Volume Loss - Historical Data Comparison

Year	Total volume Loss (af-ft)	% Loss	Release Duration (day)	Volume Loss/Day (af-ft)	Normalized Volume Loss (acre-ft per 105 days)
2013	724	31%	79	9.2	962
2014	257	27%	30	8.6	899
2015	991	24%	30	33.0	3,469
2016	NA	NA	NA	NA	NA
2017	278	23%	52	5.3	561
2018*	349	10%	114	3.1	321
2019	2012	36%	110	18.3	1,921
2020*	59	9%	171	0.3	36
Average (past 5 releases)	**738**	**21%**		**12.0**	**1,262**
Average (2013 through 2015, 2017,2019)	**852**	**28%**		**14.9**	**1,562**

*Could be considered an outlier (based on percent loss)

6. Feasibility Level Construction Cost

A feasibility level construction cost estimate was completed for the length of the alignment between the flow control structure near Littlerock Dam to the entrance of the piped portion of the alignment near the Sierra Highway.

The estimate serves for budget authorization and alternative analysis and is considered to be an AACE Class 5 level. Class 5 has a typical accuracy range of -50% on the low side and +100% on the high side.

A 25% design contingency has been added to the estimate based on the project being at a feasibility level, the nature of the project and the estimate classification.

Assumptions and limitations of this estimate are listed below. The full basis of estimate is presented in **Appendix D**.

- The alignment was divided the reaches where the soil type changed while keeping them roughly 1-mile in length, when possible.
- Ditch is replaced with 48-inch diameter RCP.
- A constant cross section was assumed for the open channel and tunneled sections.
- Rock excavation was included as required in each segment as designated by the NRCS Web Soil Survey data. The following soil typed were assumed to likely include rock; 21, 711, AMF2 and GaE2. Along these lengths it was assumed that rock extends the entire excavation depth.
- Pipe to be placed on existing channel bed. A two foot over excavation was assumed for pipe bedding.
- Backfill entire ditch/tunnel/pipe section was assumed with import fill.
- Costs for manholes were included every 500 ft.
- Costs do not include hazardous material abatement or environmental mitigation.

A summary of cost per reach is presented below in **Table 6-1**. These costs represent construction costs and do not include costs for engineering, construction management, but do include items such as contractor overhead, escalation, bond and insurance and contingency.

Table 6-1 Cost Estimate Summary

Item	Description	Construction Cost	Starting Station	Ending Station	Total Length	Unit Costs ($/lf)
1	Segment 1	$2,800,000	55+00	108+70	5,370	$521
2	Segment 2	$1,500,000	108+70	140+10	3,140	$478
3	Segment 3	$2,700,000	140+10	198+40	5,830	$463
4	Segment 4	$2,100,000	198+40	243+20	4,480	$469
5	Segment 5	$3,000,000	243+20	310+70	6,250	$480
6	Segment 6	$2,700,000	310+70	369+30	5,860	$461
7	Segment 7	$2,500,000	369+30	424+00	5,470	$457
8	Segment 8	$800,000	424+00	442+10	1,810	$442
Total Costs		$18,100,000			39,210	

Although the cost per linear feet of pipe varies by reach, in general the piping costs account for about two thirds of the total cost, with the remaining one third including the demolition, excavation and fill costs. On average, construction of one mile of 48-inch diameter RCP is approximately $1.6 million.

7. Segment Prioritization

Three factors were used to prioritize segments including water savings, project costs and proximity of segments to each other. The cost per unit of water savings was calculated and used to rank the eight segments as presented in **Table 7-2**. These values were used as a tool to prioritize the construction sequencing for each segment. The ditch conversion construction work was broken up into years. It was assumed that a $4 million construction budget is available for each year. This is based on PWD receiving a $2 million grant from the USBR with $2 million of matching funds from PWD. In the first year, it was assumed that $500,000 will be needed for design and permitting and the full $4 million would be available for construction in subsequent years until the project is completed. Segment prioritization was based on lowest unit cost per acre foot of water saved. Construction packages were developed that include sections adjacent to the highest ranked sections to keep construction in one reach, even if those the adjacent section may not have been the next highest ranked. The suggested prioritization of each segment is presented in **Table 7-2** in order of priority from top to bottom.

Table 7-1 Segment Prioritization Summary

Segment No.	Length (ft)	Unit Cost for Water Savings ($ K per acre-ft/yr)
1	5,370	7.4
6	5,860	9.6
4	4,480	10.3
2	3,140	12.3
5	6,250	15.1
8	1,810	20.0
3	5,830	22.3
7	5,470	23.0

Table 7-2 Segment Prioritization Summary

Year	Assumed Budget ($ M)	Segment No.	Length (ft)	% of Segment	Unit Water Savings (cf/lf/day)	Construction Costs ($ M)	$ K/acre-ft/yr	Water Savings (ac-ft/year)
1	3.5	1	5,370	100%	29.1	2.8	7.4	433
		2	1,466	47%	16.0	0.7	12.4	
2	4	6	5,860	100%	19.9	2.7	9.6	367
		5	2,708	60%	13.2	1.3	15.1	
3	3.8	4	4,480	100%	18.8	2.1	10.3	316
		5	3,542	57%	13.2	1.7	15.1	
4	3.5	2	1,675	53%	16.0	0.8	12.4	186
		3	5,830	100%	8.6	2.7	22.3	
5	3.3	8	1,810	100%	9.2	0.8	20.0	148
		7	5,470	100%	8.2	2.5	23.0	
Total	**18.0**							**1,450**

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July 30, 2021

Appendix A: Existing Ditch Features

Starting Station	Ending Station	Length (ft)	Type	Source
55+00	61+36	636	Concrete Lining	No Survey/Interpreted from Google Earth
61+36	61+86	50	Tunnel under road	
61+86	76+14	1428	Earthen Channel	
76+14.40	78+05.80	191.4	Earthen Channel	
78+05.80	78+37.10	31.3	Tunnel	Palmdale Ditch 1991 Survey
78+37.10	83+69.90	532.80	Earthen Channel	Google Earth
83+69.90	86+38.10	268.20	Concrete Channel	Google Earth
86+38.10	86+68.60	30.5	Tunnel	Palmdale Ditch 1991 Survey
86+68.60	100+00.00	1331.4	Concrete Channel	Google Earth
100+00.00	103+76.30	376.3	Tunnel	Palmdale Ditch 1991 Survey
103+76.30	107+48.60	372.3	Concrete Channel	Google Earth
107+48.60	107+93.40	44.8	Tunnel	Palmdale Ditch 1991 Survey
107+93.40	111+32.60	339.2	Earthen Channel	Google Earth
111+32.60	118+31.20	698.6	Tunnel	Palmdale Ditch 1991 Survey
118+31.20	118+41.40	10.2	Earthen Channel	Google Earth
118+41.40	118+96.60	55.2	Concrete Channel	Google Earth
118+96.60	119+80.60	84	Earthen Channel	Google Earth
119+80.60	120+63.60	83	Concrete Channel	Google Earth
120+63.60	120+80.00	16.4	Tunnel	Palmdale Ditch 1991 Survey
120+80.00	124+01.60	321.6	Earthen Channel	Google Earth
124+01.60	125+36.50	134.9	Tunnel	Palmdale Ditch 1991 Survey
125+36.50	129+01.00	364.5	Earthen Channel	Google Earth
129+01.00	129+14.60	13.6	Concrete Channel	Google Earth
129+14.60	135+90.30	675.7	48" Pipe	Palmdale Ditch 1991 Survey
135+90.30	197+41.50	6151.2	Earthen Channel	Google Earth
197+41.50	203+88.40	646.9	Concrete Channel	Google Earth
203+88.40	204+18.40	30	Tunnel	Palmdale Ditch 1991 Survey
204+18.40	205+92.55	174.15	Concrete Channel	Google Earth
205+92.55	206+81.80	89.25	Earthen Channel	Google Earth
206+81.80	210+30.30	348.5	48" Pipe	Palmdale Ditch 1991 Survey
210+30.30	243+29.60	3299.3	Earthen Channel	Google Earth
243+29.60	259+29.70	1600.1	Concrete Channel	Google Earth
259+29.70	259+69.90	40.2	2- 48" Pipe	Palmdale Ditch 1991 Survey
259+69.90	262+88.20	318.3	Earthen Channel	Google Earth
262+88.20	265+89.50	301.3	48" Pipe	Palmdale Ditch 1991 Survey
265+89.50	286+40.50	2051	Earthen Channel	Google Earth
286+40.50	286+70.50	30	Tunnel/Covered Ditch	Palmdale Ditch 1991 Survey
286+70.50	289+00.00	229.50	Earthen Channel	Google Earth
289+00.00	Station Break			
Station Break	300+00.00	600	36" Tunnel	Palmdale Ditch 1991 Survey
300+00.00	324+04.00	2404.00	Concrete Channel	Google Earth
324+04.00	346+30.50	2226.5	Earthen Channel	Google Earth
346+30.50	347+86.90	156.4	48" Pipe	Palmdale Ditch 1991 Survey
347+86.90	352+69.70	482.8	Earthen Channel	Google Earth
352+69.70	353+71.20	101.5	Concrete Channel	Google Earth
353+71.20	354+73.70	102.5	Tunnel	Palmdale Ditch 1991 Survey
354+73.70	366+78.50	1204.8	Concrete Channel	Google Earth
366+78.50	386+81.30	2002.80	Earthen Channel	Google Earth
386+81.30	387+03.50	22.2	Concrete Channel	Google Earth
387+03.50	387+21.40	17.9	Steel Aqueduct	Palmdale Ditch 1991 Survey
387+21.40	388+28.50	107.1	Concrete Channel	Google Earth
388+28.50	401+05.80	1277.3	Earthen Channel	Google Earth
401+05.80	401+35.40	29.6	Concrete Channel	Google Earth
401+35.40	441+93.30	4057.90	Earthen Channel	Google Earth
441+93.30	442+10.00	16.70	Tunnel	Google Earth
	Total Distance	**38209.6**	ft.	
		7.2	mile	

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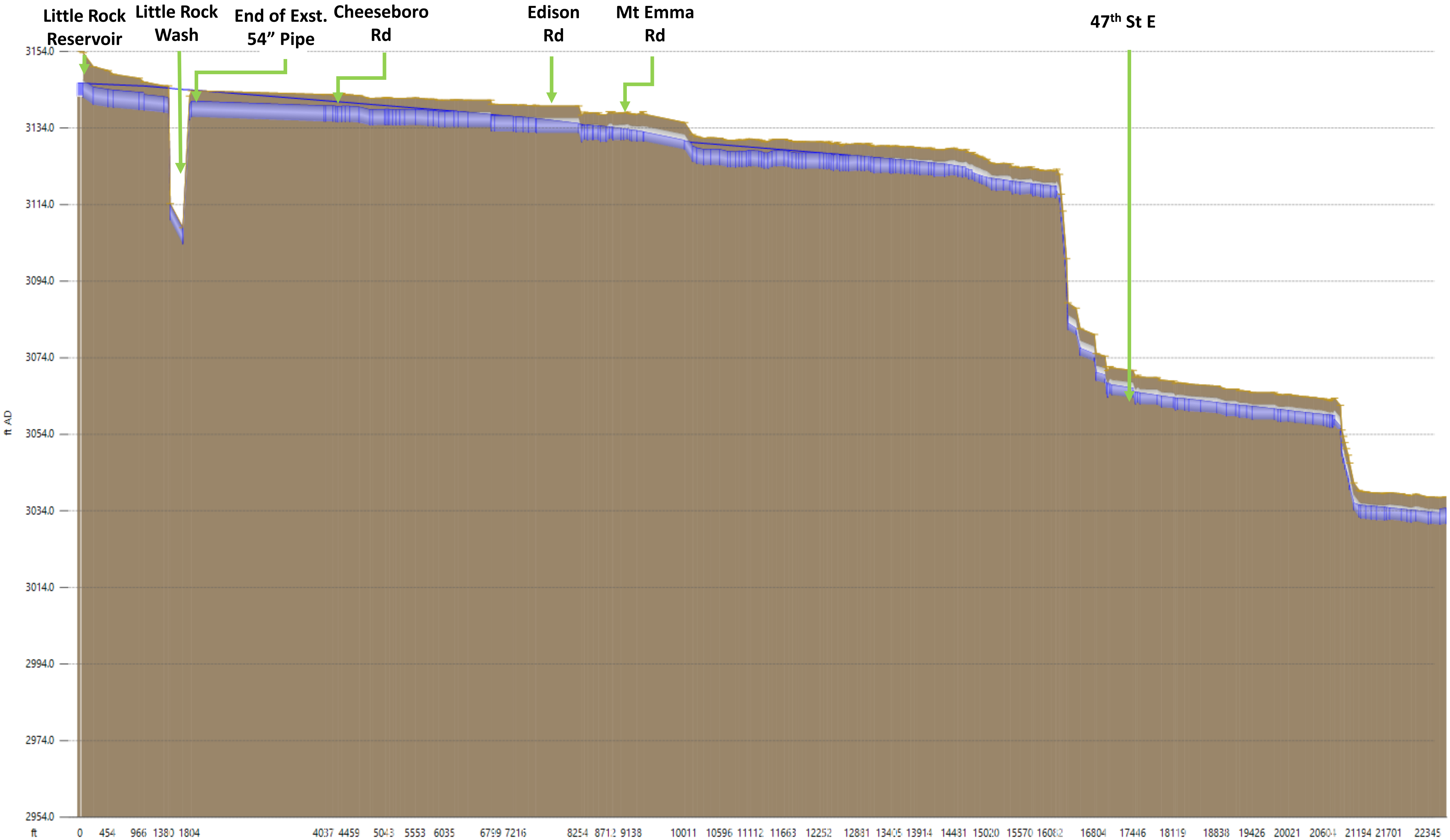
Appendix B: Hydraulic Analysis

