McMullin Area Groundwater Sustainability Agency

Water Banking Feasibility Study

Fresno County
June 2022

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Fresno County

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Abbreviations

AF	acre-feet
CCID	Central California Irrigation District
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CHRIS	California Historical Resources Information System
CL	clays
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
County	Fresno County
CPAD	California Protected Areas Database
CSLC	California State Lands Commission
CVFPB	Central Valley Flood Protection Board
CVP	Central Valley Project
DCP	Dust Control Plan
DMC	Delta-Mendota Canal
EC	Electrical Conductivity
EIR	Environmental Impact Statement
ESA	Endangered Species Act
GAMA	Groundwater Ambient Monitoring & Assessment Program
gpm	gallons per minute
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
ICs	Information Centers
ISR	Indirect Source Review
ITP	Incidental Take Permit
JID	James Irrigation District
JPA	Joint Powers Authority
KDSA	Kenneth D. Schmidt & Associates
Ksat	relative saturated hydraulic conductivity
LEDPA	Least Environmentally Damaging Practicable Alternative
LSAA	Lake and Streambed Alteration Application

MAGSA ..... McMullin Area Groundwater Sustainability Agency
mg/L ..... milligrams per liter
ML ..... silts
MOs ..... measurable objectives
MTs ..... minimum thresholds
NEPA ..... National Environmental Policy Act
NMFS ..... National Marine Fisheries Service
NPDES ..... National Pollution Discharge Elimination System
OHP ..... Office of Historic Preservation
PG&E ..... Pacific Gas and Electric
Program ..... Groundwater Banking Program
Provost & Pritchard ..... Provost & Pritchard Consulting Group
PTO ..... Permit to Operate
RWQCB ..... Regional Water Quality Control Board
SAGBI ..... Soil Agricultural Groundwater Banking Index
SHPO ..... State Historic Preservation Officer
SJVAPCD ..... San Joaquin Valley Air Pollution Control District
SLDMWA ..... San Luis& Delta-Mendota Water Authority
SM ..... silty sands
SP ..... poorly graded sands
SWP ..... State Water Project
SWPPP ..... Stormwater Pollution Prevention Plan
TDS ..... total dissolved solids
USACE ..... U.S. Army Corps of Engineers
USBR ..... United States Bureau of Reclamation
USDA ..... United States Department of Agriculture
USCS ..... Unified Soil Classification System
USFWS ..... U.S. Fish and Wildlife Service
WD ..... Water District
WDR ..... Waste Discharge Requirements

Executive Summary

This study builds upon the fatal flaws analysis to better understand the feasibility of developing the Aquaterra Groundwater Bank in the McMullin Area Groundwater Sustainability Agency (MAGSA) area with the interested parties. Additionally, work includes a review of the water quality at Mendota Pool and within MAGSA, refinement of project costs, identification of groundwater banking sites, development of an understanding of site-specific hydrogeologic conditions, and a more detailed understanding of issues related to diverting water from and returning water to the Mendota Pool.

Geologic Exploration and Site Identification

Available published information was used to preliminarily identify portions of the Groundwater Sustainability Agency (GSA) that appear geologically suited for groundwater recharge. Several geologic properties were mapped to evaluate regions within MAGSA that appear better suited for recharge of surface water supplies to groundwater. Geologic properties reviewed in this evaluation include soil texture and saturated hydraulic conductivity, the Soil Agricultural Groundwater Banking Index (SAGBI) rating, geologic facies, geologic deposits, groundwater contours, and presence/absence of regional aquitards. Groundwater recharge regions were identified based the combination of these properties that appear suitable for recharge operations.

Based on the findings discussed in **Section 2.1**, soil borings were drilled in the five regions that were identified as potentially favorable for groundwater recharge (Site 1 through Site 5). The purpose of the soil borings was to collect initial location specific soils information to begin near surface characterization of geologic conditions within the five regions. The collected information will be beneficial in helping the GSA narrow down the list of potential groundwater recharge locations to better focus future efforts, studies, and design of a groundwater banking program.

Operations Evaluation

The Aquaterra Groundwater Bank has been analyzed primarily for use by State Water Project (SWP) contractors and Central Valley Project (CVP) contractors, but can also be made available for MAGSA landowners, Kings River water users and other potential users. Water Bank users would access the groundwater bank through use of available capacity in the Delta-Mendota Canal and Mendota Pool. For SWP contractors, recharge water would be delivered to Mendota Pool from October through April, when existing Delta-Mendota Canal usage would be at low levels based on review of historical records. The limitation of recharge to an October through April period is a design assumption that is intended to be conservative. In actual operation, there are many periods outside of this seven-month period when capacity for recharge would often be available. CVP South of Delta contractors could recharge water on a similar schedule as for SWP contractors. Recovered groundwater would be returned to Mendota Pool for exchange with existing water users by making an equivalent amount available at San Luis Reservoir or within either system generally. As described in this document, the Mendota Pool refers to the reservoir upstream of Mendota Dam, which has hydraulically connected arms on both the Fresno Slough and San Joaquin River channels. Recovery would be limited by the ability to do exchanges with Mendota Pool water users, which (based on review of historical operations) would be feasible from May through September. Other (non-SWP) project participants could have more flexibility with the recharge and recovery operations depending on their specific circumstances. This report does not address multitude of possible agreements between existing Delta-Mendota Canal and Mendota Pool water users that could facilitate exchange of recovered water from the Aquaterra Groundwater Bank.

The storage capacity available for the Aquaterra Groundwater Bank is approximately, and conservatively, estimated to be at least 1.8 million acre-feet. This estimate of available groundwater storage is based on 2016 groundwater levels and data on specific yields in the aquifer, with a limitation on storage being no higher than

30-feet below the land surface. Total storage capacity, physical recharge capacity and physical recovery capacity are not expected to be limiting factors in project development. Based on anticipated participant operational banking needs, the recovery capacity and the ability to exchange recovered water at Mendota Pool during drought periods are the likely limiting factors for overall project capacity.

An initial project formulation was also developed based on 800,000 AF of priority banking storage capacity. This priority project formulation would provide for annual recharge capacity of 208,000 AF with instantaneous capacity of 770 cfs. The recovery capacity for this priority project formulation would be 146,000 AF per year, with instantaneous recovery of 480 cfs.

The project characteristics included here were developed to support facility design and project formulation and are expected to be revised in the course of final design based on a level of participant interest and more specific information on participant operational needs.

Infrastructure

The Aquaterra Groundwater Bank infrastructure consists of:

- 72 miles of canal conveyance between 300 and 500 cfs in capacity,
- 22 lift pump stations,
- 3,900 acres of recharge basins providing 1,540 acre-feet per day of recharge capacity,
- 87 recovery wells providing 960 AF per day of recovery capacity, and
- 55 monitoring wells.

Figure ES-0-1 shows the overview layout of the groundwater bank facilities. The water is initially pumped from three connections from the Fresno Slough arm of the Mendota Pool into the Jensen and American Canals. These canals flow east until they intersect the East-Side Canal. The East-Side canal follows the eastern MAGSA boundary north and south of Jensen to deliver water to five recharge site locations. After the water has been recharged and an interested party is ready to recover the water, recovery wells that are spread out among the basins will return the water to the canal. The canals will then return the water to the starting point at the Fresno Slough.

Capital, annual, operations and maintenance costs were analyzed for the project. These costs are summarized in **Table ES-0-1**.

Table ES-0-1 Total Capital Project Costs

Range of Total Capital Costs	
Low	$478,250,000
High	$777,156,000
Range of Capital Costs ($/AF Storage Capacity)	
Low	$598
High	$971
Range of Baseline Annual Costs	
Low	$26,383,500
High	$42,873,600
Recovery Costs ($/AF)	$164
Recharge Costs ($/AF)	$93

Regulatory and Policy Analysis

Construction and operation of the water bank and conveyance will require coordination, consultation and permits from multiple agencies with jurisdiction for various aspects of the Project. This section looks at permits that may be needed for groundwater banking and conveyance projects. During the environmental review process, the need for the various permits and approvals will be further refined.

Participant Involvement

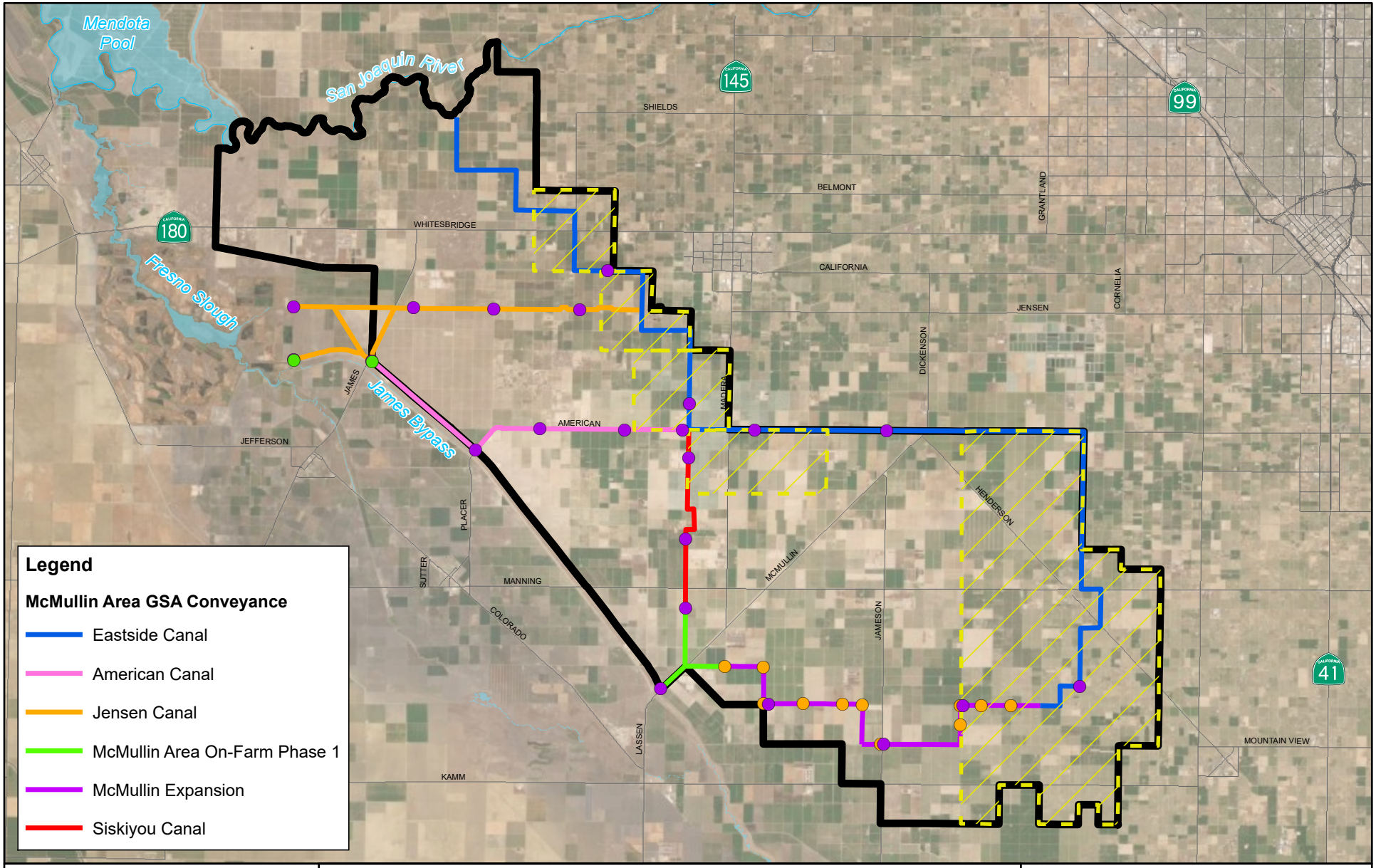
The MAGSA groundwater banking program has been formulated based on participation of outside water agencies potentially including SWP contractors, Kings River water users, CVP Contractors and other water agencies. MAGSA would develop, construct and operate the facility on behalf of the banking participants. The development, construction and operation would proceed under contracts between MAGSA and banking participants, which would provide for ongoing review of project costs and characteristics by banking participants.

The participant agreements would generally provide for participant payment for the costs of MAGSA groundwater banking program facilities and actual operational costs. Participants would generally have priority access to banking recharge and recovery facilities, with MAGSA having secondary access to those facilities for its own uses on an as-available basis. MAGSA would operate the groundwater bank and maintain banking operations accounts which would reflect physical operational losses, likely as a negotiated percentage included in the project agreements. The participant agreements, including preliminary indication of operational arrangements, are in development and will be finalized in the near future. The general parameters identified above may be refined as agreed to by project participants in the course of program development.

Recommendations

After discussions with MAGSA, the initial project formulation was developed based on 800,000 AF of banking storage. This project formulation would provide for annual recharge capacity of 208,000 AF with instantaneous capacity of 770 cfs. The recovery capacity for this project formulation would be 146,000 AF per year, with instantaneous recovery of 480 cfs. This alternative has multiple points of diversion from the Fresno Slough arm of the Mendota Pool that allows for flexibility for pumping into the project canals.

Additional storage capacity will likely be available within the water banking facilities, but this study has concentrated on the initial priority offering for the first 800,000 acre-feet of storage only.



McMullin Area GSA

Groundwater Banking Conveyance

Figure ES-1

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1 Introduction

McMullin Area Groundwater Sustainability Agency (MAGSA) has spoken with many interested parties on both the State Water Project (SWP) and Central Valley Project (CVP) systems about potentially developing a groundwater banking program and facilities. Provost & Pritchard Consulting Group (Provost & Pritchard) recently completed a draft fatal flaws analysis that reviewed the program at a high level to ascertain water supply availability, geologic conditions, environmental constraints, infrastructure needs, and the associated costs. Many of the interested parties have expressed continued interest in the Project.

Conceptually, water from an interested party would be delivered from the O'Neil Forebay through the Delta-Mendota Canal (DMC) and to the Mendota Pool. Once in the Fresno Slough arm of the Mendota Pool, water would then be diverted to MAGSA and conveyed to a dedicated groundwater banking facility, delivered to growers for them to utilize "in-lieu" of pumped groundwater, delivered to growers for them to recharge through an on-farm recharge program, or through a combination of these approaches. For the purposes of this analysis, it is assumed MAGSA will develop dedicated recharge and recovery facilities in order to develop a more conservative opinion of capital costs. Water recovered in dry years would be collected in MAGSA and returned to the Mendota Pool, where it would be exchanged through the DMC for a water supply in the San Luis Reservoir on the California Aqueduct.

This feasibility study builds upon the fatal flaws analysis to better understand the feasibility of building facilities in MAGSA that would facilitate a groundwater banking program with the interested parties. Additionally, work includes a review of water quality at the Mendota Pool and within MAGSA, refinement of project costs, identification of groundwater banking sites, development of an understanding of site-specific hydrogeologic conditions, and a more detailed understanding of issues related to diverting water from and returning water to the Mendota Pool.

2 Geologic Exploration & Site Identification

2.1 Geologic and Hydrogeologic Information

Approach

Available published information was used to preliminarily identify portions of the GSA that appear geologically suited for groundwater recharge. Several geologic properties were mapped to evaluate regions within MAGSA that appear better suited for recharge of surface water supplies to groundwater based on the totality of the geologic properties. Geologic properties reviewed in this evaluation include soil texture and saturated hydraulic conductivity, the Soil Agricultural Groundwater Banking Index (SAGBI) rating, geologic facies, geologic deposits, groundwater contours, and presence/absence of regional aquitards.

As shown on **Figure 2-1** and **Figure 2-2**, soils within the MAGSA were grouped and mapped based on soil texture (coarseness) and relative saturated hydraulic conductivity (Ksat). Other features that could positively effect or negatively impact groundwater recharge were then added to the maps. These include:

- *Areas of shallow regional aquitards (A-Clay and C-Clay) which could impede percolation of groundwater (**Figure 2-1** and **Figure 2-2**).*

- *Extent of the regional E clay (Corcoran clay) aquitard, as generally, recovery of banked groundwater would primarily occur from the portion of the aquifer above it and if the project is in an area underlain by the E clay, recharged water will pre-dominantly reside above the E clay.*

- *Geologic facies, as mapped by the USGS (Page and LeBlanc 1969), which are relatively conducive to groundwater recharge (**Figure 2-1**).*

    - *Facies D: 50-66% coarse grained material*
    - *Facies E: 66-80% coarse grained material*

- *Geologic deposit types, mapped by Page and LeBlanc in 1969, which provide general indication of relative favorability of surface water percolation to groundwater (**Figure 2-2**).*

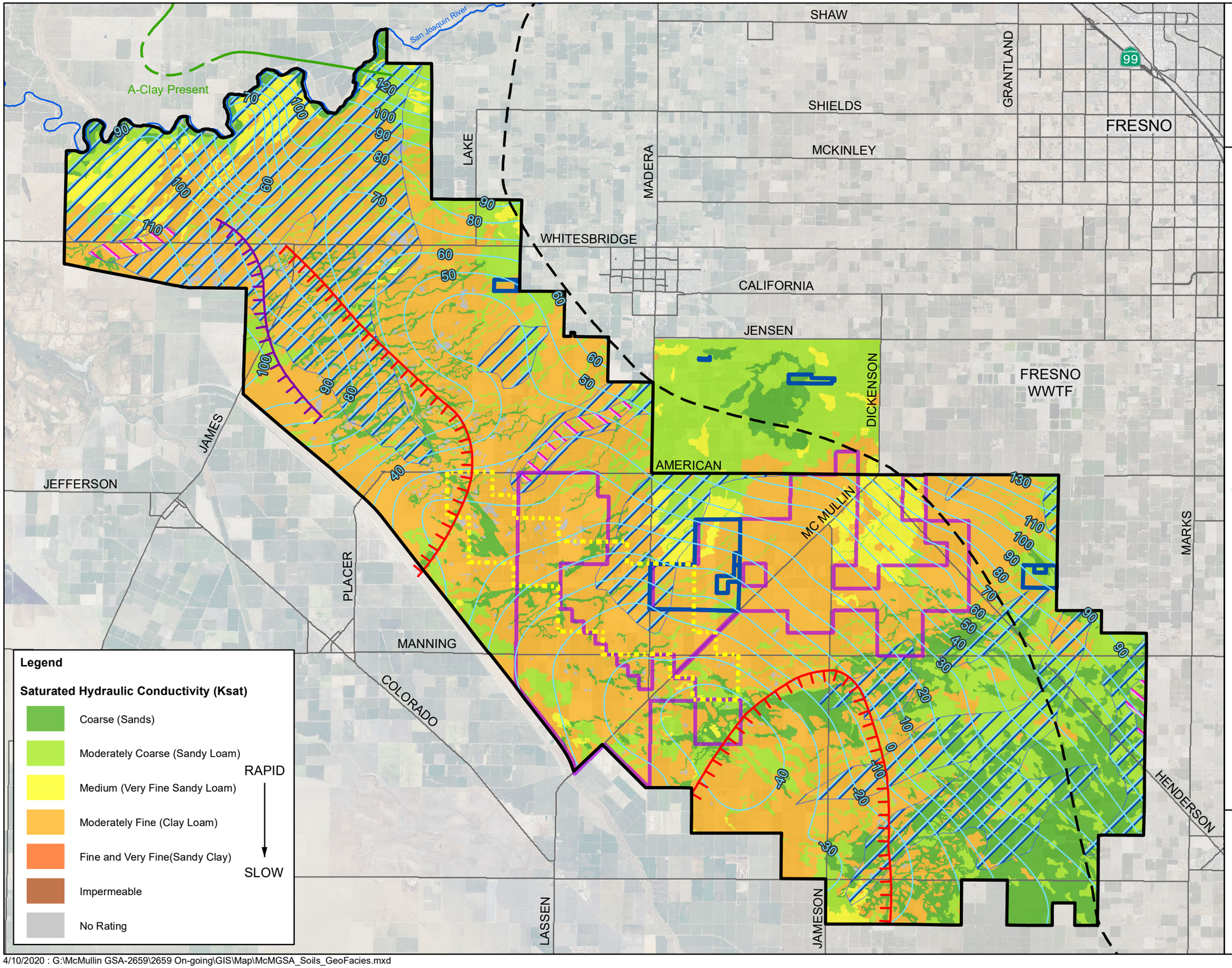
    - *Sand Dune Deposits (relatively favorable for recharge)*
    - *Younger Alluvium (relatively favorable for recharge)*
    - *Older Alluvium (relatively favorable for recharge)*
    - *Flood Basin Deposits (relatively unfavorable for recharge)*

- *Groundwater surface elevation contours to site possible locations with sufficient storage space, determine directions of groundwater flow as they relate to areas of poor groundwater quality and the likely direction recharged water will flow (**Figure 2-1** and **Figure 2-2**).*

McMullin Area GSA

Soils and Near Surface Features

Figure 2-1



Legend

Saturated Hydraulic Conductivity (Ksat)

- Coarse (Sands)
- Moderately Coarse (Sandy Loam)
- Medium (Very Fine Sandy Loam)
- Moderately Fine (Clay Loam)
- Fine and Very Fine(Sandy Clay)
- Impermeable
- No Rating

RAPID ↓ SLOW

- McMullin Area GSA
- Corcoran Clay Extent (E-Clay, Page 1986)
- FID Basins
- James ID Well Field
- Raisin City Oil Field
- A-Clay Extent (USGS 1958)
- A-Clay Boundary (dashed where inferred)
- C-clay Extent (USGS 1958)
- *Eastern Extent of E-Clay (Corcoran Clay) (Page and LeBlanc, 1969 (Modified by KDSA))*
- Water Surface Elevation (10ft interval)*

Geologic Facies (Page and LeBlanc 1969)

Facies Code

- Facies - D: 50-66% Coarse grained material
- Facies - E: 66-80% Coarse grained material

**Contours created for Kings Subbasin Coordinated Effort, KDSA.*

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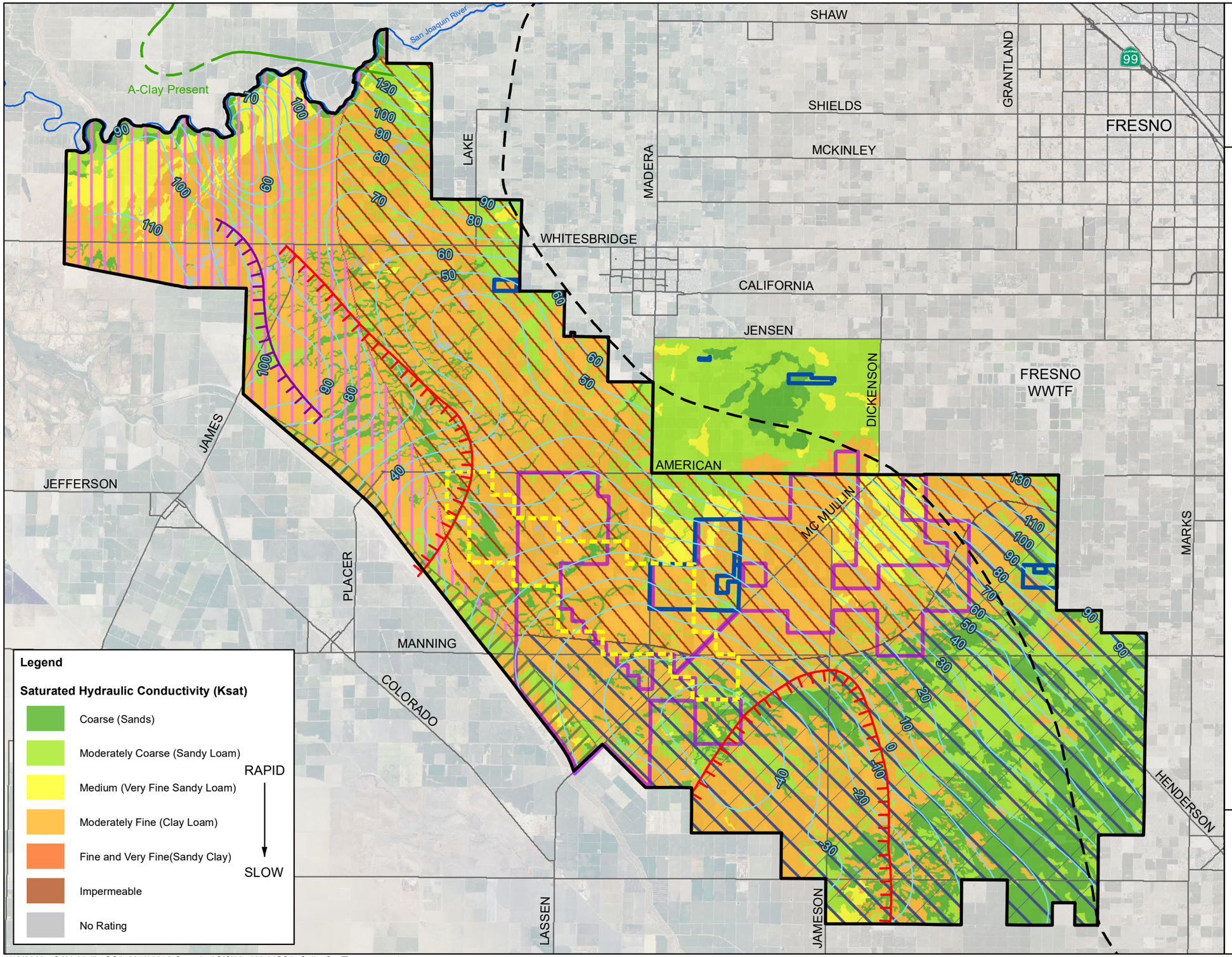
McMullin Area GSA

Soils and Near Surface Features

Figure 2-2



Legend

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- C-clay Extent (USGS 1958)
- *Eastern Extent of E-Clay (Corcoran Clay) (Page and LeBlanc, 1969 (Modified by KDSA))*
- Water Surface Elevation (10ft interval)*

Geologic Deposits

Page and LeBlanc, 1969

- Flood Basin Deposits (Unconsolidated) (Qb)
- Older Alluvium (Unconsolidated) (Qoao)
- Sand Dunes (Unconsolidated) (Qsd)
- Younger Alluvium (Unconsolidated) (Qya)

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Geologic Findings

As shown on **Figure 2-1** and **Figure 2-2**, coarse- to moderately coarse-grained soils are predominately located along the northern edge, the western boundary, the eastern edge (from approximately Whitesbridge Avenue to American Avenue) and the south-eastern portion of the MAGSA. The vast majority of the GSA interior is covered by moderately fine (clay loam) type soils.

Large areas of the northwestern, central-west and southwestern MAGSA are underlain by relatively shallow regional aquitards (A-Clay and C-Clay) that are considered limiting factors in groundwater recharge. The vast majority of the MAGSA is underlain by the E-Clay aquitard, however the E-Clay is at such depths that it is not considered a limiting factor to groundwater recharge of the groundwater table.

Geologic deposits (**Figure 2-2**), as mapped by Page and LeBlanc (1969), indicate that the southern third of the MAGSA is comprised of unconsolidated sand dune deposits. Previous experience has shown that the sand dune deposits are generally favorable for recharge. The bulk of the remaining MAGSA area is comprised of unconsolidated younger and older alluvium deposits. Unconsolidated flood basin deposits, which are generally considered unfavorable for groundwater recharge occur along the western margin of the MAGSA.

Page and LeBlanc (1969) mapped the Geologic Facies in the greater Kings Subbasin. These geologic facies were grouped based on the percentage of coarse-grained materials into Facies A through E. Facies D and E are generally considered favorable for groundwater recharge while Facies A through C are generally considered non-favorable for groundwater recharge as they have higher percentages of fine-grained materials. As shown in **Figure 2-1**, Geologic Facies D and E are generally located in the northern and southern ends of the MAGSA. Small areas of Facies D and E are also located along the eastern edge of the GSA.

Groundwater elevation contours showing groundwater flow directions are presented on **Figure 2-1** and **Figure 2-2**. As shown, groundwater typically flows into the GSA from the east in a south-west direction. A large cone of depression can be seen in the southwest portion of the MAGSA as a result of regional groundwater pumping. Groundwater, above the E clay, generally flows towards this depression from surrounding areas.

Initially Selected Regions of MAGSA Geologically Suitable for Groundwater Recharge

By layering the soils, geologic, and groundwater quality data presented in **Figure 2-1, Figure 2-2,** and **Figure 3-8**, several regions within the MAGSA were identified where relative groundwater percolation rates could be higher, where limiting factors such as shallow regional aquitards are not present, and where existing TDS in groundwater appears to be relatively lower. The area near the San Joaquin River along the eastern most boundary of MAGSA also appears to be an area where recharge could be viable. This area is not shown on **Figure 2-1** as the A clay has been mapped in this area north of the San Joaquin River, but due the close proximity of the site to one of the potential sources of water for the project and the apparently favorable geologic conditions for recharge (other than the potential presence of the A clay) this area may warrant further study and consideration.

Based on this initial study, the regions that appear favorable for recharge are generally located along the eastern boundary of the GSA and in the southeastern portion of the GSA. For discussion purposes, these identified regions have been labeled from north to south as Site 1, Site 2, Site 3, Site 4, and Site 5 (**Figure 2-3**). Initial geologic findings were reviewed by Kenneth D. Schmidt and Associates (KDSA) and the findings are discussed in a memo dated August 14, 2020 (**Appendix A)**. The memo summarizes the number of well logs available for evaluation by site and indicates areas with apparently favorable conditions for recharge for each of the five sites. The memo recommended twenty-eight borings be completed on the five sites. Two soil borings per site were included as part of this scope of work with the understanding more soil borings will be needed as recharge basin locations are identified. As shown in **Table 2-2**, ten borings were completed on the five sites. Additional borings will be needed during the next steps in project development. Included in the memo are map figures that show the areas of apparently favorable recharge. The memo notes that Site 2 does

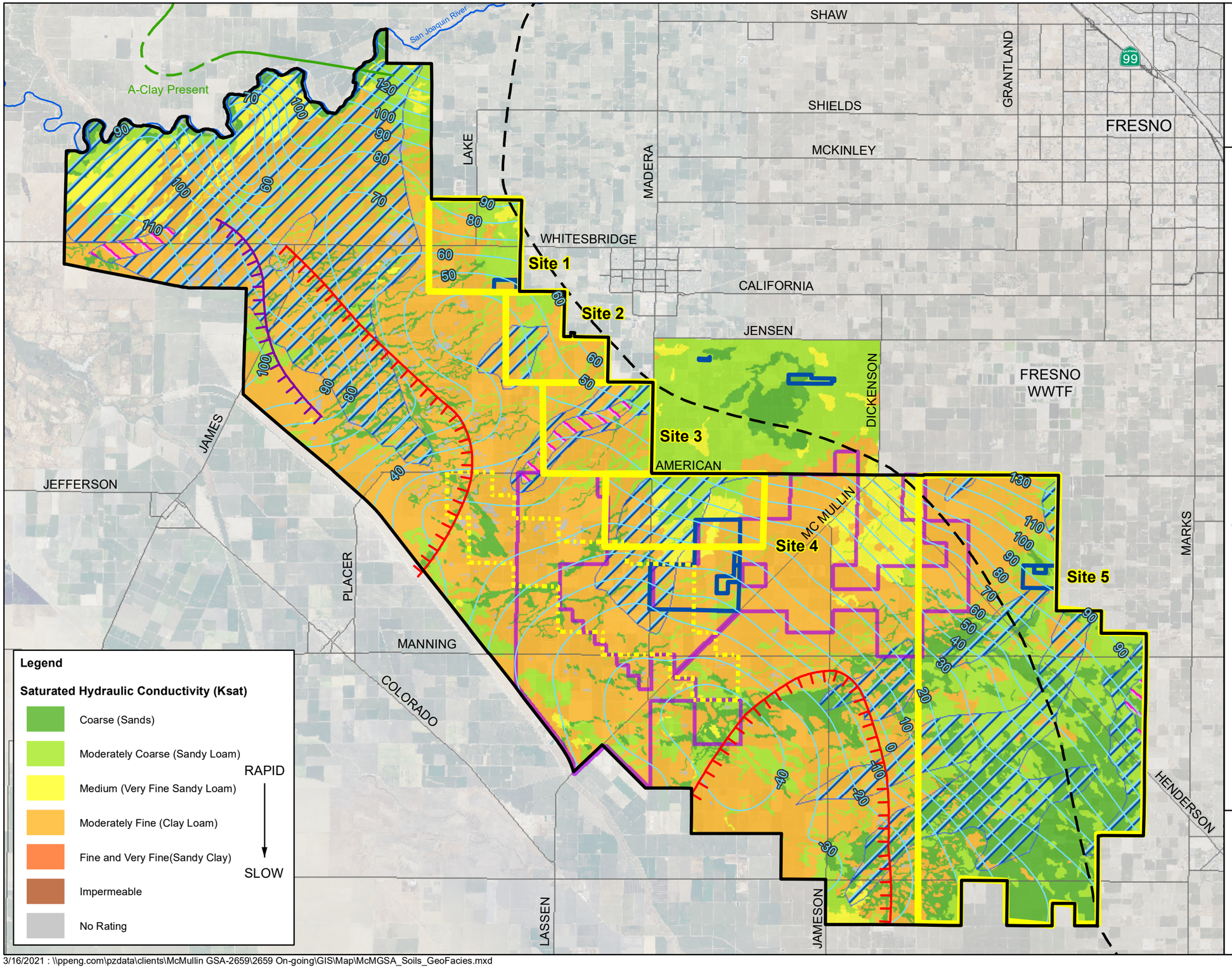
not have any well logs that indicate apparently favorable conditions for basin recharge, and soil borings were not recommended at this site. Two soil borings were conducted at Site 2 to collect location specific data on the soil conditions at the site.

The groundwater flow within MAGSA is generally from northeast to southwest towards the cone of depression. The cone of depression is in the southwest portion of MAGSA. **Figure 2-4** shows the unconfined groundwater contours. The contours show the groundwater flows towards the cone of depression. This shows that recharged groundwater will not generally flow outside of the MAGSA boundaries. Groundwater may flow outside of the GSA if the cone of depression moves. This is advantageous for the banking program since it is expected banked water will not migrate out of the region.

McMullin Area GSA

Soils and Near Surface Features

Figure 2-3



- McMullin Area GSA
- Recharge Site
- Corcoran Clay Extent (E-Clay, Page 1986)
- FID Basins
- James ID Well Field
- Raisin City Oil Field
- A-Clay Extent (USGS 1958)
- A-Clay Boundary (dashed where inferred)
- C-clay Extent (USGS 1958)
- *Eastern Extent of E-Clay (Corcoran Clay) (Page and LeBlanc, 1969 (Modified by KDSA))*
- Water Surface Elevation (10ft interval)*

Geologic Facies (Page and LeBlanc 1969)

Facies Code

- Facies - D: 50-66% Coarse grained material
- Facies - E: 66-80% Coarse grained material

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McMullin Area GSA

Groundwater Elevation Contours
Spring 2016
Figure 2-4

MADERA CO.
FRESNO CO.
SAN JOAQUIN RIVER
JAMES BYPASS
FRESNO SLOUGH
Mendota
Biola
Kerman
Tranquillity
San Joaquin
Raisin City
Caruthers
Cantua Creek
Old Fig Garden
Mayfair
Fresno
West Park
Calwa
Easton

- McMullin Area GSA
- Kings Subbasin (DWR, Modified 2018)
- Mid-Valley WD
- Raisin City WD
- State of California Ecological Reserve
- Raisin City Community
- City/Town
- Generalized Groundwater Flow Direction
- Water Surface Elevation (10ft interval)*

**Contours created for Kings Subbasin Coordinated Effort, KDSA.*

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

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2.2 Soil Borings

Based on the findings discussed above (**Section 2.1**), soil borings were drilled in the five regions that were identified as appearing favorable for groundwater recharge (Site 1 through Site 5). The purpose of the soil borings was to collect initial location specific soils information to begin near surface characterization of geologic conditions within the five regions. The collected information will be beneficial in helping the GSA narrow down the list of potential groundwater recharge locations to better focus future efforts, studies, and design of a groundwater banking program.

2.2.1 Site Locations

Soil borings were advanced to approximately 90 to 100 feet below ground in the areas shown on **Figure 2-5**. Soil Borings 1-1 and 1-2 were advanced within Site 1, Borings 2-1 and 2-2 within Site 2, Borings 3-1 and 3-2 within Site 3, Borings 4-1 and 4-2 within Site 4, and Borings 5-1 and 5-2 within Site 5. An additional two soil borings, A-1 and A-2 were drilled near either side of the mapped A-clay boundary to assess the possibility of basin construction within the northern-central MAGSA area.

2.2.2 Soil Boring Data

Drilling was performed by a CME-55 drill rig using hollow stem augers and a Continuous Tube Sampler. Continuous-core soil samples were reviewed by a California licensed Professional Geologist during drilling and the results were logged consistent with the Unified Soil Classification System (USCS). Soil boring logs for each soil boring drilled during this assessment are in **Appendix B, Part 1.** Additionally, KDSA selected 12 soil samples to send to the laboratory for grain-size distribution by ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates (**Table 2-1**, on following page). The samples were sent to the laboratory to provide additional soil texture data and confirm field estimated texture, especially when a material was logged with an intermediate texture, which most of the submitted samples were. Intermediate textured soils on the boring logs have a dual symbol in the USCS Field Classification column. Of note on the boring logs, is that the vast majority of fine-grained materials and the fine-grained fraction of coarse-grained materials were logged mostly as silt and not clay in the field. Hydrometers, generally used to differentiate between the percentages of clay and silt, were not run on the samples submitted to the laboratory. Therefore, because the majority of fine-grained deposits were logged as silt in field, the fine fraction, i.e., finer than the #200 sieve, from the sieve analysis samples is assumed to be silt. Of the 12 samples submitted, 11 of the laboratory results confirmed the field estimated soil texture. The laboratory results are included in **Appendix B, Part 2**, and the data can also be found on the soil boring logs (**Appendix B, Part 1**). The soil classification, as estimated in the field, was not changed on the boring logs based on the laboratory data.

Table 2-1 Soil Samples Submitted for Sieve Analysis

Site	Boring Number	Sample Depth
1	1-1	50'
2	2-2	10'
2	2-2	25'/30'
2	2-2	45'
3	3-1	45'
3	3-2	45'
4	4-1	30'/35'
4	4-1	55'
4	4-2	15'
4	4-2	40'/45'
5	5-1	5'
5	5-2	60'/65'

2.2.2.1 Soil Boring Log Analysis – Percentage of Permeable Materials

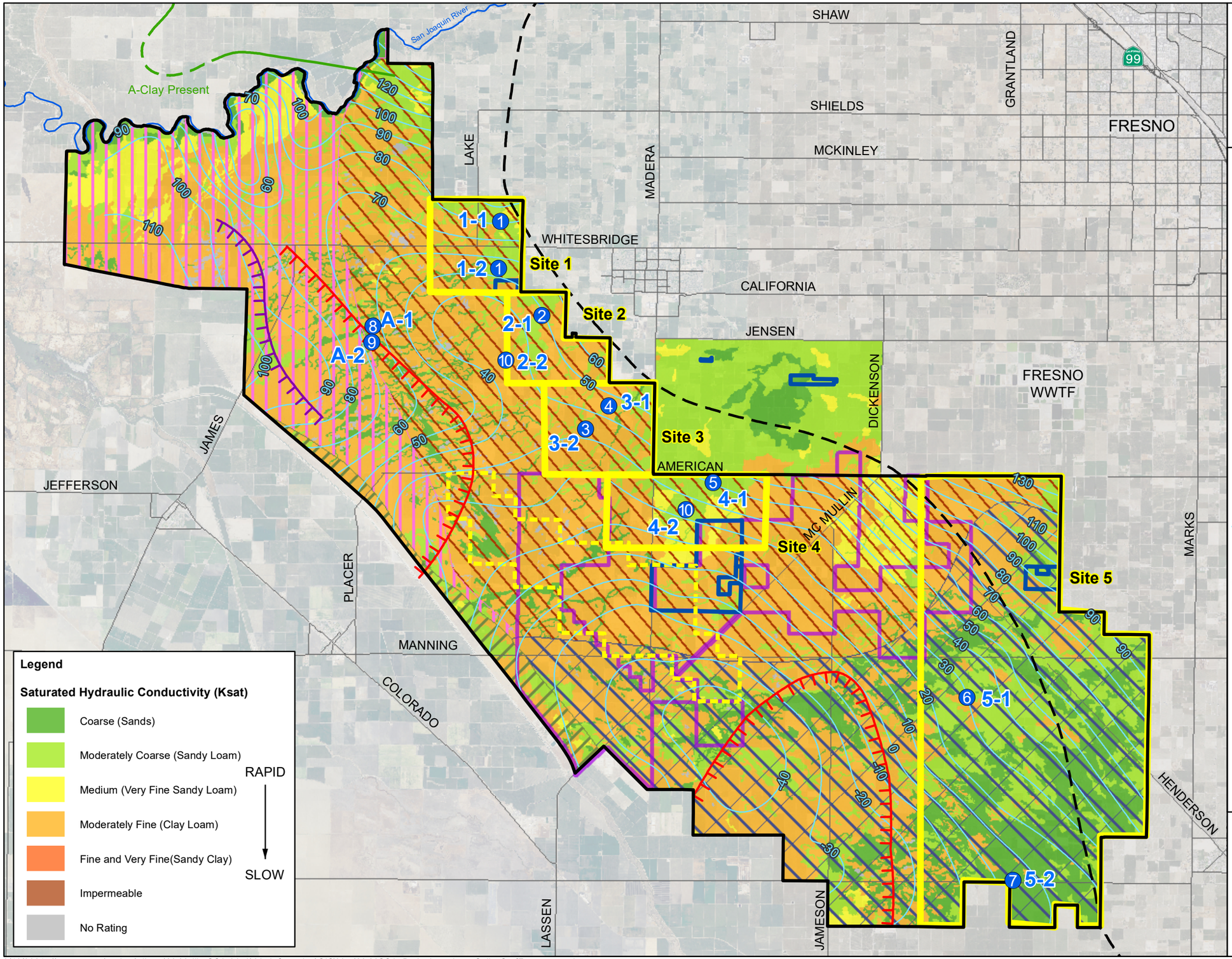
For the purposes of this assessment, materials logged as poorly graded sands (SP) or silty sands (SM) with grain sizes described as fine to coarse-grained were considered relatively permeable. While materials described as silts (ML) or clays (CL) or generally as very fine-grained were considered relatively less permeable. Based on visual classification of the encountered soils, the percentage of relatively permeable materials in the upper 10-feet, 20-feet, 50-feet, and 100-feet were summarized. For each of these depth intervals the soil borings were sub-ranked in numerical order based on the percentage of permeable materials (SP and SM) with a lower sub-ranking number indicating a higher percentage of materials considered relatively permeable. The depth interval rankings were then summed for an overall ranking of each soil boring. Results of the soil boring ranking are summarized in **Table 2-2**.

As shown in **Table 2-2**, the soils borings with the highest overall percentage of more permeable materials were located in Site 1 (Borings 1-1 and 1-2), Site 2 (Boring 2-1), and Site 3 (Borings 3-1 and 3-2). Soil borings with the lowest percentage of permeable materials were located in the area of the A-Clay assessment (Borings A-1 and A-2) and at Site 4 (Borings 4-1 and 4-2) and Site 5 (Borings 5-1 and 5-2). For the purposes of this assessment, it is assumed that boring locations with the highest overall percentage of permeable materials would be relatively more efficient in groundwater recharge.

McMullin Area GSA

Soil Boring Locations with
Soils and Near Surface Features

Figure 2-5



Legend

Saturated Hydraulic Conductivity (Ksat)

- Coarse (Sands)
- Moderately Coarse (Sandy Loam)
- Medium (Very Fine Sandy Loam)
- Moderately Fine (Clay Loam)
- Fine and Very Fine(Sandy Clay)
- Impermeable
- No Rating

RAPID ↓ SLOW

- McMullin Area GSA
- Recharge Site
- Corcoran Clay Extent (E-Clay, Page 1986)
- FID Basins
- James ID Well Field
- Raisin City Oil Field
- A-Clay Extent (USGS 1958)
- A-Clay Boundary (dashed where inferred)
- C-clay Extent (USGS 1958)
- *Eastern Extent of E-Clay (Corcoran Clay) (Page and LeBlanc, 1969 (Modified by KDSA))*
- Water Surface Elevation (10ft interval)*
- Boring Location (Permeable Material Ranking)

Geologic Deposits

Page and LeBlanc, 1969

- Flood Basin Deposits (Unconsolidated) (Qb)
- Older Alluvium (Unconsolidated) (Qoao)
- Sand Dunes (Unconsolidated) (Qsd)
- Younger Alluvium (Unconsolidated) (Qya)

**Contours created for Kings Subbasin Coordinated Effort, KDSA.*

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Table 2-2 Soil Boring Ranking Based on Field Estimated Percentages of Permeable Material

Boring 1-1					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	95%	83%	77%	64%	--	--
Ranking Points (%SP/SM)	2	2	2	3	9	1
Boring 1-2					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	80%	75%	78%	75%	--	--
Ranking Points (%SP/SM)	3	4	1	1	9	1

Boring 2-1					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	100%	88%	68%	61%	--	--
Ranking Points (%SP/SM)	1	1	5	5	12	2
Boring 2-2					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	0%	35%	29%	40%	--	--
Ranking Points (%SP/SM)	7	10	12	9	38	10

Boring 3-1					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	20%	60%	76%	74%	--	--
Ranking Points (%SP/SM)	5	6	3	2	16	4
Boring 3-2					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	100%	68%	75%	62%	--	--
Ranking Points (%SP/SM)	1	5	4	4	14	3

Boring 4-1					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	95%	78%	54%	60%	--	--
Ranking Points (%SP/SM)	2	3	8	6	19	5
Boring 4-2					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	0%	0%	30%	31%	--	--
Ranking Points (%SP/SM)	7	10	11	10	38	10

Boring 5-1					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	10%	56%	67%	49%	--	--
Ranking Points (%SP/SM)	6	7	6	8	27	6
Boring 5-2					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	0%	45%	61%	58%	--	--
Ranking Points (%SP/SM)	7	9	7	7	30	7

Boring A-1					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	80%	55%	47%	25%	--	--
Ranking Points (%SP/SM)	3	8	9	12	32	8
Notes from log:						
Boring A-2					**Total Score**	**Total Ranking**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--	--
SP & SM Combined	50%	45%	40%	30%	--	--
Ranking Points (%SP/SM)	4	9	10	11	34	9

2.2.2.2 Soil Boring Log Analysis – Potential Impediments to Recharge

In addition to the overall percentages of permeable materials in the soil borings, the presence of soil beds that could restrict the vertical movement of recharge water should also be discussed in siting locations for recharge basins.

Hard drilling conditions were encountered in several of the soil borings at depths ranging from approximately 30 feet to 70 feet below ground. These hard drilling conditions often corresponded to partially cemented silt layers in the soil column, of which several had the appearance of hardpan, but at deeper depths than hardpan is typically encountered. These soils were encountered in Boring 2-2 (48'-50'), Boring 3-1 (47'-48'), Boring 3-2 (43'-45'), and Boring 4-1 (67'-68').

These partially cemented silt layers could be interpreted as being related to hardpan and non-hardpan paleosols as described by Cehrs, Soenke, and Bianchi (1980) in USDA Technical Bulletin 1604, including those identified as components of the Riverbank Formation. While these were previously described by Cehrs, Soenke, and Bianchi at relatively shallower depths in the greater Fresno area, given the valley structure, southwestward dipping alluvial deposits and depositional environment in the valley, finding these paleosol-like features at depths deeper than in their study area is reasonable.

These partially cemented silt layers were typically noted as having blocky structure which would appear to be secondary porosity for the material as no appreciable perched water was encountered above. Based only on soil texture, it would be reasonable to assume that these layers would be impediments to groundwater percolation, however the secondary porosity (blocky structure) indicates these layers may not necessarily be an issue in severely limiting groundwater percolation.

Perched groundwater indicating soil layers restrictive of groundwater percolation was not encountered in the soil borings except for Boring 4-1 at approximately 85 feet in poorly graded sand. However due to extremely soft drilling conditions and heaving sands, this soil boring could not be sampled below 95' and the assumed restrictive layer was not reached in the boring. Current water levels in this vicinity are between approximately 165 to 200 feet deep, therefore the perched groundwater encountered in Boring 4-1 does not appear to be related to the regional groundwater table.

Pilot scale percolation tests are the best way to quantify recharge rates and should be performed, if possible, on any parcel before proceeding with project development. Pilot scale percolation tests on one or more parcels would involve temporary basins of about one acre and the installation of piezometers at varying depths corresponding with the depths of possible percolation barriers, such as those discussed above, to assess impediments to groundwater percolation.

Several of the borings have shallow fine-grained material overlying sequences of sands and silty sands, e.g., Boring 3-1. If these shallow fine-grained materials can be removed during basin construction thereby exposing more coarse-grained materials, these locations would most likely have relatively higher recharge rates. As only two locations were assessed at each Site, the location, presence, prevalence, and thickness of the shallower fine-grained materials cannot be confirmed across the Sites until more borings or backhoe pits can be completed. These additional data would be used to refine the nature and extent of surface or near surface fine-grained materials to ascertain if the shallow fine-grained materials are pervasive across the Site. This information would be used to provide recommendations on how deep a given basin will need to be excavated to expose underlying coarse-grained materials.

2.2.3 Summary of Geologic Findings

As discussed above and shown in **Table 2-2**, Site 1 has the highest percentage of coarse-grained materials logged in the borings. Followed in descending order with regards to percent coarse grained material by Site 2, Site 3, Site 4 and Site 5. Based on the regional geologic data for geologic facies, SAGBI rating, relative saturated hydraulic conductivity, and geologic deposits, the Site 1 area was not expected to have as permeable materials as Site 5 which is in an area of sand dune deposits with predominately sand and sandy loam topsoils.

KDSA did not recommend additional borings in Site 2 based on their well log review (**Appendix A**). The relatively high ranking of Boring 2-1, ranked second of the ten borings, illustrates that site specific data is needed to confirm the preliminary findings from the regional data. However, Boring 2-2 on Site 2 does appear to confirm KDSA's finding that the southwestern portion of the site does not appear to be favorable for recharge. Based on geologic facies, Site 3 appeared to have a relatively higher percentage of coarse-grained materials with both Facies D and E mapped there. Significant portions of Site 5 are mapped by Page and Leblanc as Facies D however, the two borings conducted there do not appear to be in areas mapped as Facies D. Future borings in the Site 5 area should be advanced in locations mapped as Facies D to evaluate and compare material textures between areas not mapped as Facies D and areas mapped as Facies D. In addition, the 2 borings completed in Site 5 were about 5 miles apart and assessing this large of an area would require addition borings. It is possible, and maybe even likely, that there are areas in Site 5 with soil texture comparable to Site 1, and Boring 2-1.

Based on soil texture data logged in the field, the area around Borings 1-1, 1-2 and 2-1 appears to be relatively better for recharge, however the selection of a site should also consider groundwater quality as, discussed below in **Section 3.2** and available groundwater storage space above local groundwater levels. Considering the variations in soil texture between borings and between sites, additional soil borings should be conducted at sites selected for additional consideration. Furthermore, the information from the borings indicates that if additional lands are identified in the areas near Sites 1 – 5, site specific borings are warranted even if the regional literature may indicate less than favorable conditions for recharge in the area.

3 Operations Evaluation

3.1 Operations

Surface Water Deliveries

The proposed Aquaterra Groundwater Bank would be developed to receive surface water from, and deliver water to, the Fresno Slough and the hydraulically connected Mendota Pool in Fresno County. The Aquaterra Groundwater Bank would develop access to water supplies from the Kings River, the San Joaquin River, the CVP DMC, and the SWP (through use of available capacity in the DMC). While the Kings and San Joaquin Rivers are potential surface water sources, this study focuses on water that would be developed with potential partner agencies on the CVP and SWP systems.

Kings River – During years when flood water is released from Pine Flat Dam, the Kings River flows into James Bypass, which terminates in the Mendota Pool. As described in the MAGSA Groundwater Sustainability Plan (GSP), there are occasionally periods when water supplies have historically exceeded local diversion capacity on the Kings River. These supplies occur infrequently under very high flow conditions and may continue to occur at times in the future. The Aquaterra Groundwater Bank diversion and conveyance facilities would be designed to access any available Kings River flows directly from the Mendota Pool, in addition to an existing diversion to MAGSA upstream on James Bypass. The potential quantities available are not identified in this report.

San Joaquin River – The San Joaquin River also flows into the Mendota Pool. During periods of good water supply conditions on the San Joaquin River, there are occasional periods of water supply availability on the San Joaquin River. Recharge of available San Joaquin River flows was described in the MAGSA GSP as a potential project to achieve sustainability. As noted in the GSP, water rights permits would be needed for recharge of available San Joaquin River flows. As with the Kings River, flows available for recharge from the San Joaquin River are not quantified in this report.

Delta-Mendota Canal – The Delta-Mendota Canal would be a direct or indirect water supply source for the Aquaterra Water Bank. The DMC extends in a southerly direction from a location on the Sacramento-San Joaquin Delta near Tracy, ultimately discharging into the Mendota Pool behind the Mendota Dam. The DMC was built to provide water supplies to various CVP water supply contractors, including water rights settlement contractors (San Joaquin River Exchange Contractors). The DMC has a capacity ranging from 4,600 cfs at its head near Tracy to 2,900 cfs at its terminus near Mendota. Over time, groundwater pumping has caused subsidence in portions of the lower DMC downstream of San Luis Reservoir, which has reduced the operational capacity somewhat just west of Mendota Pool.

The DMC is indirectly connected to San Luis Reservoir and the SWP California Aqueduct just west of Los Banos at the O'Neill Forebay. With this connection, the upper reach of the DMC can deliver water to San Luis Reservoir; typically, this occurs in wet years. The O'Neill facilities also provide a connection to the SWP California Aqueduct and SWP contractors.

Recharge to Aquaterra, from either CVP or SWP contractor participants, can be delivered to Mendota Pool through unused DMC capacity during wet periods. **Figure 3-1** shows the location of the DMC and how SWP and CVP contractor supplies can be delivered.

Extractions from the Aquaterra Groundwater Bank, for either CVP or SWP contractor participants, can also be returned to those CVP or SWP contractors by exchange using the DMC. During extraction periods, Aquaterra Groundwater Bank extractions would be provided to CVP and San Joaquin River Exchange Contractors that receive water either directly from the Mendota Pool or through direct connections to their distribution facilities. Extractions that provide for these contractors' use would make equivalent volumes of

CVP water available at upstream locations on the DMC and would allow for water to be returned to San Luis Reservoir or the SWP California Aqueduct. **Figure 3-2** shows how the DMC would be used during extraction periods to provide water at San Luis Reservoir and on the California Aqueduct.

To quantify the potential DMC delivery capability for recharge to and extraction from the Aquaterra Groundwater Bank, two data sources were analyzed: 1) CALSIM model simulation of projected DMC deliveries to Mendota Pool (1922 through 2003) prepared for the State Water Project Delivery Capability Report (2019) and 2) historical records of actual Mendota Pool diversions for the period 1980 through 2018. The CALSIM 1922-2003 study results for DMC deliveries to Mendota Pool are summarized by year type in **Table 3-1**.

Table 3-1 CALSIM SWP DCR Study

CALSIM State Water Project 2019 Delivery Capability Report Study
Delta Mendota Canal Inflows to Mendota Pool (Channel 708)
(cubic feet per second)

	October	November	December	January	February	March	April	May	June	July	August	September
Aquaterra Recharge Years												
Wet Year Type												
Average	1,163	494	183	139	261	644	734	895	1,379	1,958	2,408	1,665
Minimum	0	0	0	0	0	0	0	0	0	0	1,384	892
Maximum	1,265	545	260	263	595	1,118	1,259	1,711	2,370	2,550	2,457	1,699
Above Normal Year Type												
Average	1,208	520	226	206	429	856	963	1,387	2,047	2,379	2,434	1,688
Minimum	959	415	0	0	0	0	0	0	147	1,242	2,407	1,676
Maximum	1,265	545	260	263	595	1,113	1,248	1,703	2,359	2,541	2,457	1,699
Aquaterra Non-Operation Years												
Below Normal Year Type												
Average	1,236	496	248	195	431	1,000	1,067	1,504	2,241	2,500	2,412	1,678
Minimum	968	41	191	0	0	0	0	0	1,116	2,462	2,377	1,663
Maximum	1,265	545	260	263	595	1,109	1,245	1,695	2,348	2,524	2,434	1,688
Aquaterra Extraction Years												
Dry Year Type												
Average	1,222	526	248	249	550	1,081	1,203	1,647	2,281	2,449	2,363	1,648
Minimum	963	417	201	204	420	871	980	1,328	1,846	1,987	1,908	1,308
Maximum	1,265	545	260	263	595	1,102	1,238	1,689	2,339	2,513	2,424	1,684
Critical Year Type												
Average	1,180	508	241	242	526	937	1,051	1,423	1,975	2,122	2,042	1,416
Minimum	965	418	202	205	433	854	959	1,298	1,804	1,938	1,863	1,288
Maximum	1,262	543	258	261	584	1,092	1,221	1,651	2,287	2,452	2,368	1,659

The historical Mendota Pool diversion data is summarized in **Appendix C**. The Mendota Pool diversions represent the total diversion amount from the Mendota Pool, regardless of water supply source. These diversions are primarily provided with water from the DMC, but also use San Joaquin River flows during wet periods or during extreme dry periods. For purposes of recharge to or extraction from the Aquaterra Groundwater Bank, actual DMC deliveries to the Mendota Pool would have been the ideal data source. During wet periods, the Mendota Pool diversions would often exceed DMC deliveries to the Mendota Pool. For purposes of determining available capacity, this would actually provide a conservative estimate of DMC available capacity. During most normal or dry years, there are typically no other significant sources of supply to Mendota Pool, making the Mendota Pool diversions a reasonable approximation of DMC deliveries.

The estimates of potential unused DMC capacity for Aquaterra Groundwater Bank recharge have been made based on a conservative analysis of historical use of the lower DMC. As other programs are developed for water management programs involving the lower DMC, these programs could theoretically impact available capacity for recharge to Aquaterra. As described below, very conservative assumptions were made for the level of use of the lower DMC that would ensure that additional capacity is available for Aquaterra recharge operations. Since the Aquaterra recharge operations were evaluated based on restrictive estimates of lower DMC available capacity, these estimates allow for potential additional use by other agencies for new or developing water management programs such as recharge to other areas adjacent to the Mendota Pool (such

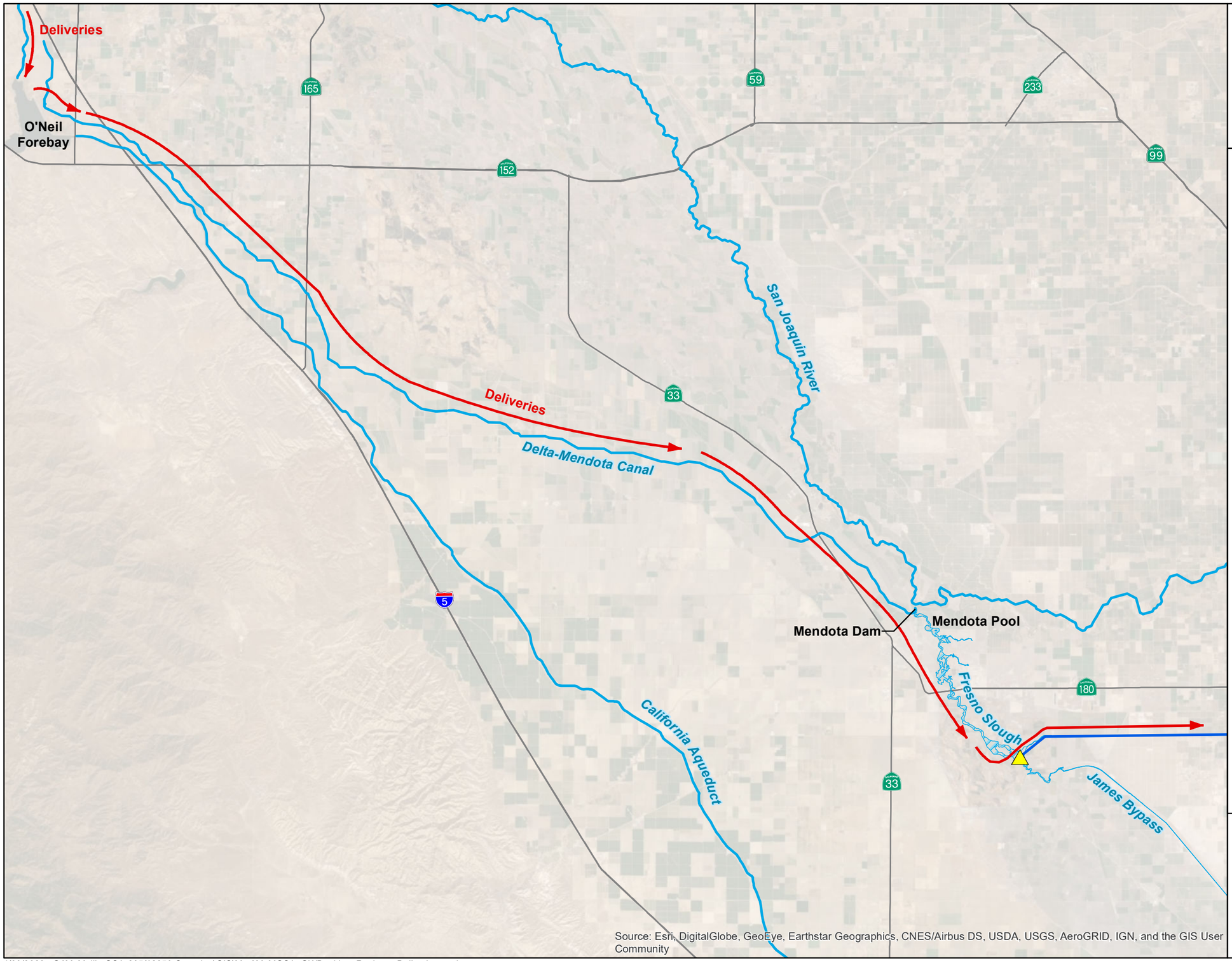
as areas in the Delta-Mendota or Madera Subbasins). The only known water management program involving the DMC is the North Valley Regional Recycling Program (NVRRP), which uses capacity in the upper portion of the DMC located upstream of San Luis Reservoir. This program is relatively small in scale and would not be expected to restrict Aquaterra recharge operations since the Aquaterra Groundwater Bank has been developed based on availability of allocated SWP or CVP water supplies, which would not be constrained by the NVRRP.

While the conservative assumptions for recharge conveyance availability are used for purposes of facility design and operations planning, available conveyance capacity would frequently be available in most non-peak irrigation months (June through August). In actual operation, Aquaterra recharge operations would normally be possible much more frequently than in the restrictive six-month period described below.

McMullin Area GSA
Recharge Deliveries

Recharge Deliveries

Figure 3-1



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- Recharge
- Waterways
- Highway
- Jensen-Pump Station Conveyance
- Pump Station

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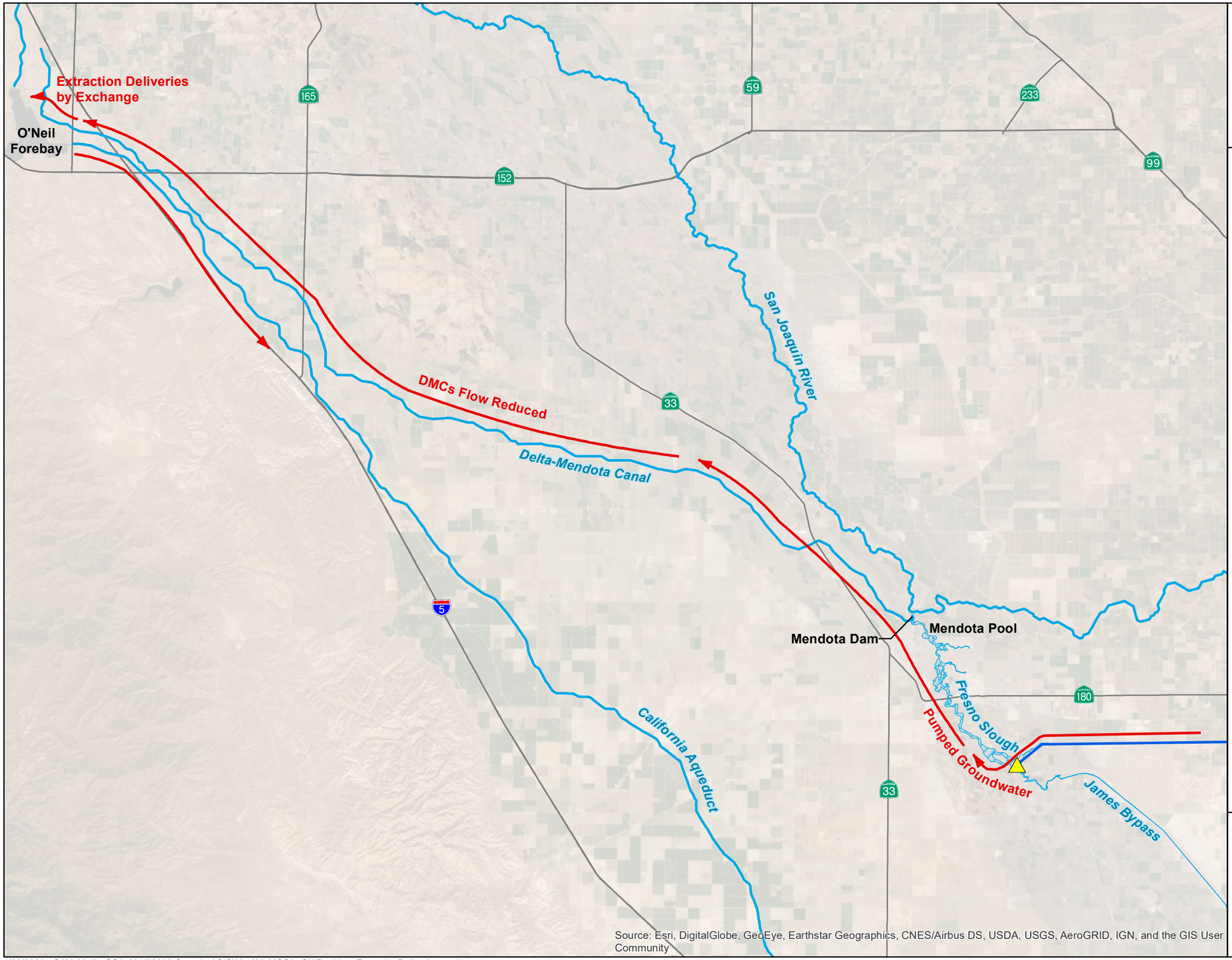
McMullin Area GSA
Extraction Facilities

Extraction Deliveries

Figure 3-2



- Flow Direction
- Waterways
- Highway
- Jensen-Pump Station Conveyance
- Pump Station

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Mendota Pool diversions over the 1980-2018 period are summarized in **Figure 3-3**. This figure shows the maximum, minimum, and average monthly diversions for the 1980-2018 period. As represented in the figure, the peak monthly diversion over this period was 179,449 AF in July 2006, which is equivalent to a flow rate of 2,918 cfs. As noted earlier, there has been some subsidence in the lower DMC in recent years, with some reduction in capacity expected. As a more conservative assumption of available capacity in recent years, diversions during the month of August 2018 were used, during a period with sole reliance on DMC deliveries to Mendota Pool diversions. The diversions during July 2018 totaled 140,741 AF, which is equivalent to a flow rate of 2,289 cfs. Using this flow rate, the minimum available capacity available for DMC additional deliveries to Aquaterra Groundwater Bank was computed as the difference between 2,289 cfs and the maximum historical monthly deliveries. This is considered to be a conservative estimate of DMC capacity available for conveyance of recharge supplies to Aquaterra Groundwater Bank. As described below, a refined estimate was developed using a 90-percentile estimate of maximum baseline DMC delivery use. It may be appropriate to refine the estimate of actual and estimated DMC capacity into the Mendota Pool based on current operational experience and potential future subsidence through discussions with the San Luis & Delta-Mendota Water Authority, which operates the DMC.

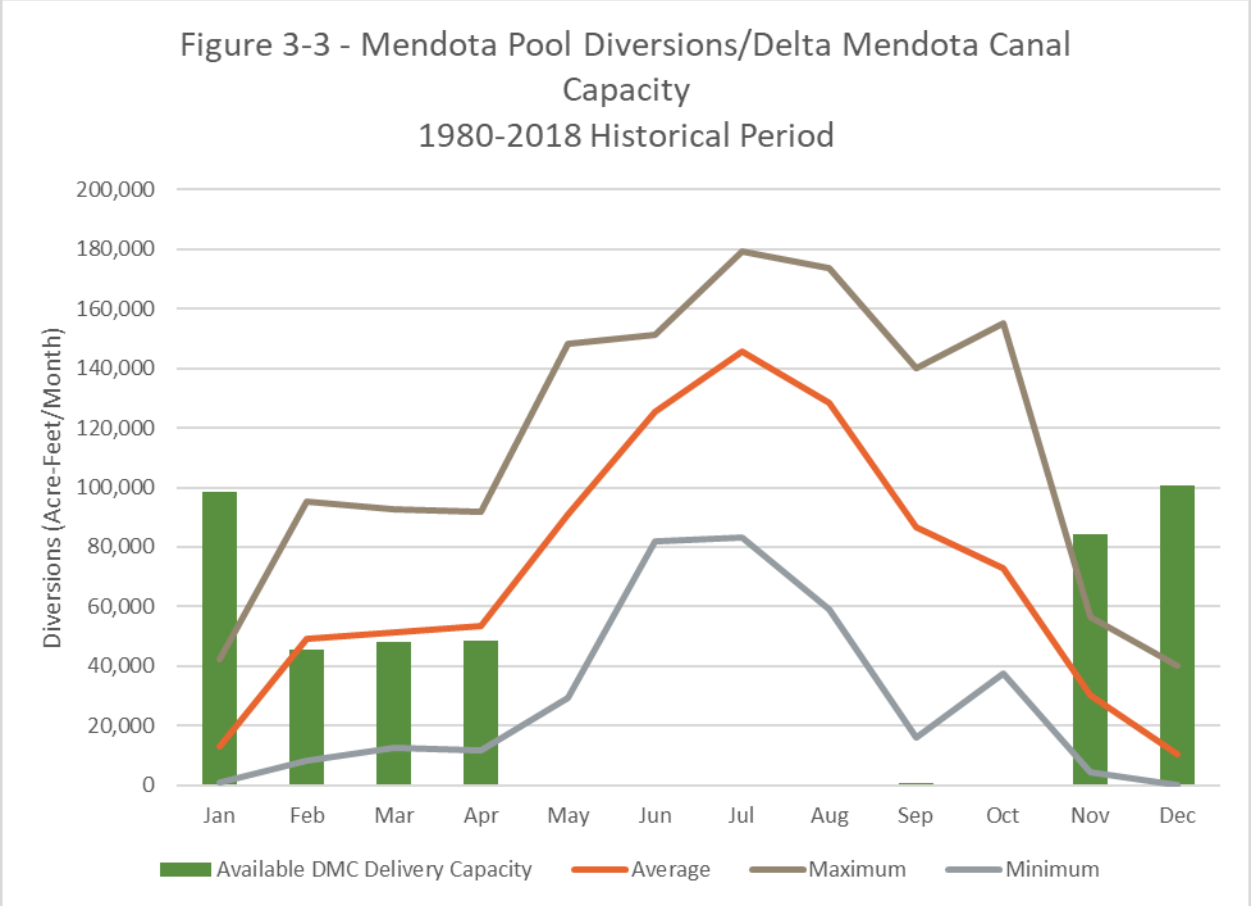


Figure 3-3 Mendota Pool Diversions/Delta-Mendota Canal Capacity

As shown in **Figure 3-3**, there is capacity available in the DMC for recharge for more than 40,000 AF per month for six months of the year based on the maximum historical use of the DMC. This is likely an overly conservative estimate of available capacity due to extreme anomalies that occasionally occurred in various months in the historical record.

Figure 3-4 shows a somewhat less extreme, but still very conservative approach to capacity which will be used for project definition. **Figure 3-4** shows the 10-percentile wettest monthly diversions (rather than absolute maximum values) and the 90-percentile driest monthly diversions (rather than the absolute minimum values.) The remaining DMC capacity at the 10-percentile wettest monthly conditions is also shown, as compared to the assumed DMC capacity (actual July 2018 diversions). Based on the 10-percentile wet conditions, this figure shows that there is a minimum of 40,000 acre-feet of recharge conveyance capacity available for seven months (October through April). This figure also shows no recharge conveyance capacity available for the three summer peak irrigation months of June through August. There are moderate, but limited, amounts of recharge conveyance capacity available in May and September.

The CALSIM projections of DMC deliveries to Mendota Pool for 1922 through 2003 corroborate the estimates of available conveyance identified above based on Mendota Pool Deliveries. The DMC deliveries shown in Table 3-1 are no higher than 1,265 cfs for the period October through April, which results in available lower DMC recharge conveyance capability of no less than 1,000 cfs for the proposed recharge period (2,289 cfs less 1,265 cfs), which is well above the 40,000 acre-feet available recharge conveyance capacity identified based on the Mendota Pool diversion data.

In addition to identifying capacity available for recharge through the lower DMC, the analysis above also indicates periods when recharge capacity would be available for local water users for surplus flows on the San Joaquin and Kings River. This analysis indicates that the months of June through August would be a period when allocated imported water would generally not be conveyed through the lower DMC. Because of the limited available lower DMC capacity during the June through August period, Aquaterra recharge capacity during those periods would be available for local San Joaquin River and Kings River flows.

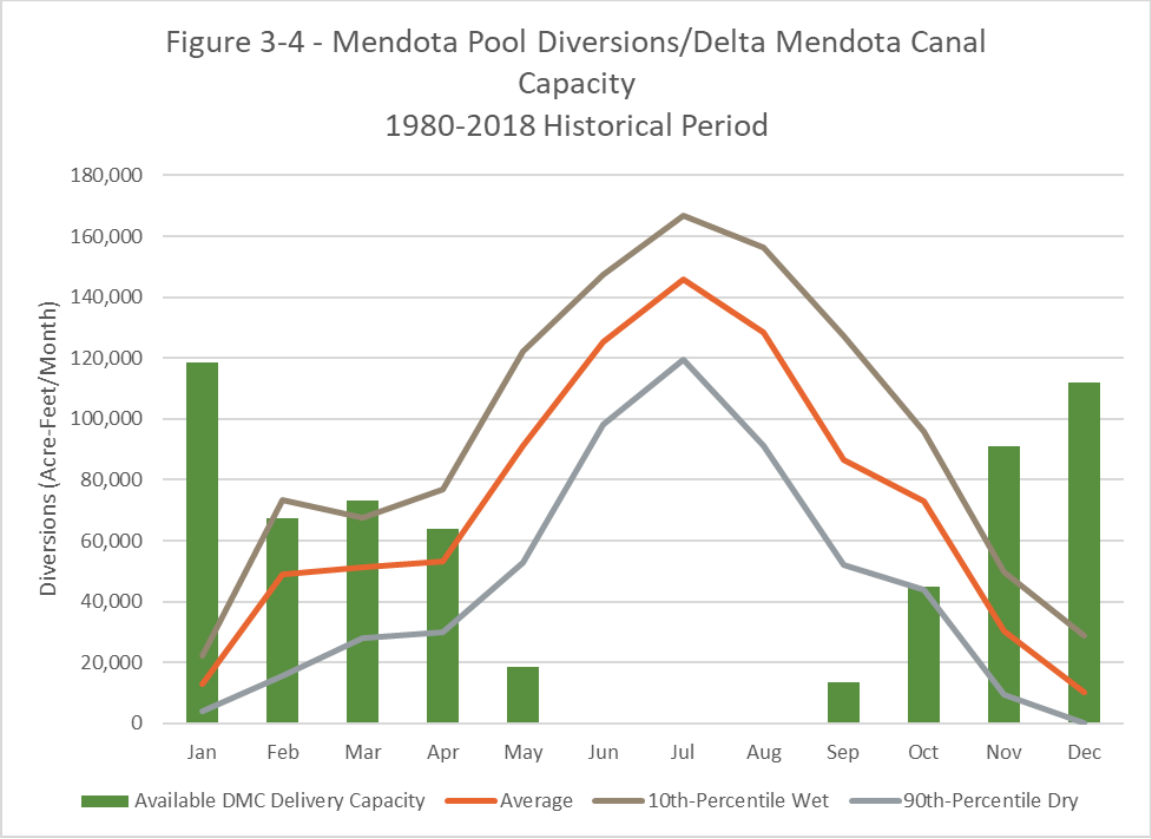


Figure 3-4 Mendota Pool Diversions/Delta-Mendota Canal Capacity- Historical Period

During extraction operations, Aquaterra pumping would return groundwater to the Mendota Pool where it would need to be exchanged for lower DMC deliveries, which would return water to O'Neill Reservoir and the California Aqueduct. The limiting factors for these extraction exchanges is the amount of DMC deliveries to the Mendota Pool. While Aquaterra recharge would rely on unused DMC capacity (primarily in non-irrigation months), exchanges of extracted Aquaterra groundwater would rely on deliveries of CVP water through the lower DMC to Mendota Pool waters users. The potential extraction conveyance capacity is interpreted from this figure as the 90-percentile driest delivery amounts. This would represent the amounts of DMC water delivered to the Mendota Pool during the 90-percentile conditions and would be an upper limit to the amount of potential Aquaterra Groundwater Bank extractions that could be delivered by exchange back to San Luis Reservoir or the California Aqueduct. This figure indicates that monthly extractions of up to 40,000 acre-feet per month (approximately 667 cfs) could potentially be pumped into Mendota Pool for five months (May through September). The ability to exchange for Aquaterra extractions is supported by the CALSIM projections in Table 3-1, which indicate that projected DMC deliveries to the Mendota Pool during Aquaterra extraction years (normally Dry and Critical Years) fall no lower than 1,298 cfs during the proposed five-month extraction period (May through September.) Extractions during other months would be more limited. In practice, there are potential water quality blending restrictions that might also limit the potential conveyance (by exchange) of extractions in dry years, which are discussed later.

While the CALSIM projections and Mendota Pool diversion data indicate that there would be adequate DMC deliveries to the Mendota Pool to support exchanges of Aquaterra extractions, estimates of the extreme dry conditions for recent actual years indicate that there could be some additional constraints that may affect potential exchanges. As shown in **Table 3-2**, computed DMC deliveries to Mendota Pool during 2014, 2015 and 2021 were lower than projected by CALSIM or experienced in prior dry years. The outlined periods indicate when Aquaterra Groundwater Bank extractions would have been likely. Based on this review of recent operations, there would have been five months during 2014 and 2015 when actual DMC deliveries to the Mendota Pool dropped below the 40,000 acre-feet per month target extraction exchange capacity. Based on the recent 2014-2015 period, it appears that the Aquaterra extraction period might need to be extended to earlier or later in the season, when DMC water is being delivered that could be exchanged. Additionally, extraction exchanges of a high proportion of the DMC flows could be a concern for Mendota Pool divertors which could have water quality concerns that need to be addressed. Finally, potential options for physical return of some portion of Aquaterra extractions could be explored by MAGSA together with project participants to provide a higher level of assurance that dry year extractions can be exchanged back to the California Aqueduct.

Table 3-2 Computed DMC Inflows to Mendota Pool

Computed DMC Inflow to Mendota Pool
Delta Mendota Canal
(acre-feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2014	6,040	24,125	12,128	25,944	46,814	33,840	51,813	38,724	19,661	68,907	50,310	242,157	620,463
2015	6,770	40,000	26,839	19,570	38,859	88,256	75,053	17,564	41,888	55,246	32,226	23,077	465,348
2016	4,498	35,321	33,958	37,845	74,954	126,365	121,375	89,828	80,817	67,469	29,340	1,348	703,118
2017	3,608	6,547	3,347	3,249	10,004	12,955	84,220	131,976	97,312	84,370	45,522	34,076	517,186
2018	22,732	72,466	19,034	26,199	56,767	110,966	145,932	117,790	85,262	76,092	48,746	13,355	795,341
2019	13,783	23,019	23,670	57,844	44,843	29,783	124,202	139,040	28,506	80,333	59,135	20,201	644,359
2020	23,330	68,396	32,218	33,355	70,146	114,868	127,916	111,602	85,348	80,631	44,888	20,996	813,694
2021	8,507	24,315	26,552	36,089	67,109	87,912	104,328	75,399	47,428	0	0	0	477,639

Potential Aquaterra Extraction Period
Potential Aquaterra Extraction Period with low DMC inflows

The potential recharge and extraction conveyance capacities identified above were used as the basis for developing the Aquaterra Groundwater Bank operations. The capacities described above were used as constraints on potential conveyance in evaluating project operations.

Banking Operations and Project Yield

As described previously, the Aquaterra Groundwater Bank could be available for use by a wide variety of potential water agencies, subject to provisions that are defined in banking program framework agreements. In the analysis presented here, potential needs for possible SWP contractor participants have been used as the basis for identifying program design capacities. The use of SWP contractors as target Water Bank participants is for purposes of defining potential project facility capacities and does not preclude other water agency groups from participating in the Aquaterra Groundwater Bank. Because potential Aquaterra Groundwater Bank project participants are expected to have major water supply sources from Central Valley Watersheds (e.g., SWP, Central Valley Project Export Contractors, San Joaquin Valley Water Users), their general water supply needs are expected to be similar to the needs of SWP contractors. In great part, they have the same patterns of dry water supply periods and wet water supply periods, although the specific quantities are likely to differ. The project operations described here are a first level analysis and will be refined in the future as specific water users are identified for potential project participation. A detailed summary of the analysis of water needs for potential project participants is presented in **Appendix D**.

Table 3-3 shows assumed water bank operations for Aquaterra Groundwater Bank participants for purposes of facility design and cost estimation. This shows total project storage of 800,000 acre-feet, with recharge rates of 770 cfs (about 45,800 acre-feet per month) and extraction rates of 480 cfs (about 28,600 acre-feet per month).

Table 3-3 Aquaterra Groundwater Bank Program Characteristics

	Design Characteristics
Recharge	
Capacity (cfs)	770
Monthly Recharge (TAF)	45.8
Extraction	
Capacity (cfs)**	480
Monthly Extraction (TAF)	28.6
Maximum Storage (TAF)	800

*Only water that has been recharged may be extracted.

As described in the later discussion of facility configuration, one or more new conveyance facilities would be built from Mendota Pool to identified recharge basin locations, which would have a total capacity of 770 cfs. Recharge basins would be identified based on the 770 cfs design recharge rate. Groundwater pumps would be located, and their costs estimated for 480 cfs. The recharge conveyance facilities would be used to return extractions back to the Fresno Slough arm of Mendota Pool for exchange with DMC flows.

Assumed annual recharge operations for the Aquaterra Groundwater Bank are shown in **Figure 3-5**. This figure, based on typical Delta export water supply availability, shows that two different periods of recharge are possible in years when water is available: February-March for Temporary Water (SWP Article 21 Water, CVP Section 215 Water and Carryover Water from both SWP and CVP) and October-December for allocated SWP and CVP water that exceeds annual demands needs for participants. These two periods were selected as a very conservative potential operation based on a very wet flow scenario on the DMC. In actual operation, it would frequently be possible to recharge for extended periods based on actual unused capacity in the lower DMC.

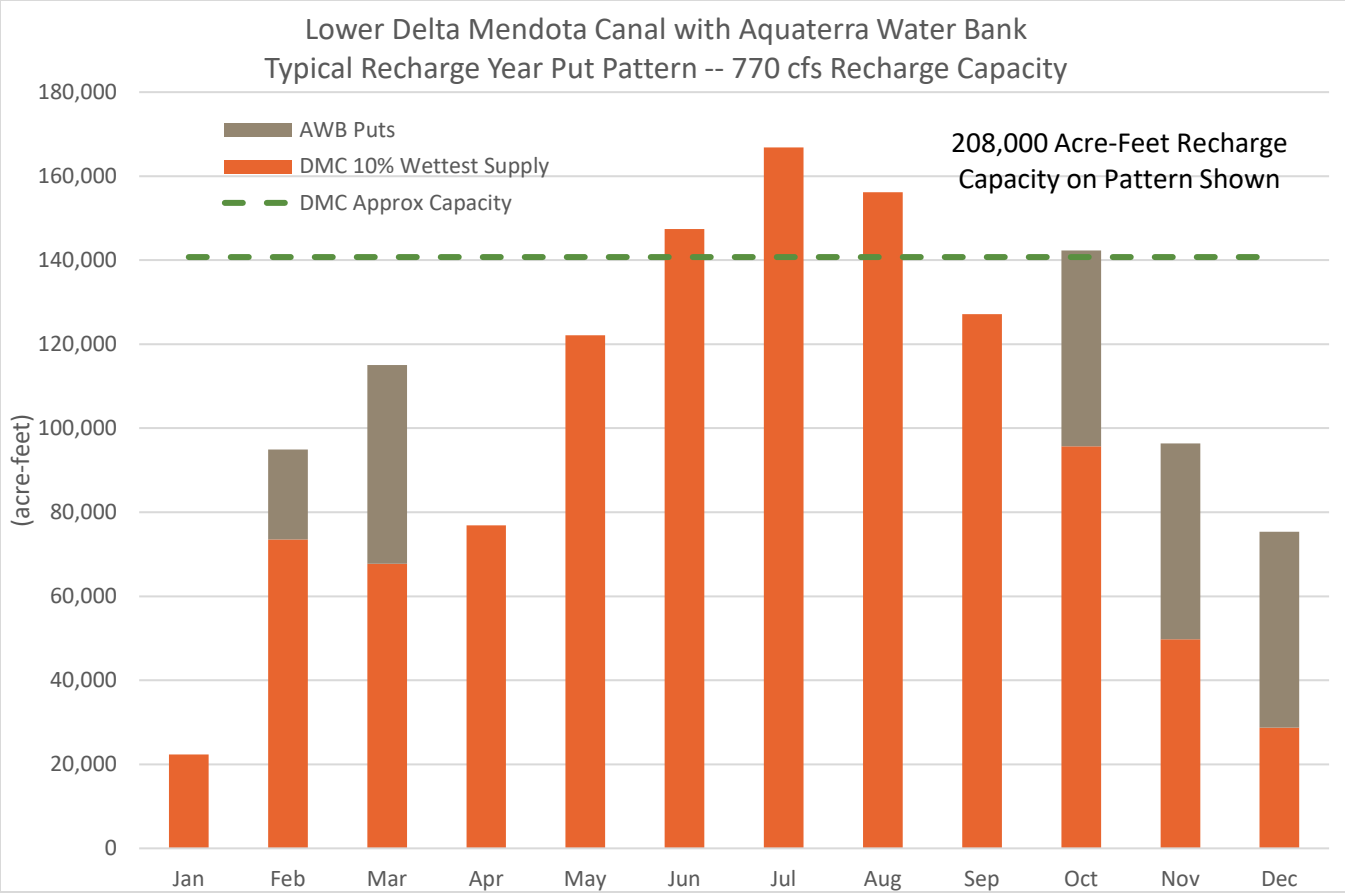


Figure 3-5 Lower Delta-Mendota Canal with Aquaterra Groundwater Bank Typical Recharge Year Put Pattern

Extraction operations for the Aquaterra Groundwater Bank for a typical drought year are shown in **Figure 3-6** for project participants. This shows pumping of 28,600 acre-feet per month for the period May through September, with total pumping for the year of 146,000 acre-feet. **Figure 3-6** compares the amount of extractions to lower DMC deliveries in dry years (using 90th percentile as criteria for dry conditions), which would be the maximum amounts that could physically be extracted while providing the ability to exchange with DMC flows upstream at O'Neill Forebay. As with recharge, this is a generally conservative proposed operation and, in actual operation, extractions could frequently be started earlier in the year than April and extended later in the year past September to provide increased extractions. If greater annual extractions were required, additional pumping capacity could also be added during the peak DMC flow months of June through August. As noted in the discussion of water quality below, there may be additional restrictions due to salinity based on sensitivity to water quality of existing Mendota Pool water users.