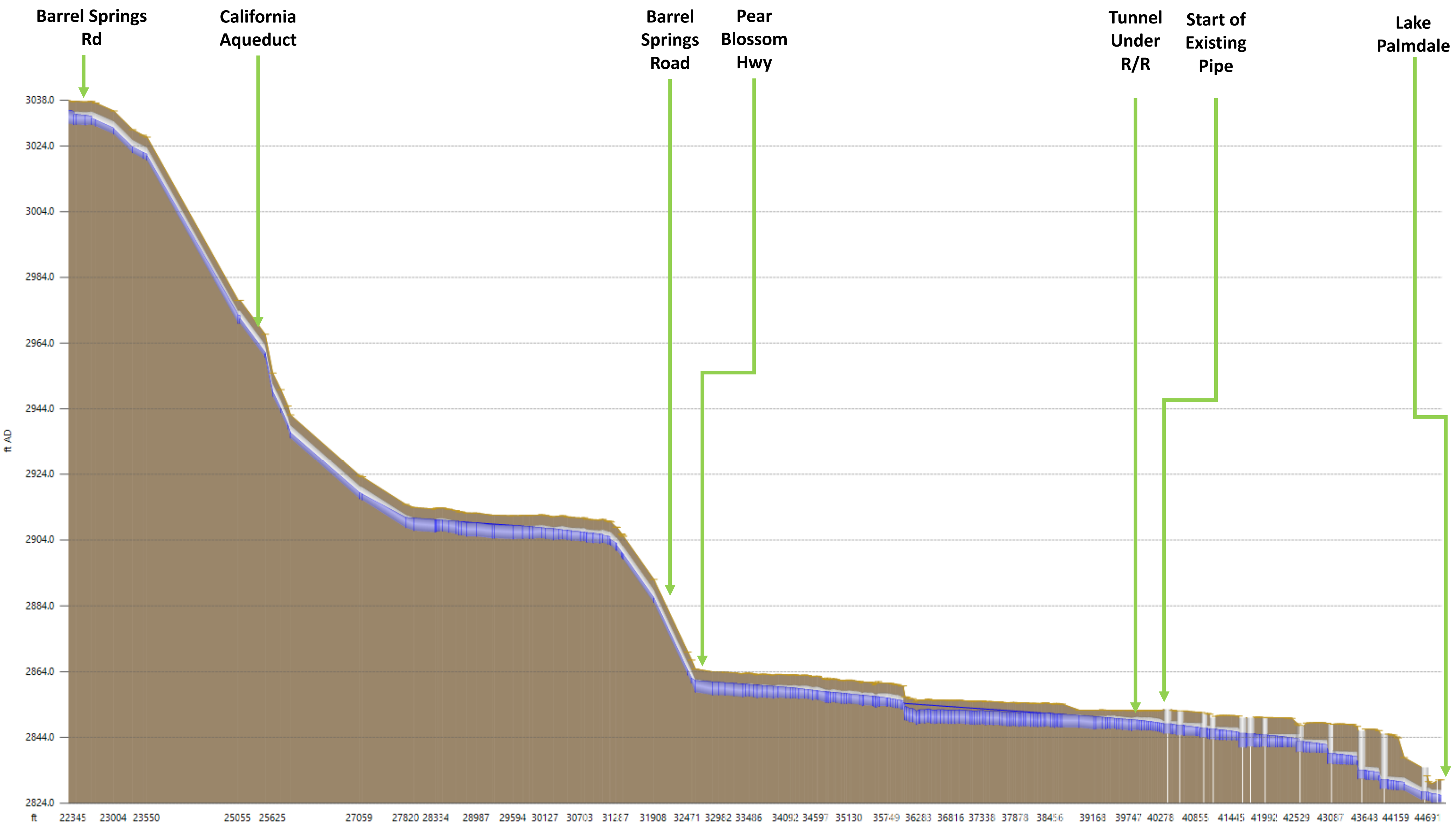


PALMDALE WATER DISTRICT
A CENTURY OF SERVICE

PALMDALE DITCH CONVERSION FEASIBILITY STUDY

48" Pipeline under 60 CFS Scenario – Upstream of Channel Midpoint

Hazen



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PALMDALE DITCH CONVERSION FEASIBILITY STUDY

48” Pipeline under 60 CFS Scenario – Downstream of Channel Midpoint

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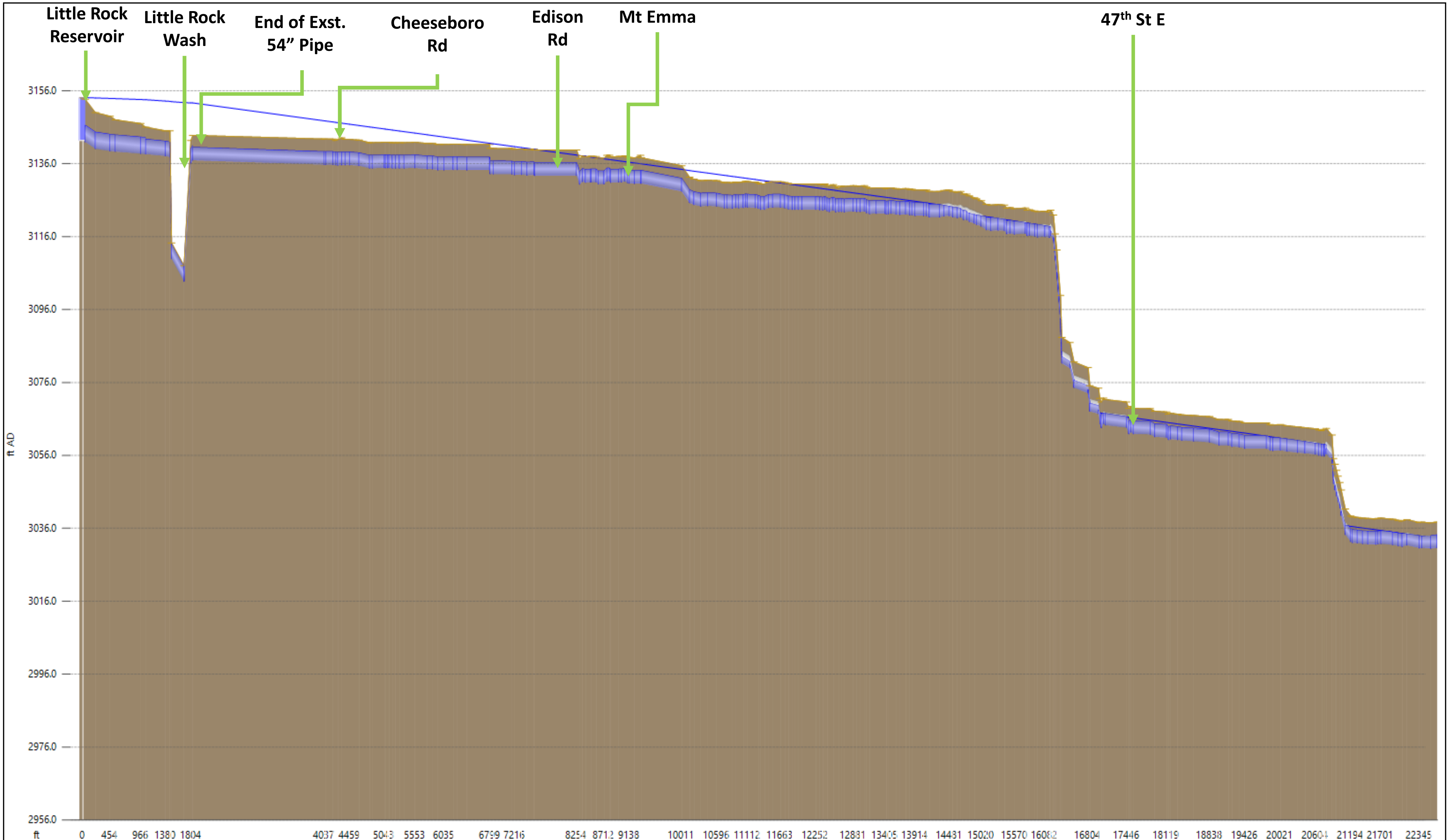

PALMDALE WATER DISTRICT
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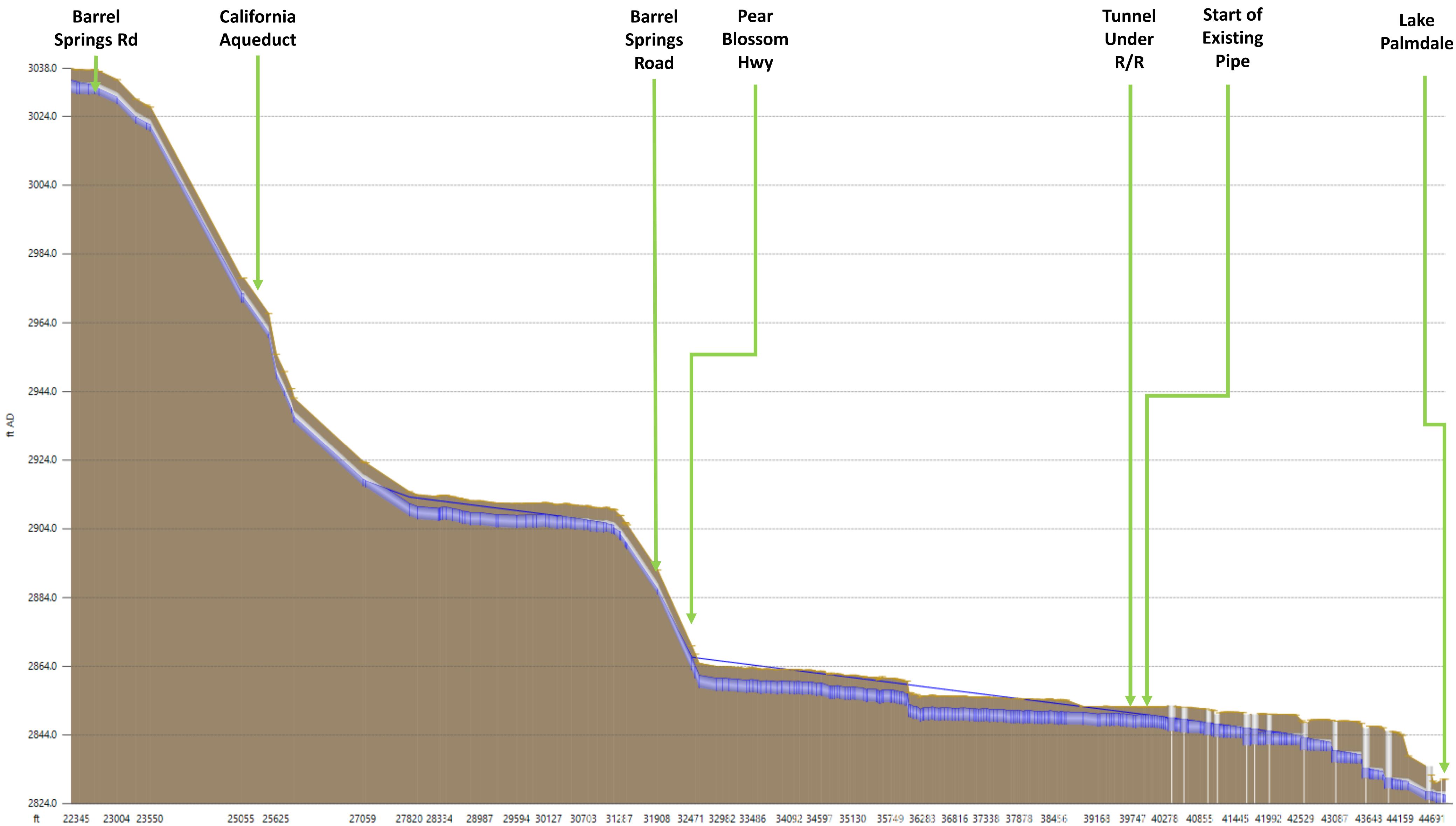
PALMDALE DITCH CONVERSION FEASIBILITY STUDY

42” Pipeline under 60 CFS Scenario – Upstream of Channel Midpoint

Hazen



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PALMDALE DITCH CONVERSION FEASIBILITY STUDY

42” Pipeline under 60 CFS Scenario – Downstream of Channel Midpoint

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48-Inch Diamter Pipe
Hydraulic Model Output

Approximate US Station	Length (ft)	Segment Length	Culmulative Distance	Max US flow (ft3/s)	Max US total head (ft AD)	Max DS total head (ft AD)	Max US velocity (ft/s)	Max DS velocity (ft/s)	Max DS Froude number	Max US Froude number
3635.7	40.0			60.3	3146.1	3146.0	4.8	4.3	0.4	0.5
3675.7	169.3	40.0	40.0	60.3	3146.0	3145.7	4.3	3.6	0.0	0.4
3845.0	245.0	169.3	209.3	60.3	3145.7	3145.6	3.6	3.6	0.0	0.0
4090.0	90.4	245.0	454.3	60.3	3145.6	3145.5	3.6	3.6	0.0	0.0
4180.4	421.1	90.4	544.7	60.3	3145.5	3145.2	3.6	3.6	0.0	0.0
4601.5	84.9	421.1	965.8	60.3	3145.2	3145.2	3.6	3.6	0.0	0.0
4686.4	329.4	84.9	1050.7	60.3	3145.3	3144.9	4.6	4.6	0.1	0.1
5015.8	75.2	329.4	1380.1	60.3	3144.9	3144.8	4.6	4.6	0.1	0.1
5091.0	27.6	75.2	1455.3	60.3	3144.8	3144.6	4.6	3.9	0.1	0.1
5118.6	208.4	27.6	1482.9	60.3	3144.6	3144.3	3.9	3.8	0.0	0.1
5327.0	113.0	208.4	1691.3	60.3	3144.3	3144.3	3.8	4.5	0.1	0.0
5440.0	33.0	113.0	1804.3	60.3	3144.3	3144.3	4.5	4.6	0.1	0.1
5473.0	2200.0	33.0	1837.3	60.3	3144.3	3141.5	4.6	4.6	0.1	0.1
7673.0	23.9	2200.0	4037.3	60.3	3141.5	3141.4	4.6	4.6	0.1	0.1
7696.9	121.3	23.9	4061.2	60.3	3141.4	3141.3	4.6	4.6	0.1	0.1
7818.2	46.3	121.3	4182.5	60.3	3141.3	3141.2	4.6	4.6	0.1	0.1
7864.5	31.3	46.3	4228.8	60.3	3141.2	3141.2	4.6	4.6	0.1	0.1
7895.8	66.6	31.3	4260.1	60.3	3141.2	3141.1	4.6	4.6	0.1	0.1
7962.4	58.0	66.6	4326.7	60.3	3141.1	3141.0	4.6	4.6	0.1	0.1
8020.4	74.1	58.0	4384.7	60.3	3141.0	3140.9	4.6	4.6	0.1	0.1
8094.5	158.0	74.1	4458.8	60.3	3140.9	3140.7	4.6	4.6	0.1	0.1
8252.5	176.2	158.0	4616.8	60.3	3140.7	3140.5	4.6	4.6	0.1	0.1
8428.7	46.7	176.2	4793.0	60.3	3140.5	3140.4	4.6	4.6	0.1	0.1
8475.4	203.0	46.7	4839.7	60.3	3140.4	3140.2	4.6	4.6	0.1	0.1
8678.4	18.5	203.0	5042.7	60.3	3140.2	3140.2	4.6	4.6	0.1	0.1
8696.9	30.6	18.5	5061.2	60.3	3140.2	3140.1	4.6	4.6	0.1	0.1
8727.5	26.7	30.6	5091.8	60.3	3140.1	3140.1	4.6	4.6	0.1	0.1
8754.2	56.1	26.7	5118.5	60.3	3140.1	3140.0	4.6	4.6	0.1	0.1
8810.3	54.1	56.1	5174.6	60.3	3140.0	3140.0	4.6	4.6	0.1	0.1
8864.4	64.3	54.1	5228.7	60.3	3140.0	3139.9	4.6	4.6	0.1	0.1
8928.7	77.4	64.3	5293.0	60.3	3139.9	3139.8	4.6	4.6	0.1	0.1
9006.1	182.5	77.4	5370.4	60.3	3139.8	3139.5	4.6	4.6	0.2	0.1
9188.6	207.4	182.5	5552.9	60.3	3139.5	3139.3	4.6	4.6	0.1	0.2
9396.0	86.1	207.4	5760.3	60.3	3139.3	3139.2	4.6	4.7	0.2	0.1
9482.1	91.4	86.1	5846.4	60.3	3139.2	3139.0	4.7	4.6	0.1	0.2
9573.5	97.1	91.4	5937.8	60.3	3139.0	3138.9	4.6	4.6	0.2	0.1
9670.6	156.4	97.1	6034.9	60.3	3138.9	3138.7	4.6	4.7	0.3	0.2
9827.0	70.8	156.4	6191.3	60.3	3138.7	3138.6	4.7	4.8	0.3	0.3
9897.8	161.1	70.8	6262.1	60.3	3138.6	3138.4	4.8	4.9	0.3	0.3
10058.9	376.4	161.1	6423.2	60.3	3138.4	3138.0	4.9	5.5	0.5	0.3
10435.3	9.9	376.4	6799.6	60.3	3138.0	3137.8	5.5	4.7	0.2	0.5
10445.2	51.9	9.9	6809.5	60.3	3137.8	3137.7	4.7	4.7	0.2	0.2
10497.1	310.4	51.9	6861.4	60.3	3137.7	3137.4	4.7	4.9	0.3	0.2
10807.5	44.8	310.4	7171.8	60.3	3137.4	3137.3	4.9	4.8	0.3	0.3
10852.3	116.4	44.8	7216.6	60.3	3137.3	3137.1	4.8	4.9	0.4	0.3
10968.7	93.0	116.4	7333.0	60.3	3137.1	3137.0	4.9	4.9	0.3	0.4
11061.7	115.7	93.0	7426.0	60.3	3137.0	3136.9	4.9	5.2	0.4	0.3
11177.4	14.0	115.7	7541.7	60.3	3136.9	3136.8	5.2	5.0	0.4	0.4
11191.4	698.6	14.0	7555.7	60.3	3136.8	3136.1	5.0	7.7	1.0	0.4
11890.0	49.7	698.6	8254.3	60.3	3136.1	3135.2	8.3	4.6	0.1	1.1
11939.7	49.6	49.7	8304.0	60.3	3135.2	3135.2	4.6	5.0	0.4	0.1
11989.3	49.5	49.6	8353.6	60.3	3135.2	3135.1	5.0	4.8	0.3	0.4
12038.8	79.0	49.5	8403.1	60.3	3135.1	3135.0	4.8	5.0	0.4	0.3
12117.8	20.4	79.0	8482.1	60.3	3135.0	3135.0	5.0	5.1	0.4	0.4
12138.2	79.5	20.4	8502.5	60.3	3135.0	3134.9	5.1	5.1	0.4	0.4