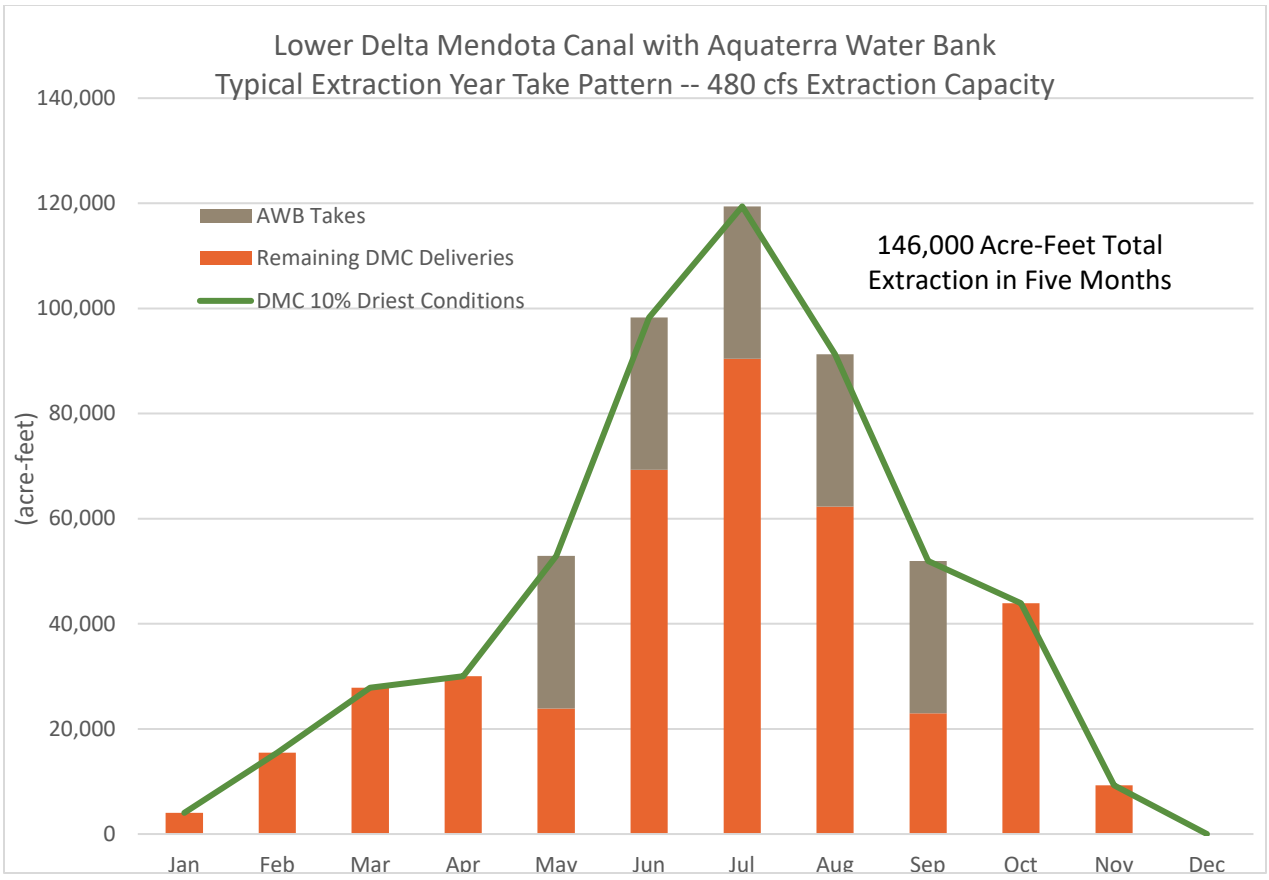


Figure 3-6 Lower Delta-Mendota Canal with Aquaterra Groundwater Bank Typical Extraction Year Take Pattern

The typical recharge and extraction operations presented in this chapter are for the purposes of identifying design capacities for facilities. Depending on the operational needs of individual water bank participants, other project recharge or extraction capacities could be more optimal than the design capacities identified here, and the project could be modified as appropriate. In general, the design assumptions made here are expected to be very conservative estimates of the capacity needed, and any refinement of those capacities is expected to result in reduced construction costs, for example from a smaller acreage of recharge basins.

3.2 Water Quality

Planning for the Aquaterra Groundwater Bank requires consideration of groundwater quality for both recharge and extraction operations.

3.2.1 Exchange and/or Recharge Surface Water Quality

For recharge operations, water quality information was retrieved from the California Data Exchange Center for Station DM3, located at Check 21 on the Delta-Mendota Canal. This location is near the Delta-Mendota Canal's discharge to Mendota Pool and is an appropriate representation of the quality of water that would be available for recharge or would be exchanged through extractions. The values were downloaded as daily values and averaged for monthly and annual amounts, with interpolation to fill-in missing data and corrections for occasional anomalous data values.

Figure 3-7 shows average concentrations of Electrical Conductivity (microsiemens, µ-siemens) for each year from 2000 through 2019. This figure also shows approximate TDS (milligrams per liter, mg/L) values, which were estimated using an approximate conversion factor from EC of 0.64. For the 20-year 2000-2019 period, EC at Check 21 averaged 512 µ-siemens and TDS averaged ~326 mg/L. Average EC during Wet and Above Normal years during proposed recharge periods (February through March and September through December) when recharge would be anticipated was 446 which is roughly equivalent to a TDS of ~285 mg/L. Average EC during proposed extraction periods (May through September) of Dry and Critical years, when extractions would generally occur, was somewhat higher than the average at 574 µ-siemens which is equivalent to a TDS value of ~368 mg/L.

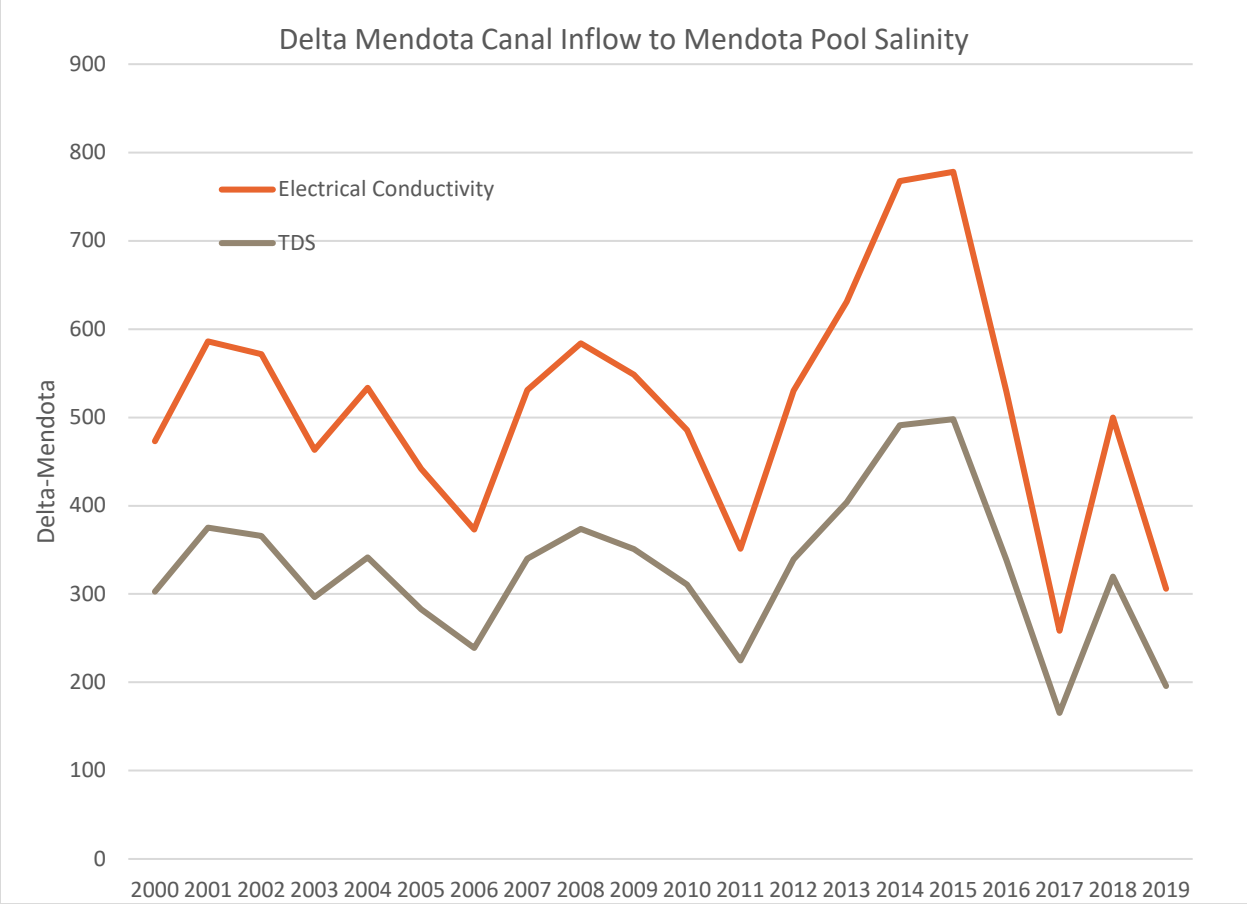


Figure 3-7 Delta-Mendota Canal Inflow to Mendota Pool Salinity

3.2.2 Groundwater Quality

To anticipate water quality from recovery wells for water banking operations, **Figure 3-8** shows TDS measurements from wells within MAGSA. This figure provides a general indication of likely salinity levels. There are limited measurements of TDS available, and these measurements represent a variety of wells – unconfined, confined and composite – that were sampled over a wide range of years. Based on the prior investigations, groundwater quality varies significantly by aquifer zone, geographic location and by time period.

Areas of existing poor groundwater quality that could negatively impact the quality of extracted recharge water were mapped based on available data. As shown in **Figure 3-8,** groundwater quality relative to Total Dissolved Solids (TDS) within the MAGSA was mapped from historically available Groundwater Ambient Monitoring & Assessment Program (GAMA) data and from a 2010 AB303 Study conducted in the areas around the James Irrigation District (JID) well field located within MAGSA.

USGS studies of San Joaquin Valley Groundwater (Page and LeBlanc, 1969) described groundwater water quality based on sampling in the 1950s and 1960s. Their study identified several geochemical types in the MAGSA. The northwestern portion of MAGSA, located outside areas proposed for recharge or extraction, had sodium chloride type water. This water type is typical of portions of the westside of the San Joaquin Valley and adjacent basin areas, which have a high proportion of sediments derived from the Coastal Range. Groundwater quality in this area (in addition to the localized areas affected by the Raisin City Oilfield and the

American Avenue landfill) generally has higher salinity than the rest of MAGSA, with TDS values often exceeding 500 mg/L. The bulk of MAGSA, including areas proposed for recharge and extraction, have groundwater quality types such as sodium bicarbonate, sodium calcium bicarbonate, and calcium sodium bicarbonate that generally are associated with sediments primarily from the Sierra Nevada. Groundwater quality in this recharge and recovery zone of MAGSA has historically had lower TDS values, with widespread occurrence of TDS values of 300 mg/L or less.

Figure 3-8 includes the American Avenue Landfill and the Raisin City Oil Field where groundwater quality issues are known to exist in MAGSA. The Raisin City Oilfield (located primarily in Township 15S/Range 17E) overlies areas of higher salinity. Historic oilfield extractions and disposal of excess brines on the land appear to have degraded local groundwater quality in the vicinity of the oilfield. As an example, Well T15S/R17E-10R1M, located adjacent to the oilfield, had TDS increase from 336 mg/L in 1953, to 1,310 mg/L in 1959, with a corresponding increase in proportions of sodium and chloride. Measurements of oilfield brine in the Raisin City Oilfield show TDS values of 27,000 mg/L. Discharges of oilfield brine have been regulated in recent decades[1], but historic areas of high salinity groundwater appear to remain in areas near the Raisin City Oilfield. Proposed water banking recharge and extractions operations are being located upgradient from the oilfield to reduce the potential adverse salinity impacts.

For potential banking operations, additional groundwater quality review was conducted on proposed recharge and recovery areas, identified as areas 1 through 5 in **Figure 3-8**. The more detailed review focuses on the area of MAGSA east of the Raisin City Oilfield and south of Highway 180 (Whitesbridge Road). Additional water quality sampling in this area was conducted for a limited suite of compounds (including TDS, cations and anions) in November and December 2020 (**Figure 3-8**).

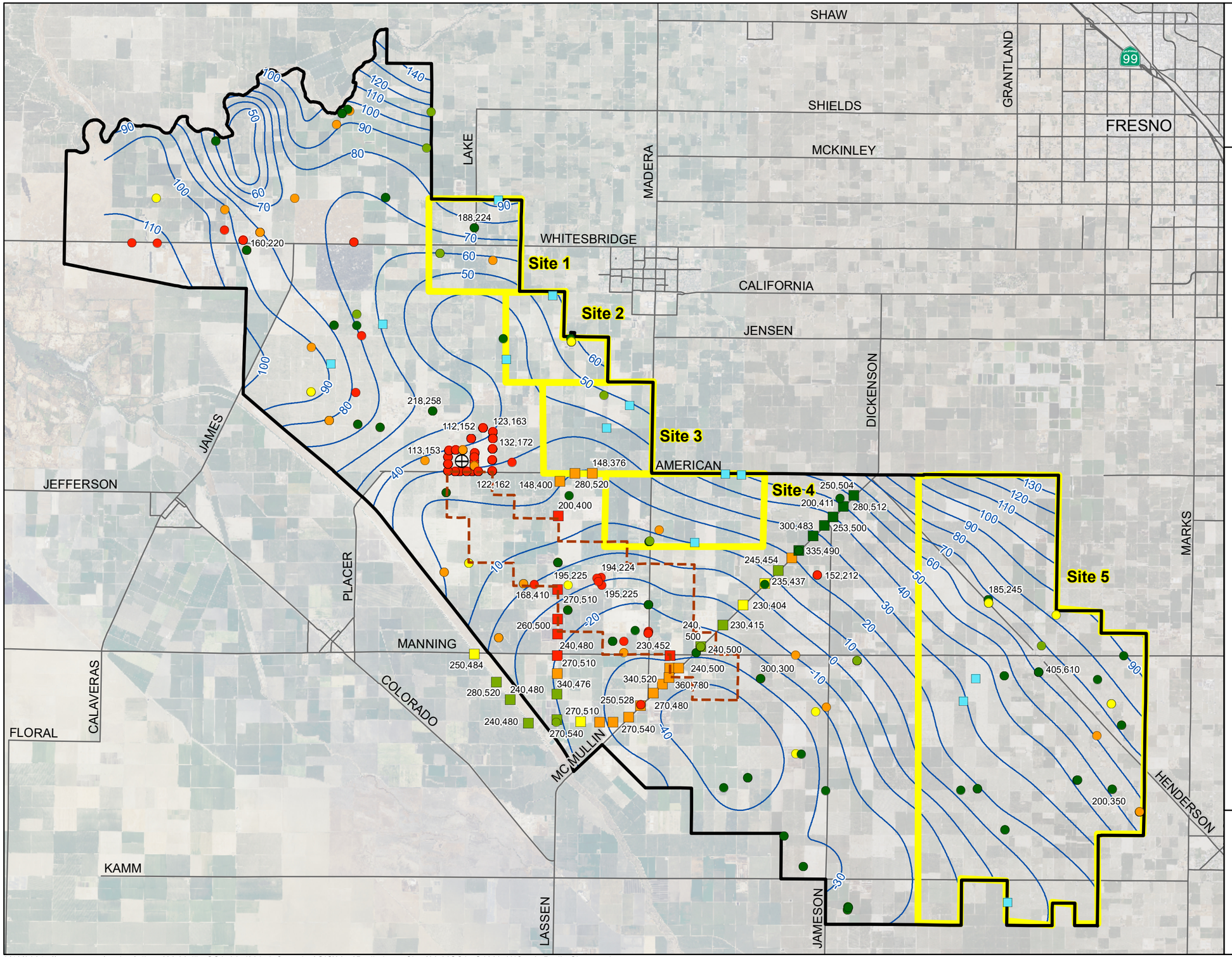
[1] https://geotracker.waterboards.ca.gov/profile_report?global_id=T10000006602

McMullin Area GSA

Historical Total Dissolved Solids Concentrations

Preliminary Sites

Figure 3-8



- McMullin Area
- Recharge Site
- Raisin City Oil Field
- Water Quality Sample Location
- American Avenue
- Water Surface Elevation, Spring 2016 (10ft interval)

Historical Concentration of TDS (MCL = 1,000 mg/L)*

- Detections between 0-299
- Detections between 300-399
- Detections between 400-499
- Detections between 500-999
- Detections between 1,000-11,200

James I.D. Production and Monitoring Wells 1977-2009 TDS (MCL = 1,000 mg/L)**

- Detections between 0-299
- Detections between 300-399
- Detections between 400-499
- Detections between 500-999
- Detections between 1,000-1,907

*SWRCB - GAMA Water Quality Data
Wells labeled with Top and Bottom of Perforation

** Wells labeled with Top and Bottom of Peforation

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Table 3-4 summarizes TDS and mineral concentrations for sampled groundwater wells in the extraction area. This table includes a variety of groundwater quality measurements including the earlier 1950s and 1960s measurements and more recent groundwater quality sampling from recent decades. These measurements were also evaluated for geochemical characteristics to identify potential causes of groundwater quality trends.

The more recent groundwater quality measurements indicate generally higher salinities in the recharge/ extraction area. Where groundwater salinities in the 1950s and 1960s were typically below 300 mg/L in much of MAGSA, the newer sampling shows higher salinity values, with TDS (salinity) values averaging about 540 mg/L. The new sampling also shows a wide range of variation in salinities, ranging from 111 to 978 mg/L TDS in the potential recharge/recovery area. The sampling revealed large local variations in salinity that did not appear in a systematic pattern and could be related to the source aquifer and well construction. Of the recently sampled wells with construction information, the wells were equally split between unconfined and composite wells. As one example, two wells sampled in Recharge Area 5 had TDS values ranging from 240 at Site 10 to 556 mg/L at Site 11 which are located within a half mile of each other. For these two wells, the 556 mg/L value was in an unconfined well while the 240 mg/L value was in a composite well. There is no obvious reason why the unconfined water quality in that area should be better than confined water quality that would be picked up by the composite well.

The wells tabulated in **Table 3-4** were summarized for geochemical characteristics using a piper diagram (shown as **Figure 3-9**), which shows the relative proportion of major cations and anions. The purpose of this effort was to identify groundwater quality trends and their possible causes. Characteristics were looked at, such as date of the water quality sampling, location, well depth, and total TDS, for possible relationships with salinity.

Table 3-4 MAGSA Water Bank Recharge/Extraction Area Representative Groundwater Chemical Analyses

MAGSA Water Bank Recharge/Extraction Area Representative Groundwater Chemical Analyses

Well Label	Group	Date	Calcium mg/L	Magnesium mg/L	Sodium mg/L	Potassium mg/L	BiCarbonate mg/L	Sufate mg/L	Chloride mg/L	Fluoride mg/L	Total Dissolved Solids mg/L
USGS-363255119550301	GAMA	14-Aug-63	24	1.3	23	3.2	98	11	16	0.1	166
USGS-363317119515001	GAMA	1-Sep-93	110	9.4	94	4.8	248	90	130	0	1294
USGS-363342119554301	GAMA	4-Jun-64	35	3.8	27	4.6	98	19	40		416
USGS-363353119532001	GAMA	29-Aug-63	47	4.1	35	3.9	120	24	50	0.1	277
USGS-363457119521701	GAMA	12-Aug-63	68	8.4	100	5.7	250	59	92	0.1	538
USGS-363500120000001	GAMA	12-Sep-13	84.1	6.19	86.9	13.7	175	58.9	139	0.08	610
USGS-363522119523201	GAMA	8-Jul-87	61	7.3	74	9.5	240	55	62	0	471
USGS-363553119550601	GAMA	8-Jul-87	68	14	55	11	222	35	81	0.1	463
USGS-363638120033801	GAMA	17-Dec-65	1400	110	1300	55	120	4.1	4800		16580
USGS-363700119550001	GAMA	29-Aug-13	121	33.4	92.4	16.3	496	62.2	96	0.03	621
USGS-363700119550002	GAMA	18-Sep-13	101	14.4	62.8	16.6	312	42.2	83.3	0.08	478
USGS-363700119590001	GAMA	18-Sep-13	297	88.7	62.8	18.9	381	199	465	0	1420
USGS-363711120033801	GAMA	30-Jul-58	15	3	53	6.3	130	4.8	39	0.2	264
USGS-363711120033801	GAMA	13-Jul-59	36	7	65	6.8	130	4.4	100	0.3	364
USGS-363711120033801	GAMA	19-Jul-60	84	16	83	12	130	2.3	250	0.3	586
USGS-363824120033801	GAMA	19-Jul-60	38	19	38	7.6	140	27	80	0.2	373
JID/C-58	AB303	28-Jun-10	106	17	96	16	300	74	136	0	771
JID/C-60	AB303	28-Jun-10	127	31	87	14	270	89	214	0.2	850
JID/C-71	AB303	30-Jun-10	46	4	111	12	220	57	90	0.1	558
JID/C-72	AB303	30-Jun-10	54	7	101	11	240	51	84	0.1	563
JID/C-80	AB303	30-Jun-10	34	10	42	4	190	16	27	0.1	342
JID/C-88	AB303	30-Jun-10	40	7	64	5	190	20	66	0.2	399
JID/D-51	AB303	30-Jun-10	26	2	102	9	170	28	77	0.2	428
JID/D-57	AB303	28-Jun-10	10	0	196	3	220	11	158	0.5	598
15S17E12J001M	Page	19-Jul-60	38	19	38	7.6	142	27	80	0.2	373
15S19E15C001M	Page	14-Aug-63	78	21	50	13	331	32	56	0.1	499
15S19E35L001M	Page	12-Aug-63	68	8.4	103	5.7	246	59	92	0.1	538
16S19E05P001M	Page	4-Jun-64	35	3.8	27	4.6	98	19	40		238
16S19E07E001M	Page	27-May-54		6.7		1.8		20	36		
Site #1	MAGSA	19-Nov-20	83	12	55	10	330	79.7	18	<0.1	595
Site #2	MAGSA	19-Nov-20	138	34	76	14	430	127	95	<0.1	978
Site #5	MAGSA	8-Dec-20	86	6	106	15	160	107	195	<0.1	675
Site #6	MAGSA	19-Nov-20	6	<1	50	1	130	9.8	15	0.2	213
Site #7	MAGSA	19-Nov-20	39	4	85	8	200	34.3	74	0.2	454
Site #8	MAGSA	8-Dec-20	79	16	59	13	330	32.8	35	<0.1	590
Site #9	MAGSA	8-Dec-20	92	6	116	12	360	62.5	102	<0.1	836
Site #10	MAGSA	19-Nov-20	14	<1	47	5	130	10.7	20	0.1	240
Site #11	MAGSA	8-Dec-20	75	11	61	14	190	49.7	108	<0.1	556
Site #12	MAGSA	19-Nov-20	2	<1	37	<1	60	3.8	8	0.3	111

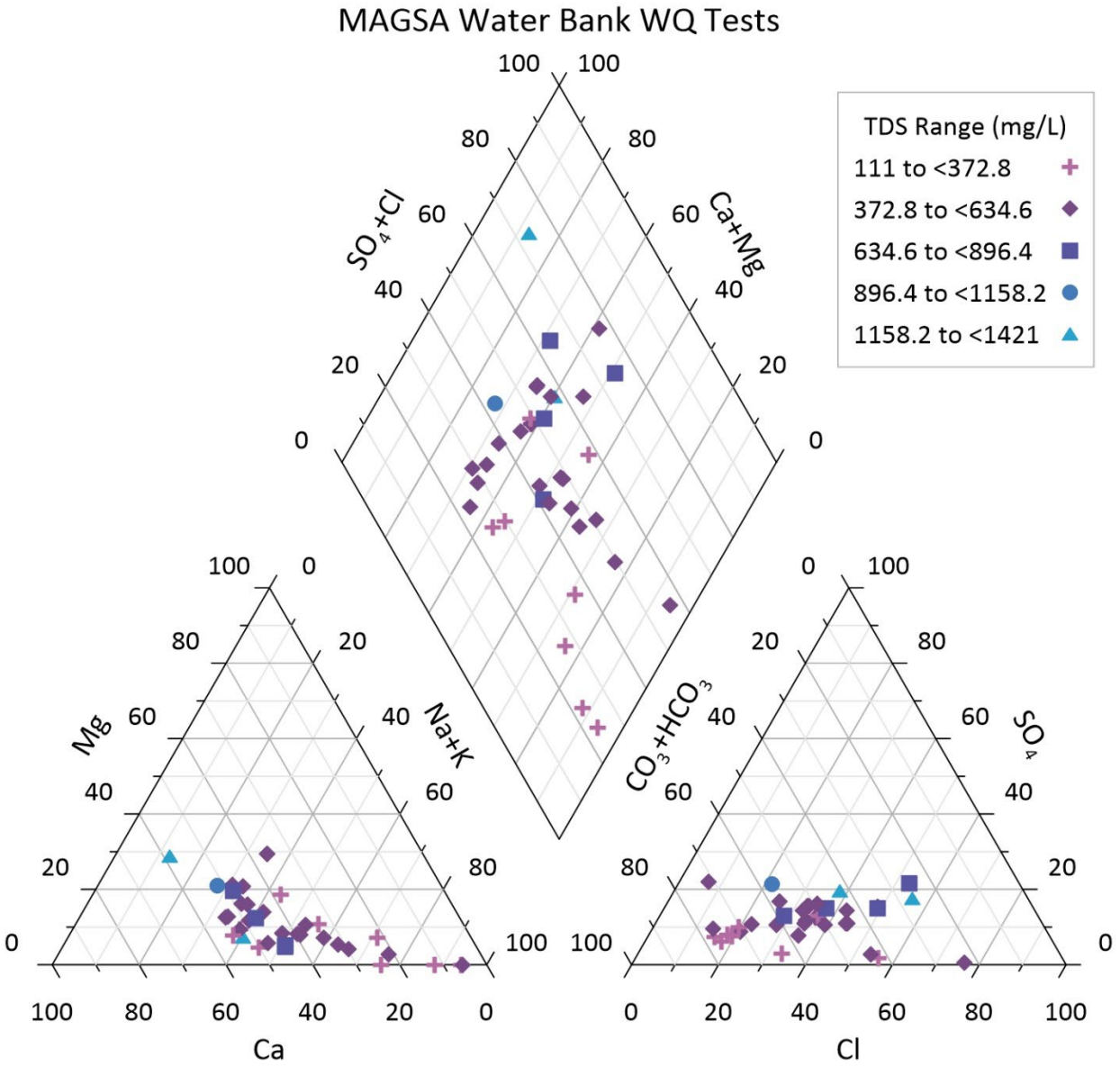


Figure 3-9 MAGSA Water Bank WQ Tests

No clear trends emerged from the geochemical analysis. The lower TDS samples (shown as a small cross) tended to have higher percentages of bicarbonate and sodium. The lower TDS samples also were more likely to be from older groundwater quality samples, which tended to be shallow wells. In the anions, there may be a trend towards lower chloride concentrations with lower TDS. The lack of a trend may be a function of the large area being sampled and the wide range of depths and well types.

Based on the available groundwater quality data, it appears likely that the available groundwater quality (generally more than 500 mg/L) could have higher salinity than DMC inflows to Mendota Pool (generally less than 400 mg/L). The recently completed Mendota Pool Group Environmental Impact Statement/ Environmental Impact Report includes criteria for surface water quality that are expected to be comparable to those likely to be implemented for the Aquaterra Groundwater Bank. The criteria (**Table 3-5** and **Table 3-6,** taken from the Mendota Pool Group Final EIS/EIR) require that water quality in the Mendota Pool (at sampling point 9, on Fresno Slough south of Highway 180) be maintained at salinity levels that are less than

450 mg/L. These are also the water quality requirements for water returned to the Mendota Pool. While the average groundwater quality that has been characterized for the Aquaterra Groundwater Bank storage area (**Figure 3-8**) appears to average roughly 540 mg/L based on preliminary groundwater quality sampling, there are many areas with groundwater quality that is better than 450 mg/L. The Aquaterra Groundwater Bank will be able to preferentially extract groundwater with better water quality than the 450 mg/L target through locating wells in good groundwater quality areas. During project development, extraction wells would be preferentially located in areas of better water quality and during operations, the better-quality wells could be preferentially operated for extractions

Table 3-5 Surface Water Quality Thresholds (Metals)

Parameter	Maximum Concentration	Reference and Notes
Arsenic	10 µg/L[1]	Sacramento-San Joaquin Valley Basin Plan, CVRWQCB 2016a; criteria for Sacramento River and Delta. Dept. of Public Health Primary Maximum Contaminant Level (MCL).
Boron	800 µg/L[1]	Sacramento-San Joaquin Valley Basin Plan, CVRWQCB 2016a; criteria for San Joaquin River reach between Merced River and Vernalis.
Molybdenum	19 µg/L[1]	Sacramento-San Joaquin Valley Basin Plan, CVRWQCB 2016a; criteria for San Joaquin River reach between Sack Dam and Merced River. Beneficial Use Agricultural Water Quality, Ayers & Wescot 1985.
Selenium	2.0 µg/L[1]	Sacramento-San Joaquin Valley Basin Plan, CVRWQCB 2016a; criteria for San Joaquin River reach between Sack Dam and Merced River. Beneficial Use Agricultural Water Quality, Ayers & Wescot 1985.

Notes: Beneficial uses of California waters that may be protected against water quality degradation include domestic, municipal, agricultural, industrial, recreational, aesthetic enjoyment, preservation of fish and wildlife, and aquatic resources or preserves. Beneficial uses do not include all reasonable uses of water (i.e., wastewater disposal or dilution of salts; CVRWQCB 2016a).

[1] As the Basin Plans do not contain specific WQOs for the Mendota Pool or Fresno Slough, objectives that apply to nearby regions included within the Basin Plans are used. Thresholds for arsenic, boron, molybdenum and selenium concentrations are the same as thresholds for trace element concentrations in the 2004 Final EIS and are the WQOs listed in the Annual Reports. Reclamation's standard for selenium concentration in non-Project water introduced into federal facilities or for exchange is ≤ 2 ppb with no allowance for dilution. This criterion is based on the CVRWQCB's 1996 selenium objective of 2 ppb monthly average for Grasslands wetlands water supply channels.

Sources: CDFW 2011; California Toxics Rule; National Toxics Rule; CVRWQCB 2016a.

Table 3-6 Surface Water Quality Thresholds (Salinity)

Parameter	Maximum Concentration	Measurement Type
TDS	600 mg/L	Monthly (January – August; December)
	450 mg/L	Monthly (September – November)
	450 mg/L	Annual

Additionally, the water bank will seek to improve groundwater water quality with a variety of approaches. Recharge of surface water with relatively lower TDS should improve the groundwater quality in the unconfined aquifer. Over time, water quality in the unconfined aquifer may improve somewhat in quality to become comparable to the recharge water (which is estimated to have a TDS of about 285 mg/L). The volume of unconfined groundwater above the confining clay layer in the Aquaterra Groundwater Bank

storage area is estimated to be 2.2 million acre-feet based on 2016 groundwater levels, estimated specific yield values and the mapped elevation of the confining clay layer. Assuming 800,000 acre-feet of storage is added to the existing unconfined storage volume through the Aquaterra Groundwater Bank initial storage operations, the overall groundwater quality would improve from 540 mg/L to 476 mg/L.

In addition to the project benefits of lower recharge salinity from water bank operations, MAGSA plans to augment local water supply with other high quality surface water supplies. The addition of lower salinity recharge from water bank operations and other water supply actions will gradually improve local groundwater quality. In summary, it appears that MAGSA extractions can be provided at salinity levels that meet Mendota Pool beneficial uses as identified in the Mendota Pool Group EIR and that Aquaterra Groundwater Bank groundwater salinity will improve over time to levels that approach the extracted water quality targets. Aquaterra Groundwater Bank water quality is a topic that will be reviewed with regulatory agencies and water agencies that rely on water from Mendota Pool as the program is developed. It is expected that agreements will be developed, potentially with discharge requirements similar to the recently adopted Mendota Pool Group requirements, which would address salinity and water quality needs, and would include ongoing monitoring to document compliance.

4 Infrastructure Requirements

4.1 General Description

The Aquaterra Groundwater Bank infrastructure will consist of canal conveyance, pump stations, recharge basins, recovery wells, and monitoring wells. The project design analyzed is based on a 770 cfs flow into facility during maximum recharge operations, and 480 cfs of flow to the Mendota Pool during maximum recovery operations. **Figure 4-1** shows the overview layout of the Aquaterra Groundwater Bank facilities. During recharge operations, water will be initially pumped from the Fresno Slough into the Jensen Canal at the west end of the Jensen Canal and outside the wildlife refuge. The canal will follow Jensen Avenue to the eastern boundary of MAGSA and to the East-Side Canal. The East-Side Canal will generally follow the eastern MAGSA boundary north and south of Jensen Avenue to deliver water to the four recharge site locations. After the water has been recharged and an interested party is ready to recover water, recovery wells spread out among the basins will return water to the canal system. The canals will then return the water to the starting point at the Fresno Slough. The components of the Aquaterra Groundwater Bank infrastructure are discussed in the following sections. For concept designs, refer to **Appendix E** for Jensen Canal and **Appendix** for East-Side Canal.

4.2 Design Considerations

Conveyance

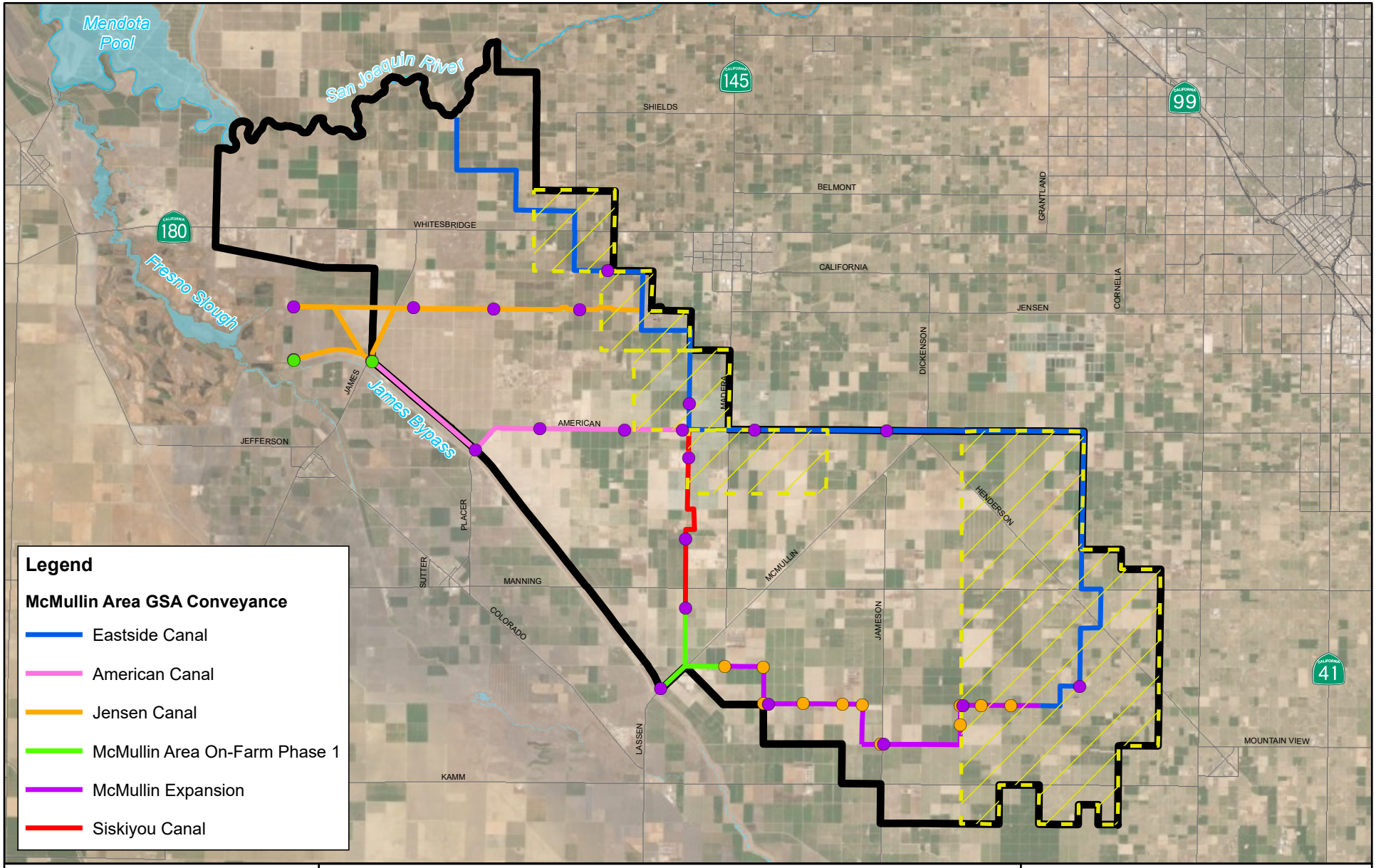
The canals will be designed to have 1.5:1 side slopes, 0.0001 hydraulic slope, 2 feet of freeboard, and 14 feet drive roads on both sides of the canal. The pump stations will consist of concrete pump structure and a combination of natural gas pumps due to the limited use and electrical pumps to meet air quality standards. The pump stations will be standardized for 13.5 feet of lift which provides MAGSA with simpler operations and maintenance and allows for the canal earthwork to be balanced without requiring large fills.

Recharge Sites

Recharge sites for the Aquaterra Groundwater Bank will be comprised of multiple basins broken down into cells that are on average 40-acres. The total area for recharge were estimated assuming the basins could recharge 0.5 acre-feet per day. It is assumed only 80% of the acreage would be utilized for active recharge with the remaining 20% of the area would be comprised of levees and drive roads. The basins will have minimum side slopes of 3:1 and have a minimum top width of 14 feet to accommodate a drive road for construction, operations and maintenance equipment.

Recovery Wells

Recovery wells will be located at the recharge basins to discharge water into the conveyance canal that would be used to send water back to the Fresno Slough and Mendota Pool. The recovered water will either discharge directly into the canal or be returned to canal by a return pipeline. The recovery wells will be spaced at least a quarter mile from each other and from landowner wells to minimize well interference. For the purposes of this study the recovery wells are assumed to produce 2,500 gpm (5.5 cfs) based on experience in other groundwater banks in the area. The well pumps will be driven with electric motors. It is important to note that the recovery wells are planned to be perforated and completed above the E-Clay in order to recover water from the same aquifer that receives the recharged water.



McMullin Area GSA

Groundwater Banking Conveyance

Figure 4-1

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Monitoring Wells

To track groundwater conditions during recharge and recovery operations, dedicated monitoring wells will be constructed at each of the recharge sites. Each recharge site will have about 10 shallow monitoring wells and 1 or 2 deep monitoring wells. The shallow monitoring wells will be around 100-200 feet deep and be a half a mile between the monitoring wells. In some instances where the basins are close together, there may be a quarter mile between monitoring wells. The deep monitoring wells will be around 500 feet deep with perforations from 200/300 feet to 500 feet depth. Generally, a deep monitoring well will be located next to one of the shallow monitoring wells.

4.3 Facilities

To convey water to and from the recharge facilities, approximately 72 miles of canal and 22 pump stations will be built. There will be three connections to the Mendota Pool. The first is a 400 cfs canal from the Mendota Pool along the Jensen Avenue alignment. The second is a 250 cfs connection near the existing Mid-Valley Water District pump station canal utilizing a pump station at Mid Valley Water District and a pump station at the start of the James Bypass. There would be a 250 cfs canal from the James Bypass pump station to the Mid-Valley Water District pump station. After the Mid-Valley Water District pump station, the canal would be 400 cfs and parallel the bypass then follow American Avenue to the east side of MAGSA. The East-Side Canal would be 500 cfs and connect recharge sites 1, 2, 3, 4, and 5. There are two canals that extend the McMullin Phase 1 canal: Siskiyou and McMullin Expansion. The Siskiyou canal goes north from Phase 1 to the East-Side Canal along Siskiyou Ave. The McMullin Expansion goes east along Floral and Nebraska Ave to the East-Side Canal.

There are approximately 3,840 acres of direct recharge facilities planned along the northern and eastern borders of MAGSA. There is approximately 400 acres in site 1, 450 acres in site 2, 550 acres at site 3, 500 acres at site 4, and 1,940 acres at site 5. At full buildout, these sites would provide a combined 1,540 AF/day of recharge capacity.

To return water to the Mendota Canal there are 87 recovery wells with 12 recovery wells at Site 1, 14 recovery wells at Site 2, 10 recovery wells at Site 3, 19 recovery wells at Site 4, and 33 recovery wells at Site 5. The layout of alternative 4 is shown in **Figure 4-1.** Combined these wells could recover up to 485 cfs, or 960 AF/day.

4.4 Project Costs

Costs were analyzed for the project assuming a recharge capacity up to 770 cfs (1,540 AF/day) and a recovery capacity of 480 cfs (960 AF/day). The costs were developed to provide a rough order of magnitude estimate, appropriate for the current level of project definition. Earthwork quantities for the canals were estimated based on the McMullin Expansion Project (currently being designed). Costs were developed using a variety of sources including RS Means and experience with other construction projects in the region. Given the level of development of the project, it is appropriate to provide a range of costs between -20% and +30% of the estimated capital costs. Total capital costs are expected to range between $478,250,000 and $777,156,000. Capital costs are presented in **Table 4-1**, with more detail provided in **Appendix G**. The capital costs break down to approximately $598 to $971 per AF of storage capacity, as shown in **Table 4-2**.

Table 4-1 Summary of Capital Costs

Construction Costs	
Jensen Canal	$58,557,000
East-Side Canal	$82,674,000
American Canal	$58,566,000
Siskiyou Canal	$23,514,000
McMullin Canal	$40,000,000
Recharge Facilities	$73,024,000
Recovery Facilities	$87,000,000
Monitoring Wells	$1,750,000
General Conditions Costs	$48,890,000
Construction Subtotal	**$425,085,000**
Non-Construction Costs	
Land Acquisition	$87,710,000
Engineering	$37,918,000
Permitting and Compliance	$18,959,000
Construction Management	$37,918,000
Non-Construction Subtotal	**$172,727,000**
Project Total	**$597,812,000**
Project Total +30%	**$777,156,000**
Project Total -20%	**$478,250,000**

Table 4-2 Cost of Storage Capacity

	Initial Capital Cost	Storage Capacity (AF)	Initial Capital Cost ($/AF Capacity)
Project Total -20%	$478,250,000	800,000	$598
Project Total	$597,812,000	800,000	$747
Project Total + 30%	$777,156,000	800,000	$971

To develop annual costs, capital costs were amortized over a 40-year period, assuming a 4% interest rate. Annual maintenance costs are assumed to be 10% of the amortized capital costs. The combined capital amortization and maintenance costs are considered the baseline annual costs. However, costs are expected to vary between recharge and recovery years. During recharge years, there will be additional energy costs, both

natural gas and electric, to convey water from the Mendota Pool to the recharge sites through the canals and pump stations. Using PG&E rates, natural gas was assumed to cost of $1.32 per 100,000 BTU and $0.30 per kilowatt-hour. The annual recharge assumes water is recharged 24 hours a day for 5 months out of the year. During recovery years, there will be electric energy costs to recover the banked water from the aquifer and convey it to the Mendota Pool. For the purposes of developing recovery pumping costs, pumping depths are assumed to be between 225 and 320 feet below ground surface. Conveyance towards the Mendota Pool will be by gravity, subsequently there will not be significant energy costs associated with recovered water conveyance. The annual recovery costs assume the recovery wells run 24 hours a day for 5 months out of the year. **Table 4-3** summarizes range of baseline annual costs. **Table 4-4** summarizes the additional cost to convey water to the recharge facilities from the Mendota Pool. **Table 4-5** summarizes the additional cost to recover water and return it to the Mendota Pool.

Table 4-3 Baseline Annual Costs

	Amortized Capital Costs	Annual Maintenance	Total Annual Costs
Project Total -20%	$23,985,000	$2,398,500	$26,383,500
Project Total	$29,982,000	$2,998,200	$32,980,200
Project Total + 30%	$38,976,000	$3,897,600	$42,873,600

Table 4-4 Recharge Costs

Electric Costs	$12,714,000
Natural Gas Costs	$6,660,800
Total Cost	$19,374,800
Annual Recharge (AF)	208,000
Recharge Cost ($/AF)	$93

Table 4-5 Recovery Costs

Electric Costs	$23,934,000
Annual Recovery (AF)	146,000
Recovery Cost ($/AF)	$164

5 Regulatory Considerations

5.1 Permits and Approvals

Construction and operation of the water bank and conveyance will require coordination, consultation and permits from multiple agencies with jurisdiction for various aspects of Aquaterra Groundwater Bank. The following **Table 5-1** is based on experience in developing various groundwater water banking and conveyance projects. During the environmental review process, the need for the various permits and approvals will be further refined.

Table 5-1 Permits and Approvals

Agency	Requirement	Applicability	Compliance Procedure
County of Fresno	Groundwater Export	The groundwater bank will operate to recover banked water	File for a permit as described in County of Fresno Ordinance 14.03.
U.S. Army Corps of Engineers (USACE)	Section 404 Nationwide or Individual Permit	Work requiring discharge of fill to surface waters	Submit Section 404 Permit Application. Wetland delineation may be required. This process may take 18 – 24 months.
U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act	Any work that could impact listed species	Section 7 Consultation prior to submittal of Section 404 Permit Application to USACE.
Central Valley Regional Water Quality Control Board (RWQCB)	Section 401 Water Quality Certification Stormwater Pollution Prevention Plan (SWPPP)	Work requiring discharge of fill to surface waters Any work disturbing one acre or more.	Submit Section 401 Water Quality Certification application during design process. Develop SWPPP prior to project bidding. Construction contractor to obtain final permit with initiation of construction.
California Department of Fish and Wildlife (CDFW)	Streambed Alteration Agreement California ESA	Work altering a stream channel Any work that could impact listed species	Submit LSAA application. Initiate with CDFW.

Agency	Requirement	Applicability	Compliance Procedure
San Joaquin Valley Air Pollution Control District	Indirect Source Review (ISR)	All development work	Submit ISR application to SJVAPCD during CEQA process.
	Dust Control Plan (DCP)	All development with over 5 acres of disturbed area	Submit plan for conditional approval during design. Contractor to obtain final approval.
	Permit to Operate (PTO)	Only needed if propane or natural gas driven engines are used to operate lift pumps	Submit application during design and prior to initiation of construction.
U.S. Bureau of Reclamation	Warren Act Contract	Project partners conveying non-federal water through federal facilities (i.e., Delta-Mendota Canal)	Coordinate with USBR staff in the local office.
	Acknowledged Water Bank	While not required, this acknowledgement allows CVP contractors to take delivery of their water at the bank. It may be advantageous for MAGSA to obtain for their project partners.	Submit a detailed proposal as outlined in USBR's *"Groundwater Banking Guidelines for Central Valley Project Water"*.
Central California Irrigation District (CCID) / San Luis & Delta-Mendota Water Authority (SLDMWA)	Agreements for utilization of Mendota Pool	CCID owns Mendota Dam. San Luis & Delta-Mendota Water Authority operate the Mendota Pool	Initiate discussions and develop agreement(s) as needed.
Various	Encroachment Permits	Work within other agencies rights-of-way	Coordination and submittals to Union Pacific Railroad, California Dept. of Transportation, Reclamation District 1606, County of Fresno Public Works, and potentially others.

5.2 Environmental

California contains several rare plant and animal species. In this context, "rare" is defined as species known to have low populations or limited distributions. As the human population grows, resulting in urban expansion which encroaches on the already limited suitable habitat, these sensitive species become increasingly more vulnerable to extirpation. A variety of state and federal regulations, including the Endangered Species Act, have provided the California Department of Fish and Wildlife (CDFW) and the U.S. Fish and Wildlife Service (USFWS) with a mechanism for conserving and protecting the diversity of native plant and animal species. Numerous native plants and animals have been formally designated as "threatened" or "endangered" under State and federal endangered species legislation. Other formal designations include "candidate" for listing or "species of special concern" by CDFW. The California Native Plant Society (CNPS) maintains a list of native plants considered rare, threatened, or endangered. All plants with a CNPS Rare Plant Rank of 1 or 2 meet the definition of the California Endangered Species Act and are eligible for State listing. Collectively these plants and animals are referred to as "special status species." Impacts to these species, either directly through injury or mortality, or indirectly through habitat loss must be analyzed during the preparation of environmental documents relating to California Environmental Quality Act (CEQA).

A thorough search of the California Natural Diversity Database (CNDDB) for published accounts of special status plant and animal species was conducted for the *Mendota Dam, Gravelly Ford, Tranquillity, Jamesan, Kerman, Kearney Park, San Joaquin, Helm, Raisin, and Caruthers 7.5-minute quadrangles that contain the MAGSA area, and for the 20 surrounding quadrangles: Firebaugh, Poso Farm, Firebaugh NE, Bonita Ranch, Madera, Biola, Hernson, Fresno North, Fresno South, Malaga, Conejo, Laton, Riverdale, Burrel, Five Points, Westside, Tres Picos Farms, Cantua Creek, Levis, and Coit Ranch.* A list of these species and a discussion regarding their potential to occur within the Project area can be found in **Appendix H**. Raw data obtained from the CNDDB is available in **Appendix I**. **Figure 5-1** shows the locations of the CNDDB published accounts of special status species observations within and adjacent to the GSA. It is important to note that CNDDB is a positive detection database. Records only exist in the database where species have been detected. There may be additional occurrences or additional species within this area which have not yet been surveyed and/or mapped. Lack of information in the CNDDB about a species or an area can never be used as proof that *no* special status species occur in an area.

The proposed pump station is located within the Fresno Slough in the Mendota Wildlife Area. Several protected aquatic and terrestrial species are known to occur in this area of high-quality wetland habitat. The Fresno Slough is considered a Water of the U.S. or "jurisdictional water" subject to the jurisdiction of the U.S. Army Corps of Engineers (USACE). The USACE regulates the filling or grading of Waters of the U.S. under the authority of Section 404 of the Clean Water Act. All activities that involve the discharge of dredge or fill material into Waters of the U.S. are subject to the permit requirements of the USACE. Such permits are typically issued on the condition that the applicant agrees to provide mitigation that result in no net loss of wetland functions or values. It is important to note that USACE is not obligated to issue a permit if the Project applicant cannot prove that the Project as described is the Least Environmentally Damaging Practicable Alternative (LEDPA). Furthermore, USACE cannot issue a permit until the Regional Water Quality Control Board (RWQCB) issues a Section 401 Water Quality Certification (or waiver of such certification) verifying that the proposed activity will meet state water quality standards.

Under the Porter-Cologne Water Quality Control Act of 1969, the State Water Resources Control Board has regulatory authority to protect the water quality of all surface water and groundwater in the State of California ("Waters of the State"). Nine RWQCBs oversee water quality at the local and regional level. The RWQCB for a given region regulates discharges of fill or pollutants into Waters of the State through the issuance of various permits and orders. Discharges into Waters of the State that are also Waters of the U.S. require a Section 401 Water Quality Certification from the RWQCB as a prerequisite to obtaining certain federal permits, such as a Section 404 Clean Water Act permit. Discharges into all Waters of the State, even those that are not also Waters of the U.S., require Waste Discharge Requirements (WDRs), or waivers of WDRs,

from the RWQCB. The RWQCB also administers the Construction Storm Water Program and the federal National Pollution Discharge Elimination System (NPDES) program. Projects that disturb one or more acres of soil must obtain a Construction General Permit under the Construction Storm Water Program. A prerequisite for this permit is the development of a Storm Water Pollution Prevention Plan (SWPPP) by a certified Qualified SWPPP Developer. Projects that discharge wastewater, storm water, or other pollutants into a Water of the U.S. may require a NPDES permit.

CDFW has jurisdiction over the bed and bank of natural drainages and lakes according to provisions of Section 1601 and 1602 of the California Fish and Game Code. Activities that may substantially modify such waters through the diversion or obstruction of their natural flow, change or use of any material from their bed or bank, or the deposition of debris require a Notification of Lake or Streambed Alteration. If CDFW determines that the activity may adversely affect fish and wildlife resources, a Lake or Streambed Alteration Agreement will be prepared. Such an agreement typically stipulates that certain measures will be implemented to protect the habitat values of the lake or drainage in question.

The following is a list of permits and/or approvals anticipated to be required in order to construct a new turnout or pumping facility within the Fresno Slough:

- *Coordination with CDFW regarding construction within the Mendota Wildlife Area*
- *ESA Consultation with CDFW and Incidental Take Permit (ITP)*
- *ESA Consultation with USFWS and National Marine Fisheries Service (NMFS)*
- *USACE Section 404 permit (may qualify for coverage under a Nationwide Permit)*
- *RWQCB Section 401 Water Quality Certification*
- *Section 1602 Lake or Streambed Alteration Agreement*
- *Central Valley Flood Protection Board (CVFPB) Encroachment Permit*
- *California State Lands Commission (CSLC) Lease*
- *CEQA and NEPA documentation*

In order to obtain the aforementioned permits, the following services are anticipated to be required:

- *Biological surveys and reports*
    - *Giant gartersnake trapping, DNA sampling, and focused surveys*
    - *USFWS Biological Assessment*
    - *NMFS Biological Assessment*
    - *CDFW Biological Assessment*
    - *Protocol-level Swainson's Hawk Surveys*
    - *Protocol-level Rare Plant Surveys*
- *Aquatic Resources Delineation and Jurisdictional Determination or Verification*
- *Section 106 Cultural Resources Inventory and State Historic Preservation Officer (SHPO) Consultation*
- *Preparation of a Habitat Conservation Plan and Mitigation and Monitoring Program*
- *Engineering, design, and implementation of NMFS-approved fish screens*
- *Dewatering of the channel and implementation of giant gartersnake exclusion fencing (if required by the USFWS and CDFW consultation)*
- *If dewatering is required, implementation of a fish rescue and relocation plan approved by USFWS, CDFW, and NMFS*
- *Compensatory mitigation for temporary and permanent impacts within the Fresno Slough and associated wetland habitat*

The aforementioned anticipated permits, approvals, and associated services are based on assumptions made from the preliminary Project information available at this time. This is not an exhaustive list. Additional permits, fees, and agency coordination may be required.

Figure 5-2 shows the locations of protected areas administered by public agencies and non-profits. The Mendota Wildlife Area is comprised of approximately 11,800 acres consisting of flatlands and floodplain. Major representative plant communities and habitat types are seasonally flooded freshwater emergent wetland, valley foothill riparian and, to a lesser extent, alkali sink scrub. Wildlife species of particular interest which occur at this wildlife area include a variety of migratory waterfowl, pheasants, and several potentially occurring rare, threatened or endangered plants and animals. Additional state preservation areas in the GSA include the Alkali Sink Ecological Preserve and Kerman Ecological Reserve. Both of these areas provide habitat for special status species and should be avoided if possible. Work within an ecological preserve would require additional agency coordination and would increase the chances of encountering a special status species, as evidenced by the number of CNDDB occurrences recorded in these areas. For example, as illustrated in **Figure 5-3**, the Alkali Sink Ecological Reserve contains USFWS-designated critical habitat for the state- and federally-threatened Fresno kangaroo rat. Other inventoried non-profit conservation easements are labeled in brown on **Figure 5-2**. A conservation easement is a voluntary legal agreement that permanently limits uses of the land in order to protect its conservation values. Like ecological preserves, conservation easements also typically provide habitat for special status species. If possible, it is recommended that MAGSA avoid these areas, as well, since there will be land use restrictions and additional agency coordination required to work within these areas.

While the aforementioned discussion describes areas that the Aquaterra Groundwater Bank should potentially avoid, **Figure 5-4** helps to illustrate some areas that may be more suitable for developing groundwater basins within the GSA. **Figure 5-4** illustrates the various vegetation communities within the GSA. Some of these communities provide higher quality habitat for wildlife than others. If possible, Aquaterra Groundwater Bank should aim for development of groundwater basins in areas with lower quality habitat such as those mapped as urban, barren, or cropped.

Figure 5-5 illustrates the locations of inventoried streams, wetlands, and waterbodies, although many of those illustrated on the map may be historical and no longer accurate. When possible, streams, wetlands, and waterbodies should be avoided because these areas can provide habitat and serve as movement corridors for special status species. Furthermore, impacts to aquatic features typically require additional permitting, restoration, and/or compensatory mitigation depending on the value of the impacted resource. While **Figure 5-5** gives a broad idea of where some of these aquatic resources may be located, it is recommended that a biologist conduct a field survey of proposed Aquaterra Groundwater Bank areas to determine whether jurisdictional aquatic features are present.

McMullin Area GSA

CNDDB
Flora and Fauna

Figure 5-1

FIREBAUGH
MENDOTA DAM
GRAVELLY FORD
BIOLA
HERNDON
FRESNO NORTH
FRESNO
COIT RANCH
TRANQUILLITY
JAMESAN
KERMAN
KEARNEY PARK
FRESNO SOUTH
CANTUA CREEK
SAN JOAQUIN
HELM
RAISIN
CARUTHERS
LEVIS
TRES PICOS FARMS
WESTSIDE
FIVE POINTS
BURREL
RIVERDALE
LILLIS RANCH

SHAW
SHIELDS
MCKINLEY
WHITESBRIDGE
CALIFORNIA
JENSEN
AMERICAN
MANNING
KAMM
FLORAL
JEFFERSON
DAKOTA
WEST SHAW
FRUIT
PALM
WEBER
TEILMAN
WEST FRUIT
WALNUT
ANNA
AMERICA
LINCOLN
MARKS
GRANTLAND
LAKE
MADERA
DICKENSON
MC MULLIN
PLACER
COLORADO
CALAVERAS
LASSEN
JAMESON
HENDERSON
WEST
SECOND
MARIE
DOS PALOS
PANOCHE
SAN BENITO
SANTA FE GRADE
JAMES
99
SR 180

McMullin Area GSA
Quad Name

CNDDB

- Plant (80m)
- Plant (specific)
- Plant (non-specific)
- Plant (circular)
- Animal (80m)
- Animal (specific)
- Animal (non-specific)
- Animal (circular)
- Terrestrial Comm. (specific)
- Terrestrial Comm. (circular)
- Multiple (80m)
- Multiple (non-specific)
- Multiple (circular)
- Sensitive EO's (Commercial only)

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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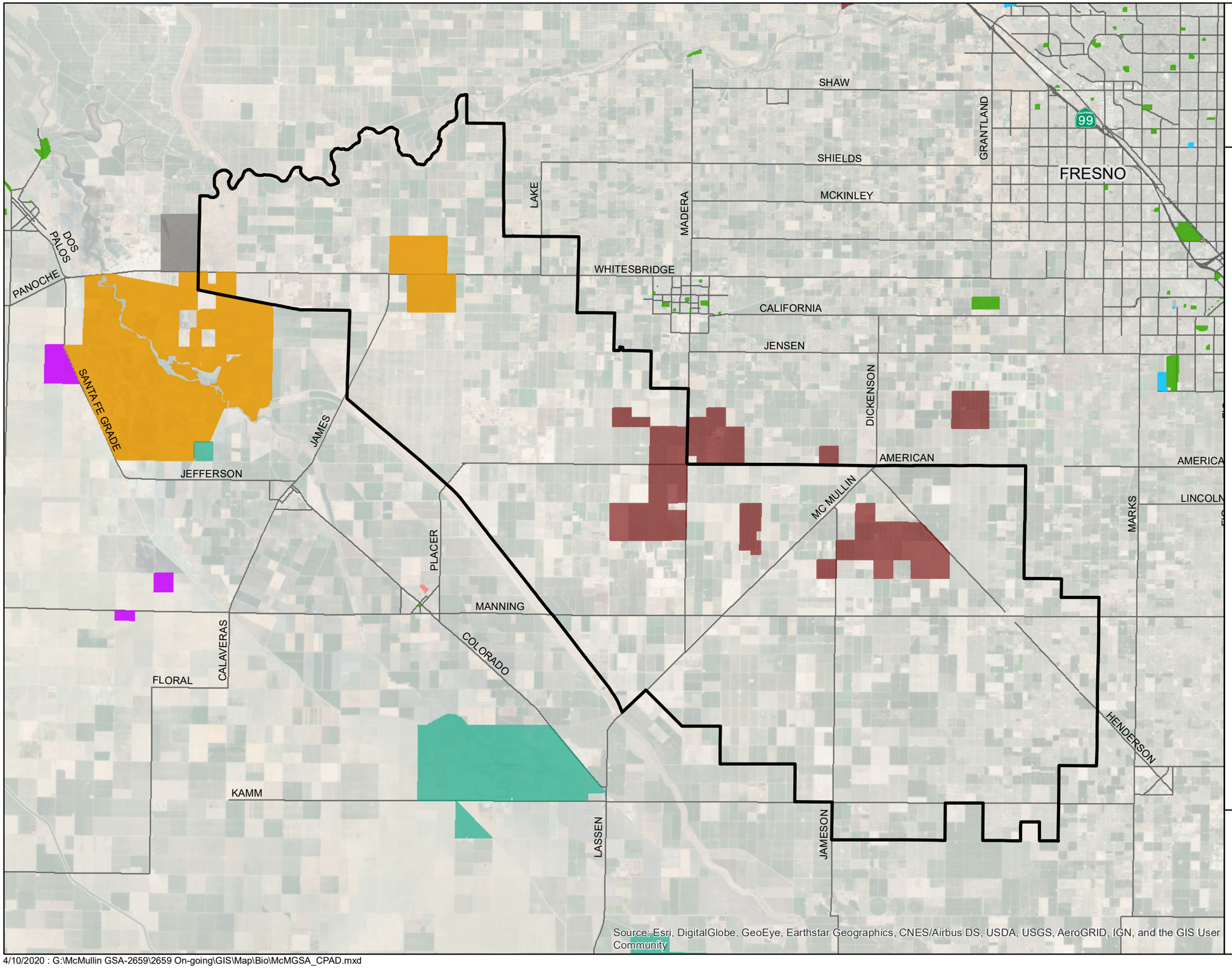
McMullin Area GSA

Protected Areas

Figure 5-2



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

McMullin Area GSA

Undesignated CDFW Easement

CA Protected Area Database

Local Other or Unknown

Local Park

Local Recreation Area

Research or Educational Area

State Conservation Area

CA Conservation Easement Database

Federal

NonProfit

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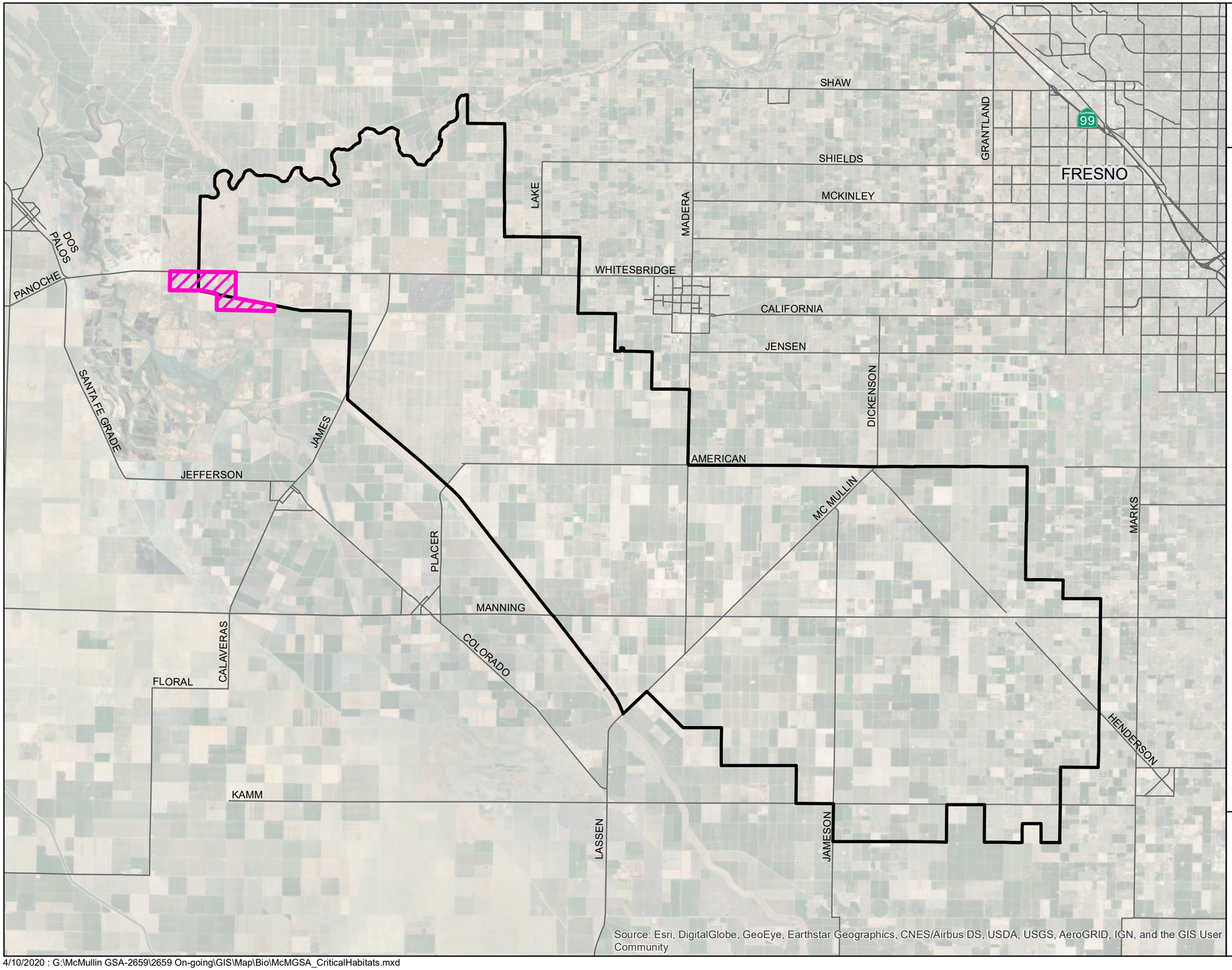
McMullin Area GSA

Critical Habitat

Figure 5-3



McMullin Area GSA

Critical Habitat, USFWS 2020

Fresno kangaroo rat

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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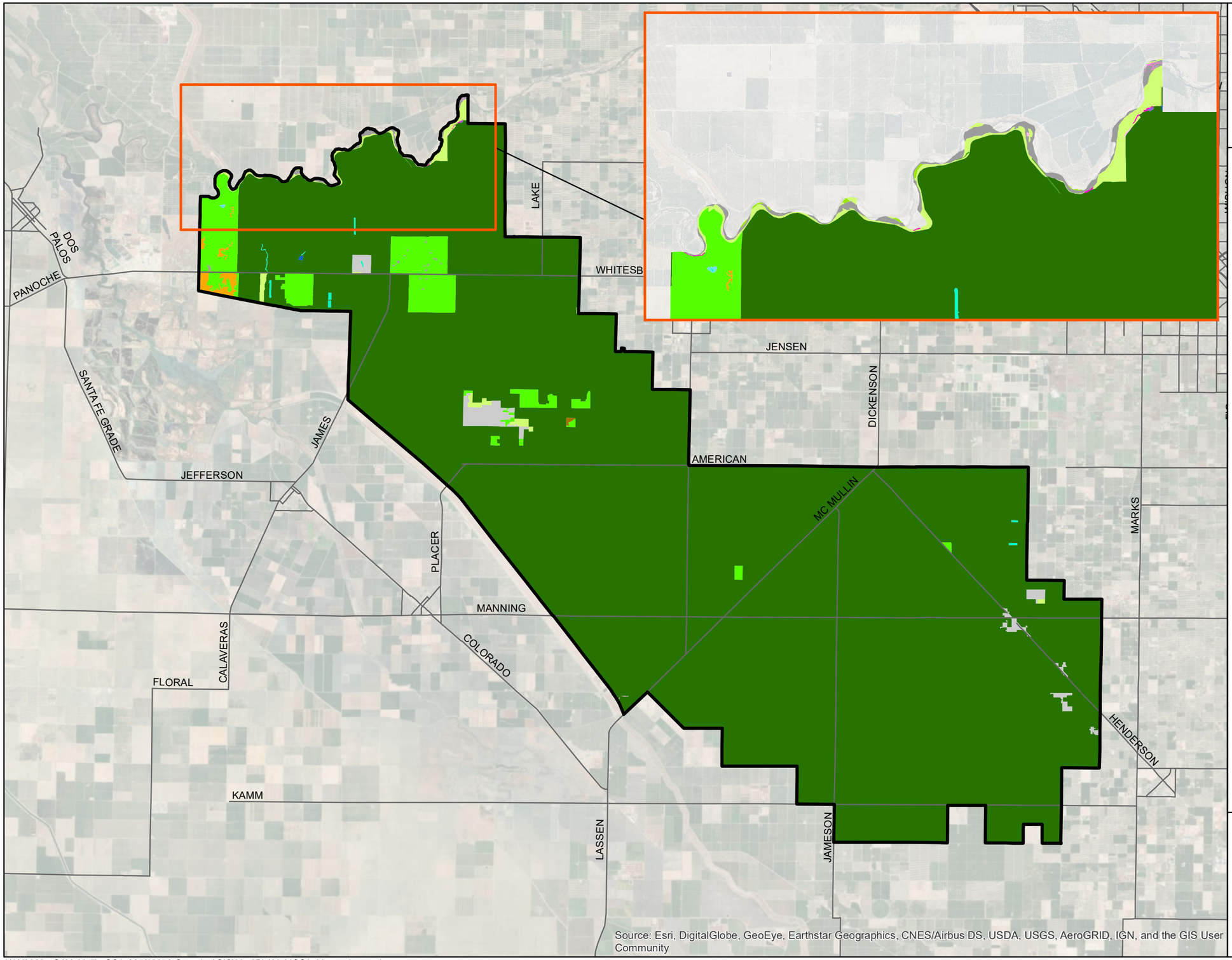
McMullin Area GSA

Vegetation
Wildlife - Habitat Relationship

Figure 5-4



McMullin Area GSA

Vegetation (DFW)

- Urban
- Barren
- Alkali Desert Scrub
- Alkali Desert Scrub, Desert Scrub
- Annual Grassland
- Annual Grassland, Alkali Desert Scrub
- Coastal Scrub
- Coastal Scrub, Valley Foothill Riparian
- Cropped
- Eucalyptus
- Fresh Emergent Wetland
- Fresh Emergent Wetland, Urban
- Lacustrine, Riverine
- Valley Foothill Riparian
- Valley Foothill Riparian, Desert Riparian
- Valley Foothill Riparian, Montane Riparian

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McMullin Area GSA

Waterbody and Wetlands

Figure 5-5

MENDOTA POOL
SAN JOAQUIN RIVER
FRESNO SLOUGH
DOS PALOS
PANOCHE
SANTA FE GRADE
JEFFERSON
JAMES
LAKE
WHITESBRIDGE
JENSEN
DICKENSON
AMERICAN
MC MULLIN
MARKS
PLACER
MANNING
COLORADO
CALAVERAS
FLORAL
KAMM
LASSEN
JAMESON
HENDERSON

McMullin Area GSA
Named Waterways
Stream/River
Canal/Ditch
Artificial Path

NHD Waterbody Type

Lake Pond
Reservoir
Swamp Marsh

NWI Wetland Type

Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Riverine

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Cultural Resources

Record Search 20-139 (**Appendix J**) was received April 14, 2020, for the McMullin Area GSA Groundwater Banking Reconnaissance Study Project. The California Office of Historic Preservation (OHP) contracts with the California Historical Resources Information System's (CHRIS) regional Information Centers (ICs) to maintain information in the CHRIS inventory and make it available to local, state, and federal agencies, cultural resource professionals, Native American tribes, researchers, and the public. According to the information in their files, there have been 30 previous cultural resource studies conducted within portions of the project area.

There are 30 recorded resources within the project area. These resources include prehistoric era lithic scatters, bedrock milling features, beads, groundstones, mounds, firecracked rocks, and burials. They also include historic era railroads, canals, trash scatters transmission lines, a farming community, and various types of buildings.

Resource P-10-006617, the Fresno Slough Bypass, has been given a National Register status code of 2D2, indicating it is a contributor to a district that has been determined eligible for listing in the National Register of Historic Places by a consensus through the Section 106 process. It is also listed in the California Register of Historical Resources. There are no other recorded cultural resources within the project area that are listed in the National Register of Historic Places, the California Register of Historical Resources, the California Points of Historical Interest, California Inventory of Historic Resources, or the California State Historic Landmarks.

This cultural resources review was conducted with the understanding 1) that the purpose of this project is to identify areas that would be best suited for a groundwater bank and look at a fatal flaws analysis at a programmatic level within the 120,000-acre MAGSA boundary, and 2) that because specific project areas have not yet been identified, no ground disturbance activities are currently planned. Prior to any future ground disturbance activities related to this project, it is recommended that a new record search be conducted for each specific ground disturbance project area identified so specific recommendations can be made.

6 Participant Involvement

Initial meetings continue to be held with interested program participants to identify their level of project interest for use in operations planning. A project planning agreement is in development that will provide for joint payment of specified project development costs in return for a future share of the developed project facilities. The planning agreement will specify the percentage involvement of program participants and their role in providing advice on project development.

6.1 Physical Aspects of Aquaterra Groundwater Bank

Regulation Capacity – Regulation capacity (or recharge capacity) is defined here as the volume and flow rate that can be delivered to the Aquaterra Groundwater Bank facility and is typically measured at the Point of Delivery at Mendota Pool or James Bypass. The maximum regulation capacity will be determined by the physical limitations of recharging water at the banking site(s). A minimum amount might be needed so that MAGSA is not regulating small amounts of water, or operating for short durations, thus incurring unreasonably high operational costs. An alternative to defining a minimum regulation capacity would be establishing a specified recovery usage charge that would pay for use up front and would be credited to actual recovery operations cost.

Recovery Capacity – Recovery capacity is defined here as the volume and flow rate that can be recovered from the banking facility and delivered to the Point of Delivery. This should be bounded by a minimum amount and a maximum amount. The maximum amount will be limited based on the recovery well capacities and available conveyance capacity. The minimum amount may be needed to minimize operational costs and to allow MAGSA to analyze the return in the context of their SGMA obligations for MOs / MTs. The banking partner would need to propose a recovery schedule by a certain date (April / May) to MAGSA. The schedule allows MAGSA to anticipate their seasonal operational needs and to confirm availability of conveyance capacity, either direct or by exchange. The recovery schedule would also provide the benefit of aiding in a SGMA analysis to ascertain whether the operations would cause the aquifer to approach a MT. This may also be limited based on operational constraints as recovery may cause declining water levels for the adjacent landowners.

Storage Capacity – Storage Capacity is defined as the maximum volume allowed to be stored at any one time in the aquifer below MAGSA. The storage capacity was identified based on physical available groundwater storage (which was not limiting), participant operational needs and ability to recharge or recover stored water over design hydrologic periods. The banking partners are allowed, and even encouraged, to cycle water through the facility often, provided that the maximum storage capacity is not exceeded. The storage capacity will be defined in participant agreements, which may also provide for flexibility in use of other participants' storage capacity if other participants agree. Storage capacity for the initial phase would be 800,000 AF.

Operational Losses – Most banking arrangements account for losses due to evaporation and conveyance as well as losses within the aquifer as a percentage of the volume delivered. Actual recharge losses can be difficult to directly measure or calculate and are typically stipulated at 10% but may be as high as 15%. In programs where the losses are lower, it is usually because the evaporation losses are being directly calculated, but the other losses are still stipulated as a percentage.

Point of Delivery – This location will be where water is measured in and out of the bank. For this program, where water is envisioned to be sourced from either the SWP or the CVP, it is recommended the Point of

Delivery be the Mendota Pool. Any losses to get water back to the banking partners beyond the Mendota Pool would be the responsibility of the banking partner.

Conveyance Priority – Priority for the use of the conveyance system to the banking facilities will need to be defined in project operation agreements. As the banking partners are the major financial contributors to the program, they will need assurances that when they have water available, MAGSA will make the conveyance facility available. If there are conveyance capacity limitations in the local conveyance system, MAGSA may need to shift their operations to accommodate the banking partners.

Recharge Priority – As the banking partners are providing the majority of the capital for the project, it is reasonable that they would expect for their water to be recharged as the priority.

6.2 Financial Aspects of Aquaterra Groundwater Bank

Capital Costs – Capital costs are planned to be the responsibility of the banking partner, with MAGSA having the option to provide funding in exchange for recharge or recovery priority. Capital costs (land, construction, design, permitting, etc.) will be agreed to between MAGSA and participants prior to construction and documented in an agreement. MAGSA and the banking partner will mutually agree on project scaling to keep the project within the budget, or mutually agree on budget increases if necessary. The banking partner and MAGSA may also consider pursuing grants for the project to offset capital costs.

Operations, Maintenance and Replacement Costs – The banking partner will be responsible to pay for the operation and maintenance costs actually incurred. MAGSA may consider using a specified recovery usage charge to provide funding in advance of actual use and to assure maintenance of operational capability during periods of low or minimal banking use. If MAGSA utilizes the facilities, then the amount could be prorated for the year based on the volume of water each entity has delivered to the facility.

- *Operations costs will include, but are not limited to:*
  - *Energy costs to pump water to the banking sites*
  - *Energy costs to recover water from the banking sites*
- *Maintenance costs will consist of all costs to maintain the facilities and their proper function.*
- *Replacement costs will be developed based on the present value of components and amortized over the life of the project.*

Governance and Partner Relationships

Generally, there are two ways the Aquaterra Groundwater Bank could be developed. First, a Joint Powers Authority (JPA) could be formed between MAGSA and the banking partner(s). This would provide for joint ownership which would lead to shared operations, maintenance, and management responsibilities. It may also delay development of the project, as very little work would be done until the JPA was formed. Second, the Aquaterra Groundwater Bank could be developed by agreement between MAGSA and program participants. There are various forms of water banking program agreements that range from extremely detailed to very brief; the detail depends on the parties involved and the circumstances under which the bank will operate. The agreements could be developed as MAGSA simultaneously develops the project(s). It is understood that MAGSA desires to develop this program and begin operations as soon as possible as part of their GSP implementation strategy. It is primarily for this reason that it is recommended MAGSA pursue the program through an agreement.

Project Development

It is envisioned that MAGSA would retain complete ownership of any project facilities and hold water that is stored in the aquifer in trust for the banking partners. As such, MAGSA will be responsible for the project

execution inclusive of all permits, environmental documentation, design, construction, land acquisition, and other responsibilities to develop a functioning project. The banking partners would review and agree to contracts and costs as they are developed and prior to MAGSA entering into any agreements.

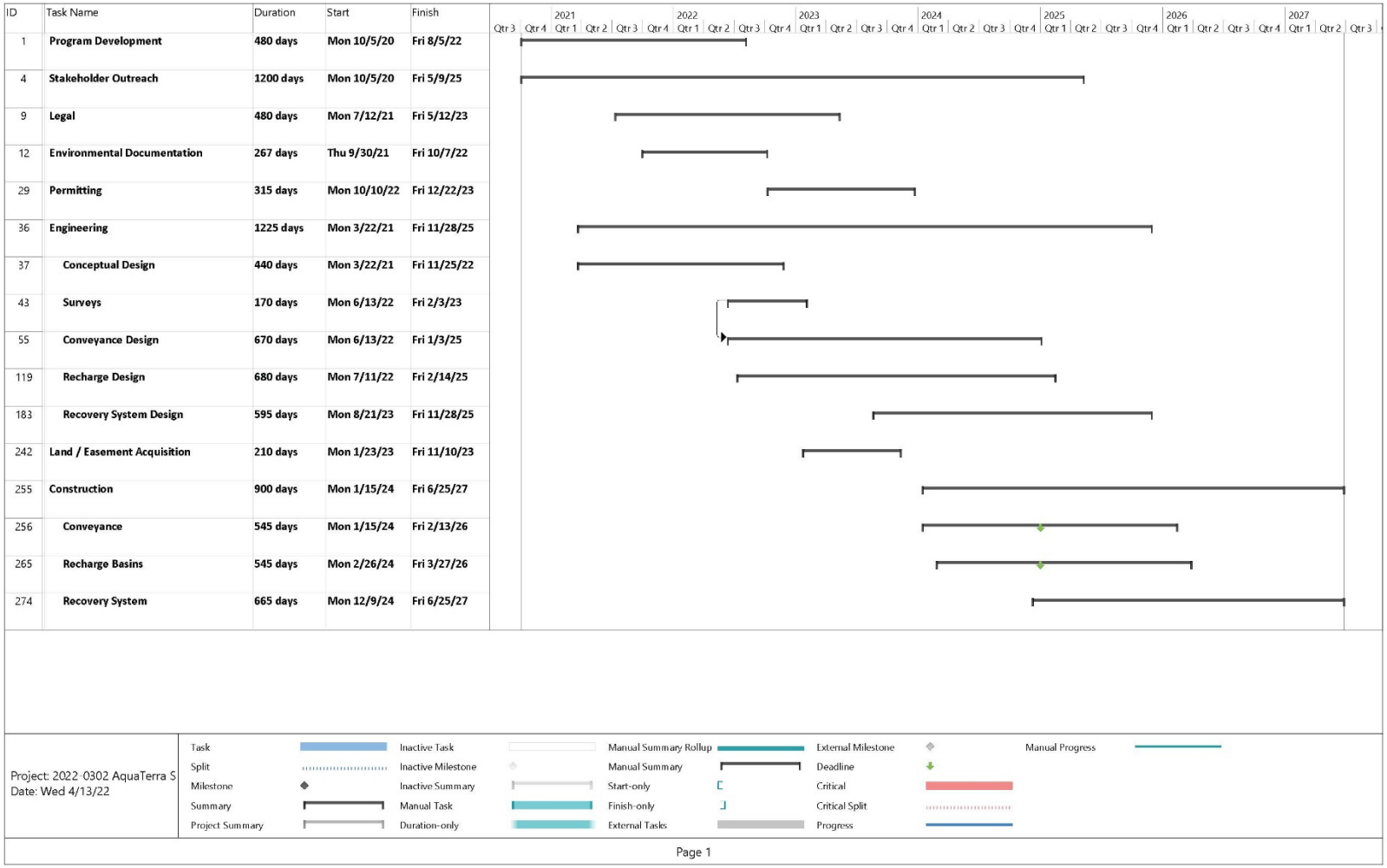
Monitoring Committee

A monitoring committee that is made up of representatives from MAGSA, banking partners, and adjacent landowners is recommended. The committee would review operations annually and provide advisory recommendations regarding the bank's operations. It is recommended to include adjacent landowners on the committee so their concerns, if any, can be voiced and directly addressed.

Schedule

A preliminary schedule has been prepared to aggressively develop the Aquaterra Groundwater Bank. The schedule assumes MAGSA has banking partners ready to commit to the program, and that the work to develop the program will continue immediately after completion of this study. It is anticipated that environmental permitting could be accomplished by the end of 2023. A phased approach to the engineering and construction will be employed to allow for some work to commence without the entire program design being complete. The first phase of recharge projects could be ready to accept water in the second quarter 2024 with all recharge facilities completed by 2026. Recovery facilities will be developed over a 3-year period beginning in 2024 and ending in 2027. The schedule is shown in **Figure 6-1**, with more detail provided in **Appendix K**.

Figure 6-1 Preliminary Schedule



ID	Task Name	Duration	Start	Finish
1	**Program Development**	**480 days**	**Mon 10/5/20**	**Fri 8/5/22**
4	**Stakeholder Outreach**	**1200 days**	**Mon 10/5/20**	**Fri 5/9/25**
9	**Legal**	**480 days**	**Mon 7/12/21**	**Fri 5/12/23**
12	**Environmental Documentation**	**267 days**	**Thu 9/30/21**	**Fri 10/7/22**
29	**Permitting**	**315 days**	**Mon 10/10/22**	**Fri 12/22/23**
36	**Engineering**	**1225 days**	**Mon 3/22/21**	**Fri 11/28/25**
37	**Conceptual Design**	**440 days**	**Mon 3/22/21**	**Fri 11/25/22**
43	**Surveys**	**170 days**	**Mon 6/13/22**	**Fri 2/3/23**
55	**Conveyance Design**	**670 days**	**Mon 6/13/22**	**Fri 1/3/25**
119	**Recharge Design**	**680 days**	**Mon 7/11/22**	**Fri 2/14/25**
183	**Recovery System Design**	**595 days**	**Mon 8/21/23**	**Fri 11/28/25**
242	**Land / Easement Acquisition**	**210 days**	**Mon 1/23/23**	**Fri 11/10/23**
255	**Construction**	**900 days**	**Mon 1/15/24**	**Fri 6/25/27**
256	**Conveyance**	**545 days**	**Mon 1/15/24**	**Fri 2/13/26**
265	**Recharge Basins**	**545 days**	**Mon 2/26/24**	**Fri 3/27/26**
274	**Recovery System**	**665 days**	**Mon 12/9/24**	**Fri 6/25/27**

7 Conclusions and Recommendations

7.1 Summary of Findings

7.1.1 Geology and Soils

As discussed previously and shown in **Table 2-2**, Site 1 has the highest percentage of coarse-grained materials logged in the borings. Followed in descending order with regards to precent coarse grained material by Site 2, Site 3, Site 4 and Site 5. Based on the regional geologic data for geologic facies, SAGBI rating, relative saturated hydraulic conductivity, and geologic deposits, the Site 1 area was not expected to have as permeable materials as Site 5 which is in an area of sand dune deposits with predominately sand and sandy loam soils.

The relatively high ranking of Boring 2-1, ranked second of the ten borings, illustrates that site specific data is needed to confirm the preliminary findings from the regional data. However, Boring 2-2 on Site 2 does appear to confirm KDSA's finding that the southwestern portion of the site does not appear to be favorable for recharge. Based on geologic facies, Site 3 appeared to have a relatively higher percentage of coarse-grained materials with both Facies D and E mapped there. Significant portions of Site 5 are mapped by Page and Leblanc as Facies D however, the two borings conducted do not appear to be in areas mapped as Facies D. Future borings in the Site 5 area should be advanced in locations mapped as Facies D to evaluate and compare material textures between areas not mapped as Facies D and areas mapped as Facies D. In addition, the two borings completed in Site 5 were about 5 miles apart and assessing this large of an area would require addition borings. It is possible, and maybe even likely, that there are areas in Site 5 with soil texture comparable to Site 1, and Boring 2-1.

Based on soil texture data logged in the field, the area around Borings 1-1, 1-2 and 2-1 appears to be relatively better for recharge, however the selection of a site should also consider groundwater quality as, discussed below in **Section 3.2** and available groundwater storage space above local groundwater levels. Considering the variations in soil texture between borings and between sites, additional soil borings should be conducted at sites selected for additional consideration. Furthermore, the information from the borings indicates that if additional lands are identified in the areas near Sites 1 – 5, site specific borings are warranted even if the regional literature may indicate less than favorable conditions for recharge in the area.

7.1.2 Groundwater Quality

The better water quality is located on the eastern edge of MAGSA and is the preferred area for recharge basins. It appears that MAGSA extractions are likely to be somewhat higher than exchanged DMC water. This is a topic that will be reviewed with regulatory agencies and water agencies that rely on water from Mendota Pool as the program is developed. It is expected that agreements can be developed that would address salinity degradation concerns and would include ongoing monitoring to document compliance and address potential compensation for possible degradation.

7.1.3 Project Operations

The Aquaterra Groundwater Bank has been formulated based on participation of outside water agencies potentially including SWP contractors, CVP contractors, Kings River water users, and other water agencies. MAGSA would develop, construct and operate the facility on behalf of the banking participants. The

development, construction and operation would proceed under contracts between MAGSA and banking participants, which would provide for ongoing review of project costs and characteristics by banking participants.

7.1.4 Infrastructure Refinement

After discussions with MAGSA, an expanded initial project formulation was also developed based on a slightly larger group of SWP contractors that would provide a total of 800,000 AF of banking storage. This expanded project formulation would provide for annual recharge capacity of 208,000 AF with instantaneous capacity of 770 cfs. The recovery capacity for this initial project formulation would be 146,000 AF per year, with instantaneous recovery of 480 cfs.

The Aquaterra Groundwater Bank will have a recharge capacity to 770 cfs to accommodate the larger group of potential partners. As currently envisioned, the project consists of approximately 72 miles of canal and 22 pump stations. To accommodate the increase in capacity, there will be two canals from the Mendota Pool to the East-Side Canal. The first canal from the Pool will be the original alignment along Jensen Avenue at 400 cfs. The second canal will be the same alignment as Alternative 2 utilizing a pump station at Mid Valley Water District and a pump station at the start of the James Bypass. There would be a 200 cfs canal from the James Bypass pump station to the Mid-Valley Water District pump station. After the Mid-Valley Water District pump station, the canal would be 400 cfs and run parallel to the bypass and then follow American Avenue to the east side of MAGSA. The East-Side Canal would be 500 cfs and connect recharge sites 1, 2, 3, 4, and 5. There are two canals that extend the McMullin Phase 1 Canal: Siskiyou Canal and McMullin Expansion. The Siskiyou Canal goes north from Phase 1 to the East-Side Canal along Siskiyou Ave. The McMullin Expansion goes east along Floral and Nebraska Ave to the East-Side Canal. There is approximately 400 acres in Site 1, 450 acres in Site 2, 550 acres at Site 3, 500 acres at Site 4, and 1,940 acres at Site 5. To return water to the Mendota Canal there are 87 recovery wells with 12 recovery wells at site 1, 14 recovery wells at site 2, 10 recovery wells at site 3, 19 recovery wells at site 4, and 33 recovery wells at site 5.

7.1.5 Regulatory Considerations

Construction and operation of the water bank and conveyance will require coordination, consultation and permits from multiple agencies with jurisdiction for various aspects of the Project. This section looks at permits that may be needed for groundwater water banking and conveyance projects. During the environmental review process, the need for the various permits and approvals will be further refined.

7.1.6 Participant Involvement

The participant agreements would generally provide for participant payment for the costs of Aquaterra Groundwater Bank facilities and their payment of actual operational costs. Participants would generally have priority access to banking recharge and recovery facilities, with MAGSA having secondary access to those facilities for its own uses on an as-available basis. MAGSA would operate the groundwater bank and maintain banking operations accounts which would reflect physical operational losses, likely as a negotiated percentage included in the project agreements. Aquaterra Groundwater Bank development agreements, including preliminary indication of operational arrangements are in development and will be finalized in the near future. The general parameters identified above may be refined as agreed to by project participants in the course of program development.

7.2 Recommended Next Steps

The following next steps are recommended for the continued development of the Aquaterra Groundwater Bank and offered for consideration by MAGSA:

- Considering the variations in soil texture between borings and between sites, additional soil borings should be conducted at sites considered for basin construction. Typically, the depth to future soil borings can be limited to 50 feet below grade to identify potential shallow fine-grained soil layers that could be a limiting factor for groundwater recharge. Furthermore, the information from the borings indicates that if additional lands are identified in the areas near Sites 1 – 5, site specific borings are warranted even if the regional literature may indicate less than favorable conditions for recharge in the area.
- Continue discussions and pursue commitments from interested parties to further develop the program.
- Refine operations and analyses based on the commitments from interested parties.
- Initiate the CEQA and NEPA processes.
- Initiate a public outreach effort that includes stakeholder discussions with the following groups:
    - Stakeholders that could affect the exchange in the Mendota Pool. These are anticipated to be the San Joaquin River Exchange Contractors and the San Luis & Delta-Mendota Water Authority. MAGSA should also consider *initiating* discussions with US Bureau of Reclamation, US Fish and Wildlife Service, and CA Dept. of Fish and Game to better understand permitting issues and timelines associated with the Mendota Pool.
    - Stakeholders affected by the Aquaterra Groundwater Bank. These would consist of landowners within the recharge sites as well as those along the planned conveyance alignments.
    - Neighboring Agencies. These would consist of the GSAs that adjoin MAGSA, as well as the neighboring irrigation and water districts.
    - MAGSA Landowners. This would be general in nature to educate the landowners within MAGSA of the benefits that will be received by developing the Aquaterra Groundwater Bank.

8 Bibliography/References

Cehrs, Soenke, and Bianchi (1980), USDA Technical Bulletin 1604: A Geologic Approach to Artificial Recharge Site Selection in the Fresno-Clovis area, California.

Westlands Water District (2019), Mendota Pool Group 20-Year Exchange Program Final Environmental Impact Statement/Environmental Impact Report.

Appendix A – Kenneth D. Schmidt & Associates Memorandum

MEMO

To: Matt Hurley
From: Ken Schmidt
Topic: Potential Recharge Sites
Date: August 14, 2020

I have reviewed and interpreted drillers logs for wells at and near the five preliminary sites identified by Provost and Pritchard. Of most importance are 1) the thickness of surficial deposits that would need to be removed in order to construct basins or ponds, and 2) potential restricting layers above a depth of about 50 feet. A number of the wells were drilled by the cable-tool method, and logs for these are usually highly reliable in terms of texture. Following are my assessments of the sites.

Site 1

The site is west of Kerman, generally between Belmont and California Avenues and Lake and Trinity Avenues (Figure 1). We found logs for 27 wells in or near this site. Only three logs indicate apparently favorable or marginal conditions for basin recharge. These were all along a north-northeast to south-southwest trending area. At two of the well sites, the upper ten feet of deposits would have to be excavated. Hardpan and relatively thick clay were common within the uppermost 60 to 70 feet of deposits at the remaining wells. Where present, sands were relatively thin at these other wells. Four soil borings are recommended in the part of Site 1 shown on Figure 1. Three borings would be done by the hollow-stem auger method to a depth of 50 feet, and the remaining one to a depth of 80 feet.

Site 2

This site is located southwest of Kerman, primarily between California and North Avenues and Lake and Lassen Avenues (Figure 2). We found logs for 19 wells in or near this site. In general, there is more clay and sandy clay above a depth of about 70 to 80 feet at this site then at Site 1. Hardpan was also indicated at eight of the wells. None of the well logs indicated apparently favorable conditions for basin recharge. I do not recommend any soil borings at this site.

Site 3

This site is located south of Kerman, generally between North and American Avenues and Shasta and Del Norte Avenues (Figure 3). We found logs for 13 wells in or near the site.

Logs for three of these wells indicated apparently favorable conditions for basin recharge. At one well site, about six feet of surficial hardpan would need to be excavated. The favorable well sites were all located in Section 26. At the other sites, relatively thick clays were predominant to a depth of about 60 feet. Hardpan was indicated at seven well sites. I recommend soil borings in the west part of Section 25, the southwest three fourths of Section 26, and in the north half of Section 35. A total of eight borings would be done, six to a depth of 50 feet and two to a depth of 80 feet.

Site 4

This site is south of Kerman, between American and Lincoln Avenues and Madera and Howard Avenues. We found logs for 22 wells in or near this site (Figure 4). Only one of these indicated apparently favorable conditions for recharge, due to the presence of thick clays above about 60 feet in depth at the other wells. There were no logs in Section 5, except for one well near the northeast corner. It is possible that favorable conditions may be present in part of this section, as the most favorable log was adjacent to the south boundary of this section. I recommend four borings, two in the west half and two in the south half of Section 5. Three would be 50 feet deep and one would be 80 feet deep.

Site 5

Because of its large size, we divided Site 5 into two parts. Site 5-A is north of Manning Avenue, and Site 5-B is south of Manning Avenue.

Site 5-A

This area is bounded by American Avenue on the north, Manning Avenue on the south, and is between West Lawn and Brawley Avenues (Figure 5). We found drillers logs for about sixty wells in this area. Apparently favorable conditions for basin recharge were indicated at only six of these. All of the favorable well sites were between South and Manning Avenues and Grantland and Cornelia Avenues. This area is primarily in Sections 21 and 22 of T15S/R19E, just north of Raisin City. At other well sites, thick clay layers were usually predominant in the uppermost 60 to 70 feet of deposits. At one of the favorable well sites, about six feet of surficial material would need to be removed.

Site 5-B

This area is bounded by Manning Avenue on the north and Conejo Avenue on the south, and is in between West Lawn and Brawley Avenues. We found logs for about 160 wells in this area

(Figure 6). Favorable conditions for basin recharge were indicated at about 24 well sites. One of the largest apparently favorable areas is between Huntsman and Manning Avenues and Bryan and Brawley Avenues. Favorable conditions were indicated at eight well sites in an east-northwest to west-southwest trending area, east and south of Raisin City. Another apparently favorable area is between Nebraska and Mountain View Avenues and Chateau Fresno and Hayes Avenues, where conditions at five well sites were apparently favorable, in an east-west trending area. There were two additional smaller apparently favorable areas. One was near Huntsman Avenue, between Cornelia and Brawley Avenues, and another was between Floral and Rose Avenues and Chateau Fresno and Grantland Avenues. Two well sites in each area indicated apparently favorable conditions, and both areas trended from east to west.

The northernmost large area comprises about 700 acres. I recommend about six soil borings in this area. Four would be 50 feet deep and two would be 80 feet deep. The southernmost large area comprises about 850 acres. I recommend six soil borings in this area, four would be 50 feet deep and two would be 80 feet deep.

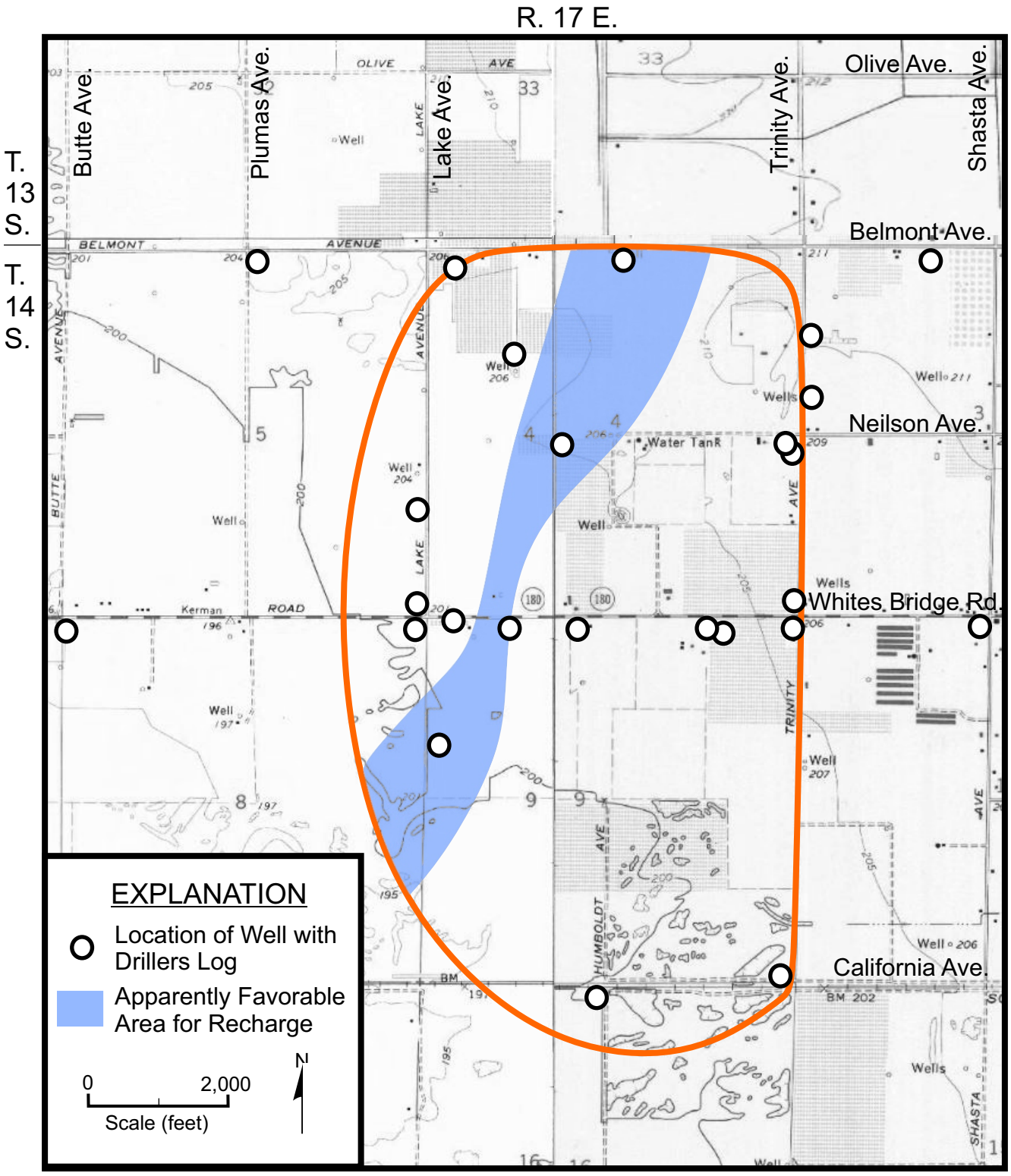


FIGURE 1 - LOCATIONS OF WELLS WITH DRILLERS LOGS AND APPARENTLY FAVORABLE AREAS FOR RECHARGE IN SITE 1

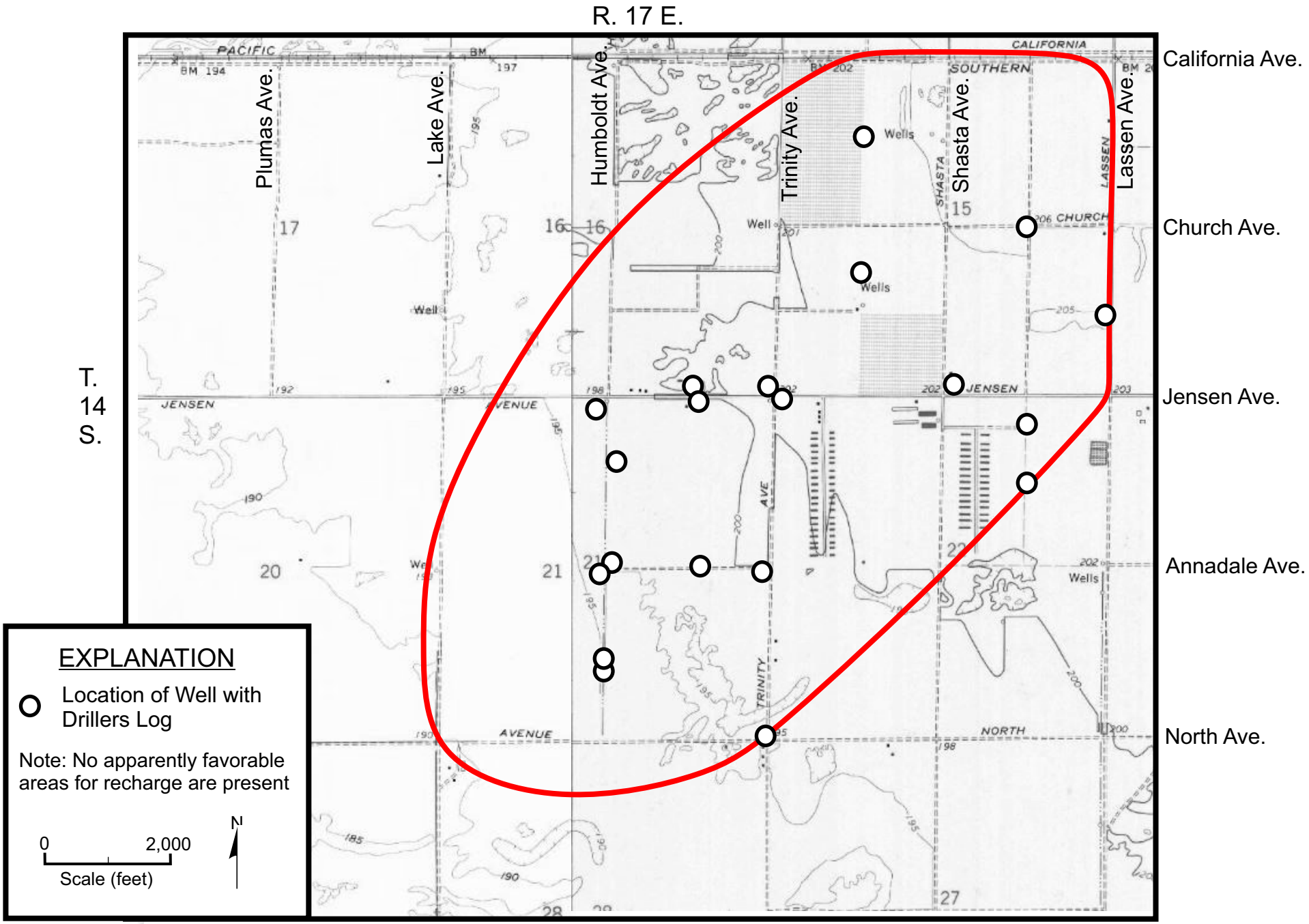


FIGURE 2 - LOCATIONS OF WELLS WITH DRILLERS LOGS FOR SITE 2

R. 17 E.

T. 14 S.

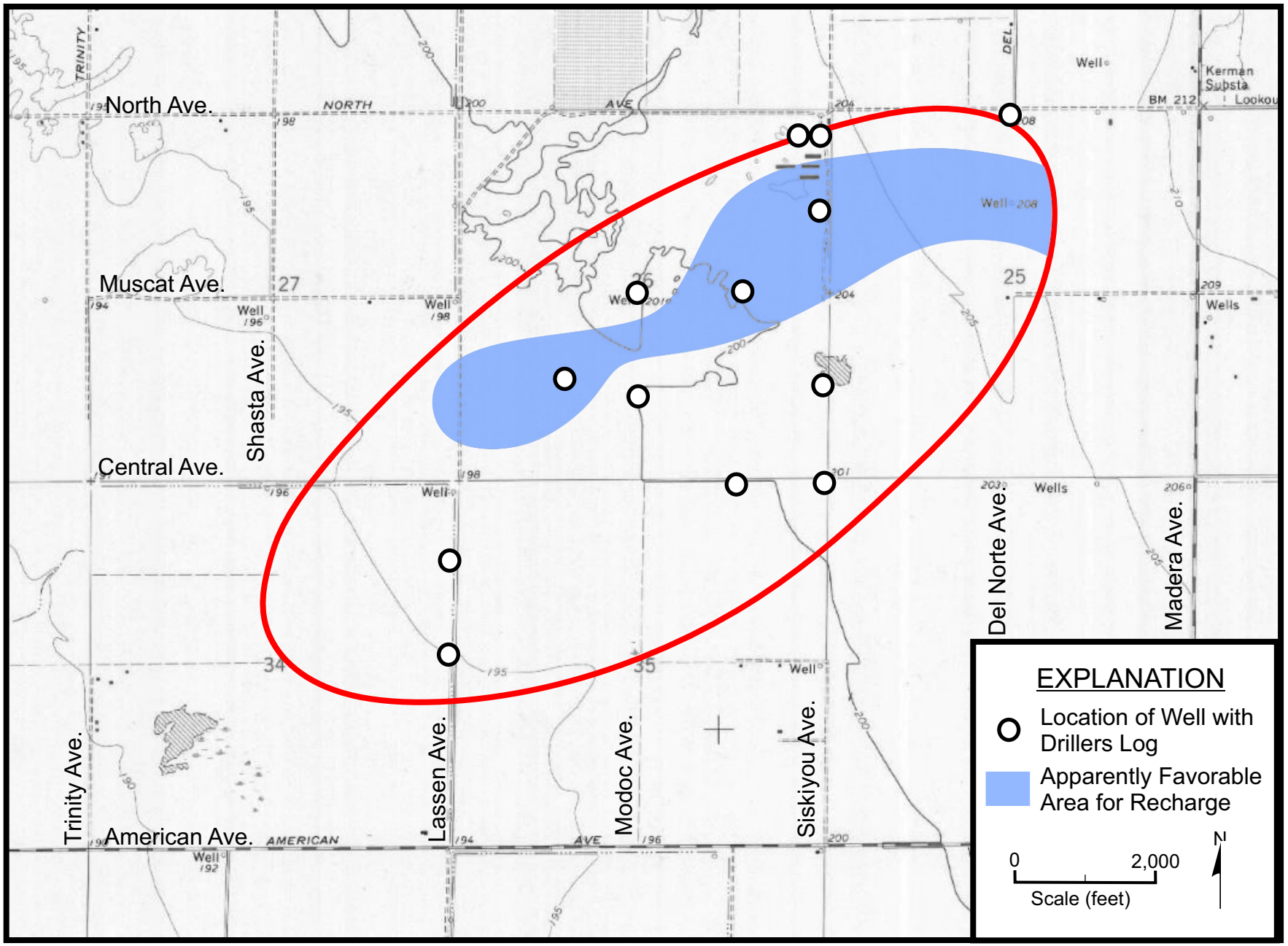


FIGURE 3 - LOCATIONS OF WELLS WITH DRILLERS LOGS AND APPARENTLY FAVORABLE AREAS FOR RECHARGE IN SITE 3

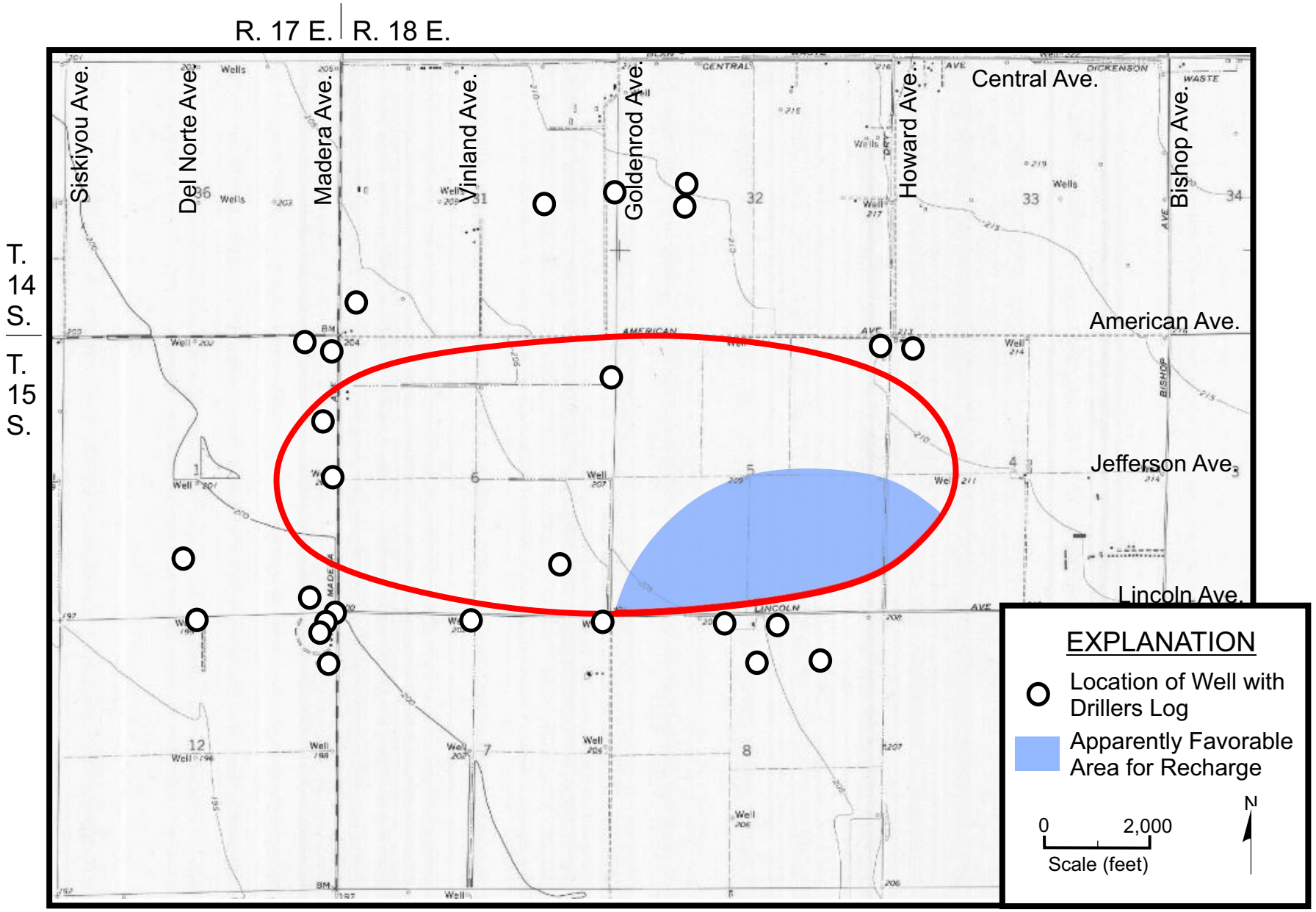


FIGURE 4 - LOCATIONS OF WELLS WITH DRILLERS LOGS AND APPARENTLY FAVORABLE AREAS FOR RECHARGE IN SITE 4

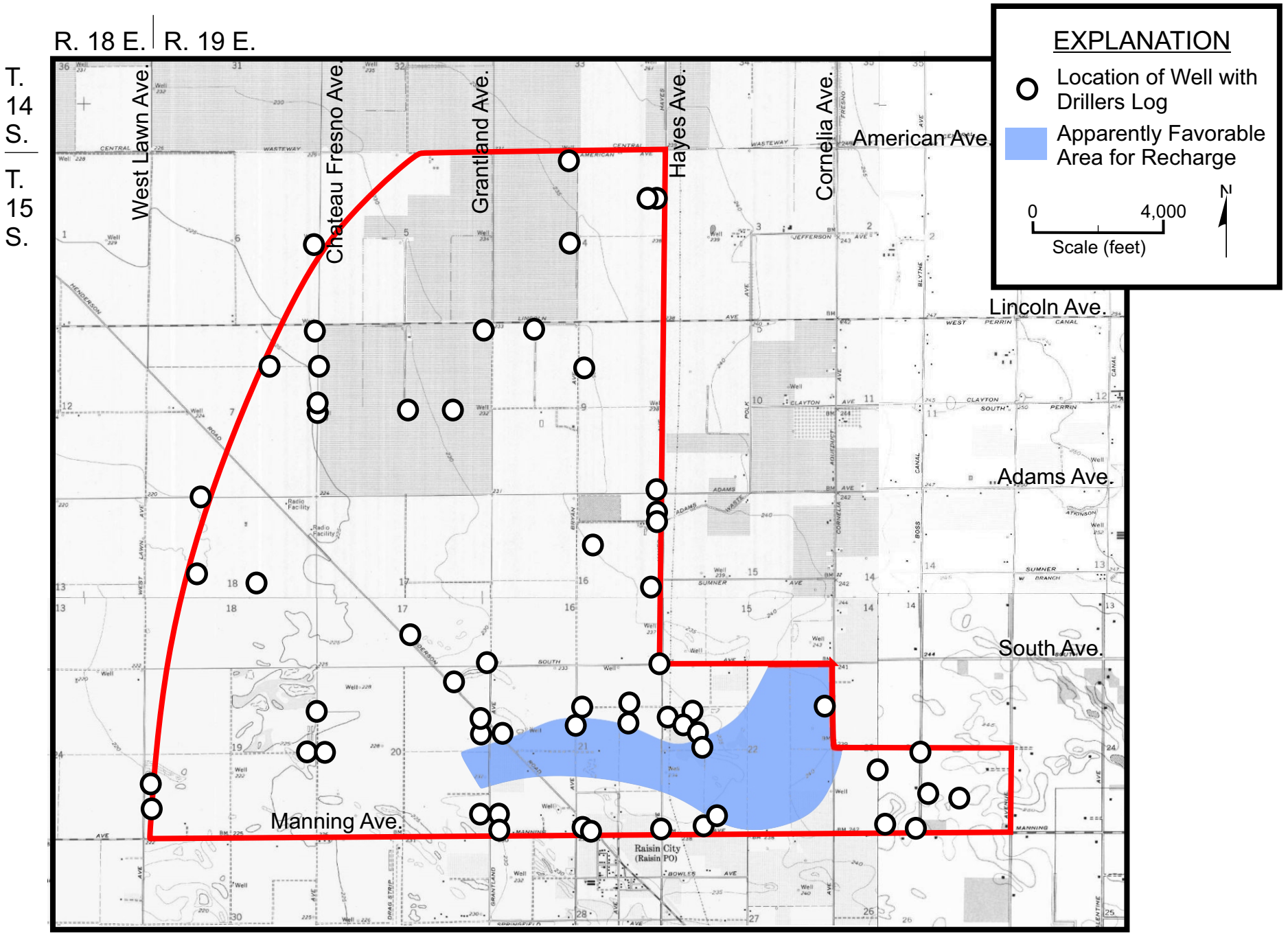


FIGURE 5 - LOCATIONS OF WELLS WITH DRILLERS LOGS AND APPARENTLY FAVORABLE AREAS FOR RECHARGE IN SITE 5A

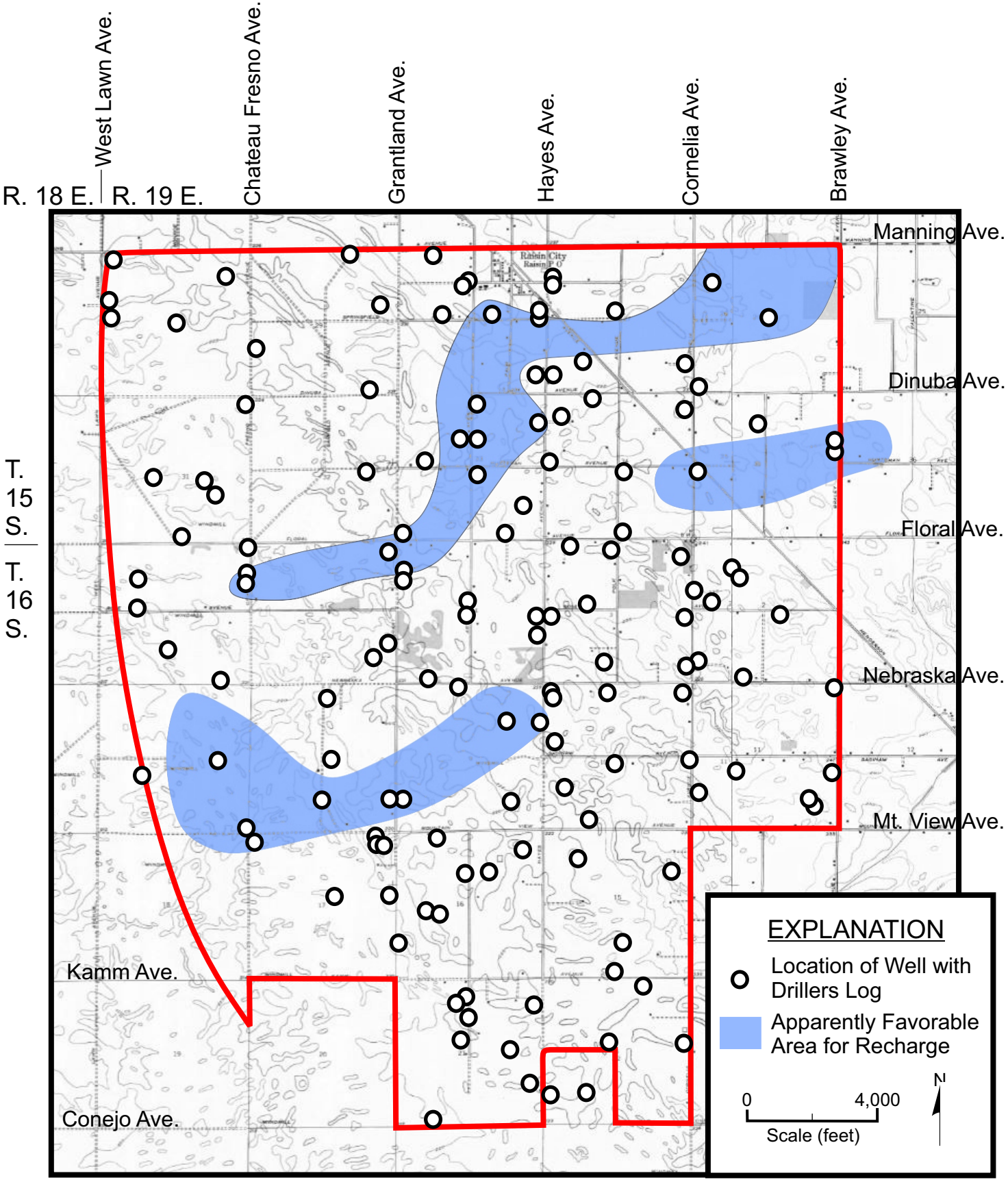


FIGURE 6 - LOCATIONS OF WELLS WITH DRILLERS LOGS AND APPARENTLY FAVORABLE AREAS FOR RECHARGE IN SITE 5B

Appendix B: Soil Boring Logs and Lab Reports

Appendix B1: Soil Boring Logs

EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

Boring Log

1-1

Job No. **2659-20-002 GWB**

Date: **November 6, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	SM	(0-2') Silty Sand, light brown, fine-grained, dry, loose (2-9.5') Silty Sand, reddish brown, fine-grained, moist, loose.	
10				ML	(9.5-12.5') Silt, gray, moist, firm, red oxidation staining.	
15				SP	(12.5-20') Sand, poorly graded, white to gray, medium to coarse-grained, moist, loose. (18-20') Occasional pea gravel.	
20				SM	(20-24') Silty Sand, gray, very fine-grained, moist, medium dense.	
25				SP	(24-33.5') Sand, poorly graded, gray, very fine-grained, moist, loose.	
35				ML	(33.5-40') Silt, dark brown, moist, very stiff, white streaks.	Driller indicated drilling became harder at 34'
40						

EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

Boring Log

1-1

Job No. **2659-20-002 GWB**

Date: **November 6, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	SP	(40-48') Sand, poorly graded, gray, fine-grained, moist, loose.	
50				ML	(48-53') Sandy Silt, reddish brown, fine-grained sand, moist, hard.	Lab result: 70% Sand, 30% Silt/Clay
55				SP	(53-57') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
				SM/ML	(57-59') Sandy Silt/Silty Sand, gray, very fine-grained, moist, red oxidation staining.	
60				SP	(59-63') Sand, poorly graded, white to gray, fine-grained, moist, loose.	
65				SM/ML	(63-68') Sandy Silt/Silty Sand, gray, very fine-grained, moist, red oxidation staining.	
70				ML	(68-73.5') Silt, gray, moist, firm.	
75				SM	(73.5-75' Silty Sand, gray, very fine-grained, moist, dense.	
				SM/ML	(75-78') Sandy Silt/Silty Sand, dark gray, very fine-grained, moist, firm.	
80				ML	(78-80') Silt, bright reddish brown, moist, firm, highly oxidized	

EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

Boring Log

1-1

Date: November 6, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	SM	(80-83') Silty Sand, gray, very fine-grained, loose.	
				SP	(83-90') Sand, poorly graded, gray, fine-grained, moist, loose.	
90					(90-93.5) medium-grained with occasional gravel up to an inch in diameter.	
95				ML	(93.5-98') Silt, gray, moist, hard.	
100				SP	(98-100') Sand, poorly graded, gray, fine to medium-grained, moist, loose.	
105					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
110						
115						
120						

EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

Boring Log

1-2

Job No. 2659-20-002 GWB

Date: November 4/5, 2020
Project: Mid-Valley Water Bank
Logged by: SWO/ARB/SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
-	5' Continous Tube Sampler	Not Used	Not Used	ML	(0-2') Silt with Sand, light yellowish brown, moist, dense.	
-				SP	(2-10') Very fine sand with silt, light gray, moist, moderately loose, grades to light brown at 4 ft.	
5					Very dense from 5 to 6 ft.	
-					Loose from 6 to 6.5 ft, mottled light gray/orange, partially cemented sand	
-					Loose at 9 feet, very fine.	
10						
-				ML	(10-12') Silt, light brown and gray, moist, loose, moderately oxidized	
-				SP	(12-18') Fine to very fine sand, light gray-yellow, moist, loose, some oxidation mottling	
15					Dense SP lens at 15.5 ft, 4 in	
-					Dense SP lens at 17 ft, 3 in	
-				ML	(18-19') Silt, brown	
20				SP	(19-20) Fine sand, light gray, moist, loose	
-				ML	(20-21.5') Silt, gray-brown, moist, dense	
-				SP	(21.5-24') Fine to medium sand, gray, moist, loose	
25				ML	(24-26') Silt, gray-green, moist, dense	
-				SM	(26-36') Silty sand, gray-green, moist, dense, cemented	Hard drilling at 28 ft
30					Prevalent CaCO3 at 29.5 ft	
-					Yellow-brown at 31 ft	
-					Reddish-brown at 32.5 ft	
35						
-				ML	(36-38.5') Silt, light olive, very moist, dense, grades into SP by 38.5 ft, some oxidation	
40				SP	(38.5-53.5') Fine sand, gray with prevalent orange oxidation, moist, dense, prevalent oxidation	

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Boring Log

1-2

Date: November 4/5, 2020
Project: Mid-Valley Water Bank
Logged by: SWO/ARB/SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	SP	Becomes loose at about 40ft Siltier than above, light brown, dense Silt decreases at 46.5ft, coarsens to medium grained with trace very coarse sand, $CaCO_3$ and trace silt	
50				SM	(50-55') Silty Sand, reddish brown, fine-grained moist, loose.	
55				SP	(55-60') Sand, poorly graded, white to gray, fine grained, moist, loose.	
60				ML	(60-67') Silt, gray, moist, firm, blocky structure	
65						
70				SP	(67'-81') Sand, poorly graded, white to gray, fine-grained, moist, loose.	
75						
80						

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1-2

Job No. 2659-20-002 GWB

Date: November 4/5, 2020
Project: Mid-Valley Water Bank
Logged by: SWO/ARB/SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used		(80-81') fine to medium-grained.	
				ML	(81-88.5') Silt, gray, moist, firm, red oxidation staining	
90				SP	(88.5-100') Sand, poorly graded, white to gray, fine-grained, moist, loose, red oxidation staining	
95						
100						
105					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
110						
115						
120						

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Boring Log

2-1

Job No. 2659-20-002 GWB

Date: November 4, 2020
Project: Mid-Valley Water Bank
Logged by: SWO/ARB
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	SM	(0-4') Fine sand with silt, light yellow-brown, moist, moderately loose.	
5				SP	(5-17.5') Fine to medium sand, light yellow-gray, slightly moist, loose, trace pebbles.	
10					(13.5') Fine to very fine sand, slightly gray.	Hard drilling at 13.5
15					(15.5-16') Silt lens.	
20				ML	(17.5-24') Silt, light gray, moist, moderately dense, oxidation mottles at contact Gray-brown, friable Structureless	
25				SM	(24-25') Silty sand, gray-brown, moist, moderate dense	
				SP	(25-29') Medium to coarse sand, trace pebbles, orange, moist, moderately dense.	
30				ML	(29-38.5') Silt with fine sand, light brown, moist, dense, CaCO3 mottling	
35					(34') No to trace sand?? Orange oxidation mottles, friable.	
40				SP	(38.5-46') Fine to very fine sand, yellow-olive, moist, moderately loose.	

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2-1

Job No. 2659-20-002 GWB

Date: November 4, 2020
Project: Mid-Valley Water Bank
Logged by: SWO/ARB
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	SP	Grades to light gray by 41.5'. 6" silt at 41-41.5'. Some oxidation mottling.	
50				SM	(46-51') Silty sand, orange brown to gray, moist, dense. CaCO3 mottles prevalent at 49'.	
				SP	(51-54') Fine to medium sand with trace coarse intervals, gray-brown, moist, moderately loose.	
55				ML	(54-57') Silt, gray, moist, dense, CaCO3 mottles Grades to SM/ML by 57', light yellow-gray-brown.	
60				SP	(57-62') Fine to very fine sand, gray with yellow-brown streaks, moderately loose. Prelavent black oxidation mottling, cross-bedding. (62-69') Light brown-gray, moist, medium dense.	
65					Silt lens at 65'.	
70				SP ML	(69-76') Silt and very fine sand, light gray, moist, dense, with orange oxidation mottling, sand contains crossbedding	
75				SP	(76-79') Fine to medium sand, light, moist, loose, prevalent oxidation	
80				ML	(79-81') Silt with fine sand, orange oxidation mottles, moist, medium dense, prevalent orange & black oxidation mottling at contact with above	

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2-1

Job No. **2659-20-002 GWB**

Date: **November 4, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SWO/ARB**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	ML	(81-85') Silt, light gray, moist, medium dense, orange oxidation mottles	
				SP	(85-91') Fine sand, light gray, moist, medium loose, orange oxidation mottles	
90					Turns light brown with trace of silt.	
				ML	(91-92') Silt, light gray, moist, dense, orange oxidation mottles	
				SP	(92-93') Fine sand, light gray, moist, moderately loose, orange oxidation mottles	
95				ML	(93-95.5') Silt, light gray, moist, dense, orange oxidation mottles, bioturbation	
				SP ML	(95.5-99') Very fine sand with silt, light gray, moist, moderately dense, grades to SM by 99', heavy orange oxidation mottles, oxidation lessens by 96.5'	
100				SM	(99-100') Silty sand, light gray, moist, moderately dense.	
105					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
110						
115						
120						

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2-2

Job No. **2659-20-002 GWB**

Date: **November 5, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	ML	(0-2') Sandy Silt, light brown, fine-grained sands, dry, soft.	
				ML	(2-5') Sandy Silt, brown, fine-grained sands, moist, firm.	
5				SM/ML	(5-13') Sandy Silt/Silty Sand, gray, very fine-grained, moist, soft to firm, red oxidation staining.	
10						Lab Result - 10': 14% Sand, 86% Silt/Clay
15				SP	(13-15') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
				SP	(15-23.5') Sand, poorly graded, reddish brown, fine to medium-grained with some occasional pea gravel, moist, loose.	
20						
25				ML	(23.5-34.5') Sandy Silt, reddish brown, very fine-grained sand, moist, hard, white streaks, partially cemented.	Lab Result - 25'/30': 31% Sand, 69% Silt/Clay
30						
35				SP	(34.5-36.5') Sand, poorly graded, gray, very fine-grained, moist, loose.	
				ML	(36.5-38') Silt, gray, moist, firm, red oxidation staining.	
40				SM	(38-40') Silty Sand, reddish brown, fine-grained, moist, loose.	

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2-2

Job No. **2659-20-002 GWB**

Date: **November 5, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Soil Group	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	SM/ML	(40-48') Sandy Silt/Silty Sand, gray, very fine-grained, moist, firm.	Lab Report - 45': 7% Sand, 93% Silt/Clay
50				ML	(48-50') Silt, red to pink in color, very hard, partially cemented.	Driller indicated very hard drilling at 48'.
55				SM/ML	(50-58.5') Sandy Silt/Silty Sand, reddish brown, very fine-grained, moist, firm.	Paleosol soil hard pan?
60				SP	(58.5-61.5') Sand, poorly graded, gray, very fine grained, moist, loose.	
65				ML	(61.5'-65') Silt, gray, moist, firm, red oxidation staining, blocky and brittle	
				SP	(65'-68') Sand, poorly graded, gray, fine to medium grained, moist, loose.	
70				ML	(68-70') Silt, gray, moist, very stiff, white streaking, red oxidation staining.	
75				SP	(70'-75') Sand, poorly graded,reddish brown, fine-grained, moist, loose.	
80				SM/ML	(75-84') Sandy Silt/Silty Sand, reddish brown, very fine-grained, moist, firm.	

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2-2

Job No. **2659-20-002 GWB**

Date: **November 5, 2020**
Project: **Mid-Valley Water Bank**
Logged by: **SEV**
Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Soil Group	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	SP	(84-90') Sand, poorly graded, reddish brown, fine to medium-grained, moist, loose	
90					(90-98') with some occasional pea gravel, moist, loose	
95						
100				ML	(98-100') Sandy Silt, gray, very fine-grained sand, moist, firm, red oxidations staining.	
105					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
110						
115						
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3-1

Job No. **2659-20-002 GWB**

Date: **November 3, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	SM / M	(0-2') Silty Sand/Sandy Silt, light brown, very fine-grained, dry, loose. (2-4') Moist.	Farmer indicated soil has been deep ripped to 6' due to hard pan.
5				ML	(4-8') Sandy Silt, light gray, very fine-grained, moist, firm, red oxidation staining, blocky structure	
10				SP	(8-17') Sand, poorly graded, reddish brown, very fine-grained, moist, loose.	
15						
20				SM	(17-20') Silty Sand, reddish brown, fine-grained, moist, loose.	
20				SP	(20-44') Sand, poorly graded, reddish brown to gray, fine-grained, moist, loose.	
25						
30						
35						
40						

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3-1

Date: November 3, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	SP		
				ML	(44-47') Sandy Silt, gray, very fine-grained sands, moist, firm, red oxidation staining.	Lab Report - 45': 46% Sand, 54% Silt/Clay
				ML	(47-48') Sandy Silt, gray to reddish brown, very fine-grained, white streaking, partially cemented.	Possible paleosol hard pan? Driller indicated drilling became very hard at 47'.
50				SM	(48-58.5') Silty Sand, reddish brown, fine-grained, moist, medium dense.	
55						
60				SP	(58.5-71') Sand, poorly graded, gray to reddish brown, medium to coarse-grained with occasional pea size gravel.	
65						
70						
				ML	(71-75') Silt, gray, moist, firm, red oxidation staining.	
75				SP	(75-84') Sand, poorly graded, gray, fine to medium-grained, moist, loose, red oxidation staining.	
80						

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3-1

Job No. **2659-20-002 GWB**

Date: **November 3, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	ML	(84-90') Sandy Silt, gray, very fine-grained sands, moist, firm, red oxidation staining.	
90				SP	(90-95') Sand, poorly graded, white to gray, fine-grained, moist, loose, red oxidation staining.	
95				ML	(95-100') Silt, gray, moist, firm, red oxidation staining.	
100					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
105						
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120						

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3-2

Job No. **2659-20-002 GWB**

Date: **November 2&3, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	SM	(0-1.5') Silty Sand, light brown, very fine-grained, dry, loose.	
5				SM	(1.5-8') Silty Sand, reddish brown, very fine-grained, moist, dense.	Farmer indicated soil has been deep ripped to 6' due to hard pan.
10				SP	(8-11') Sand, poorly graded, white to light gray, very fine-grained, moist, loose.	
15				ML	(11-15') Silt with some clay, gray, moist, stiff, blocky	
20				SP	(15-17.5') Sand, poorly graded, dark gray, very fine-grained, moist, loose.	
25				ML	(17.5-20') Silt, gray, moist, loose, blocky structure, red oxidation staining	
30				SM	(20-25') Silty Sand, reddish brown, very fine-grained, moist, loose.	
35				SP	(25-38') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
40					(33-35') very red.	
				ML	(38-40') Sandy Silt, gray, very fine-grained sand, moist, stiff.	

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3-2

Date: November 2&3, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	SP	(40-43') Sand, poorly graded, gray, very fine-grained, dense, moist.	
				SM/ML	(43-47') Sandy Silt/Silty Sand, reddish brown, moist, hard, brittle, partially cemented, white streaks.	Lab Report: 80% Sand, 17% Silt/Clay. Driller indicated hard drilling at 43-45'. Has hard pan appearance. Paleosol?
				SM	(47-48.5') Silty Sand, reddish brown, very fine-grained, moist, medium dense.	
50				SP	(48.5-64') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
55						
60					(59-60') coarse-grained.	Driller indicated harder drilling at 63'.
65				ML	(64-65') Silt, gray, moist, dense, red oxidation staining.	
				SP	(65-65.5') Sand, poorly graded, gray, very fine-grained, moist, loose, red oxidation staining.	
				ML	(65.5-69') Sandy Silt, reddish brown, very fine-grained, moist, medium dense, red oxidation staining.	
70				SP	(69-70.5') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
75				ML	(70.5-76') Silt, gray, moist, firm, red oxidation staining.	
80				SM/ML	(76-80') Silty Sand/Sandy Silt, gray, very fine-grained sand, moist, firm, red oxidations staining.	

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3-2

Date: November 2&3, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	ML	(80-89') Silt, gray with white streaking, damp to wet, some portions appear partially cemented.	Apparent groundwater percolation barrior.
90				SM ML	(89-92') Silty Sand/Sandy Silt, gray, very fine-grained sand, moist to wet, firm, wet from 91-92'.	
95				SP	(92-100') Sand, poorly graded, gray, very fine-grained, moist, loose, red oxidation staining, wet from 97 to 98'.	
100					(98-100') medium to coarse grained.	
105					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
110						
115						
120						

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4-1

Job No. **2659-20-002 GWB**

Date: **December 3, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	SM	(0-4.5') Silty Sand, reddish brown, fine-grained, moist, loose.	
5				ML	(4.5-5') Silt, gray to brown, moist, firm.	
				SP	(5-15') Sand, poorly graded, gray to red, fine-grained, moist, loose.	
15				ML	(15-19') Sandy Silt, reddish brown, moist, firm.	
20				SP	(19-27') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
30				SM ML	(27-37.5') Sandy Silt/Silty Sand, reddish brown, very fine-grained, moist, firm, occassional beds of poorly graded sands, very fine-grained, up to a several inches in thickness.	Lab Report: 57% Sand, 43% Silt/Clay.
40				SP	(37.5-42') Sand, poorly graded, white to gray, fine-grained, moist, loose.	

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4-1

Date: December 3, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	ML	(42-45') Silt, gray, moist, stiff, red oxidation staining and white streaking.	
50				SM/ML	(45-60') Sandy Silt/Silty Sand, gray to reddish brown, very fine-grained, moist, stiff, red oxidation staining.	
55						Lab Report: 19% Sand, 81% Silt/Clay.
60				SP	(60-64') Sand, poorly graded, gray, fine grained, moist, loose, red oxidation staining, damp to wet at 63'.	
65				ML	(64-67.5') Sandy Silt, dark brown, very fine-grained, moist, firm.	
70				ML SM	(67.5-68.5') Sandy Silt, dark brown, very fine-grained, moist, very hard, red oxidation staining, white streaking, hard pan? (68.5-73') Silty Sand, dark brown, fine-grained, moist, medium dense.	
75				SP	(73-85') Sand, poorly graded, reddish brown, fine to medium-grained, moist, loose.	
80						

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4-1

Job No. **2659-20-002 GWB**

Date: **December 3, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	SP	(85-95') Sand, poorly graded, reddish brown, fine to medium-grained, wet, very loose.	Driller indicates drilling becomes very soft.
95					Bottom of boring: 95' due to heaving sands. Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
100						
105						
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120						

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4-2

Job No. **2659-20-002 GWB**

Date: **December 3 &4, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	ML	(0-3') Sandy Silt, reddish brown, very fine-grained, moist, soft.	
5				ML	(3-5') Sandy Silt, reddish brown, very fined grained, very hard, white streaking.	
				ML	(5-15') Silt, gray, moist, firm, red oxidation staining.	
15				SM/ML	(15-20') Sandy Silt/Silty Sand, reddish brown to gray, very fine-grained, moist, firm.	Lab Report - 15': 50% Sand, 50% Silt/Clay.
20				SP	(20-35') Sand, poorly graded, white to gray, fine-grained, moist, loose.	
35				ML	(35-40') Silt, reddish brown, moist, firm, white streaking.	
40						

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4-2

Job No. 2659-20-002 GWB

Date: December 3 &4, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	SM M	(40-50') Sandy Silt/Silty Sand, dark brown, very fine-grained, moist, firm, some white streaking.	Lab Report - 40'/45': 47% Sand, 53% Silt/Clay.
50				ML	(50-58') Silt, gray, moist, firm, red oxidation staining, white streaking.	
55						
60				SP	(58-59.5') Sand, poorly graded, gray to light brown, moist, loose	
				ML	(59.5-61') Silt, gray, moist, firm, red oxidation staining.	
65				SM ML	(61-69') Sandy Silt/Silty Sand, gray, very fine-grained, moist, firm.	Driller indicates hard drilling at 67'.
70				SM	(69-70') Silty Sand, reddish brown, fine to medium-grained, moist, dense.	
				SP	(70-75') Sand, poorly graded, fine-grained, moist, loose.	
75				SP	(75-78.5') Sand, poorly graded, very fine-grained, moist, loose.	
80				ML	(78.5-80') Silt, gray, moist, firm, red oxidation staining.	

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4-2

Date: December 3 &4, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	ML	(80-85') Silt, gray to reddish brown, moist, firm.	
90					(88-92.5') Heavily oxidized.	
95				SP	Sand, poorly graded, reddish brown, fine to medium-grained, loose, moist.	
100					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
105						
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5-1

Job No. **2659-20-002 GWB**

Date: **November 2, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	SM/ML	(0-2') Silty Sand/Sandy Silt, light brown, very fine-grained, dry, loose/soft.	
					(2-9') soil is moist	
5						Lab Report - 5': 31% Sand, 69% Silt/Clay.
10				SM	(9-13.5') Silty Sand, reddish brown, fine-grained, moist, loose, red oxidation staining.	
				SP	(13.5-21') Sand, poorly graded, white to light gray, fine-grained, moist, loose, red oxidation staining.	
15						
20						
				SM	(21-22') Silty Sand, reddish brown, very fine-grained,	
				ML	(22-23') Silt, gray, moist, firm, red oxidation staining.	
				SP	(23-41') Sand, poorly graded, white to light gray, fine-grained, moist, loose, red oxidation staining.	
25						
30						
35						
40						Driller noted harder drilling around 40'

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Boring Log

5-1

Job No. **2659-20-002 GWB**

Date: **November 2, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	ML	(41-41.5') Sandy Silt, grayish brown, moist, very stiff, blocky structure	
				SM ML	(41.5-45') Silty Sand/Sandy Silt, grayish brown, very fine to fine-grained, moist, dense/stiff.	
				SP	(45-47.5') Sand, poorly graded, reddish/brown, fine-grained, moist, loose.	
50				CL	(47.5-53') Silty Clay, gray, moist, hard, red oxidation staining, blocky structure.	
				SP	(53-55') Sand, poorly graded, white to light gray, fine-grained, moist, loose.	
55				SM ML	(55-58') Silty Sand/Sandy Silt, gray, very fine to fine-grained, moist, dense/stiff.	
				SP	(58-59') Sand, poorly graded, gray/brown, fine-grained, moist, loose.	
60				SM ML	(59-65') Silty Sand/Sandy Silt, gray, very fine-grained, moist, dense/stiff.	
65				CL ML	(65-72') Silt/Clay, gray, moist, hard, red oxidation staining,	
70						
				SP	(72-79') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
75						
80				ML	(79-88') Sandy Silt, gray, moist, hard	

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5-1

Job No. **2659-20-002 GWB**

Date: **November 2, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	ML		
90				CL	(88-92') Clay, gray, moist, hard, blocky structure	
95				SP	(92-95') Sand, poorly graded, gray, fine-grained, moist, loose.	
				CL	(95-98.5') Clay, gray, moist, hard, red oxidation staining, blocky structure.	
100				SP	(98.5-100') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
105					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
110						
115						
120						

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Boring Log

5-2

Job No. **2659-20-002 GWB**

Date: **November 17, 2020**

Project: **Mid-Valley Water Bank**

Logged by: **SEV**

Drilling Equipment: **CME-55 HSA**

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	ML	(0-1.5') Sandy Silt, light brown, very fine-grained sand, dry, loose.	
					(1.5-5') Sandy Silt, light brown, very fine-grained sand, moist, loose.	
5					(5-10') Silt, tan to gray, moist, firm	
10				SP	(10-11.5') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
				ML	(11.5-12.5') Silt, reddish brown, very fine-grained, moist, firm.	
15				SP	(12.5-15') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
20					(15-34') Sand, poorly graded, reddish brown, fine to medium-grained, moist, loose.	
25						
30						
35				ML	(34-42') Silt, gray, moist, firm, red oxidation staining.	
40						

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Boring Log

5-2

Job No. 2659-20-002 GWB

Date: November 17, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	SP	(42-43') Sand, poorly graded, gray, fine to medium-grained, moist, loose, red oxidation staining.	
				SM	(43-49.5') Silty Sand, dark brown, fine-grained, moist, medium dense.	
50				ML	(49.5-50') Silt, gray, moist, stiff, red oxidation staining.	
				SM	(50-55') Silty Sand, reddish brown, fine-grained, moist, medium dense.	
55				SM/ML	(55-65') Sandy Silt/Silty Sand, gray, very fine-grained, moist, firm, red oxidation staining.	
60						Lab Report - 60'/65': 29% Sand, 71% Silt/Clay.
65				SP	(65-75') Sand, poorly graded, gray to reddish brown, fine to medium-grained, moist, loose.	
70						
75				SM/ML	(75-85') Sandy Silt/Silty Sand, gray to brown, very fine-grained, moist, firm.	
80						

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Boring Log

5-2

Date: November 17, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	SP	(85-87') Sand, poorly graded, gray, fine-grained, moist, loose.	
				ML	(87-90') Sandy Silt/Silty Sand, gray to brown, very fine-grained, moist, firm.	
90				SP	(90-100') Sand, poorly graded, gray, fine to medium-grained, moist, loose.	
95						
100						
105					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
110						
115						
120						

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Boring Log

A-1

Job No. 2659-20-002 GWB

Date: November 17, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	SM	(0-1.5') Silty Sand, light brown, fine-grained, dry, loose.	
				SM	(1.5-5') Silty Sand, reddish brown, moist, loose.	
5				ML	(5-7') Silt, gray, moist, firm, red oxidation staining.	
				SP	(7-10') Sand, poorly graded, gray, fine to medium grained, moist, loose.	
10				ML	(10-17') Silt, gray, moist, firm, red oxidation staining.	
15						
				SP	(17-21.5') Sand, poorly graded, gray, fine-grained, moist, loose.	
20				ML	(21.5-24') Silt, dark gray, moist, firm, red oxidation staining.	
25				SP	(24-35') Sand, poorly graded, reddish brown, fine-grained, moist, loose.	
30						
35				ML	(35-40') Sandy Silt, reddish brown, very fine-grained, moist, firm.	
40						

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Boring Log

A-1

Date: November 17, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45–50	5' Continous Tube Sampler	Not Used	Not Used	SM ML	(40-54') Sandy Silt/Silty Sand, gray, very fine-grained, moist, medium dense.	
55				ML	(54-59') Sandy Silt, blue/gray, fine-grained, moist to wet, dense.	
60				ML CL	(59-63.5') Clay/Silt, blue/gray, moist, stiff.	
65				SP	(63.5-65') Sand, poorly graded, blue/gray, fine to medium-grained, moist, dense.	
				ML	(65-70') Sandy Silt, blue/gray, very fine-grained, moist, firm.	
70–75				ML	(70-85') Silt, blue/gray, moist, stiff.	
80						

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Boring Log

A-1

Job No. 2659-20-002 GWB

Date: November 17, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used	ML CL	(85-95') Clay/Silt, blue/gray, lean, moist, stiff.	
95				SM ML	(95-100') Sandy Silt/Silty Sand, gray/blue, very fine-grained, moist, firm.	
100					Bottom of boring: 100' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
105						
110						
115						
120						

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Boring Log

A-2

Job No. 2659-20-002 GWB

Date: November 18, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
0	5' Continous Tube Sampler	Not Used	Not Used	SM	(0-4') Silty Sand, light brown, fine-grained, dry, loose.	
5				ML	(4-8') Silt, gray to red, stiff	Appears to be hard pan layer at 4.5'.
				SP	(8-9') Sand, poorly graded, reddish brown, fine-grained,	
10				ML CL	moist, loose. (9-12') Silt/Clay, gray, moist, stiff, red oxidation staining.	
				SP	(12-15') Sand, poorly graded, gray, fine to medium-grained, moist, loose.	
15				ML	(15-17.5') Sandy Silt, reddish brown, very fine-grained, moist, firm.	
				SP	(17.5-18.5') Sand, poorly graded, gray, fine-grained, moist,	
20				ML	loose. (18.5-30') Sandy Silt, reddish brown, very fine-grained, moist, firm, red oxidation staining.	
25						
30				SP	(30-34') Sand, poorly graded, gray, fine-grained, moist, loose.	
35				ML	(34-38') Sandy Silt, reddish brown, very fine grained, moist, firm, red oxidation staining.	
40				SP	(38-45') Sand, poorly graded, gray, fine-grained, moist, loose.	

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Boring Log

A-2

Date: November 18, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
45	5' Continous Tube Sampler	Not Used	Not Used	ML	(45-50') Sandy Silt, gray, very fine-grained, moist, occasional interbedded sand layers a few inches in thickness.	
50				ML	(50-55') Sandy Silt, gray/green, very fine-grained, moist.	
55				SM SC	(55-60') Silty Sand/Clayey Sand, blue/gray, moist, firm.	
60				SP	(60-67') Sand, poorly graded, gray/blue, fine-grained, moist.	
65						
70				SM ML	(67-90') Silty Sand/Sandy Silt, gray/blue, very fine-grained, moist, firm. Occasional interbedded poorly graded sands 3 to 4 inches in thickness.	Driller indicates hard drilling around 70'.
75						
80						

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Boring Log

A-2

Job No. 2659-20-002 GWB

Date: November 18, 2020
Project: Mid-Valley Water Bank
Logged by: SEV
Drilling Equipment: CME-55 HSA

Depth, feet	Type of Sampler	Blow Count (bpf)	PID/FID	USCS Field Classification	Field Material Descriptions	Notes
85	5' Continous Tube Sampler	Not Used	Not Used		Drilling stopped at 90' due to hard drilling and equipment conerns.	
90					Bottom of boring: 90' Hole backfilled with cuttings. Drilling Contractor: Salem Engineering Group Driller: Allen Bushey/Josh Palmer	
95						
100						
105						
110						
115						
120						

Individual Boring Ranking (% SP/SM)

Boring 1-1					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	95%	83%	77%	64%	--
Ranking Points (%SP/SM)	2	2	2	3	9
Boring 1-2					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	80%	75%	78%	75%	--
Ranking Points (%SP/SM)	3	4	1	1	9

Boring 2-1					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	100%	88%	68%	61%	--
Ranking Points (%SP/SM)	1	1	5	5	12
Boring 2-2					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	0%	35%	29%	40%	--
Ranking Points (%SP/SM)	7	10	12	9	38

Boring 3-1					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	20%	60%	76%	74%	--
Ranking Points (%SP/SM)	5	6	3	2	16
Boring 3-2					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	100%	68%	75%	62%	--
Ranking Points (%SP/SM)	1	5	4	4	14

Boring 4-1					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	95%	78%	54%	60%	--
Ranking Points (%SP/SM)	2	3	8	6	19
Boring 4-2					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	0%	0%	30%	31%	--
Ranking Points (%SP/SM)	7	10	11	10	38

Boring 5-1					**Total Score**
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	10%	56%	67%	49%	--
Ranking Points (%SP/SM)	6	7	6	8	27

Boring 5-2					Total Score
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	0%	45%	61%	58%	--
Ranking Points (%SP/SM)	7	9	7	7	30

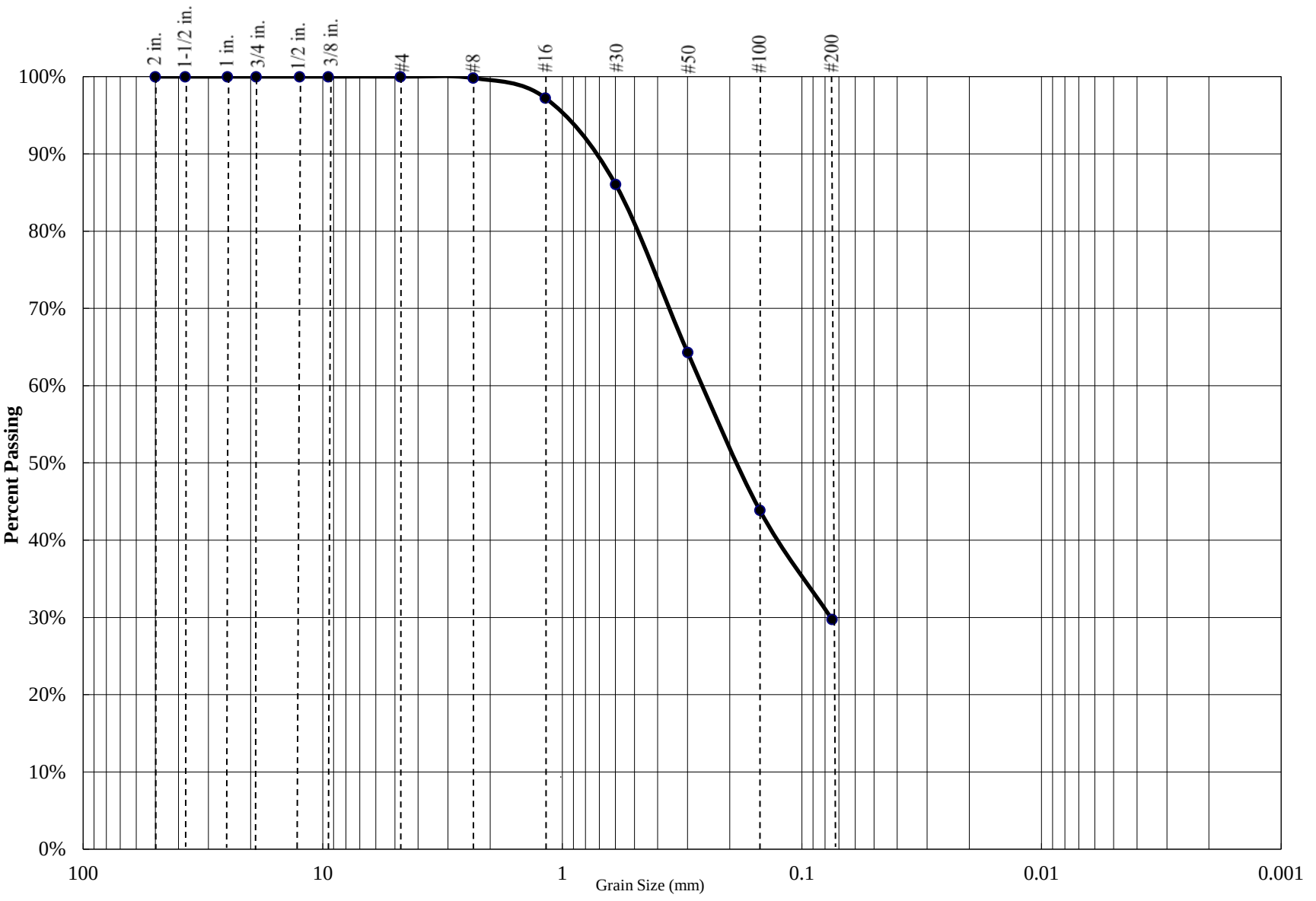
Boring A-1					Total Score
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	80%	55%	47%	25%	--
Ranking Points (%SP/SM)	3	8	9	12	32
Notes from log:					

Boring A-2					Total Score
Soil Type	Upper 10'	Upper 20'	Upper 50'	Upper 100'	--
SP & SM Combined	50%	45%	40%	30%	--
Ranking Points (%SP/SM)	4	9	10	11	34

Appendix B2: Soil Boring Lab Reports

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	70%	30%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	99.8%
#16	97.2%
#30	86.1%
#50	64.3%
#100	43.9%
#200	29.8%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION
Silty Sand (SM)

Project Name: 2659 Mid Valley Waterbank

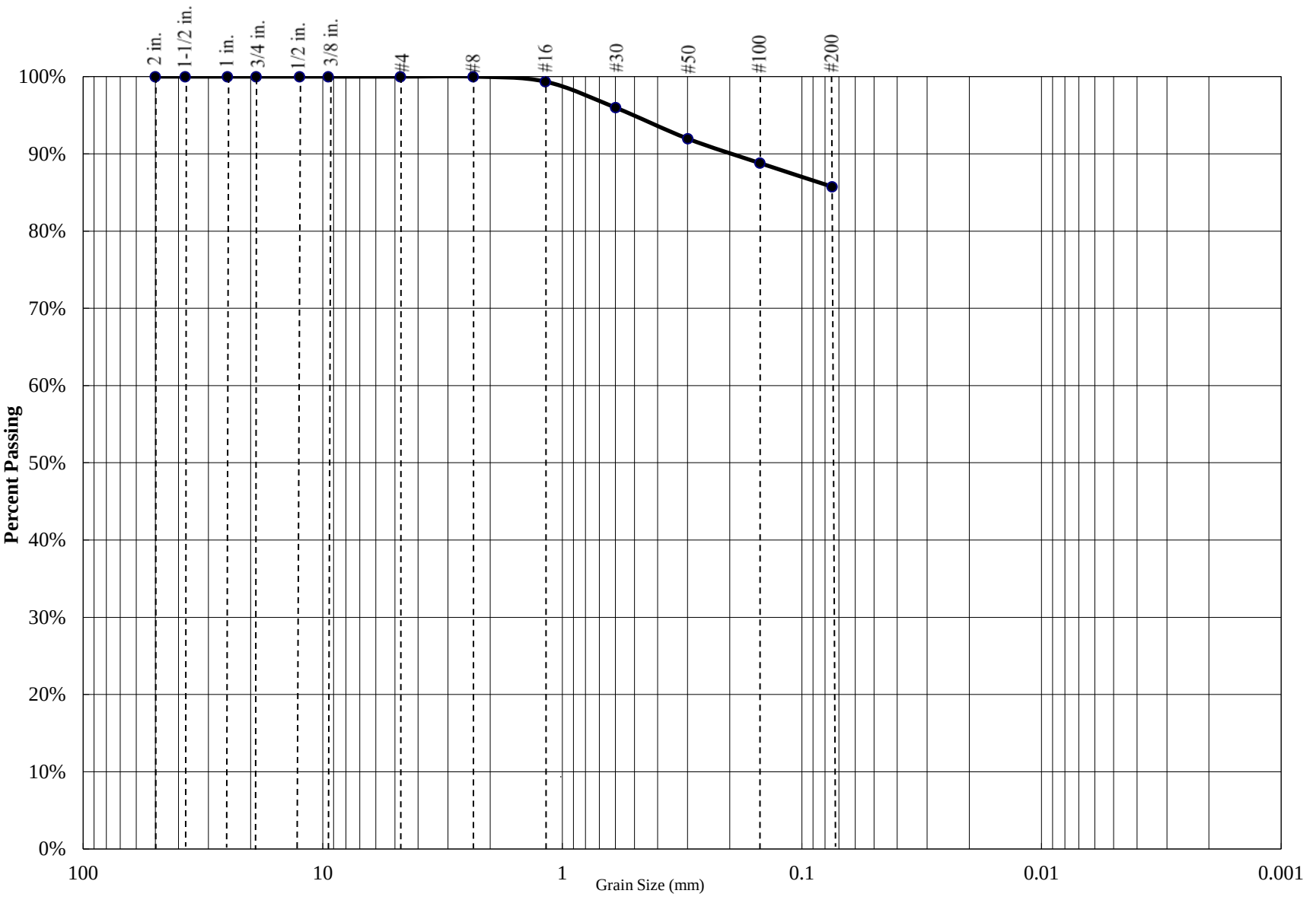
Project Number: 1-120-0914

Boring: 1-1 @ 50'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	14%	86%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	100.0%
#16	99.4%
#30	96.0%
#50	92.0%
#100	88.8%
#200	85.8%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

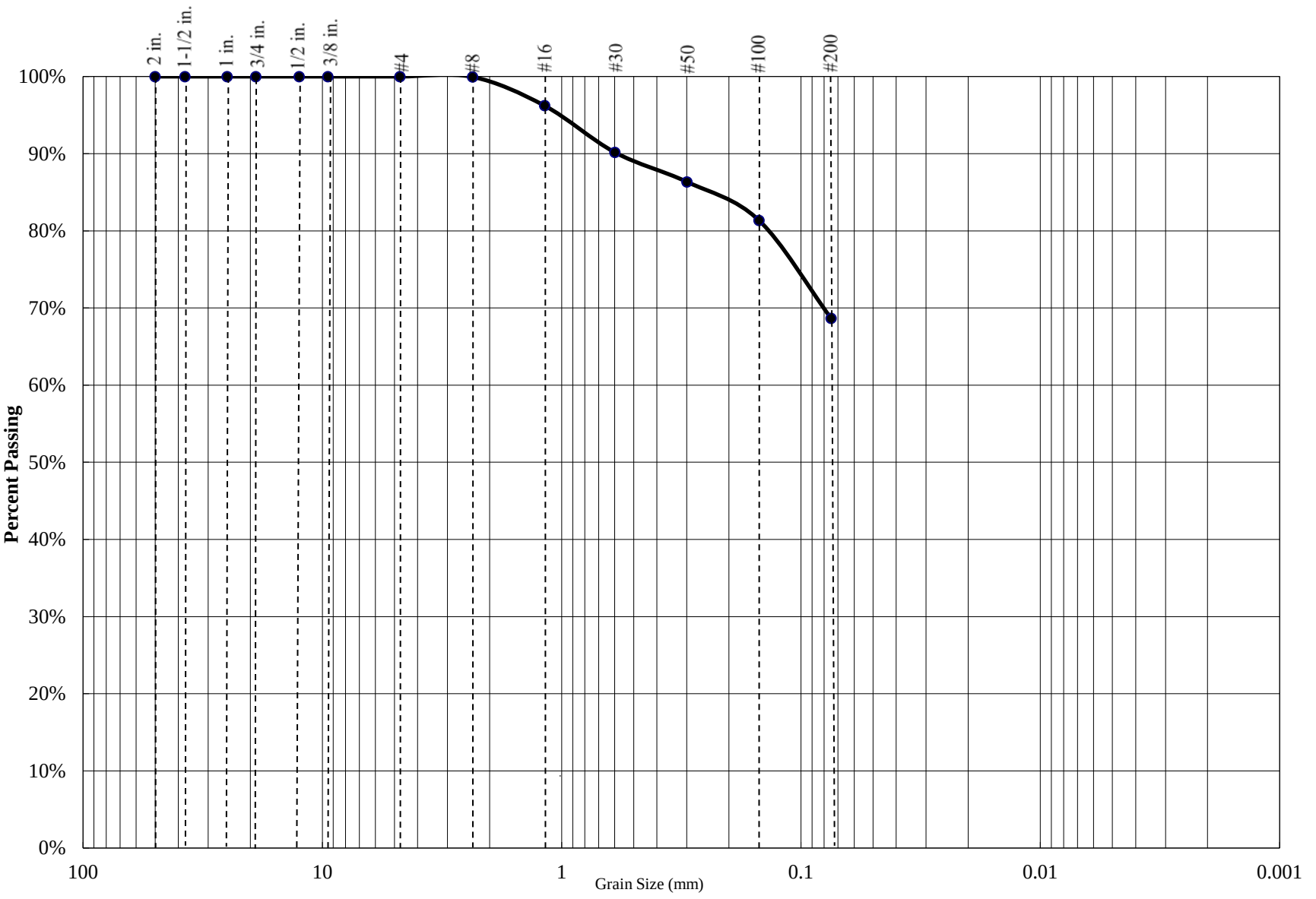
Project Number: 1-120-0914

Boring: 2-2 @ 10'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	31%	69%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	100.0%
#16	96.2%
#30	90.2%
#50	86.4%
#100	81.4%
#200	68.7%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

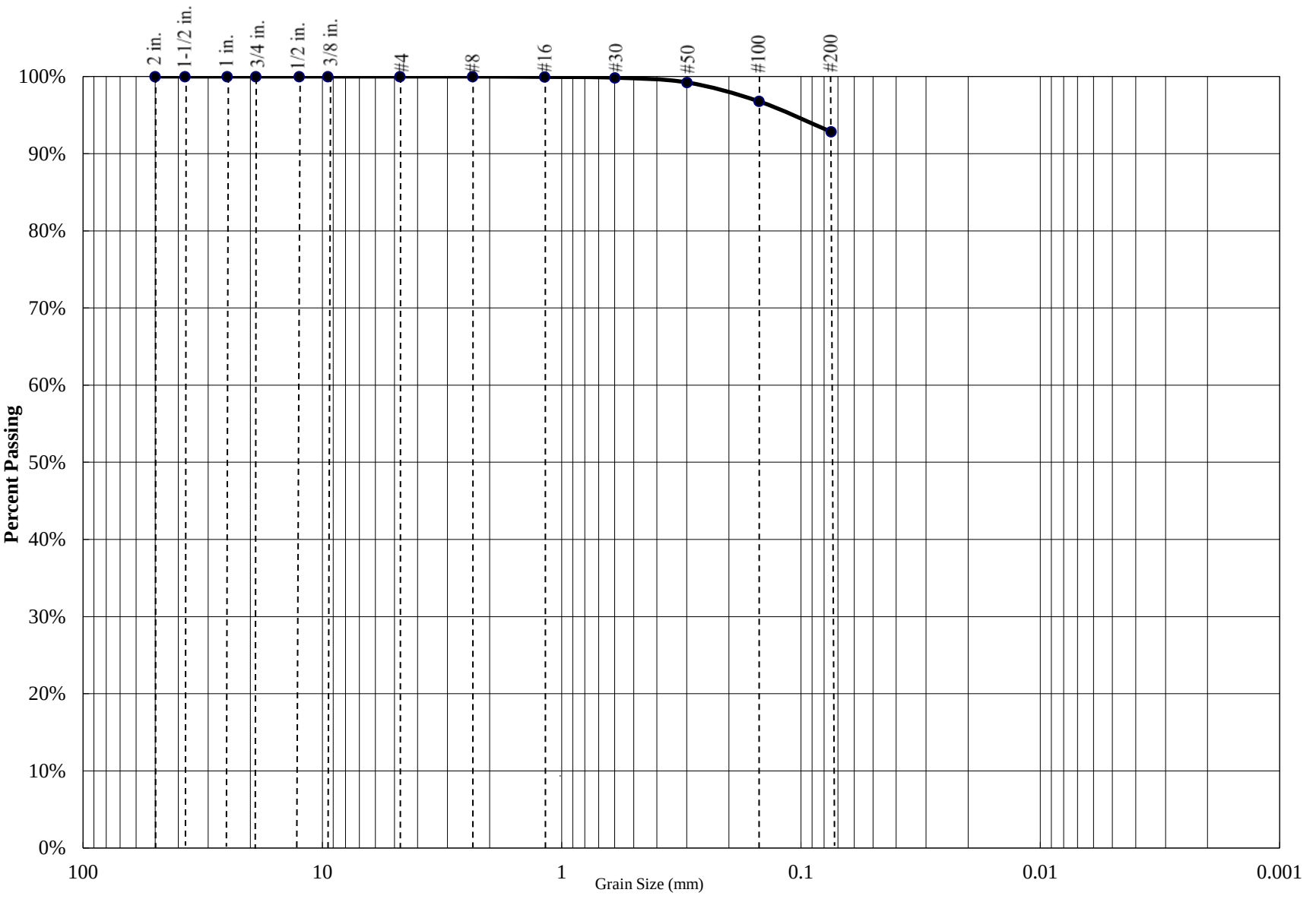
Project Number: 1-120-0914

Boring: 2-2 @ 25' / 30'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	7%	93%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	100.0%
#16	99.9%
#30	99.8%
#50	99.2%
#100	96.8%
#200	92.8%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

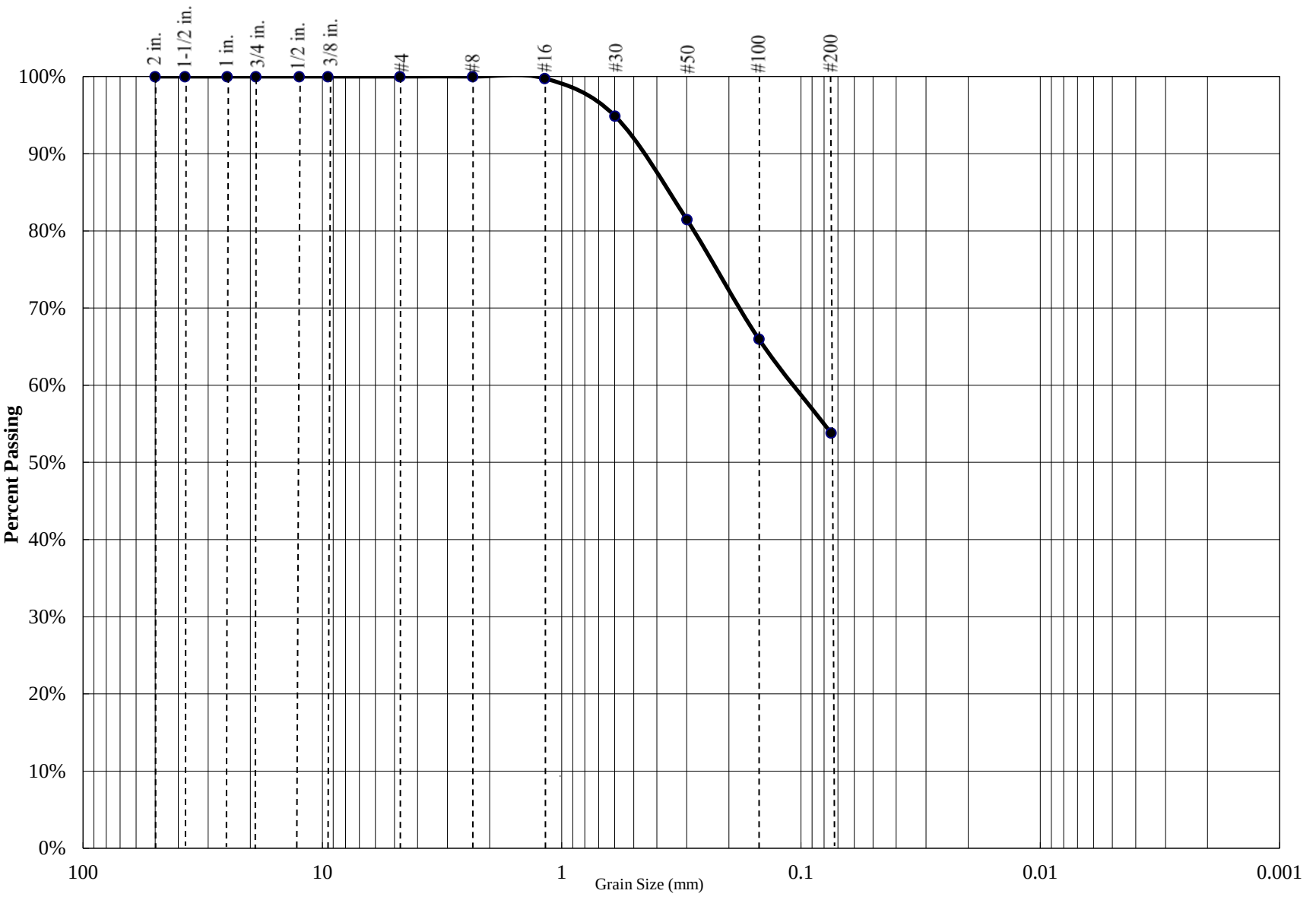
Project Number: 1-120-0914

Boring: 2-2 @ 45'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	46%	54%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	100.0%
#16	99.8%
#30	94.9%
#50	81.5%
#100	66.0%
#200	53.8%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

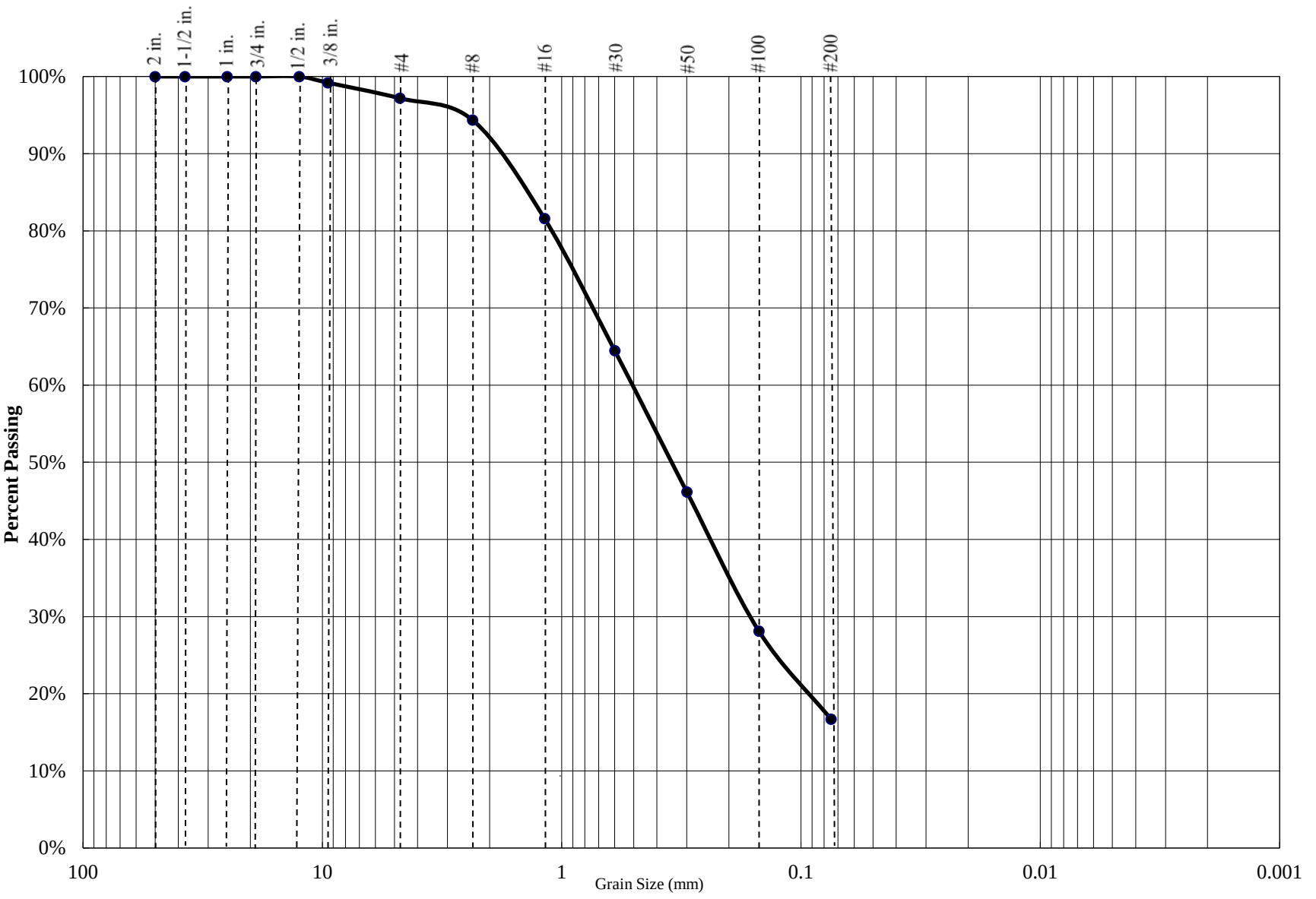
Project Number: 1-120-0914

Boring: 3-1 @ 45'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
3%	80%	17%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	99.2%
#4	97.2%
#8	94.4%
#16	81.6%
#30	64.5%
#50	46.2%
#100	28.1%
#200	16.7%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION
Silty Sand (SM)