12217.7	33.0	79.5	8582.0	60.3	3134.9	3134.8	5.1	4.8	0.3	0.4
12250.7	97.2	33.0	8615.0	60.3	3134.8	3134.7	4.8	4.9	0.3	0.3
12347.9	50.6	97.2	8712.2	60.3	3134.7	3134.8	4.9	6.0	0.6	0.3
12398.5	41.5	50.6	8762.8	60.3	3134.8	3134.7	6.0	6.2	0.7	0.6
12440.0	20.1	41.5	8804.3	60.3	3134.7	3134.6	6.2	5.5	0.5	0.7
12460.1	134.9	20.1	8824.4	60.3	3134.6	3134.4	5.5	6.2	0.7	0.5
12595.0	46.0	134.9	8959.3	60.3	3134.4	3134.4	6.2	6.5	0.7	0.7
12641.0	59.2	46.0	9005.3	60.3	3134.4	3134.5	6.5	7.4	0.9	0.7
12700.2	44.7	59.2	9064.5	60.3	3134.5	3134.2	7.4	6.5	0.7	0.9
12744.9	28.5	44.7	9109.2	60.3	3134.2	3134.1	6.5	6.4	0.7	0.7
12773.4	84.7	28.5	9137.7	60.3	3134.1	3134.0	6.4	6.6	0.7	0.7
12858.1	99.5	84.7	9222.4	60.3	3134.0	3133.9	6.6	7.7	1.0	0.7
12957.6	13.7	99.5	9321.9	60.3	3133.9	3133.9	7.7	7.9	1.0	1.0
12971.3	675.8	13.7	9335.6	60.3	3133.9	3131.8	8.1	8.1	1.0	1.0
13647.1	132.7	675.8	10011.4	60.3	3131.8	3130.6	8.9	4.6	0.1	1.2
13779.8	71.2	132.7	10144.1	60.3	3130.6	3130.5	4.6	4.6	0.1	0.1
13851.0	115.0	71.2	10215.3	60.3	3130.5	3130.3	4.6	4.6	0.1	0.1
13966.0	114.8	115.0	10330.3	60.3	3130.3	3130.2	4.6	4.6	0.1	0.1
14080.8	151.0	114.8	10445.1	60.3	3130.2	3130.0	4.6	4.6	0.1	0.1
14231.8	126.4	151.0	10596.1	60.3	3130.0	3129.8	4.6	4.6	0.1	0.1
14358.2	51.2	126.4	10722.5	60.3	3129.8	3129.8	4.6	4.6	0.1	0.1
14409.4	82.7	51.2	10773.7	60.3	3129.8	3129.7	4.6	4.6	0.1	0.1
14492.1	59.8	82.7	10856.4	60.3	3129.7	3129.6	4.6	4.6	0.1	0.1
14551.9	48.9	59.8	10916.2	60.3	3129.6	3129.5	4.6	4.6	0.1	0.1
14600.8	77.3	48.9	10965.1	60.3	3129.5	3129.4	4.6	4.6	0.1	0.1
14678.1	36.9	77.3	11042.4	60.3	3129.4	3129.4	4.6	4.6	0.1	0.1
14715.0	33.0	36.9	11079.3	60.3	3129.4	3129.3	4.6	4.6	0.1	0.1
14748.0	126.3	33.0	11112.3	60.3	3129.3	3129.2	4.6	4.6	0.1	0.1
14874.3	53.3	126.3	11238.6	60.3	3129.2	3129.1	4.6	4.6	0.1	0.1
14927.6	40.5	53.3	11291.9	60.3	3129.1	3129.0	4.6	4.6	0.1	0.1
14968.1	63.3	40.5	11332.4	60.3	3129.0	3129.0	4.6	4.6	0.1	0.1
15031.4	65.0	63.3	11395.7	60.3	3129.0	3128.9	4.6	4.6	0.1	0.1
15096.4	71.7	65.0	11460.7	60.3	3128.9	3128.8	4.6	4.6	0.1	0.1
15168.1	130.3	71.7	11532.4	60.3	3128.8	3128.6	4.6	4.7	0.2	0.1
15298.4	70.7	130.3	11662.7	60.3	3128.6	3128.5	4.7	4.6	0.2	0.2
15369.1	61.1	70.7	11733.4	60.3	3128.5	3128.5	4.6	4.6	0.1	0.2
15430.2	64.5	61.1	11794.5	60.3	3128.5	3128.4	4.6	4.6	0.1	0.1
15494.7	45.5	64.5	11859.0	60.3	3128.4	3128.3	4.6	4.6	0.1	0.1
15540.2	54.7	45.5	11904.5	60.3	3128.3	3128.3	4.6	4.6	0.1	0.1
15594.9	62.6	54.7	11959.2	60.3	3128.3	3128.2	4.6	4.6	0.1	0.1
15657.5	230.0	62.6	12021.8	60.3	3128.2	3127.9	4.6	4.7	0.3	0.1
15887.5	69.2	230.0	12251.8	60.3	3127.9	3127.8	4.7	4.7	0.2	0.3
15956.7	49.5	69.2	12321.0	60.3	3127.8	3127.7	4.7	4.7	0.2	0.2
16006.2	34.0	49.5	12370.5	60.3	3127.7	3127.7	4.7	4.8	0.3	0.2
16040.2	38.8	34.0	12404.5	60.3	3127.7	3127.6	4.8	4.7	0.2	0.3
16079.0	33.4	38.8	12443.3	60.3	3127.6	3127.6	4.7	4.6	0.1	0.2
16112.4	68.8	33.4	12476.7	60.3	3127.6	3127.5	4.6	4.8	0.3	0.1
16181.2	42.2	68.8	12545.5	60.3	3127.5	3127.4	4.8	4.6	0.2	0.3
16223.4	49.8	42.2	12587.7	60.3	3127.4	3127.4	4.6	4.7	0.2	0.2
16273.2	42.9	49.8	12637.5	60.3	3127.4	3127.3	4.7	4.7	0.2	0.2
16316.1	49.3	42.9	12680.4	60.3	3127.3	3127.3	4.7	4.7	0.2	0.2
16365.4	150.8	49.3	12729.7	60.3	3127.3	3127.1	4.7	4.9	0.4	0.2
16516.2	59.4	150.8	12880.5	60.3	3127.1	3127.0	4.9	4.9	0.3	0.4
16575.6	53.8	59.4	12939.9	60.3	3127.0	3126.9	4.9	5.0	0.4	0.3
16629.4	71.0	53.8	12993.7	60.3	3126.9	3126.8	5.0	5.2	0.4	0.4
16700.4	36.1	71.0	13064.7	60.3	3126.8	3126.7	5.2	4.9	0.3	0.4
16736.5	50.2	36.1	13100.8	60.3	3126.7	3126.6	4.9	4.7	0.3	0.3
16786.7	114.4	50.2	13151.0	60.3	3126.6	3126.5	4.7	4.9	0.3	0.3
16901.1	139.3	114.4	13265.4	60.3	3126.5	3126.3	4.9	5.1	0.4	0.3

17040.4	27.1	139.3	13404.7	60.3	3126.3	3126.3	5.1	4.9	0.4	0.4
17067.5	34.5	27.1	13431.8	60.3	3126.3	3126.2	4.9	5.1	0.4	0.4
17102.0	43.1	34.5	13466.3	60.3	3126.2	3126.2	5.1	5.3	0.5	0.4
17145.1	86.1	43.1	13509.4	60.3	3126.2	3126.1	5.3	5.2	0.4	0.5
17231.2	61.4	86.1	13595.5	60.3	3126.1	3126.0	5.2	5.1	0.4	0.4
17292.6	99.3	61.4	13656.9	60.3	3126.0	3125.9	5.1	5.5	0.5	0.4
17391.9	67.2	99.3	13756.2	60.3	3125.9	3125.8	5.5	5.3	0.5	0.5
17459.1	37.3	67.2	13823.4	60.3	3125.8	3125.7	5.3	5.4	0.5	0.5
17496.4	53.1	37.3	13860.7	60.3	3125.7	3125.6	5.4	5.2	0.5	0.5
17549.5	140.0	53.1	13913.8	60.3	3125.6	3125.4	5.2	5.6	0.5	0.5
17689.5	51.0	140.0	14053.8	60.3	3125.4	3125.4	5.6	5.7	0.6	0.5
17740.5	46.3	51.0	14104.8	60.3	3125.4	3125.2	5.7	5.2	0.4	0.6
17786.8	170.1	46.3	14151.1	60.3	3125.2	3125.0	5.2	5.6	0.5	0.4
17956.9	72.2	170.1	14321.2	60.3	3125.0	3125.1	5.6	6.5	0.7	0.5
18029.1	86.9	72.2	14393.4	60.3	3125.1	3125.1	6.5	7.6	0.9	0.7
18116.0	63.6	86.9	14480.3	60.3	3125.1	3124.7	7.6	6.8	0.8	0.9
18179.6	75.8	63.6	14543.9	60.3	3124.7	3124.6	6.8	6.6	0.8	0.8
18255.4	54.3	75.8	14619.7	60.3	3124.6	3124.7	6.6	7.7	1.0	0.8
18309.7	51.1	54.3	14674.0	60.3	3124.8	3124.0	9.5	7.3	0.9	1.3
18360.8	51.8	51.1	14725.1	60.3	3124.0	3124.0	7.3	7.9	1.0	0.9
18412.6	40.9	51.8	14776.9	60.3	3124.4	3123.6	**11.3**	9.9	1.4	1.7
18453.5	86.3	40.9	14817.8	60.3	3123.6	3123.1	9.9	9.9	1.4	1.4
18539.8	33.6	86.3	14904.1	60.3	3123.1	3122.7	10.0	9.3	1.3	1.4
18573.4	82.2	33.6	14937.7	60.3	3122.7	3122.2	9.3	8.5	1.1	1.3
18655.6	79.8	82.2	15019.9	60.3	3122.2	3121.4	8.5	6.1	0.6	1.1
18735.4	81.7	79.8	15099.7	60.3	3121.4	3121.2	6.1	5.9	0.6	0.6
18817.1	119.9	81.7	15181.4	60.3	3121.2	3121.1	5.9	6.8	0.8	0.6
18937.0	104.7	119.9	15301.3	60.3	3121.1	3121.0	6.8	7.3	0.9	0.8
19041.7	41.1	104.7	15406.0	60.3	3121.0	3120.5	7.3	5.4	0.5	0.9
19082.8	51.4	41.1	15447.1	60.3	3120.5	3120.5	5.4	5.9	0.6	0.5
19134.2	71.4	51.4	15498.5	60.3	3120.5	3120.4	5.9	5.6	0.5	0.6
19205.6	187.6	71.4	15569.9	60.3	3120.4	3120.2	5.6	7.0	0.8	0.5
19393.2	30.3	187.6	15757.5	60.3	3120.2	3119.9	7.0	5.7	0.6	0.8
19423.5	36.9	30.3	15787.8	60.3	3119.9	3119.9	5.7	6.0	0.6	0.6
19460.4	87.6	36.9	15824.7	60.3	3119.9	3119.7	6.0	5.7	0.6	0.6
19548.0	48.1	87.6	15912.3	60.3	3119.7	3119.6	5.7	5.5	0.5	0.6
19596.1	121.6	48.1	15960.4	60.3	3119.6	3119.5	5.5	6.1	0.6	0.5
19717.7	75.4	121.6	16082.0	60.3	3119.5	3119.3	6.1	5.9	0.6	0.6
19793.1	20.7	75.4	16157.4	60.3	3119.3	3119.6	5.9	7.3	0.9	0.6
19813.8	46.3	20.7	16178.1	60.3	3122.0	3120.6	**16.9**	**16.9**	3.1	3.1
19860.1	29.5	46.3	16224.4	60.3	3129.5	3123.7	**29.7**	**29.0**	6.5	6.7
19889.6	27.9	29.5	16253.9	60.3	3123.7	3119.3	**29.0**	**29.0**	6.5	6.5
19917.5	59.6	27.9	16281.8	60.3	3121.1	3108.6	**31.0**	**31.0**	7.1	7.1
19977.1	24.2	59.6	16341.4	60.3	3116.2	3085.2	**38.2**	**11.9**	1.8	9.4
20001.3	134.9	24.2	16365.6	60.3	3085.2	3083.9	**11.9**	**11.9**	1.8	1.8
20136.2	68.7	134.9	16500.5	60.3	3089.2	3078.2	**22.9**	**10.4**	1.5	4.7
20204.9	234.6	68.7	16569.2	60.3	3078.2	3076.7	**10.4**	**10.4**	1.5	1.5
20439.5	30.5	234.6	16803.8	60.3	3087.2	3071.5	**29.2**	9.2	1.3	6.5
20470.0	145.3	30.5	16834.3	60.3	3071.5	3070.8	9.2	9.2	1.3	1.3
20615.3	21.5	145.3	16979.6	60.3	3078.3	3068.0	**25.2**	6.7	0.8	5.3
20636.8	25.6	21.5	17001.1	60.3	3068.0	3067.7	6.7	5.0	0.4	0.8
20662.4	36.0	25.6	17026.7	60.3	3067.7	3068.1	5.0	7.3	0.9	0.4
20698.4	34.7	36.0	17062.7	60.3	3068.1	3067.7	8.1	7.0	0.8	1.0
20733.1	348.6	34.7	17097.4	60.3	3067.7	3067.0	7.0	7.9	1.0	0.8
21081.7	39.1	348.6	17446.0	60.3	3067.9	3065.5	**12.9**	5.8	0.6	2.1
21120.8	38.6	39.1	17485.1	60.3	3065.5	3065.8	5.8	7.3	0.9	0.6
21159.4	37.2	38.6	17523.7	60.3	3065.8	3065.4	7.3	6.2	0.7	0.9
21196.6	281.4	37.2	17560.9	60.3	3065.4	3065.2	6.2	7.8	1.0	0.7
21478.0	76.8	281.4	17842.3	60.3	3065.2	3064.6	7.8	6.3	0.7	1.0

21554.8	199.9	76.8	17919.1	60.3	3064.6	3064.3	6.3	6.9	0.8	0.7
21754.7	29.7	199.9	18119.0	60.3	3064.3	3064.0	6.9	5.6	0.5	0.8
21784.4	37.9	29.7	18148.7	60.3	3064.0	3064.1	5.6	6.1	0.6	0.5
21822.3	115.4	37.9	18186.6	60.3	3064.1	3063.9	6.1	6.1	0.6	0.6
21937.7	68.2	115.4	18302.0	60.3	3063.9	3063.7	6.1	5.9	0.6	0.6
22005.9	199.9	68.2	18370.2	60.3	3063.7	3063.4	5.9	6.2	0.7	0.6
22205.8	267.2	199.9	18570.1	60.3	3063.4	3063.0	6.2	6.8	0.8	0.7
22473.0	156.9	267.2	18837.3	60.3	3063.0	3062.5	6.8	5.6	0.5	0.8
22629.9	155.6	156.9	18994.2	60.3	3062.5	3062.3	5.6	6.2	0.7	0.5
22785.5	59.2	155.6	19149.8	60.3	3062.3	3062.1	6.2	5.6	0.5	0.7
22844.7	120.7	59.2	19209.0	60.3	3062.1	3062.0	5.6	5.8	0.6	0.5
22965.4	95.6	120.7	19329.7	60.3	3062.0	3061.8	5.8	5.3	0.5	0.6
23061.0	360.3	95.6	19425.3	60.3	3061.8	3061.4	5.3	6.6	0.8	0.5
23421.3	61.2	360.3	19785.6	60.3	3061.4	3061.1	6.6	5.8	0.6	0.8
23482.5	46.5	61.2	19846.8	60.3	3061.1	3061.0	5.8	5.7	0.6	0.6
23529.0	127.4	46.5	19893.3	60.3	3061.0	3060.9	5.7	6.5	0.7	0.6
23656.4	113.5	127.4	20020.7	60.3	3060.9	3060.6	6.5	6.3	0.7	0.7
23769.9	171.1	113.5	20134.2	60.3	3060.6	3060.3	6.3	6.2	0.7	0.7
23941.0	125.5	171.1	20305.3	60.3	3060.3	3060.1	6.2	6.3	0.7	0.7
24066.5	172.8	125.5	20430.8	60.3	3060.1	3059.8	6.3	6.2	0.7	0.7
24239.3	61.0	172.8	20603.6	60.3	3059.8	3059.7	6.2	5.8	0.6	0.7
24300.3	45.9	61.0	20664.6	60.3	3059.7	3059.5	5.8	5.6	0.5	0.6
24346.2	33.4	45.9	20710.5	60.3	3059.5	3059.6	5.6	6.3	0.7	0.5
24379.6	8.3	33.4	20743.9	60.3	3059.6	3059.5	6.3	5.6	0.5	0.7
24387.9	5.8	8.3	20752.2	60.3	3059.5	3059.5	5.6	5.9	0.6	0.5
24393.7	26.7	5.8	20758.0	60.3	3059.5	3059.8	5.9	7.3	0.9	0.6
24420.4	97.1	26.7	20784.7	60.3	3061.3	3059.5	14.7	14.7	2.5	2.5
24517.5	25.2	97.1	20881.8	60.3	3071.9	3056.7	32.5	21.9	4.4	7.6
24542.7	25.3	25.2	20907.0	60.3	3056.7	3054.9	21.9	21.7	4.3	4.4
24568.0	25.2	25.3	20932.3	60.3	3054.9	3053.3	21.7	21.7	4.3	4.3
24593.2	23.9	25.2	20957.5	60.3	3053.5	3051.0	22.0	20.7	4.1	4.4
24617.1	30.9	23.9	20981.4	60.3	3051.0	3049.3	20.7	20.7	4.1	4.1
24648.0	23.6	30.9	21012.3	60.3	3051.4	3048.6	23.8	22.8	4.6	4.9
24671.6	68.5	23.6	21035.9	60.3	3048.6	3038.1	22.8	11.7	1.8	4.6
24740.1	89.3	68.5	21104.4	60.3	3038.1	3036.0	11.7	5.8	0.6	1.8
24829.4	31.2	89.3	21193.7	60.3	3036.0	3035.9	5.8	5.3	0.5	0.6
24860.6	78.3	31.2	21224.9	60.3	3035.9	3035.8	5.3	5.4	0.5	0.5
24938.9	88.7	78.3	21303.2	60.3	3035.8	3035.6	5.4	5.2	0.5	0.5
25027.6	88.2	88.7	21391.9	60.3	3035.6	3035.5	5.2	5.3	0.5	0.5
25115.8	133.0	88.2	21480.1	60.3	3035.5	3035.3	5.3	5.4	0.5	0.5
25248.8	39.5	133.0	21613.1	60.3	3035.3	3035.3	5.4	5.7	0.5	0.5
25288.3	47.6	39.5	21652.6	60.3	3035.3	3035.3	5.7	6.1	0.6	0.5
25335.9	193.7	47.6	21700.2	60.3	3035.3	3035.0	6.1	6.1	0.6	0.6
25529.6	97.2	193.7	21893.9	60.3	3035.0	3034.8	6.1	5.8	0.6	0.6
25626.8	63.3	97.2	21991.1	60.3	3034.8	3034.6	5.8	5.6	0.5	0.6
25690.1	80.4	63.3	22054.4	60.3	3034.6	3034.7	5.6	6.7	0.8	0.5
25770.5	209.3	80.4	22134.8	60.3	3034.7	3034.2	6.7	5.8	0.6	0.8
25979.8	40.2	209.3	22344.1	60.3	3034.2	3034.2	5.8	6.1	0.6	0.6
26020.0	151.2	40.2	22384.3	60.3	3034.2	3033.9	6.1	6.2	0.7	0.6
26171.2	100.1	151.2	22535.5	60.3	3033.9	3034.0	6.2	7.7	1.0	0.7
26271.3	67.3	100.1	22635.6	60.3	3034.3	3033.8	11.1	11.1	1.7	1.7
26338.6	300.4	67.3	22702.9	60.3	3033.9	3031.5	11.5	11.5	1.8	1.8
26639.0	309.5	300.4	23003.3	60.3	3032.5	3025.9	14.7	12.1	1.9	2.5
26948.5	175.0	309.5	23312.8	60.3	3025.9	3024.1	12.1	11.5	1.8	1.9
27123.5	62.1	175.0	23487.8	60.3	3024.1	3023.5	11.5	11.5	1.8	1.8
27185.6	1504.9	62.1	23549.9	60.3	3025.9	2973.3	17.7	7.6	0.9	3.3
28690.5	30.2	1504.9	25054.8	60.3	2973.3	2973.3	7.6	7.9	1.0	0.9
28720.7	414.2	30.2	25085.0	60.3	2975.4	2965.0	16.0	16.0	2.8	2.8
29134.9	125.0	414.2	25499.2	60.3	2970.0	2954.5	24.5	18.6	3.5	5.1

29259.9	133.0	125.0	25624.2	60.3	2954.5	2949.5	18.6	18.6	3.5	3.5
29392.9	117.5	133.0	25757.2	60.3	2949.9	2944.9	19.4	19.4	3.7	3.7
29510.4	42.2	117.5	25874.7	60.3	2946.2	2939.7	21.6	14.1	2.4	4.3
29552.6	1141.6	42.2	25916.9	60.3	2939.7	2920.3	14.1	11.3	1.7	2.4
30694.2	43.1	1141.6	27058.5	60.3	2920.3	2919.9	11.3	11.3	1.7	1.7
30737.3	718.0	43.1	27101.6	60.3	2920.2	2911.3	12.4	6.0	0.6	2.0
31455.3	136.2	718.0	27819.6	60.3	2911.3	2911.0	6.0	5.0	0.4	0.6
31591.5	346.5	136.2	27955.8	60.3	2911.0	2910.5	5.0	4.9	0.4	0.4
31938.0	13.3	346.5	28302.3	60.3	2910.5	2910.5	4.9	5.0	0.4	0.4
31951.3	4.9	13.3	28315.6	60.3	2910.5	2910.5	5.0	5.2	0.4	0.4
31956.2	12.6	4.9	28320.5	60.3	2910.5	2910.5	5.2	5.3	0.5	0.4
31968.8	33.4	12.6	28333.1	60.3	2910.5	2910.5	5.3	5.5	0.5	0.5
32002.2	61.1	33.4	28366.5	60.3	2910.5	2910.4	5.5	5.6	0.5	0.5
32063.3	100.0	61.1	28427.6	60.3	2910.4	2910.2	5.6	5.2	0.5	0.5
32163.3	118.8	100.0	28527.6	60.3	2910.2	2910.0	5.2	5.0	0.4	0.5
32282.1	51.2	118.8	28646.4	60.3	2910.0	2909.9	5.0	4.8	0.3	0.4
32333.3	36.7	51.2	28697.6	60.3	2909.9	2909.9	4.8	4.8	0.3	0.3
32370.0	94.0	36.7	28734.3	60.3	2909.9	2909.7	4.8	4.7	0.2	0.3
32464.0	158.4	94.0	28828.3	60.3	2909.7	2909.5	4.7	4.7	0.3	0.2
32622.4	261.0	158.4	28986.7	60.3	2909.5	2909.2	4.7	4.7	0.2	0.3
32883.4	35.2	261.0	29247.7	60.3	2909.2	2909.2	4.7	4.7	0.2	0.2
32918.6	310.2	35.2	29282.9	60.3	2909.2	2908.8	4.7	4.7	0.3	0.2
33228.8	153.3	310.2	29593.1	60.3	2908.8	2908.6	4.7	4.9	0.4	0.3
33382.1	110.8	153.3	29746.4	60.3	2908.6	2908.4	4.9	5.1	0.4	0.4
33492.9	58.7	110.8	29857.2	60.3	2908.4	2908.4	5.1	5.2	0.4	0.4
33551.6	144.1	58.7	29915.9	60.3	2908.4	2908.2	5.2	6.0	0.6	0.4
33695.7	66.9	144.1	30060.0	60.3	2908.2	2908.1	6.0	5.8	0.6	0.6
33762.6	130.6	66.9	30126.9	60.3	2908.1	2907.8	5.8	5.4	0.5	0.6
33893.2	89.6	130.6	30257.5	60.3	2907.8	2907.8	5.4	6.1	0.6	0.5
33982.8	60.2	89.6	30347.1	60.3	2907.8	2907.7	6.1	6.8	0.8	0.6
34043.0	76.5	60.2	30407.3	60.3	2907.7	2907.5	6.8	6.4	0.7	0.8
34119.5	62.5	76.5	30483.8	60.3	2907.5	2907.4	6.4	6.2	0.7	0.7
34182.0	156.4	62.5	30546.3	60.3	2907.4	2907.1	6.2	6.6	0.7	0.7
34338.4	59.5	156.4	30702.7	60.3	2907.1	2907.1	6.6	7.2	0.9	0.7
34397.9	43.4	59.5	30762.2	60.3	2907.1	2906.8	7.2	6.4	0.7	0.9
34441.3	104.4	43.4	30805.6	60.3	2906.8	2906.6	6.4	6.3	0.7	0.7
34545.7	109.6	104.4	30910.0	60.3	2906.6	2906.4	6.3	6.7	0.8	0.7
34655.3	47.6	109.6	31019.6	60.3	2906.4	2906.6	6.7	7.7	1.0	0.8
34702.9	84.1	47.6	31067.2	60.3	2906.6	2906.1	8.7	7.9	1.0	1.2
34787.0	33.9	84.1	31151.3	60.3	2906.1	2906.0	7.9	7.9	1.0	1.0
34820.9	16.5	33.9	31185.2	60.3	2906.7	2906.5	12.5	12.5	2.0	2.0
34837.4	85.1	16.5	31201.7	60.3	2906.8	2904.3	13.6	8.9	1.2	2.2
34922.5	12.0	85.1	31286.8	60.3	2904.3	2904.2	8.9	8.9	1.2	1.2
34934.5	80.4	12.0	31298.8	60.3	2906.2	2904.2	16.0	16.0	2.8	2.8
35014.9	10.1	80.4	31379.2	60.3	2904.4	2903.0	16.4	14.1	2.4	2.9
35025.0	18.4	10.1	31389.3	60.3	2903.0	2902.7	14.1	14.1	2.4	2.4
35043.4	500.0	18.4	31407.7	60.3	2903.6	2890.5	16.2	16.2	2.9	2.9
35543.4	562.3	500.0	31907.7	60.3	2891.8	2869.7	18.9	18.8	3.5	3.6
36105.7	62.3	562.3	32470.0	60.3	2869.7	2865.8	18.8	15.8	2.8	3.5
36168.0	61.8	62.3	32532.3	60.3	2865.8	2861.7	15.8	5.3	0.5	2.8
36229.8	287.1	61.8	32594.1	60.3	2861.7	2861.2	5.3	4.8	0.3	0.5
36516.9	99.9	287.1	32881.2	60.3	2861.2	2861.1	4.8	4.9	0.3	0.3
36616.8	103.4	99.9	32981.1	60.3	2861.1	2861.0	4.9	5.0	0.4	0.3
36720.2	150.9	103.4	33084.5	60.3	2861.0	2860.8	5.0	5.0	0.4	0.4
36871.1	141.0	150.9	33235.4	60.3	2860.8	2860.6	5.0	4.9	0.3	0.4
37012.1	52.5	141.0	33376.4	60.3	2860.6	2860.5	4.9	5.1	0.4	0.3
37064.6	56.9	52.5	33428.9	60.3	2860.5	2860.5	5.1	5.2	0.4	0.4
37121.5	74.6	56.9	33485.8	60.3	2860.5	2860.3	5.2	5.1	0.4	0.4
37196.1	50.5	74.6	33560.4	60.3	2860.3	2860.2	5.1	4.9	0.3	0.4