Project Name: 2659 Mid Valley Waterbank

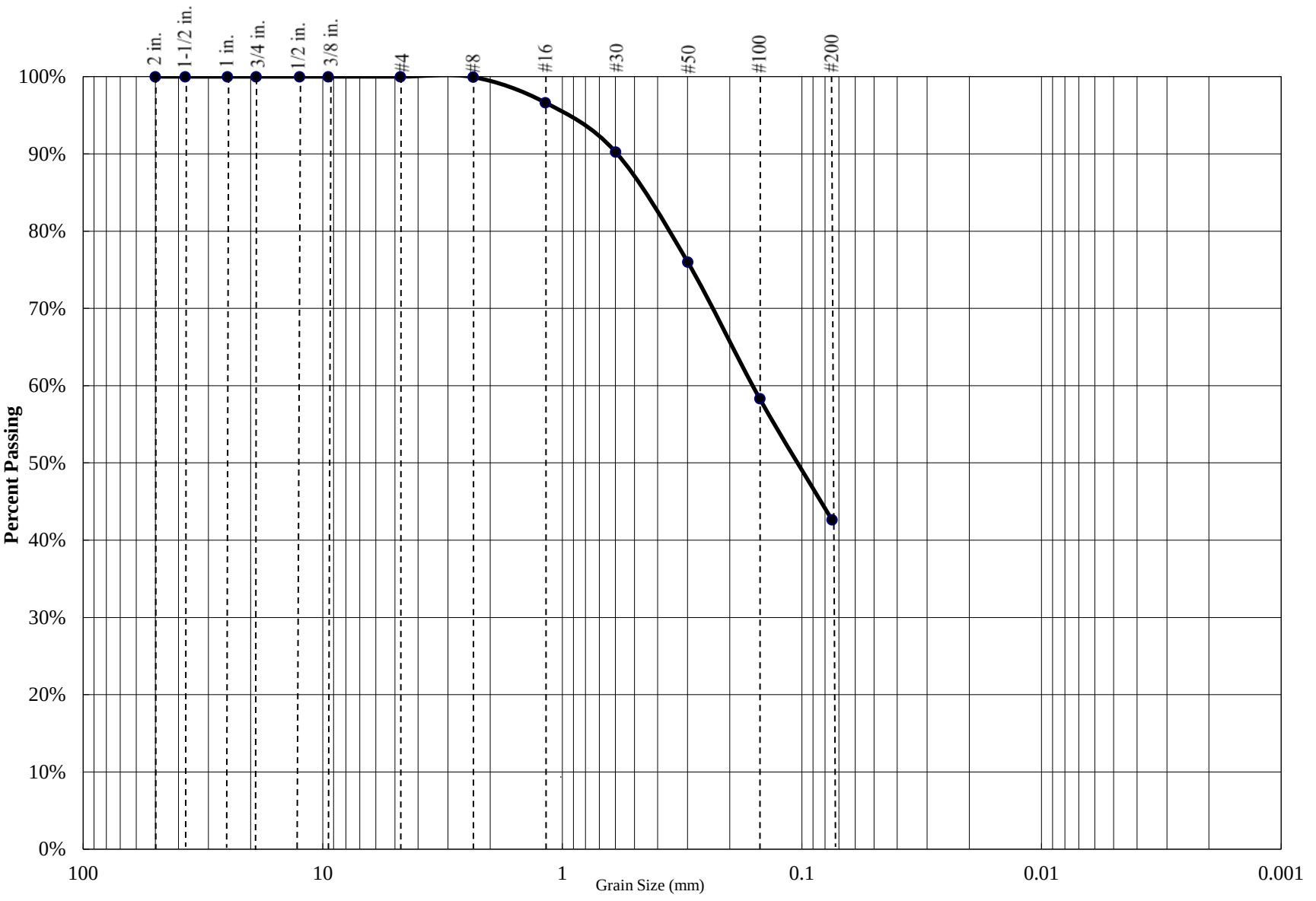
Project Number: 1-120-0914

Boring: 3-2 @ 45'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	57%	43%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	99.9%
#16	96.7%
#30	90.3%
#50	76.0%
#100	58.3%
#200	42.6%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION
Silty Sand (SM)

Project Name: 2659 Mid Valley Waterbank

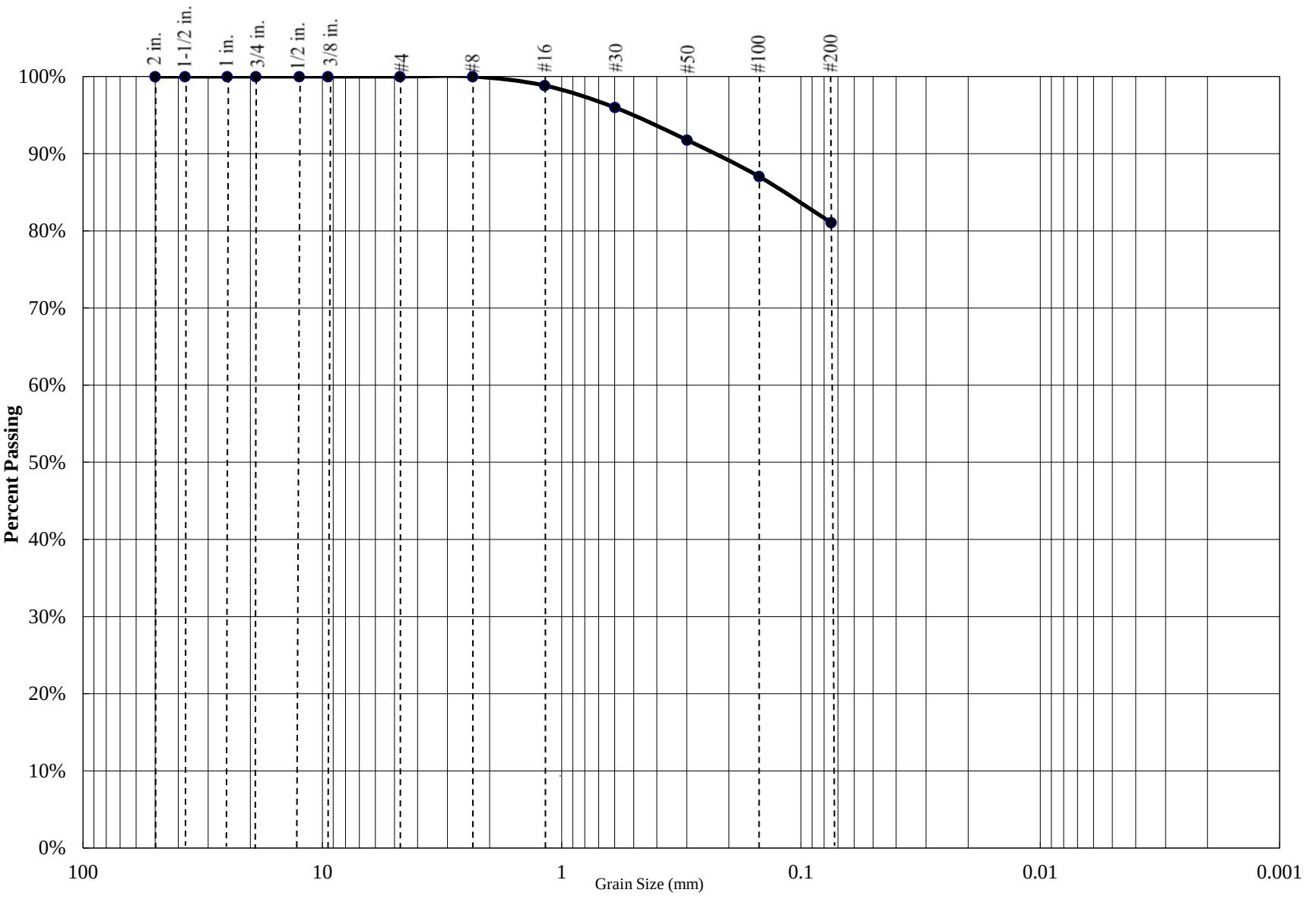
Project Number: 1-120-0914

Boring: 4-1 @ 30' / 35'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	19%	81%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	100.0%
#16	98.8%
#30	96.0%
#50	91.8%
#100	87.0%
#200	81.1%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

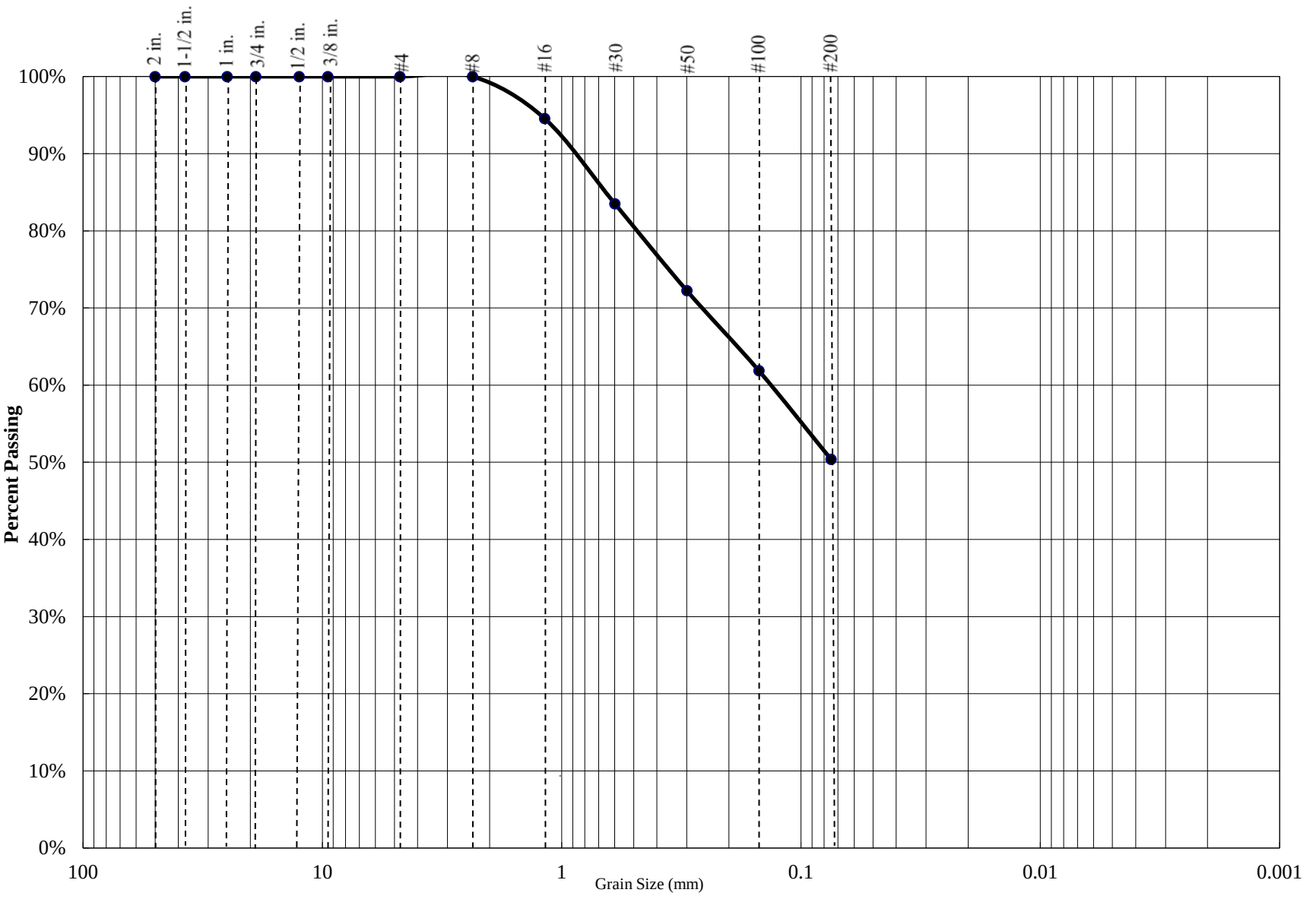
Project Number: 1-120-0914

Boring: 4-1 @ 55'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	50%	50%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	100.0%
#16	94.6%
#30	83.5%
#50	72.2%
#100	61.9%
#200	50.4%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

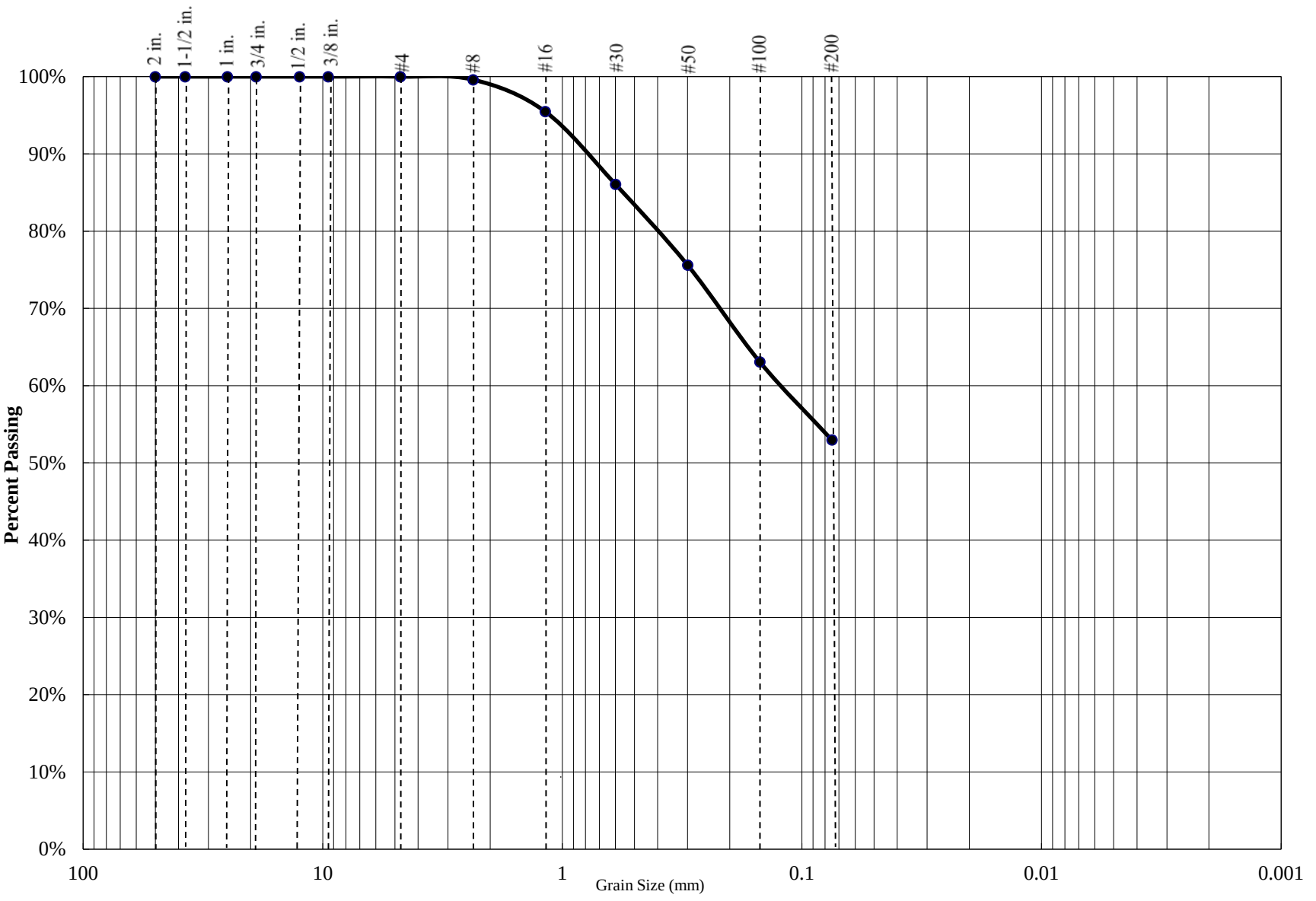
Project Number: 1-120-0914

Boring: 4-2 @ 15'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	47%	53%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	99.6%
#16	95.5%
#30	86.1%
#50	75.6%
#100	63.1%
#200	53.0%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

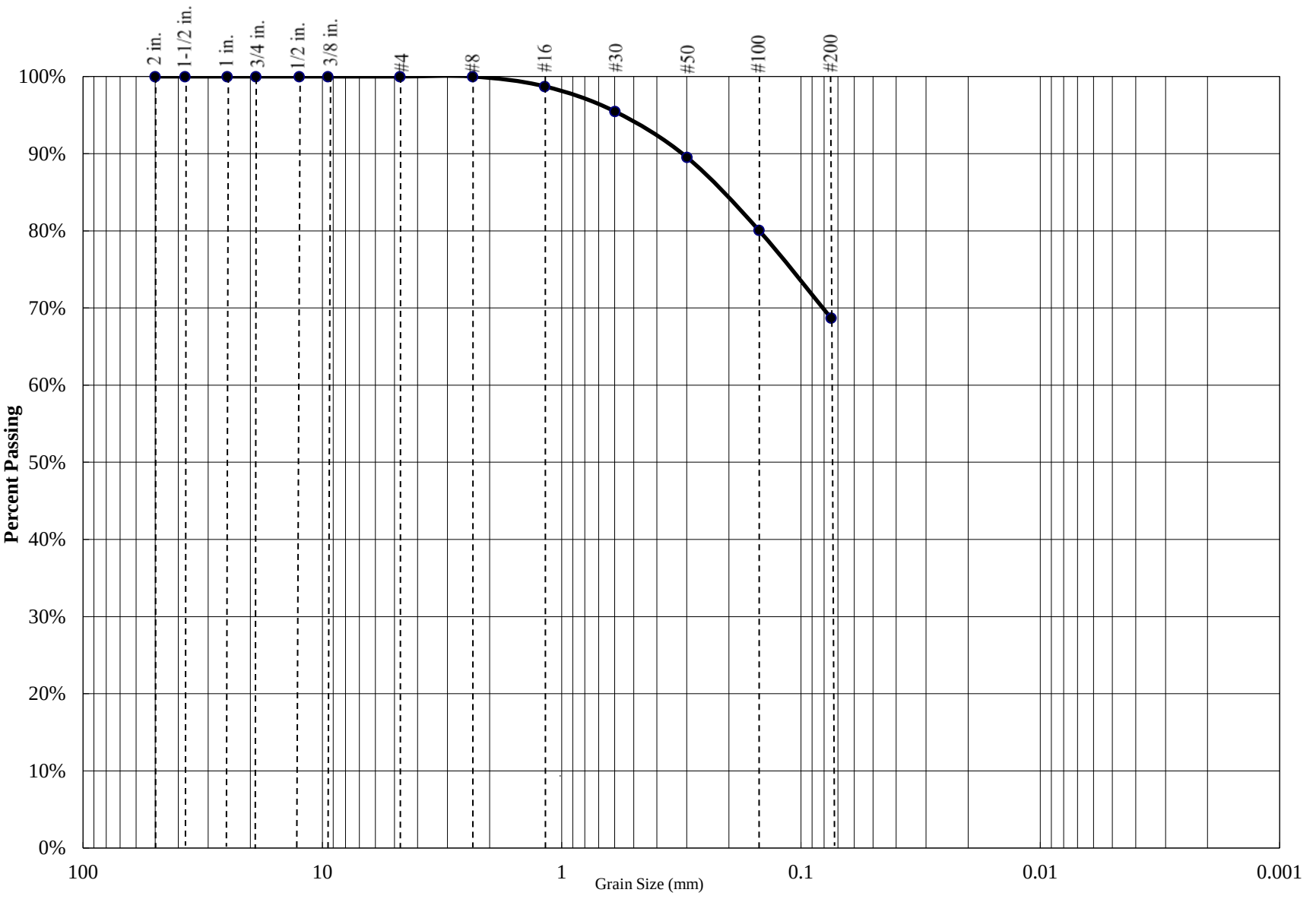
Project Number: 1-120-0914

Boring: 4-2 @ 40' / 45'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	31%	69%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	100.0%
#16	98.7%
#30	95.5%
#50	89.5%
#100	80.1%
#200	68.7%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

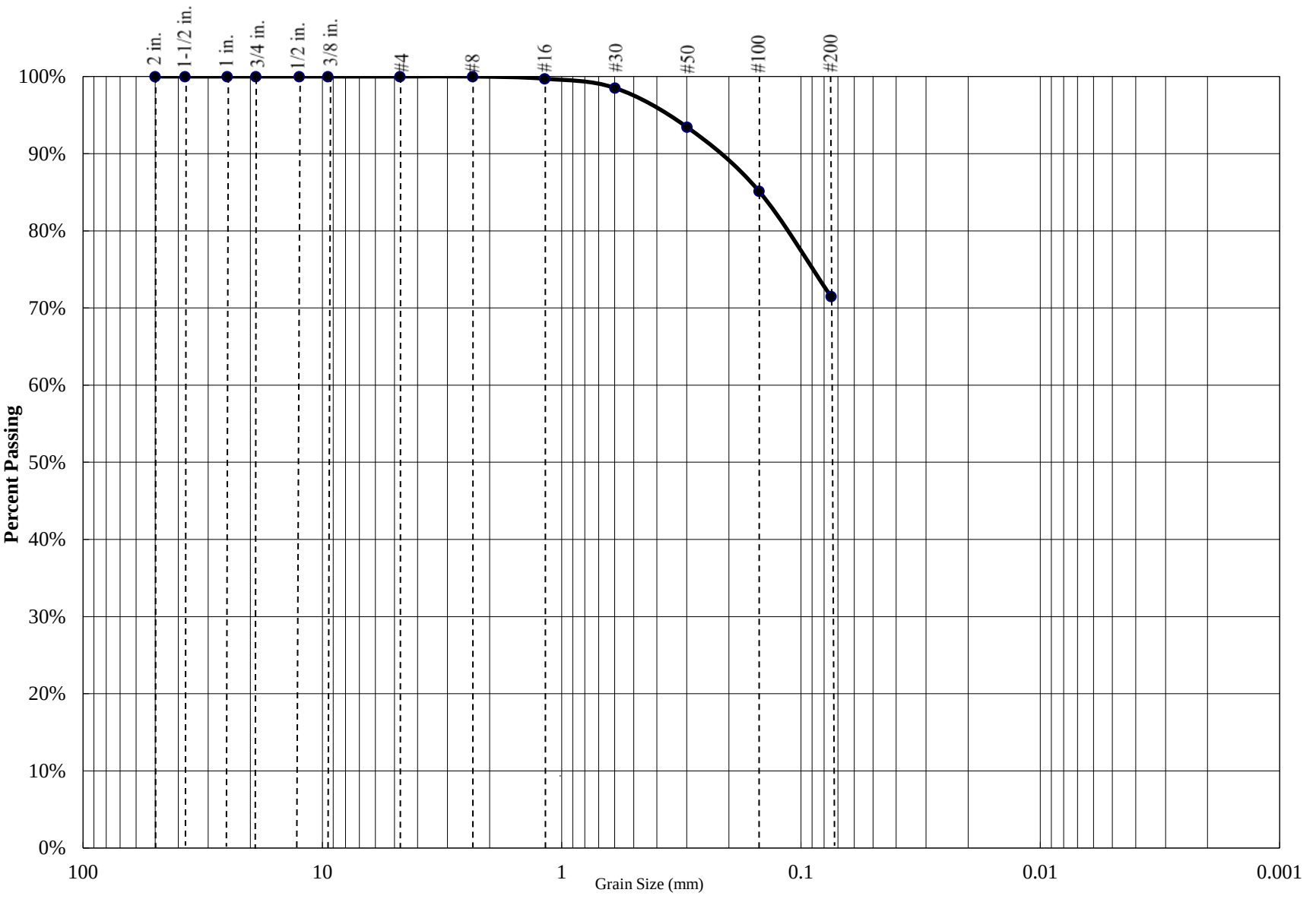
Project Number: 1-120-0914

Boring: 5-1 @ 5'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	29%	71%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	100.0%
#16	99.7%
#30	98.5%
#50	93.5%
#100	85.1%
#200	71.5%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION

Project Name: 2659 Mid Valley Waterbank

Project Number: 1-120-0914

Boring: 5-2 @ 60' / 65'

SALEM engineering group, inc.

Appendix C – Historical Mendota Pool Diversion Data

Attachment 1- San Joaquin River Total Mendota Pool Diversions San Joaquin River

(acre-feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1980	4,154	32,027	52,097	92,021	110,654	132,740	155,339	150,912	92,470	67,661	33,314	2,071	925,460
1981	15,246	44,632	36,832	84,536	122,150	151,208	171,236	142,355	85,673	60,360	9,482	173	923,883
1982	9,723	49,197	40,404	42,598	148,464	146,415	162,565	162,741	92,935	73,782	11,634	1,354	941,812
1983	1,671	14,625	12,507	56,515	112,950	149,842	156,957	152,231	94,552	67,009	9,244	266	828,369
1984	11,307	52,988	63,384	82,235	130,613	147,056	166,837	149,336	83,482	73,245	4,422	0	964,905
1985	5,563	51,074	86,739	73,527	102,098	129,317	140,783	118,407	79,180	42,568	8,029	0	837,285
1986	7,293	15,499	31,282	76,875	110,578	144,416	153,480	127,397	64,867	62,861	34,117	876	829,541
1987	12,533	39,460	48,944	76,525	97,819	126,413	136,095	120,001	66,378	61,267	18,272	93	803,800
1988	10,029	58,374	54,554	47,056	85,631	122,949	148,685	132,129	65,733	37,612	9,199	5,892	777,843
1989	10,581	43,448	61,888	69,139	92,704	122,193	134,646	119,723	78,596	42,744	28,022	10,215	813,899
1990	8,990	45,638	57,935	54,076	62,349	117,192	161,540	140,044	70,021	87,756	19,839	449	825,829
1991	14,727	49,824	41,316	30,991	52,907	98,291	119,406	105,057	51,944	63,443	41,697	5,148	674,751
1992	4,531	20,337	56,332	41,878	61,311	98,648	109,771	88,500	39,606	69,878	24,961	6,233	621,986
1993	811	13,116	52,645	51,172	85,012	112,204	131,124	129,169	80,834	67,020	38,150	25,956	787,213
1994	10,014	51,131	65,590	44,124	44,488	105,519	127,856	91,270	15,894	55,558	12,854	9,064	633,362
1995	2,596	54,249	26,012	45,366	64,692	121,272	158,770	162,040	100,683	100,394	29,826	13,063	878,963
1996	13,194	42,061	48,876	74,112	94,195	131,640	158,766	140,030	75,161	73,605	22,050	16,112	889,802
1997	4,015	50,624	92,730	56,446	110,005	130,069	156,375	130,257	127,145	54,140	37,283	4,202	953,291
1998	14,742	8,122	36,408	19,431	29,177	89,483	152,671	155,342	117,632	73,378	52,770	15,871	765,027
1999	42,098	71,053	60,284	51,035	116,597	129,835	151,202	132,877	127,833	94,839	50,445	6,533	1,034,631
2000	10,371	40,629	56,312	60,881	97,607	146,571	147,652	137,195	128,529	71,212	34,917	40,040	971,916
2001	30,038	66,313	52,202	51,081	106,840	150,597	158,285	132,800	108,793	77,041	41,364	10,644	985,998
2002	8,525	72,197	58,554	59,165	77,137	143,230	160,074	130,708	81,834	155,047	46,993	33,194	1,026,658
2003	20,299	72,919	65,032	49,126	83,517	147,398	164,819	173,497	139,873	94,456	35,350	13,566	1,059,852
2004	20,385	71,826	67,710	61,810	107,859	131,088	146,885	126,300	111,313	123,180	56,363	0	1,024,719
2005	14,219	43,516	49,365	43,196	70,230	135,515	170,181	148,650	101,655	78,963	49,752	6,043	911,285
2006	11,484	92,884	37,557	11,783	96,075	129,684	179,449	156,179	103,188	95,700	48,273	30,759	993,015
2007	41,267	80,993	47,511	47,657	95,934	121,114	137,800	98,602	67,696	67,236	20,941	17,343	844,094
2008	14,838	54,656	75,231	60,196	98,165	105,374	122,707	100,027	86,811	67,028	30,196	1,609	816,838
2009	7,964	34,689	55,020	57,264	93,763	113,828	129,361	99,045	100,302	74,174	29,047	0	794,457
2010	4,339	41,850	43,163	29,934	99,458	139,412	155,006	137,555	99,130	70,831	35,391	24,601	880,670
2011	16,634	57,662	47,980	49,977	92,010	120,691	161,623	155,227	113,054	79,641	34,455	2,016	930,970
2012	18,652	95,231	39,165	37,566	103,088	129,077	139,834	129,500	88,844	66,401	31,983	15,627	894,968
2013	18,057	73,523	62,801	69,596	120,564	120,425	133,794	99,391	69,544	63,301	30,732	14,628	876,356
2014	13,035	25,919	21,529	30,028	59,540	95,454	101,548	85,748	60,441	65,905	46,816	18,347	624,310
2015	5,215	35,070	41,722	31,350	44,028	81,697	83,295	58,860	39,962	43,919	26,375	17,364	508,857
2016	8,913	30,993	45,946	47,557	80,312	123,861	125,493	102,070	80,017	68,043	35,416	7,120	755,741
2017	13,422	17,353	50,573	56,889	127,725	139,460	147,862	127,828	89,455	69,160	38,832	28,731	907,290
2018	22,311	67,614	27,854	39,673	93,189	123,320	140,741	108,742	77,336	64,054	44,037	12,178	821,049
Average	12,754	49,093	51,323	53,341	91,117	125,496	145,734	128,308	86,433	72,865	30,404	10,260	857,128
Maximum	42,098	95,231	92,730	92,021	148,464	151,208	179,449	173,497	139,873	155,047	56,363	40,040	1,059,852
Minimum	811	8,122	12,507	11,783	29,177	81,697	83,295	58,860	15,894	37,612	4,422	0	508,857

Minimum Available (Based on 2018 Historical Use)												
Acre-Feet	98,643	45,510	48,011	48,720	0	0	0	0	868	0	84,378	100,701
cfs	1,604	819	781	819	0	0	0	0	15	0	1,418	1,638
90-Percentile Use												
Acre-Feet	22,311	73,523	67,710	76,875	122,150	147,398	166,837	156,179	127,145	95,700	49,752	28,731
90-Percentile Availability												
Acre-Feet	157,138	105,926	111,739	102,574	57,299	32,051	12,612	23,270	52,304	83,749	129,697	150,718
cfs	2,556	1,907	1,817	1,724	932	539	205	378	879	1,362	2,180	2,451

Appendix D – Analysis of Water Needs for Potential Project Participants

As described in this Feasibility Report, the Aquaterra Groundwater Bank program would be available for use by a wide variety of potential water agencies, subject to provisions that are defined in banking program framework agreements. The potential water bank needs of water agencies would vary depending on their portfolio of water supplies, the characteristics of their water demands and other water management options (such as in-district surface or groundwater storage). For the analysis here, the focus is on the potential needs for SWP contractor participants, many of which have many common water management objectives. The use of SWP contractors as target Water Bank participants is for purposes of defining potential project facility capacities and does not preclude other water agency groups from participating in the Aquaterra Groundwater Bank. The project operations described here are a first level analysis and will be refined in the future as specific water users are identified for potential project participation. Additionally, while the analysis here is focused on specifics of SWP water supply availability and constraints, it can be refined in the future based on operational needs for agencies with other types of water supplies.

In informal discussions with SWP contractors, there are several individual contractors that potentially have an interest in participation in a project like the Aquaterra Groundwater Bank. These contractors have experienced periods in recent years when their carryover water supply in San Luis Reservoir has been placed at risk on relatively short notice due to fast developing wet water supply conditions in the Sacramento-San Joaquin Delta. In addition to potentially losing carryover water supplies, these contractors have often lost access to available Article 21 Water supplies, which only are provided on an immediate basis. The ability to store water in a project like the Aquaterra Groundwater Bank would potentially provide benefits for both protection of carryover water supplies and access to Article 21 Water.

To give a range of the potential needs, a typical project has been identified that starts with a 1% share of Table A amounts[2] for SWP contractors. This hypothetical 1% SWP Table A share is then used to quickly scale up to likely participation rates by a range of SWP contractors. For purposes of this discussion, a range of SWP contractor participation is assumed for between 6% and 14%. The 6% level of SWP contractor participation is considered to be likely, while a higher percentage participation is less likely and may be more price-sensitive. The development of likely operations for the Aquaterra Groundwater Bank starts with the 1% SWP contractor share and is then scaled up to 6% and to 14%. Because the level of participation is likely price-sensitive, project facilities will be sized and costs estimated for both the lower and higher participation levels.

For recharge, there are potentially two different conditions that would define the recharge capacity needed. Carryover water could occur in years when SWP Table A allocations are higher than a SWP contractor's own direct needs. The Table A allocations are normally finalized sometime in spring – typically in March or April. A typical SWP contractor would be able to quantify how much water it needs in a year and how much could be available for carryover by summer. Once the amount of potential carryover is known, it could be recharged in the Aquaterra Groundwater Bank over an extended period. The length of this recharge period is defined by when recharge conveyance capacity is available (the beginning) and when carryover water supplies are vulnerable to "spilling" (technically, this would result from SWP water displacing the carryover water in San Luis Reservoir storage). Based on the recharge capacity for the 10% wettest year identified above, there would be firm capacity available for the months of October through December. This three-month period is a conservative assumption and in actual operation, water agencies would likely take advantage of additional capacity in earlier months such as September. The amount of recharge capacity needed for carryover would be divided by three to get the monthly and instantaneous capacity needed.

The other potential need for recharge conveyance capacity would be for Article 21 Water. As noted previously, this water is available on a near instantaneous basis and potentially requires high capacity to store. Article 21 Water becomes available once the SWP share of San Luis Reservoir fills, which would normally not happen prior to January and would be most likely to occur in the last half of February and throughout the

[2] SWP water supply is allocated based on each SWP contractors Table A amounts. The total Table A amounts for all SWP contractors is 4,172,786 acre-feet. Water supplies are typically made available based on each individual SWP contractors share of the total Table A amounts.

entire month of March. After April 1, restrictions in the Sacramento-San Joaquin Delta limit available SWP exports and Article 21 Water would no longer be available.

The potential availability of Article 21 Water for recharge in the Aquaterra Groundwater Bank was determined from available CALSIM operations studies. Studies were obtained with Delta Conveyance facilities with best estimates of likely future operations with the 2020 Incidental Take Permit and anticipated Voluntary Agreements with in-basin water users. Based on these studies, the frequency of available Article 21 Water for the months of February and March was documented as shown in **Figure 1**. This figure shows the availability of Article 21 Water for a hypothetical 1% of a Table A SWP contractor's share using two computations. Incremental supply is taken as the amount of reported Article 21 Water from CALSIM. This computation is considered potentially subject to underestimation of actual availability as it relies on DWR assumptions about the actual carryover of water by SWP contractors in San Luis Reservoir. In recent years, SWP contractors have often retained allocated Table A amounts in San Luis Reservoir storage that are higher than the amounts assumed in CALSIM studies. A potentially more realistic metric for the amount of Article 21 Water available can be determined by using CALSIM monthly deliveries for the total of Table A Amounts, Article 56 (Carryover) Water and Article 21 Water. The total deliveries are considered to be a more realistic estimate of the potential supply available for recharge. Finally, the reported amounts from CALSIM are based on a 1-percent SWP contractor's allocated share of Article 21 Water. In actual operation, an SWP contractor would also have access to unused shares of Article 21 Water for other SWP contractors that are not able to use Article 21 Water.

Based on **Figure 1**, the likely maximum capacity needed by a one-percent SWP contractor would be slightly more than 60 cfs based on total deliveries. Depending on the cost of facilities and price sensitivity, a lower rate of 40 cfs might also be appropriate based on the incremental amount of water supply available. Alternatively, a higher recharge rate of up to 80 cfs might be preferable based on the ability to recharge all available Article 21 Water. This higher recharge capacity would provide the ability to recharge all available Article 21 Water. Scaling up to a larger project (for 14% of SWP Table A Amounts), the total potential recharge capacity would be about 1,120 cfs. For the month of March, when available DMC capacity would be more limiting than in February, 1,120 cfs would be equivalent to about 69,000 acre-feet. 69,000 acre-feet is slightly less than the available lower DMC capacity identified above, indicating that that amount would be feasible for banking recharge operations.

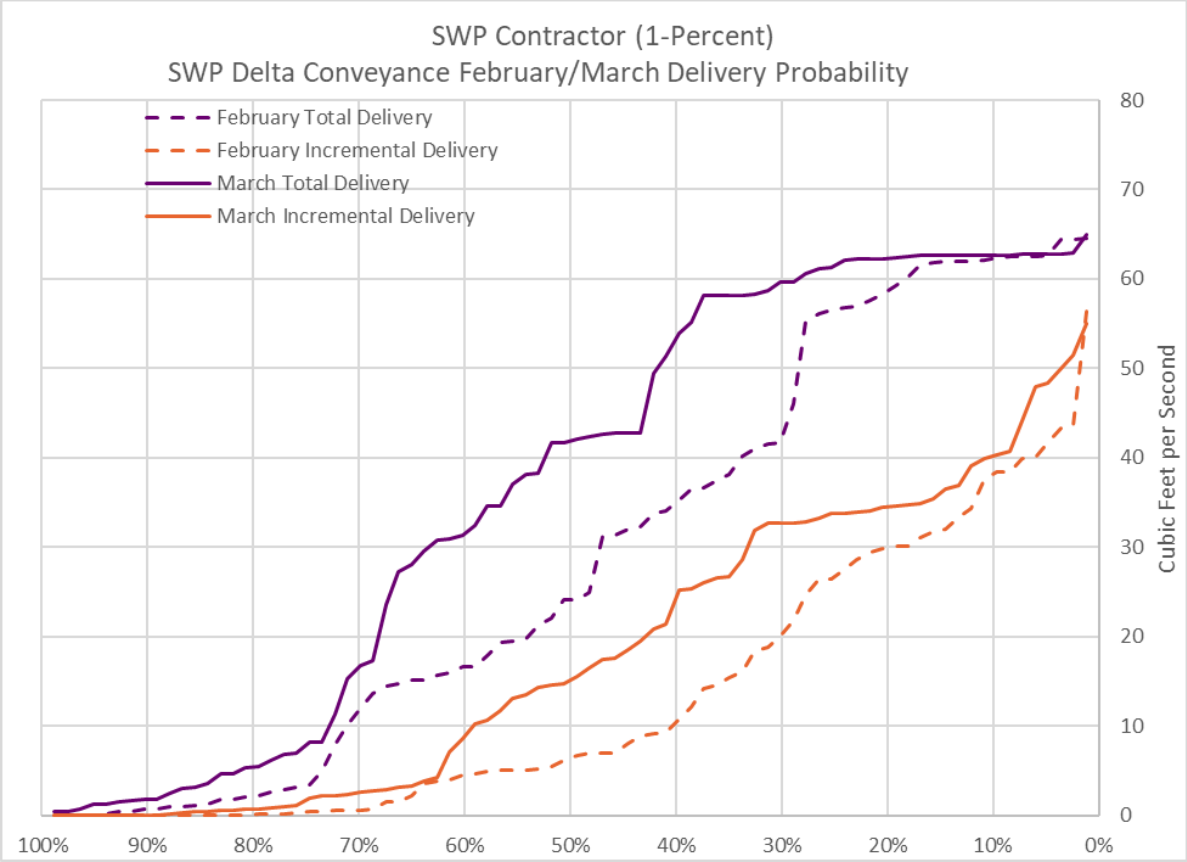


Figure 1 SWP Contractor Delivery Probability

To estimate extraction quantities, an approximate operation of water bank facilities is needed. Specifically, the water bank performance requirements in terms of ability to extract water over a design drought period. Realistically, this would vary for individual SWP contractors and ultimately needs to be developed on a contractor-by-contractor basis considering the characteristics of each SWP contractor's service area demand and other water management facilities (both local and out of district) that would be available. As the project development proceeds, the potential operation of facilities should be refined to reflect the specific SWP contractors that would participate and their water management capabilities and needs.

In the absence of information on specific SWP contractors' participation, a generalized water banking operation was developed for a generic SWP contractor. This operation is based on the availability of SWP Table A allocations and does not integrate the banking operations with other water management capabilities. The starting point for the theoretical 1% SWP contractor banking operation is the Table A allocations, which are summarized by allocation level in **Figure 2**.

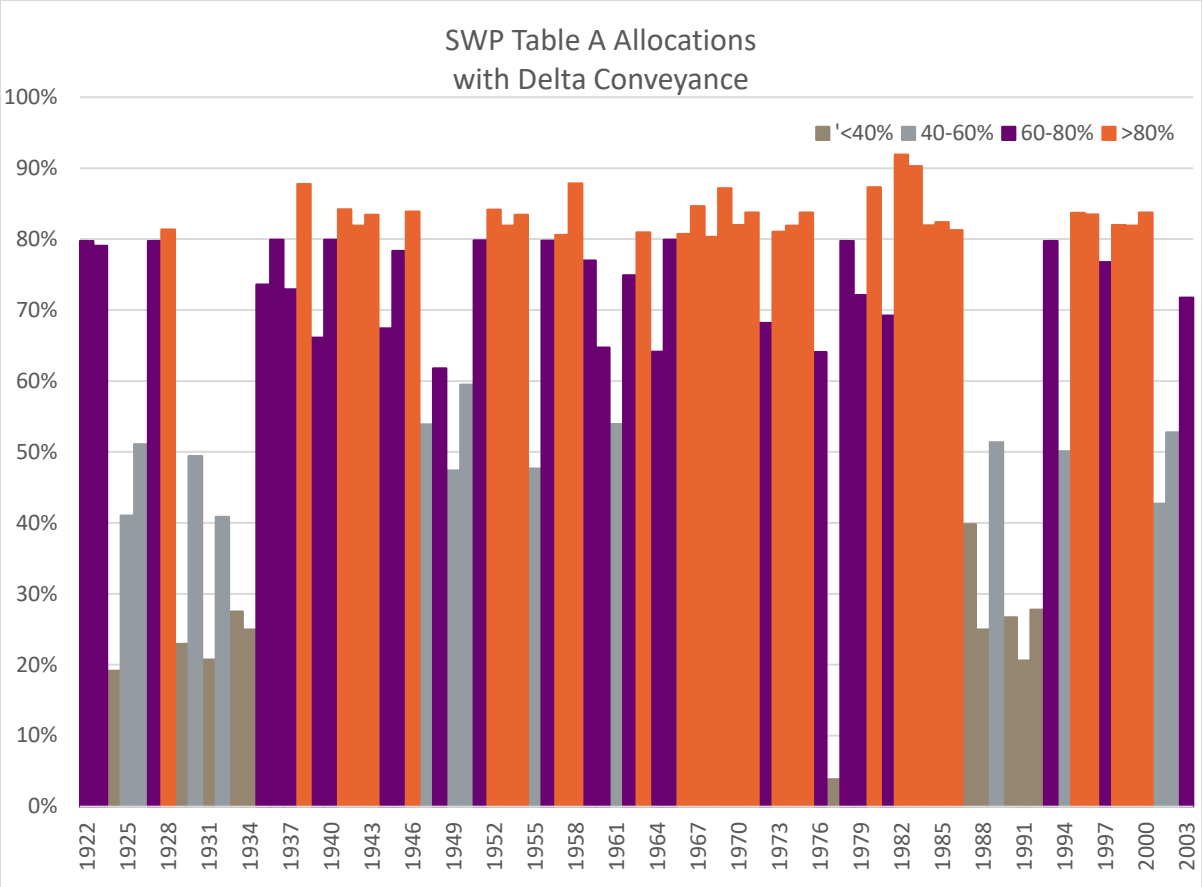


Figure 2 SWP Table A Allocations with Delta Conveyance

As shown in **Figure 2,** SWP allocations are frequently higher than 70% and have two extended dry periods that dominate water supply planning – the 1929-1934 drought and the 1987-1992 drought. Since the CALSIM water supply simulation ends in 2003, it does not represent the recent 2007-2010 and 2012-2016 drought periods.

For planning purposes, thresholds were selected to trigger when extractions would occur and when recharge of higher Table A allocations could occur. For extractions, an assumption has been made that extractions would occur when Table A allocations are less than 60%. Table A allocations are below 60% roughly 30%of the time during the 82-year operations study period. For recharge, a threshold of 80% was used, which occurs in about 40% of the years in the operations study. In addition to recharge of Table A allocation amounts in excess of 80%, it is also assumed that SWP contractors would recharge any available Article 21 Water, which is assumed to occur primarily in February and March, regardless of year type. These assumptions were made as a general guide to project planning for SWP contractors. Individual SWP or CVP contractors are expected to have specific recharge and extraction thresholds based on their own water use characteristics and overall water management strategies.

Using Table A allocations as a guide, a sequence of recharge and extraction events were evaluated to identify the total amount of stored water and extraction rates for a project. A general guideline of maintaining a balanced supply and use over the 82-year study period was used to identify the storage amounts and extraction rates. The extraction rates were identified as those necessary to extract available storage amounts over the two extended dry periods in the analysis period. Based on these goals and using the projected maximum recharge rate of 80 cfs, a storage account of 80,000 acre-feet was identified as appropriate for the model 1% SWP contractor. To use the available storage, the 1% SWP contractor would have access to 50 cfs

of extraction capability. As discussed above, the 50 cfs capacity was assumed to be available for a five-month (May through September) extraction period. Maximum extraction in one year would be 15,200 acre-feet. Because the operations studies start with one of the drought periods occurring relatively soon after the start of the studies, the assumption is made that operations would begin after a period of recharge has allowed storage to fill to normal operational levels. For the analysis, the initial storage level was assumed as 70,000 acre-feet.

Based on these parameters, a theoretical operation of the water bank for a 1% SWP contractor was developed and is shown in **Figure 3**.

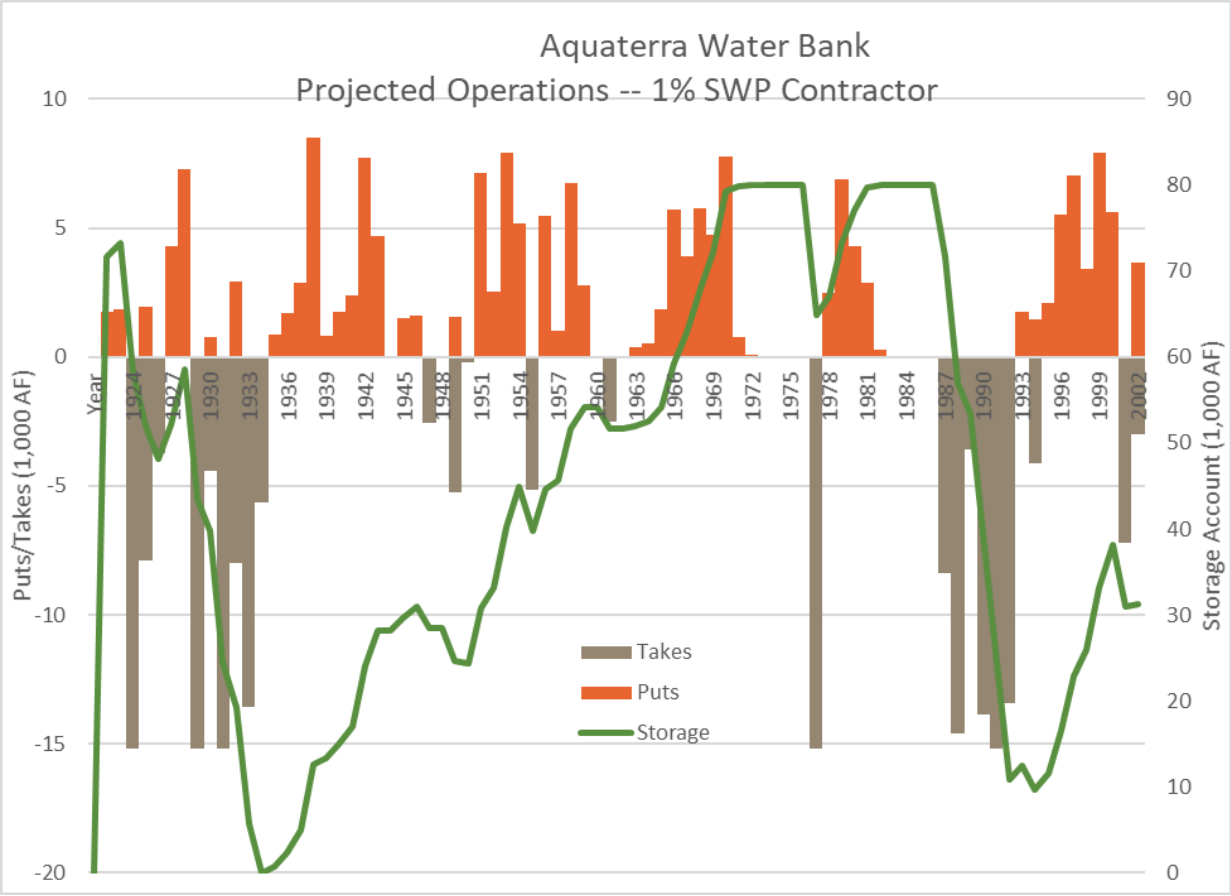


Figure 3 Aquaterra Groundwater Bank Projected Operations

The water bank operation shown would extract essentially the entire volume in the bank by 1934. Subsequently, water would be recharged over an extended period of years and would remain full or near full during the 1970s and 1980s. A large portion of the available storage would then be used again during the early 1990s drought period.

Table 1 was prepared to show the scaling-up of water bank operations for the smaller and larger contractor groups. This shows total project storage potentially ranging from 500,000 acre-feet for a smaller group of SWP Contractors, to 800,000 acre-feet for a medium group and a total of 1,100,000 acre-feet for a larger group. As noted earlier, these estimates are approximate and have been developed to identify a range of project facilities that would be required for the proposed project. Future evaluations will refine the parameters in **Table 1.** based on the specific SWP or CVP contractors that are interested in participation.

Table 1 Aquaterra Groundwater Bank Program Characteristics

	Period	Prototype 1% SWP Contractor	Small SWP Contractor Group (Options 1a, 1b, 2a, 2b, 3)	Medium SWP Contractor Group (Option 4)	Large SWP Contractor Group
Table A Amounts		41.7	248.7	400.0	556.8
Percent Table A Amounts		1.0%	6.0%	9.6%	13.3%
Recharge					
Capacity (cfs)		80	480	770	1070
Recharge (TAF)	Monthly	4.8	28.6	45.8	63.7
Table A Recharge (TAF)	Oct-Dec	14.6	87	140	195
Article 21 Water Recharge (TAF)	Feb-Mar	7.1	43	68	95
Extraction					
Capacity (cfs)**		50	300	480	670
Monthly (TAF)	Monthly	3.0	17.9	28.6	39.9
Annual (TAF)	May-Sep	15	91	146	203
Maximum Storage (TAF)		80	500	800	1,100

*Only water that has been recharged may be extracted.

As described in the feasibility report, the Aquaterra Groundwater Bank operations have been based on the characteristics for the Medium SWP Contractor Group. Further refinement of these parameters and corresponding design capacities will be updated during future design efforts based on the specific needs of Aquaterra Groundwater Bank project participants.

Appendix E – Jensen Canal Concept Designs

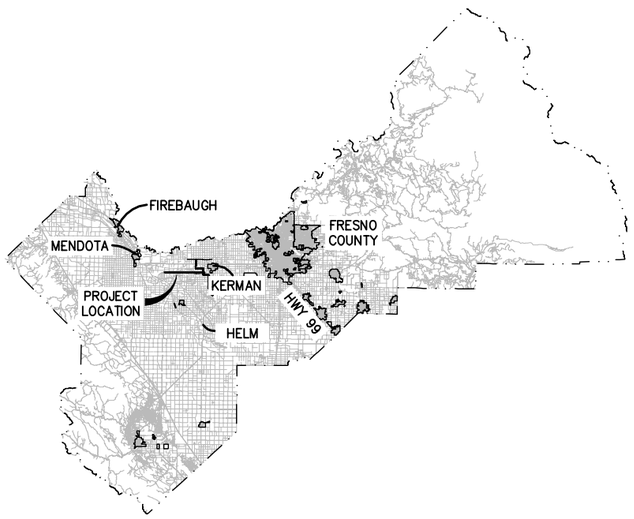
811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD

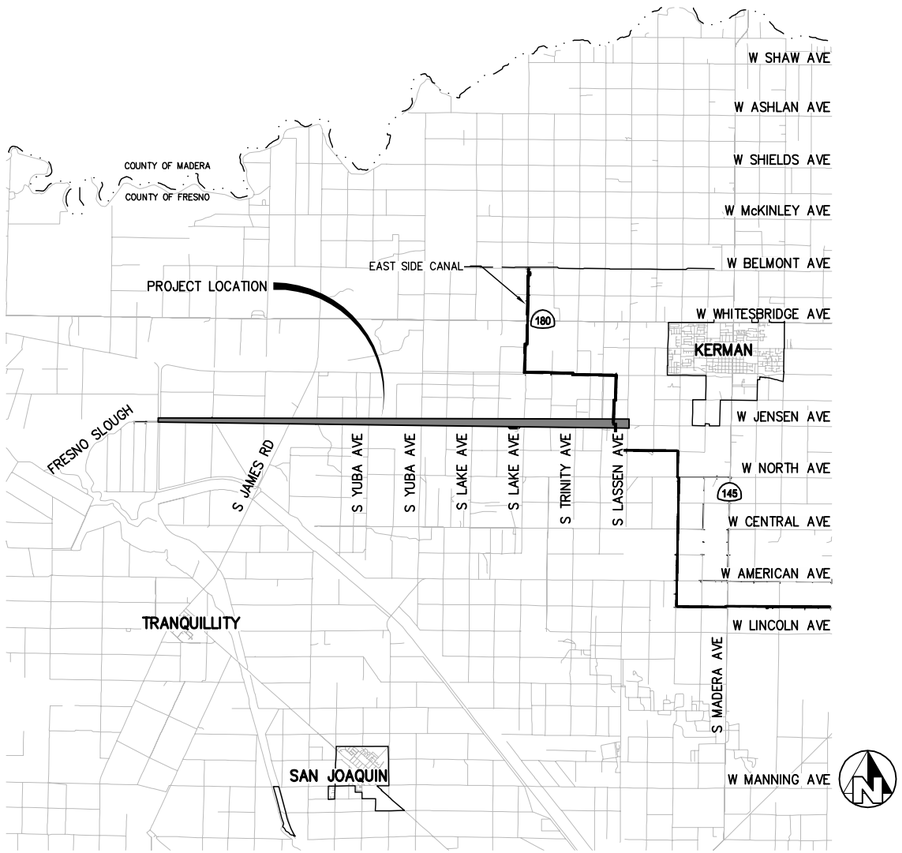
McMULLIN GSA

FRESNO COUNTY, CA

AQUATERRA WATER BANK - JENSEN AVE



VICINITY MAP
NOT TO SCALE



SITE MAP
NOT TO SCALE

SPECIAL NOTE

WHERE UNDERGROUND AND SURFACE STRUCTURES ARE SHOWN ON THE PLANS, THE LOCATIONS, DEPTH AND DIMENSIONS OF STRUCTURES ARE BELIEVED TO BE REASONABLY CORRECT, BUT ARE NOT GUARANTEED. SUCH STRUCTURES ARE SHOWN FOR THE INFORMATION OF THE CONTRACTOR, BUT INFORMATION SO GIVEN IS NOT TO BE CONSTRUED AS A REPRESENTATION THAT SUCH STRUCTURES WILL, IN ALL CASES, BE FOUND WHERE SHOWN, OR THAT THEY REPRESENT ALL OF THE STRUCTURES WHICH MAY BE ENCOUNTERED.

SITE SAFETY AND PROTECTION NOTES

THE DUTY OF THE ENGINEER, OWNER OR ITS AGENTS TO CONDUCT CONSTRUCTION REVIEW OF THE CONTRACTOR'S PERFORMANCE AND THE UNDERTAKING OF INSPECTIONS OR THE GIVING OF INSTRUCTIONS AS AUTHORIZED HEREIN IS NOT INTENDED TO INCLUDE REVIEW OF THE ADEQUACY OF THE CONTRACTOR'S SAFETY MEASURES IN, ON, OR NEAR THE CONSTRUCTION SITE AND SHALL NOT BE CONSTRUED AS SUPERVISION OF THE ACTUAL CONSTRUCTION NOR MAKE THE ENGINEER, OWNER OR ITS AGENTS RESPONSIBLE FOR PROVIDING A SAFE PLACE FOR THE PERFORMANCE OF WORK BY THE CONTRACTOR, SUBCONTRACTORS, OR SUPPLIERS, OR FOR ACCESS, VISITS, USE, WORK, TRAVEL OR OCCUPANCY BY ANY PERSON.

THE CONTRACTOR SHALL HAVE AT THE WORK SITE, COPIES OR SUITABLE EXTRACTS OF CONSTRUCTION SAFETY ORDERS, ISSUED BY CAL-OSHA. CONTRACTOR SHALL COMPLY WITH PROVISIONS OF THESE AND ALL OTHER APPLICABLE LAWS, ORDINANCES AND REGULATIONS. THE CONTRACTOR MUST COMPLY WITH PROVISIONS OF THE SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION, PROMULGATED BY THE SECRETARY OF LABOR UNDER SECTION 107 OF THE CONTRACT WORK HOURS AND SAFETY STANDARDS ACT, AS SET FORTH IN TITLE 29 C.F.R.

TO PROTECT THE LIVES AND HEALTH OF CONTRACTOR'S EMPLOYEES UNDER THE CONTRACT, THE CONTRACTOR SHALL COMPLY WITH ALL PERTINENT PROVISIONS OF THE "MANUAL OF ACCIDENT PREVENTION IN CONSTRUCTION" ISSUED BY THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA, INC., AND SHALL MAINTAIN AN ACCURATE RECORD OF ALL CASES OF DEATH, OCCUPATIONAL DISEASE, AND INJURY REQUIRING MEDICAL ATTENTION OR CAUSING LOSS OF TIME FROM WORK, ARISING OUT OF AND IN THE COURSE OF EMPLOYMENT OR WORK UNDER THE CONTRACT.

THE CONTRACTOR ALONE SHALL BE RESPONSIBLE FOR THE SAFETY, EFFICIENCY, AND ADEQUACY OF CONTRACTOR'S FACILITIES, APPLIANCES, AND METHODS AND FOR ANY DAMAGE, WHICH MAY RESULT FROM THEIR FAILURE OR THEIR IMPROPER CONSTRUCTION, MAINTENANCE OR OPERATION.

THE CONTRACTOR AGREES THAT IT SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE OWNER, PROVOST & PRITCHARD CONSULTING GROUP, AND THEIR RESPECTIVE AGENTS HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF OWNER, ENGINEER, OR THEIR RESPECTIVE AGENTS.

THE OWNER AND ITS AGENTS' SITE RESPONSIBILITIES ARE LIMITED SOLELY TO THE ACTIVITIES OF THEIR EMPLOYEES ON SITE. THESE RESPONSIBILITIES SHALL NOT BE INFERRED BY ANY PARTY TO MEAN THAT THE OWNER OR ITS AGENTS HAVE RESPONSIBILITY FOR SITE SAFETY. SAFETY IN, ON, OR ABOUT THE SITE IS THE SOLE AND EXCLUSIVE RESPONSIBILITY OF THE CONTRACTOR ALONE. THE CONTRACTOR'S METHODS OF WORK PERFORMANCE, SUPERINTENDENCE AND THE CONTRACTOR'S EMPLOYEES, AND SEQUENCING OF CONSTRUCTION ARE ALSO THE SOLE AND EXCLUSIVE RESPONSIBILITIES OF THE CONTRACTOR ALONE.

TOPOGRAPHY NOTE

TOPOGRAPHY SHOWN WAS COLLECTED BY PROVOST & PRITCHARD CONSULTING GROUP DURING A FIELD SURVEY CONDUCTED IN AUGUST OF 2020.

BOUNDARY NOTE

THE BOUNDARY/EASEMENT INFORMATION SHOWN ON THESE PLANS IS BASED UPON RECORD INFORMATION TIED TO PHYSICAL MONUMENTS, AND WAS PREPARED UNDER THE DIRECTION OF BRYAN W. BOWERS, PLS 8469.

GENERAL NOTES

1. ALL CONSTRUCTION SHALL BE IN CONFORMANCE WITH THESE PLANS AND PROJECT SPECIFICATIONS.
2. CONTRACTOR SHALL FIELD VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL EXISTING FACILITIES PRIOR TO COMMENCING WORK. CALL UNDERGROUND SERVICE ALERT (USA) AT 8-1-1. CONTRACTOR SHALL MAKE ENGINEER AWARE OF ANY DISCREPANCIES.
3. ALL CAST-IN-PLACE CONCRETE STRUCTURES SHALL BE FORMED INSIDE AND OUT AND CONCRETE VIBRATED SUFFICIENTLY TO PROVIDE FOR SMOOTH SURFACED WALLS/FLOORS WITHOUT VOIDS AND HONEYCOMBS.
4. McMULLIN GSA SHALL INSPECT ALL WORK PHASES ON CONCRETE FACILITIES FOR CONFORMANCE TO McMULLIN GSA SPECIFICATIONS. REINFORCING SHALL NOT BE ENCASED IN CONCRETE WITHOUT PRIOR McMULLIN GSA INSPECTIONS. LIKEWISE, CONCRETE SHALL NOT BE COVERED WITH EARTH PRIOR TO McMULLIN GSA INSPECTION.
5. CONCRETE DESIGN MIX SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL. ALL CONCRETE SHALL HAVE A 28-DAY MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI UNLESS OTHERWISE SPECIFIED.
6. ALL STEEL PIPE AND FITTINGS SHALL BE FURNISHED WITH A SHOP APPLIED HIGH SOLIDS EPOXY COATING ON THE INTERIOR AND EXTERIOR, UNLESS OTHERWISE INDICATED. ALL OTHER EXPOSED STEEL SHALL BE PAINTED WITH A PRE-TREATMENT PRIMER, AN UNDERCOAT AND A FINAL COAT OF PAINT IN ACCORDANCE WITH McMULLIN GSA SPECIFICATIONS.
7. ALL NUTS, BOLTS, AND WASHERS USED TO SECURE UNDERGROUND FITTINGS SHALL BE STAINLESS STEEL. AFTER INSTALLATION, ALL STEEL HARDWARE SHALL BE COATED WITH A RUST PREVENTATIVE, WRAPPED WITH 4 MIL POLYETHYLENE SHEETING, AND SECURE WITH PVC TAPE.
8. THRUST RESTRAINTS TO BE PROVIDED AT ALL PIPELINE BENDS, WHETHER OR NOT SHOWN ON THE PLANS.
9. ALL CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE HEALTH AND SAFETY LAWS OF THE STATE OF CALIFORNIA AND CAL/OSHA STANDARDS.
10. TRENCH BACKFILL AND RESERVOIR EMBANKMENTS SHALL BE COMPACTED IN ACCORDANCE WITH THE SPECIFICATIONS AND THE GEOTECHNICAL REPORT CONTAINED IN THE SPECIFICATIONS.
11. CONTRACTOR WILL BE RESPONSIBLE FOR THE REPAIR OF ALL PIPELINE CRACKS, WHICH DEVELOP DURING CONSTRUCTION OF IMPROVEMENTS AFFECTING EXISTING FACILITIES.
12. CONCRETE VAULTS AND BOXES MAY BE PURCHASED FROM A PRECAST MANUFACTURER OR CONTRACTOR MAY CONSTRUCT THE STRUCTURES IF STRUCTURAL CALCULATIONS AND DESIGN IS APPROVED BY THE McMULLIN GSA AND THE ENGINEER.
16. ALL EXCESS MATERIAL AND/OR DEBRIS SHALL BE REMOVED UPON COMPLETION OF INSTALLATION.
17. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATE DUST CONTROL AT ALL TIMES.

APPROVALS

--APPROVAL 1-- DATE

--APPROVAL 2-- DATE

SHEET INDEX

NUMBER	SHEET	DESCRIPTION
GENERAL		
1	G1	COVER
2	G2	LEGEND & ABBREVIATIONS
3	G3	TYPICAL CROSS SECTION
4	G4	INDEX SHEET
PLAN & PROFILE		
5	PP1	STA 10+00 TO STA 33+00
6	PP2	STA 33+00 TO STA 60+50
7	PP3	STA 60+50 TO STA 88+00
8	PP4	STA 88+00 TO STA 116+00
9	PP5	STA 116+00 TO STA 144+00
10	PP6	STA 144+00 TO STA 172+00
11	PP7	STA 172+00 TO STA 200+00
12	PP8	STA 200+00 TO STA 228+00
13	PP9	STA 228+00 TO STA 256+00
14	PP10	STA 256+00 TO STA 284+00
15	PP11	STA 284+00 TO STA 312+00
16	PP12	STA 312+00 TO STA 340+00
17	PP13	STA 340+00 TO STA 368+00
18	PP14	STA 368+00 TO STA 396+00
19	PP15	STA 396+00 TO STA 424+00
20	PP16	STA 424+00 TO STA 452+00
21	PP17	STA 452+00 TO STA 480+00
22	PP18	STA 480+00 TO STA 508+00
23	PP19	STA 508+00 TO STA 536+00
24	PP20	STA 536+00 TO STA 562+00
CROSS SECTIONS		
25	CS1	CROSS SECTIONS
26	CS2	CROSS SECTIONS
27	CS3	CROSS SECTIONS
STRUCTURAL		
28	S1	PUMP STATION
DETAILS		
29	D1	CONSTRUCTION DETAILS
30	D2	CONSTRUCTION DETAILS

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK - JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
GENERAL
COVER

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
1234 E. SHAW AVENUE, SUITE 101
FRESNO, CALIFORNIA 93710-8162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD
CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.
SHEET G1
1 OF 30

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ABBREVIATIONS

AB	AGGREGATE BASE	HORIZ	HORIZONTAL	TC	TOP OF CURB
AC	ASPHALT CONCRETE	HP	HINGE POINT, HIGH POINT, HORSEPOWER	TCE	TEMPORARY CONSTRUCTION EASEMENT
ACP	ASBESTOS–CEMENT PIPE	HP GAS	HIGH PRESSURE GAS	TDI	TENSILE DUCTILE IRON
AD	ALUMINUM DISK	HPS	HIGH PRESSURE SWITCH	TELE	TELEPHONE
AGG	AGGREGATE	HR	HANDRAIL	TF	TOP OF FOOTING
AH	AHEAD	H/T	HUB & TACK	TFC	TOP FACE OF CURB
ALT	ALTERNATE	HWL	HIGH WATER LEVEL	TG	TOP OF GRATE
AP	ANGLE POINT	HYDRO	HYDROPNEUMATIC	TH	THREAD
APPROX	APPROXIMATE	ID	INSIDE DIAMETER	TL	TOP OF LINING
APN	ASSESSOR'S PARCEL NUMBER	IN	INCH	TOE	TOE OF SLOPE
ARV	AIR RELIEF VALVE	INV	INVERT	TOP	TOP OF SLOPE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	IP	IRON PIPE	TP	TELEPHONE POLE
AV	AIR VENT	IRR	IRRIGATION	TR	TELEPHONE RISER
AVE	AVENUE	JP	JUNCTION POLE	TRANS	TRANSFORMER
AWWA	AMERICAN WATER WORKS ASSOCIATION	LBS	POUNDS	TRFC	TRAFFIC
BAR	BARRIER	LC	LENGTH OF CURVE	TS	TOP OF STRUCTURE
BC	BEGIN CURVE	LCW	LONG CRESTED WEIR	TSB	TELEPHONE SPLICE BOX
BD	BRASS DISK	LF	LINEAR FEET	TYP	TYPICAL
BFP	BACKFLOW PREVENTER	LG	LONG	TWL	TOP OF WALL
BK	BACK	LT	LEFT	UG	UNDERGROUND
BLDG	BUILDING	LPG	LIQUEFIED PETROLEUM GAS	UP	UTILITY POLE
BM	BENCHMARK	MAX	MAXIMUM	UT	UTILITY
BO	BOLLARD	MB	MAILBOX	U/S	UPSTREAM
BTM	BOTTOM	MCC	MOTOR CONTROL CENTER	VCP	VERIFIED CLAY PIPE
BVC	BEGIN VERTICAL CURVATURE	MFR	MANUFACTURER	VERT	VERTICAL
BW	BACK OF WALK	MH	MANHOLE	VG	VALLEY GUTTER
BWL	BACK OF WALL	MIN	MINIMUM	VLT	VAULT
BWR	BARB WIRE	MISC	MISCELLANEOUS	VLV	VALVE
C, CONC	CONCRETE	MJ	MECHANICAL JOINT	(W)	WEST
CA	CALIFORNIA	MN	MAG NAIL	W	WATER
CAB	CABINET	MP	MEDIUM PRESSURE GAS LINE	WL	WATER LINE
CBL	CABLE	MPT	MALE PIPE THREAD	WM	WATER METER
CFS	CUBIC FEET PER SECOND	MRKR	MARKER	WS	WATER SERVICE
C&G	CURB & GUTTER	MS	MILD STEEL	WV	WATER VALVE
CHK	CHECK	(N)	NORTH	WW	WASTE WATER
CHLK	CHAIN LINK	NAVD	NORTH AMERICAN VERTICAL DATUM	W/	WITH
CI	CAST IRON	NC	NORMALLY CONSOLIDATED	W/O	WITHOUT
CIP	CAST IRON PIPE	NGVD	NATIONAL GEODETIC VERTICAL DATUM		
CIPCP	CAST–IN–PLACE CONCRETE PIPE	NIC	NOT IN CONTRACT		
CL	CLASS	NPT	NATIONAL PIPE THREAD		
CLVT	CULVERT	NTS	NOT TO SCALE		
℄	CENTERLINE	OC	ON CENTER		
CLF	CHAIN LINK FENCE	OD	OUTSIDE DIAMETER		
CLR	CLEAR, CLEARANCE	OH	OVERHEAD		
CMLC	CEMENT MORTAR LINED & COATED	OP	OPERATING		
CMP	CORRUGATED METAL PIPE	OSHA	OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION		
CN	CONCRETE NAIL	O&M	OPERATIONS & MAINTENANCE		
CNS	COMPACTED NATIVE SOIL	(P)	PROPOSED		
CO	SEWER CLEAN OUT	PB	PULL BOX		
CONT	CONTINUOUS	PC	POINT OF CURVATURE		
CONST	CONSTRUCT/CONSTRUCTION	PCC	POINT OF COMPOUND CURVATURE		
COR	CORNER	PCC	PORTLAND CEMENT CONCRETE		
CORP	CORPORATION	PE	PERMANENT EASEMENT		
COL	COLUMN	PER	PERIMETER		
COUP	COUPLING	PI	POINT OF INTERSECTION		
CP	CONTROL POINT	PIP	PLASTIC IRRIGATION PIPE		
CR	CROWN	PLC	PROGRAMMABLE LOGIC CONTROLLER		
CU	CUBIC	P℄	PROPERTY LINE		
CY	CUBIC YARDS	PNL	PANEL		
DA	DRIVE APPROACH	POC	POINT ON CURVE		
DEC	DECIDUOUS	POL	POINT ON LINE		
DEMO	DEMOLISH/DEMOLITION	POT	POINT ON TANGENT		
DI	DROP INLET	PP	POWER POLE		
DIA, ⌀	DIAMETER	PRC	POINT OF REVERSE CURVATURE		
DIM	DIMENSION	PRV	PRESSURE REDUCING VALVE		
DIP	DUCTILE IRON PIPE	PSF	POUNDS PER SQUARE FOOT		
D/S	DOWNSTREAM	PSI	POUNDS PER SQUARE INCH		
DW	DRIVEWAY	PT	POINT OF TANGENCY		
DWG	DRAWING	PVC	POLYVINYL CHLORIDE		
(E)	EXISTING, EAST	PVCC	POINT OF VERTICAL COMPOUND CURVATURE		
EA	EACH	PVMT	PAVEMENT		
EC	END CURVE	PVRC	POINT OF VERTICAL REVERSE CURVATURE		
ECC	ECCENTRIC	PVI	POINT OF VERTICAL INTERSECTION		
EF	EACH FACE	R	RADIUS		
EG	EXISTING GRADE	RBR	REBAR		
EL, ELEV	ELEVATION	RC	RADIUS OF CURVE		
ELC	EPOXY LINED & COATED	RCP	REINFORCED CONCRETE PIPE		
ELEC	ELECTRIC	RD	RELATIVE DENSITY		
ELL	ELBOW	RD	ROAD		
EM	ELECTRIC METER	RE	REFERENCE		
EOL	END OF LINE	REQD	REQUIRED		
EP	EDGE OF PAVEMENT	RET	RETURN		
EQUIV	EQUIVALENT	REV	REVISION		
ESMT	EASEMENT	RGRCP	RUBBER GASKETED REINFORCED CONCRETE PIPE		
EUC	EUCALYPTUS	RGS	RIGID GALVANIZED STEEL		
EVC	END VERTICAL CURVE	RP	RADIUS POINT		
EW	EACH WAY	RR	RAILROAD		
EXP	EXPOSED	RT	RIGHT		
(F)	FUTURE	RTU	REMOTE TERMINAL UNIT		
F&I	FURNISH & INSTALL	R/W	RIGHT OF WAY		
FD	FOUND	(S)	SOUTH, SOLVENT WELD		
FDC	FIRE DEPARTMENT CONNECTION	S	SLIP		
FF	FINISHED FLOOR	S=	SLOPE		
FG	FINISHED GRADE	SCH	SCHEDULE		
FH	FIRE HYDRANT	SCP	STANDARD CONCRETE PIPE		
℄ , FL	FLOW LINE	SD	STORM DRAIN		
FLG	FLANGE	SDMH	STORM DRAIN MANHOLE		
FLGD	FLANGED	SEC	SECTION		
FM	FORCE MAIN	SERV	SERVICE		
FNC	FENCE	SF	SQUARE FEET		
FRP	FIBER REINFORCED POLYESTER PIPE	SP	SERVICE POLE		
FT	FOOT/FEET	SPEC	SPECIFICATION		
FW	FRONT OF WALK	SPNDL	SPINDLE		
FWL	FACE OF WALL	SQ	SQUARE		
GA	GAUGE	SS	SANITARY SEWER		
GAL	GALLON	SS OR STS	STAINLESS STEEL		
GALV	GALVANIZED	SSMH	SANITARY SEWER MANHOLE		
GB	GRADE BREAK	STA	STATION		
GM	GAS METER	STD	STANDARD		
GPM	GALLONS PER MINUTE	STL	STEEL		
GRVL	GRAVEL	STP	STAND PIPE		
GS	GAS	STRC	STRUCTURE		
GSV	GAS VALVE	STRP	STRIPING		
GUY	GUY WIRE	SWL	SWALE		
GV	GATE VALVE	STWL	STILLING WELL		
HD	HEAD	(T)	THREADED		
HDPE	HIGH DENSITY POLYETHYLENE	T	THREAD		
HDR	HEADER	T&B	TOP & BOTTOM		
HDW	HEADWALL	TB	TOP OF BANK		
HGL	HYDRAULIC GRADE LINE	TBM	TEMPORARY BENCHMARK		

LINETYPES

LINETYPE	EXISTING	NEW	DESCRIPTION
			WATER LEVEL
			BARRICADE
			CONTOUR (DEPRESSION)
	123	123	CONTOUR (MAJOR)
			CONTOUR (MINOR)
			EMBANKMENT TOE
			EMBANKMENT TOP
			FENCE (BLOCK WALL)
			FENCE (CHAIN LINK)
			FENCE (WOOD)
			FENCE (WIRE)
	SF	SF	FENCE (SILT)
			GATE SWING
			GRADE BREAK
			GUARDRAIL
			RAILROAD
			RETAINING WALL
	C/C	XX" C/C	SWALE CENTERLINE
	E	XX" ELEC (AERIAL)	SWALE W/FLOW ARROWS
	E	XX" ELEC (BURIED)	WATER (LAKE/POND)
	FO	XX" FO	WATER (MARSH/SWAMP)
	G	XX" GAS	COMPUTER/COMM. (BURIED)
	IRR	XX" IRR	ELECTRIC (AERIAL)
	O	XX" OIL	ELECTRIC (BURIED)
	S	XX" SS	FIBER–OPTIC
	FM	XX" FM	GAS
		XX"	IRRIGATION
	S I	XX" SI	OIL
		XX" STEAM	SANITARY SEWER
	SD	XX" SD	SANITARY SEWER FORCE MAIN
	T	XX" TELE (AERIAL)	SANITARY SEWER LATERAL
	T	XX" TELE (BURIED)	SIGNAL INTERCONNECT (BURIED)
	TV	XX" TV (AERIAL)	STEAM
	TV	XX" TV (BURIED)	STORM DRAINAGE
	W	XX" W	TELEPHONE (AERIAL)
			TELEPHONE (BURIED)
			TELEVISION (AERIAL LINE)
			TELEVISION (BURIED LINE)
			WATER
			CENTERLINE
			EASEMENT
			MEANDER LINE
			PROPERTY LINE
			RESERVATION/PARK/FOREST
			RIGHT–OF–WAY
			RELINQUISH ACCESS LINE
			SECTION LINE
			STATE/COUNTY/CORPORATE LIMIT
			REVISION CLOUD
			SAWCUT LINE
			DEMO LINE
			WORK LIMITS

HATCHES

HATCH TYPE	EXISTING	NEW	DESCRIPTION
			AGGREGATE
			AC PAVEMENT
			CONCRETE
			CONCRETE LINING (PLAN VIEW)
			EARTH
			RIP RAP
			SAND
			GRATING
			EXPANDED METAL

SYMBOLS

SYMBOL EXISTING	SYMBOL NEW	DESCRIPTION
		ELECTRIC METER
		PAD MOUNTED TRANSFORMER
E	E	ELECTRIC VAULT
		UTILITY POLE
		UTILITY POLE ANCHOR
		ELECTRIC MANHOLE
		GAS METER
		GAS VALVE
		SANITARY SEWER CLEAN OUT
	OR	SANITARY SEWER MANHOLE
		SSMH (ECCENTRIC CONE)
		STORM DRAIN CATCH BASIN
		STORM DRAIN INLET
		STORM DRAIN CULVERT
		STORM DRAIN MANHOLE
		MAIL BOX
		SIGN
		YARD LIGHT
		GUARD POST
		CONTROL POINT
		BENCH MARK
		IRON PIPE
		MONUMENT
		MONUMENT (OPTIONAL)
		OWNERSHIP TIE
NO.	NO.	LOT NUMBER
		TELEPHONE RISER
T	T	TELEPHONE VAULT
		2–NOZZLE HYDRANT
		3–NOZZLE HYDRANT
FD	FD	FIRE DEPT. CONNECTION
F	F	FIRE VAULT
		WATER METER
W	W	WELL
		WATER VALVE
		BLOW–OFF
		AIR RELIEF VALVE
BFP	BFP	BACK FLOW PREVENTOR
		GATE VALVE HANDLE
		STILLING WELL
		FENCE POST
		FENCE GATE
	XX	REVISION
	X	CONSTRUCTION CALLOUT
# / SHT	DETAIL NUMBER / SHEET NUMBER	DETAIL CALLOUT
		LINE BREAK
		PIPE END (SCHEMATIC)
		PIPE END
		EMBANKMENT ARROW
HWL= XXX.XX		HIGH WATER LINE
(E) XX XXX.XX / XX XXX.XX		SPOT ELEVATION
		SECTION VIEW

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AQUATERRA WATER BANK – JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
GENERAL

LEGEND & ABBREVIATIONS

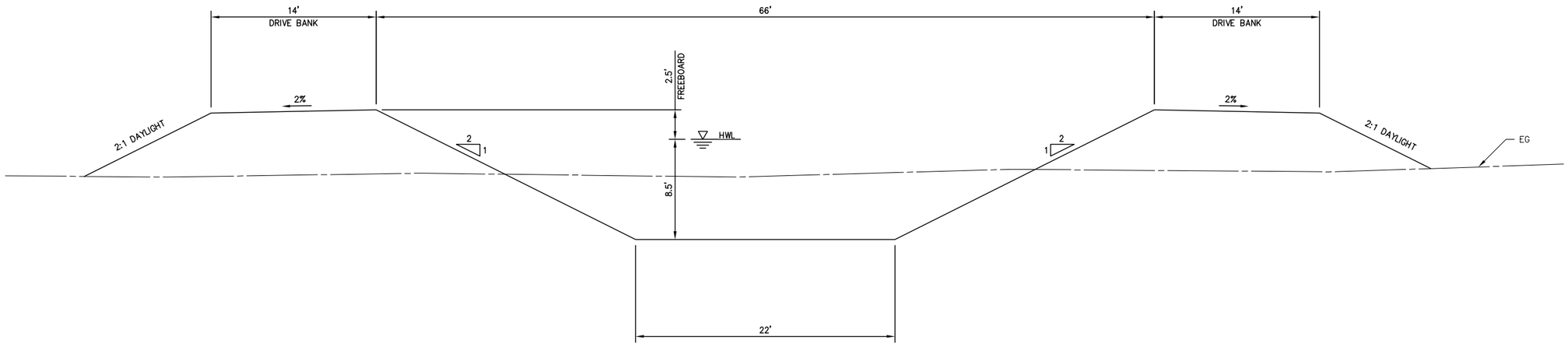
PROVOST & PRITCHARD
CONSULTING GROUP
EST. 1946
An Employee Owned Company
PROFESSIONAL CORPORATION
FRESNO, CALIFORNIA 93711-5162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.
SHEET G2
2 OF 30

3/26/2021 3:12 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\01_General\G2 LEGEND & ABBREVIATIONS.dwg -Lindsey Sciacca

811
Know what's below.
Call before you dig.

WARNING
POWER LINES
OVERHEAD



TYPICAL CROSS SECTION – JENSEN AVE ALIGNMENT

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3/26/21

No.	REVISION	BY	DATE

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AQUATERRA WATER BANK – JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
GENERAL
TYPICAL CROSS SECTION

EST. 1956
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
PROVOST & PRITCHARD ENGINEERING GROUP, INC.
2885 E. CAMPUS DRIVE, SUITE 101
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET **G3**

3 OF **30**

3/26/2021 3:13 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\01_General\G3 TYPICAL CROSS SECTION.dwg -Lindsey Sciacca

811
Know what's below.
Call before you dig.

WARNING
POWER LINES
OVERHEAD

PP1 PP2 PP3 PP4 PP5 PP6 PP7 PP8 PP9 PP10 PP11 PP12 PP13 PP14 PP15 PP16 PP17 PP18 PP19 PP20

10+00 20+00 40+00 60+00 80+00 100+00 120+00 140+00 160+00 180+00 200+00 220+00 240+00 260+00 280+00 300+00 320+00 340+00 360+00 380+00 400+00 420+00 440+00 460+00 480+00 500+00 520+00 540+00 560+00 576+87

FRESNO SLOUGH

TRANQUILLITY

EAST SIDE CANAL

W BELMONT AVE

W WHITESBRIDGE AVE

W JENSEN AVE

W NORTH AVE

W CENTRAL AVE

W AMERICAN AVE

W LINCOLN AVE

S JAMES RD

S YUBA AVE

S YUBA AVE

S LAKE AVE

S LAKE AVE

S TRINITY AVE

S LASSEN AVE

180

SCALE IN FEET
0 1000 2000 4000

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
GENERAL
INDEX SHEET

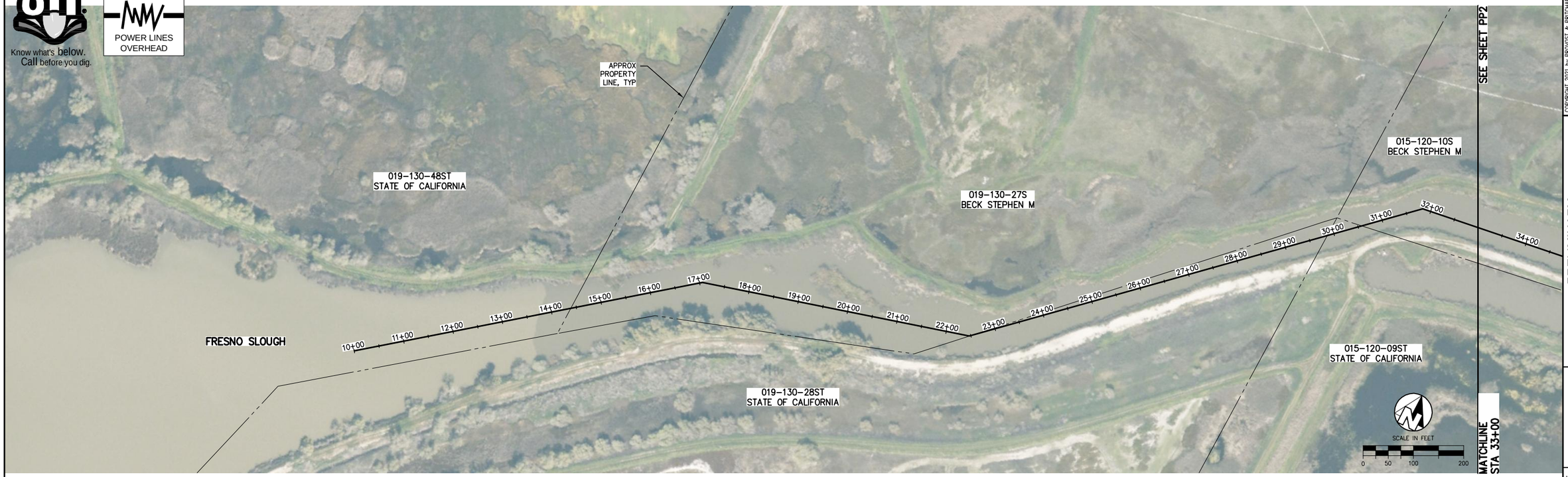
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
1234 H STREET, SUITE 101
FRESNO, CALIFORNIA 93721-2162
559/449-2700 FAX 559/449-2715
www.ppeng.com

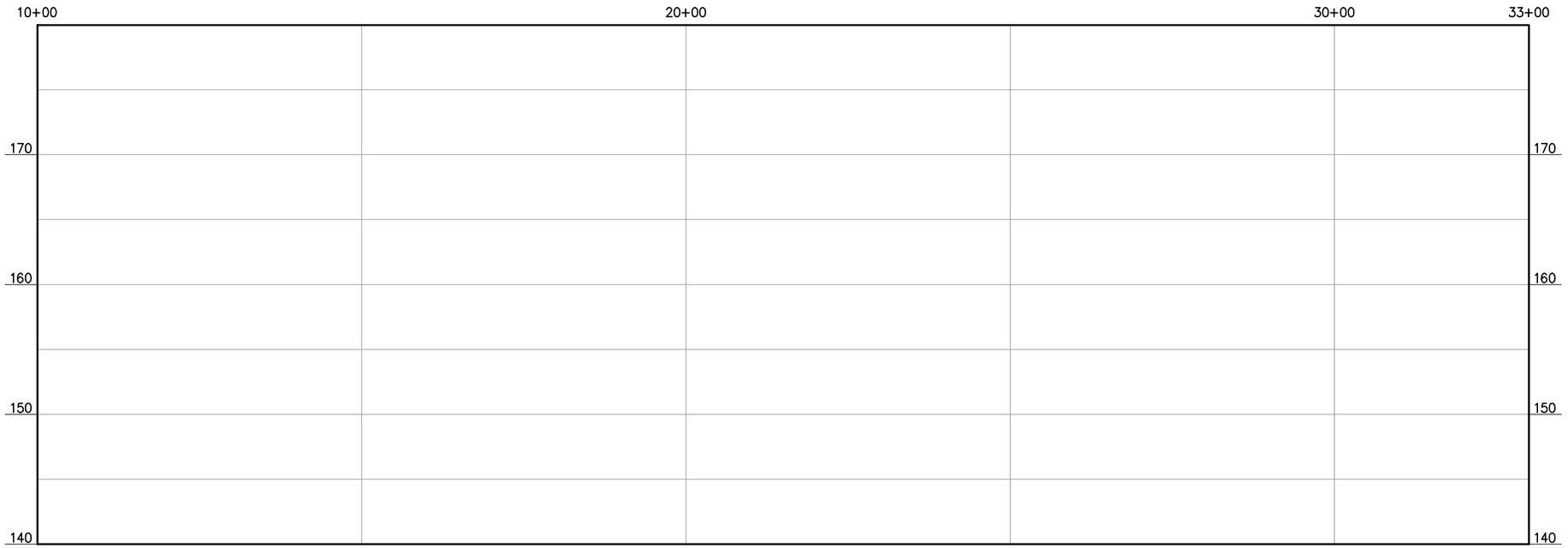
DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD
CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.
SHEET G4
4 OF 30

3/26/2021 3:49 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\01_General\G4 INDEX SHEET.dwg -Phillip Dansby