37246.6	88.6	50.5	33610.9	60.3	2860.2	2860.2	4.9	5.2	0.4	0.3
37335.2	76.3	88.6	33699.5	60.3	2860.2	2860.1	5.2	5.2	0.4	0.4
37411.5	109.4	76.3	33775.8	60.3	2860.1	2859.9	5.2	5.1	0.4	0.4
37520.9	76.4	109.4	33885.2	60.3	2859.9	2859.9	5.1	5.5	0.5	0.4
37597.3	129.9	76.4	33961.6	60.3	2859.9	2859.7	5.5	5.7	0.6	0.5
37727.2	71.8	129.9	34091.5	60.3	2859.7	2859.6	5.7	5.7	0.6	0.6
37799.0	40.2	71.8	34163.3	60.3	2859.6	2859.6	5.7	6.0	0.6	0.6
37839.2	40.4	40.2	34203.5	60.3	2859.6	2859.5	6.0	6.2	0.7	0.6
37879.6	55.4	40.4	34243.9	60.3	2859.5	2859.4	6.2	6.0	0.6	0.7
37935.0	100.0	55.4	34299.3	60.3	2859.4	2859.3	6.0	6.8	0.8	0.6
38035.0	55.8	100.0	34399.3	60.3	2859.3	2859.2	6.8	6.9	0.8	0.8
38090.8	74.1	55.8	34455.1	60.3	2859.2	2858.9	6.9	6.2	0.7	0.8
38164.9	67.3	74.1	34529.2	60.3	2858.9	2859.0	6.2	7.2	0.9	0.7
38232.2	22.2	67.3	34596.5	60.3	2859.0	2858.9	7.2	7.0	0.8	0.9
38254.4	125.0	22.2	34618.7	60.3	2858.9	2858.4	7.0	5.6	0.5	0.8
38379.4	27.2	125.0	34743.7	60.3	2858.4	2858.3	5.6	5.7	0.6	0.5
38406.6	19.7	27.2	34770.9	60.3	2858.3	2858.3	5.7	5.7	0.6	0.6
38426.3	30.4	19.7	34790.6	60.3	2858.3	2858.3	5.7	5.8	0.6	0.6
38456.7	53.7	30.4	34821.0	60.3	2858.3	2858.3	5.8	6.4	0.7	0.6
38510.4	40.9	53.7	34874.7	60.3	2858.3	2858.2	6.4	6.1	0.6	0.7
38551.3	86.2	40.9	34915.6	60.3	2858.2	2858.0	6.1	5.8	0.6	0.6
38637.5	51.3	86.2	35001.8	60.3	2858.0	2857.9	5.8	6.0	0.6	0.6
38688.8	38.1	51.3	35053.1	60.3	2857.9	2857.9	6.0	6.1	0.6	0.6
38726.9	37.6	38.1	35091.2	60.3	2857.9	2857.9	6.1	6.5	0.7	0.6
38764.5	37.1	37.6	35128.8	60.3	2857.9	2857.8	6.5	6.4	0.7	0.7
38801.6	140.0	37.1	35165.9	60.3	2857.8	2857.5	6.4	6.3	0.7	0.7
38941.6	44.0	140.0	35305.9	60.3	2857.5	2857.3	6.3	5.6	0.5	0.7
38985.6	19.5	44.0	35349.9	60.3	2857.3	2857.4	5.6	6.1	0.6	0.5
39005.1	145.1	19.5	35369.4	60.3	2857.4	2857.2	6.1	6.5	0.7	0.6
39150.2	22.6	145.1	35514.5	60.3	2857.2	2857.1	6.5	6.1	0.7	0.7
39172.8	27.0	22.6	35537.1	60.3	2857.1	2856.9	6.1	5.7	0.5	0.7
39199.8	17.0	27.0	35564.1	60.3	2856.9	2856.9	5.7	5.7	0.6	0.5
39216.8	31.3	17.0	35581.1	60.3	2856.9	2857.0	5.7	6.4	0.7	0.6
39248.1	19.1	31.3	35612.4	60.3	2857.0	2857.0	6.4	6.6	0.7	0.7
39267.2	116.5	19.1	35631.5	60.3	2857.0	2856.9	6.6	7.5	0.9	0.7
39383.7	20.5	116.5	35748.0	60.3	2856.9	2856.9	7.5	7.8	1.0	0.9
39404.2	44.6	20.5	35768.5	60.3	2856.9	2856.8	7.8	7.9	1.0	1.0
39448.8	39.0	44.6	35813.1	60.3	2856.8	2856.6	8.1	7.8	1.0	1.0
39487.8	50.6	39.0	35852.1	60.3	2856.6	2856.4	7.8	7.5	0.9	1.0
39538.4	31.8	50.6	35902.7	60.3	2856.4	2856.4	7.5	7.9	1.0	0.9
39570.2	57.7	31.8	35934.5	60.3	2856.4	2856.0	8.0	7.1	0.9	1.0
39627.9	28.6	57.7	35992.2	60.3	2856.0	2856.0	7.1	7.7	1.0	0.9
39656.5	29.7	28.6	36020.8	60.3	2856.4	2854.7	**11.2**	4.6	0.1	1.7
39686.2	30.0	29.7	36050.5	60.3	2854.7	2854.6	4.6	4.6	0.1	0.1
39716.2	46.4	30.0	36080.5	60.3	2854.6	2854.6	4.6	4.6	0.1	0.1
39762.6	52.6	46.4	36126.9	60.3	2854.6	2854.5	4.6	4.6	0.1	0.1
39815.2	62.0	52.6	36179.5	60.3	2854.5	2854.4	4.6	4.6	0.1	0.1
39877.2	40.8	62.0	36241.5	60.3	2854.4	2854.4	4.6	4.6	0.1	0.1
39918.0	18.1	40.8	36282.3	60.3	2854.4	2854.3	4.6	4.6	0.1	0.1
39936.1	76.0	18.1	36300.4	60.3	2854.3	2854.2	4.6	4.6	0.1	0.1
40012.1	61.8	76.0	36376.4	60.3	2854.2	2854.2	4.6	4.6	0.1	0.1
40073.9	43.3	61.8	36438.2	60.3	2854.2	2854.1	4.6	4.6	0.1	0.1
40117.2	62.6	43.3	36481.5	60.3	2854.1	2854.0	4.6	4.6	0.1	0.1
40179.8	34.1	62.6	36544.1	60.3	2854.0	2854.0	4.6	4.6	0.1	0.1
40213.9	59.5	34.1	36578.2	60.3	2854.0	2853.9	4.6	4.6	0.1	0.1
40273.4	55.7	59.5	36637.7	60.3	2853.9	2853.8	4.6	4.6	0.1	0.1
40329.1	72.9	55.7	36693.4	60.3	2853.8	2853.8	4.6	4.6	0.1	0.1
40402.0	49.3	72.9	36766.3	60.3	2853.8	2853.7	4.6	4.6	0.1	0.1
40451.3	61.5	49.3	36815.6	60.3	2853.7	2853.6	4.6	4.6	0.1	0.1

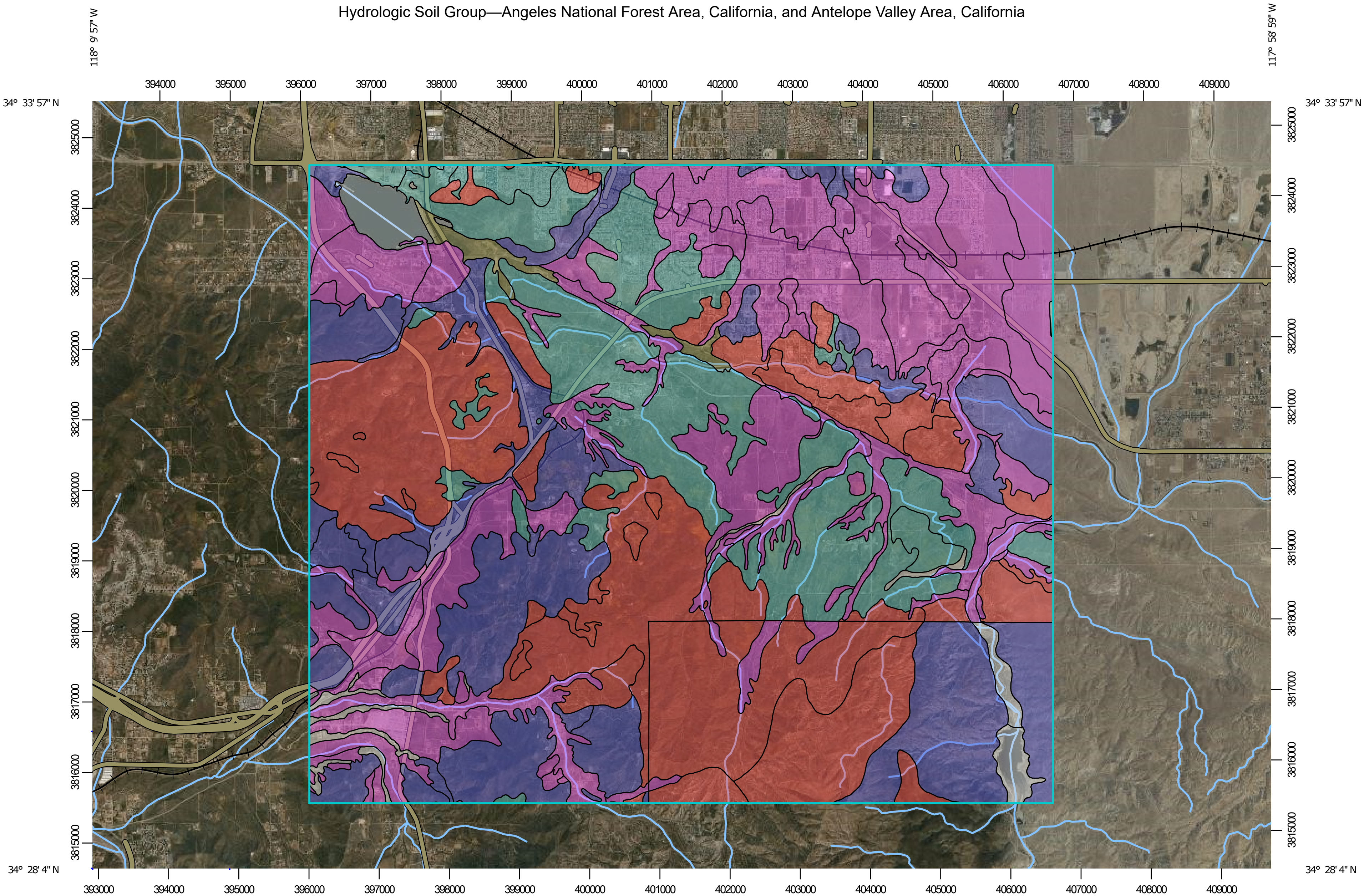
40512.8	71.4	61.5	36877.1	60.3	2853.6	2853.5	4.6	4.6	0.1	0.1
40584.2	99.3	71.4	36948.5	60.3	2853.5	2853.4	4.6	4.6	0.1	0.1
40683.5	83.4	99.3	37047.8	60.3	2853.4	2853.3	4.6	4.6	0.1	0.1
40766.9	30.5	83.4	37131.2	60.3	2853.3	2853.3	4.6	4.6	0.1	0.1
40797.4	40.3	30.5	37161.7	60.3	2853.3	2853.2	4.6	4.6	0.1	0.1
40837.7	44.4	40.3	37202.0	60.3	2853.2	2853.1	4.6	4.6	0.1	0.1
40882.1	44.0	44.4	37246.4	60.3	2853.1	2853.1	4.6	4.6	0.1	0.1
40926.1	47.5	44.0	37290.4	60.3	2853.1	2853.0	4.6	4.6	0.1	0.1
40973.6	43.9	47.5	37337.9	60.3	2853.0	2853.0	4.6	4.6	0.1	0.1
41017.5	68.6	43.9	37381.8	60.3	2853.0	2852.9	4.6	4.6	0.1	0.1
41086.1	61.1	68.6	37450.4	60.3	2852.9	2852.8	4.6	4.6	0.1	0.1
41147.2	103.0	61.1	37511.5	60.3	2852.8	2852.7	4.6	4.6	0.1	0.1
41250.2	45.0	103.0	37614.5	60.3	2852.7	2852.6	4.6	4.6	0.1	0.1
41295.2	76.9	45.0	37659.5	60.3	2852.6	2852.5	4.6	4.6	0.1	0.1
41372.1	36.6	76.9	37736.4	60.3	2852.5	2852.5	4.6	4.6	0.1	0.1
41408.7	31.7	36.6	37773.0	60.3	2852.5	2852.4	4.6	4.6	0.1	0.1
41440.4	37.1	31.7	37804.7	60.3	2852.4	2852.4	4.6	4.6	0.1	0.1
41477.5	36.2	37.1	37841.8	60.3	2852.4	2852.3	4.6	4.6	0.1	0.1
41513.7	53.5	36.2	37878.0	60.3	2852.3	2852.3	4.6	4.6	0.1	0.1
41567.2	40.0	53.5	37931.5	60.3	2852.3	2852.2	4.6	4.6	0.2	0.1
41607.2	43.0	40.0	37971.5	60.3	2852.2	2852.2	4.6	4.7	0.2	0.2
41650.2	29.9	43.0	38014.5	60.3	2852.2	2852.1	4.7	4.7	0.2	0.2
41680.1	79.9	29.9	38044.4	60.3	2852.1	2852.0	4.7	4.6	0.2	0.2
41760.0	52.9	79.9	38124.3	60.3	2852.0	2852.0	4.6	4.7	0.2	0.2
41812.9	32.4	52.9	38177.2	60.3	2852.0	2851.9	4.7	4.7	0.2	0.2
41845.3	35.6	32.4	38209.6	60.3	2851.9	2851.9	4.7	4.7	0.2	0.2
41880.9	49.4	35.6	38245.2	60.3	2851.9	2851.8	4.7	4.7	0.2	0.2
41930.3	52.6	49.4	38294.6	60.3	2851.8	2851.8	4.7	4.7	0.3	0.2
41982.9	25.6	52.6	38347.2	60.3	2851.8	2851.7	4.7	4.9	0.3	0.3
42008.5	82.9	25.6	38372.8	60.3	2851.7	2851.6	4.9	4.8	0.3	0.3
42091.4	39.6	82.9	38455.7	60.3	2851.6	2851.6	4.8	4.8	0.3	0.3
42131.0	28.2	39.6	38495.3	60.3	2851.6	2851.5	4.8	4.7	0.2	0.3
42159.2	24.9	28.2	38523.5	60.3	2851.5	2851.5	4.7	4.9	0.3	0.2
42184.1	27.1	24.9	38548.4	60.3	2851.5	2851.5	4.9	4.8	0.3	0.3
42211.2	34.1	27.1	38575.5	60.3	2851.5	2851.4	4.8	4.8	0.3	0.3
42245.3	33.2	34.1	38609.6	60.3	2851.4	2851.4	4.8	4.8	0.3	0.3
42278.5	279.4	33.2	38642.8	60.3	2851.4	2851.0	4.8	5.1	0.4	0.3
42557.9	245.2	279.4	38922.2	60.3	2851.0	2850.7	5.1	4.9	0.3	0.4
42803.1	33.5	245.2	39167.4	60.3	2850.7	2850.7	4.9	5.0	0.4	0.3
42836.6	106.6	33.5	39200.9	60.3	2850.7	2850.5	5.0	5.4	0.5	0.4
42943.2	57.8	106.6	39307.5	60.3	2850.5	2850.5	5.4	5.3	0.5	0.5
43001.0	28.5	57.8	39365.3	60.3	2850.5	2850.5	5.3	5.7	0.6	0.5
43029.5	37.6	28.5	39393.8	60.3	2850.5	2850.4	5.7	5.6	0.5	0.6
43067.1	77.5	37.6	39431.4	60.3	2850.4	2850.4	5.6	6.2	0.7	0.5
43144.6	30.5	77.5	39508.9	60.3	2850.4	2850.2	6.2	5.7	0.6	0.7
43175.1	39.2	30.5	39539.4	60.3	2850.2	2850.2	5.7	6.0	0.6	0.6
43214.3	60.8	39.2	39578.6	60.3	2850.2	2850.1	6.0	5.8	0.6	0.6
43275.1	106.9	60.8	39639.4	60.3	2850.1	2849.9	5.8	5.7	0.5	0.6
43382.0	43.9	106.9	39746.3	60.3	2849.9	2849.8	5.7	5.6	0.5	0.5
43425.9	88.0	43.9	39790.2	60.3	2849.8	2849.9	5.6	6.5	0.7	0.5
43513.9	40.6	88.0	39878.2	60.3	2849.9	2849.8	6.5	6.4	0.7	0.7
43554.5	38.3	40.6	39918.8	60.3	2849.8	2849.7	6.4	6.3	0.7	0.7
43592.8	39.7	38.3	39957.1	60.3	2849.7	2849.7	6.3	6.8	0.8	0.7
43632.5	48.6	39.7	39996.8	60.3	2849.7	2849.6	6.8	6.8	0.8	0.8
43681.1	28.0	48.6	40045.4	60.3	2849.6	2849.7	6.8	7.4	0.9	0.8
43709.1	33.7	28.0	40073.4	60.3	2849.7	2849.6	7.4	7.3	0.9	0.9
43742.8	33.7	33.7	40107.1	60.3	2849.6	2849.5	7.3	7.3	0.9	0.9
43776.5	45.0	33.7	40140.8	60.3	2849.5	2849.4	7.3	7.3	0.9	0.9
43821.5	34.6	45.0	40185.8	60.3	2849.4	2849.3	7.3	7.3	0.9	0.9

43856.1	26.8	34.6	40220.4	60.3	2849.3	2849.2	7.3	7.2	0.9	0.9
43882.9	30.2	26.8	40247.2	60.3	2849.2	2849.0	7.2	6.8	0.8	0.9
43913.1	105.4	30.2	40277.4	60.3	2849.0	2848.7	6.8	5.9	0.6	0.8
44018.5	90.5	105.4	40382.8	60.3	2848.7	2848.6	5.9	6.3	0.7	0.6
44109.0	62.8	90.5	40473.3	60.3	2848.6	2848.5	6.3	6.7	0.8	0.7
44171.8	47.7	62.8	40536.1	60.3	2848.5	2848.2	6.7	6.0	0.6	0.8
44219.5	79.2	47.7	40583.8	60.3	2848.2	2848.1	6.0	6.2	0.7	0.6
44298.7	191.0	79.2	40663.0	60.3	2848.1	2847.9	6.2	7.1	0.8	0.7
44489.7	24.0	191.0	40854.0	60.3	2847.9	2847.9	7.1	7.3	0.9	0.8
44513.7	68.9	24.0	40878.0	60.3	2847.9	2847.8	7.3	7.9	1.0	0.9
44582.6	30.5	68.9	40946.9	60.3	2847.8	2847.4	7.9	6.3	0.7	1.0
44613.1	65.5	30.5	40977.4	60.3	2847.4	2847.3	6.3	6.2	0.7	0.7
44678.6	32.9	65.5	41042.9	60.3	2847.3	2847.2	6.2	6.2	0.7	0.7
44711.5	58.1	32.9	41075.8	60.3	2847.2	2847.0	6.2	5.8	0.6	0.7
44769.6	39.5	58.1	41133.9	60.3	2847.0	2847.0	5.8	5.9	0.6	0.6
44809.1	61.8	39.5	41173.4	60.3	2847.0	2846.9	5.9	6.0	0.6	0.6
44870.9	22.0	61.8	41235.2	60.3	2846.9	2846.9	6.0	6.1	0.6	0.6
44892.9	37.1	22.0	41257.2	60.3	2846.9	2846.8	6.1	6.2	0.7	0.6
44930.0	58.1	37.1	41294.3	60.3	2846.8	2846.7	6.2	6.5	0.7	0.7
44988.1	91.4	58.1	41352.4	60.3	2846.7	2846.6	6.5	7.0	0.8	0.7
45079.5	71.6	91.4	41443.8	60.3	2846.6	2846.5	7.0	7.5	0.9	0.8
45151.1	40.3	71.6	41515.4	60.3	2846.5	2846.5	7.5	7.9	1.0	0.9
45191.4	62.9	40.3	41555.7	60.3	2846.5	2846.0	8.3	7.1	0.8	1.1
45254.3	131.7	62.9	41618.6	60.3	2845.6	2845.4	4.7	4.8	0.3	0.2
45386.0	95.1	131.7	41750.3	60.3	2845.4	2845.3	4.8	4.9	0.4	0.3
45481.1	51.6	95.1	41845.4	60.3	2845.3	2845.2	4.9	5.0	0.4	0.4
45532.7	50.3	51.6	41897.0	60.3	2845.2	2845.2	5.0	5.1	0.4	0.4
45583.0	43.4	50.3	41947.3	60.3	2845.2	2845.1	5.1	5.2	0.4	0.4
45626.4	40.2	43.4	41990.7	60.3	2845.1	2845.1	5.2	5.2	0.5	0.4
45666.6	36.1	40.2	42030.9	60.3	2845.1	2845.0	5.2	5.3	0.5	0.5
45702.7	94.6	36.1	42067.0	60.3	2845.0	2844.9	5.3	5.5	0.5	0.5
45797.3	32.6	94.6	42161.6	60.3	2844.9	2844.9	5.5	5.6	0.5	0.5
45829.9	48.2	32.6	42194.2	60.3	2844.9	2844.8	5.6	5.8	0.6	0.5
45878.1	22.5	48.2	42242.4	60.3	2844.8	2844.8	5.8	5.9	0.6	0.6
45900.6	22.4	22.5	42264.9	60.3	2844.8	2844.8	5.9	6.0	0.6	0.6
45923.0	67.9	22.4	42287.3	60.3	2844.8	2844.7	6.0	6.3	0.7	0.6
45990.9	26.6	67.9	42355.2	60.3	2844.7	2844.6	6.3	6.4	0.7	0.7
46017.5	46.1	26.6	42381.8	60.3	2844.6	2844.6	6.4	6.7	0.8	0.7
46063.6	100.0	46.1	42427.9	60.3	2844.6	2844.5	6.7	7.6	0.9	0.8
46163.6	25.9	100.0	42527.9	60.3	2844.5	2844.5	7.6	7.9	1.0	0.9
46189.5	11.1	25.9	42553.8	60.3	2845.3	2843.3	**12.5**	5.7	0.6	2.0
46200.6	108.5	11.1	42564.9	60.3	2843.3	2843.1	5.7	6.0	0.6	0.6
46309.1	56.6	108.5	42673.4	60.3	2843.1	2843.0	6.0	6.1	0.6	0.6
46365.7	112.3	56.6	42730.0	60.3	2843.0	2842.9	6.1	6.6	0.7	0.6
46478.0	45.6	112.3	42842.3	60.3	2842.9	2842.8	6.6	6.8	0.8	0.7
46523.6	42.9	45.6	42887.9	60.3	2842.8	2842.8	6.8	7.1	0.8	0.8
46566.5	87.0	42.9	42930.8	60.3	2842.8	2842.7	7.1	7.9	1.0	0.8
46653.5	68.4	87.0	43017.8	60.3	2846.3	2839.6	**19.2**	5.8	0.6	3.6
46721.9	26.9	68.4	43086.2	60.3	2839.6	2839.6	5.8	5.8	0.6	0.6
46748.8	63.4	26.9	43113.1	60.3	2839.6	2839.5	5.8	6.0	0.6	0.6
46812.2	56.0	63.4	43176.5	60.3	2839.5	2839.4	6.0	6.2	0.7	0.6
46868.2	31.6	56.0	43232.5	60.3	2839.4	2839.4	6.2	6.3	0.7	0.7
46899.8	63.2	31.6	43264.1	60.3	2839.4	2839.3	6.3	6.6	0.7	0.7
46963.0	37.3	63.2	43327.3	60.3	2839.3	2839.3	6.6	6.8	0.8	0.7
47000.3	44.5	37.3	43364.6	60.3	2839.3	2839.2	6.8	7.0	0.8	0.8
47044.8	28.8	44.5	43409.1	60.3	2839.2	2839.2	7.0	7.2	0.9	0.8
47073.6	72.2	28.8	43437.9	60.3	2839.2	2839.1	7.2	7.9	1.0	0.9
47145.8	73.7	72.2	43510.1	60.3	2843.8	2834.8	**21.1**	6.8	0.8	4.2
47219.5	63.0	73.7	43583.8	60.3	2834.8	2834.7	6.8	6.9	0.8	0.8

47282.5	24.8	63.0	43646.8	60.3	2834.7	2834.6	6.9	7.0	0.8	0.8
47307.3	32.4	24.8	43671.6	60.3	2834.6	2834.6	7.0	7.1	0.8	0.8
47339.7	82.3	32.4	43704.0	60.3	2834.6	2834.4	7.1	7.4	0.9	0.8
47422.0	80.5	82.3	43786.3	60.3	2834.4	2834.3	7.4	7.9	1.0	0.9
47502.5	88.7	80.5	43866.8	60.3	2836.2	2831.8	**15.7**	6.5	0.7	2.8
47591.2	68.2	88.7	43955.5	60.3	2831.8	2831.7	6.5	6.7	0.8	0.7
47659.4	51.7	68.2	44023.7	60.3	2831.7	2831.6	6.7	6.8	0.8	0.8
47711.1	33.6	51.7	44075.4	60.3	2831.6	2831.6	6.8	7.0	0.8	0.8
47744.7	49.2	33.6	44109.0	60.3	2831.6	2831.5	7.0	7.2	0.9	0.8
47793.93	26.3	49.2	44158.2	60.3417	2831.491	2831.449	7.162	7.296	0.88	0.854
47820.23	97.7	26.3	44184.5	60.3417	2831.449	2831.31	7.296	7.877	0.996	0.88
47917.93	342.2	97.7	44282.2	60.3417	2831.776	2828.41	**11.417**	7.949	1.01	1.744
48260.13	35.4	342.2	44624.4	60.3417	2828.41	2828.303	7.949	7.949	1.01	1.01
48295.53	30.2	35.4	44659.8	60.3417	2828.303	2828.21	7.949	7.949	1.01	1.01
48325.73	53.3	30.2	44690	60.3417	2828.22	2827.678	8.358	6.802	0.782	1.093
48379.03	118	53.3	44743.3	60.3417	2827.678	2827.61	6.802	7.897	1	0.782
48497.03	26.4	118	44861.3	60.3417	2827.625	2827.525	8.469	8.469	1.116	1.116

Hazen

Appendix C: NRCS Data Output



Map Scale: 1:76,700 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Angeles National Forest Area, California
Survey Area Data: Version 14, May 27, 2020

Soil Survey Area: Antelope Valley Area, California
Survey Area Data: Version 13, May 27, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 18, 2016—Jul 8, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
7	Hanford family, 3 to 25 percent slopes	A	129.9	0.5%
21	Riverwash		75.2	0.3%
89	Pismo-Trigo, dry-Exchequer, dry families complex, 30 to 70 percent slopes	D	119.3	0.5%
711	Trigo family, dry-Lithic Xerorthents, warm complex, 50 to 80 percent slopes	B	1,192.6	5.0%
755	Haploxerols, shallow-Lithic Xerorthents, warm complex, 45 to 75 percent slopes	D	795.8	3.3%
765	Haploxerolls, shallow-Trigo family, dry-Haploxeralfs complex, 90 percent slopes	D	1,259.6	5.3%
766	Water		108.5	0.5%
Subtotals for Soil Survey Area			**3,680.8**	**15.5%**
Totals for Area of Interest			**23,772.6**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AcA	Adelanto coarse sandy loam, 2 to 5 percent slopes	A	418.9	1.8%
AmF2	Amargosa rocky coarse sandy loam, 9 to 55 percent slopes, eroded	D	257.0	1.1%
AsB	Arizo gravelly loamy sand, 0 to 5 percent slopes	A	420.3	1.8%
CaA	Cajon loamy sand, 0 to 2 percent slopes	A	1,042.3	4.4%
CkD	Castaic silty clay loam, 9 to 15 percent slopes	C	129.0	0.5%
CmF2	Castaic-Balcom silty clay loams, 30 to 50 percent slopes, eroded	C	58.3	0.2%
Co	Chino loam	C/D	172.1	0.7%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
GaE2	Gaviota rocky sandy loam, 15 to 30 percent slopes, eroded	D	509.2	2.1%
GaF2	Gaviota rocky sandy loam, 30 to 50 percent slopes, eroded	D	361.0	1.5%
GP	Gravel pits		5.0	0.0%
GsC	Greenfield sandy loam, 2 to 9 percent slopes	A	1,356.8	5.7%
GsD2	Greenfield sandy loam, 9 to 15 percent slopes, eroded	A	260.4	1.1%
HbA	Hanford coarse sandy loam, 0 to 2 percent slopes	A	99.7	0.4%
HbC	Hanford coarse sandy loam, 2 to 9 percent slopes	A	1,745.0	7.3%
HbD	Hanford coarse sandy loam, 9 to 15 percent slopes	A	135.3	0.6%
HcC	Hanford sandy loam, 2 to 9 percent slopes	A	701.2	2.9%
HdC	Hanford gravelly sandy loam, 2 to 9 percent slopes	A	490.6	2.1%
HkA	Hesperia fine sandy loam, 0 to 2 percent slopes	A	356.0	1.5%
LaE	Las Posas loam, 9 to 30 percent slopes	D	290.5	1.2%
LdF	Las Posas-Toomes rocky loams, 30 to 50 percent slopes	D	3,054.2	12.8%
RcB	Ramona coarse sandy loam, 2 to 5 percent slopes	C	37.1	0.2%
RcC	Ramona coarse sandy loam, 5 to 9 percent slopes	C	42.0	0.2%
RcD	Ramona coarse sandy loam, 9 to 15 percent slopes	C	27.2	0.1%
RdE2	Ramona sandy loam, 9 to 30 percent slopes, eroded	C	909.2	3.8%
ReC	Ramona gravelly sandy loam, 2 to 9 percent slopes	C	293.3	1.2%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ReE	Ramona gravelly sandy loam, 9 to 30 percent slopes	C	2,448.8	10.3%
Rg	Riverwash	A	71.2	0.3%
Ro	Rosamond fine sandy loam	B	84.9	0.4%
Rp	Rosamond loam	B	106.9	0.4%
Rs	Rosamond loam, sandy loam substratum	B	22.8	0.1%
RzF	Rough broken land		0.6	0.0%
SoB	Soboba cobbly loamy sand, 2 to 5 percent slopes	A	44.4	0.2%
TsF	Terrace escarpments		175.2	0.7%
VbB	Vernalis loam, 2 to 5 percent slopes	B	40.6	0.2%
VsD2	Vista coarse sandy loam, 9 to 15 percent slopes, eroded	B	180.4	0.8%
VsE	Vista coarse sandy loam, 15 to 30 percent slopes	B	23.2	0.1%
VsE2	Vista coarse sandy loam, 15 to 30 percent slopes, eroded	B	54.2	0.2%
VsF	Vista coarse sandy loam, 30 to 50 percent slopes	B	2,211.6	9.3%
VsF2	Vista coarse sandy loam, 30 to 50 percent slopes, eroded	B	577.7	2.4%
W	Water		221.2	0.9%
WgC	Wyman gravelly loam, 2 to 9 percent slopes	B	504.9	2.1%
WgD	Wyman gravelly loam, 9 to 15 percent slopes	B	148.9	0.6%
Subtotals for Soil Survey Area			**20,089.2**	**84.5%**
Totals for Area of Interest			**23,772.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

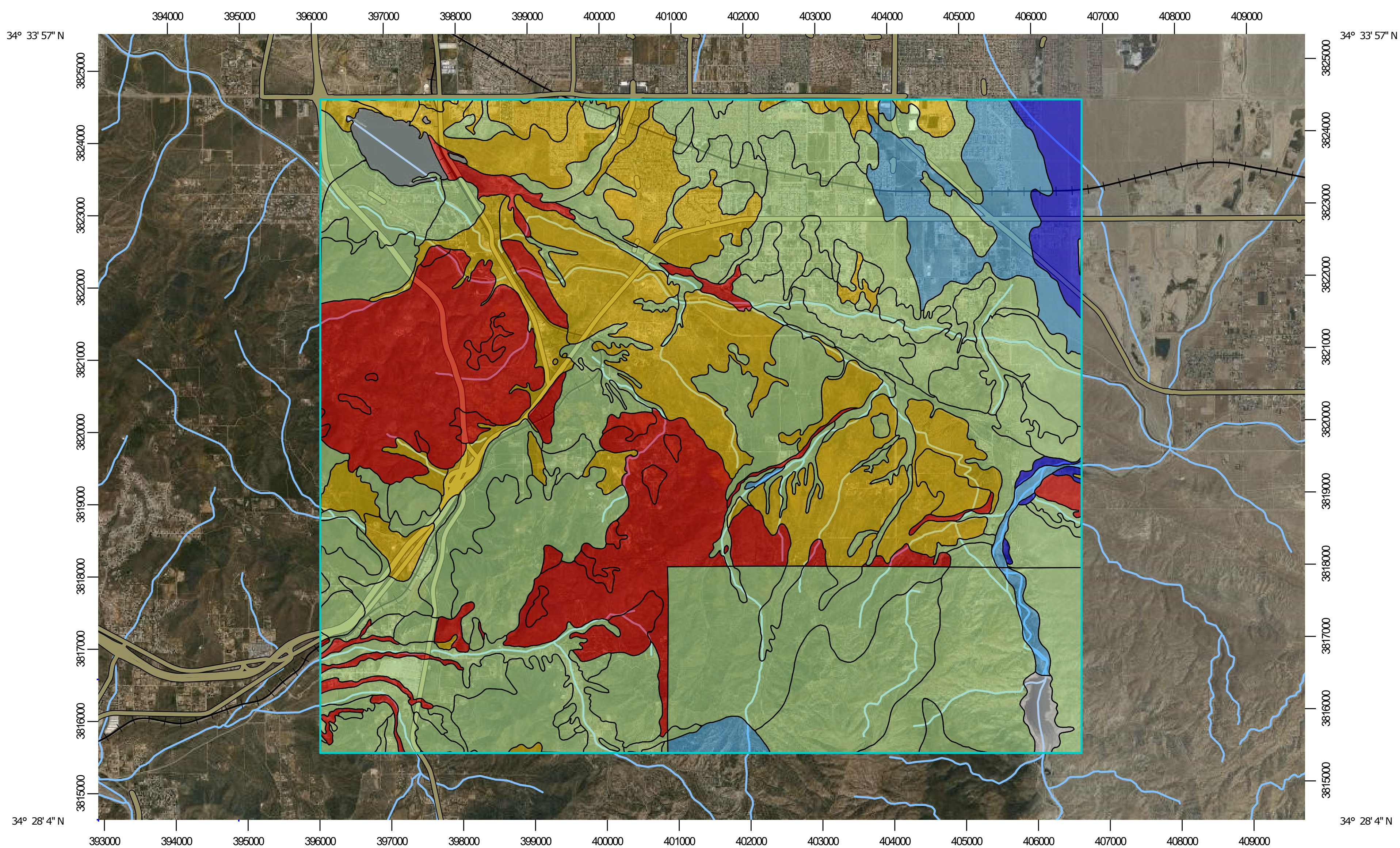
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Saturated Hydraulic Conductivity (Ksat)—Angeles National Forest Area, California, and Antelope Valley Area, California