811
Know what's below.
Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 10+00 TO STA 33+00

EST. 1958
PROVOST & PRITCHARD CONSULTING GROUP
An Employee Owned Company
2955 CORNELIA AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: _____

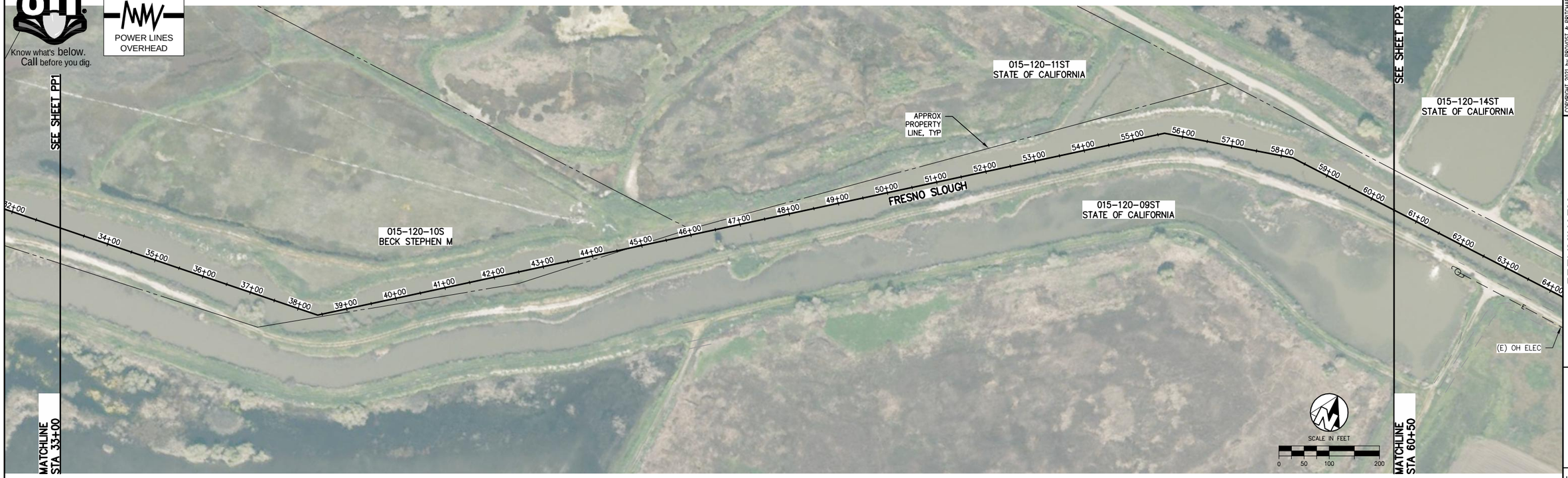
DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

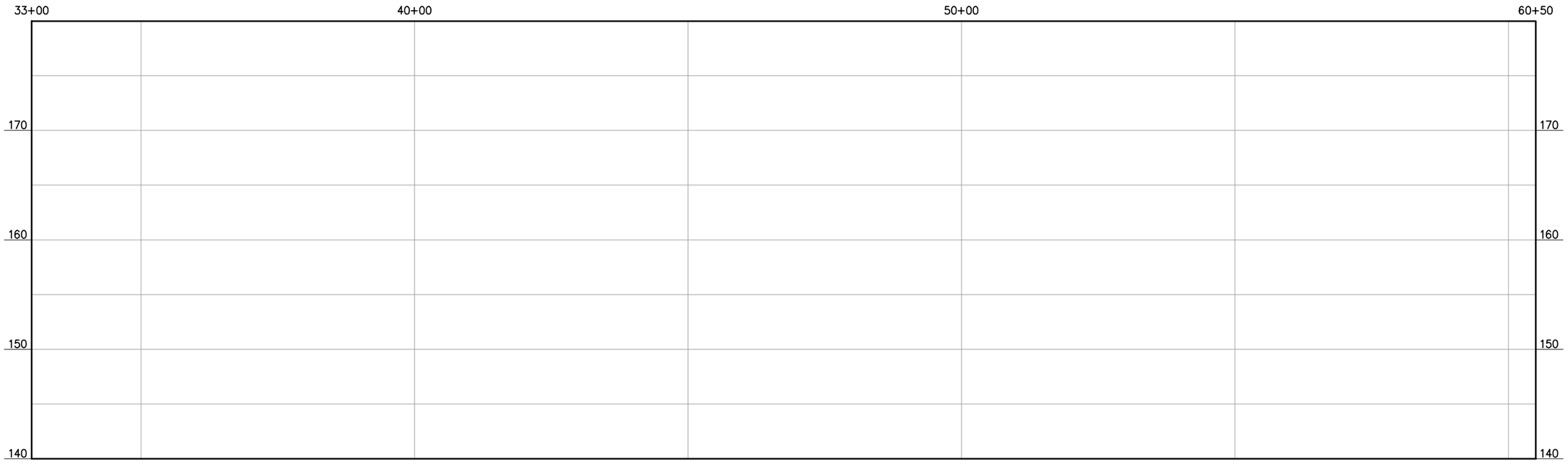
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET PP1

5 OF 30

3/26/2021 3:15 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP1 STA 10+00 TO STA 33+00.dwg -Lindsey Sciacca





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 33+00 TO STA 60+50

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
2885 E. SHAW AVENUE, SUITE 101
FRESNO, CALIFORNIA 93710-8162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21

JOB NO: 256920002

PROJECT NO:

PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

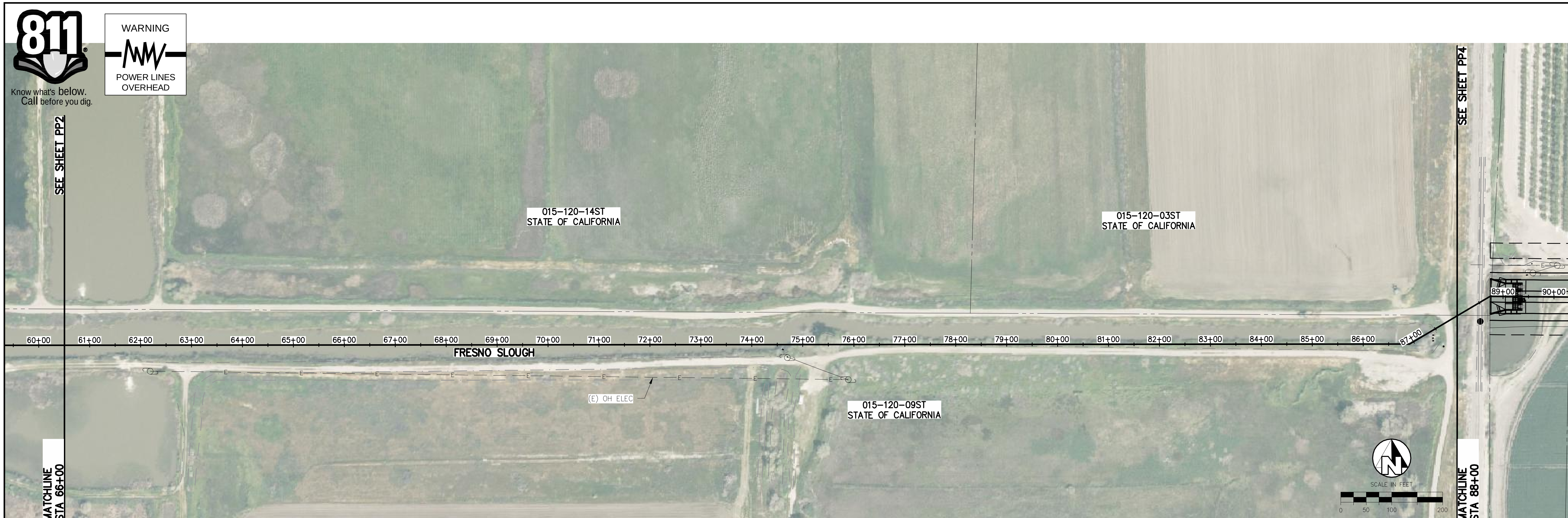
SHEET **PP2**

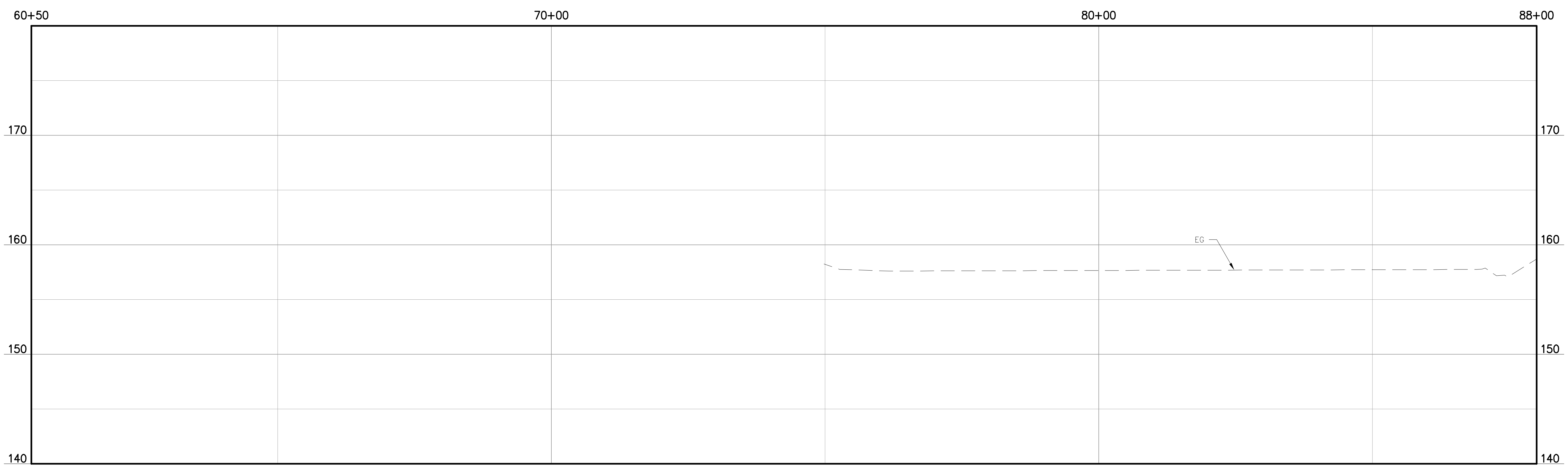
6 OF **30**

3/26/2021 3:16 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP2 STA 33+00 TO STA 60+50.dwg -Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





No.	REVISION	BY	DATE

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

FOR REVIEW ONLY

AQUATERRA WATER BANK - JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 60+50 TO STA 88+00

EST. 1968
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 WEST CROMWELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD
CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

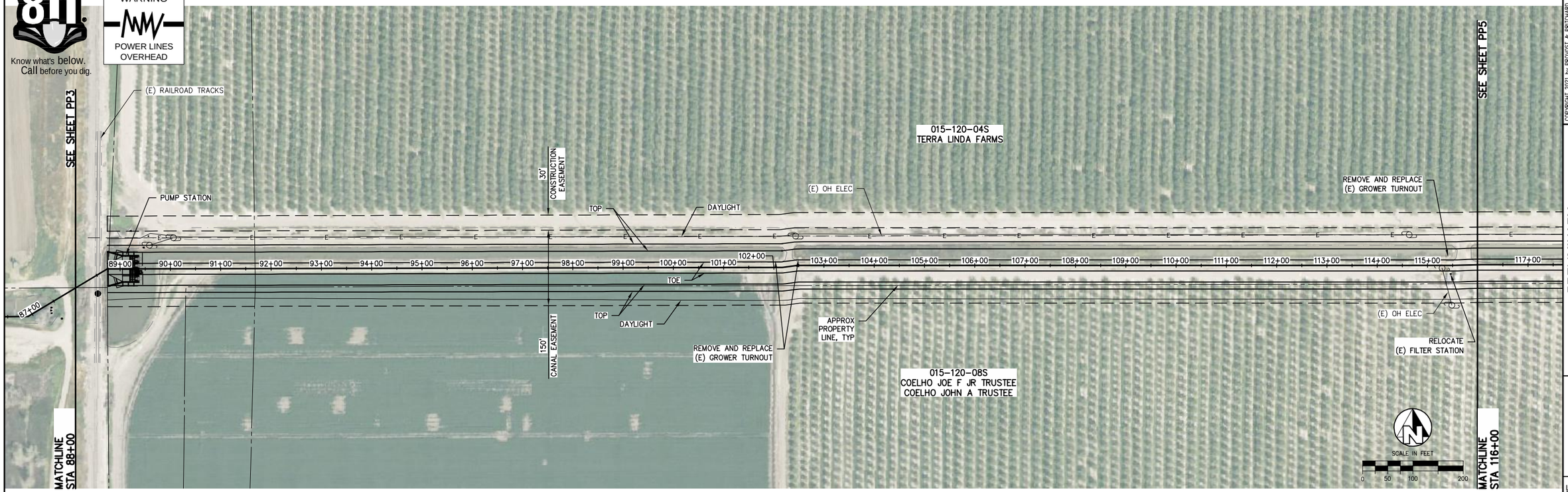
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

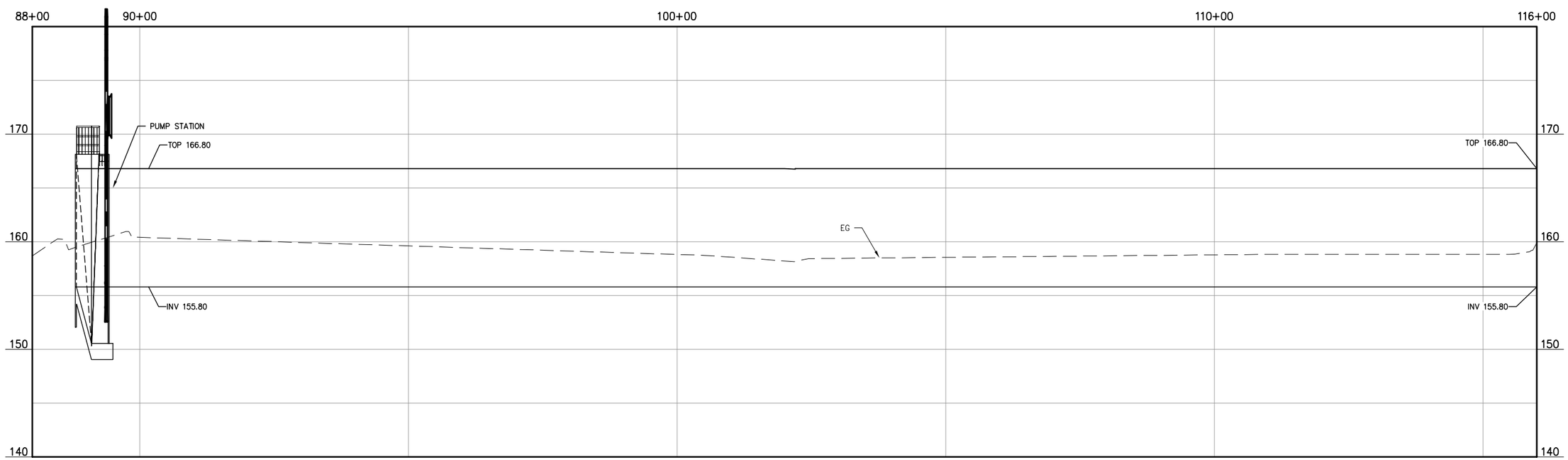
SHEET PP3

3/26/2021 3:16 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP3 STA 60+50 TO STA 88+00.dwg -Lindsey Sciacca

Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 88+00 TO STA 116+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
2001 TULARE STREET, SUITE 640
FRESNO, CALIFORNIA 93721-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

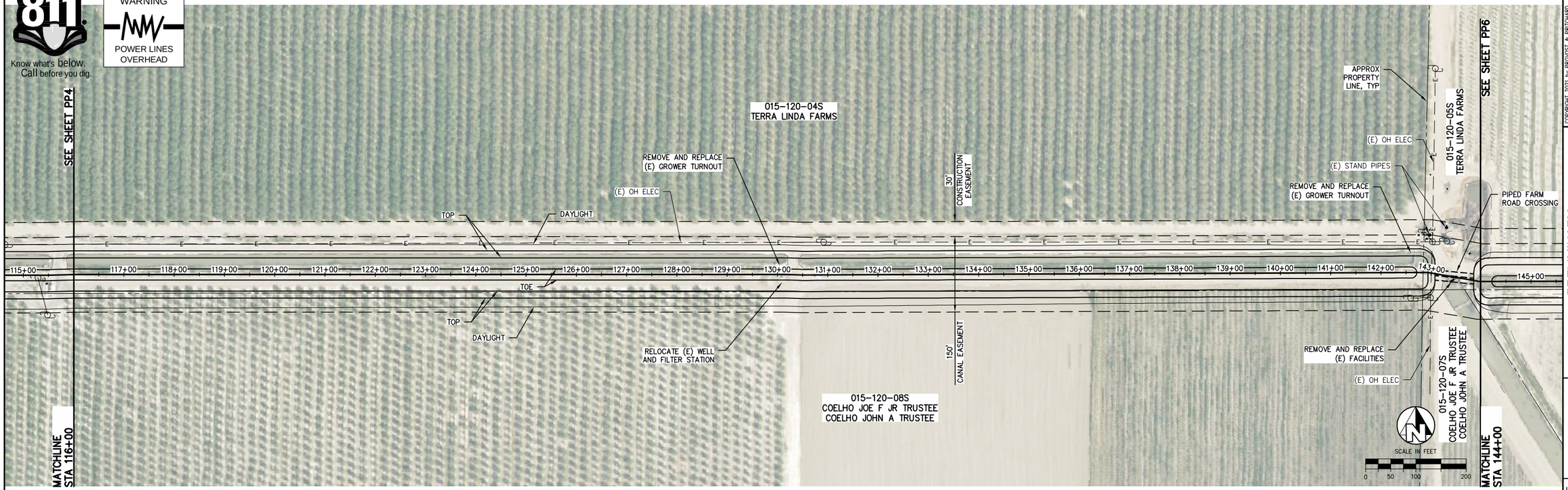
SHEET PP4

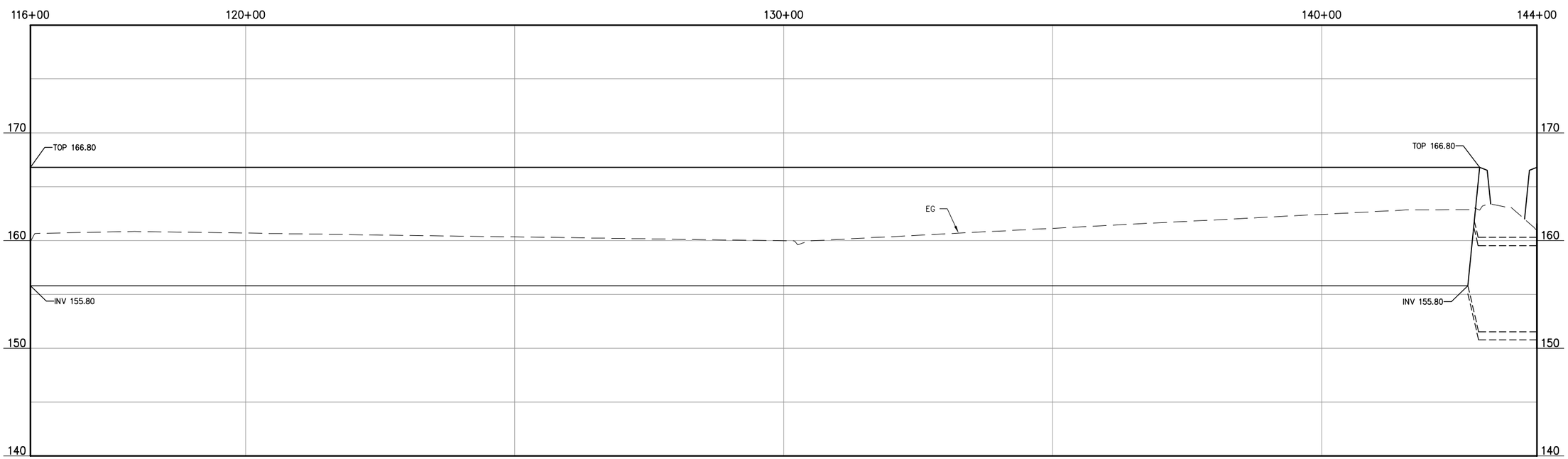
8 OF 30

3/26/2021 3:17 PM g:\mcmullin gsa-2659\2659 cn-going\CAD\340 sheet sets\02_Plan & Profile\PP4 STA 88+00 TO STA 116+00.dwg –Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





No.	REVISION	BY	DATE

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
PLAN & PROFILE
STA 116+00 TO STA 144+00

ESTABLISHED 1950
PROVOST & PRITCHARD CONSULTING GROUP
An Employee Owned Company
286 W. CROMWELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD
CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

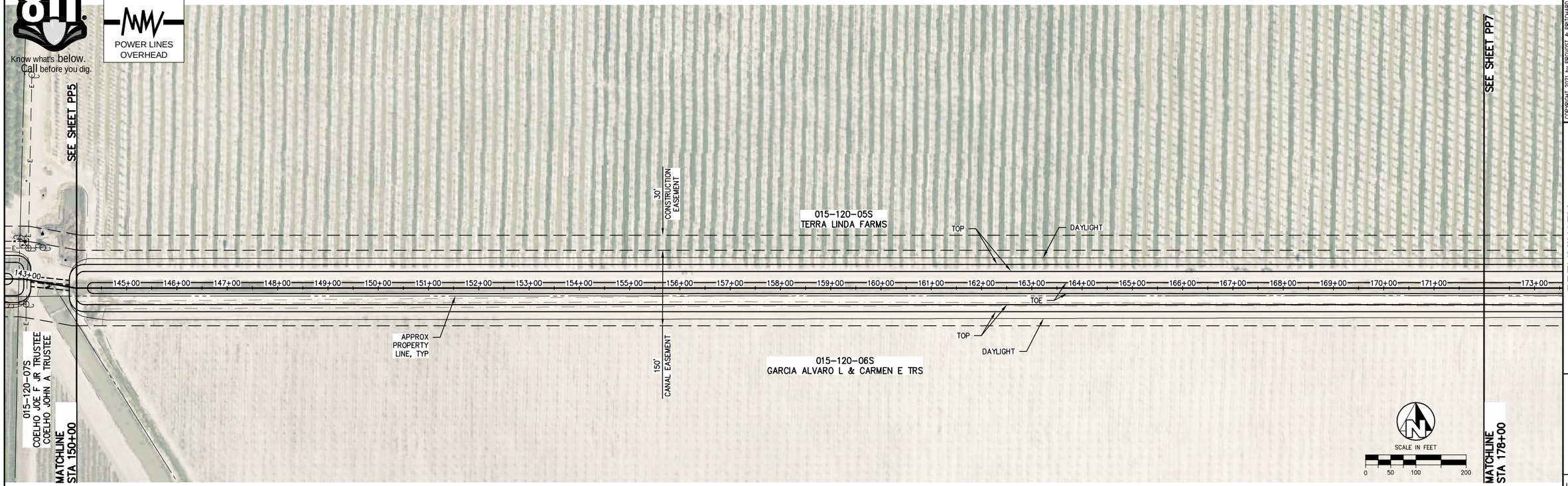
SHEET **PP5**

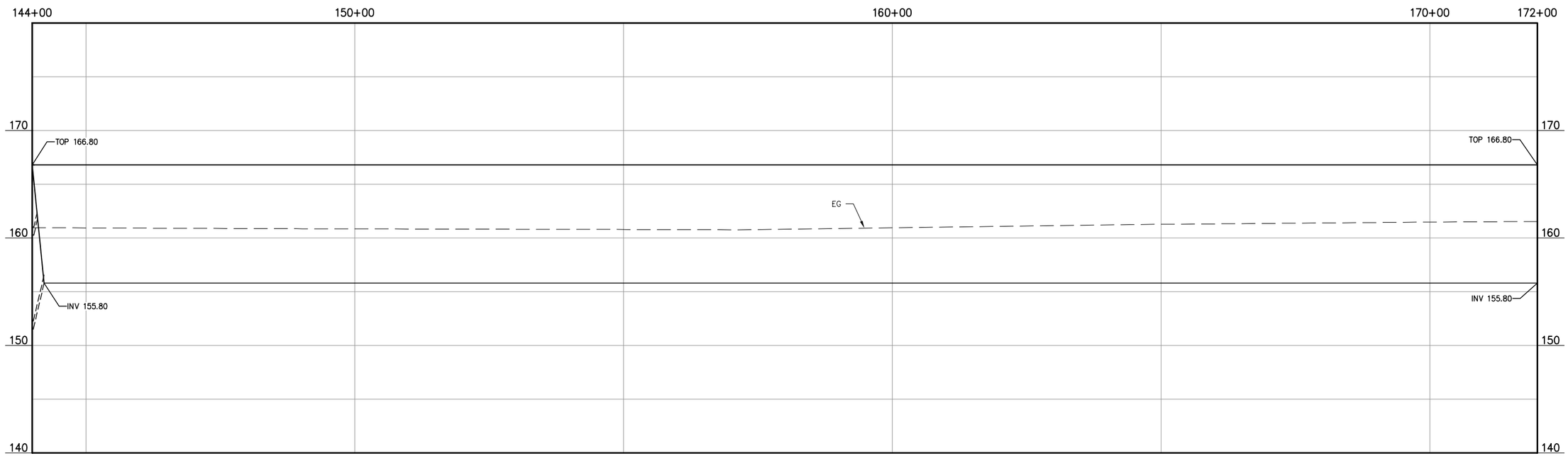
9 OF **30**

3/26/2021 3:17 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP5 STA 116+00 TO STA 144+00.dwg -Lindsey Sciacca

811
Know what's below.
Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 144+00 TO STA 172+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
1234 H STREET, SUITE 101
FRESNO, CALIFORNIA 93721-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

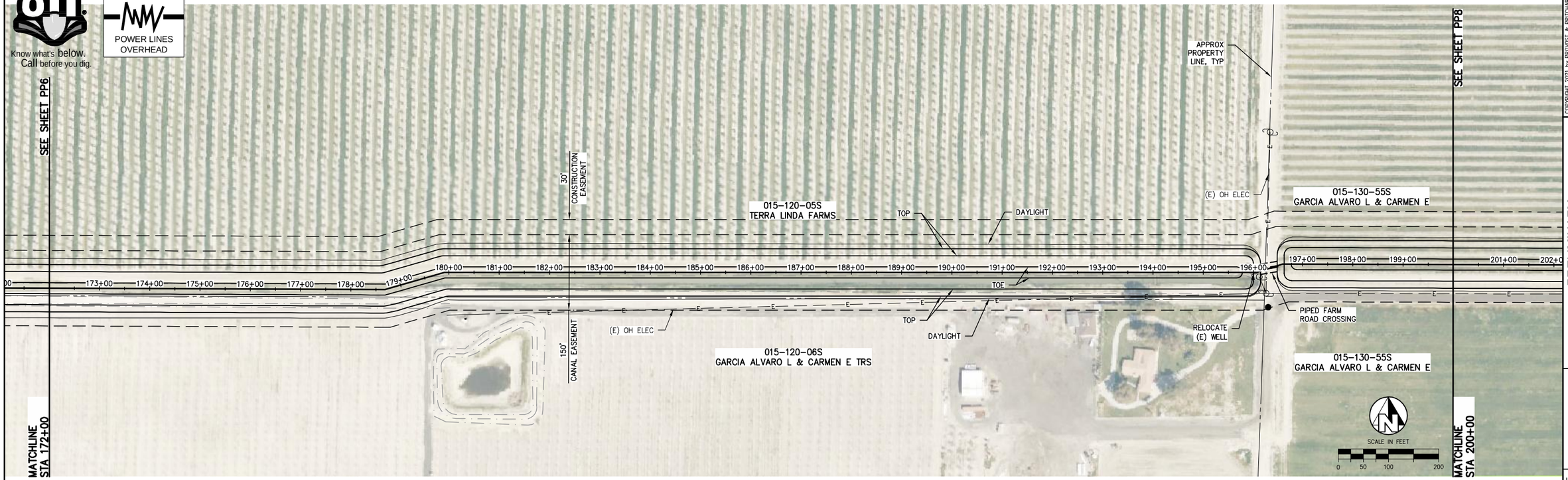
SHEET PP6

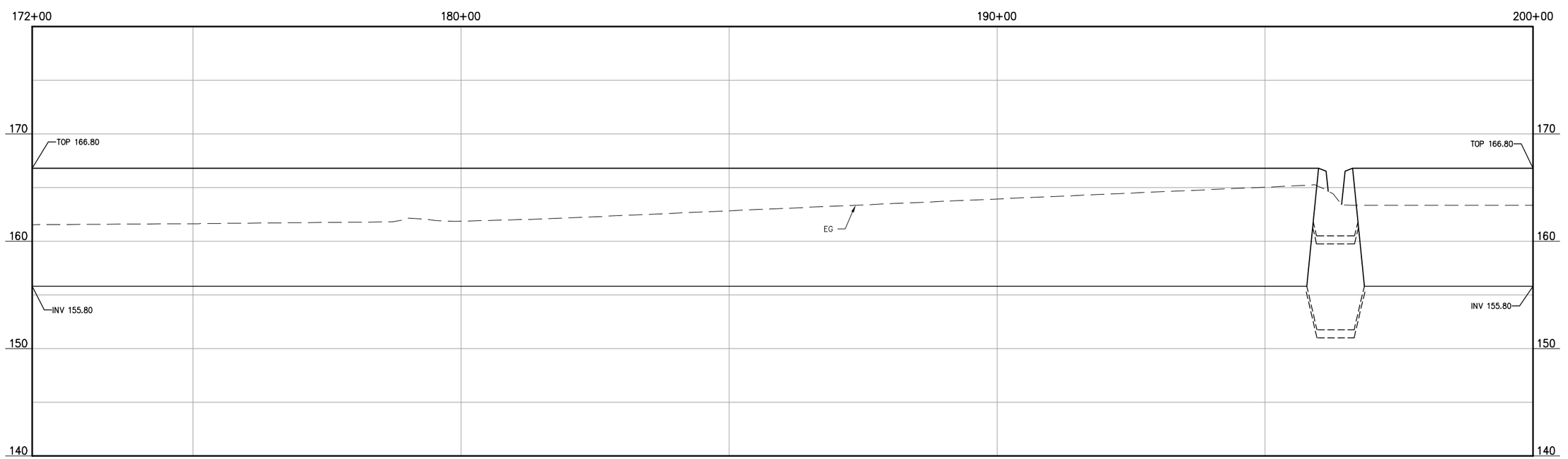
10 OF 30

3/26/2021 3:18 PM g:\mcmullin gsa-2659\2659 cn-going\CAD\340 sheet sets\02_Plan & Profile\PP6 STA 144+00 TO STA 172+00.dwg -Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 172+00 TO STA 200+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
PROFESSIONAL ENGINEERS
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY: PAD | CHECKED BY:

DATE: 3/26/21

JOB NO: 256920002

PROJECT NO:

PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

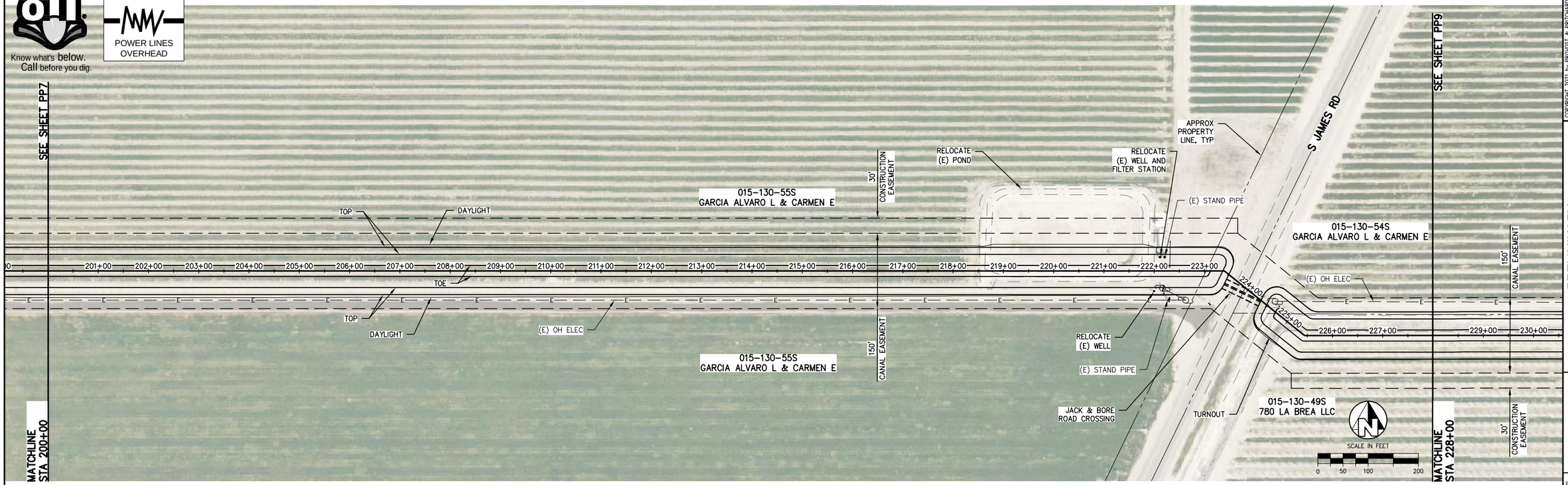
SHEET PP7

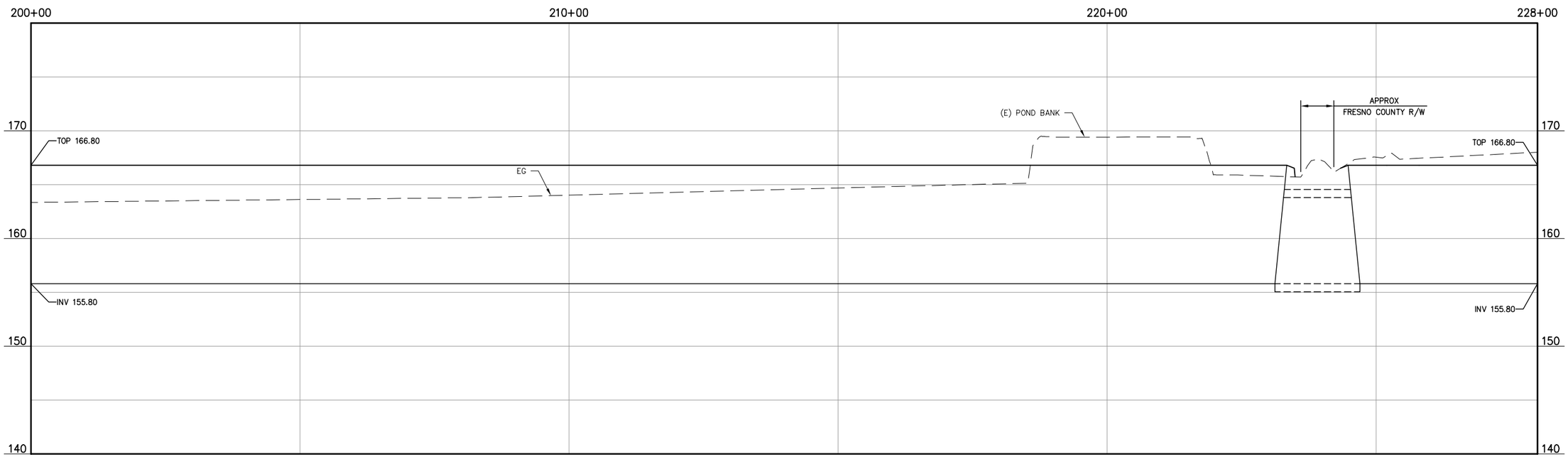
11 OF 30

3/26/2021 3:18 PM g:\mcmullin gsa-2659\2659 cn-going\CAD\340 sheet sets\02_Plan & Profile\PP7 STA 172+00 TO STA 200+00.dwg -Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 200+00 TO STA 228+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
2546 West Shaw Lane, Suite 101
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

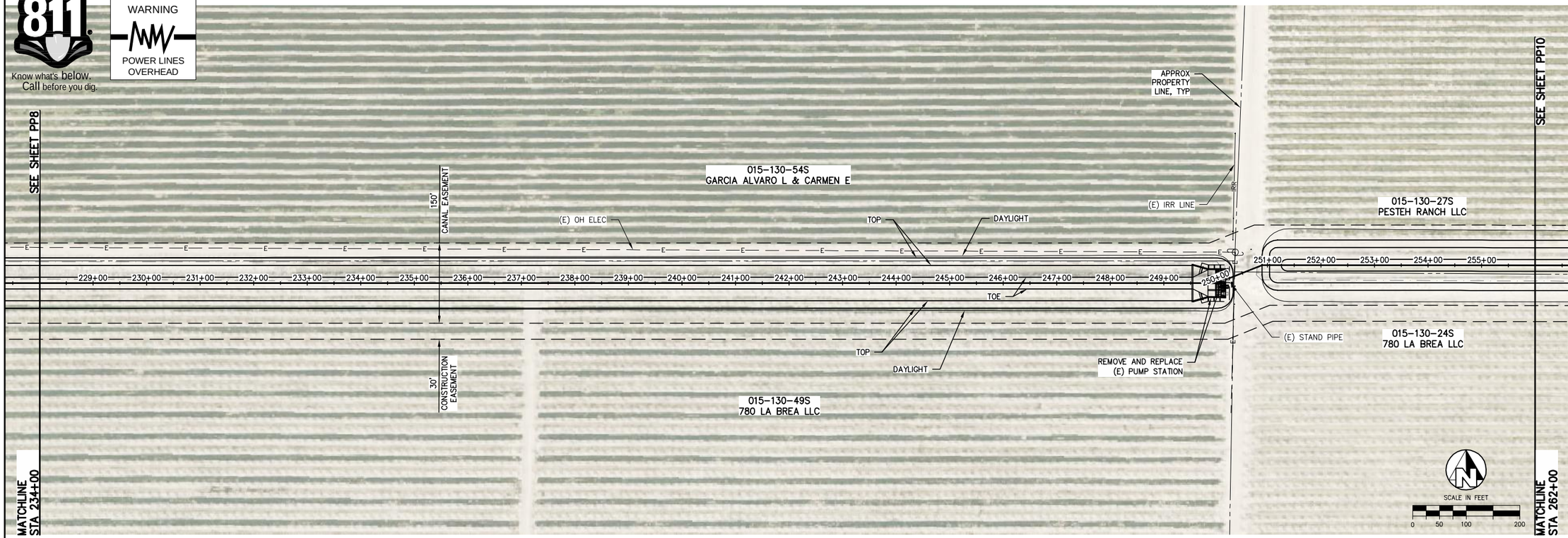
SHEET PP8

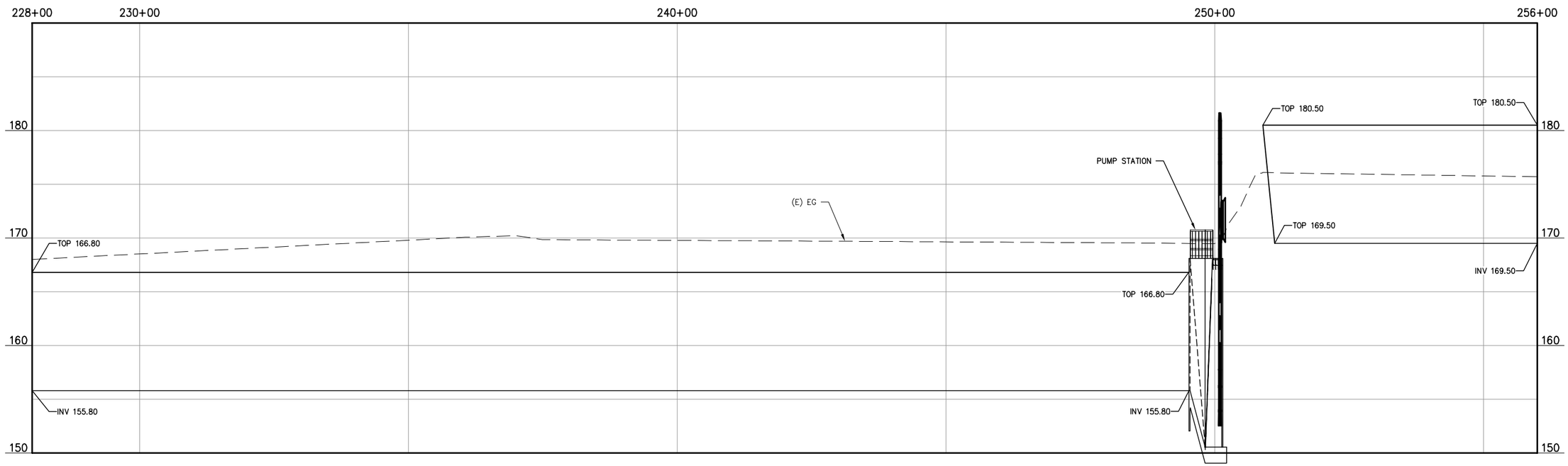
12 OF 30

3/26/2021 3:18 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP8 STA 200+00 TO STA 228+00.dwg -Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 228+00 TO STA 256+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
PROVOST & PRITCHARD
7541 N. ERICA AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY: PAD	CHECKED BY:

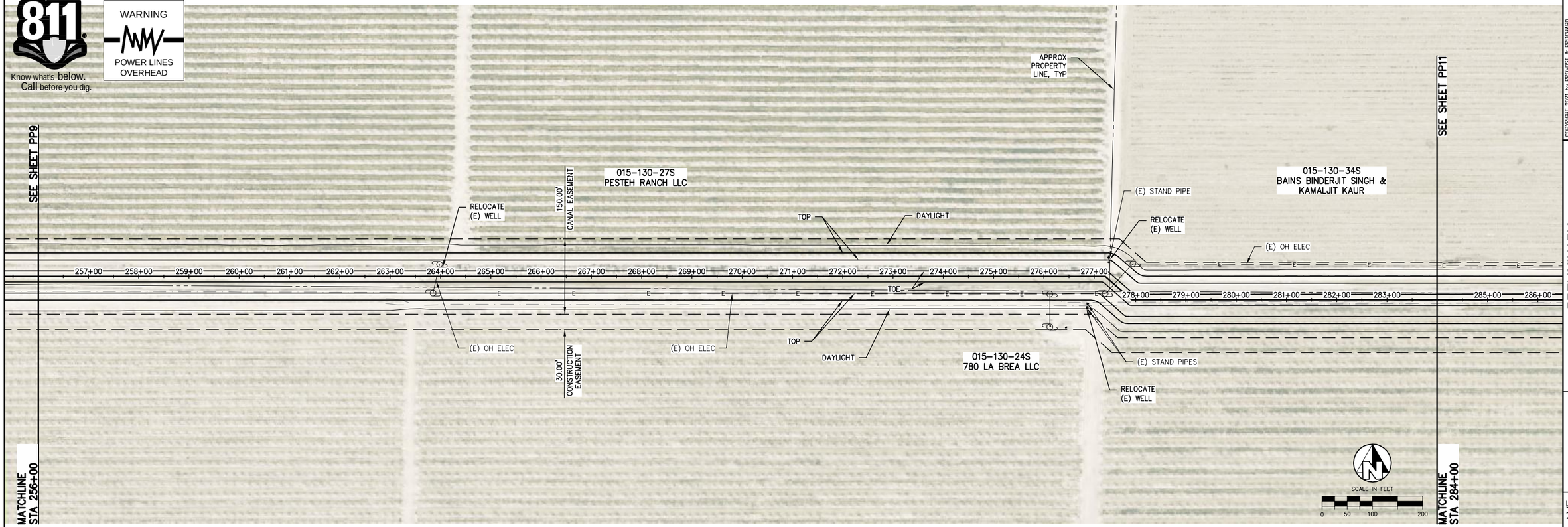
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

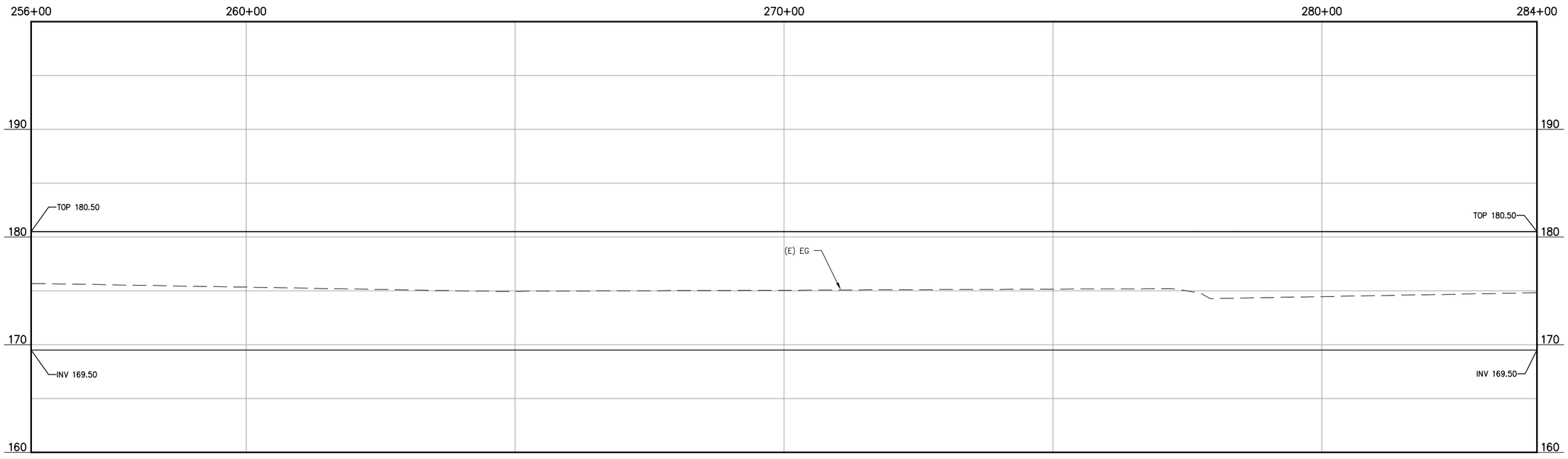
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET PP9

13 OF 30

3/26/2021 3:19 PM g:\mcmullin gsa-2659\2659 cm-going\CAD\340 sheet sets\02_Plan & Profile\PP9 STA 228+00 TO STA 256+00.dwg -Lindsey Sciacca





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 256+00 TO STA 284+00

PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
1234 H STREET, SUITE 101
FRESNO, CALIFORNIA 93721-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

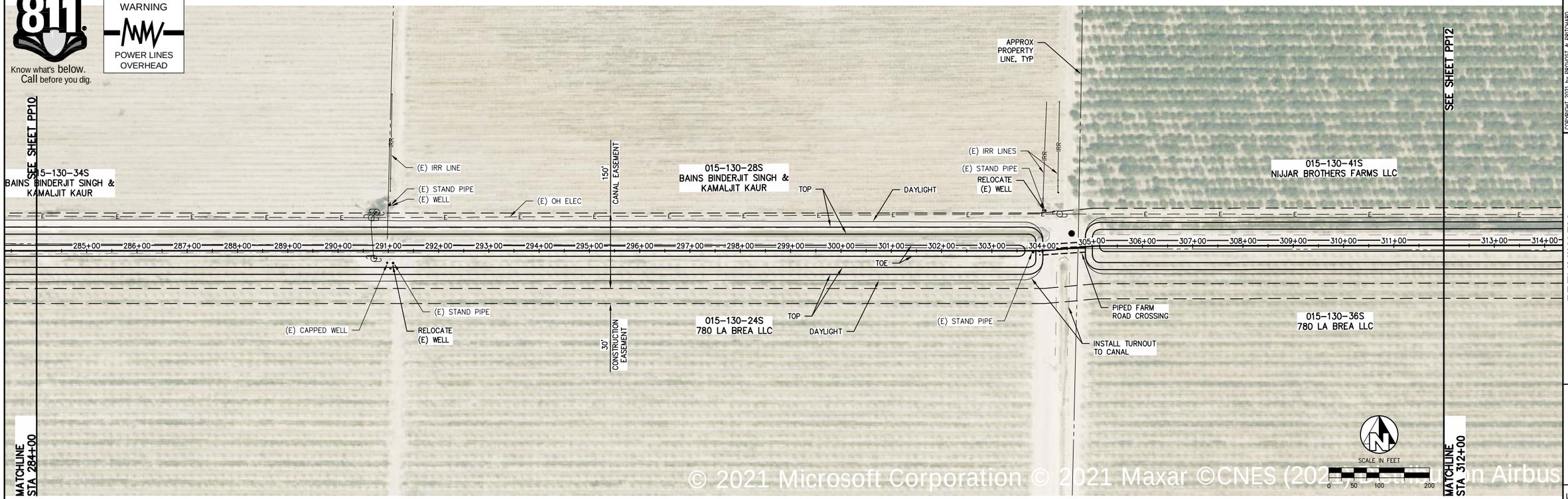
SHEET **PP10**

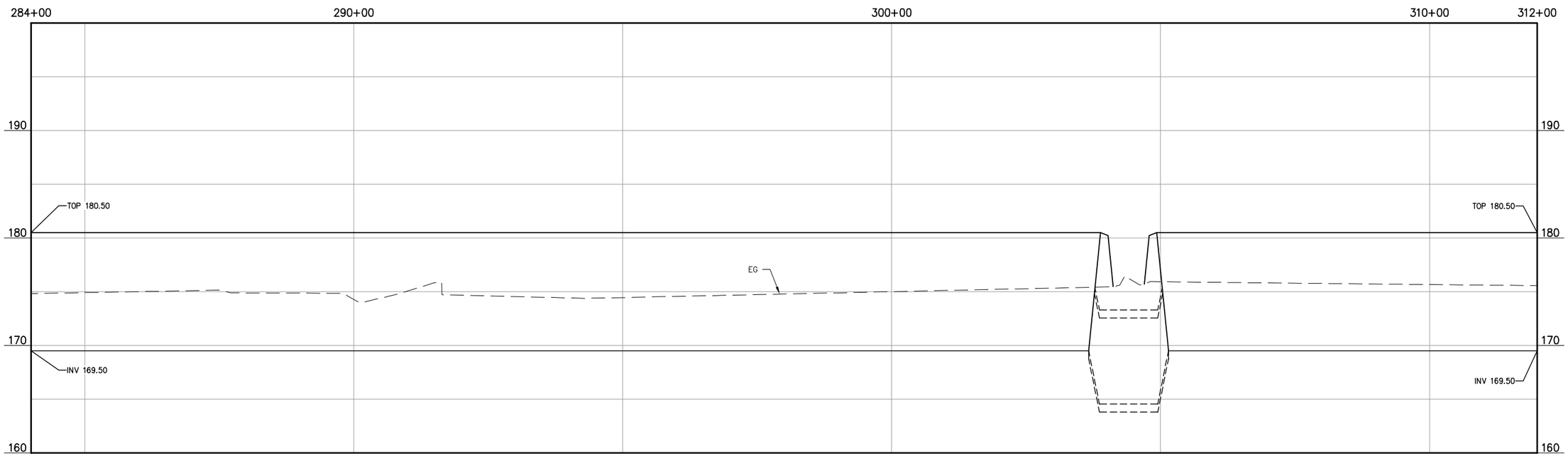
14 OF **30**

3/26/2021 3:19 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP10 STA 256+00 TO STA 284+00.dwg –Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





No.	REVISION	BY	DATE

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 284+00 TO STA 312+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
2981 W. Ashlan Avenue
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

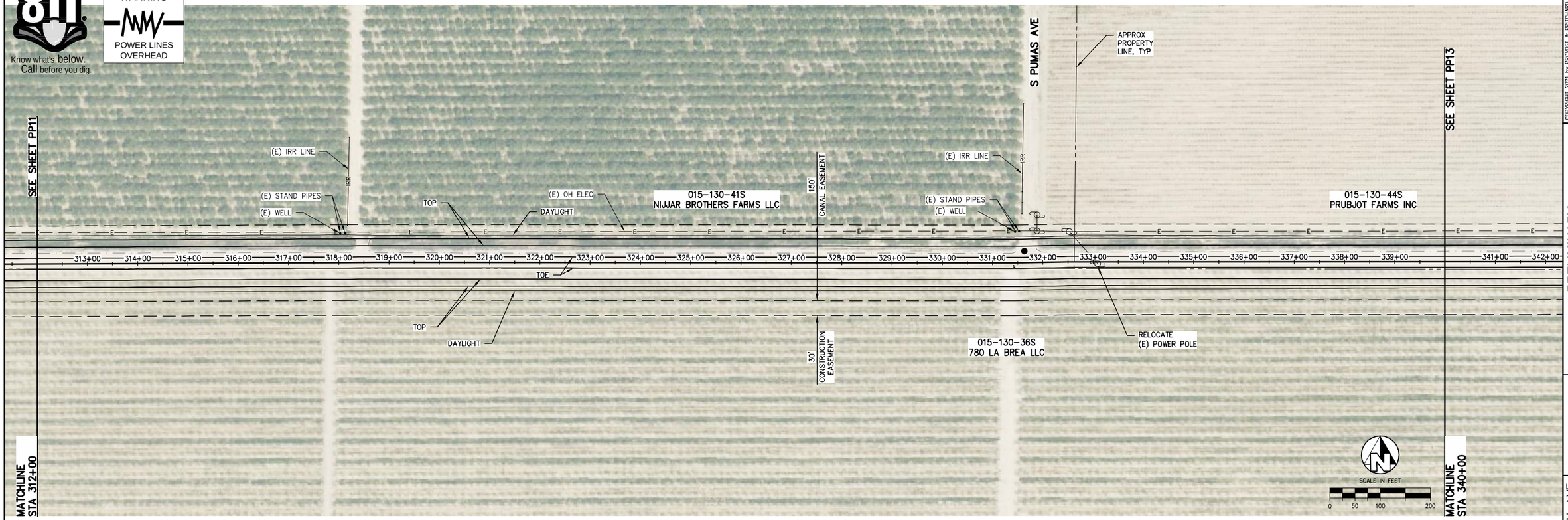
SHEET PP11

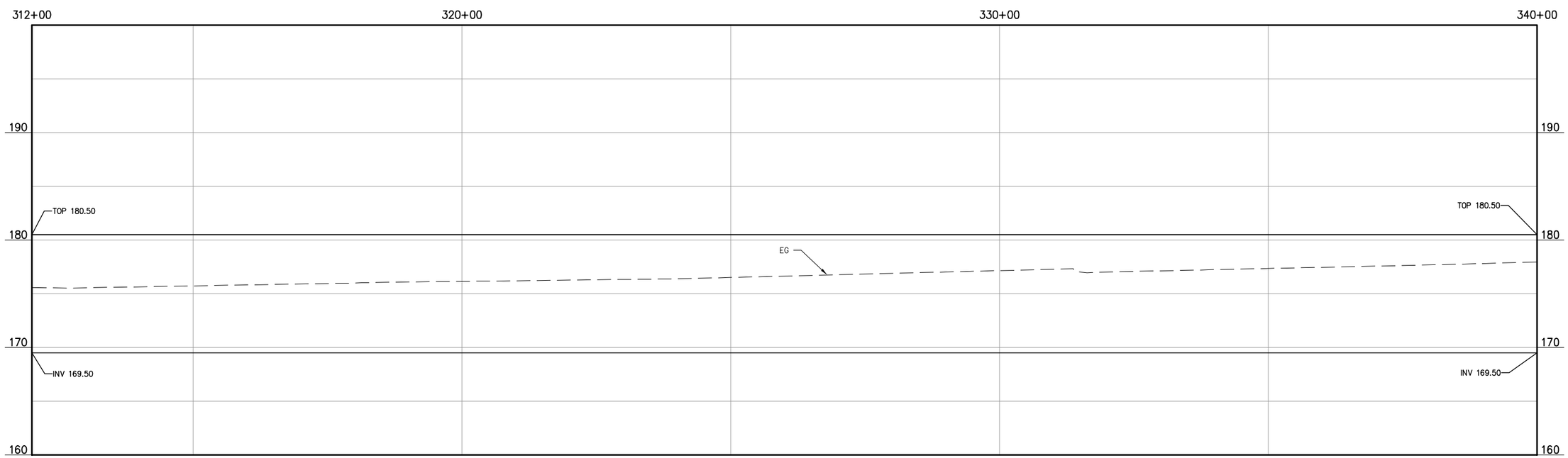
15 OF 30

3/26/2021 3:20 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP11 STA 284+00 TO STA 312+00.dwg -Lindsey Sciocca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 312+00 TO STA 340+00

ESTD 1946
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
1234 H STREET, SUITE 101
FRESNO, CALIFORNIA 93721-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

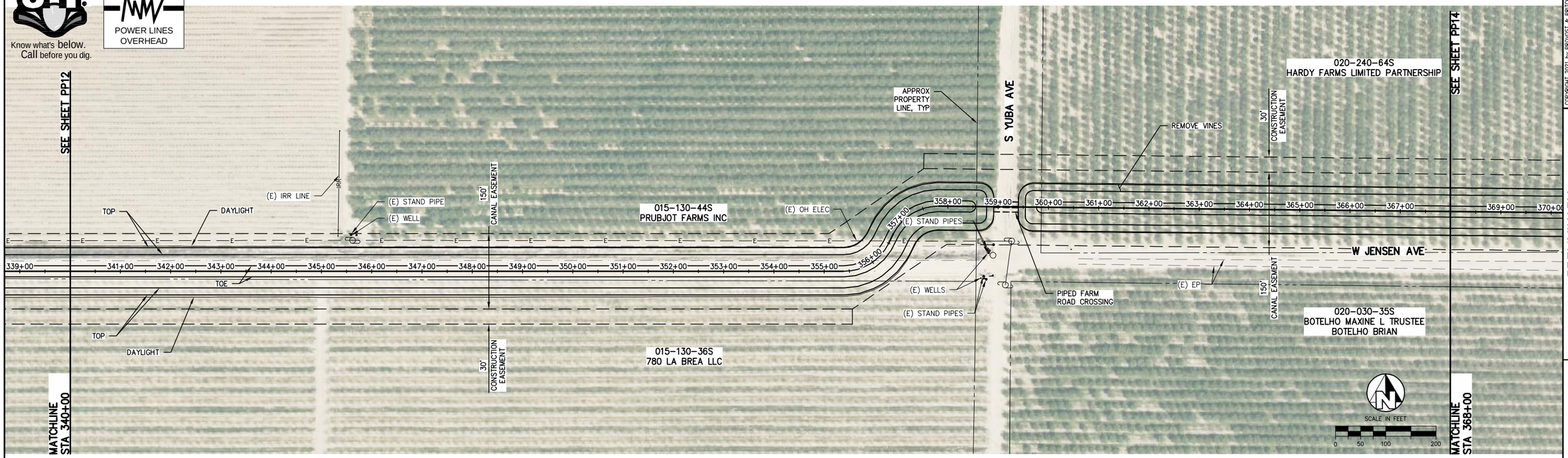
SHEET PP12

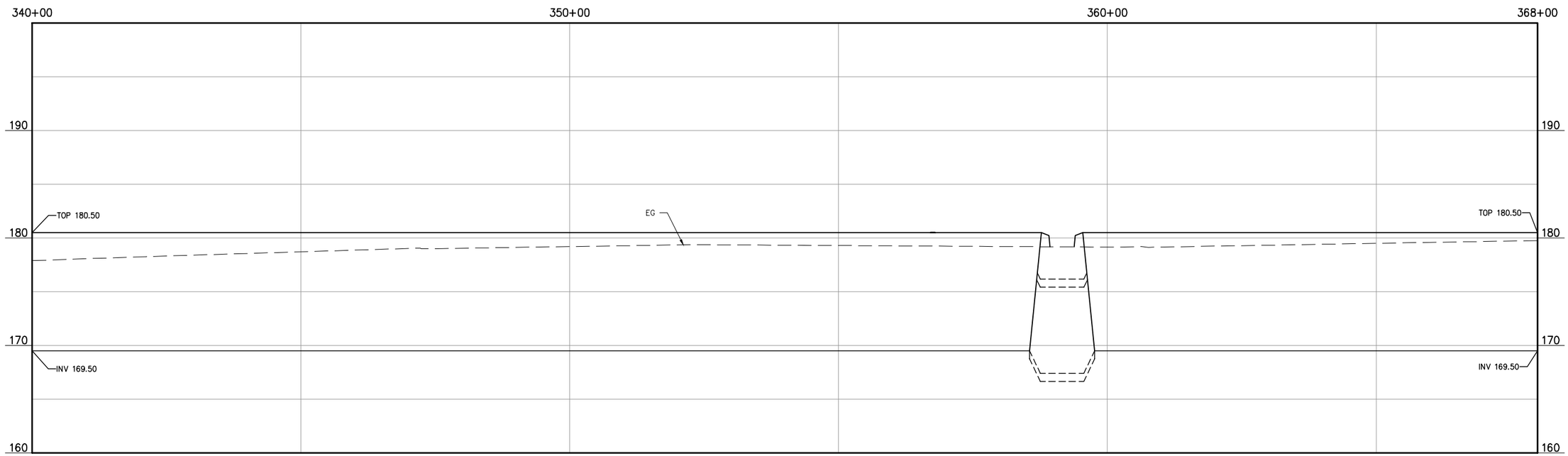
16 OF 30

3/26/2021 3:20 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP12 STA 312+00 TO STA 340+00.dwg -Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
PLAN & PROFILE
STA 340+00 TO STA 368+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1923
An Employee Owned Company
VISALIA, CALIFORNIA 93277-8162
FRESNO, CALIFORNIA 93711-0915
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO:

DRAFTED BY: PAD | CHECKED BY:

DATE: 3/26/21

JOB NO: 256920002

PROJECT NO:

PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET PP13

17 OF 30

3/26/2021 3:21 PM lg:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP13 STA 340+00 TO STA 368+00.dwg -Lindsey Sciocca

811
Know what's below.
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WARNING
POWER LINES
OVERHEAD

SEE SHEET PP14

MATCHLINE
STA 368+00

369+00 370+00 371+00 372+00 373+00 374+00 375+00 376+00 377+00 378+00 379+00 380+00 381+00 382+00 383+00 384+00 385+00 386+00 387+00 388+00 389+00 390+00 391+00 392+00 393+00 394+00 395+00 396+00 397+00 398+00

TOP
DAYLIGHT
TOE
TOP
DAYLIGHT
PUMP STATION
(E) IRR LINE
IRR
W JENSEN AVE
020-030-35S
BOTELHO MAXINE L TRUSTEE
BOTELHO BRIAN
APPROX PROPERTY LINE, TYP
(E) CAPPED WELL TO REMAIN
(E) STAND PIPE TO REMAIN
(E) OH ELEC
(E) IRR LINE
020-240-64S
HARDY FARMS LIMITED PARTNERSHIP
REMOVE VINES
30' CONSTRUCTION EASEMENT
150' CANAL EASEMENT
60' R.W.
SECTION LINE
(E) OH ELEC
(E) EP
020-030-36S
4G HOLDINGS LLC
IRR
SEE SHEET PP10
MATCHLINE
STA 396+00

SCALE IN FEET
0 50 100 200

368+00 370+00 380+00 390+00 396+00

190
180
170
160

TOP 192.70
TOP 180.50
TOP 180.50
INV 181.70
EG
INV 169.50
INV 169.50
TOP 192.70
INV 181.70

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
PLAN & PROFILE
STA 368+00 TO STA 396+00

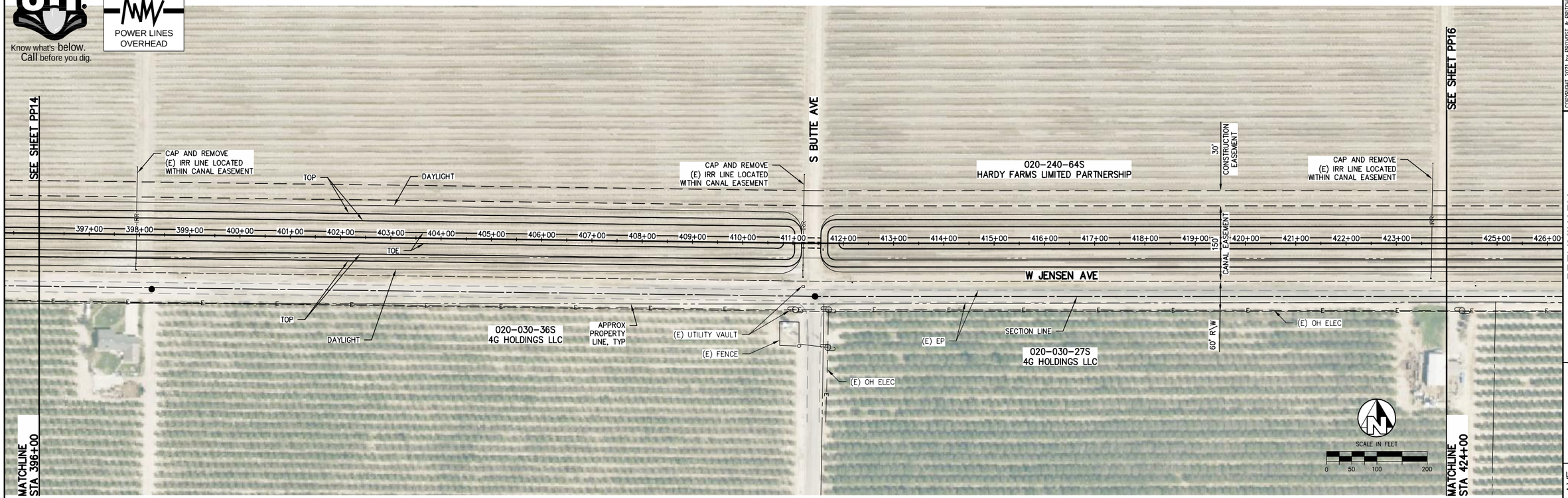
EST. 1956
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 W. CROMWELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

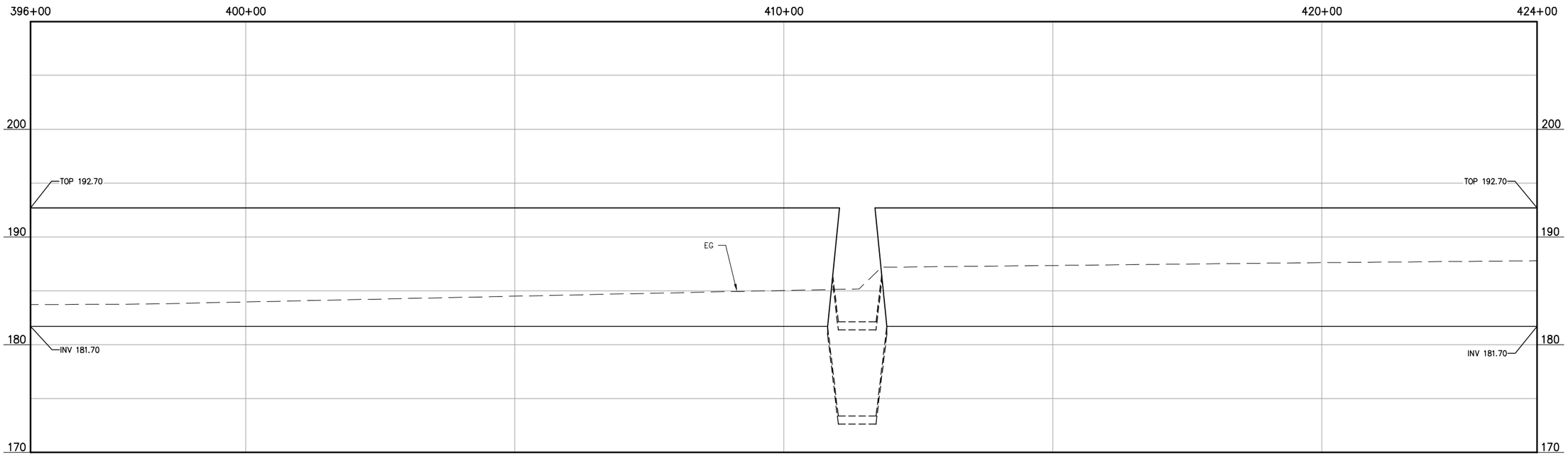
DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD
CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.
SHEET PP14
18 OF 30

3/26/2021 3:21 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP14 STA 368+00 TO STA 396+00.dwg -Lindsey Sciacca

Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

NO	REVISION	BY	DATE

020-030-31S
GEORGESON BENJAMIN

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 396+00 TO STA 424+00

PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
1234 H STREET, SUITE 101
FRESNO, CALIFORNIA 93721-6162
559/449-2700 FAX 559/449-2715
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DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET PP15

19 OF 30

3/26/2021 3:22 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP15 STA 396+00 TO STA 424+00.dwg -Lindsey Sciacca

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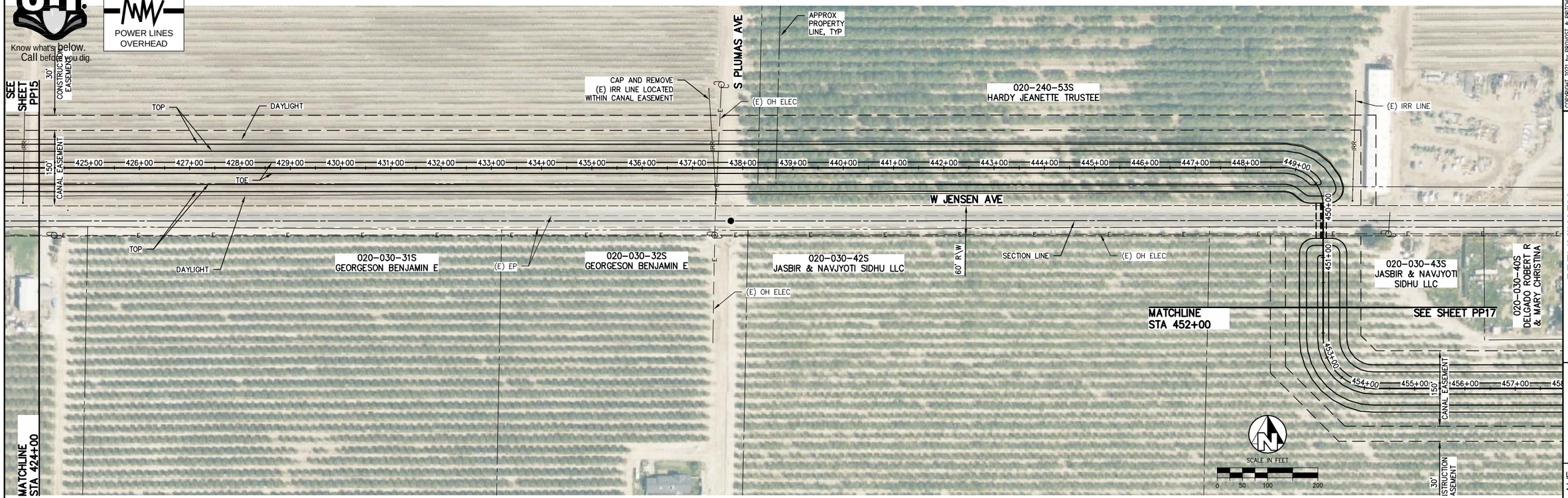
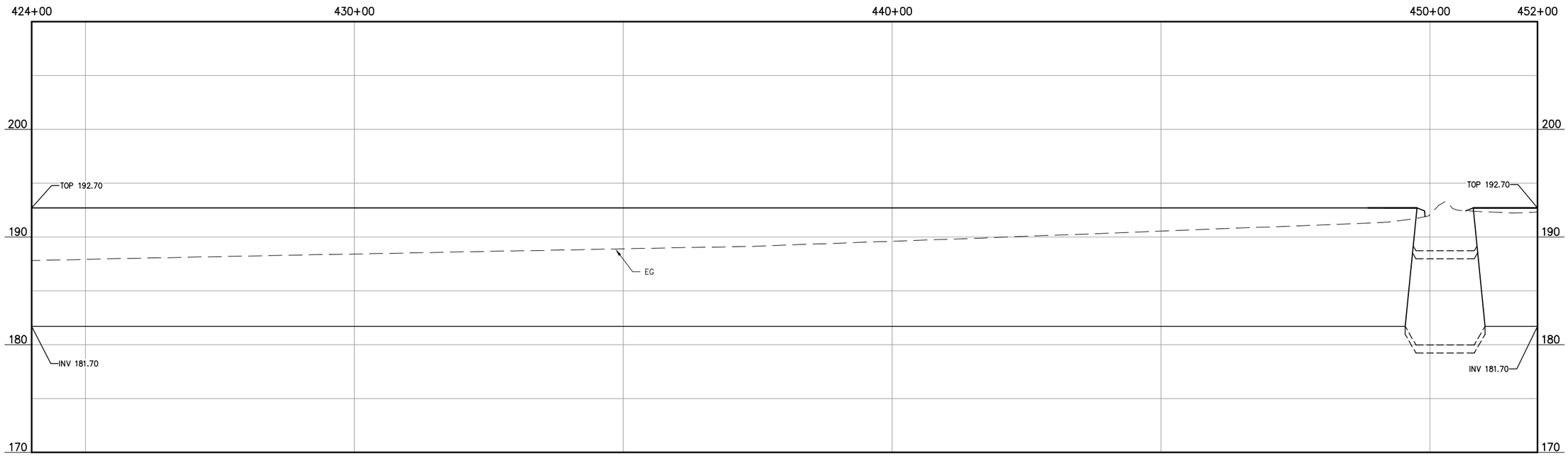
WARNING
POWER LINES OVERHEAD





No.	REVISION	BY	DATE

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3/26/21

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN CSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 424+00 TO STA 452+00

PROVOST & PRITCHARD
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PROVOST & PRITCHARD
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
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DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

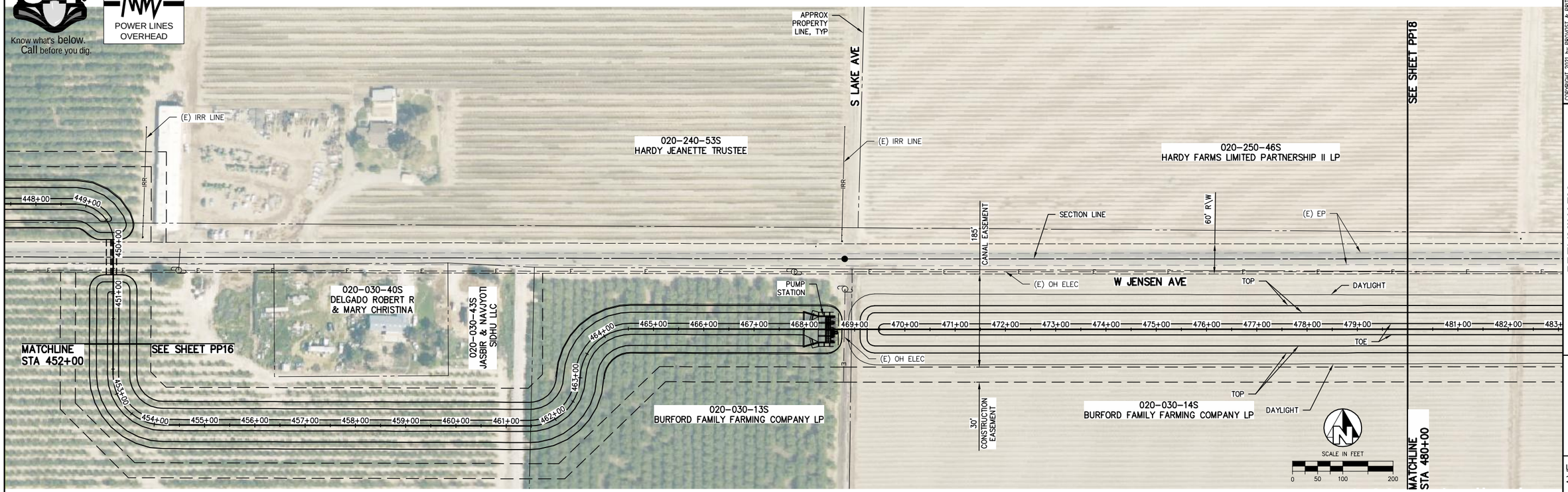
DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

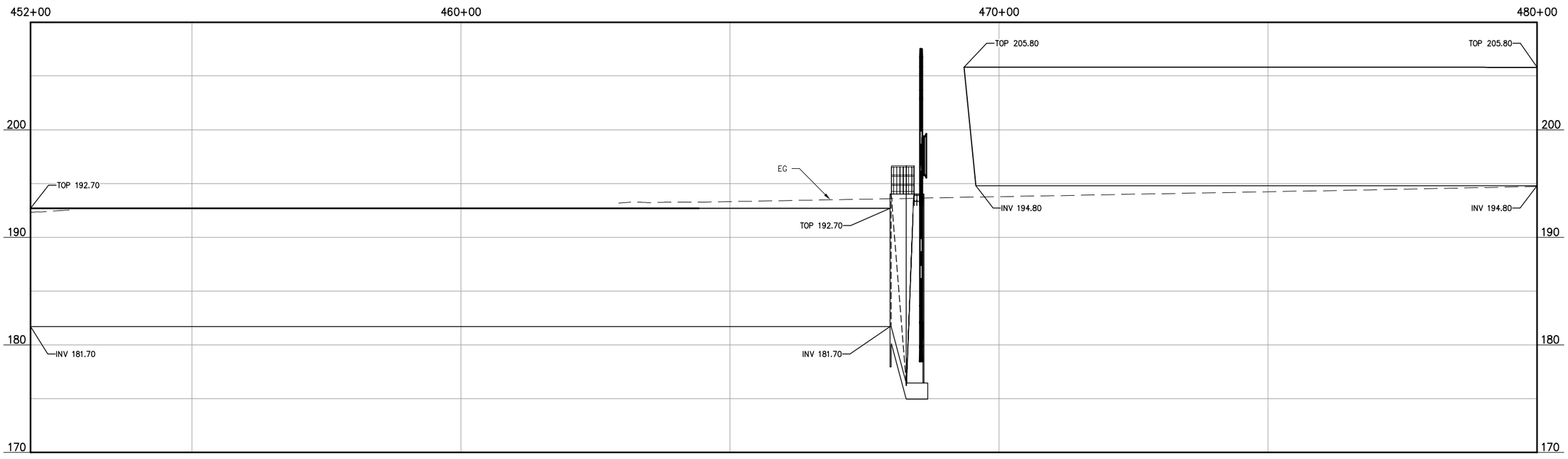
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET PP16

20 OF 30

3/26/2021 3:22 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP16 STA 424+00 TO STA 452+00.dwg –Lindsey Sciacca





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 452+00 TO STA 480+00

EST. 1949
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
1900 N. MOLLY AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD
CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

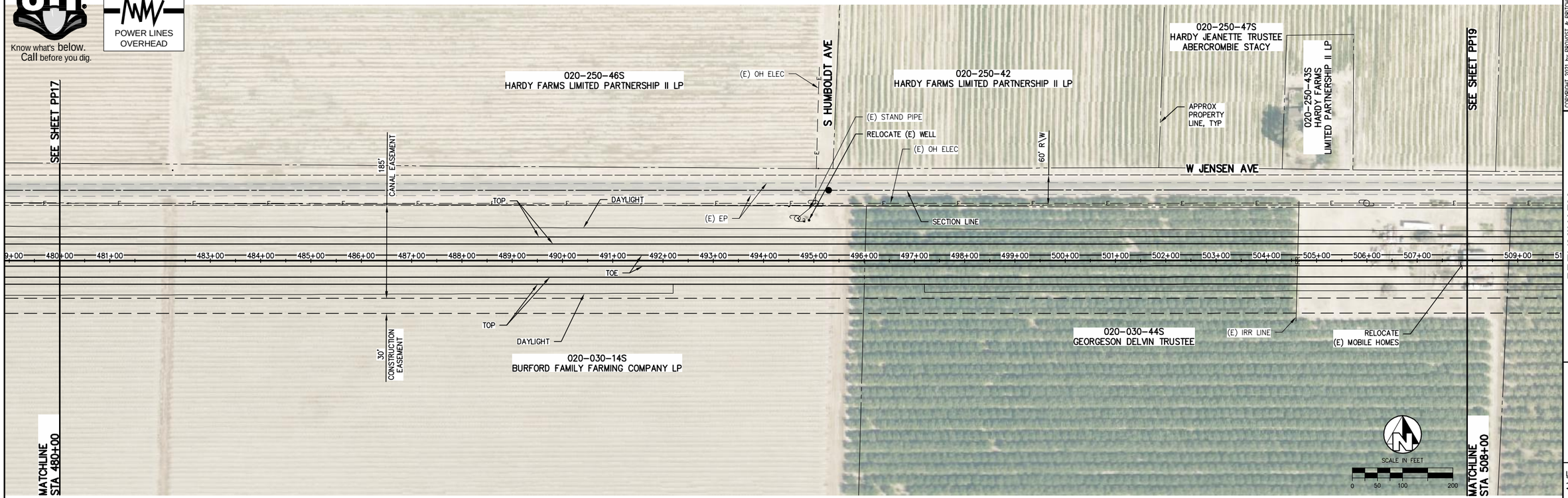
SHEET **PP17**

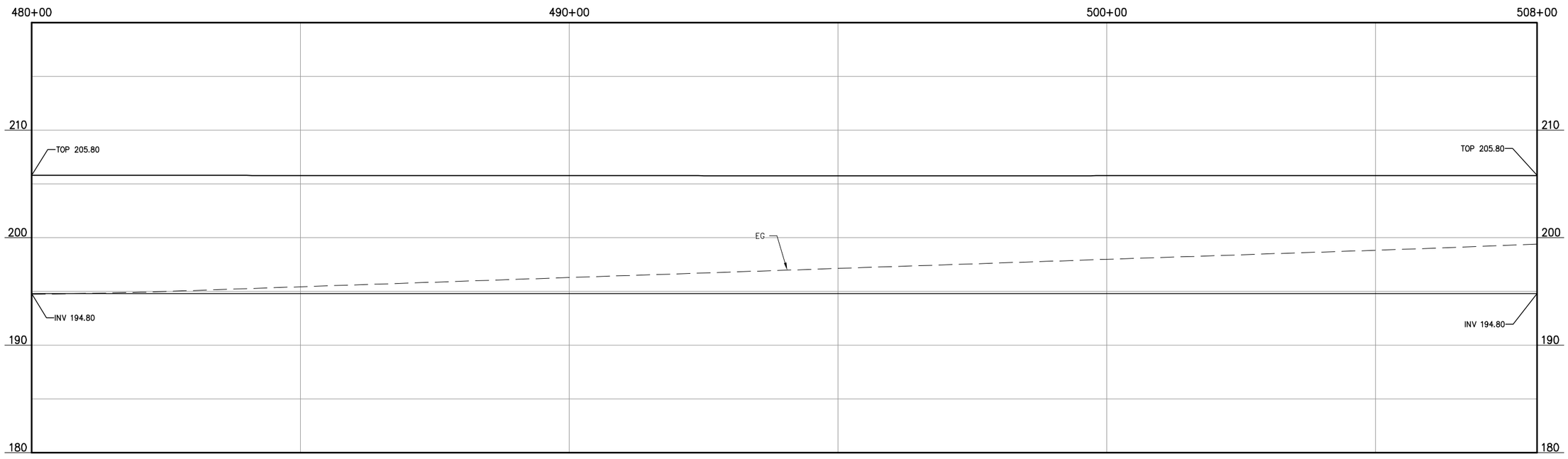
21 OF 30

3/26/2021 3:23 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP17 STA 452+00 TO STA 480+00.dwg -Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





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No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
PLAN & PROFILE
STA 480+00 TO STA 508+00

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1900 N. GATEWAY BLVD., SUITE 101
FRESNO, CALIFORNIA 93711-6162
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DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

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PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

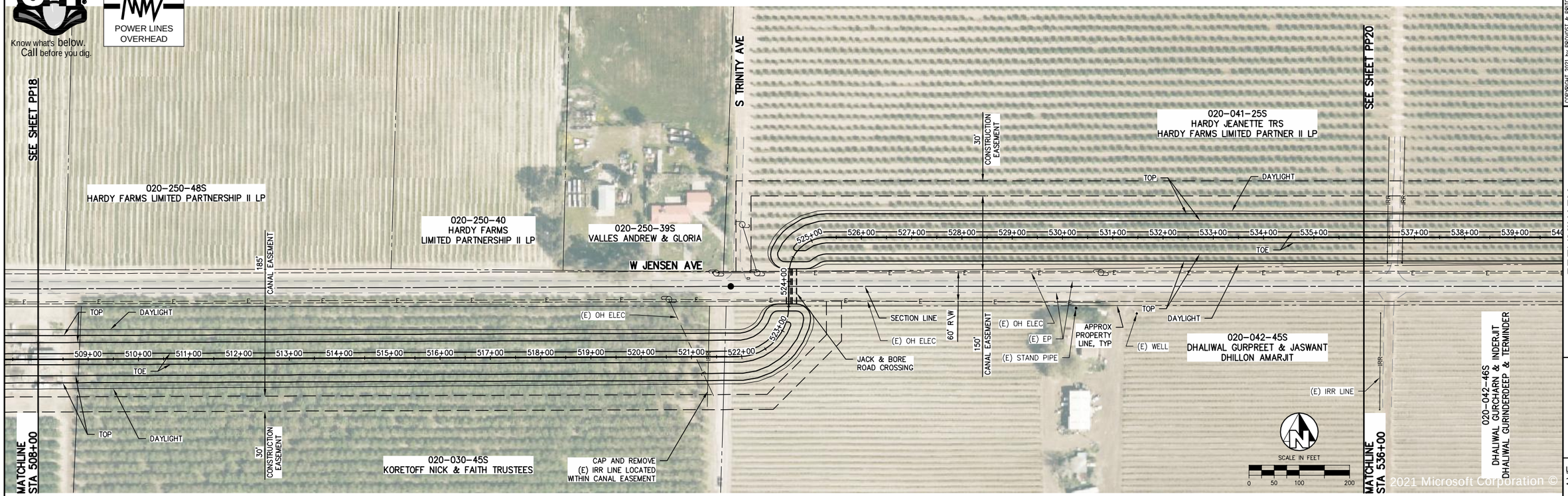
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

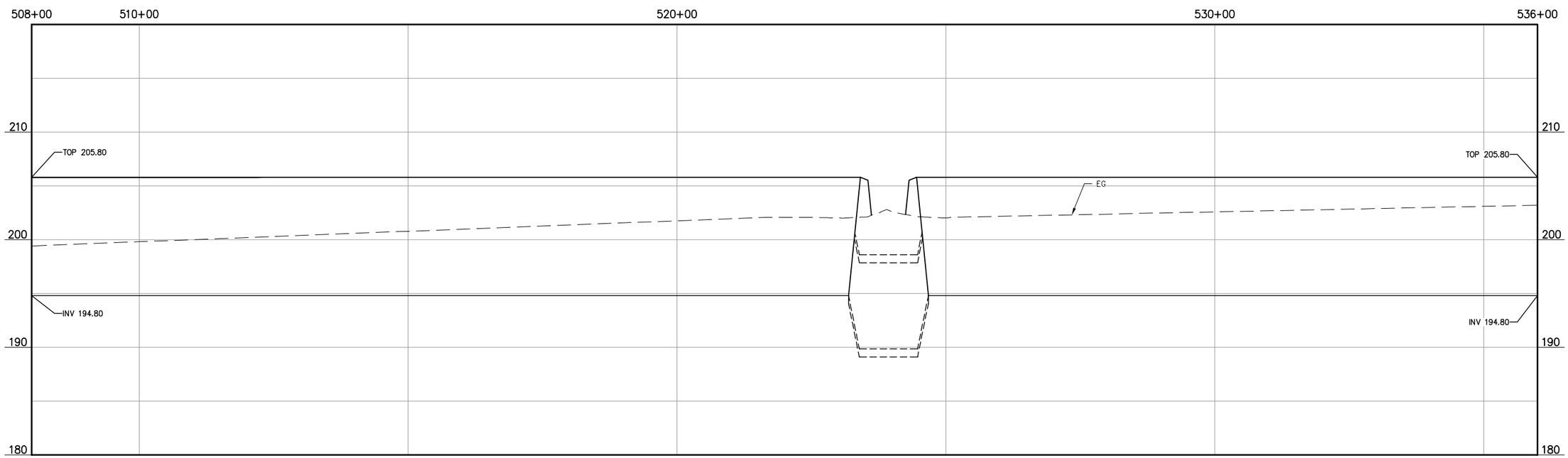
SHEET PP18
22 OF 30

3/26/2021 3:23 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP18 STA 480+00 TO STA 508+00.dwg –Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