Map Scale: 1:76,700 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 1000, 2000, 4000, 6000

Feet: 0, 3500, 7000, 14000, 21000

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

<= 4.3993

> 4.3993 and <= 14.0000

> 14.0000 and <= 28.0000

> 28.0000 and <= 92.0000

> 92.0000 and <= 141.0000

Not rated or not available

Soil Rating Lines

<= 4.3993

> 4.3993 and <= 14.0000

> 14.0000 and <= 28.0000

> 28.0000 and <= 92.0000

> 92.0000 and <= 141.0000

Not rated or not available

Soil Rating Points

<= 4.3993

> 4.3993 and <= 14.0000

> 14.0000 and <= 28.0000

> 28.0000 and <= 92.0000

> 92.0000 and <= 141.0000

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Angeles National Forest Area, California
Survey Area Data: Version 14, May 27, 2020

Soil Survey Area: Antelope Valley Area, California
Survey Area Data: Version 13, May 27, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 18, 2016—Jul 8, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
7	Hanford family, 3 to 25 percent slopes	28.0000	129.9	0.5%
21	Riverwash	92.0000	75.2	0.3%
89	Pismo-Trigo, dry-Exchequer, dry families complex, 30 to 70 percent slopes	92.0000	119.3	0.5%
711	Trigo family, dry-Lithic Xerorthents, warm complex, 50 to 80 percent slopes	28.0000	1,192.6	5.0%
755	Haploxerols, shallow-Lithic Xerorthents, warm complex, 45 to 75 percent slopes	28.0000	795.8	3.3%
765	Haploxerolls, shallow-Trigo family, dry-Haploxeralfs complex, 90 percent slopes	28.0000	1,259.6	5.3%
766	Water		108.5	0.5%
Subtotals for Soil Survey Area			**3,680.8**	**15.5%**
Totals for Area of Interest			**23,772.6**	**100.0%**

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
AcA	Adelanto coarse sandy loam, 2 to 5 percent slopes	19.3716	418.9	1.8%
AmF2	Amargosa rocky coarse sandy loam, 9 to 55 percent slopes, eroded	23.0000	257.0	1.1%
AsB	Arizo gravelly loamy sand, 0 to 5 percent slopes	138.4211	420.3	1.8%
CaA	Cajon loamy sand, 0 to 2 percent slopes	92.0000	1,042.3	4.4%
CkD	Castaic silty clay loam, 9 to 15 percent slopes	2.4645	129.0	0.5%
CmF2	Castaic-Balcom silty clay loams, 30 to 50 percent slopes, eroded	2.4645	58.3	0.2%
Co	Chino loam	4.3993	172.1	0.7%

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
GaE2	Gaviota rocky sandy loam, 15 to 30 percent slopes, eroded	23.4419	509.2	2.1%
GaF2	Gaviota rocky sandy loam, 30 to 50 percent slopes, eroded	23.4419	361.0	1.5%
GP	Gravel pits		5.0	0.0%
GsC	Greenfield sandy loam, 2 to 9 percent slopes	28.0000	1,356.8	5.7%
GsD2	Greenfield sandy loam, 9 to 15 percent slopes, eroded	28.0000	260.4	1.1%
HbA	Hanford coarse sandy loam, 0 to 2 percent slopes	28.0000	99.7	0.4%
HbC	Hanford coarse sandy loam, 2 to 9 percent slopes	28.0000	1,745.0	7.3%
HbD	Hanford coarse sandy loam, 9 to 15 percent slopes	28.0000	135.3	0.6%
HcC	Hanford sandy loam, 2 to 9 percent slopes	28.0000	701.2	2.9%
HdC	Hanford gravelly sandy loam, 2 to 9 percent slopes	28.0000	490.6	2.1%
HkA	Hesperia fine sandy loam, 0 to 2 percent slopes	28.0000	356.0	1.5%
LaE	Las Posas loam, 9 to 30 percent slopes	1.6934	290.5	1.2%
LdF	Las Posas-Toomes rocky loams, 30 to 50 percent slopes	1.7425	3,054.2	12.8%
RcB	Ramona coarse sandy loam, 2 to 5 percent slopes	9.1048	37.1	0.2%
RcC	Ramona coarse sandy loam, 5 to 9 percent slopes	9.1048	42.0	0.2%
RcD	Ramona coarse sandy loam, 9 to 15 percent slopes	9.1048	27.2	0.1%
RdE2	Ramona sandy loam, 9 to 30 percent slopes, eroded	6.7847	909.2	3.8%
ReC	Ramona gravelly sandy loam, 2 to 9 percent slopes	7.3624	293.3	1.2%

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
ReE	Ramona gravelly sandy loam, 9 to 30 percent slopes	7.3624	2,448.8	10.3%
Rg	Riverwash	92.0000	71.2	0.3%
Ro	Rosamond fine sandy loam	11.5000	84.9	0.4%
Rp	Rosamond loam	9.0000	106.9	0.4%
Rs	Rosamond loam, sandy loam substratum	14.0000	22.8	0.1%
RzF	Rough broken land		0.6	0.0%
SoB	Soboba cobbly loamy sand, 2 to 5 percent slopes	141.0000	44.4	0.2%
TsF	Terrace escarpments	0.0000	175.2	0.7%
VbB	Vernalis loam, 2 to 5 percent slopes	9.0000	40.6	0.2%
VsD2	Vista coarse sandy loam, 9 to 15 percent slopes, eroded	28.0000	180.4	0.8%
VsE	Vista coarse sandy loam, 15 to 30 percent slopes	28.0000	23.2	0.1%
VsE2	Vista coarse sandy loam, 15 to 30 percent slopes, eroded	28.0000	54.2	0.2%
VsF	Vista coarse sandy loam, 30 to 50 percent slopes	28.0000	2,211.6	9.3%
VsF2	Vista coarse sandy loam, 30 to 50 percent slopes, eroded	28.0000	577.7	2.4%
W	Water		221.2	0.9%
WgC	Wyman gravelly loam, 2 to 9 percent slopes	9.0000	504.9	2.1%
WgD	Wyman gravelly loam, 9 to 15 percent slopes	9.0000	148.9	0.6%
Subtotals for Soil Survey Area			**20,089.2**	**84.5%**
Totals for Area of Interest			**23,772.6**	**100.0%**

Description

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Rating Options

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

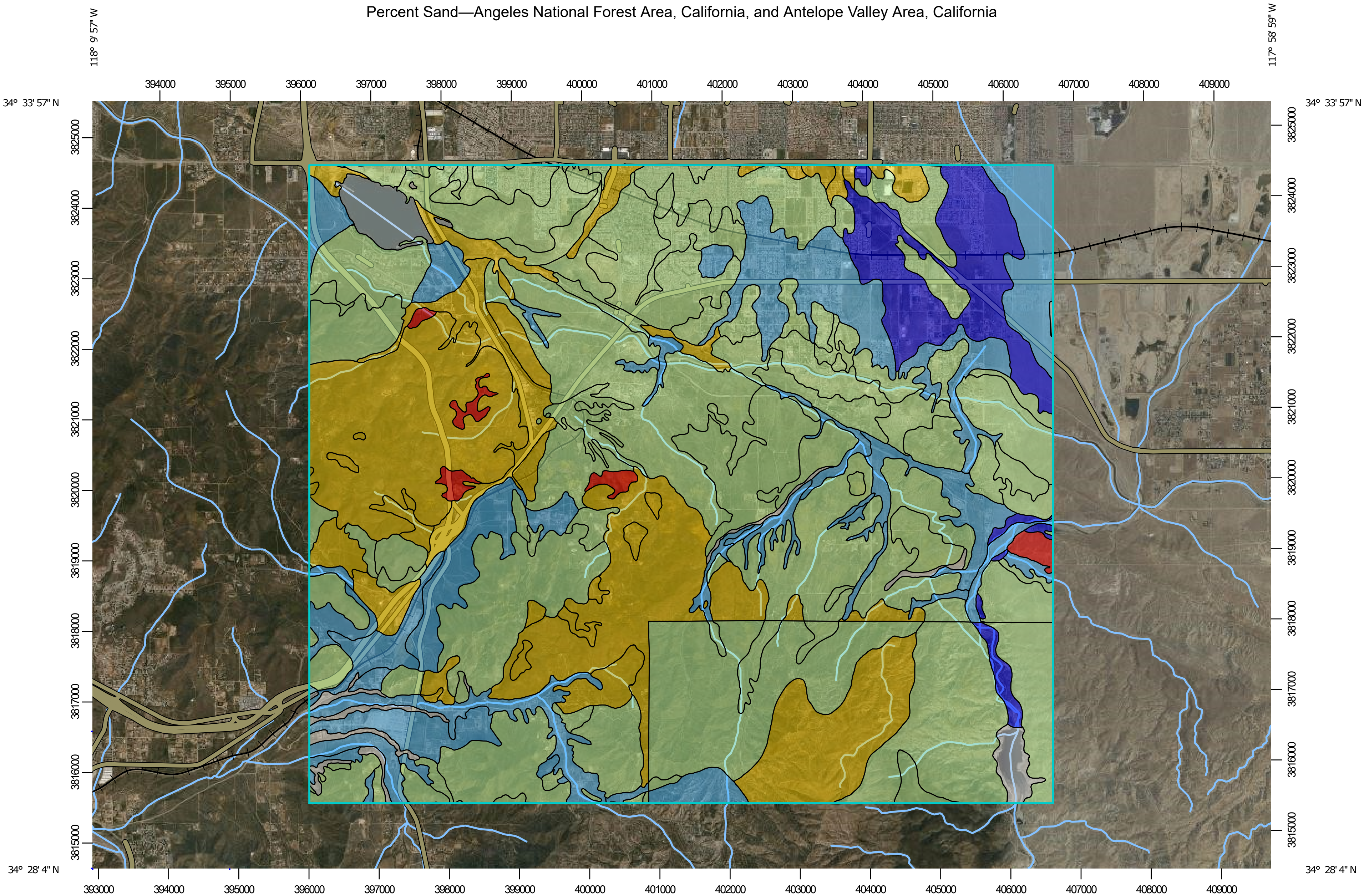
Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Percent Sand—Angeles National Forest Area, California, and Antelope Valley Area, California



Map Scale: 1:76,700 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- <= 6.7
- > 6.7 and <= 44.0
- > 44.0 and <= 69.6
- > 69.6 and <= 80.5
- > 80.5 and <= 94.0
- Not rated or not available

Soil Rating Lines

- <= 6.7
- > 6.7 and <= 44.0
- > 44.0 and <= 69.6
- > 69.6 and <= 80.5
- > 80.5 and <= 94.0
- Not rated or not available

Soil Rating Points

- <= 6.7
- > 6.7 and <= 44.0
- > 44.0 and <= 69.6
- > 69.6 and <= 80.5
- > 80.5 and <= 94.0
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Angeles National Forest Area, California
Survey Area Data: Version 14, May 27, 2020

Soil Survey Area: Antelope Valley Area, California
Survey Area Data: Version 13, May 27, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 18, 2016—Jul 8, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Percent Sand

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
7	Hanford family, 3 to 25 percent slopes	68.6	129.9	0.5%
21	Riverwash	94.0	75.2	0.3%
89	Pismo-Trigo, dry-Exchequer, dry families complex, 30 to 70 percent slopes	80.2	119.3	0.5%
711	Trigo family, dry-Lithic Xerorthents, warm complex, 50 to 80 percent slopes	65.9	1,192.6	5.0%
755	Haploxerols, shallow-Lithic Xerorthents, warm complex, 45 to 75 percent slopes	44.0	795.8	3.3%
765	Haploxerolls, shallow-Trigo family, dry-Haploxeralfs complex, 90 percent slopes	56.4	1,259.6	5.3%
766	Water		108.5	0.5%
Subtotals for Soil Survey Area			**3,680.8**	**15.5%**
Totals for Area of Interest			**23,772.6**	**100.0%**

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
AcA	Adelanto coarse sandy loam, 2 to 5 percent slopes	68.2	418.9	1.8%
AmF2	Amargosa rocky coarse sandy loam, 9 to 55 percent slopes, eroded	66.8	257.0	1.1%
AsB	Arizo gravelly loamy sand, 0 to 5 percent slopes	80.5	420.3	1.8%
CaA	Cajon loamy sand, 0 to 2 percent slopes	93.5	1,042.3	4.4%
CkD	Castaic silty clay loam, 9 to 15 percent slopes	6.7	129.0	0.5%
CmF2	Castaic-Balcom silty clay loams, 30 to 50 percent slopes, eroded	6.7	58.3	0.2%
Co	Chino loam	24.0	172.1	0.7%

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
GaE2	Gaviota rocky sandy loam, 15 to 30 percent slopes, eroded	66.8	509.2	2.1%
GaF2	Gaviota rocky sandy loam, 30 to 50 percent slopes, eroded	66.8	361.0	1.5%
GP	Gravel pits		5.0	0.0%
GsC	Greenfield sandy loam, 2 to 9 percent slopes	66.6	1,356.8	5.7%
GsD2	Greenfield sandy loam, 9 to 15 percent slopes, eroded	66.6	260.4	1.1%
HbA	Hanford coarse sandy loam, 0 to 2 percent slopes	75.7	99.7	0.4%
HbC	Hanford coarse sandy loam, 2 to 9 percent slopes	75.7	1,745.0	7.3%
HbD	Hanford coarse sandy loam, 9 to 15 percent slopes	75.7	135.3	0.6%
HcC	Hanford sandy loam, 2 to 9 percent slopes	70.6	701.2	2.9%
HdC	Hanford gravelly sandy loam, 2 to 9 percent slopes	70.6	490.6	2.1%
HkA	Hesperia fine sandy loam, 0 to 2 percent slopes	69.6	356.0	1.5%
LaE	Las Posas loam, 9 to 30 percent slopes	31.2	290.5	1.2%
LdF	Las Posas-Toomes rocky loams, 30 to 50 percent slopes	31.2	3,054.2	12.8%
RcB	Ramona coarse sandy loam, 2 to 5 percent slopes	61.1	37.1	0.2%
RcC	Ramona coarse sandy loam, 5 to 9 percent slopes	61.1	42.0	0.2%
RcD	Ramona coarse sandy loam, 9 to 15 percent slopes	61.1	27.2	0.1%
RdE2	Ramona sandy loam, 9 to 30 percent slopes, eroded	59.8	909.2	3.8%
ReC	Ramona gravelly sandy loam, 2 to 9 percent slopes	59.3	293.3	1.2%

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
ReE	Ramona gravelly sandy loam, 9 to 30 percent slopes	59.3	2,448.8	10.3%
Rg	Riverwash	70.7	71.2	0.3%
Ro	Rosamond fine sandy loam	24.8	84.9	0.4%
Rp	Rosamond loam	21.4	106.9	0.4%
Rs	Rosamond loam, sandy loam substratum	37.3	22.8	0.1%
RzF	Rough broken land		0.6	0.0%
SoB	Soboba cobbly loamy sand, 2 to 5 percent slopes	90.4	44.4	0.2%
TsF	Terrace escarpments		175.2	0.7%
VbB	Vernalis loam, 2 to 5 percent slopes	31.5	40.6	0.2%
VsD2	Vista coarse sandy loam, 9 to 15 percent slopes, eroded	66.8	180.4	0.8%
VsE	Vista coarse sandy loam, 15 to 30 percent slopes	66.8	23.2	0.1%
VsE2	Vista coarse sandy loam, 15 to 30 percent slopes, eroded	66.8	54.2	0.2%
VsF	Vista coarse sandy loam, 30 to 50 percent slopes	66.8	2,211.6	9.3%
VsF2	Vista coarse sandy loam, 30 to 50 percent slopes, eroded	66.8	577.7	2.4%
W	Water		221.2	0.9%
WgC	Wyman gravelly loam, 2 to 9 percent slopes	37.1	504.9	2.1%
WgD	Wyman gravelly loam, 9 to 15 percent slopes	37.1	148.9	0.6%
Subtotals for Soil Survey Area			**20,089.2**	**84.5%**
Totals for Area of Interest			**23,772.6**	**100.0%**

Description

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In the database, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: percent

Aggregation Method: Dominant Component

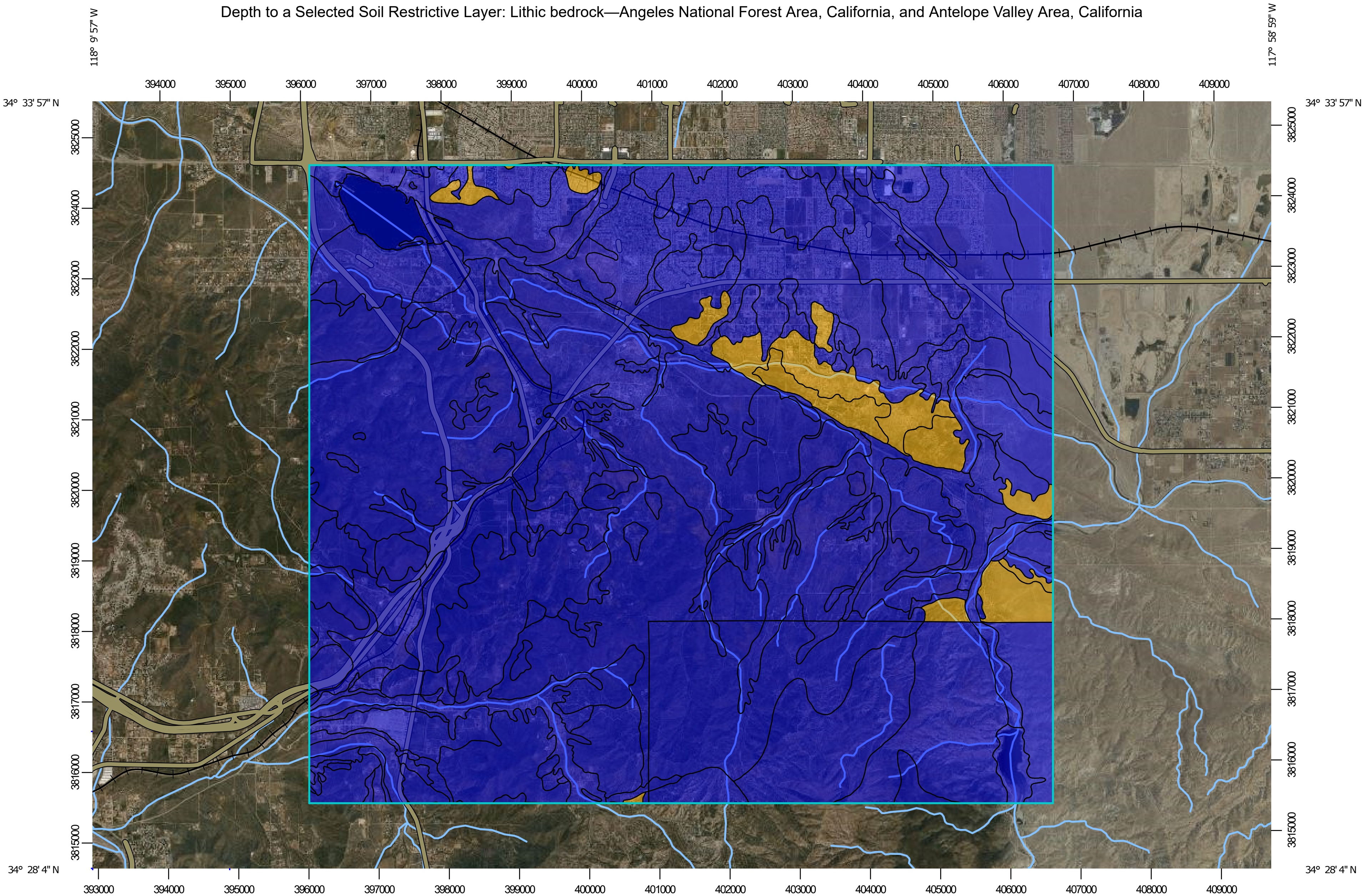
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Depth to a Selected Soil Restrictive Layer: Lithic bedrock—Angeles National Forest Area, California, and Antelope Valley Area, California



Map Scale: 1:76,700 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 1000, 2000, 4000, 6000

Feet: 0, 3500, 7000, 14000, 21000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Soil Rating Lines

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Soil Rating Points

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Angeles National Forest Area, California
Survey Area Data: Version 14, May 27, 2020

Soil Survey Area: Antelope Valley Area, California
Survey Area Data: Version 13, May 27, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 18, 2016—Jul 8, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to a Selected Soil Restrictive Layer: Lithic bedrock

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
7	Hanford family, 3 to 25 percent slopes	>200	129.9	0.5%
21	Riverwash	>200	75.2	0.3%
89	Pismo-Trigo, dry-Exchequer, dry families complex, 30 to 70 percent slopes	>200	119.3	0.5%
711	Trigo family, dry-Lithic Xerorthents, warm complex, 50 to 80 percent slopes	>200	1,192.6	5.0%
755	Haploxerols, shallow-Lithic Xerorthents, warm complex, 45 to 75 percent slopes	>200	795.8	3.3%
765	Haploxerolls, shallow-Trigo family, dry-Haploxeralfs complex, 90 percent slopes	>200	1,259.6	5.3%
766	Water	>200	108.5	0.5%
Subtotals for Soil Survey Area			**3,680.8**	**15.5%**
Totals for Area of Interest			**23,772.6**	**100.0%**

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
AcA	Adelanto coarse sandy loam, 2 to 5 percent slopes	>200	418.9	1.8%
AmF2	Amargosa rocky coarse sandy loam, 9 to 55 percent slopes, eroded	46	257.0	1.1%
AsB	Arizo gravelly loamy sand, 0 to 5 percent slopes	>200	420.3	1.8%
CaA	Cajon loamy sand, 0 to 2 percent slopes	>200	1,042.3	4.4%
CkD	Castaic silty clay loam, 9 to 15 percent slopes	>200	129.0	0.5%
CmF2	Castaic-Balcom silty clay loams, 30 to 50 percent slopes, eroded	>200	58.3	0.2%
Co	Chino loam	>200	172.1	0.7%

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
GaE2	Gaviota rocky sandy loam, 15 to 30 percent slopes, eroded	36	509.2	2.1%
GaF2	Gaviota rocky sandy loam, 30 to 50 percent slopes, eroded	36	361.0	1.5%
GP	Gravel pits	>200	5.0	0.0%
GsC	Greenfield sandy loam, 2 to 9 percent slopes	>200	1,356.8	5.7%
GsD2	Greenfield sandy loam, 9 to 15 percent slopes, eroded	>200	260.4	1.1%
HbA	Hanford coarse sandy loam, 0 to 2 percent slopes	>200	99.7	0.4%
HbC	Hanford coarse sandy loam, 2 to 9 percent slopes	>200	1,745.0	7.3%
HbD	Hanford coarse sandy loam, 9 to 15 percent slopes	>200	135.3	0.6%
HcC	Hanford sandy loam, 2 to 9 percent slopes	>200	701.2	2.9%
HdC	Hanford gravelly sandy loam, 2 to 9 percent slopes	>200	490.6	2.1%
HkA	Hesperia fine sandy loam, 0 to 2 percent slopes	>200	356.0	1.5%
LaE	Las Posas loam, 9 to 30 percent slopes	>200	290.5	1.2%
LdF	Las Posas-Toomes rocky loams, 30 to 50 percent slopes	>200	3,054.2	12.8%
RcB	Ramona coarse sandy loam, 2 to 5 percent slopes	>200	37.1	0.2%
RcC	Ramona coarse sandy loam, 5 to 9 percent slopes	>200	42.0	0.2%
RcD	Ramona coarse sandy loam, 9 to 15 percent slopes	>200	27.2	0.1%
RdE2	Ramona sandy loam, 9 to 30 percent slopes, eroded	>200	909.2	3.8%
ReC	Ramona gravelly sandy loam, 2 to 9 percent slopes	>200	293.3	1.2%

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
ReE	Ramona gravelly sandy loam, 9 to 30 percent slopes	>200	2,448.8	10.3%
Rg	Riverwash	>200	71.2	0.3%
Ro	Rosamond fine sandy loam	>200	84.9	0.4%
Rp	Rosamond loam	>200	106.9	0.4%
Rs	Rosamond loam, sandy loam substratum	>200	22.8	0.1%
RzF	Rough broken land	>200	0.6	0.0%
SoB	Soboba cobbly loamy sand, 2 to 5 percent slopes	>200	44.4	0.2%
TsF	Terrace escarpments	>200	175.2	0.7%
VbB	Vernalis loam, 2 to 5 percent slopes	>200	40.6	0.2%
VsD2	Vista coarse sandy loam, 9 to 15 percent slopes, eroded	>200	180.4	0.8%
VsE	Vista coarse sandy loam, 15 to 30 percent slopes	>200	23.2	0.1%
VsE2	Vista coarse sandy loam, 15 to 30 percent slopes, eroded	>200	54.2	0.2%
VsF	Vista coarse sandy loam, 30 to 50 percent slopes	>200	2,211.6	9.3%
VsF2	Vista coarse sandy loam, 30 to 50 percent slopes, eroded	>200	577.7	2.4%
W	Water	>200	221.2	0.9%
WgC	Wyman gravelly loam, 2 to 9 percent slopes	>200	504.9	2.1%
WgD	Wyman gravelly loam, 9 to 15 percent slopes	>200	148.9	0.6%
Subtotals for Soil Survey Area			**20,089.2**	**84.5%**
Totals for Area of Interest			**23,772.6**	**100.0%**

Description

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to the user selected type of restrictive layer as described in for each map unit. If no restrictive layer is described in a map unit, it is represented by the "greater than 200" depth class.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Restriction Kind: Lithic bedrock

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Hazen

July 30, 2021

Appendix D: Cost Estimate

Hazen *Memorandum*

July 6, 2021

To: Hazen Design Team

From: Chris Portner, PE, CEP

Re: City of Palmdale

Ditch Conversion

Feasibility Study

1. Introduction

This memorandum is a supplement to the cost estimate that corresponds to the Feasibility Study Estimate submitted to the client in July 2021. The project work is to be performed in Los Angeles County, California. This estimate is for replacement of an open canal with a buried pipeline.

The estimate serves for budget authorization and alternative analysis and is considered to be an AACE Class 5 level. Class 5 has a typical accuracy range of -50% on the low side and +100% on the high side. A 25% design contingency has been added to the estimate based on current status of the design documents, the nature of the project and the estimate classification.

2. Estimate Basis

Estimate costs are derived from the following:

1. Discussions with Design Team.

3. Planning Basis

Base Assumptions are the following

1. Construction NTP was assumed to be fourth quarter 2022.
2. Construction Duration was assumed to be 9 months.
3. The project is assumed to be procured as a single prime contract through a traditional design/bid/build process.

4. Cost Basis

1. Wage rates utilized are based on prevailing wages published for Los Angeles County current to June 30, 2021.
2. A 40-hour work week is assumed, no shift, weekend or other premium time is provided.
3. Wherever possible, equipment rates are based on current published rental rates as listed in the AED Blue Book, supplemented by RS Mean's data, the AED Green Book and local rental

suppliers.

4. Crews, equipment and productivity used for work items are based mostly on standards specific to each trade. Some information was supplemented by RS Mean's data modified where necessary by estimator judgment.
5. No vendor quotes were used for this estimate.

5. Itemized Estimate Notes

Note that the project is divided into segments for bidding purposes. The scope of each segment is similar. The scope for the entire run is provided below for simplicity.

1. **Demolition**

- Clear and grub unlined portions of the reach (17-ft wide at top and 8-ft wide at bottom and 4.5-ft deep).
- Demolish existing concrete lined portions of the run (assume 17-ft wide at top and 8-ft wide at bottom x 4.5-ft deep).
- Demolish existing tunnel portions of the run (assume 6-ft wide x 5-ft deep).
- Demolish existing pipe portions of the run (assume 48-inch diameter).
    - Include excavation to uncover pipe, assume 3-ft cover.
- Include rock excavation as required in each section. Where rock detected assume it extends the entire excavation depth.

2. **Buried Pipe**

- Furnish/install 48-inch diameter RCP.
- Assume pipe to be placed on existing channel bed.
    - Include 2-ft overexcavation for pipe bedding.
    - Include backfill entire canal/tunnel/pipe section (see above for dimensions) with import fill.
- Include manholes every 500lf.

6. Below the Line Adders

The following adders were used:

Below the Line Adders	
Item	**%**
General Conditions (Div01)	5
Contractor Overhead	5
Contractor Profit	8
Escalation to mid-point of construction	3
Insurance and Bonding	3
Contingency	25

These factors are generally in-line with recent estimated projects in this location and of this size and conform to the AACE Class of each scope.

7. Other Assumptions

Additional assumptions to the estimate include:

1. It is assumed that high groundwater will not impact excavations.
2. It is assumed that normal soils are present for excavation purposes and are suitable as backfill.
3. It is assumed that no hazardous materials are present.
4. It is assumed that no sensitive, protected or endangered species are present in the work area and no environmental mitigation or other measures will be required.

8. Exclusions

The following items are specifically excluded from the scope of this estimate:

1. Hazardous material abatement, removal or disposal.
2. Environmental mitigation.

9. Exceptions

None taken.

10. Risks and Opportunities

Some risk items and opportunities need to be considered in the process of reviewing estimated costs. These are the following:

1. Whenever performing underground work, there is the risk that previously unmarked utilities, cultural artifacts or other unknown buried objects will be uncovered that will lead to delays and cost impacts to the project.
2. The current pandemic has affected supply chains for both materials and labor. A recent surge in demand has led to a dramatic increase in commodity prices. It is unclear how long this disruption will last or if costs will continue in the short term. Depending upon the time horizon of the project, the bidding environment may still be affected as a result of the pandemic which could affect the number and price of bids received.

11. Estimate Quality Assurance

Estimate review has been ongoing. No second party review has been undertaken.

12. Estimating Team

Oversight to the estimating team is provided by Hallie Thornburrow and Jack Adam, PE.

The principal or lead estimator is Chris Portner, P.E, CEP.

All estimate reviews have been internally reviewed by the Design and Estimating Teams.