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3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE
McMULLIN GSA
FRESNO COUNTY, CA
PLAN & PROFILE
STA 508+00 TO STA 536+00

PROVOST & PRITCHARD CONSULTING GROUP
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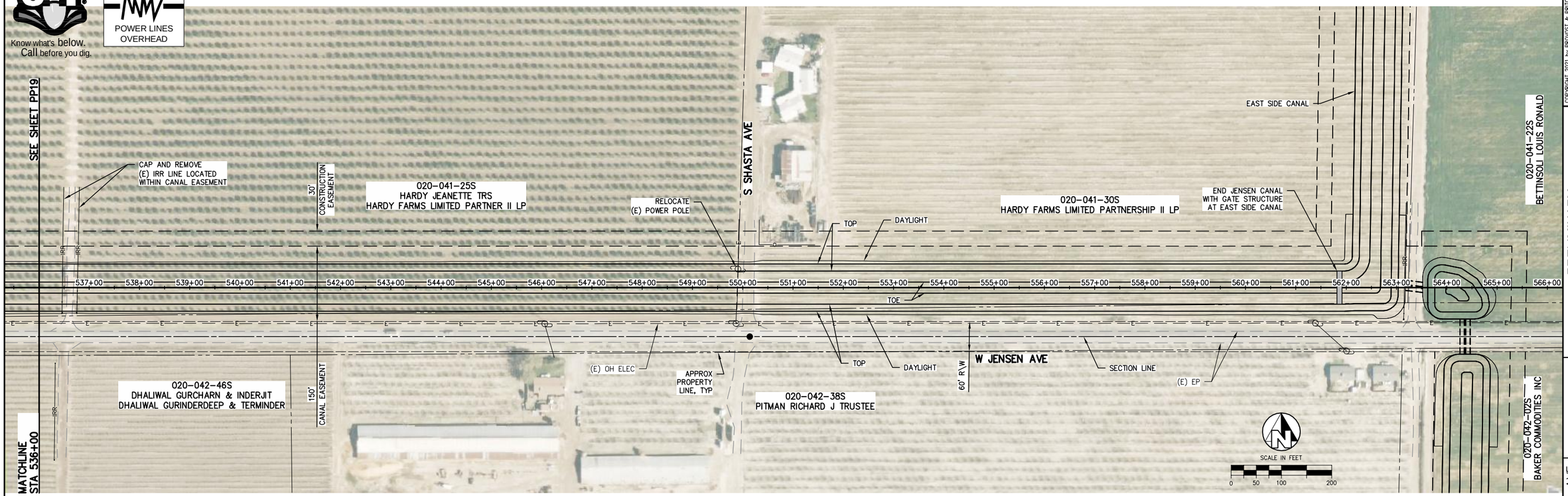
An Employee Owned Company
VISALIA, WEST SACRAMENTO, LAKE ISABELLA
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

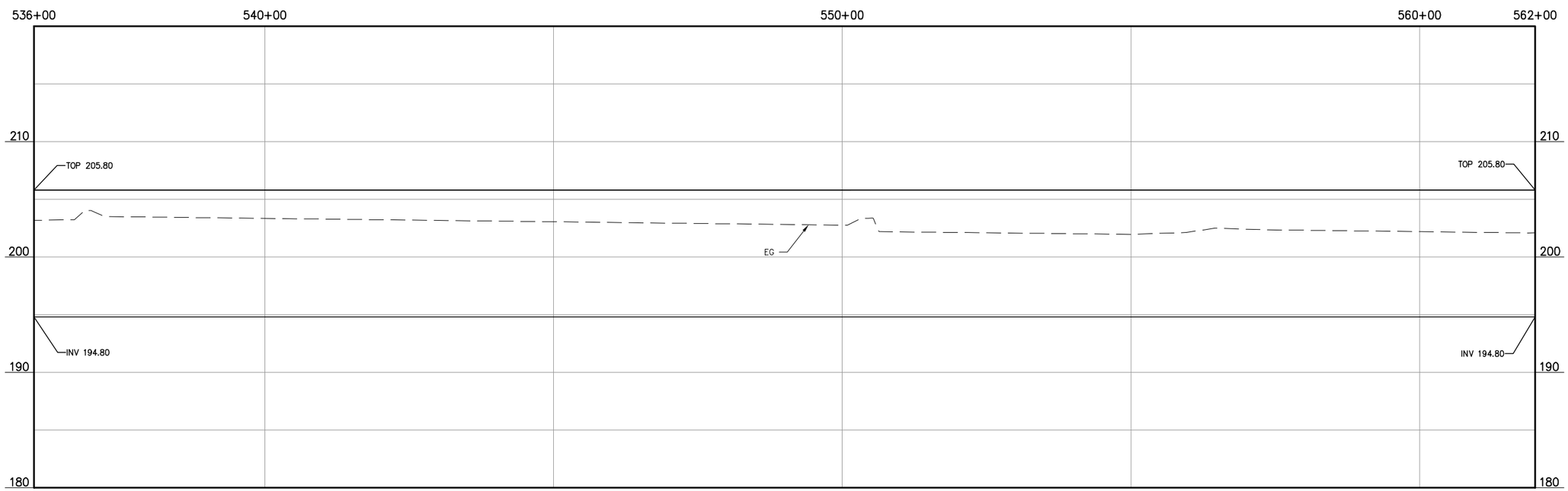
DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD
CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.
SHEET PP19
23 OF 30

3/26/2021 3:24 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP19 STA 508+00 TO STA 536+00.dwg -Lindsey Sciacca

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 536+00 TO STA 562+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1950
An Employee Owned Company
PROFESSIONAL CORPORATION
FRESNO, CALIFORNIA 93711-5162
559/449-2700 FAX 559/449-2715
www.ppeng.com

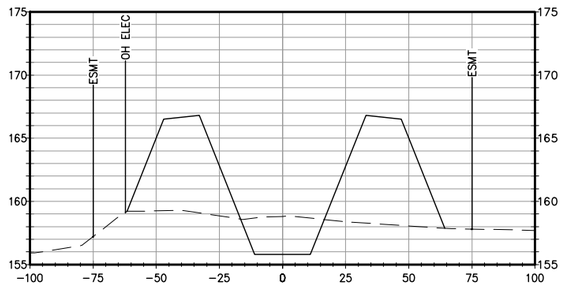
DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----
DRAFTED BY: PAD
CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

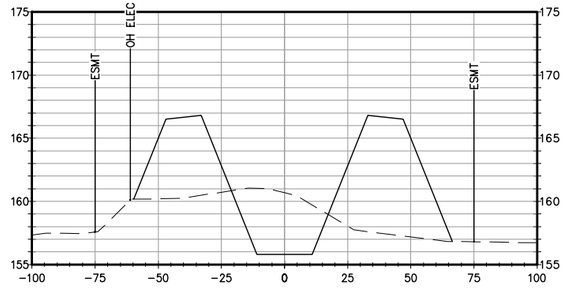
SHEET PP20

24 OF 30

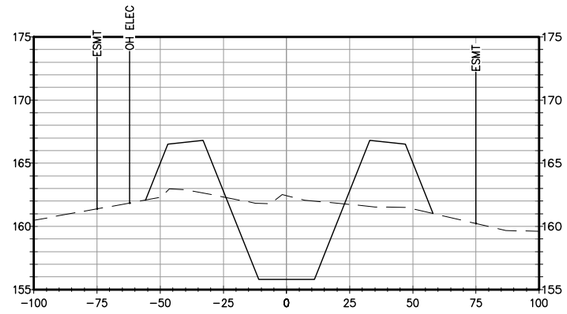
3/26/2021 3:24 PM g:\mcmullin gsa-2659\2659 on-going\CAD\340 sheet sets\02_Plan & Profile\PP20 STA 536+00 TO STA 562+00.dwg -Lindsey Sciacca



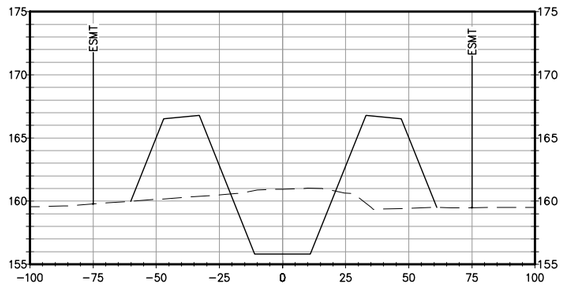
McMullin GWB
STA 100+00



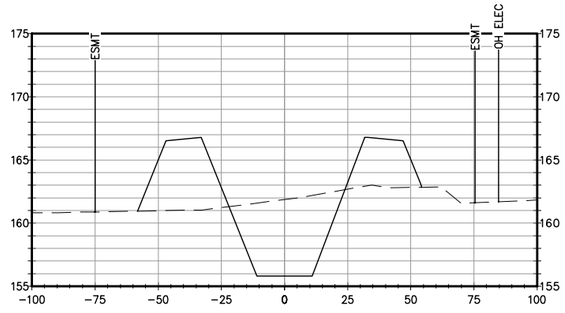
McMullin GWB
STA 120+00



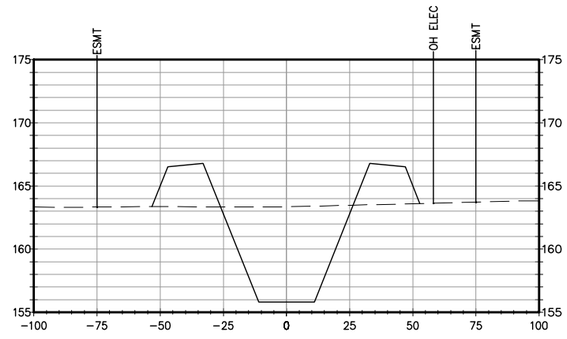
McMullin GWB
STA 140+00



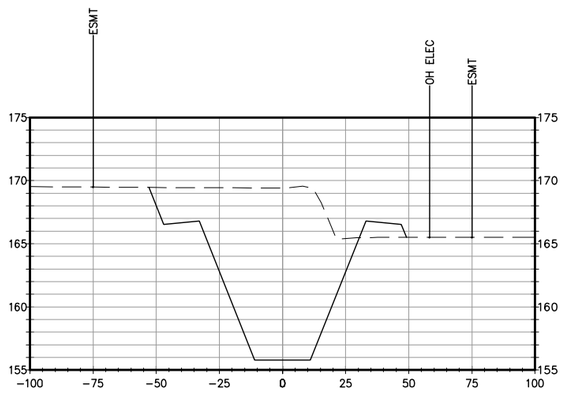
McMullin GWB
STA 160+00



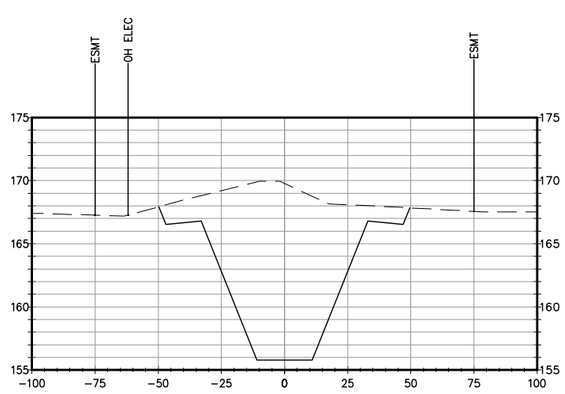
McMullin GWB
STA 180+00



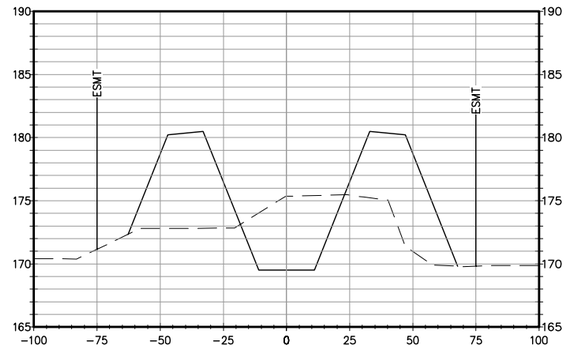
McMullin GWB
STA 200+00



McMullin GWB
STA 220+00



McMullin GWB
STA 240+00



McMullin GWB
STA 260+00

PRELIMINARY
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3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

CROSS SECTIONS

CROSS SECTIONS

EST. 1958
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
1885 N. Kelly Park Drive
FRESNO, CALIFORNIA 93711-5162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:
____

DRAFTED BY:	CHECKED BY:
PAD	

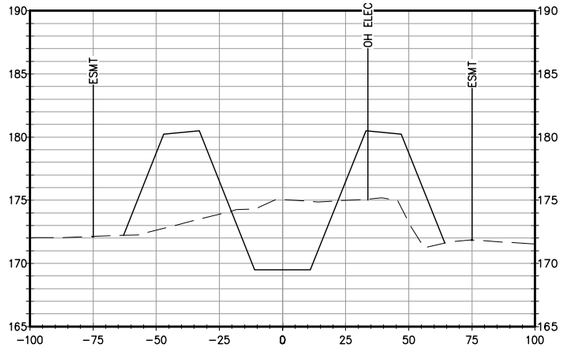
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

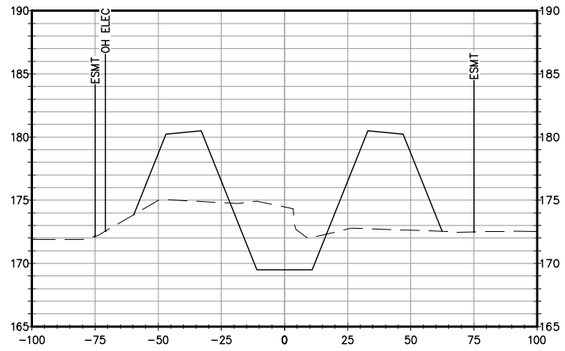
SHEET CS1

25 OF 30

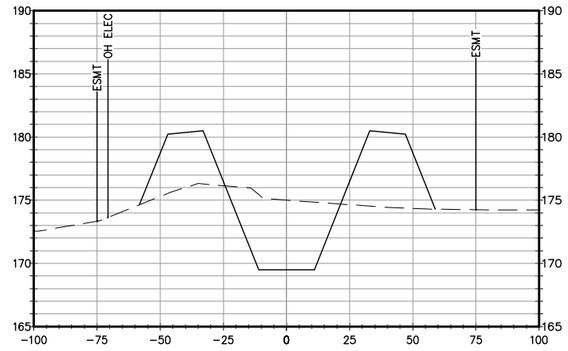
3/26/2021 3:25 PM g:\mcmullin gsa-2859\2859 on-going\CAD\340 sheet sets\03_Cross Sections\CS3 CROSS SECTIONS.dwg -Lindsey Solorio



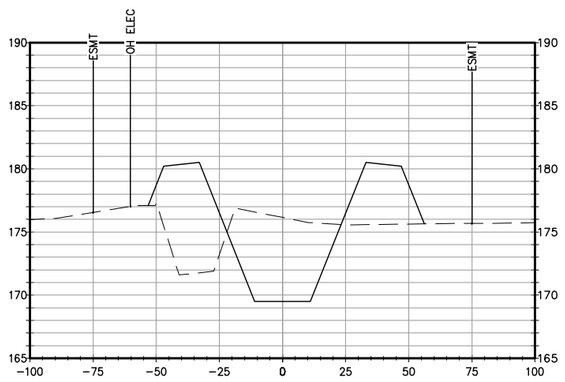
McMullin GWB
STA 270+00



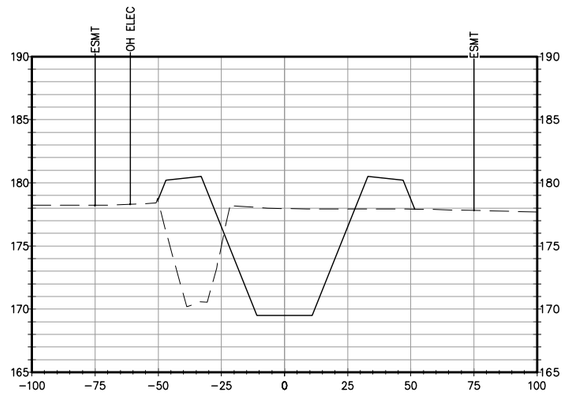
McMullin GWB
STA 280+00



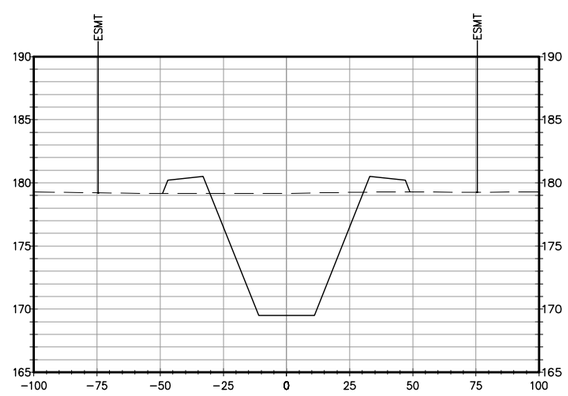
McMullin GWB
STA 300+00



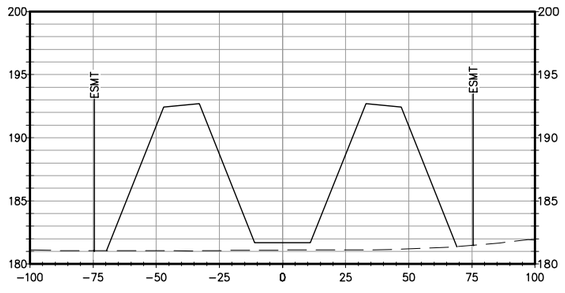
McMullin GWB
STA 320+00



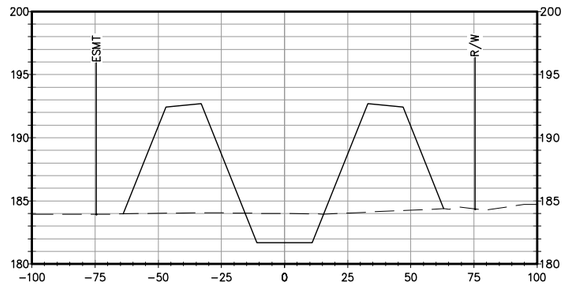
McMullin GWB
STA 340+00



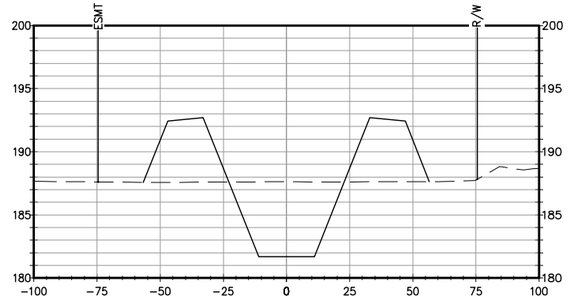
McMullin GWB
STA 360+00



McMullin GWB
STA 380+00



McMullin GWB
STA 400+00



McMullin GWB
STA 420+00

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3/26/21

No.	REVISION	BY	DATE

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AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

CROSS SECTIONS

CROSS SECTIONS

PROVOST & PRITCHARD CONSULTING GROUP
ESTABLISHED 1956
An Employee Owned Company
2955 GOLLY AVENUE, P.O. BOX 28340
FRESNO, CALIFORNIA 93711-8162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD
CHECKED BY:

DATE: 3/26/21

JOB NO: 256920002

PROJECT NO:

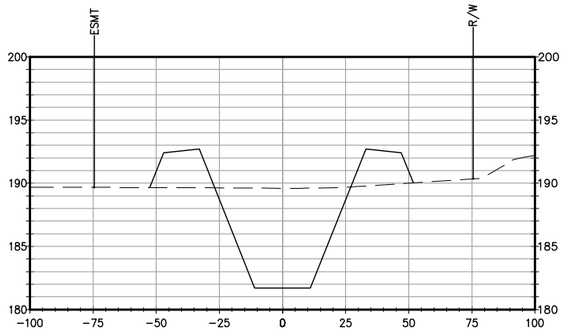
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET CS2

26 OF 30

3/26/2021 3:25 PM g:\mcmullin gsa-2859\2859 on-going\CAD\340 sheet sets\03_Cross Sections\CS3 CROSS SECTIONS.dwg -Lindsey Solorio



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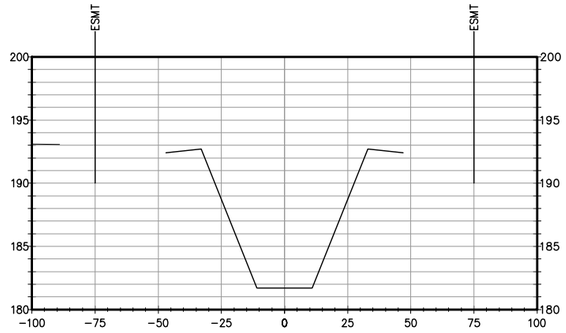

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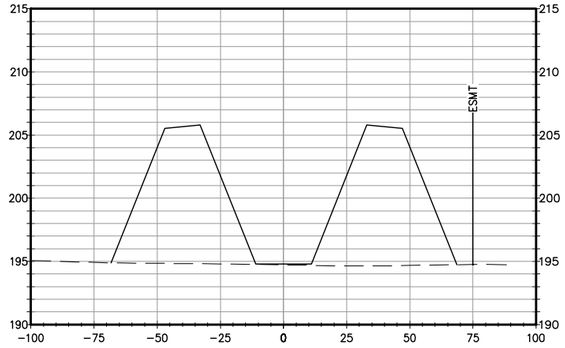

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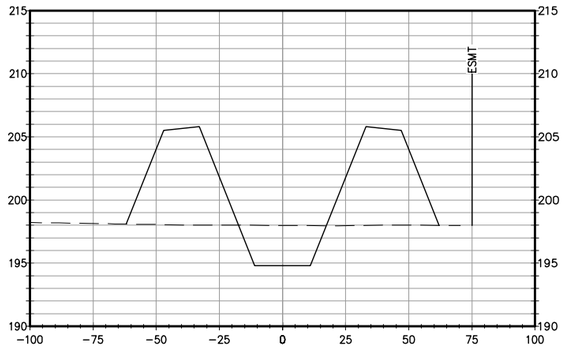

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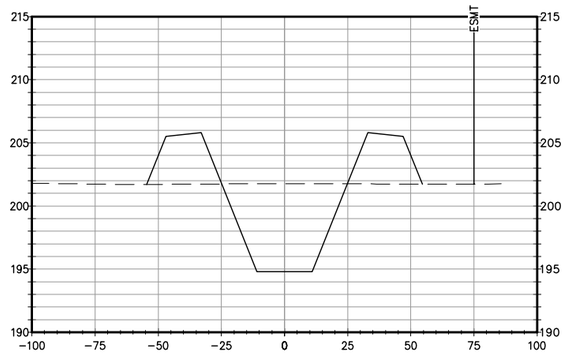

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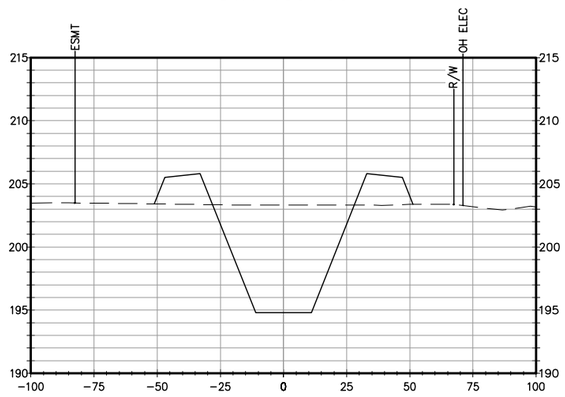

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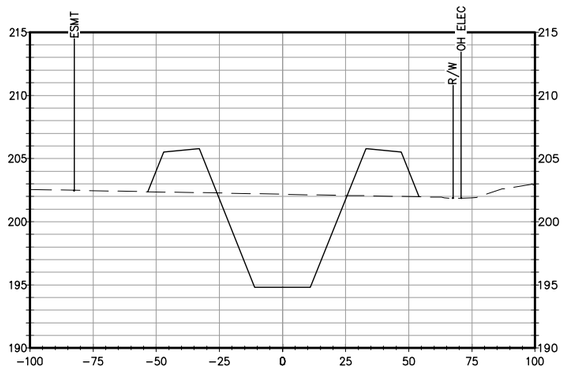

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AQUATERRA WATER BANK – JENSEN AVE

McMULLIN GSA
FRESNO COUNTY, CA

CROSS SECTIONS

CROSS SECTIONS

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1956
An Employee Owned Company
2955 CORNELL AVENUE
FRESNO, CALIFORNIA 93721-2162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:
____

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET **CS3**

27 OF 30

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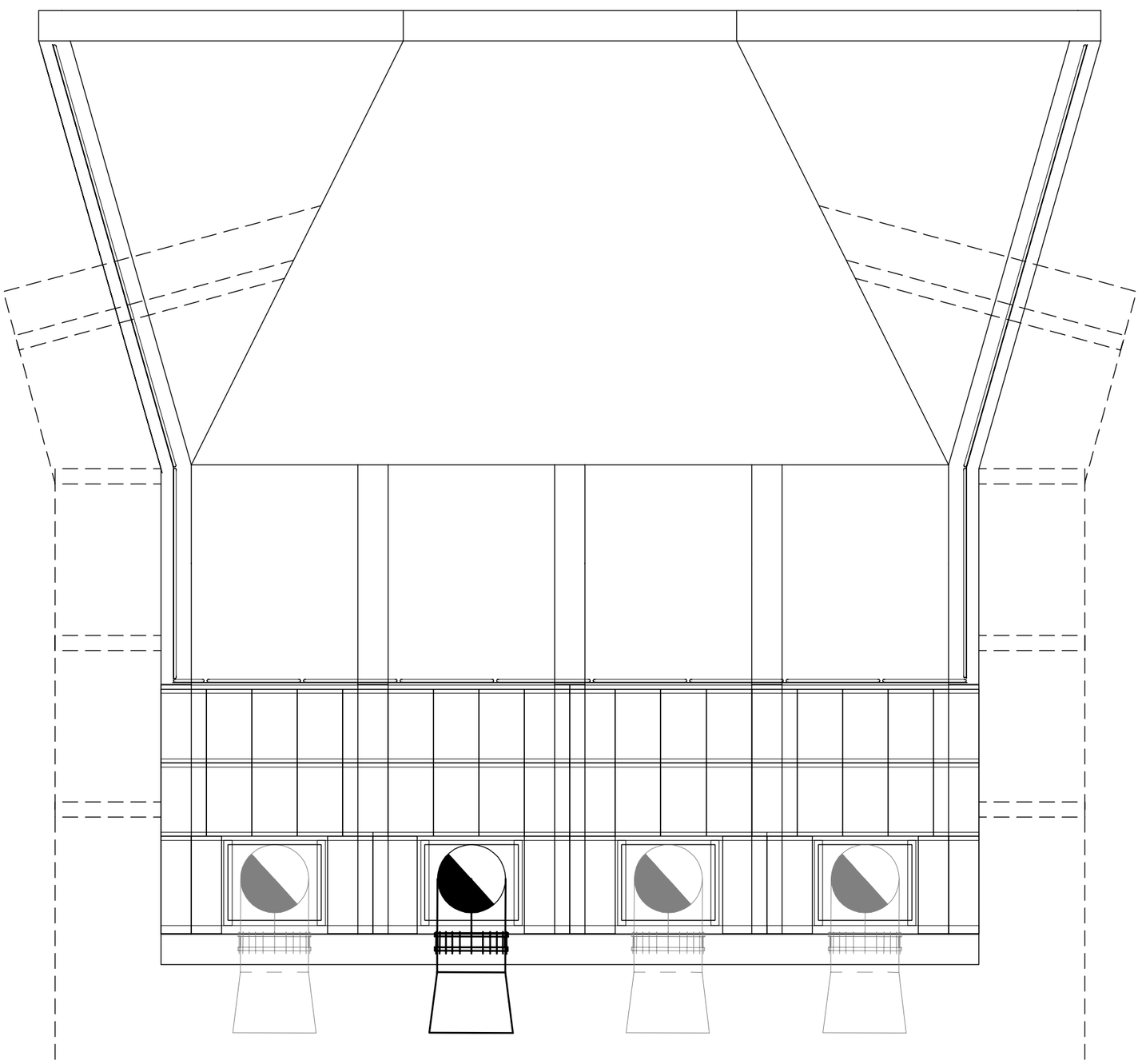

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LICENSE NO: ----	DATE: 3/26/21		
	JOB NO: 2569200002		
	PROJECT NO:		
	PHASE:		
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	SHEET S1		
	28 OF 30		

ESTD 1958
PROVOST& PRITCHARD
CONSULTING GROUP
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PUMP STATION

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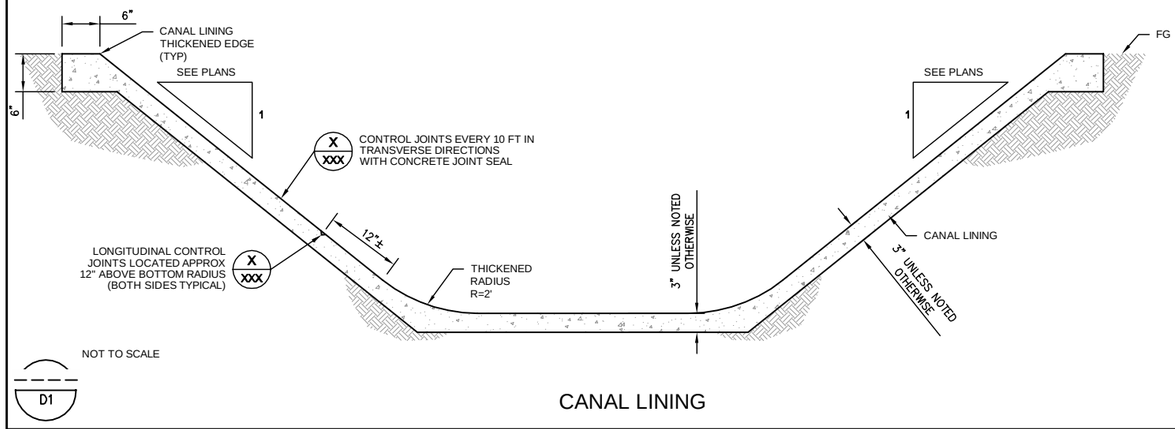
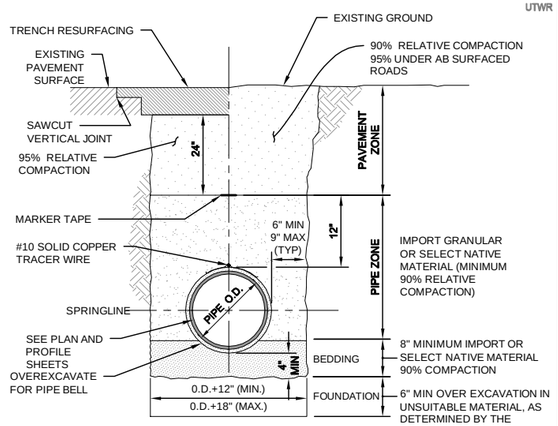


CANAL LINING

UTWR



TYPICAL PIPE BEDDING

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FRESNO COUNTY, CA
DETAILS

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CONSULTING GROUP
An Employee Owned Company
1885 CRAWFORD LANE
FRESNO, CALIFORNIA 93711-5162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:
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PAD	

DATE: 3/26/21
JOB NO: 256920002
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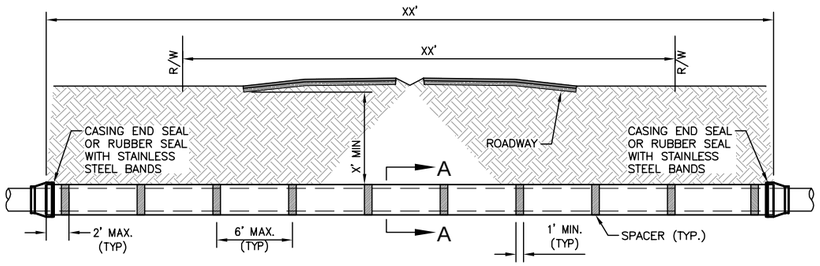
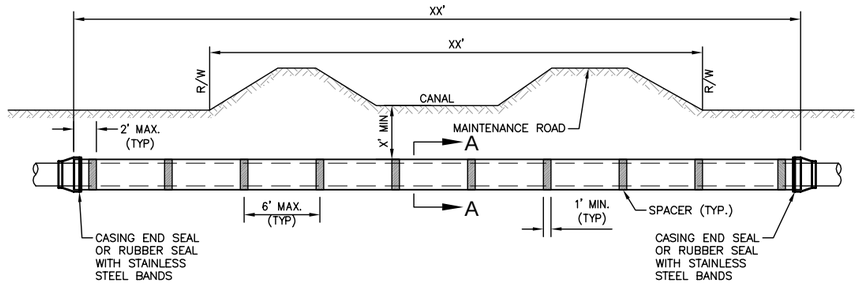


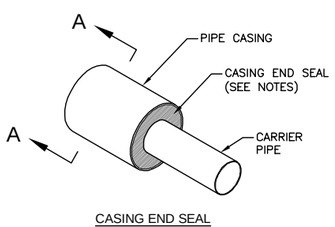
SECTION VIEW - ROADWAY

ALL DIMENSIONS ALONG CENTERLINE OF PIPELINE

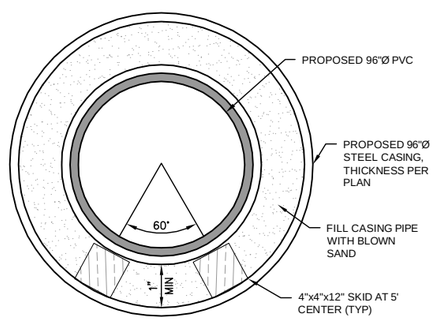


SECTION VIEW - OPEN CANAL

ALL DIMENSIONS ALONG CENTERLINE OF PIPELINE



CASING END SEAL



SECTION A-A

NOT TO SCALE

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D1

JACK AND BORE

PLACEMENT OF SPACERS ON CARRIER PIPE

1. GENERAL - ONE SPACER SHALL BE PLACED NOT MORE THAN TWO FEET FROM EACH END OF CASING. SUBSEQUENT SPACERS SHALL BE PLACED AT 6' INTERVALS WITHIN THE CASING, OR IN ACCORDANCE WITH PIPE MANUFACTURERS RECOMMENDATIONS.

2. FOR ALL CARRIER PIPE, ONE SPACER SHALL BE PLACED ON THE SPIGOT END OF EACH SEGMENT AT THE LINE MARKING THE LIMIT OF INSERTION INTO THE BELL. WHEN THE JOINT IS COMPLETE, THE SPACER SHALL BE IN CONTACT WITH THE BELL OF THE JOINT SO THAT THE SPACER PUSHES THE JOINT AND RELIEVES COMPRESSION WITHIN THE JOINT. SUBSEQUENT SPACERS SHALL BE PLACED AT 6'-10' INTERVALS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

CARRIER PIPE

1. CARRIER PIPE SHALL BE CENTERED WITHIN CASING BY USING OF ONE OF THESE METHODS:

   WOOD SKIDS
   PRESSURE TREATED #2 DF 2XS, #3 REDWOOD 2XS

   MANUFACTURED SPACERS
   HDPE OR STEEL

   CASING SPACERS AS MANUFACTURED BY ONE OF THE FOLLOWING
   ADVANCE PRODUCTS & SYSTEMS, INC.; CCI PIPELINE SYSTEMS; PUBLIC WORKS MARKETING, INC.; PIPELINE SEAL & INSULATOR, INC.; OR APPROVED EQUAL

BLOWN SAND

1. CASING SHALL BE FILLED WITH BLOWN SAND AFTER INSTALLATION OF CARRIER PIPE

CASING END SEALS

1. CASING END SEALS SHALL BE SEALED BY USING ONE OF THESE METHODS:

   RUBBER SEALS
   WRAP AROUND, NEOPRENE RUBBER, MIN. THICKNESS:1/8";
   TEMPERATURE RATING: -20°F TO 170°F.

   STEEL BAND
   STAINLESS STEEL BANDING; MIN. 2 BANDS PER SEAL; T304 STAINLESS STEEL WITH 100% NON-MAGNETIC WORM GEAR, 1/2" MIN. WIDTH.

BORE AND RECEIVING PIT NOTES

1. THE [AGENCY] HAS OBTAINED IT'S PORTION OF A [AGENCY] ENCROACHMENT PERMIT. THE CONTRACTOR SHALL OBTAIN HIS PORTION OF THE [AGENCY'S] PERMIT (NO PERMIT FEE) PRIOR TO PERFORMING ANY WORK WITHIN THE [AGENCY'S] RIGHT OF WAY.

2. ALL WORK WITHIN THE [AGENCY'S] RIGHT OF WAY SHALL BE IN CONFORMANCE WITH [AGENCY'S] ENCROACHMENT PERMIT REQUIREMENTS.

3. BORE AND RECEIVING PITS SHALL BE LOCATED 5 FEET (MINIMUM) OUTSIDE OF [AGENCY'S] RIGHT OF WAY.

4. IF THE AGENCY IS CALTRANS: THE BORE AND RECEIVING PITS ARE UNDER STATE OF CALIFORNIA JURISDICTION, REGARDLESS OF THEIR LOCATION. SIZE AND LOCATION OF BORE AND RECEIVING PITS ARE THE CONTRACTOR'S RESPONSIBILITY SUBJECT TO CALTRANS APPROVAL.

4. IF THE AGENCY IS NOT CALTRANS:SIZE AND LOCATION OF BORE AND RECEIVING PITS ARE THE CONTRACTOR'S RESPONSIBILITY SUBJECT TO [AGENCY'S] APPROVAL.

5. ACCESS TO THE BORE AND RECEIVING PITS SHALL ONLY BE FROM THE CONSTRUCTION EASEMENTS OBTAINED BY [AGENCY]. THE PARKING OF EQUIPMENT AND/OR MATERIALS SHALL NOT BE WITHIN 20' OF THE ROADWAY LANES.

6. BORE AND RECEIVING PITS SHALL BE ADEQUATELY FENCED AND/OR HAVE A TYPE-K BARRIER PLACED AROUND THEM.

7. BORE AND RECEIVING PITS SHALL BE ADEQUATELY SHORED IN ACCORDANCE WITH CAL OSHA REQUIREMENTS.

8. SHORING PLANS, SIGNED BY A REGISTERED ENGINEER, SHALL BE SUBMITTED AND APPROVED BY [AGENCY] BEFORE EXCAVATING.

9. CASING PIPE MAY BE NEW OR USED STEEL PIPE WITH A MINIMUM YIELD STRENGTH OF 36,000 PSI. (ASTM A36). USED STEEL PIPE SHALL BE PRE-APPROVED BY [AGENCY'S] BEFORE INSTALLATION.

10. CASING PIPE MAY BE SPIRAL WELDED PIPE PROVIDED THE PIPE IS NEW AND THE WELD IS SMOOTH.

11. ALL CASING LENGTHS SHALL BE EQUAL TO THE AUGER LENGTH.

12. ALL CASING JOINTS WELDED IN THE FIELD SHALL BE FULLY WELDED AROUND THE CIRCUMFERENCE OF THE PIPE WITH COMPLETE PENETRATION WELD.

13. [AGENCY] SHALL SET AND CHECK A SURVEY GRID PER [AGENCY'S] APPROVED ENCROACHMENT PERMIT. CONTRACTOR SHALL PRESERVE ALL MONUMENTS ASSOCIATED WITH SURVEY GRID.

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Appendix F – East-Side Canal Concept Designs

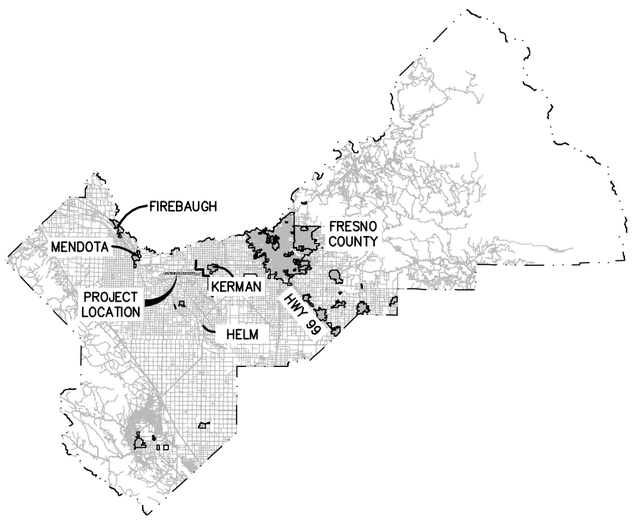
811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD

McMULLIN GSA

FRESNO COUNTY, CA

AQUATERRA WATER BANK - EAST SIDE CANAL



VICINITY MAP
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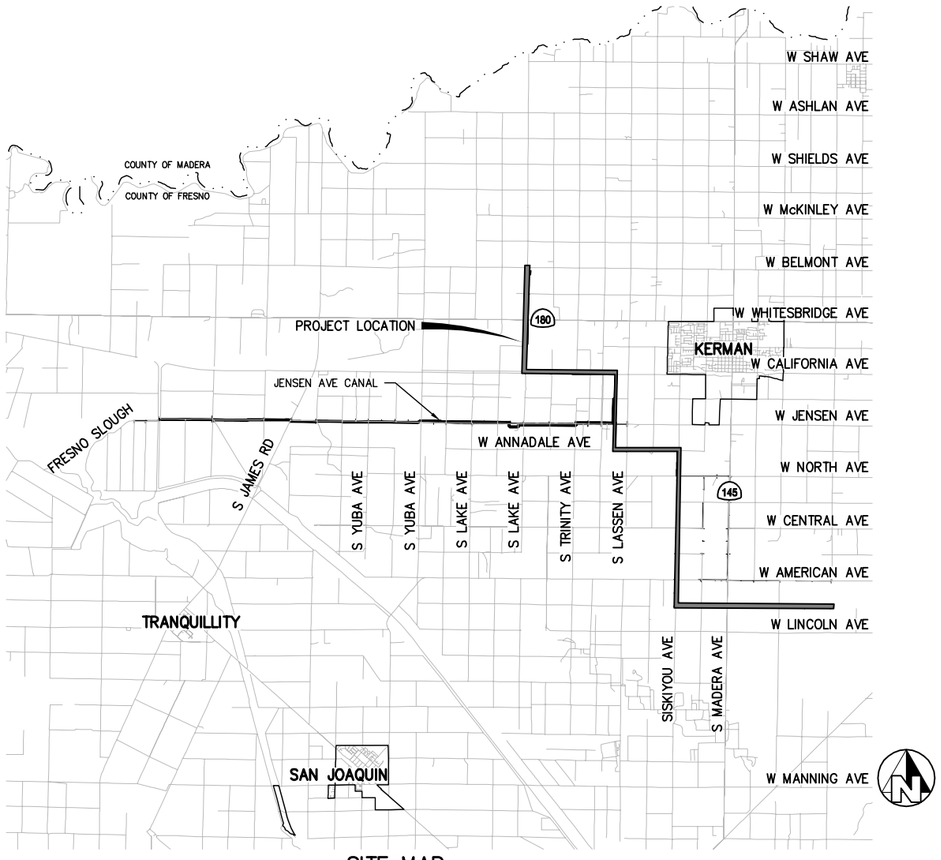

SITE MAP
NOT TO SCALE

SPECIAL NOTE

WHERE UNDERGROUND AND SURFACE STRUCTURES ARE SHOWN ON THE PLANS, THE LOCATIONS, DEPTH AND DIMENSIONS OF STRUCTURES ARE BELIEVED TO BE REASONABLY CORRECT, BUT ARE NOT GUARANTEED. SUCH STRUCTURES ARE SHOWN FOR THE INFORMATION OF THE CONTRACTOR, BUT INFORMATION SO GIVEN IS NOT TO BE CONSTRUED AS A REPRESENTATION THAT SUCH STRUCTURES WILL, IN ALL CASES, BE FOUND WHERE SHOWN, OR THAT THEY REPRESENT ALL OF THE STRUCTURES WHICH MAY BE ENCOUNTERED.

SITE SAFETY AND PROTECTION NOTES

THE DUTY OF THE ENGINEER, OWNER OR ITS AGENTS TO CONDUCT CONSTRUCTION REVIEW OF THE CONTRACTOR'S PERFORMANCE AND THE UNDERTAKING OF INSPECTIONS OR THE GIVING OF INSTRUCTIONS AS AUTHORIZED HEREIN IS NOT INTENDED TO INCLUDE REVIEW OF THE ADEQUACY OF THE CONTRACTOR'S SAFETY MEASURES IN, ON, OR NEAR THE CONSTRUCTION SITE AND SHALL NOT BE CONSTRUED AS SUPERVISION OF THE ACTUAL CONSTRUCTION NOR MAKE THE ENGINEER, OWNER OR ITS AGENTS RESPONSIBLE FOR PROVIDING A SAFE PLACE FOR THE PERFORMANCE OF WORK BY THE CONTRACTOR, SUBCONTRACTORS, OR SUPPLIERS, OR FOR ACCESS, VISITS, USE, WORK, TRAVEL OR OCCUPANCY BY ANY PERSON.

THE CONTRACTOR SHALL HAVE AT THE WORK SITE, COPIES OR SUITABLE EXTRACTS OF CONSTRUCTION SAFETY ORDERS, ISSUED BY CAL-OSHA. CONTRACTOR SHALL COMPLY WITH PROVISIONS OF THESE AND ALL OTHER APPLICABLE LAWS, ORDINANCES AND REGULATIONS. THE CONTRACTOR MUST COMPLY WITH PROVISIONS OF THE SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION, PROMULGATED BY THE SECRETARY OF LABOR UNDER SECTION 107 OF THE CONTRACT WORK HOURS AND SAFETY STANDARDS ACT, AS SET FORTH IN TITLE 29 C.F.R.

TO PROTECT THE LIVES AND HEALTH OF CONTRACTOR'S EMPLOYEES UNDER THE CONTRACT, THE CONTRACTOR SHALL COMPLY WITH ALL PERTINENT PROVISIONS OF THE "MANUAL OF ACCIDENT PREVENTION IN CONSTRUCTION" ISSUED BY THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA, INC., AND SHALL MAINTAIN AN ACCURATE RECORD OF ALL CASES OF DEATH, OCCUPATIONAL DISEASE, AND INJURY REQUIRING MEDICAL ATTENTION OR CAUSING LOSS OF TIME FROM WORK, ARISING OUT OF AND IN THE COURSE OF EMPLOYMENT OR WORK UNDER THE CONTRACT.

THE CONTRACTOR ALONE SHALL BE RESPONSIBLE FOR THE SAFETY, EFFICIENCY, AND ADEQUACY OF CONTRACTOR'S FACILITIES, APPLIANCES, AND METHODS AND FOR ANY DAMAGE, WHICH MAY RESULT FROM THEIR FAILURE OR THEIR IMPROPER CONSTRUCTION, MAINTENANCE OR OPERATION.

THE CONTRACTOR AGREES THAT IT SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE OWNER, PROVOST & PRITCHARD CONSULTING GROUP, AND THEIR RESPECTIVE AGENTS HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF OWNER, ENGINEER, OR THEIR RESPECTIVE AGENTS.

THE OWNER AND ITS AGENTS' SITE RESPONSIBILITIES ARE LIMITED SOLELY TO THE ACTIVITIES OF THEIR EMPLOYEES ON SITE. THESE RESPONSIBILITIES SHALL NOT BE INFERRED BY ANY PARTY TO MEAN THAT THE OWNER OR ITS AGENTS HAVE RESPONSIBILITY FOR SITE SAFETY. SAFETY IN, ON, OR ABOUT THE SITE IS THE SOLE AND EXCLUSIVE RESPONSIBILITY OF THE CONTRACTOR ALONE. THE CONTRACTOR'S METHODS OF WORK PERFORMANCE, SUPERINTENDENCE AND THE CONTRACTOR'S EMPLOYEES, AND SEQUENCING OF CONSTRUCTION ARE ALSO THE SOLE AND EXCLUSIVE RESPONSIBILITIES OF THE CONTRACTOR ALONE.

TOPOGRAPHY NOTE

TOPOGRAPHY SHOWN WAS COLLECTED BY PROVOST & PRITCHARD CONSULTING GROUP DURING A FIELD SURVEY CONDUCTED IN AUGUST OF 2020.

BOUNDARY NOTE

THE BOUNDARY/EASEMENT INFORMATION SHOWN ON THESE PLANS IS BASED UPON RECORD INFORMATION TIED TO PHYSICAL MONUMENTS, AND WAS PREPARED UNDER THE DIRECTION OF BRYAN W. BOWERS, PLS 8469.

GENERAL NOTES

1. [AGENCY] (XXX-XXX-XXXX) SHALL BE CONTACTED AT LEAST 48 HOURS PRIOR TO COMMENCEMENT OF WORK ON OR NEAR EXISTING DISTRICT FACILITIES.
2. USED MATERIAL, REJECTS, MISFITS, OR SECONDS, ETC. ARE NOT ACCEPTABLE FOR USE ON [AGENCY] FACILITIES.
3. ALL CONSTRUCTION SHALL BE IN CONFORMANCE WITH THESE PLANS, PROJECT SPECIFICATIONS AND [AGENCY] SPECIFICATIONS.
4. CONTRACTOR SHALL FIELD VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL EXISTING FACILITIES PRIOR TO COMMENCING WORK. CALL UNDERGROUND SERVICE ALERT (USA) AT 8-1-1. CONTRACTOR SHALL MAKE ENGINEER AWARE OF ANY DISCREPANCIES.
5. ALL CAST-IN-PLACE CONCRETE STRUCTURES SHALL BE FORMED INSIDE AND OUT AND CONCRETE VIBRATED SUFFICIENTLY TO PROVIDE FOR SMOOTH SURFACED WALLS/FLOORS WITHOUT VOIDS AND HONEYCOMBS.
6. [AGENCY] SHALL INSPECT ALL WORK PHASES ON CONCRETE FACILITIES FOR CONFORMANCE TO [AGENCY] SPECIFICATIONS. REINFORCING SHALL NOT BE ENCASED IN CONCRETE WITHOUT PRIOR [AGENCY] INSPECTIONS. LIKEWISE, CONCRETE SHALL NOT BE COVERED WITH EARTH PRIOR TO [AGENCY] INSPECTION.
7. CONCRETE DESIGN MIX SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL. ALL CONCRETE SHALL HAVE A 28-DAY MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI UNLESS OTHERWISE SPECIFIED.
8. ALL STEEL PIPE AND FITTINGS SHALL BE FURNISHED WITH A SHOP APPLIED HIGH SOLIDS EPOXY COATING ON THE INTERIOR AND EXTERIOR, UNLESS OTHERWISE INDICATED. ALL OTHER EXPOSED STEEL SHALL BE PAINTED WITH A PRE-TREATMENT PRIMER, AN UNDERCOAT AND A FINAL COAT OF PAINT IN ACCORDANCE WITH [AGENCY] SPECIFICATIONS.
9. ALL NUTS, BOLTS, AND WASHERS USED TO SECURE UNDERGROUND FITTINGS SHALL BE STAINLESS STEEL. AFTER INSTALLATION, ALL STEEL HARDWARE SHALL BE COATED WITH A RUST PREVENTATIVE, WRAPPED WITH 4 MIL POLYETHYLENE SHEETING, AND SECURE WITH PVC TAPE.
10. THRUST RESTRAINTS TO BE PROVIDED AT ALL PIPELINE BENDS, WHETHER OR NOT SHOWN ON THE PLANS.
11. ALL CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE HEALTH AND SAFETY LAWS OF THE STATE OF CALIFORNIA AND CAL/OSHA STANDARDS.
12. TRENCH BACKFILL AND RESERVOIR EMBANKMENTS SHALL BE COMPACTED IN ACCORDANCE WITH THE SPECIFICATIONS AND THE GEOTECHNICAL REPORT CONTAINED IN THE SPECIFICATIONS.
13. CONTRACTOR WILL BE RESPONSIBLE FOR THE REPAIR OF ALL PIPELINE CRACKS, WHICH DEVELOP DURING CONSTRUCTION OF IMPROVEMENTS AFFECTING EXISTING FACILITIES.
14. CONCRETE VAULTS AND BOXES MAY BE PURCHASED FROM A PRECAST MANUFACTURER OR CONTRACTOR MAY CONSTRUCT THE STRUCTURES IF STRUCTURAL CALCULATIONS AND DESIGN IS APPROVED BY THE [AGENCY] AND THE ENGINEER.
16. ALL EXCESS MATERIAL AND/OR DEBRIS SHALL BE REMOVED UPON COMPLETION OF INSTALLATION.
17. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATE DUST CONTROL AT ALL TIMES.

APPROVALS

--APPROVAL 1-- DATE

--APPROVAL 2-- DATE

SHEET INDEX

SHEET NO.	DESCRIPTION
GENERAL	
G1	COVER SHEET
G2	ABBREVIATIONS & SYMBOLS
G3	INDEX SHEET
LAND DEVELOPMENT	
LD1	HORIZONTAL CONTROL
LD2	GRADING PLAN
LD3	UTILITY PLAN
LD4	PARKING LOT
LD5	PIPELINE PLAN AND PROFILE
LD6	STREET CONSTRUCTION
LD7	ROAD SUPERELEVATION DIAGRAM
LD8	ROADWAY CROSS SECTIONS
LD9	TYPICAL DETAILS
AGRICULTURAL	
AG1	SITE DETAILS
AG2	CANAL PLAN AND PROFILE
AG3	CANAL CROSS SECTIONS
AG4	TYPICAL DETAILS
STRUCTURAL	
ST1	STRUCTURAL DETAILS
ST2	STRUCTURAL DETAILS

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No.	REVISION	BY	DATE

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AQUATERRA WATER BANK - EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA
GENERAL
COVER

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An Employee Owned Company
1234 H STREET, SUITE 101
FRESNO, CALIFORNIA 93721-6162
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ABBREVIATIONS

AB	AGGREGATE BASE	HORIZ	HORIZONTAL
AC	ASPHALT CONCRETE	HP	HINGE POINT, HIGH POINT, HORSEPOWER
ACP	ASBESTOS–CEMENT PIPE	HP GAS	HIGH PRESSURE GAS
AD	ALUMINUM DISK	HPS	HIGH PRESSURE SWITCH
AGG	AGGREGATE	HR	HANDRAIL
AH	AHEAD	H/T	HUB & TACK
ALT	ALTERNATE	HWL	HIGH WATER LEVEL
AP	ANGLE POINT	HYDRO	HYDROPNEUMATIC
APPROX	APPROXIMATE	ID	INSIDE DIAMETER
APN	ASSESSOR'S PARCEL NUMBER	IN	INCH
ARV	AIR RELIEF VALVE	INV	INVERT
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	IP	IRON PIPE
AV	AIR VENT	IRR	IRRIGATION
AVE	AVENUE	JP	JUNCTION POLE
AWWA	AMERICAN WATER WORKS ASSOCIATION	LBS	POUNDS
BAR	BARRIER	LC	LENGTH OF CURVE
BC	BEGIN CURVE	LCW	LONG CRESTED WEIR
BD	BRASS DISK	LF	LINEAR FEET
BFP	BACKFLOW PREVENTER	LG	LONG
BK	BACK	LT	LEFT
BLDG	BUILDING	LPG	LIQUEFIED PETROLEUM GAS
BM	BENCHMARK	MAX	MAXIMUM
BO	BOLLARD	MB	MAILBOX
BTM	BOTTOM	MCC	MOTOR CONTROL CENTER
BVC	BEGIN VERTICAL CURVATURE	MFR	MANUFACTURER
BW	BACK OF WALK	MH	MANHOLE
BWL	BACK OF WALL	MIN	MINIMUM
BWR	BARB WIRE	MISC	MISCELLANEOUS
C, CONC	CONCRETE	MJ	MECHANICAL JOINT
CA	CALIFORNIA	MN	MAG NAIL
CAB	CABINET	MP	MEDIUM PRESSURE GAS LINE
CBL	CABLE	MPT	MALE PIPE THREAD
CFS	CUBIC FEET PER SECOND	MRKR	MARKER
C&G	CURB & GUTTER	MS	MILD STEEL
CHK	CHECK	(N)	NORTH
CHLK	CHAIN LINK	NAVD	NORTH AMERICAN VERTICAL DATUM
CI	CAST IRON	NC	NORMALLY CONSOLIDATED
CIP	CAST IRON PIPE	NGVD	NATIONAL GEODETIC VERTICAL DATUM
CIPCP	CAST–IN–PLACE CONCRETE PIPE	NIC	NOT IN CONTRACT
CL	CLASS	NPT	NATIONAL PIPE THREAD
CLVT	CULVERT	NTS	NOT TO SCALE
℄	CENTERLINE	OC	ON CENTER
CLF	CHAIN LINK FENCE	OD	OUTSIDE DIAMETER
CLR	CLEAR, CLEARANCE	OH	OVERHEAD
CMLC	CEMENT MORTAR LINED & COATED	OP	OPERATING
CMP	CORRUGATED METAL PIPE	OSHA	OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION
CN	CONCRETE NAIL	O&M	OPERATIONS & MAINTENANCE
CNS	COMPACTED NATIVE SOIL	(P)	PROPOSED
CO	SEWER CLEAN OUT	PB	PULL BOX
CONT	CONTINUOUS	PC	POINT OF CURVATURE
CONST	CONSTRUCT/CONSTRUCTION	PCC	POINT OF COMPOUND CURVATURE
COR	CORNER	PCC	PORTLAND CEMENT CONCRETE
CORP	CORPORATION	PE	PERMANENT EASEMENT
COL	COLUMN	PER	PERIMETER
COUP	COUPLING	PI	POINT OF INTERSECTION
CP	CONTROL POINT	PIP	PLASTIC IRRIGATION PIPE
CR	CROWN	PLC	PROGRAMMABLE LOGIC CONTROLLER
CU	CUBIC	P℄	PROPERTY LINE
CY	CUBIC YARDS	PNL	PANEL
DA	DRIVE APPROACH	POC	POINT ON CURVE
DEC	DECIDUOUS	POL	POINT ON LINE
DEMO	DEMOLISH/DEMOLITION	POT	POINT ON TANGENT
DI	DROP INLET	PP	POWER POLE
DIA, ø	DIAMETER	PRC	POINT OF REVERSE CURVATURE
DIM	DIMENSION	PRV	PRESSURE REDUCING VALVE
DIP	DUCTILE IRON PIPE	PSF	POUNDS PER SQUARE FOOT
D/S	DOWNSTREAM	PSI	POUNDS PER SQUARE INCH
DW	DRIVEWAY	PT	POINT OF TANGENCY
DWG	DRAWING	PVC	POLYVINYL CHLORIDE
(E)	EXISTING, EAST	PVCC	POINT OF VERTICAL COMPOUND CURVATURE
EA	EACH	PVMT	PAVEMENT
EC	END CURVE	PVRC	POINT OF VERTICAL REVERSE CURVATURE
ECC	ECCENTRIC	PVI	POINT OF VERTICAL INTERSECTION
EF	EACH FACE	R	RADIUS
EG	EXISTING GRADE	RBR	REBAR
EL, ELEV	ELEVATION	RC	RADIUS OF CURVE
ELC	EPOXY LINED & COATED	RCP	REINFORCED CONCRETE PIPE
ELEC	ELECTRIC	RD	RELATIVE DENSITY
ELL	ELBOW	RD	ROAD
EM	ELECTRIC METER	RE	REFERENCE
EOL	END OF LINE	REQD	REQUIRED
EP	EDGE OF PAVEMENT	RET	RETURN
EQUIV	EQUIVALENT	REV	REVISION
ESMT	EASEMENT	RGRCP	RUBBER GASKETED REINFORCED CONCRETE PIPE
EUC	EUCALYPTUS	RGS	RIGID GALVANIZED STEEL
EVC	END VERTICAL CURVE	RP	RADIUS POINT
EW	EACH WAY	RR	RAILROAD
EXP	EXPOSED	RT	RIGHT
(F)	FUTURE	RTU	REMOTE TERMINAL UNIT
F&I	FURNISH & INSTALL	R/W	RIGHT OF WAY
FD	FOUND	(S)	SOUTH, SOLVENT WELD
FDC	FIRE DEPARTMENT CONNECTION	S	SLIP
FF	FINISHED FLOOR	S=	SLOPE
FG	FINISHED GRADE	SCH	SCHEDULE
FH	FIRE HYDRANT	SCP	STANDARD CONCRETE PIPE
F℄, FL	FLOW LINE	SD	STORM DRAIN
FLG	FLANGE	SDMH	STORM DRAIN MANHOLE
FLGD	FLANGED	SEC	SECTION
FM	FORCE MAIN	SERV	SERVICE
FNC	FENCE	SF	SQUARE FEET
FRP	FIBER REINFORCED POLYESTER PIPE	SP	SERVICE POLE
FT	FOOT/FEET	SPEC	SPECIFICATION
FW	FRONT OF WALK	SPNDL	SPINDLE
FWL	FACE OF WALL	SQ	SQUARE
GA	GAUGE	SS	SANITARY SEWER
GAL	GALLON	SS OR STS	STAINLESS STEEL
GALV	GALVANIZED	SSMH	SANITARY SEWER MANHOLE
GB	GRADE BREAK	STA	STATION
GM	GAS METER	STD	STANDARD
GPM	GALLONS PER MINUTE	STL	STEEL
GRVL	GRAVEL	STP	STAND PIPE
GS	GAS	STRC	STRUCTURE
GSV	GAS VALVE	STRP	STRIPING
GUY	GUY WIRE	SWL	SWALE
GV	GATE VALVE	STWL	STILLING WELL
HD	HEAD	(T)	THREADED
HDPE	HIGH DENSITY POLYETHYLENE	T	THREAD
HDR	HEADER	T&B	TOP & BOTTOM
HDW	HEADWALL	TB	TOP OF BANK
HGL	HYDRAULIC GRADE LINE	TBM	TEMPORARY BENCHMARK
		TC	TOP OF CURB
		TCE	TEMPORARY CONSTRUCTION EASEMENT
		TDI	TENSILE DUCTILE IRON
		TELE	TELEPHONE
		TF	TOP OF FOOTING
		TFC	TOP FACE OF CURB
		TG	TOP OF GRATE
		TH	THREAD
		TL	TOP OF LINING
		TOE	TOE OF SLOPE
		TOP	TOP OF SLOPE
		TP	TELEPHONE POLE
		TR	TELEPHONE RISER
		TRANS	TRANSFORMER
		TRFC	TRAFFIC
		TS	TOP OF STRUCTURE
		TSB	TELEPHONE SPLICE BOX
		TYP	TYPICAL
		TWL	TOP OF WALL
		UG	UNDERGROUND
		UP	UTILITY POLE
		UT	UTILITY
		U/S	UPSTREAM
		VCP	VERIFIED CLAY PIPE
		VERT	VERTICAL
		VG	VALLEY GUTTER
		VLT	VAULT
		VLV	VALVE
		(W)	WEST
		W	WATER
		WL	WATER LINE
		WM	WATER METER
		WS	WATER SERVICE
		WV	WATER VALVE
		WW	WASTE WATER
		W/	WITH
		W/O	WITHOUT

LINETYPES

LINETYPE	EXISTING	NEW	DESCRIPTION
			WATER LEVEL
			BARRICADE
			CONTOUR (DEPRESSION)
	123	123	CONTOUR (MAJOR)
			CONTOUR (MINOR)
			EMBANKMENT TOE
			EMBANKMENT TOP
			FENCE (BLOCK WALL)
			FENCE (CHAIN LINK)
			FENCE (WOOD)
			FENCE (WIRE)
	SF	SF	FENCE (SILT)
			GATE SWING
			GRADE BREAK
			GUARDRAIL
			RAILROAD
			RETAINING WALL
	C/C	XX" C/C	SWALE CENTERLINE
	E	XX" ELEC (AERIAL)	SWALE W/FLOW ARROWS
	E	XX" ELEC (BURIED)	WATER (LAKE/POND)
	FO	XX" FO	WATER (MARSH/SWAMP)
	G	XX" GAS	COMPUTER/COMM. (BURIED)
	IRR	XX" IRR	ELECTRIC (AERIAL)
	O	XX" OIL	ELECTRIC (BURIED)
	S	XX" SS	FIBER–OPTIC
	FM	XX" FM	GAS
		XX"	IRRIGATION
	S I	XX" SI	OIL
		XX" STEAM	SANITARY SEWER
	SD	XX" SD	SANITARY SEWER FORCE MAIN
	T	XX" TELE (AERIAL)	SANITARY SEWER LATERAL
	T	XX" TELE (BURIED)	SIGNAL INTERCONNECT (BURIED)
	TV	XX" TV (AERIAL)	STEAM
	TV	XX" TV (BURIED)	STORM DRAINAGE
	W	XX" W	TELEPHONE (AERIAL)
			TELEPHONE (BURIED)
			TELEVISION (AERIAL LINE)
			TELEVISION (BURIED LINE)
			WATER
			CENTERLINE
			EASEMENT
			MEANDER LINE
			PROPERTY LINE
			RESERVATION/PARK/FOREST
			RIGHT–OF–WAY
			RELINQUISH ACCESS LINE
			SECTION LINE
			STATE/COUNTY/CORPORATE LIMIT
			REVISION CLOUD
			SAWCUT LINE
			DEMO LINE
			WORK LIMITS

HATCHES

HATCH TYPE	EXISTING	NEW	DESCRIPTION
			AGGREGATE
			AC PAVEMENT
			CONCRETE
			CONCRETE LINING (PLAN VIEW)
			EARTH
			RIP RAP
			SAND
			GRATING
			EXPANDED METAL

SYMBOLS

SYMBOL EXISTING	SYMBOL NEW	DESCRIPTION
		ELECTRIC METER
		PAD MOUNTED TRANSFORMER
E	E	ELECTRIC VAULT
		UTILITY POLE
		UTILITY POLE ANCHOR
		ELECTRIC MANHOLE
		GAS METER
		GAS VALVE
		SANITARY SEWER CLEAN OUT
S	OR	SANITARY SEWER MANHOLE
		SSMH (ECCENTRIC CONE)
		STORM DRAIN CATCH BASIN
		STORM DRAIN INLET
		STORM DRAIN CULVERT
D		STORM DRAIN MANHOLE
		MAIL BOX
		SIGN
		YARD LIGHT
		GUARD POST
		CONTROL POINT
		BENCH MARK
		IRON PIPE
		MONUMENT
		MONUMENT (OPTIONAL)
		OWNERSHIP TIE
NO.	NO.	LOT NUMBER
		TELEPHONE RISER
T	T	TELEPHONE VAULT
		2–NOZZLE HYDRANT
		3–NOZZLE HYDRANT
FD	FD	FIRE DEPT. CONNECTION
F	F	FIRE VAULT
		WATER METER
W	W	WELL
		WATER VALVE
		BLOW–OFF
		AIR RELIEF VALVE
BFP	BFP	BACK FLOW PREVENTOR
		GATE VALVE HANDLE
		STILLING WELL
		FENCE POST
		FENCE GATE
	XX	REVISION
	X	CONSTRUCTION CALLOUT
# SHT	DETAIL NUMBER SHEET NUMBER	DETAIL CALLOUT
		LINE BREAK
		PIPE END (SCHEMATIC)
		PIPE END
		EMBANKMENT ARROW
HWL= XXX.XX		HIGH WATER LINE
(E) XX XXX.XX	XX XXX.XX	SPOT ELEVATION
		SECTION VIEW

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE
CANAL
McMULLIN GSA
FRESNO COUNTY, CA
GENERAL

LEGEND & ABBREVIATIONS

EST. 1946
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company
WWW.PROVPRIT.COM
FRESNO, CALIFORNIA 93711–4162
559/449–2700 FAX 559/449–2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET G2
OF

3/26/2021 5:24 PM G:\McMullin GSA–2659\2659 On–going\CAD\340 Sheet Sets\01_General\East Side Canal\G2 LEGEND & ABBREVIATIONS.dwg –Phillip Dansby

Know what's **below.**
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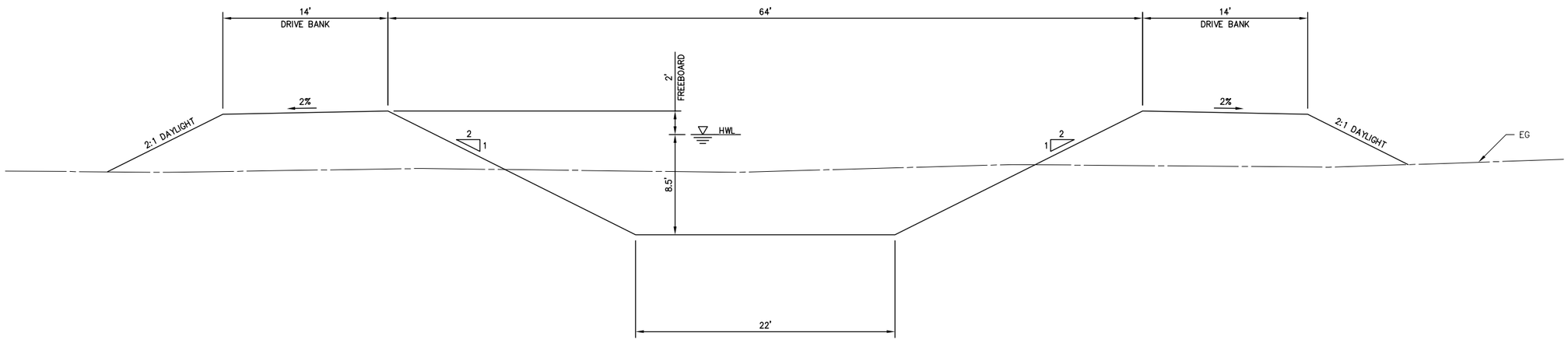
WARNING
POWER LINES
OVERHEAD



TYPICAL CROSS SECTION – EAST SIDE CANAL ALIGNMENT

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3/26/21

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AQUATERRA WATER BANK – EAST SIDE CANAL
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FRESNO COUNTY, CA

GENERAL

TYPICAL CROSS SECTION

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PROJECT NO:
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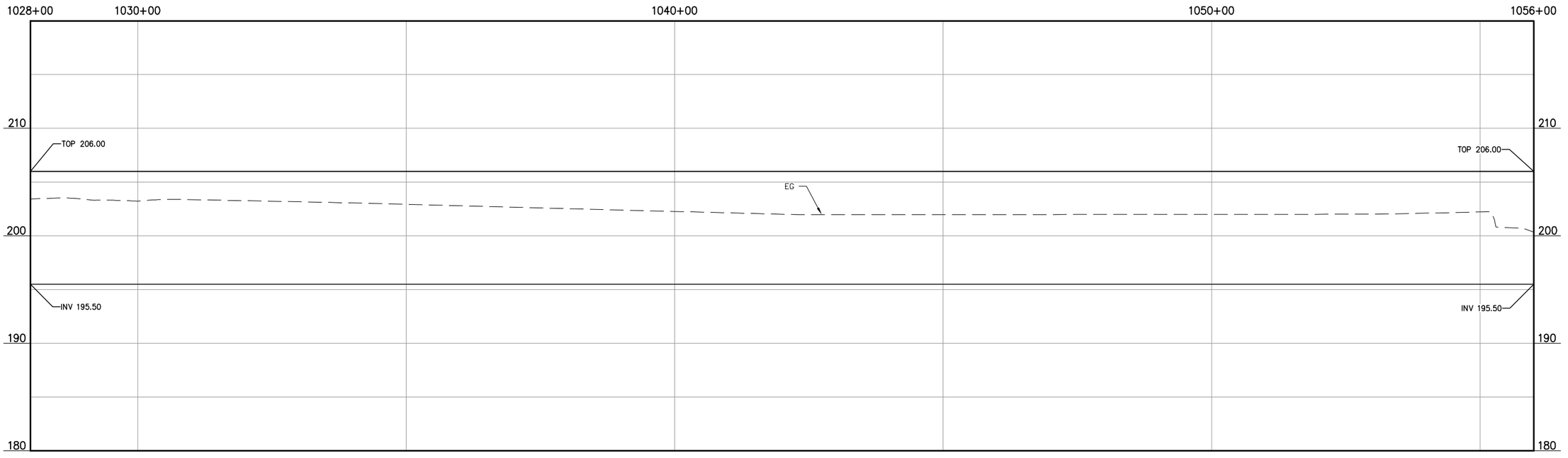

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AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1028+00 TO STA 1056+00

EST. 1949
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FRESNO, CALIFORNIA 93711-6162
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JOB NO: 256920002
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020-280-21S
TOSTE FAMILY FARMS LP

020-280-22S
TOSTE FAMILY FARMS LP

SEE SHEET PP2

SEE SHEET PP4

1055+00 1057+00 1058+00 1059+00 1060+00 1061+00 1062+00 1063+00 1064+00 1065+00 1066+00 1067+00 1068+00 1069+00 1070+00 1071+00 1072+00 1073+00 1074+00 1075+00 1076+00 1077+00 1078+00 1079+00 1081+00

APPROX PROPERTY LINE, TYP

(E) OH ELEC

S LAKE AVE

1081+00

(E) OH ELEC

1082+00 1083+00 1085+00 1086+00 108

WHITESBRIDGE AVE

(E) EP

020-270-54S
ABERCROMBIE FARMS LAND LTD PARTNERSHIP

020-270-29S
TOSTE FAMILY FARMS LP

S PLUMAS AVE

MATCHLINE STA 1056+00

MATCHLINE STA 1084+00

SCALE IN FEET
0 50 100 200

1056+00 1060+00 1070+00 1080+00 1084+00

210 200 190 180

TOP 206.00

TOP 206.00

EG

INV 195.50

INV 195.50

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PLAN & PROFILE

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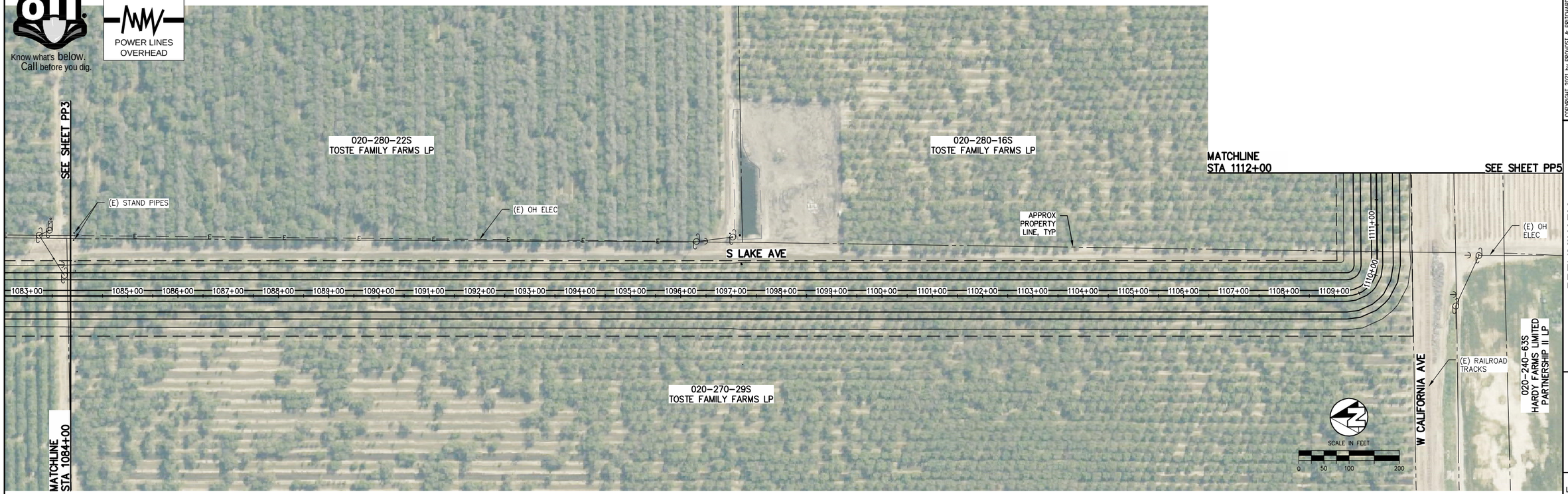

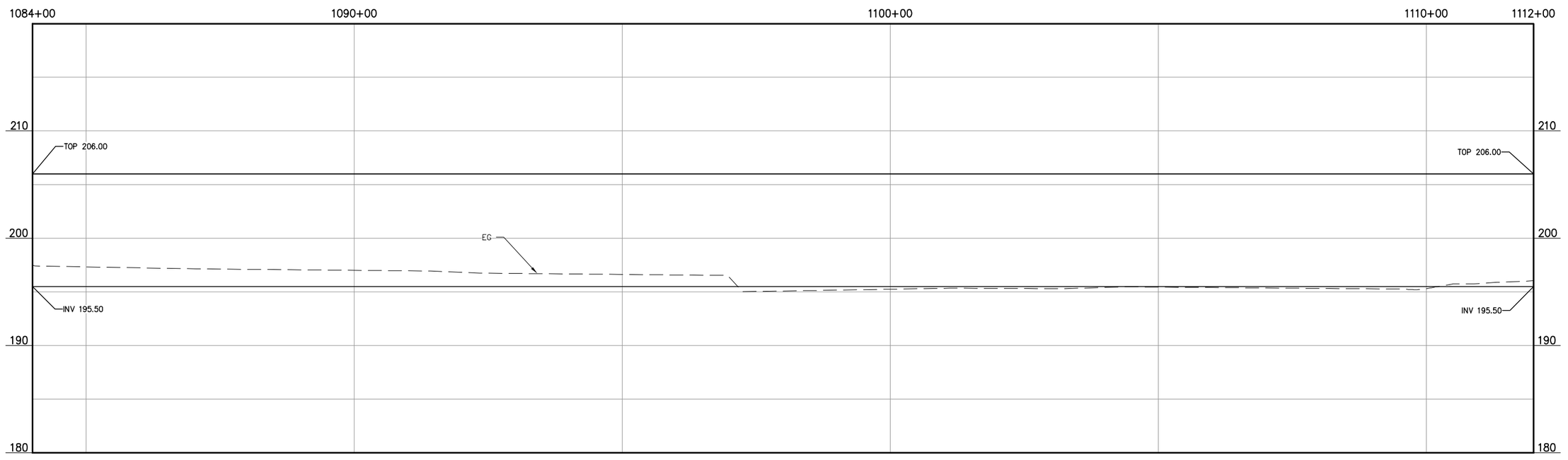

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AQUATERRA WATER BANK – EAST SIDE CANAL
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FRESNO COUNTY, CA

PLAN & PROFILE

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LICENSE NO: ____

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JOB NO: 256920002
PROJECT NO:
PHASE:

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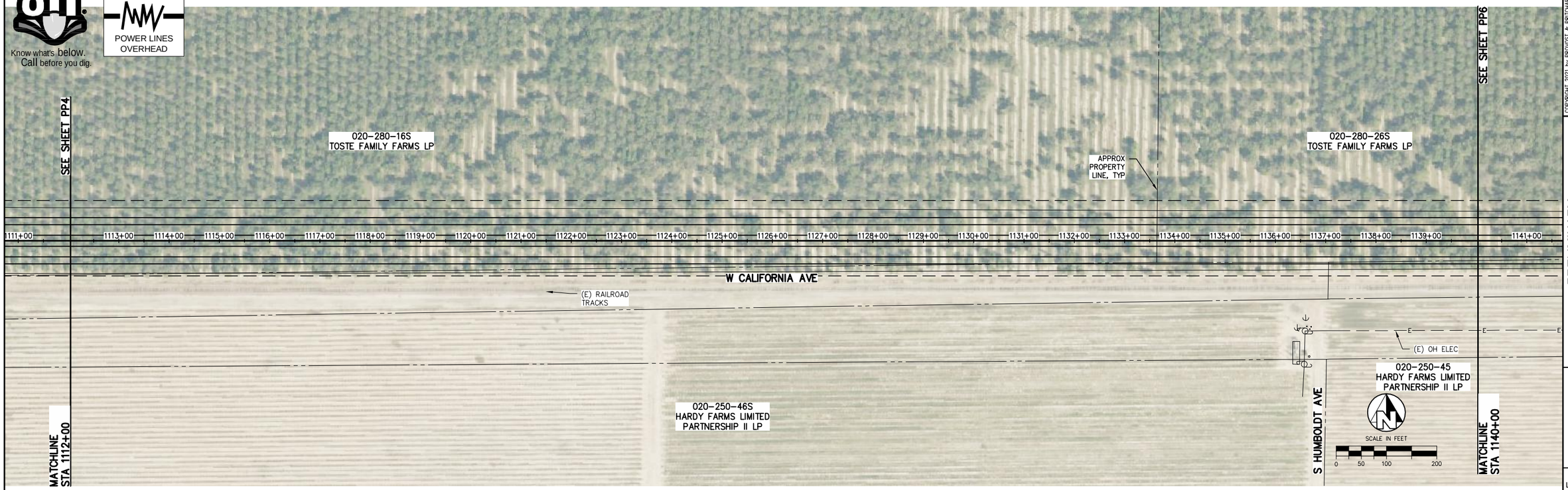

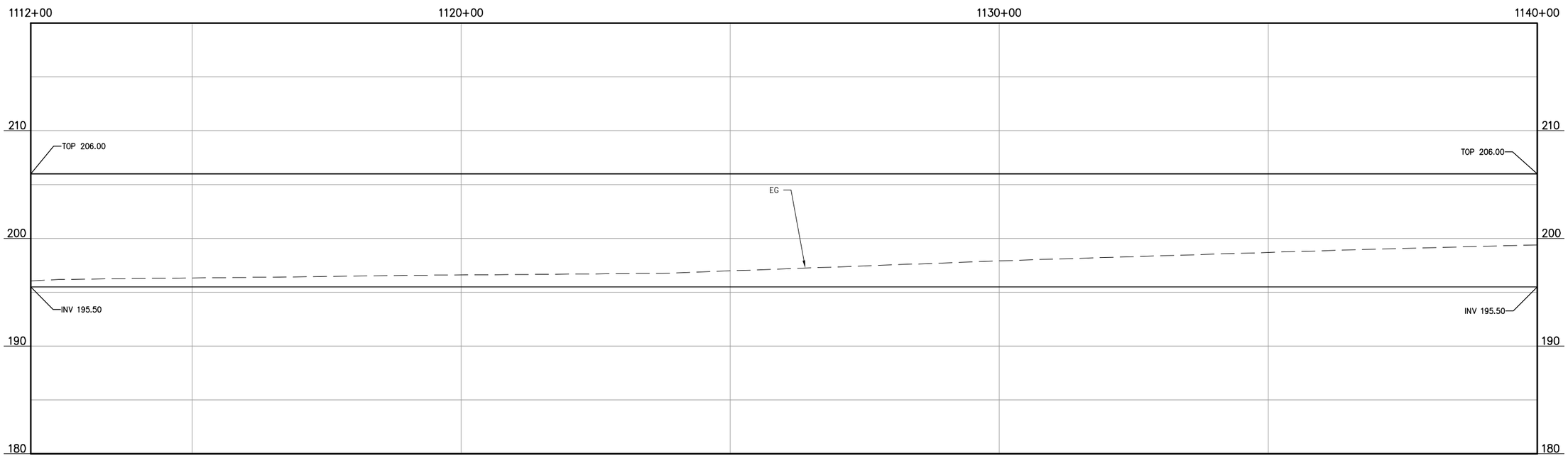

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PLAN & PROFILE

STA 1112+00 TO STA 1140+00

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DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

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DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
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SHEET PP5
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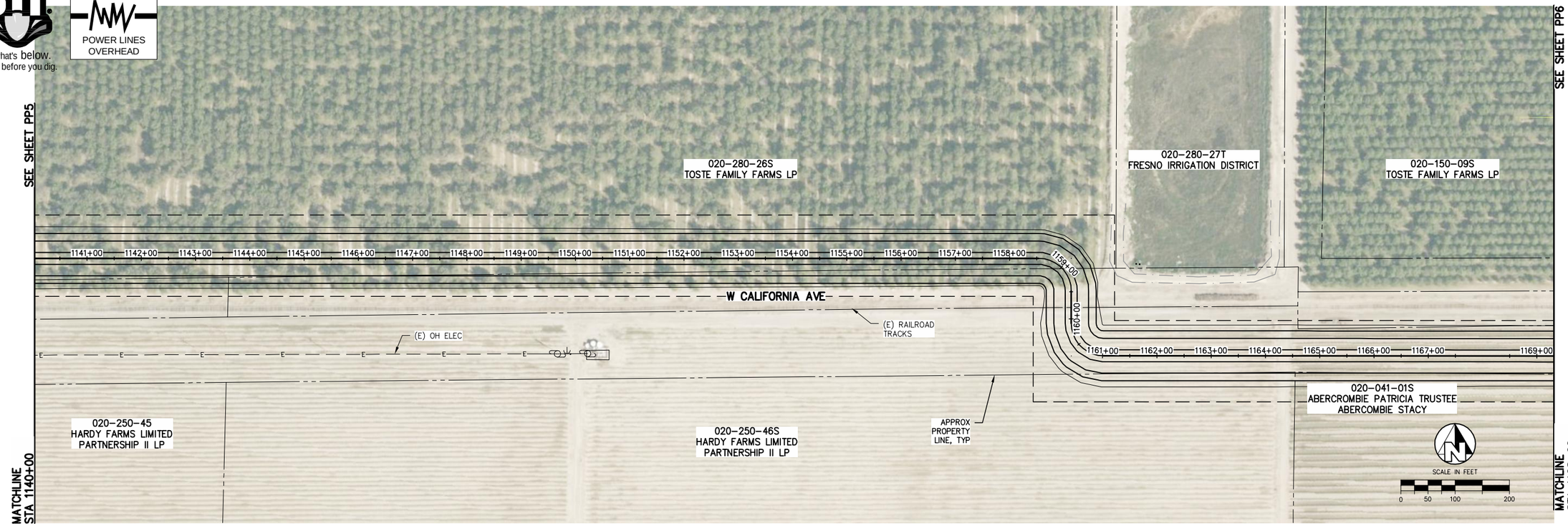
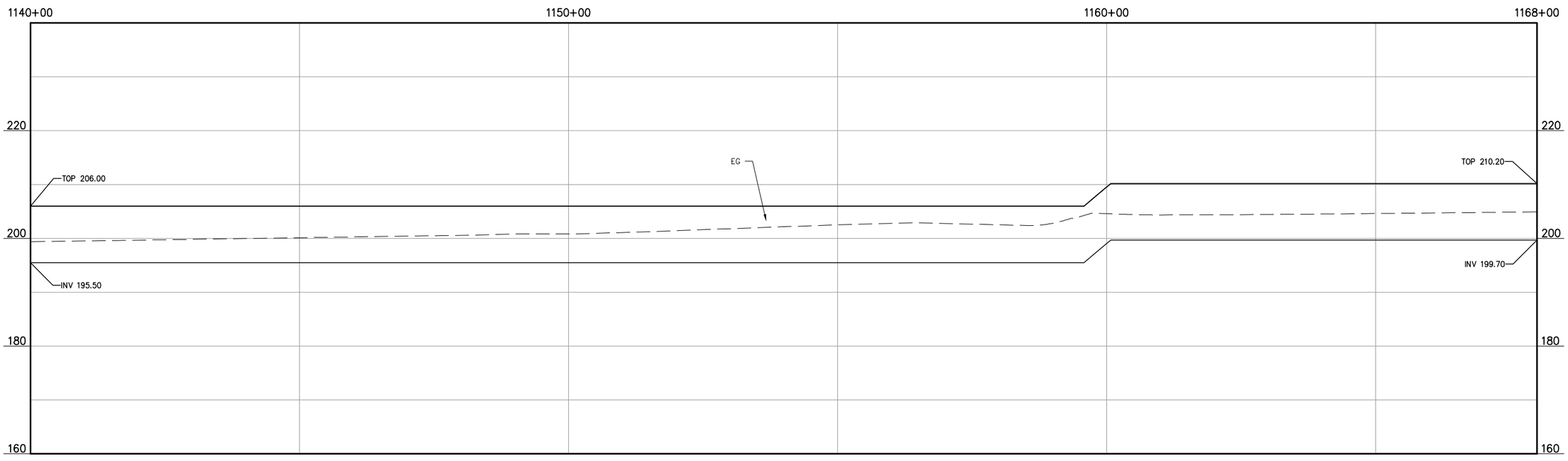
WARNING
POWER LINES OVERHEAD





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No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
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FRESNO COUNTY, CA

PLAN & PROFILE

STA 1140+00 TO STA 1168+00

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DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
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SHEET PP6
OF

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WARNING
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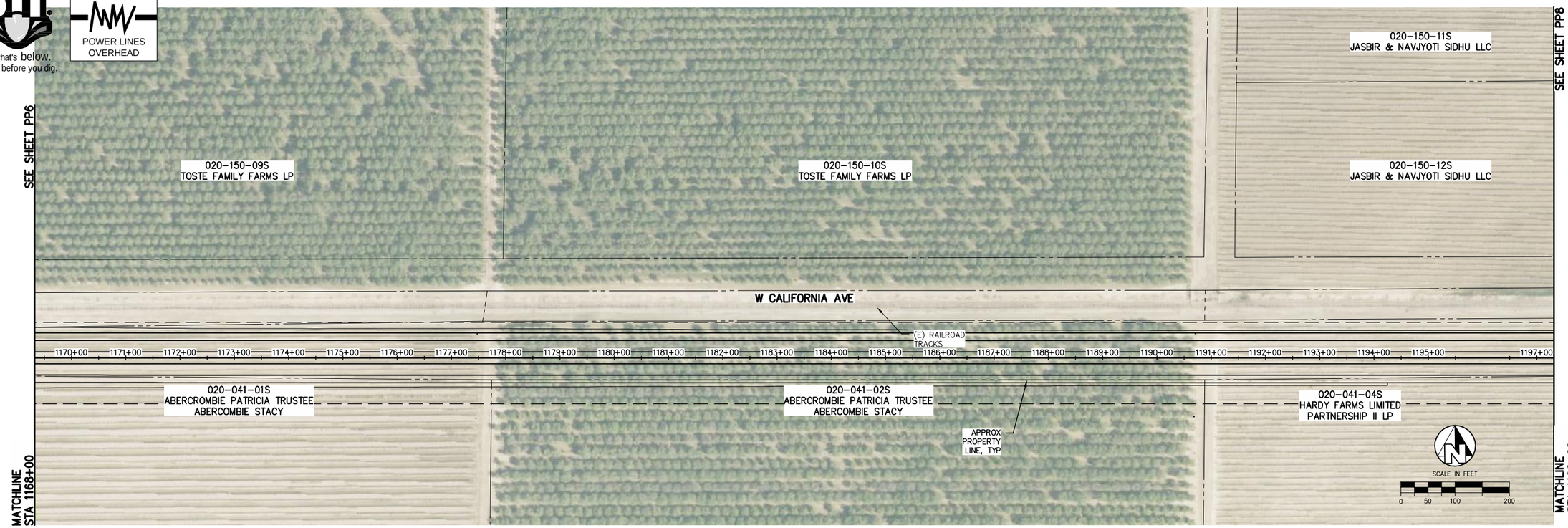

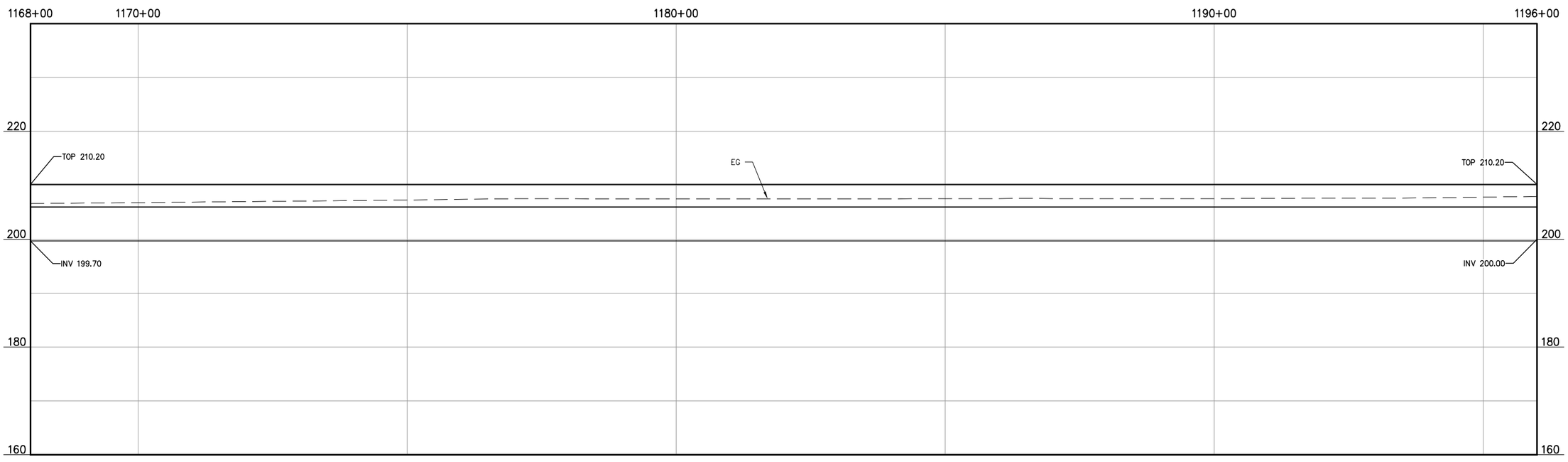

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AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1168+00 TO STA 1196+00

EST. 1949
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 W. CROMWELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

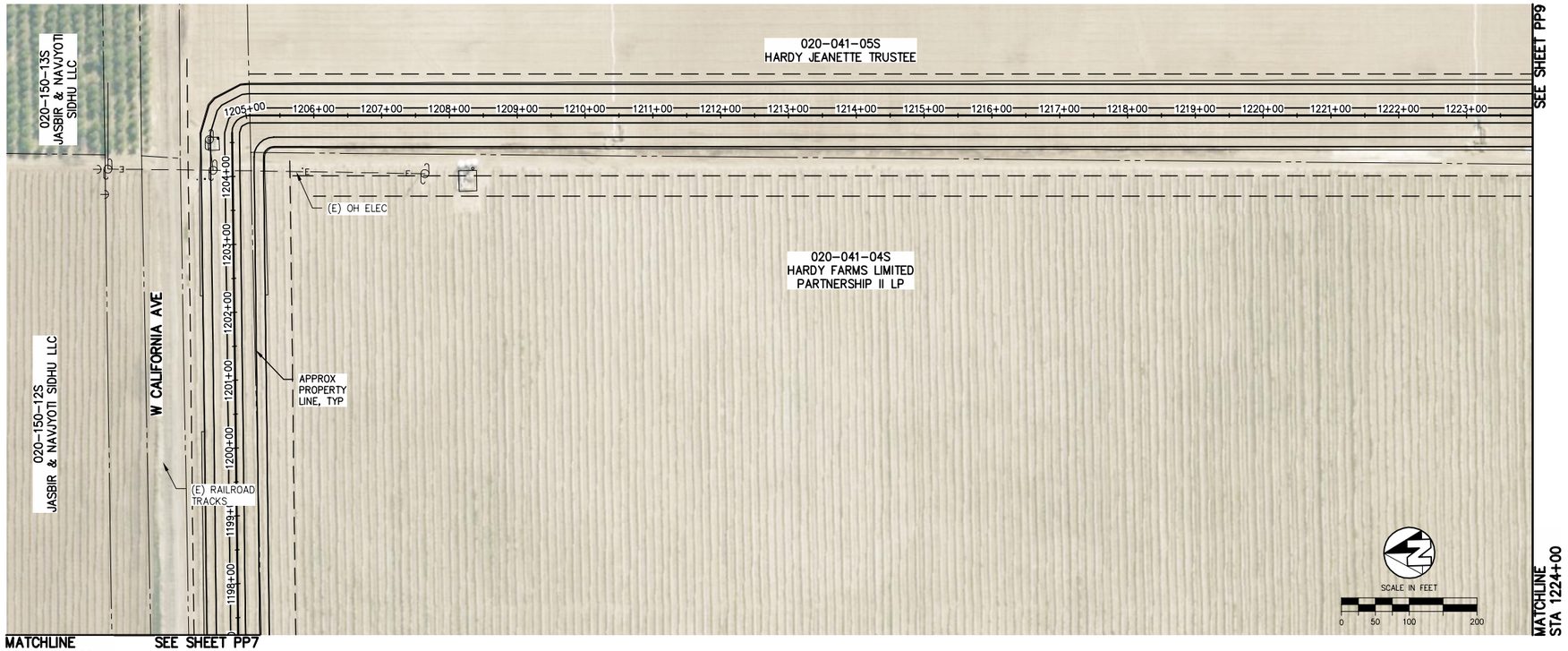
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

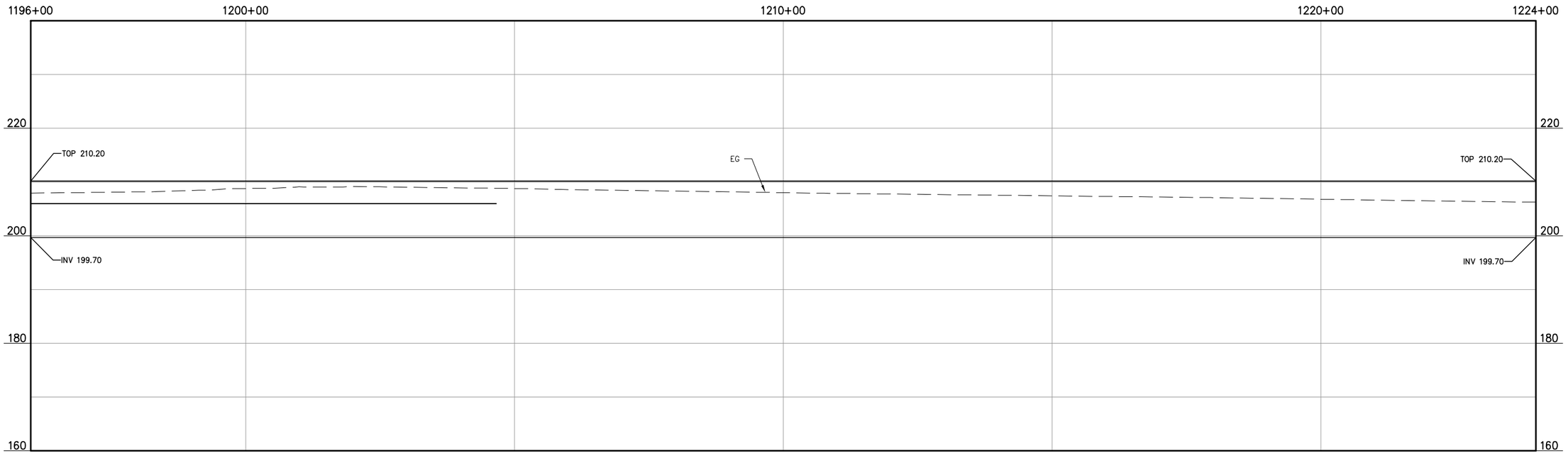
SHEET PP7
OF

3/26/2021 5:36 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP7 STA 1168+00 TO STA 1196+00.dwg —Phillip Dorsby

811
Know what's below.
Call before you dig.

WARNING
POWER LINES
OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA
PLAN & PROFILE
STA 1196+00 TO STA 1224+00

EST. 1949
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 W. CROMWELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

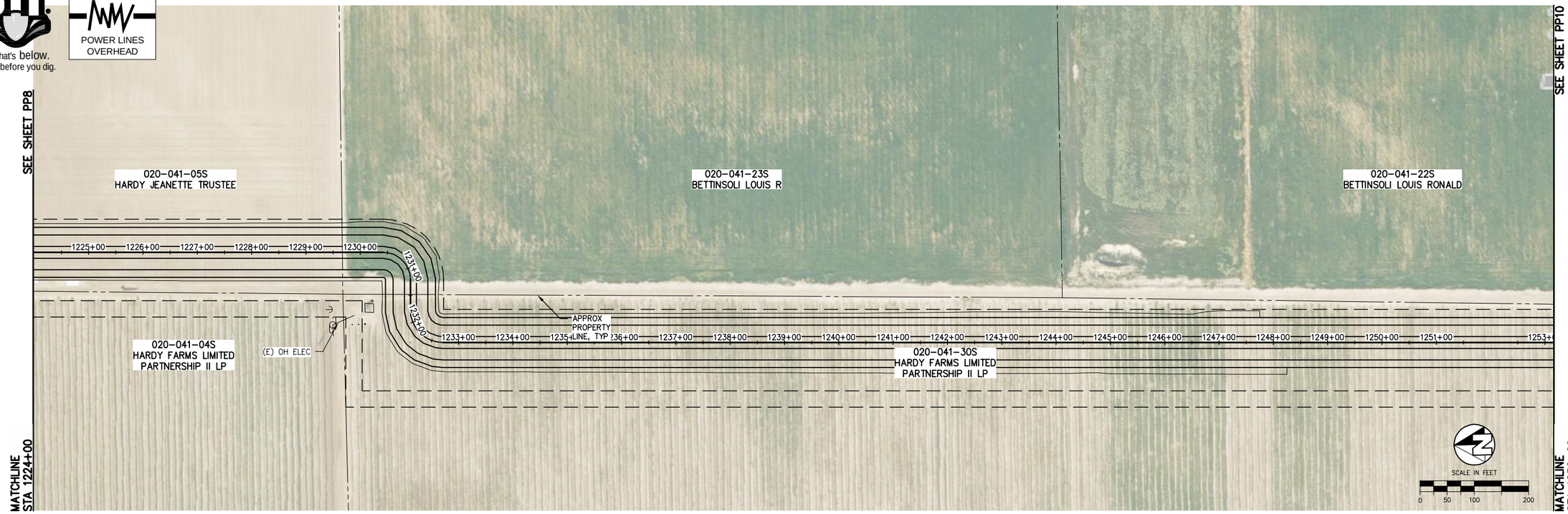
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

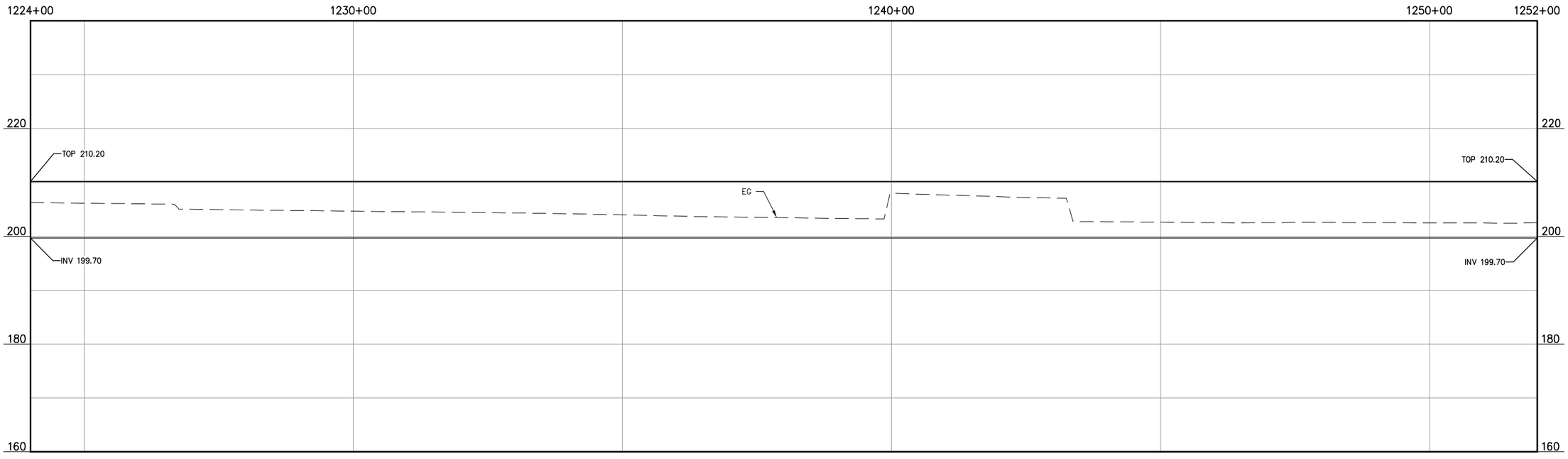
SHEET PP8
OF

3/26/2021 5:38 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP8 STA 1196+00 TO STA 1224+00.dwg -Phillip Dansby

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1224+00 TO STA 1252+00

EST. 1946
PROVOST & PRITCHARD CONSULTING GROUP
An Employee Owned Company
PROVOST & PRITCHARD
1234 E. SHAW AVENUE
FRESNO, CALIFORNIA 93710-8162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

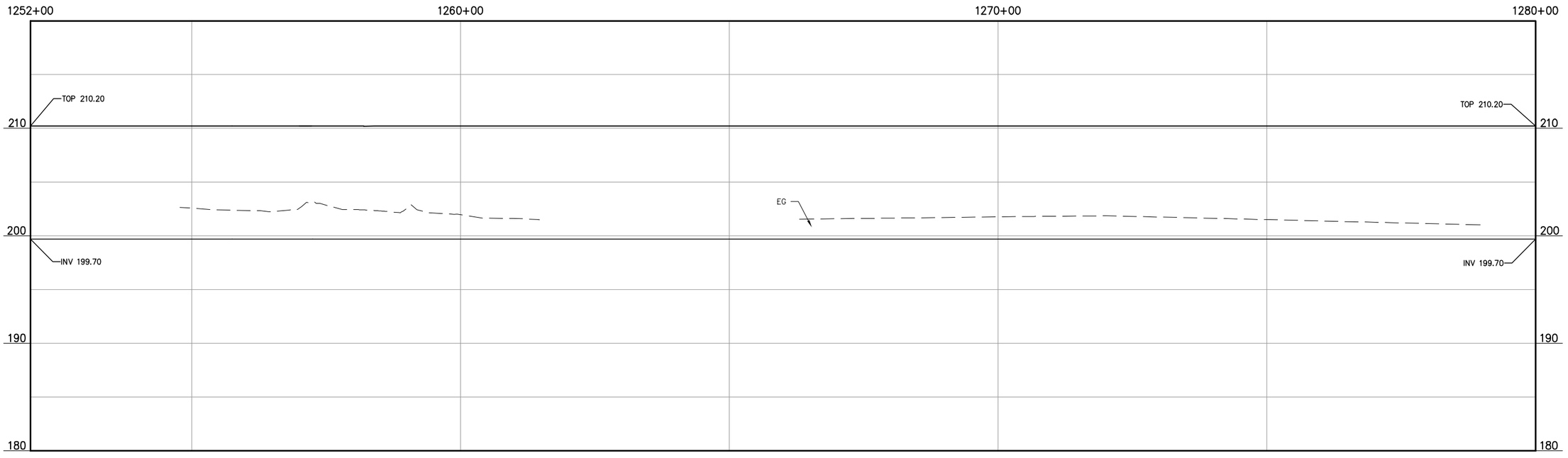
DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET **PP9**
OF

3/26/2021 5:40 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP9 STA 1224+00 TO STA 1252+00.dwg -Phillip Dansby



811
Know what's below.
Call before you dig.

WARNING
POWER LINES
OVERHEAD

No.	REVISION	BY	DATE

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

FOR
REVIEW
ONLY

AQUATERRA WATER BANK – EAST SIDE
CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1252+00 TO STA 1280+00

EST. 1968
PROVOST&
PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 WEST CROMWELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

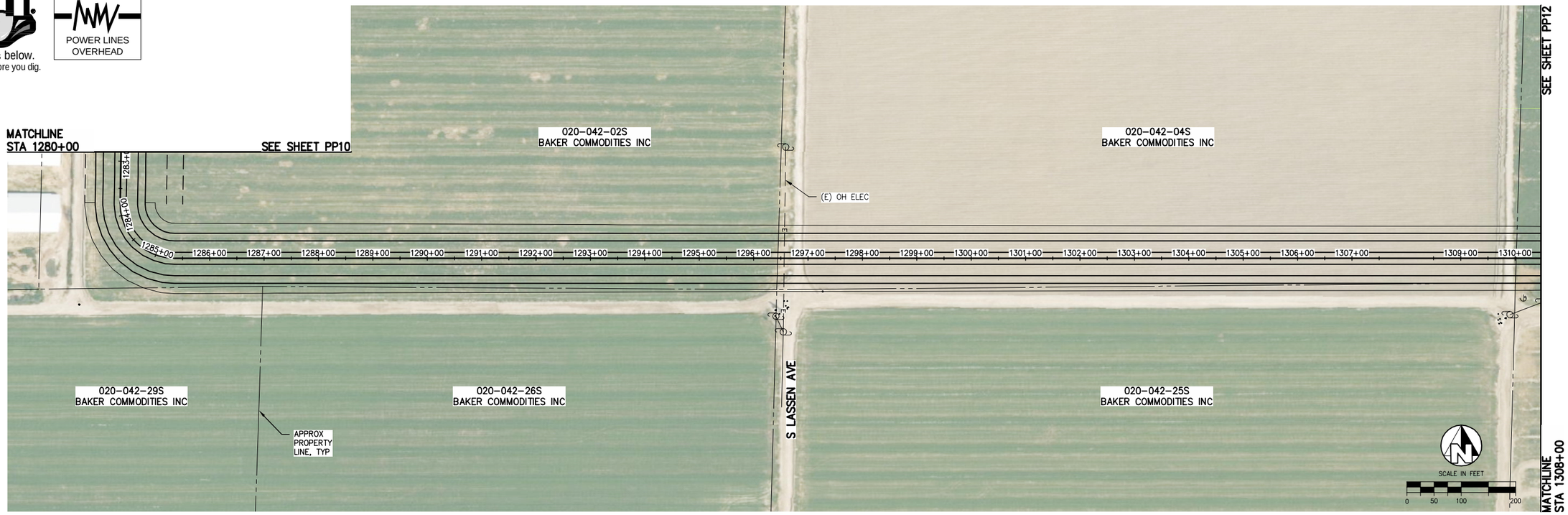
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

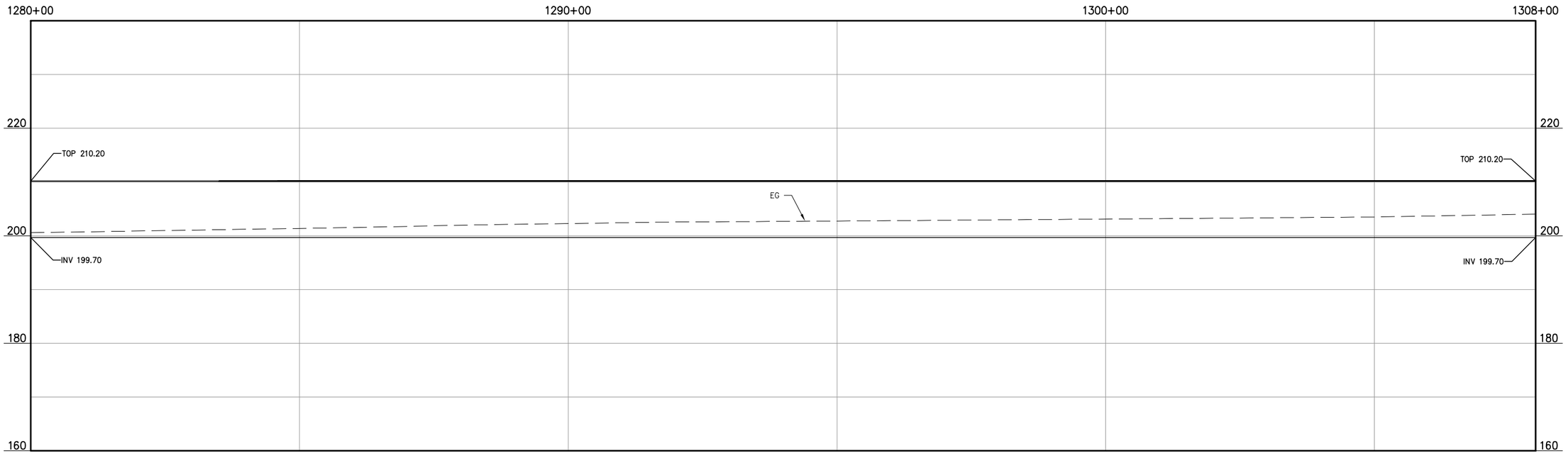
SHEET PP10
OF

3/26/2021 5:42 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP10 STA 1252+00 TO STA 1280+00.dwg -Phillip Dansby

Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1280+00 TO STA 1308+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1946
An Employee Owned Company
286 W. Cromwell Avenue
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

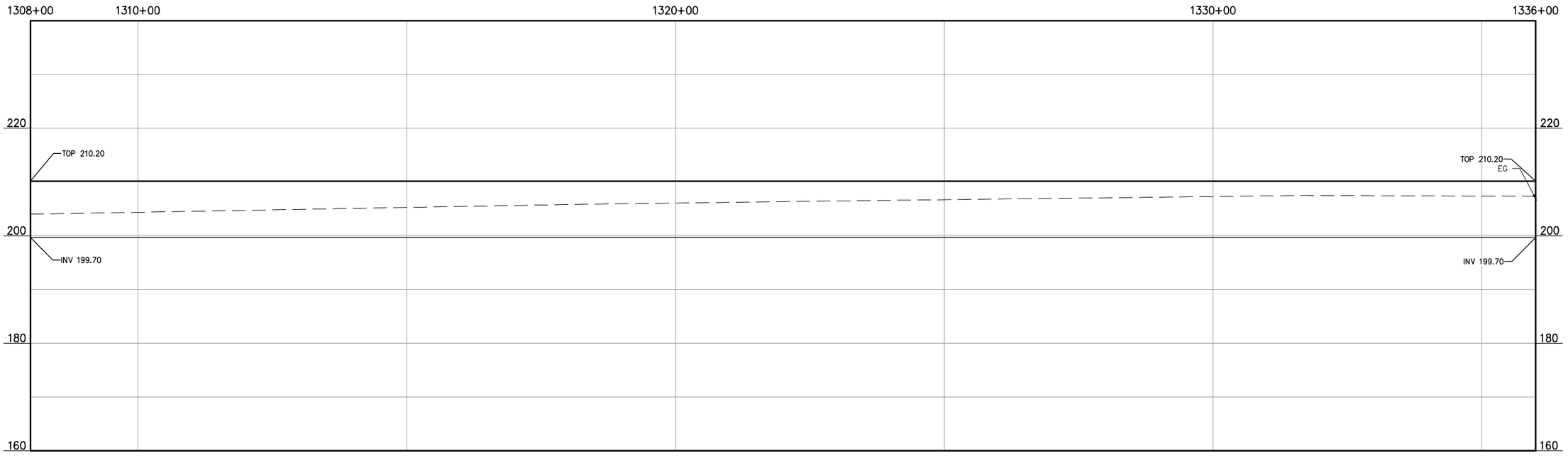
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET **PP11**
OF

3/26/2021 5:44 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP11 STA 1280+00 TO STA 1308+00.dwg -Phillip Dansby

811
Know what's below.
Call before you dig.

WARNING
POWER LINES OVERHEAD



PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1308+00 TO STA 1336+00

EST. 1946
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 W. CROMWELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

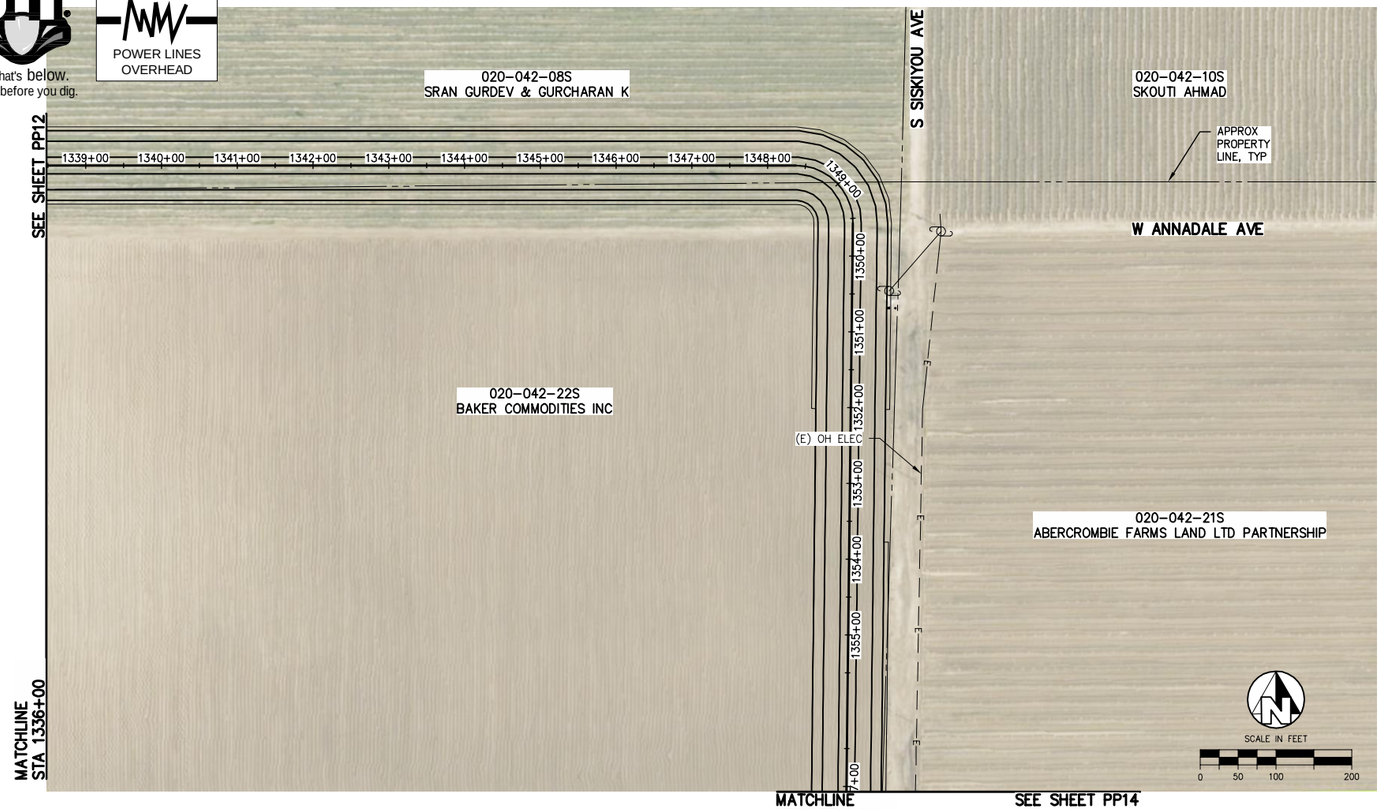
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

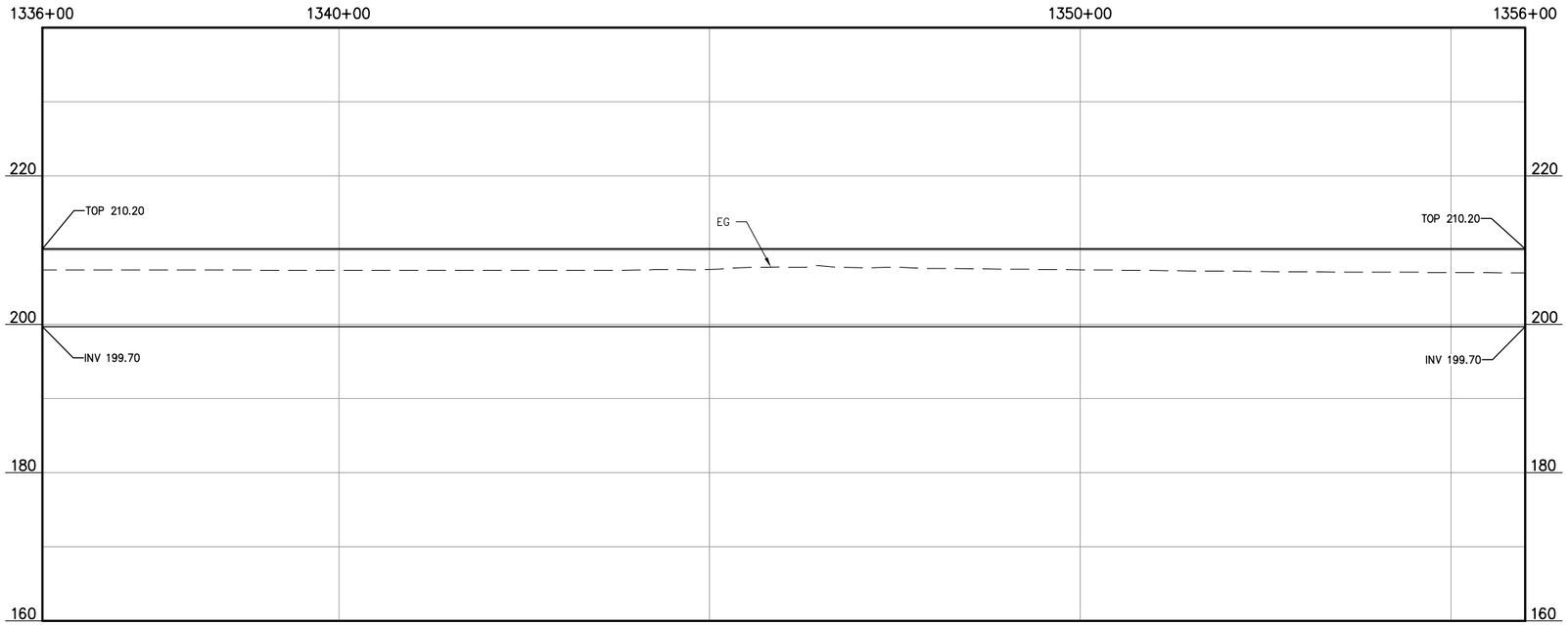
SHEET PP12
OF

3/26/2021 5:46 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP12 STA 1308+00 TO STA 1336+00.dwg -Phillip Donsby

811
Know what's below.
Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN CSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1336+00 TO STA 1356+00

PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
1234 H STREET, SUITE 101
FRESNO, CALIFORNIA 93721-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

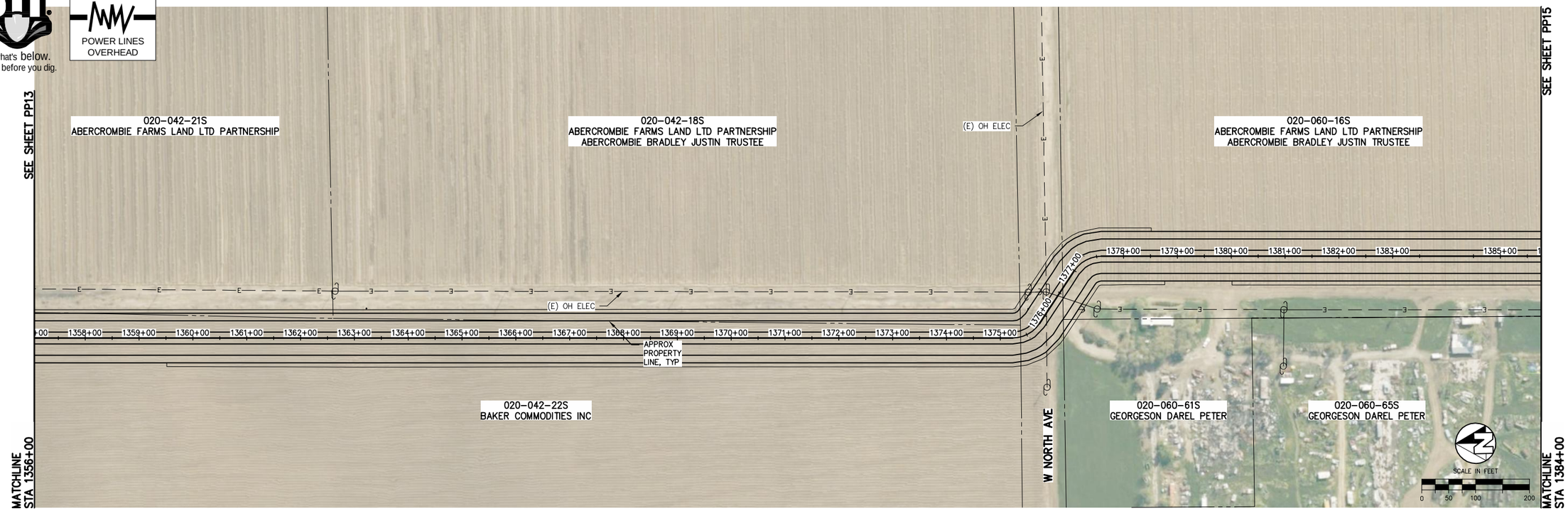
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

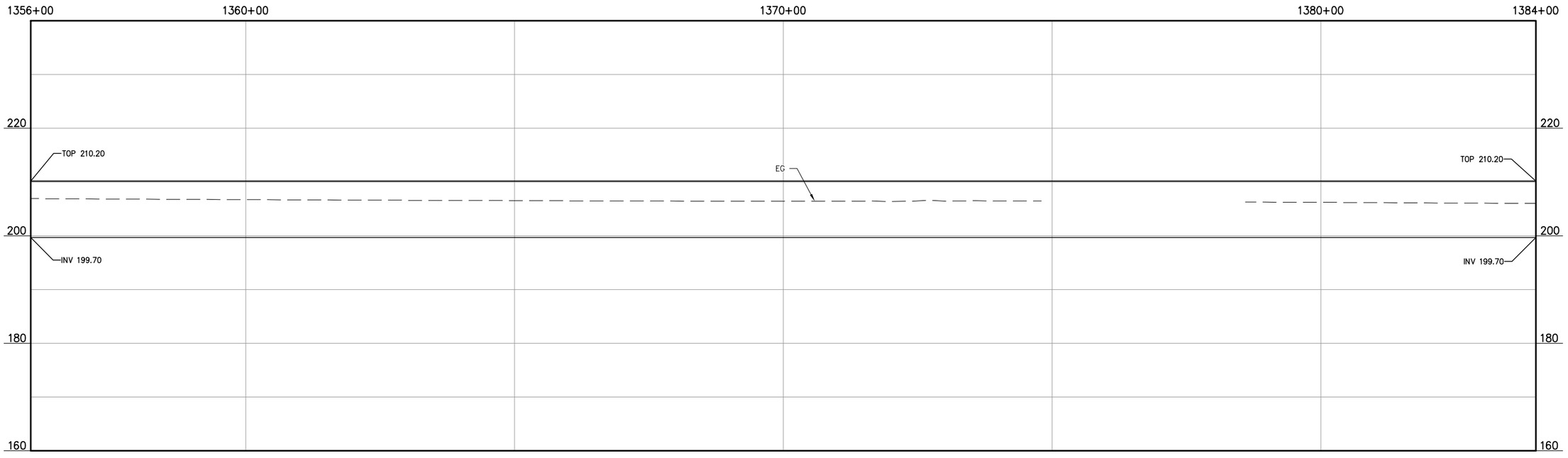
SHEET PP13
OF

3/26/2021 5:47 PM G:\McMullin CSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP13 STA 1336+00 TO STA 1356+00.dwg –Phillip Dansby

Know what's below.
Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1356+00 TO STA 1384+00

EST. 1949
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 W. Cromwell Avenue
Fresno, California 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

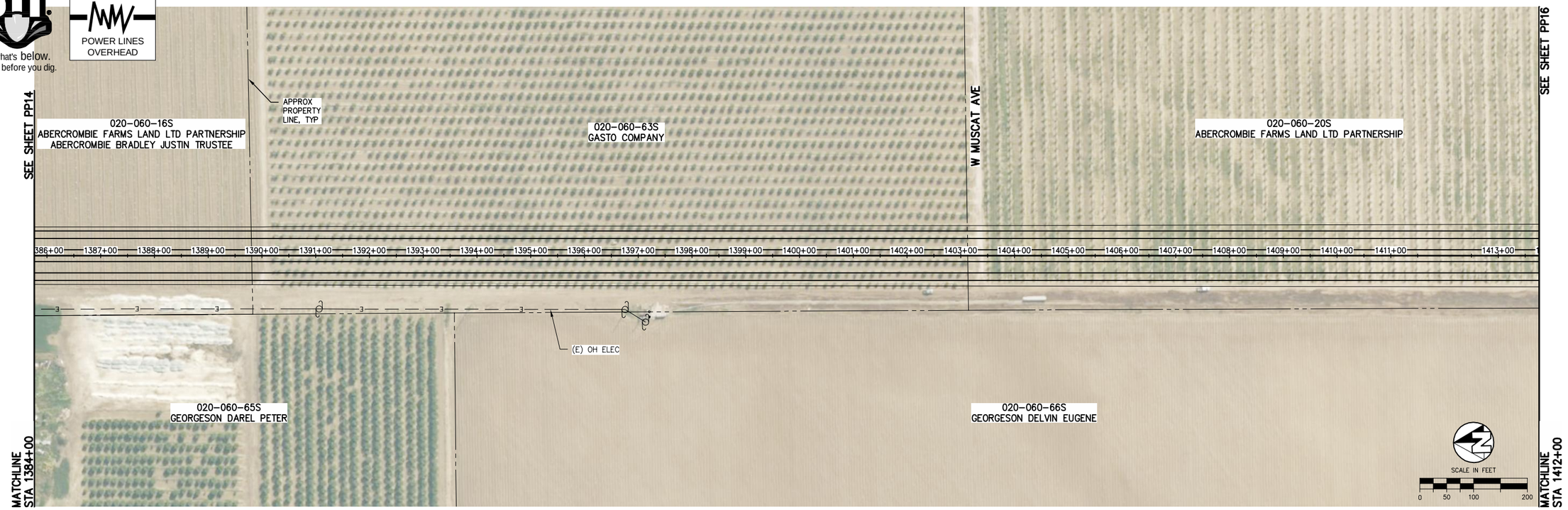
DRAFTED BY: PAD	CHECKED BY:

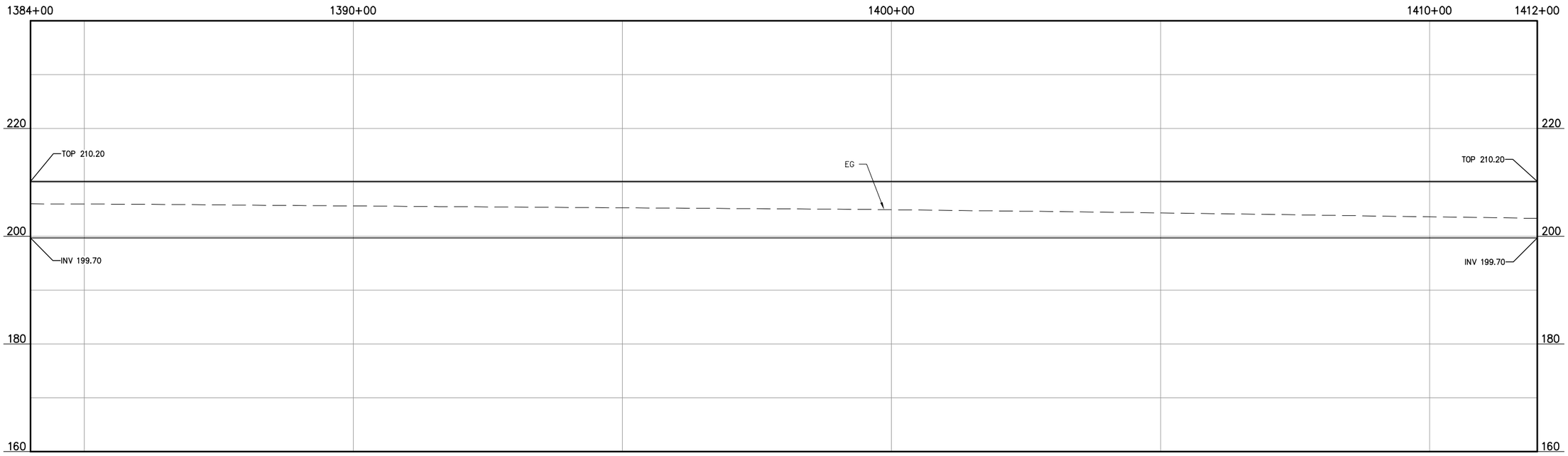
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET **PP14**
OF

3/26/2021 5:50 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP14 STA 1356+00 TO STA 1384+00.dwg -Phillip Donsby





No.	REVISION	BY	DATE

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1384+00 TO STA 1412+00

EST. 1949
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company
PROVOST & PRITCHARD ENGINEERING GROUP, INC.
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

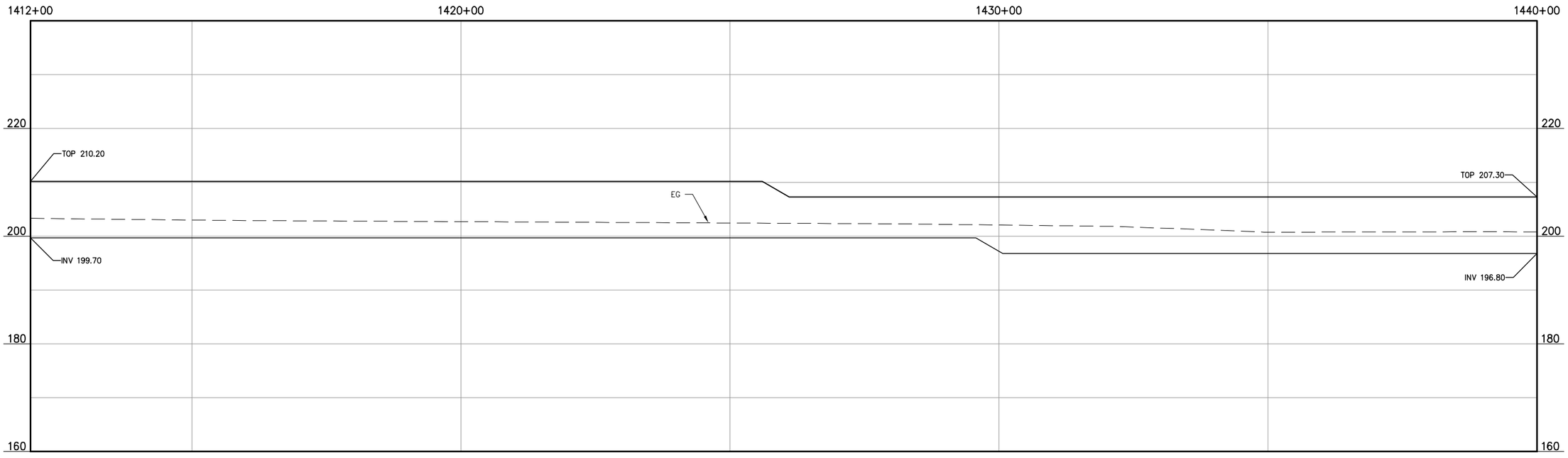
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET **PP15**
OF

3/26/2021 5:52 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP15 STA 1384+00 TO STA 1412+00.dwg -Phillip Dansby

Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD



PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1412+00 TO STA 1440+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1946
An Employee Owned Company
PROVOST & PRITCHARD, INC.
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

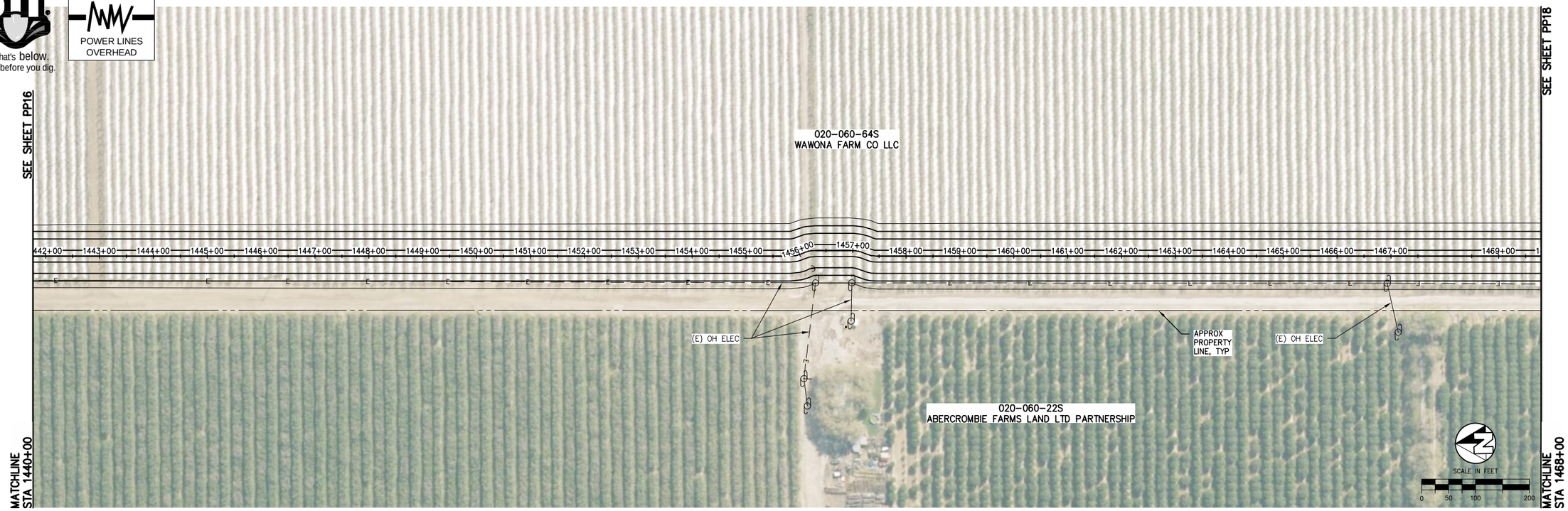
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

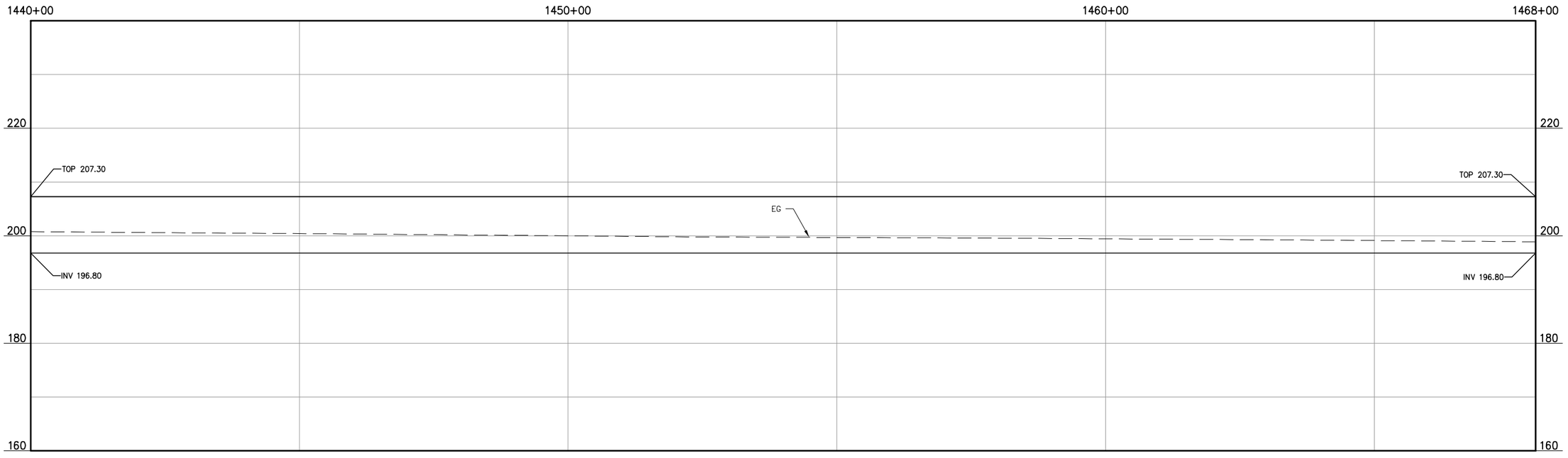
SHEET PP16
OF

3/26/2021 5:54 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP16 STA 1412+00 TO STA 1440+00.dwg -Phillip Dansby

Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1440+00 TO STA 1468+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1946
An Employee Owned Company
2981 YNYSIDRO DRIVE, SUITE 104
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: _____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

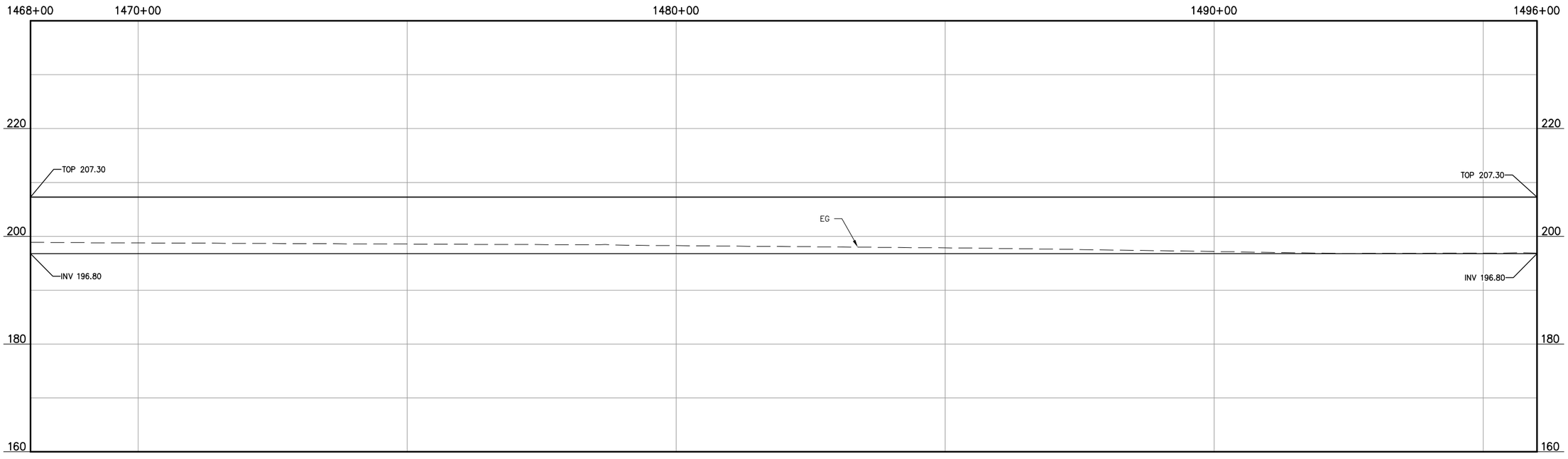
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET **PP17**
OF

3/26/2021 5:56 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP17 STA 1440+00 TO STA 1468+00.dwg -Phillip Donsby

811
Know what's below.
Call before you dig.

WARNING
POWER LINES OVERHEAD



PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1468+00 TO STA 1496+00

EST. 1949
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
PROVOST & PRITCHARD
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

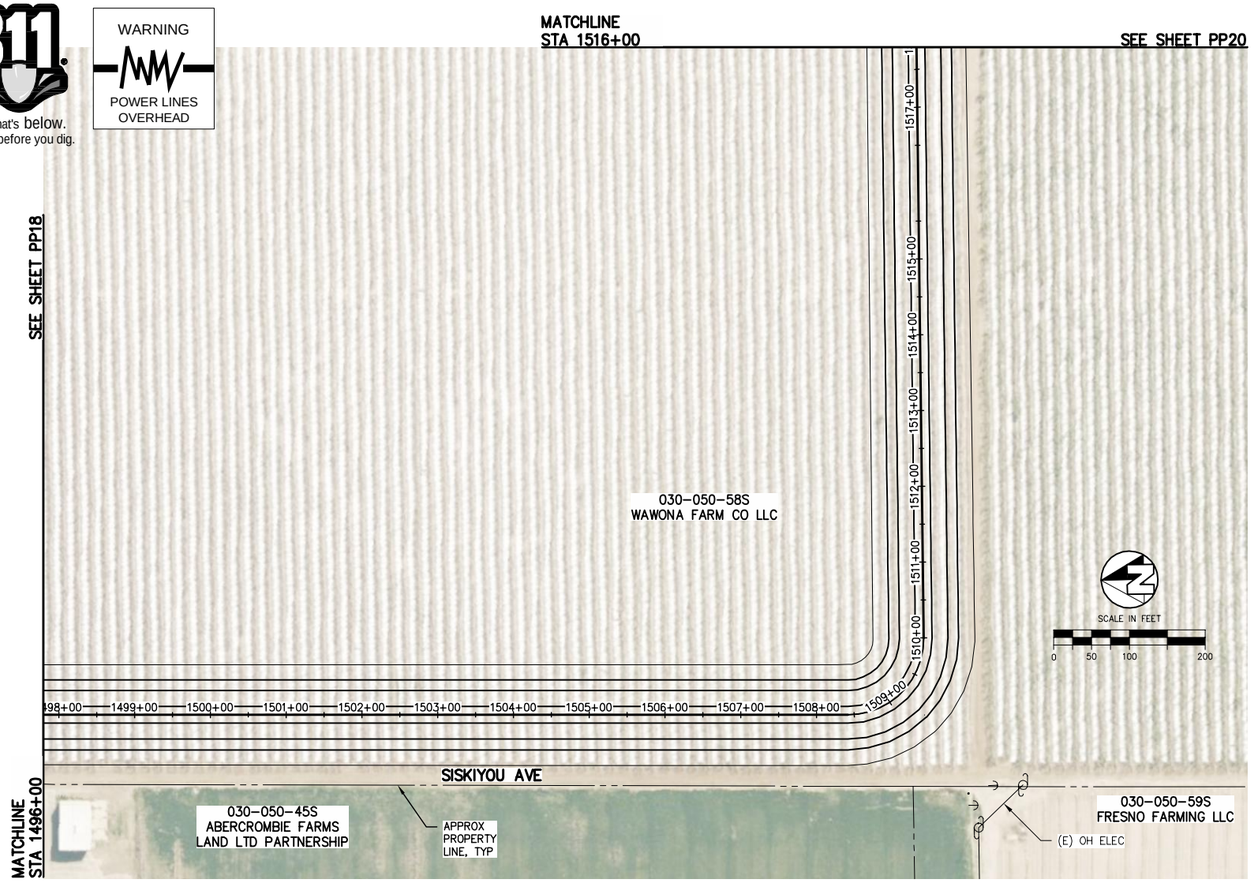
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

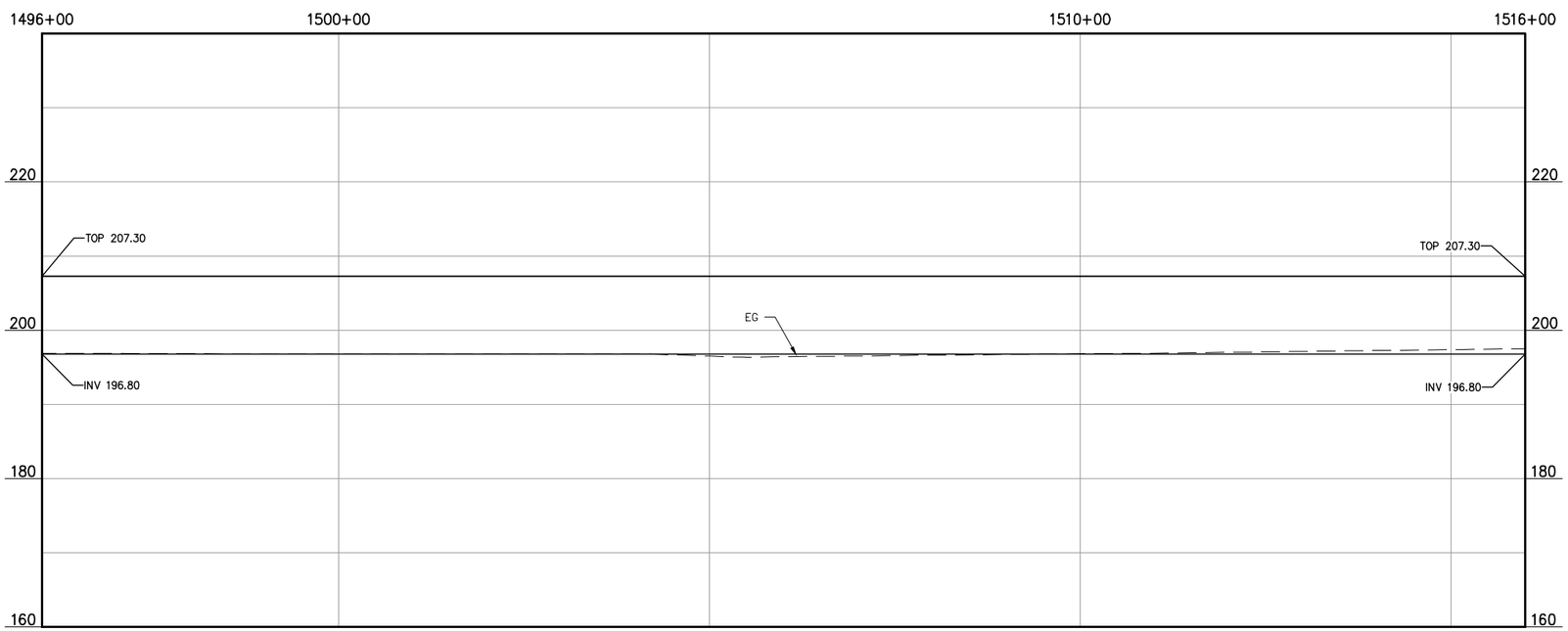
SHEET PP18
OF

3/26/2021 5:58 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP18 STA 1468+00 TO STA 1496+00.dwg -Phillip Donsby

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1496+00 TO STA 1516+00

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1951
An Employee Owned Company
3437 FIGARDEN DRIVE, SUITE 101
FRESNO, CALIFORNIA 93711-5162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ----

DRAFTED BY: PAD | CHECKED BY:
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

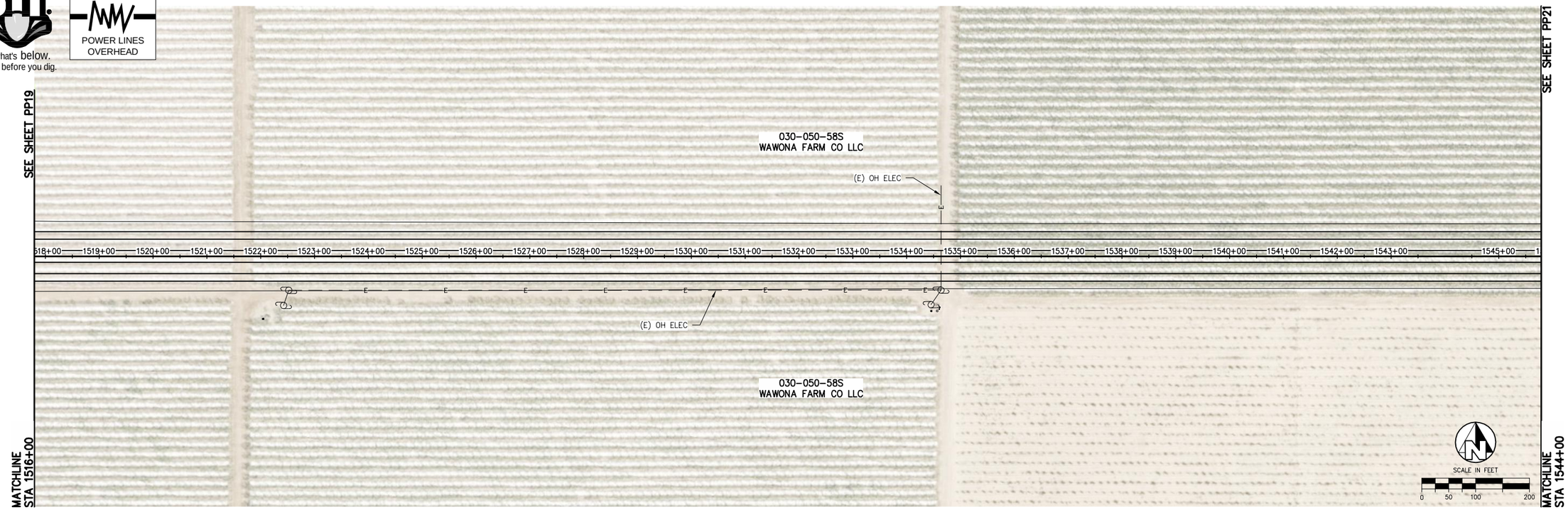
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET PP19
OF

3/26/2021 6:01 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP19 STA 1496+00 TO STA 1516+00.dwg -Phillip Dansby

811
Know what's below.
Call before you dig.

WARNING
POWER LINES OVERHEAD



PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1516+00 TO STA 1544+00

EST. 1946
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 W. CROMWELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
www.ppeng.com

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:

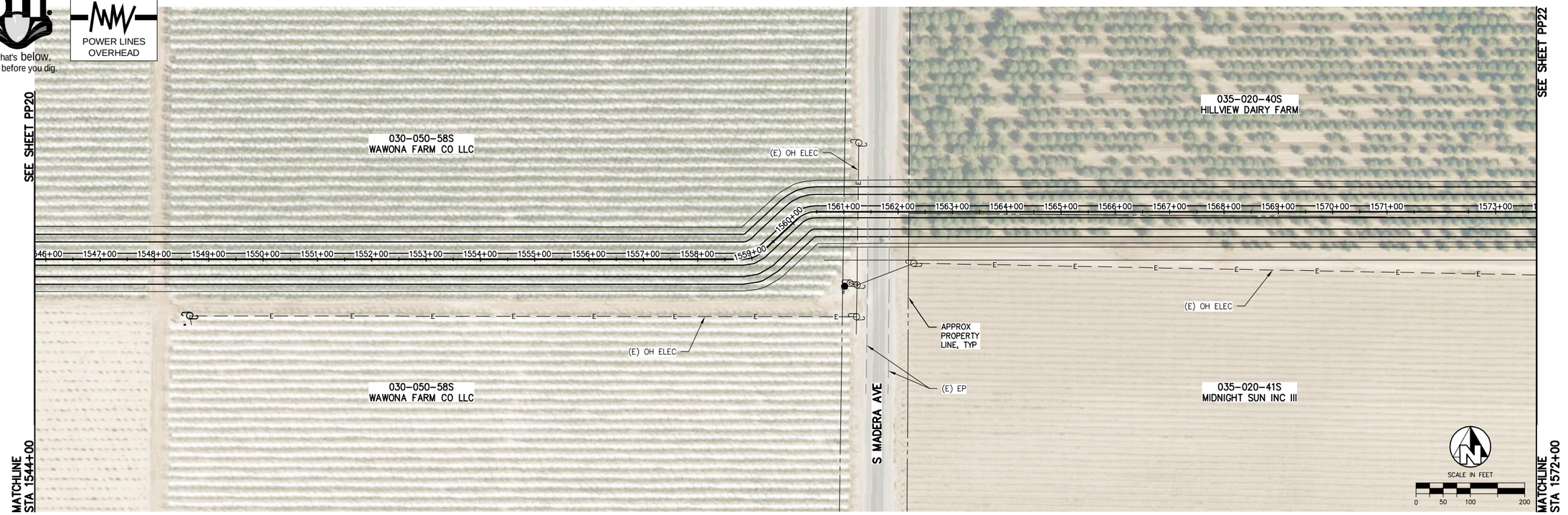
DRAFTED BY:	CHECKED BY:
PAD	

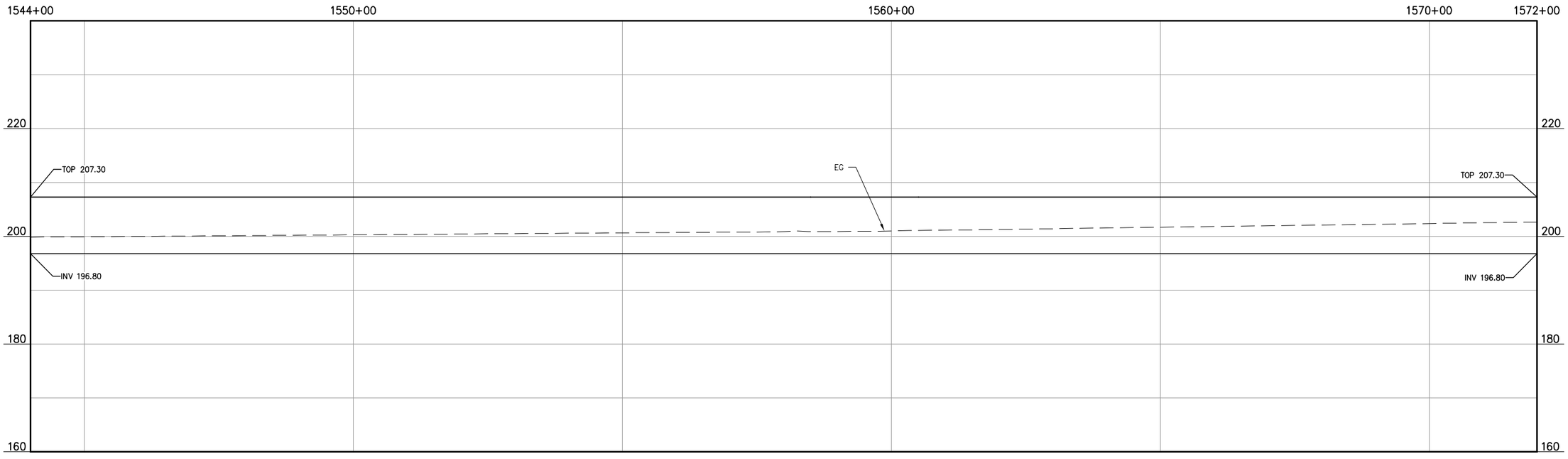
DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

SHEET **PP20**
OF

3/26/2021 6:03 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP20 STA 1516+00 TO STA 1544+00.dwg -Phillip Donaby





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1544+00 TO STA 1572+00

EST. 1946
PROVOST & PRITCHARD CONSULTING GROUP
An Employee Owned Company
PROFESSIONAL ENGINEERS
FRESNO, CALIFORNIA 93711-6162
559/449-2700 FAX 559/449-2715
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DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

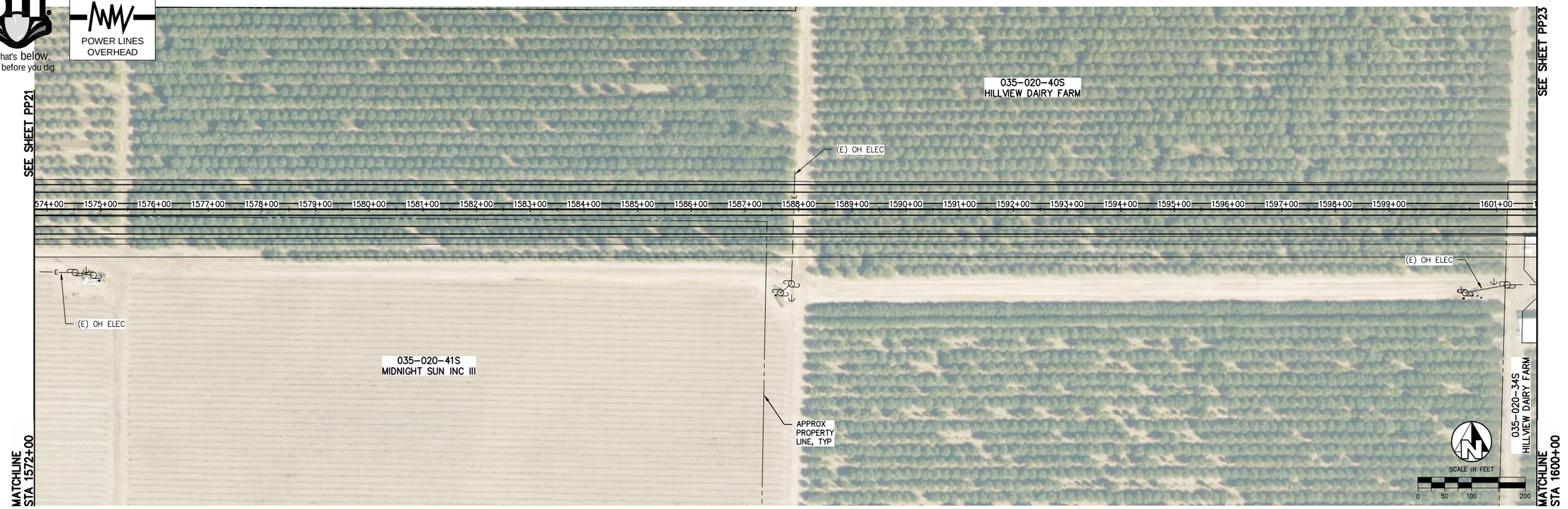
0 1"
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.

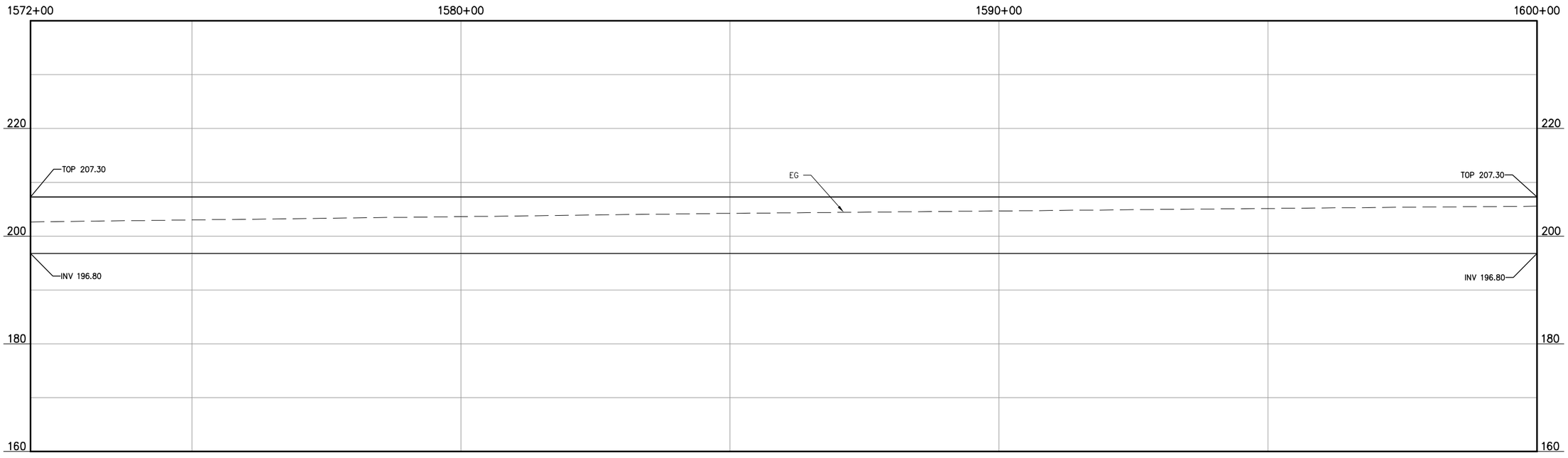
SHEET **PP21**
OF

3/26/2021 6:06 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP21 STA 1544+00 TO STA 1572+00.dwg -Phillip Donsby

811 Know what's below. Call before you dig.

WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1572+00 TO STA 1600+00

PROVOST & PRITCHARD CONSULTING GROUP
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DESIGN ENGINEER: LYNN GROUNDWATER
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OF

3/26/2021 6:08 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP22 STA 1572+00 TO STA 1600+00.dwg -Phillip Dansby

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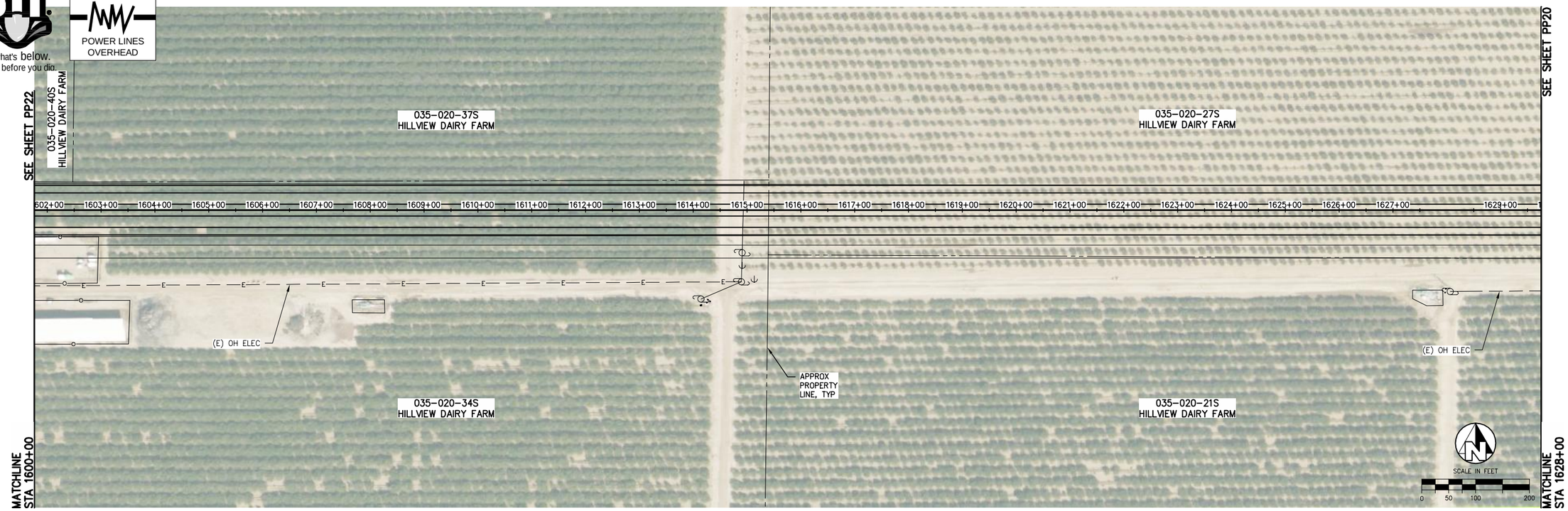

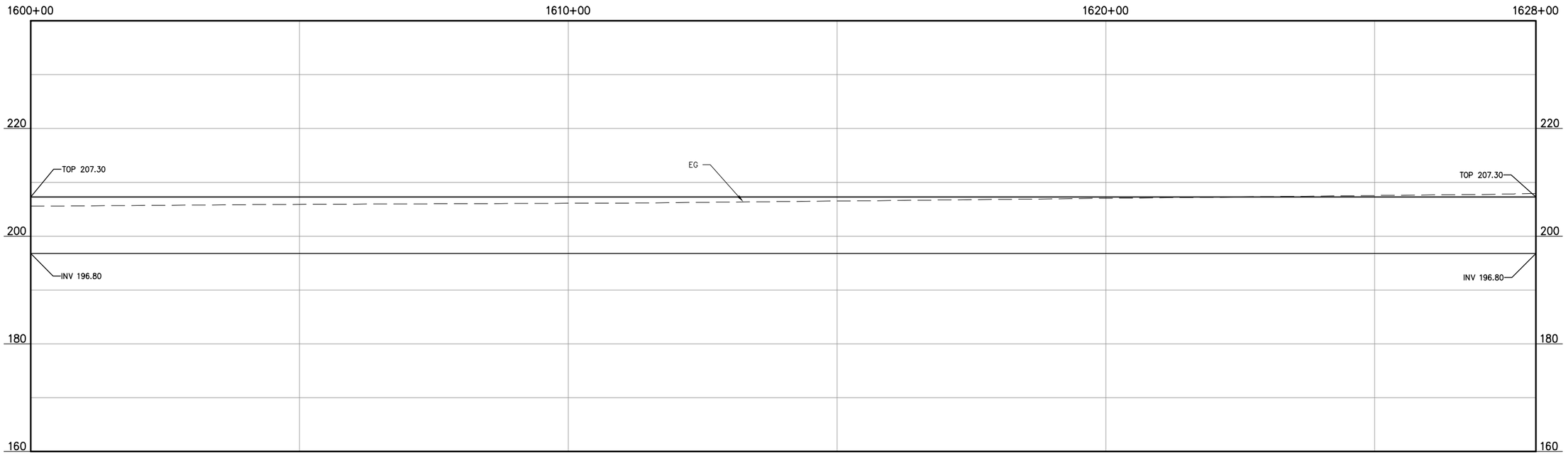

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AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1600+00 TO STA 1628+00

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DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
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SHEET **PP23**
OF

3/26/2021 6:11 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\02_Plan & Profile\East Side Canal\PP23 STA 1600+00 TO STA 1628+00.dwg -Phillip Dansby

811
Know what's below.
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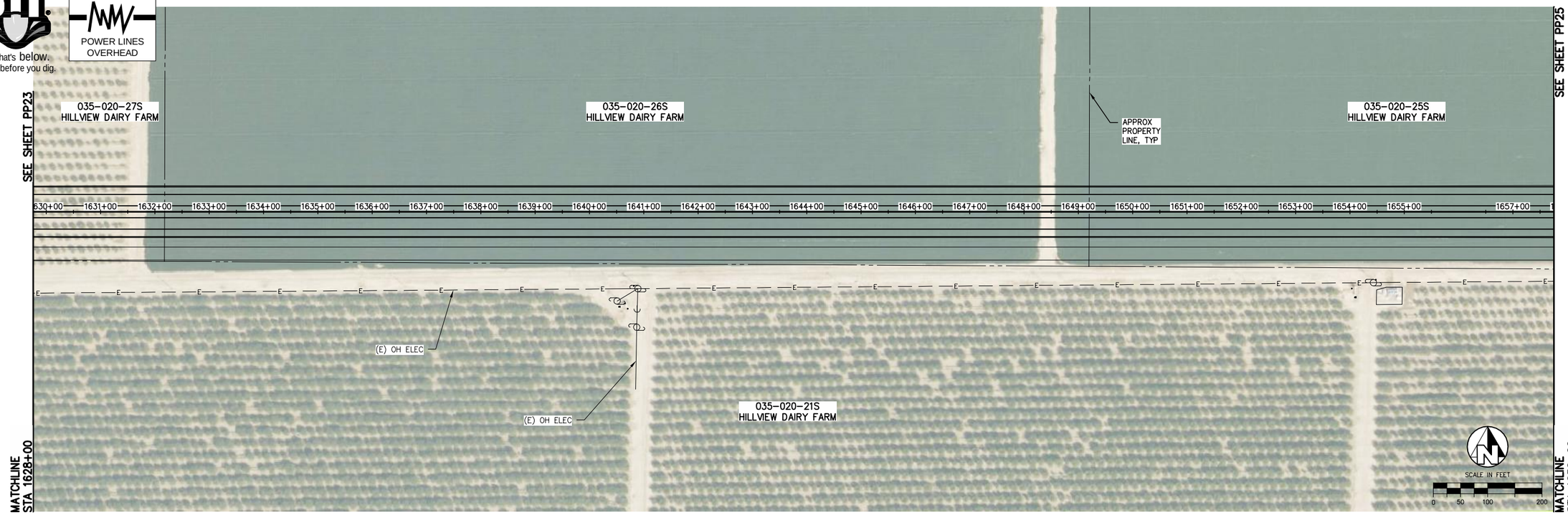
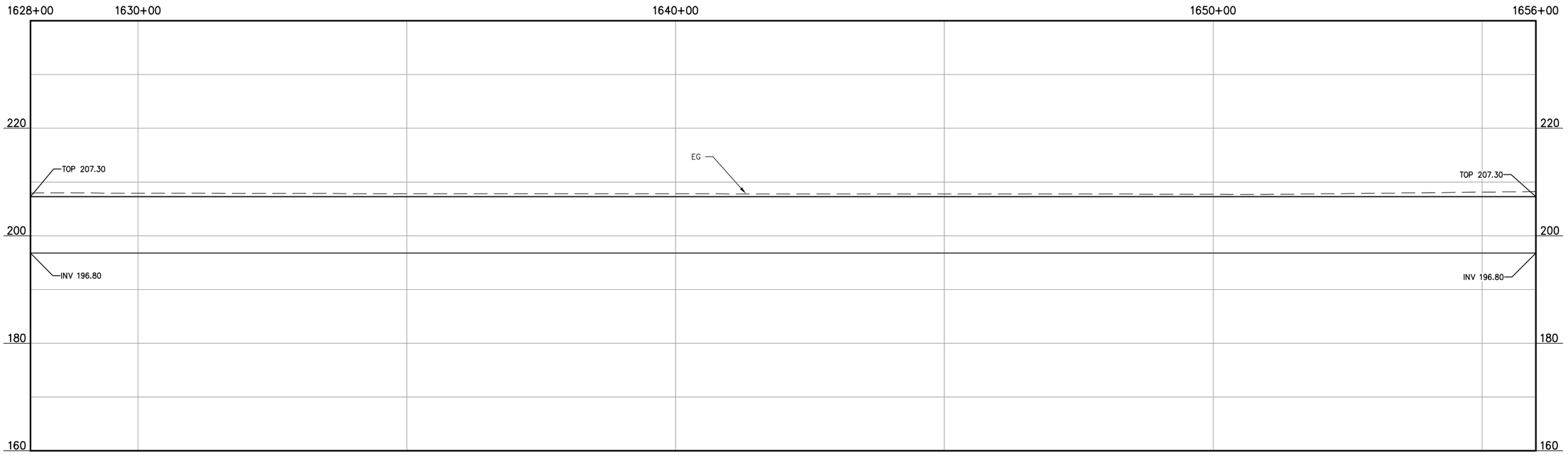
WARNING
POWER LINES OVERHEAD





PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

FOR REVIEW ONLY

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1628+00 TO STA 1656+00

PROVOST & PRITCHARD CONSULTING GROUP
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DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: _____

DRAFTED BY: PAD	CHECKED BY:

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

0 1"
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OF

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811
Know what's below.
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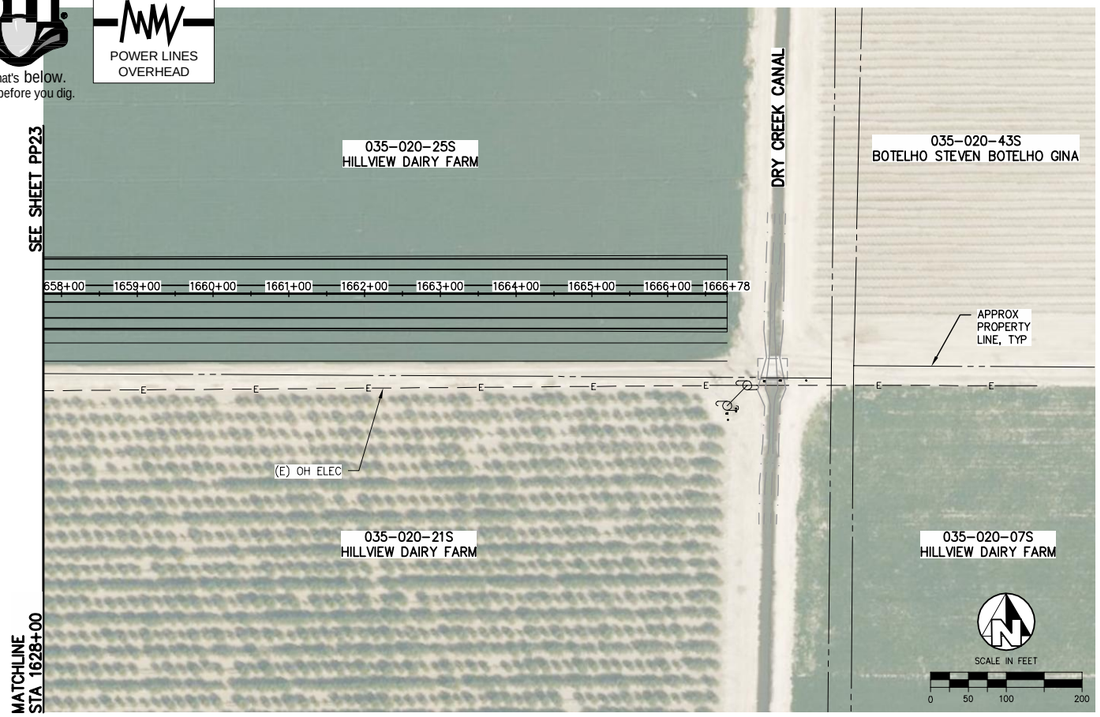
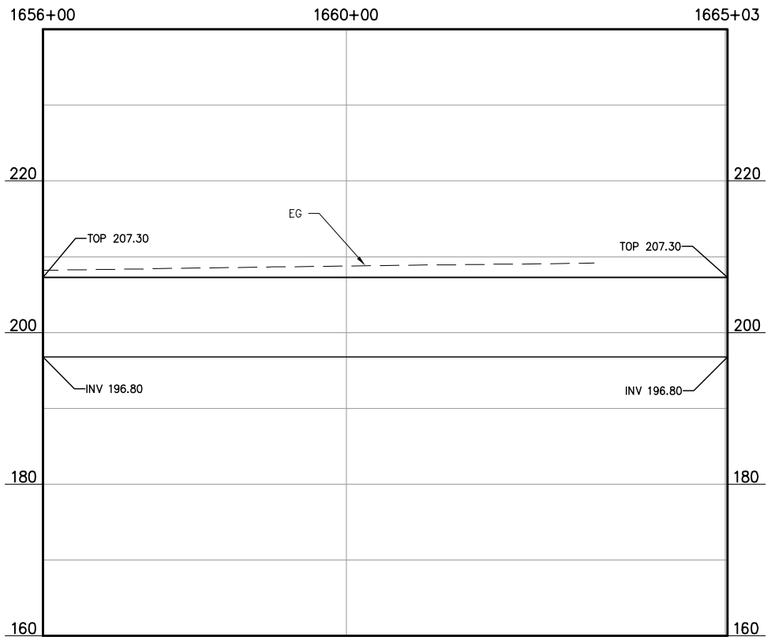
WARNING
POWER LINES
OVERHEAD





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3/26/21

No.	REVISION	BY	DATE

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AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

PLAN & PROFILE

STA 1656+00 TO STA 1665+02

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CONSULTING GROUP
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559/449-2700 FAX 559/449-2715
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DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:

DRAFTED BY:	CHECKED BY:
PAD	

DATE: 3/26/21
JOB NO: 256920002
PROJECT NO:
PHASE:

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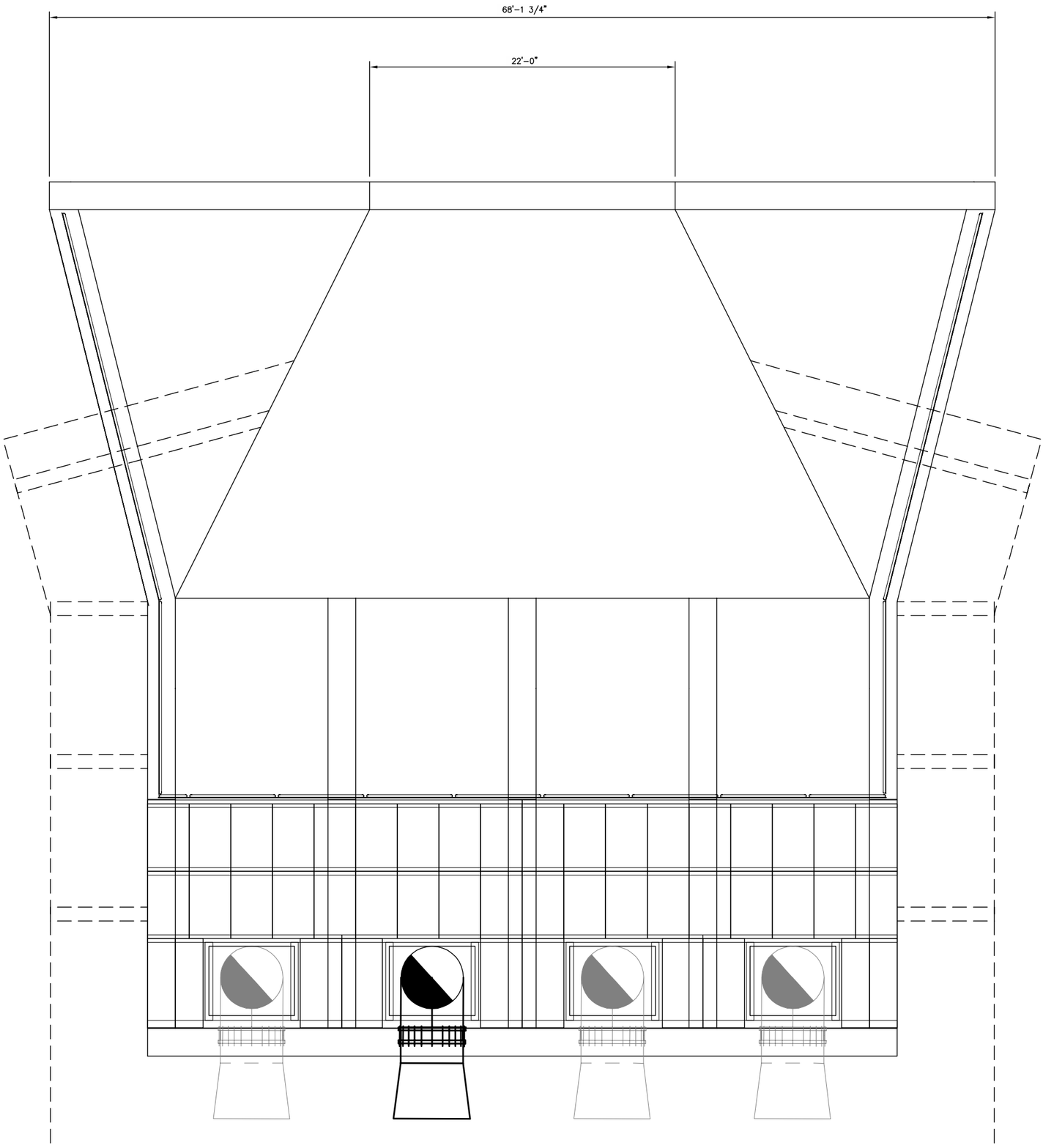

DESIGN ENGINEER
LYNN GROUNDWATER
LICENSE NO.

DRAFTED BY: PAD | CHECKED BY:

DATE: 3/26/21

JOB NO: 2569200002

PROJECT NO:

PHASE:

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ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS

SHEET S1 OF

ESTD 1958
PROVOST& PRITCHARD
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AQUATERRA WATER BANK – EAST SIDE CANAL

McMULLIN GSA
FRESNO COUNTY, CA

STRUCTURAL

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FOR REVIEW ONLY

PRELIMINARY
NOT FOR CONSTRUCTION
3/26/21

No.	REVISION	BY	DATE

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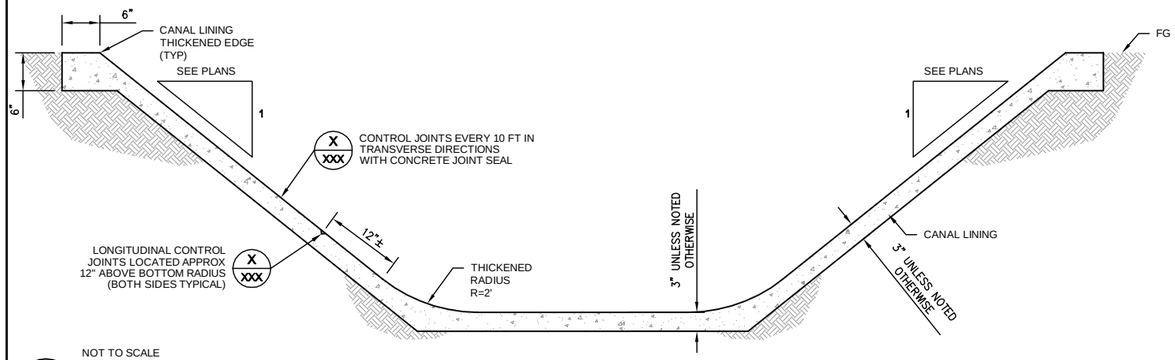

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CANAL LINING

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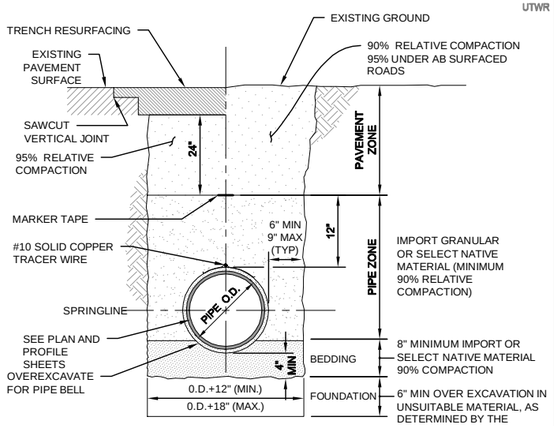

2
D1

TYPICAL PIPE BEDDING
(FARM ROAD CROSSINGS)

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA

CONSTRUCTION DETAILS
DETAILS

DESIGN ENGINEER:
LYNN GROUNDWATER
LICENSE NO:
____

DRAFTED BY: PAD
CHECKED BY:

DATE: 3/26/21

JOB NO: 256920002

PROJECT NO:

PHASE:

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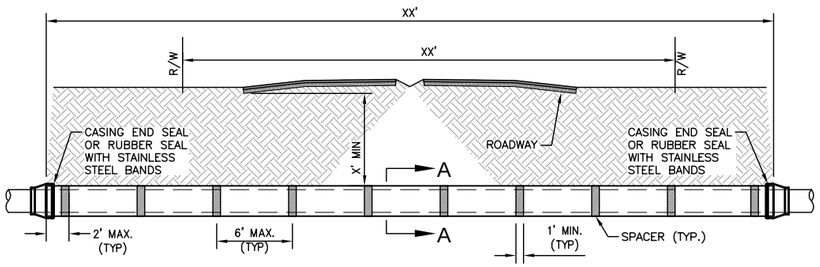
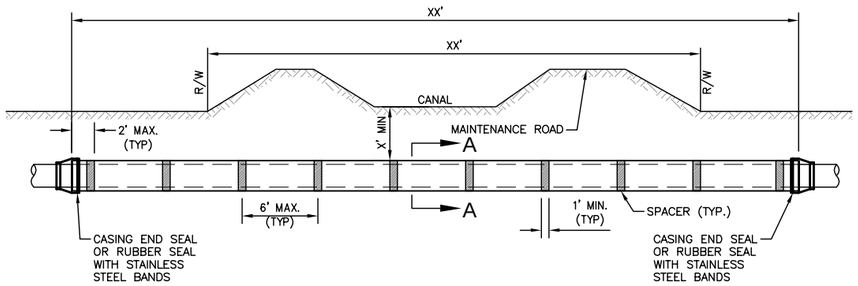
OF

3/26/2021 6:16 PM G:\McMullin GSA-2659\2659 On-going\CAD\340 Sheet Sets\04_Civil_Details\East Side Canal\D1 CONSTRUCTION DETAILS.dwg -Philip Dorsby



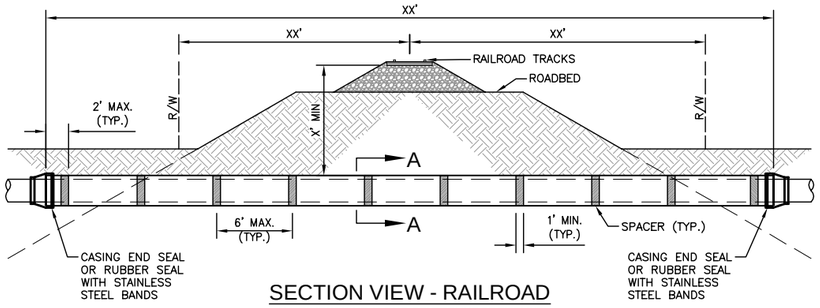
SECTION VIEW - ROADWAY

ALL DIMENSIONS ALONG CENTERLINE OF PIPELINE



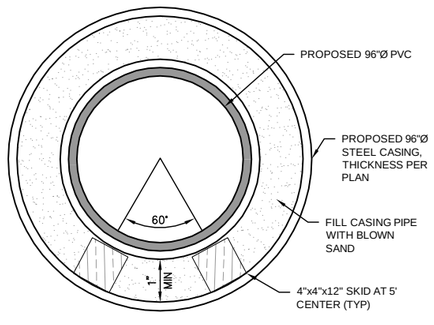
SECTION VIEW - OPEN CANAL

ALL DIMENSIONS ALONG CENTERLINE OF PIPELINE

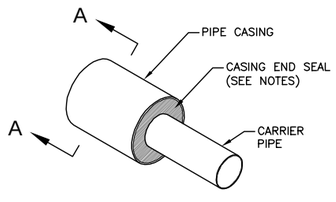


SECTION VIEW - RAILROAD

ALL DIMENSIONS ALONG CENTERLINE OF PIPELINE



SECTION A-A



CASING END SEAL

NOT TO SCALE

D1

PLACEMENT OF SPACERS ON CARRIER PIPE

1. GENERAL - ONE SPACER SHALL BE PLACED NOT MORE THAN TWO FEET FROM EACH END OF CASING. SUBSEQUENT SPACERS SHALL BE PLACED AT 6' INTERVALS WITHIN THE CASING, OR IN ACCORDANCE WITH PIPE MANUFACTURERS RECOMMENDATIONS.
2. FOR ALL CARRIER PIPE, ONE SPACER SHALL BE PLACED ON THE SPIGOT END OF EACH SEGMENT AT THE LINE MARKING THE LIMIT OF INSERTION INTO THE BELL. WHEN THE JOINT IS COMPLETE, THE SPACER SHALL BE IN CONTACT WITH THE BELL OF THE JOINT SO THAT THE SPACER PUSHES THE JOINT AND RELIEVES COMPRESSION WITHIN THE JOINT. SUBSEQUENT SPACERS SHALL BE PLACED AT 6'-10' INTERVALS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

CARRIER PIPE

1. CARRIER PIPE SHALL BE CENTERED WITHIN CASING BY USING OF ONE OF THESE METHODS:

   WOOD SKIDS
   PRESSURE TREATED #2 DF 2XS, #3 REDWOOD 2XS

   MANUFACTURED SPACERS
   HDPE OR STEEL

   CASING SPACERS AS MANUFACTURED BY ONE OF THE FOLLOWING
   ADVANCE PRODUCTS & SYSTEMS, INC.; CCI PIPELINE SYSTEMS; PUBLIC WORKS MARKETING, INC.; PIPELINE SEAL & INSULATOR, INC.; OR APPROVED EQUAL

BLOWN SAND

1. CASING SHALL BE FILLED WITH BLOWN SAND AFTER INSTALLATION OF CARRIER PIPE

CASING END SEALS

1. CASING END SEALS SHALL BE SEALED BY USING ONE OF THESE METHODS:

   RUBBER SEALS
   WRAP AROUND, NEOPRENE RUBBER, MIN. THICKNESS:1/8";
   TEMPERATURE RATING: -20°F TO 170°F.

   STEEL BAND
   STAINLESS STEEL BANDING; MIN. 2 BANDS PER SEAL; T304 STAINLESS STEEL WITH 100% NON-MAGNETIC WORM GEAR, 1/2" MIN. WIDTH.

BORE AND RECEIVING PIT NOTES

1. THE [AGENCY] HAS OBTAINED IT'S PORTION OF A [AGENCY] ENCROACHMENT PERMIT. THE CONTRACTOR SHALL OBTAIN HIS PORTION OF THE [AGENCY'S] PERMIT (NO PERMIT FEE) PRIOR TO PERFORMING ANY WORK WITHIN THE [AGENCY'S] RIGHT OF WAY.
2. ALL WORK WITHIN THE [AGENCY'S] RIGHT OF WAY SHALL BE IN CONFORMANCE WITH [AGENCY'S] ENCROACHMENT PERMIT REQUIREMENTS.
3. BORE AND RECEIVING PITS SHALL BE LOCATED 5 FEET (MINIMUM) OUTSIDE OF [AGENCY'S] RIGHT OF WAY.
4. IF THE AGENCY IS CALTRANS: THE BORE AND RECEIVING PITS ARE UNDER STATE OF CALIFORNIA JURISDICTION, REGARDLESS OF THEIR LOCATION. SIZE AND LOCATION OF BORE AND RECEIVING PITS ARE THE CONTRACTOR'S RESPONSIBILITY SUBJECT TO CALTRANS APPROVAL.
4. IF THE AGENCY IS NOT CALTRANS:SIZE AND LOCATION OF BORE AND RECEIVING PITS ARE THE CONTRACTOR'S RESPONSIBILITY SUBJECT TO [AGENCY'S] APPROVAL.
5. ACCESS TO THE BORE AND RECEIVING PITS SHALL ONLY BE FROM THE CONSTRUCTION EASEMENTS OBTAINED BY [AGENCY]. THE PARKING OF EQUIPMENT AND/OR MATERIALS SHALL NOT BE WITHIN 20' OF THE ROADWAY LANES.
6. BORE AND RECEIVING PITS SHALL BE ADEQUATELY FENCED AND/OR HAVE A TYPE-K BARRIER PLACED AROUND THEM.
7. BORE AND RECEIVING PITS SHALL BE ADEQUATELY SHORED IN ACCORDANCE WITH CAL OSHA REQUIREMENTS.
8. SHORING PLANS, SIGNED BY A REGISTERED ENGINEER, SHALL BE SUBMITTED AND APPROVED BY [AGENCY] BEFORE EXCAVATING.
9. CASING PIPE MAY BE NEW OR USED STEEL PIPE WITH A MINIMUM YIELD STRENGTH OF 36,000 PSI. (ASTM A36). USED STEEL PIPE SHALL BE PRE-APPROVED BY [AGENCY'S] BEFORE INSTALLATION.
10. CASING PIPE MAY BE SPIRAL WELDED PIPE PROVIDED THE PIPE IS NEW AND THE WELD IS SMOOTH.
11. ALL CASING LENGTHS SHALL BE EQUAL TO THE AUGER LENGTH.
12. ALL CASING JOINTS WELDED IN THE FIELD SHALL BE FULLY WELDED AROUND THE CIRCUMFERENCE OF THE PIPE WITH COMPLETE PENETRATION WELD.
13. [AGENCY] SHALL SET AND CHECK A SURVEY GRID PER [AGENCY'S] APPROVED ENCROACHMENT PERMIT. CONTRACTOR SHALL PRESERVE ALL MONUMENTS ASSOCIATED WITH SURVEY GRID.

JACK AND BORE

AQUATERRA WATER BANK – EAST SIDE CANAL
McMULLIN GSA
FRESNO COUNTY, CA
DETAILS

CONSTRUCTION DETAILS

DESIGN ENGINEER: LYNN GROUNDWATER
LICENSE NO: ____

DRAFTED BY: PAD | CHECKED BY:

DATE: 3/26/21

JOB NO: 256920002

PROJECT NO:

PHASE:

0 1"
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SHEET **D2**

OF

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Appendix G – Project Capital Costs

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1968
An Employee Owned Company

PRELIMINARY
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

PRELIMINARY

McMullin Area Groundwater Sustainability Agency
Aquaterra Water Bank
Planning/Conceptual Level Costs

APRIL 2022 DRAFT

Item No.	Item Description	Quantity	Unit	Unit Price	Amount [3]
CONSTRUCTION COSTS					
	400 cfs Jensen Canal				
1	Mendota Pump Station (200 cfs)	1	LS	$ 4,520,000	$ 4,520,000
	James Bypass Mendota Pump Station (150 cfs)	1	LS	$ 3,390,000	$ 3,390,000
	MVWD Mendota Pump Station (150 cfs)	1	LS	$ 3,390,000	$ 3,390,000
2	Intermediate Pump Stations (5-bay, 500 cfs, 400 hp pumps)	3	LS	$ 9,991,667	$ 29,975,000
3	Land Clearing (150-ft wide easement, 13.5 miles)	245	AC	$ 2,500	$ 614,000
4	Earthwork	630,000	CY	$ 10	$ 6,300,000
5	Farm Road Crossings (box culvert)	18	EA	$ 334,000	$ 6,012,000
6	Paved County Road Crossing (James Rd; Bore and Jack 3, 96" RCP for 160')	480	LF	$ 3,200	$ 1,536,000
7	Remove/Replace Grower Turnout	8	EA	$ 40,000	$ 320,000
8	Relocation of Wells/Filter Stations	10	EA	$ 250,000	$ 2,500,000
				Subtotal	**$ 58,557,000**
	500 cfs East Side Canal				
9	Land Clearing (150-ft wide canal easement, 32.4 miles)	589	AC	$ 2,500	$ 1,473,000
10	Earthwork	1,500,000	CY	$ 10	$ 15,000,000
11	Intermediate Pump Stations (10-bay, 500 cfs, 125 hp pumps)	5	LS	$ 9,991,667	$ 49,959,000
11	Farm Road Crossings (box culvert)	25	EA	$ 334,000	$ 8,350,000
12	Paved County Road Crossings (Jensen, American, Bore and Jack, 3, 96" RCP for 100' each)	600	LF	$ 3,200	$ 1,920,000
13	Railroad Crossing (Bore and Jack, 3, 96" RCP for 130')	390	LF	$ 3,200	$ 1,248,000
14	Hwy 180 & Hwy 145 Crossing (Bore and Jack, 3, 96" RCP for 220')	1,320	LF	$ 3,200	$ 4,224,000
15	Relocation of Wells	2	EA	$ 250,000	$ 500,000
				Subtotal	**$ 82,674,000**
	400 cfs American Canal				
16	Placer Rd Pump Station	1	LS	$ 9,040,000	$ 9,040,000
17	Intermediate Pump Stations (8-bay, 400 cfs, 125 hp pumps)	3	LS	$ 7,993,000	$ 23,979,000
18	Land Clearing (150-ft wide easement, 10.8 miles)	196	AC	$ 2,500	$ 491,000
19	Earthwork	500,000	CY	$ 10	$ 5,000,000
20	Farm Road Crossings (box culvert)	41	EA	$ 334,000	$ 13,694,000
21	Paved Road Crossing (open cut, 3, 72" RCP barrels, 100' length)	5	EA	$ 250,000	$ 1,250,000
22	Paved County Road Crossings (3 crossings, Bore and Jack, 3, 72" RCP for 120')	1,080	LF	$ 2,400	$ 2,592,000
23	Canal Crossing (Bore and Jack, 3, 72" RCP for 130')	390	LF	$ 2,400	$ 936,000
24	Hwy 145 Crossing (Bore and Jack, 3, 72" RCP for 220')	660	LF	$ 2,400	$ 1,584,000
				Subtotal	**$ 58,566,000**
	300 cfs Siskiyou Ave Canal				
25	Land Clearing (150-ft wide canal easement, 4.9 miles)	89	AC	$ 2,500	$ 223,000
26	Earthwork	230,000	CY	$ 10	$ 2,300,000
27	Farm Road Crossings (box culvert)	9	EA	$ 334,000	$ 3,006,000
28	Intermediate Pump Stations (6-bay, 300 cfs, 125 hp pumps)	3	LS	$ 5,995,000	$ 17,985,000
				Subtotal	**$ 23,514,000**
	McMullin Expansion				
29	McMullin Expansion Project Cost	1	LS	$ 40,000,000	$ 40,000,000
				Subtotal	**$ 40,000,000**
	Basin Work				
30	75 cfs Canal Turnouts, Discharge Pipe, Metering Stand	32	EA	$ 317,000	$ 10,144,000
31	40 Acre Basin	96	EA	$ 655,000	$ 62,880,000
				Subtotal	**$ 73,024,000**
	Extraction Facilities				
32	Extraction Wells (5.5 cfs per extraction well)	87	EA	$ 1,000,000	$ 87,000,000
				Subtotal	**$ 87,000,000**
	Monitoring Facilities				
33	Shallow Monitoring Well	50	EA	$ 25,000	$ 1,250,000
34	Deep Monitoring Well	5	EA	$ 100,000	$ 500,000
				Subtotal	**$ 1,750,000**
	General Conditions [4]				
35	Mobilization/Demobilization, Bonds and Insurance and Construction Permits	5%	LS		$ 21,250,000
36	Worker and Public Protection	0.5%	LS		$ 2,130,000
37	Miscellaneous Facilities and Operations	3%	LS		$ 12,750,000
38	Dust Control Plan & Implementation	0.5%	LS		$ 2,130,000
39	SWPPP Plan & Implementation	2%	LS		$ 8,500,000
40	Traffic Control	0.5%	LS		$ 2,130,000
				Subtotal	**$ 48,890,000**
				CONSTRUCTION COSTS SUBTOTAL	**$ 425,085,000**
NON-CONSTRUCTION COSTS					
41	Land Acquisition (Cost per 40 acre Basin)	96	EA	$ 800,000	$ 76,800,000
42	Land Purchase Jensen Alignment (120 ft width for 9 miles)	131	AC	$ 15,000	$ 1,964,000
43	Land Purchase East Side Canal (120 ft width for 23.9 miles)	348	AC	$ 15,000	$ 5,215,000
44	Land Purchase James/American Alignment (120 ft width for 10.8 miles)	157	AC	$ 15,000	$ 2,356,000

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1968
An Employee Owned Company

PRELIMINARY
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

PRELIMINARY

McMullin Area Groundwater Sustainability Agency
Aquaterra Water Bank
Planning/Conceptual Level Costs

APRIL 2022 DRAFT

Item No.	Item Description	Quantity	Unit	Unit Price	Amount /3
44	Construction Easement Jensen Alignment (35-foot wide, both sides for 9 miles)	76	AC	$ 5,000	$ 382,000
45	Construction Easement East Side Canal (35-foot wide, both sides for 12.6 miles)	107	AC	$ 5,000	$ 535,000
46	Construction Easement James/American Alignment (35-foot wide, both sides for 10.8 miles)	92	AC	$ 5,000	$ 458,000
46	Data Collection & Design /5,8	8%	LS		$ 34,006,800
47	Permitting & Compliance /5,9	4%	LS		$ 17,003,400
48	Construction Management /5,10	8%	LS		$ 34,006,800
			NON-CONTSTRUCTION SUBTOTAL		**$ 172,727,000**
				PROJECT TOTAL	**$ 597,812,000**
	Preliminary Level Overall Project Contigency /11	30	%	**$ 597,812,000**	**$ 179,344,000**
	Preliminary Level Overall Project Contigency /12	-20	%	**$ 597,812,000**	**$ (119,562,000)**
			PRELIMINARY COST W/ 30% CONTIGENCY		**$ 777,156,000**
			PRELIMINARY COST W/ -20% CONTIGENCY		**$ 478,250,000**

Notes & Assumptions:

/1 This preliminary level estimate represents the opinion of probable cost based on the engineer's experience with prior projects and cost sources such as RS Means.
/2 Costs presume work will be publically bid as a public works project.
/3 Amount totals rounded up to the nearest one-thousand dollars.
/4 Percentages are of the subtotal of the Construction Costs.
/5 Percentages are sum of Field Costs & General Conditions.
/6 Construction schedule may impact construction cost.
/7 Based on the estimated number of landowners with realty actions.
/8 Data Collection & Design includes: survey, field investigations, geotechnical investigation, reporting & legal review, design, specifications and bidding.
/9 Permitting & Compliance includes: NEPA, CEQA, federal & state ESA, Air Pollution Control District, cultural resources, land clearances, mitigation measures & legal review.
/10 Construction Mangement includes: construction admin & staking, bid award, field inspections, geotechnical, water quality monitoring, qa/qc & legal review,record documents and close out.
/11 Preliminary level contingency typically ranages from 20 to 50%.
/12 Landowner turnouts were NOT included, but presumed to be put in by landowners at their expense at a later date.
/13 District does not hold right-of-way on existing canal
/14 Cost estimate assumes there will not be any export of dirt

Appendix H – Special Status Plant and Animal Species List

Table 1 Special Status Animals with Potential to Occur Onsite and/or in the Vicinity

Species	Status	Habitat
American badger *(Taxidea taxus)*	CSC	Grasslands, savannas, and mountain meadows near timberline are preferred. Most abundant in drier open spaces of shrub and grassland. Burrows in soil.
bank swallow *(Riparia riparia)*	CT	These aerial insectivores nest colonially in burrows constructed along vertical banks and bluffs near waterbodies. This disturbance tolerant species is also known to nest in man-made sites, such as quarries, mounds of gravel or dirt, and road cuts.
blunt-nosed leopard lizard *(Gambelia sila)*	FE, CE, CFP	Inhabits semi-arid grasslands, alkali flats, low foothills, canyon floors, large washes, and arroyos, usually on sandy, gravelly, or loamy substrate, sometimes on hardpan. Often found where there are abundant rodent burrows in dense vegetation or tall grass. Cannot survive on lands under cultivation. Known to bask on kangaroo rat mounds and often seeks shelter at the base of shrubs, in small mammal burrows, or in rock piles. Adults may excavate shallow burrows but rely on deeper pre-existing rodent burrows for hibernation and reproduction.
burrowing owl *(Athene cunicularia)*	CSC	Resides in open, dry annual or perennial grasslands, deserts, and scrublands with low growing vegetation. Nests underground in existing burrows created by mammals, most often ground squirrels.
California glossy snake *(Arizona elegans occidentalis)*	CSC	Inhabits arid scrub, rocky washes, grasslands, and chaparral. Prefers open areas with loose soil for easy burrowing.
California horned lark (*Eremophila alpestris actia*)	CWL	Frequents open habitats, including short-grass prairie, mountain meadows, open coastal plains, fallow grain fields, and alkali flats. Found primarily in coastal regions, including Sonoma and San Diego Counties.
California tiger salamander *(Ambystoma californiense)*	FT, CT, CWL	Requires vernal pools or seasonal ponds for breeding and small mammal burrows for aestivation. Generally found in grassland and oak savannah plant communities in central California from sea level to 1500 feet in elevation.
coast horned lizard *(Phrynosoma blainvillii)*	CSC	Found in grasslands, coniferous forests, woodlands, and chaparral, primarily in open areas with patches of loose, sandy soil and low-lying vegetation in valleys, foothills, and semi-arid mountains. Frequently found near ant hills and along dirt roads in lowlands along sandy washes with scattered shrubs.
Crotch bumble bee (*Bombus crotchii*)	CCE	Occurs throughout coastal California, as well as east to the Sierra-Cascade crest, and south in to Mexico. Food plant genera include *Antirrhinum, Phacelia, Clarkia, Dendromecon, Eschscholzia*, and *Eriogonum*.
Fresno kangaroo rat *(Dipodomys nitratoides exilis)*	FE, CE	An inhabitant of alkali sink open grassland environments in western Fresno County. Prefers bare, alkaline, clay-based soils subject to seasonal inundation with more friable soil mounds around shrubs and grasses.

Species	Status	Habitat
giant gartersnake *(Thamnophis gigas)*	FT, CT	Occurs in marshes, sloughs, drainage canals, irrigation ditches, rice fields, and adjacent uplands. Prefers locations with emergent vegetation for cover and open areas for basking. This species uses small mammal burrows adjacent to aquatic habitats for hibernation in the winter and to escape from excessive heat in the summer.
giant kangaroo rat *(Dipodomys ingens)*	FE, CE	Inhabits annual grassland communities with few or no shrubs and well-drained, sandy-loam soils on gentle slopes.
longhorn fairy shrimp *(Branchinecta longiantenna)*	FE	Inhabits clear to turbid vernal pools or seasonally ponded areas.
merlin *(Falco columbarius)*	CWL	Found throughout North America in habitats ranging from tidal estuaries to open woodlands and valley grasslands. Generally roosts in clumps of trees or windbreaks.
mountain plover *(Charadrius montanus)*	CSC	Breeds on open plains at moderate elevations. Winters in short-grass plains and fields, plowed or fallow fields, and sandy deserts. Prefers flat, bare ground with burrowing rodents.
Nelson's antelope squirrel *(Ammospermophilus nelsoni)*	CT	Found in the western San Joaquin Valley on dry, sparsely vegetated loamy soils. Relies heavily on existing small mammal burrows.
northern California legless lizard *(Anniella pulchra)*	CSC	Found primarily underground, burrowing in loose, sandy soil. Forages in loose soil and leaf litter during the day. Occasionally observed on the surface at dusk and night.
pallid bat *(Antrozous pallidus)*	CSC	Found in grasslands, chaparral, and woodlands, where it feeds on ground- and vegetation-dwelling arthropods, and occasionally takes insects in flight. Prefers to roost in rock crevices, but may also use tree cavities, caves, bridges, and other man-made structures.
San Joaquin coachwhip *(Masticophis flagellum ruddocki)*	CSC	Found in open dry habitats with little or no tree cover in valley grassland and saltbush scrub communities in the San Joaquin Valley. Relies on mammal burrows for refuge and oviposition sites.
San Joaquin kit fox *(Vulpes macrotis mutica)*	FE, CT	Underground dens with multiple entrances in alkali sink, valley grassland, and woodland in valleys and adjacent foothills.
short-eared owl (*Asio flammeus*)	CSC	Found in wet and lowland habitats, including swamps, fresh and salt marshes, as well as irrigated alfalfa fields in the San Joaquin valley, portions of the San Francisco Bay area, the eastern Sierra Nevada range, and the northeast corner of California during the breeding season(Roberson, 2008). Numbers are highly dependent on drought conditions. Nests on dry ground, concealed in vegetation, and found in tule patches and tall grasses during the day.

Species	Status	Habitat
Steelhead – Central Valley DPS *(Oncorhynchus mykiss irideus pop.11)*	FT	This winter-run fish begins migration to fresh water during peak flows during December and February. Spawning season is typically from February to April. After hatching, fry move to deeper, mid-channel habitats in late summer and fall. In general, both juveniles and adults prefer complex habitat boulders, submerged clay and undercut banks, and large woody debris.
Swainson's hawk *(Buteo swainsoni)*	CT	Nests in large trees in open areas adjacent to grasslands, grain or alfalfa fields, or livestock pastures suitable for supporting rodent populations.
tricolored blackbird *(Agelaius tricolor)*	CT, CSC	Nests colonially near fresh water in dense cattails or tules, or in thickets of riparian shrubs. Forages in grassland and cropland. Large colonies are often found on dairy farm forage fields.
Tulare grasshopper mouse *(Onychomys torridus tularensis)*	CSC	Typically inhabit arid shrubland communities in hot, arid grassland and shrubland associations. Diet consists almost exclusively of arthropods.
two-striped gartersnake *(Thamnophis hammondii)*	CSC	Highly aquatic, found in or near permanent fresh water. Often along streams with rocky beds and riparian growth.
valley elderberry longhorn beetle *(Desmocerus californicus dimorphus)*	FT	Lives in mature elderberry shrubs of the Central Valley and foothills. Adults are active March to June.
vernal pool fairy shrimp *(Branchinecta lynchi)*	FT	Occupies vernal pools, clear to tea-colored water, in grass or mud-bottomed swales, and basalt depression pools.
western mastiff bat *(Eumops perotis californicus)*	CSC	Found in open, arid to semi-arid habitats, including dry desert washes, flood plains, chaparral, oak woodland, open ponderosa pine forest, grassland, and agricultural areas, where it feeds on insects in flight. Roosts most commonly in crevices in cliff faces but may also use high buildings and tunnels.
western pond turtle *(Emys marmorata)*	CSC	An aquatic turtle of ponds, marshes, slow-moving rivers, streams, and irrigation ditches with riparian vegetation. Requires adequate basking sites and sandy banks or grassy open fields to deposit eggs.
western red bat *(Lasiurus blossevillii)*	CSC	Roosts primarily in trees, 2–40 ft above ground, from sea level up through mixed conifer forests. Prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging.

Species	Status	Habitat
western spadefoot *(Spea hammondii)*	CSC	Prefers open areas with sandy or gravelly soils, in a variety of habitats including mixed woodlands, grasslands, coastal sage scrub, chaparral, sandy washes, lowlands, river floodplains, alluvial fans, playas, alkali flats, foothills, and mountains. Vernal pools or temporary wetlands, lasting a minimum of three weeks, which do not contain bullfrogs, fish, or crayfish are necessary for breeding.
western yellow-billed cuckoo *(Coccyzus americanus occidentalis)*	FT, CE	Suitable nesting habitat in California includes dense riparian willow-cottonwood and mesquite habitats along a perennial river. Once a common breeding species in riparian habitats of lowland California, this species currently breeds consistently in only two locations in the State: along the Sacramento and South Fork Kern Rivers.
white-faced ibis (*Plegadis chihi*)	CWL	Found in shallow freshwater marshes, using tule thickets for nesting and nearby areas of shallow water for foraging.

Table 2 Special Status Plants with Potential to Occur Onsite and/or in the Vicinity

Species	Status	Habitat
brittlescale *(Atriplex depressa)*	CNPS 1B	Found in the San Joaquin Valley and Sacramento Valley in alkaline or clay soils, typically in meadows or annual grassland in at elevations below 1050 feet. Sometimes associated with vernal pools. Blooms June–October.
California alkali grass *(Puccinellia simplex)*	CNPS 1B	Found in the San Joaquin Valley and other parts of California in saline flats and mineral springs within valley grassland and wetland-riparian communities at elevations below 3000 feet. Blooms March–May.
California jewelflower *(Caulanthus californicus)*	FE, CE, CNPS 1B	Found in the San Joaquin Valley and Western Transverse Ranges in sandy soils. Occurs on flats and slopes, generally in non-alkaline grassland at elevations between 230 feet and 6100 feet. Blooms February–April.
California satintail *(Imperata brevifolia)*	CNPS 2B	Although this facultative species is equally likely to occur in wetlands and non-wetlands, it is often found in wet springs, meadows, streambanks, and floodplains at elevations below 1600 feet. Blooms September – May.
caper-fruited tropidocarpum *(Tropidocarpum capparideum)*	CNPS 1B	Found in alkaline soils in low hills and valleys, often within Valley Grassland communities, at elevations below 1300 feet. Blooms March – April.
hairy Orcutt grass *(Orcuttia pilosa)*	FE, CE, CNPS 1B	Found in vernal pools in valley grassland, wetland, and riparian communities at elevations below 650 feet. Blooms May – September.
heartscale *(Atriplex cordulata var. cordulata)*	CNPS 1B	Found in the San Joaquin Valley and Sacramento Valley in saline or alkaline soils within shadescale scrub, valley grassland, and wetland-riparian communities at elevations below 230 feet. Blooms June–July.

Species	Status	Habitat
Indian Valley bush-mallow (*Malacothamnus aboriginum*)	CNPS 1B	Occurs through central California in chaparral and woodland habitats at elevations between 490 and 3710 feet. Grows on granitic outcrops in sandy, bare soils. Blooms May – July.
lesser saltscale *(Atriplex minuscula)*	CNPS 1B	Found in the San Joaquin Valley in sandy, alkaline soils in alkali scrub, valley and foothill grassland, and alkali sink communities at elevations below 750 feet. Blooms April–October.
Lost Hills crownscale *(Atriplex coronata var. vallicola)*	CNPS 1B	Found in the San Joaquin Valley in dried ponds and alkaline soils in alkali scrub, valley and foothill grassland, and vernal pools at elevations below 2900 feet. Blooms April–September.
Madera leptosiphon *(Leptosiphon serrulatus)*	CNPS 1B	Found in openings in foothill woodland, often yellow-pine forest, and chaparral at elevations between 1000 feet and 4300 feet. Blooms April – May.
Munz's tidy-tips *(Layia munzii)*	CNPS 1B	Found in the San Joaquin Valley in alkaline clay soils; often along hillsides in alkali scrub and sometimes valley and foothill grassland. Occurs at elevations between 145 feet and 2625 feet Blooms March–April.
palmate-bracted bird's beak *(Chloropyron palmatum)*	FE, CE, CNPS 1B	Found in the San Joaquin Valley and Sacramento Valley in alkaline soils (usually Pescadero silty clay) in chenopod scrub, valley and foothill grassland at elevations below 500 feet. Blooms June–August.
Panoche pepper-grass *(Lepidium jaredii ssp. album)*	CNPS 1B	Found on steep slopes, washes, alluvial-fans, and clay, sometimes alkaline, within Valley and Foothill Grassland communities in western Fresno County at elevations between 600–2400 feet. Blooms February–June.
recurved larkspur *(Delphinium recurvatum)*	CNPS 1B	Occurs in poorly drained, fine, alkaline soils in grassland and alakli scrub communities at elevations between 100 feet and 2600 feet. Blooms March–June.
San Joaquin Valley Orcutt grass *(Orcuttia inaequalis)*	FT, CE, CNPS 1B	Found in the eastern San Joaquin Valley and the Sierra Nevada foothills in vernal pools within valley grassland, freshwater wetland, and wetland-riparian communities at elevations below 2600 feet. Blooms April – September.
San Joaquin woollythreads *(Monolopia congdonii)*	FE, CNPS 1B	Occurs in the San Joaquin Valley in sandy soils on alkaline or loamy plains in valley and foothill grassland and alkali scrub communities at elevations between 180 feet and 2750 feet. Blooms February–May.
Sanford's arrowhead *(Sagittaria sanfordii)*	CNPS 1B	Found in the San Joaquin Valley and other parts of California in freshwater-marsh, primarily ponds and ditches, at elevations below 1000 feet. Blooms May–October.

Species	*Status*	*Habitat*
spiny-sepaled button-celery *(Eryngium spinosepalum)*	CNPS 1B	Found in the Sierra Nevada Foothills and the San Joaquin Valley. Occurs in vernal pools, swales, and roadside ditches. Often associated with clay soils in vernal pools within grassland communities. Occurs at elevations between 50 feet and 4160 feet. Blooms April–July.
subtle orache *(Atriplex subtilis)*	CNPS 1B	Found in the San Joaquin Valley in saline depressions in alkaline soils within valley and foothill grassland communities at elevations below 330 feet. Blooms June–October.
succulent owl's-clover *(Castilleja campestris var. succulenta)*	FT, CE, CNPS 1B	Found in vernal pools, often in acidic soils at elevations below 2500 feet. Blooms April – July.
vernal pool smallscale *(Atriplex persistens)*	CNPS 1B	Occurs in the San Joaquin Valley and Sacramento Valley in alkaline vernal pools at elevations below 375 feet. Blooms June–September.

EXPLANATION OF DESIGNATIONS AND STATUS CODES

STATUS CODES

FE	Federally Endangered	CE	California Endangered
FT	Federally Threatened	CT	California Threatened
CFP	California Fully Protected	CSC	California Species of Concern
CWL	California Watch List	CCE	California Endangered (Candidate)

CNPS RARE PLANT RANK

1B	Plants Rare, Threatened, or Endangered in California and elsewhere
2B	Plants Rare, Threatened, or Endangered in California but more common elsewhere

Appendix I – California Natural Diversity Database Data

Attachment 3 - MAGSA CNDDB Results
Selected Elements by Common Name
California Department of Fish and Wildlife
California Natural Diversity Database

Query Criteria: Quad IS (Mendota Dam (3612073) OR Gravelly Ford (3612072) OR Tranquillity (3612063) OR Jamesan (3612062) OR Kerman (3612061) OR Kearney Park (3611968) OR San Joaquin (3612052) OR Helm (3612051) OR Raisin (3611958) OR Caruthers (3611957) OR Firebaugh (3612074) OR Poso Farm (3612084) OR Firebaugh NE (3612083) OR Bonita Ranch (3612082) OR Madera (3612081) OR Biola (3612071) OR Herndon (3611978) OR Fresno South (3611967) OR Fresno North (3611977) OR Malaga (3611966) OR Conejo (3611956) OR Laton (3611946) OR Riverdale (3611947) OR Burrel (3611948) OR Five Points (3612041) OR Westside (3612042) OR Tres Picos Farms (3612043) OR Cantua Creek (3612053) OR Levis (3612054) OR Coit Ranch (3612064))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
American badger *Taxidea taxus*	AMAJF04010	None	None	G5	S3	SSC
Antioch efferian robberfly *Efferia antiochi*	IIDIP07010	None	None	G1G2	S1S2	
bank swallow *Riparia riparia*	ABPAU08010	None	Threatened	G5	S2	
black-crowned night heron *Nycticorax nycticorax*	ABNGA11010	None	None	G5	S4	
blunt-nosed leopard lizard *Gambelia sila*	ARACF07010	Endangered	Endangered	G1	S1	FP
brittlescale *Atriplex depressa*	PDCHE042L0	None	None	G2	S2	1B.2
burrowing owl *Athene cunicularia*	ABNSB10010	None	None	G4	S3	SSC
California alkali grass *Puccinellia simplex*	PMPOA53110	None	None	G3	S2	1B.2
California glossy snake *Arizona elegans occidentalis*	ARADB01017	None	None	G5T2	S2	SSC
California horned lark *Eremophila alpestris actia*	ABPAT02011	None	None	G5T4Q	S4	WL
California jewelflower *Caulanthus californicus*	PDBRA31010	Endangered	Endangered	G1	S1	1B.1
California satintail *Imperata brevifolia*	PMPOA3D020	None	None	G4	S3	2B.1
California tiger salamander *Ambystoma californiense*	AAAAA01180	Threatened	Threatened	G2G3	S2S3	WL
caper-fruited tropidocarpum *Tropidocarpum capparideum*	PDBRA2R010	None	None	G1	S1	1B.1
coast horned lizard *Phrynosoma blainvillii*	ARACF12100	None	None	G3G4	S3S4	SSC
Coastal and Valley Freshwater Marsh *Coastal and Valley Freshwater Marsh*	CTT52410CA	None	None	G3	S2.1	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Crotch bumble bee *Bombus crotchii*	IIHYM24480	None	Candidate Endangered	G3G4	S1S2	
Fresno kangaroo rat *Dipodomys nitratoides exilis*	AMAFD03151	Endangered	Endangered	G3TH	SH	
giant gartersnake *Thamnophis gigas*	ARADB36150	Threatened	Threatened	G2	S2	
giant kangaroo rat *Dipodomys ingens*	AMAFD03080	Endangered	Endangered	G1G2	S1S2	
great egret *Ardea alba*	ABNGA04040	None	None	G5	S4	
hairy Orcutt grass *Orcuttia pilosa*	PMPOA4G040	Endangered	Endangered	G1	S1	1B.1
heartscale *Atriplex cordulata var. cordulata*	PDCHE040B0	None	None	G3T2	S2	1B.2
hoary bat *Lasiurus cinereus*	AMACC05030	None	None	G5	S4	
Hoover's eriastrum *Eriastrum hooveri*	PDPLM03070	Delisted	None	G3	S3	4.2
Hurd's metapogon robberfly *Metapogon hurdi*	IIDIP08010	None	None	G1G2	S1S2	
Indian Valley bush-mallow *Malacothamnus aboriginum*	PDMAL0Q020	None	None	G3	S3	1B.2
lesser saltscale *Atriplex minuscula*	PDCHE042M0	None	None	G2	S2	1B.1
longhorn fairy shrimp *Branchinecta longiantenna*	ICBRA03020	Endangered	None	G1	S1S2	
Lost Hills crownscale *Atriplex coronata var. vallicola*	PDCHE04371	None	None	G4T2	S2	1B.2
Madera leptosiphon *Leptosiphon serrulatus*	PDPLM09130	None	None	G3	S3	1B.2
merlin *Falco columbarius*	ABNKD06030	None	None	G5	S3S4	WL
midvalley fairy shrimp *Branchinecta mesovallensis*	ICBRA03150	None	None	G2	S2S3	
molestan blister beetle *Lytta molesta*	IICOL4C030	None	None	G2	S2	
mountain plover *Charadrius montanus*	ABNNB03100	None	None	G3	S2S3	SSC
Munz's tidy-tips *Layia munzii*	PDAST5N0B0	None	None	G2	S2	1B.2
Nelson's antelope squirrel *Ammospermophilus nelsoni*	AMAFB04040	None	Threatened	G2	S2S3	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
northern California legless lizard *Anniella pulchra*	ARACC01020	None	None	G3	S3	SSC
Northern Claypan Vernal Pool *Northern Claypan Vernal Pool*	CTT44120CA	None	None	G1	S1.1	
Northern Hardpan Vernal Pool *Northern Hardpan Vernal Pool*	CTT44110CA	None	None	G3	S3.1	
pallid bat *Antrozous pallidus*	AMACC10010	None	None	G5	S3	SSC
palmate-bracted bird's-beak *Chloropyron palmatum*	PDSCR0J0J0	Endangered	Endangered	G1	S1	1B.1
Panoche pepper-grass *Lepidium jaredii ssp. album*	PDBRA1M0G2	None	None	G2G3T2T3	S2S3	1B.2
recurved larkspur *Delphinium recurvatum*	PDRAN0B1J0	None	None	G2?	S2?	1B.2
San Joaquin coachwhip *Masticophis flagellum ruddocki*	ARADB21021	None	None	G5T2T3	S2?	SSC
San Joaquin dune beetle *Coelus gracilis*	IICOL4A020	None	None	G1	S1	
San Joaquin kit fox *Vulpes macrotis mutica*	AMAJA03041	Endangered	Threatened	G4T2	S2	
San Joaquin Pocket Mouse *Perognathus inornatus*	AMAFD01060	None	None	G2G3	S2S3	
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	PMPOA4G060	Threatened	Endangered	G1	S1	1B.1
San Joaquin woollythreads *Monolopia congdonii*	PDASTA8010	Endangered	None	G2	S2	1B.2
Sanford's arrowhead *Sagittaria sanfordii*	PMALI040Q0	None	None	G3	S3	1B.2
short-eared owl *Asio flammeus*	ABNSB13040	None	None	G5	S3	SSC
snowy egret *Egretta thula*	ABNGA06030	None	None	G5	S4	
spiny-sepaled button-celery *Eryngium spinosepalum*	PDAPI0Z0Y0	None	None	G2	S2	1B.2
steelhead - Central Valley DPS *Oncorhynchus mykiss irideus pop. 11*	AFCHA0209K	Threatened	None	G5T2Q	S2	
subtle orache *Atriplex subtilis*	PDCHE042T0	None	None	G1	S1	1B.2
succulent owl's-clover *Castilleja campestris var. succulenta*	PDSCR0D3Z1	Threatened	Endangered	G4?T2T3	S2S3	1B.2
Swainson's hawk *Buteo swainsoni*	ABNKC19070	None	Threatened	G5	S3	

Attachment 3 - MAGSA CNDDB Results
Selected Elements by Common Name
California Department of Fish and Wildlife
California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
tricolored blackbird *Agelaius tricolor*	ABPBXB0020	None	Threatened	G2G3	S1S2	SSC
Tulare grasshopper mouse *Onychomys torridus tularensis*	AMAFF06021	None	None	G5T1T2	S1S2	SSC
two-striped gartersnake *Thamnophis hammondii*	ARADB36160	None	None	G4	S3S4	SSC
valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	IICOL48011	Threatened	None	G3T2	S2	
Valley Sacaton Grassland *Valley Sacaton Grassland*	CTT42120CA	None	None	G1	S1.1	
Valley Sink Scrub *Valley Sink Scrub*	CTT36210CA	None	None	G1	S1.1	
vernal pool fairy shrimp *Branchinecta lynchi*	ICBRA03030	Threatened	None	G3	S3	
vernal pool smallscale *Atriplex persistens*	PDCHE042P0	None	None	G2	S2	1B.2
western mastiff bat *Eumops perotis californicus*	AMACD02011	None	None	G5T4	S3S4	SSC
western pond turtle *Emys marmorata*	ARAAD02030	None	None	G3G4	S3	SSC
western red bat *Lasiurus blossevillii*	AMACC05060	None	None	G5	S3	SSC
western spadefoot *Spea hammondii*	AAABF02020	None	None	G3	S3	SSC
western yellow-billed cuckoo *Coccyzus americanus occidentalis*	ABNRB02022	Threatened	Endangered	G5T2T3	S1	
white-faced ibis *Plegadis chihi*	ABNGE02020	None	None	G5	S3S4	WL
Yuma myotis *Myotis yumanensis*	AMACC01020	None	None	G5	S4	

Record Count: 73

Appendix J – California Historical Resources Information System Search 20-139

California Historical Resources Information System

Fresno
Kern
Kings
Madera
Tulare

Southern San Joaquin Valley Information Center
California State University, Bakersfield
Mail Stop: 72 DOB
9001 Stockdale Highway
Bakersfield, California 93311-1022
(661) 654-2289
E-mail: ssjvic@csub.edu
Website: www.csub.edu/ssjvic

To: Jacqueline Lancaster
Provost & Pritchard Consulting Group, Inc.
130 N. Garden Street
Visalia, CA 93291

Record Search 20-139

Date: April 14, 2020

Re: McMullin GSA Groundwater Banking Reconnaissance Study Project

County: Fresno

Map(s): Gravelly Ford, Helm, Jamesan, Kearney Park, Kerman, Mendota Dam, Raisin, San Joaquin, & Tranquillity 7.5's

CULTURAL RESOURCES RECORDS SEARCH

The California Office of Historic Preservation (OHP) contracts with the California Historical Resources Information System's (CHRIS) regional Information Centers (ICs) to maintain information in the CHRIS inventory and make it available to local, state, and federal agencies, cultural resource professionals, Native American tribes, researchers, and the public. Recommendations made by IC coordinators or their staff regarding the interpretation and application of this information are advisory only. Such recommendations do not necessarily represent the evaluation or opinion of the State Historic Preservation Officer in carrying out the OHP's regulatory authority under federal and state law.

The following are the results of a search of the cultural resource files at the Southern San Joaquin Valley Information Center. These files include known and recorded cultural resources sites, inventory and excavation reports filed with this office, and resources listed on the National Register of Historic Places, the OHP Built Environment Resources Directory, California State Historical Landmarks, California Register of Historical Resources, California Inventory of Historic Resources, and California Points of Historical Interest. Due to processing delays and other factors, not all of the historical resource reports and resource records that have been submitted to the OHP are available via this records search. Additional information may be available through the federal, state, and local agencies that produced or paid for historical resource management work in the search area.

PRIOR CULTURAL RESOURCE STUDIES CONDUCTED WITHIN THE PROJECT AREA

According to the information in our files, there have been 30 previous cultural resource studies conducted within portions of the project area. A list is enclosed.

KNOWN/RECORDED CULTURAL RESOURCES WITHIN THE PROJECT AREA

There are 30 recorded resource within the project area. A list is enclosed. These resources include prehistoric era lithic scatters, bedrock milling features, beads, groundstones, mounds, firecracked rocks, and burials. They also include historic era railroads, canals, trash scatters transmission lines, a farming community, and various types of buildings.

Resource P-10-006617, the Fresno Slough Bypass, has been given a National Register status code of 2D2, indicating it is a contributor to a district that has been determined eligible for listing in the National Register of Historic Places by a consensus through the Section 106 process. It is also listed in the California Register of Historical Resources. There are no other recorded cultural resources within the project area that are listed in the National Register of Historic Places, the California Register of Historical Resources, the California Points of Historical Interest, California Inventory of Historic Resources, or the California State Historic Landmarks.

COMMENTS AND RECOMMENDATIONS

We understand the purpose of this project is to identify areas that would be best suited for a groundwater bank and look at fatal flaws analysis at a programmatic level with the 120,000 acre MAGSA boundary. Further, we understand, because specific project areas have not yet been identified, no ground disturbance activities are currently planned. Because no ground disturbance activities are currently planned, no further cultural resource investigation is recommended at this time. However, prior to any future ground disturbance activities related to this project, we recommend that a new record search be conducted for each ground disturbance project area identified so specific recommendations can be made. A list of qualified consultants can be found at www.chrisinfo.org.

We also recommend that you contact the Native American Heritage Commission in Sacramento. They will provide you with a current list of Native American individuals/organizations that can assist you with information regarding cultural resources that may not be included in the CHRIS Inventory and that may be of concern to the Native groups in the area. The Commission can consult their "Sacred Lands Inventory" file in order to determine what sacred resources, if any, exist within this project area and the way in which these resources might be managed. Finally, please consult with the lead agency on this project to determine if any other cultural resource investigation is required. If you need any additional information or have any questions or concerns, please contact our office at (661) 654-2289.

By:

Celeste M. Thomson, Coordinator **Date:** April 14, 2020

Please note that invoices for Information Center services will be sent under separate cover from the California State University, Bakersfield Accounting Office.

Reports in Project Area:

FR-00147
FR-00148
FR-00169
FR-00185
FR-00245
FR-00246
FR-00247
FR-00255
FR-00277
FR-00433
FR-00576
FR-00589
FR-00998
FR-01783
FR-01868
FR-02316
FR-02404
FR-02412
FR-02414
FR-02416
FR-02480
FR-02501
FR-02505
FR-02506
FR-02562
FR-02723
FR-02769
FR-02791
FR-02889
FR-02905

Resources in Project Area:

P-10-000074
P-10-000314
P-10-000398
P-10-000495
P-10-000562
P-10-000565
P-10-000566
P-10-000567
P-10-000784
P-10-002312
P-10-003930
P-10-004303
P-10-005175
P-10-005714
P-10-005715
P-10-005719
P-10-005793
P-10-006134
P-10-006202
P-10-006604
P-10-006614
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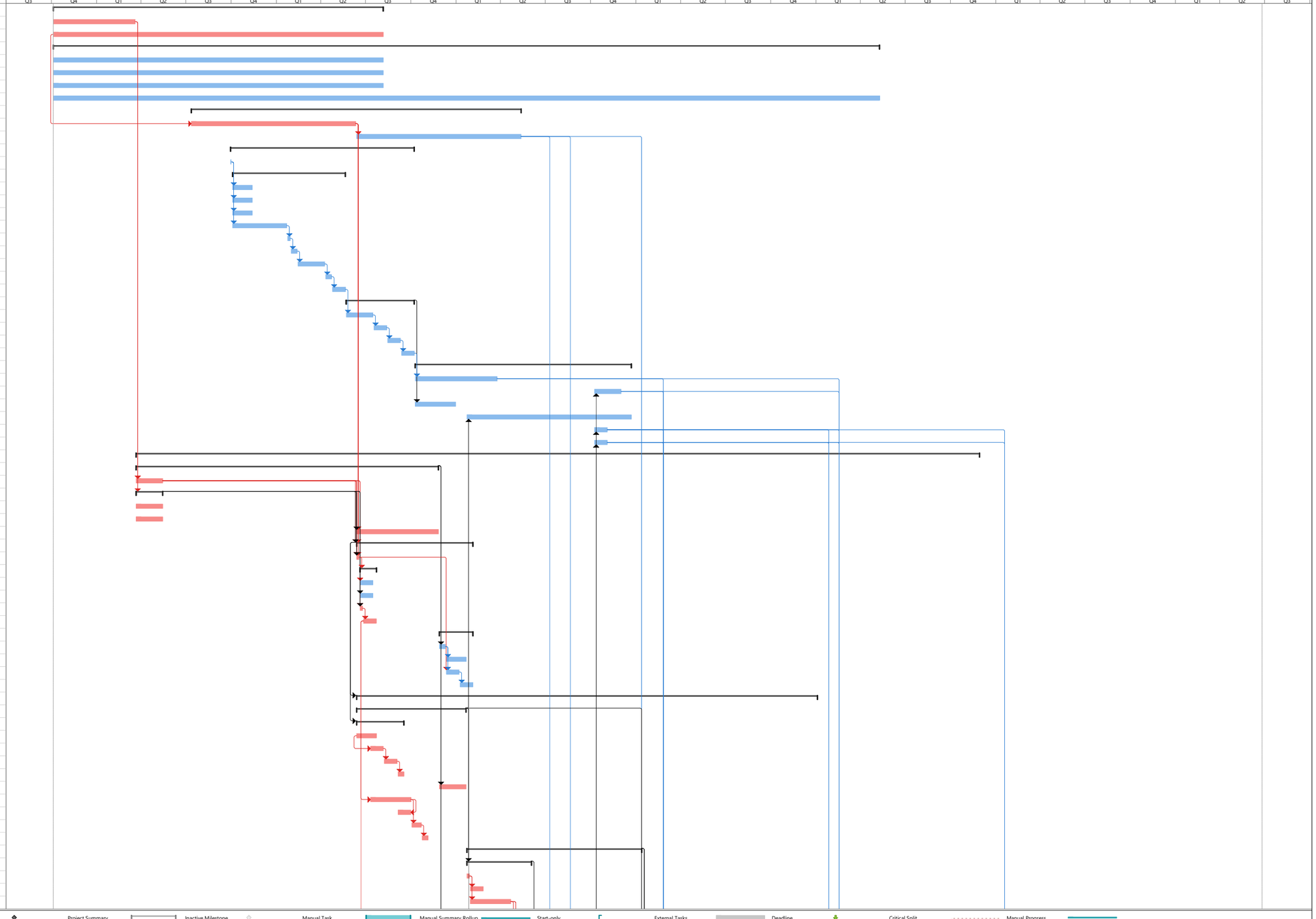
P-10-006628
P-10-006629
P-10-006630
P-10-006633
P-10-006634
P-10-006636
P-10-007057
P-10-007058

Appendix K – Detailed Preliminary Schedule

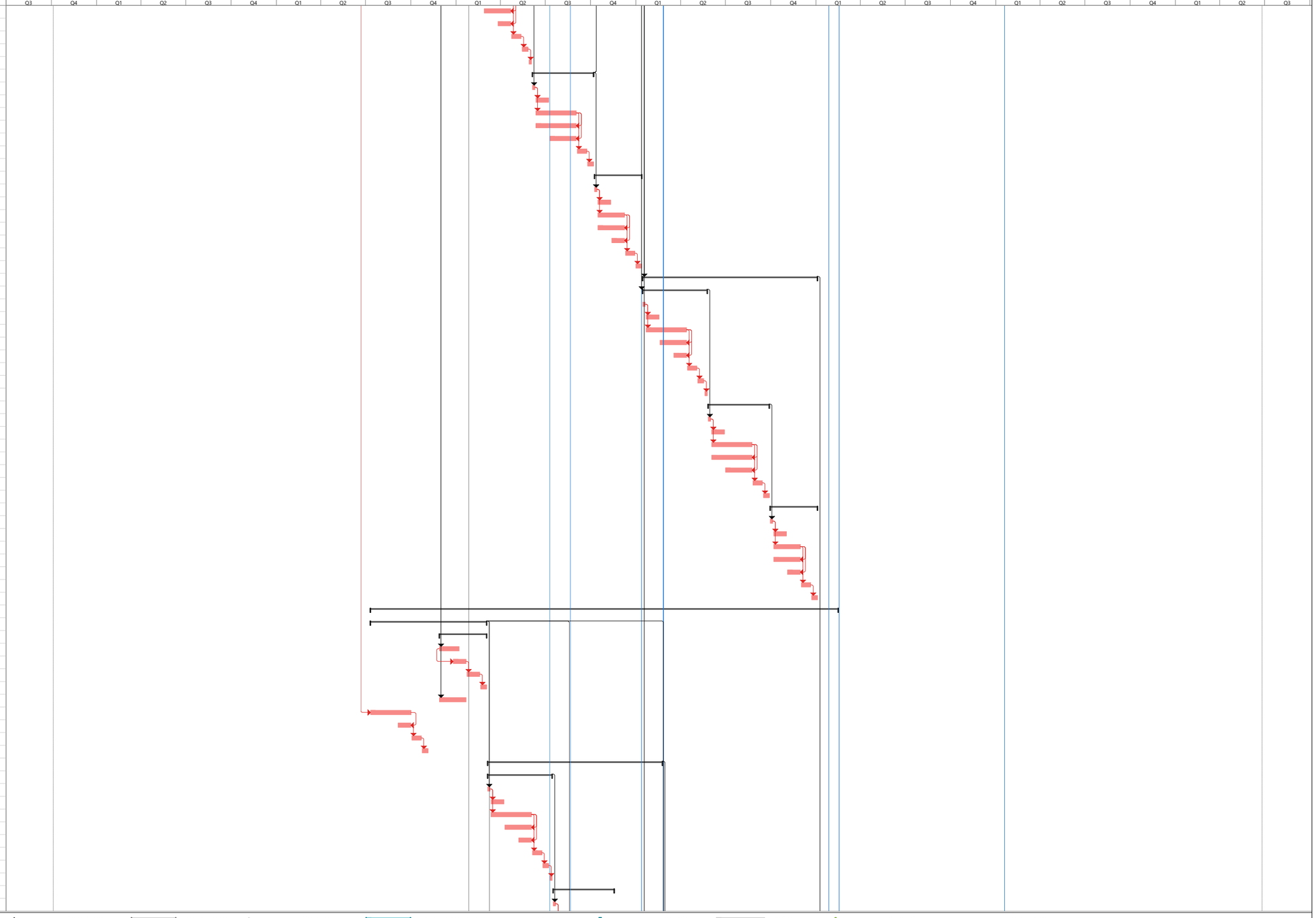
ID	Task Name	Duration	Start	Finish
1	**Program Development**	**480 days**	**Mon 10/5/20**	**Fri 8/5/22**
2	Preliminary Engineering	6 mons	Mon 10/5/20	Fri 3/19/21
3	Partner Discussions	24 mons	Mon 10/5/20	Fri 8/5/22
4	**Stakeholder Outreach**	**1200 days**	**Mon 10/5/20**	**Fri 5/9/25**
5	Coordination with SJREC	24 mons	Mon 10/5/20	Fri 8/5/22
6	Coordination with SLDMWA	24 mons	Mon 10/5/20	Fri 8/5/22
7	Coordination with Neighboring Agencie	24 mons	Mon 10/5/20	Fri 8/5/22
8	MAGSA Constituent Updates	60 mons	Mon 10/5/20	Fri 5/9/25
9	**Legal**	**480 days**	**Mon 7/12/21**	**Fri 5/12/23**
10	Subscription Agreements	12 mons	Mon 7/12/21	Fri 6/10/22
11	Banking Agreements	12 mons	Mon 6/13/22	Fri 5/12/23
12	**Environmental Documentation**	**267 days**	**Thu 9/30/21**	**Fri 10/7/22**
13	Public Scoping Meeting	1 day	Thu 9/30/21	Thu 9/30/21
14	**EA/IS Development**	**165 days**	**Mon 10/4/21**	**Fri 5/20/22**
15	Biological Surveys	6 wks	Mon 10/4/21	Fri 11/12/21
16	Cultural Surveys	6 wks	Mon 10/4/21	Fri 11/12/21
17	Groundwater Analysis	6 wks	Mon 10/4/21	Fri 11/12/21
18	Prepare Administrative Draft EA/IS	16 wks	Mon 10/4/21	Fri 1/21/22
19	Internal Team Review	1 wk	Mon 1/24/22	Fri 1/28/22
20	Prepare Draft EA/IS	2 wks	Mon 1/31/22	Fri 2/11/22
21	USBR Review	8 wks	Mon 2/14/22	Fri 4/8/22
22	Internal Team Review	2 wks	Mon 4/11/22	Fri 4/22/22
23	Revise Draft Documents	4 wks	Mon 4/25/22	Fri 5/20/22
24	**Mitigated Neg. Dec. / Finding of No Si**	**100 days**	**Mon 5/23/22**	**Fri 10/7/22**
25	Prepare MND/FONSI	8 wks	Mon 5/23/22	Fri 7/15/22
26	Public Review Process	4 wks	Mon 7/18/22	Fri 8/12/22
27	Address Public Comments	4 wks	Mon 8/15/22	Fri 9/9/22
28	Adopt MND / Final FONSI	4 wks	Mon 9/12/22	Fri 10/7/22
29	**Permitting**	**315 days**	**Mon 10/10/22**	**Fri 12/22/23**
30	CDFW LSAA	6 mons	Mon 10/10/22	Fri 3/24/23
31	Fresno County Encroachment Permits	2 mons	Mon 10/9/23	Fri 12/1/23
32	Fresno County Export Exemption	3 mons	Mon 10/10/22	Fri 12/30/22
33	PG&E Service	12 mons	Mon 1/23/23	Fri 12/22/23
34	SJVAPCD Dust Control Plan	1 mon	Mon 10/9/23	Fri 11/3/23
35	RWQCB Stormwater Pollution Preventi	1 mon	Mon 10/9/23	Fri 11/3/23
36	**Engineering**	**1225 days**	**Mon 3/22/21**	**Fri 11/28/25**
37	**Conceptual Design**	**440 days**	**Mon 3/22/21**	**Fri 11/25/22**
38	Identify Alignments	2 mons	Mon 3/22/21	Fri 5/14/21
39	**Identify Recharge Sites**	**40 days**	**Mon 3/22/21**	**Fri 5/14/21**
40	Collect/Analyze GW Quality Samp	2 mons	Mon 3/22/21	Fri 5/14/21
41	Collect Soil Borings	2 mons	Mon 3/22/21	Fri 5/14/21
42	Prepare Design Criteria Report	6 mons	Mon 6/13/22	Fri 11/25/22
43	**Surveys**	**170 days**	**Mon 6/13/22**	**Fri 2/3/23**
44	Set Project Control Points	1 wk	Mon 6/13/22	Fri 6/17/22
45	**Topographic Surveys**	**25 days**	**Mon 6/20/22**	**Fri 7/22/22**
46	Field Surveys - Conveyance Alignr	4 wks	Mon 6/20/22	Fri 7/15/22
47	Field Surveys - Survey Recharge S	4 wks	Mon 6/20/22	Fri 7/15/22
48	Utility Research	1 wk	Mon 6/20/22	Fri 6/24/22
49	Develop CAD Basemaps	4 wks	Mon 6/27/22	Fri 7/22/22
50	**Boundary Surveys**	**50 days**	**Mon 11/28/22**	**Fri 2/3/23**
51	Research existing maps and recor	2 wks	Mon 11/28/22	Fri 12/9/22
52	Order Preliminary Title Reports	6 wks	Mon 12/12/22	Fri 1/20/23
53	Field Surveys - Property & R/W B	4 wks	Mon 12/12/22	Fri 1/6/23
54	Reconcile and Develop CAD Base	4 wks	Mon 1/9/23	Fri 2/3/23
55	**Conveyance Design**	**670 days**	**Mon 6/13/22**	**Fri 1/3/25**
56	**30% Design Documents**	**160 days**	**Mon 6/13/22**	**Fri 1/20/23**
57	**Geotechnical Investigations**	**70 days**	**Mon 6/13/22**	**Fri 9/16/22**
58	Field Work (Drilling/Sampling)	6 wks	Mon 6/13/22	Fri 7/22/22
59	Lab Testing	4 wks	Mon 7/11/22	Fri 8/5/22
60	Draft Report	4 wks	Mon 8/8/22	Fri 9/2/22
61	Final Report	2 wks	Mon 9/5/22	Fri 9/16/22
62	Initial Project Calculations	2 mons	Mon 11/28/22	Fri 1/20/23
63	Prepare Plans	3 mons	Mon 7/11/22	Fri 9/30/22
64	Prepare Opinion of Construction (	1 mon	Mon 9/5/22	Fri 9/30/22
65	Internal QA/QC Review	3 wks	Mon 10/3/22	Fri 10/21/22
66	MAGSA Review	2 wks	Mon 10/24/22	Fri 11/4/22
67	**Phase 1 Conveyance Design**	**255 days**	**Mon 1/23/23**	**Fri 1/12/24**
68	**60% Design Documents**	**95 days**	**Mon 1/23/23**	**Fri 6/2/23**
69	Review and reconcile commen	1 wk	Mon 1/23/23	Fri 1/27/23
70	Update Project Calculations	1 mon	Mon 1/30/23	Fri 2/24/23
71	Prepare Plans	3 mons	Mon 1/30/23	Fri 4/21/23



Project: 2022-0302 AquaTerra S
Date: Tue 4/26/22

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Critical
Critical Split
Progress
Manual Progress

ID	Task Mode	Task Name	Duration	Start	Finish
72		Prepare Technical Specificatior	2 mons	Mon 2/27/23	Fri 4/21/23
73		Prepare Opinion of Constructic	1 mon	Mon 3/27/23	Fri 4/21/23
74		Internal QA/QC Review	3 wks	Mon 4/24/23	Fri 5/12/23
75		MAGSA Review	2 wks	Mon 5/15/23	Fri 5/26/23
76		Value Engineering Workshop	1 wk	Mon 5/29/23	Fri 6/2/23
77		**90% Design Documents**	**90 days**	**Mon 6/5/23**	**Fri 10/6/23**
78		Review and reconcile commen	1 wk	Mon 6/5/23	Fri 6/9/23
79		Update Project Calculations	1 mon	Mon 6/12/23	Fri 7/7/23
80		Prepare Plans	3 mons	Mon 6/12/23	Fri 9/1/23
81		Prepare Contract Specification	3 mons	Mon 6/12/23	Fri 9/1/23
82		Prepare Opinion of Constructic	2 mons	Mon 7/10/23	Fri 9/1/23
83		Internal QA/QC Review	3 wks	Mon 9/4/23	Fri 9/22/23
84		MAGSA Review	2 wks	Mon 9/25/23	Fri 10/6/23
85		**100% Design Documents**	**70 days**	**Mon 10/9/23**	**Fri 1/12/24**
86		Review and reconcile commen	1 wk	Mon 10/9/23	Fri 10/13/23
87		Update Project Calculations	1 mon	Mon 10/16/23	Fri 11/10/23
88		Prepare Plans	2 mons	Mon 10/16/23	Fri 12/8/23
89		Prepare Contract Specification	2 mons	Mon 10/16/23	Fri 12/8/23
90		Prepare Opinion of Constructic	1 mon	Mon 11/13/23	Fri 12/8/23
91		Internal QA/QC Review	3 wks	Mon 12/11/23	Fri 12/29/23
92		MAGSA Review	2 wks	Mon 1/1/24	Fri 1/12/24
93		**Phase 2 Conveyance Design**	**255 days**	**Mon 1/15/24**	**Fri 1/3/25**
94		**60% Design Documents**	**95 days**	**Mon 1/15/24**	**Fri 5/24/24**
95		Review and reconcile commen	1 wk	Mon 1/15/24	Fri 1/19/24
96		Update Project Calculations	1 mon	Mon 1/22/24	Fri 2/16/24
97		Prepare Plans	3 mons	Mon 1/22/24	Fri 4/12/24
98		Prepare Technical Specificatior	2 mons	Mon 2/19/24	Fri 4/12/24
99		Prepare Opinion of Constructic	1 mon	Mon 3/18/24	Fri 4/12/24
100		Internal QA/QC Review	3 wks	Mon 4/15/24	Fri 5/3/24
101		MAGSA Review	2 wks	Mon 5/6/24	Fri 5/17/24
102		Value Engineering Workshop	1 wk	Mon 5/20/24	Fri 5/24/24
103		**90% Design Documents**	**90 days**	**Mon 5/27/24**	**Fri 9/27/24**
104		Review and reconcile commen	1 wk	Mon 5/27/24	Fri 5/31/24
105		Update Project Calculations	1 mon	Mon 6/3/24	Fri 6/28/24
106		Prepare Plans	3 mons	Mon 6/3/24	Fri 8/23/24
107		Prepare Contract Specification	3 mons	Mon 6/3/24	Fri 8/23/24
108		Prepare Opinion of Constructic	2 mons	Mon 7/1/24	Fri 8/23/24
109		Internal QA/QC Review	3 wks	Mon 8/26/24	Fri 9/13/24
110		MAGSA Review	2 wks	Mon 9/16/24	Fri 9/27/24
111		**100% Design Documents**	**70 days**	**Mon 9/30/24**	**Fri 1/3/25**
112		Review and reconcile commen	1 wk	Mon 9/30/24	Fri 10/4/24
113		Update Project Calculations	1 mon	Mon 10/7/24	Fri 11/1/24
114		Prepare Plans	2 mons	Mon 10/7/24	Fri 11/29/24
115		Prepare Contract Specification	2 mons	Mon 10/7/24	Fri 11/29/24
116		Prepare Opinion of Constructic	1 mon	Mon 11/4/24	Fri 11/29/24
117		Internal QA/QC Review	3 wks	Mon 12/2/24	Fri 12/20/24
118		MAGSA Review	2 wks	Mon 12/23/24	Fri 1/3/25
119		**Recharge Design**	**680 days**	**Mon 7/11/22**	**Fri 2/14/25**
120		**30% Design Documents**	**170 days**	**Mon 7/11/22**	**Fri 3/3/23**
121		**Geotechnical Investigations**	**70 days**	**Mon 11/28/22**	**Fri 3/3/23**
122		Field Work (Drilling/Sampling)	6 wks	Mon 11/28/22	Fri 1/6/23
123		Lab Testing	4 wks	Mon 12/26/22	Fri 1/20/23
124		Draft Report	4 wks	Mon 1/23/23	Fri 2/17/23
125		Final Report	2 wks	Mon 2/20/23	Fri 3/3/23
126		Initial Project Calculations	2 mons	Mon 11/28/22	Fri 1/20/23
127		Prepare Plans	3 mons	Mon 7/11/22	Fri 9/30/22
128		Prepare Opinion of Construction	1 mon	Mon 9/5/22	Fri 9/30/22
129		Internal QA/QC Review	3 wks	Mon 10/3/22	Fri 10/21/22
130		MAGSA Review	2 wks	Mon 10/24/22	Fri 11/4/22
131		**Phase 1 Recharge Design**	**255 days**	**Mon 3/6/23**	**Fri 2/23/24**
132		**60% Design Documents**	**95 days**	**Mon 3/6/23**	**Fri 7/14/23**
133		Review and reconcile commen	1 wk	Mon 3/6/23	Fri 3/10/23
134		Update Project Calculations	1 mon	Mon 3/13/23	Fri 4/7/23
135		Prepare Plans	3 mons	Mon 3/13/23	Fri 6/2/23
136		Prepare Technical Specificatior	2 mons	Mon 4/10/23	Fri 6/2/23
137		Prepare Opinion of Constructic	1 mon	Mon 5/8/23	Fri 6/2/23
138		Internal QA/QC Review	3 wks	Mon 6/5/23	Fri 6/23/23
139		MAGSA Review	2 wks	Mon 6/26/23	Fri 7/7/23
140		Value Engineering Workshop	1 wk	Mon 7/10/23	Fri 7/14/23
141		**90% Design Documents**	**90 days**	**Mon 7/17/23**	**Fri 11/17/23**
142		Review and reconcile commen	1 wk	Mon 7/17/23	Fri 7/21/23



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Task
Split
Milestone
Summary
Project Summary
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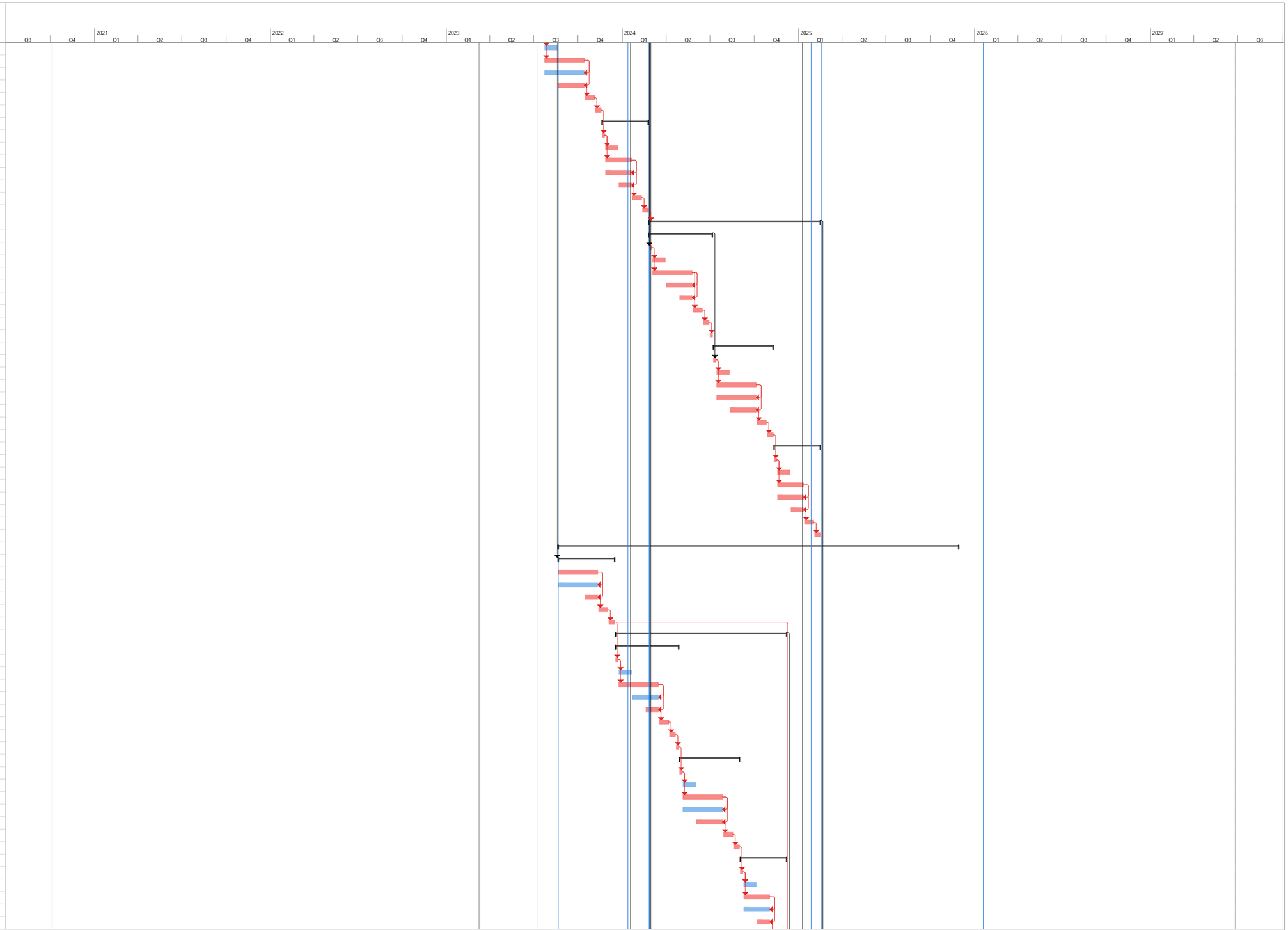
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Critical
Critical Split
Progress
Manual Progress

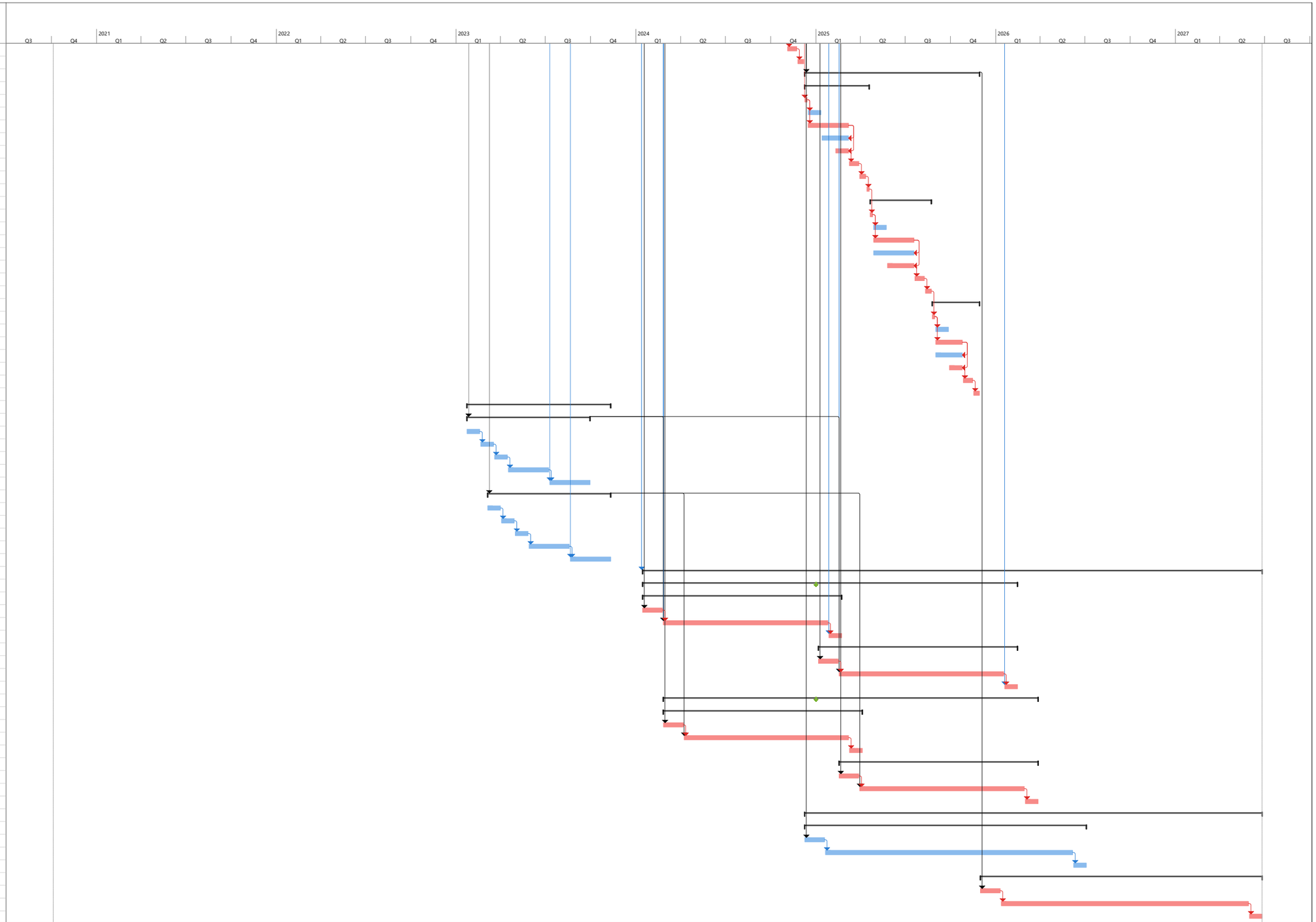
ID	Task Name	Duration	Start	Finish
143	Update Project Calculations	1 mon	Mon 7/24/23	Fri 8/18/23
144	Prepare Plans	3 mons	Mon 7/24/23	Fri 10/13/23
145	Prepare Contract Specification	3 mons	Mon 7/24/23	Fri 10/13/23
146	Prepare Opinion of Constructic	2 mons	Mon 8/21/23	Fri 10/13/23
147	Internal QA/QC Review	3 wks	Mon 10/16/23	Fri 11/3/23
148	MAGSA Review	2 wks	Mon 11/6/23	Fri 11/17/23
149	**100% Design Documents**	**70 days**	**Mon 11/20/23**	**Fri 2/23/24**
150	Review and reconcile commen	1 wk	Mon 11/20/23	Fri 11/24/23
151	Update Project Calculations	1 mon	Mon 11/27/23	Fri 12/22/23
152	Prepare Plans	2 mons	Mon 11/27/23	Fri 1/19/24
153	Prepare Contract Specification	2 mons	Mon 11/27/23	Fri 1/19/24
154	Prepare Opinion of Constructic	1 mon	Mon 12/25/23	Fri 1/19/24
155	Internal QA/QC Review	3 wks	Mon 1/22/24	Fri 2/9/24
156	MAGSA Review	2 wks	Mon 2/12/24	Fri 2/23/24
157	**Phase 2 Recharge Design**	**255 days**	**Mon 2/26/24**	**Fri 2/14/25**
158	**60% Design Documents**	**95 days**	**Mon 2/26/24**	**Fri 7/5/24**
159	Review and reconcile commen	1 wk	Mon 2/26/24	Fri 3/1/24
160	Update Project Calculations	1 mon	Mon 3/4/24	Fri 3/29/24
161	Prepare Plans	3 mons	Mon 3/4/24	Fri 5/24/24
162	Prepare Technical Specificatior	2 mons	Mon 4/1/24	Fri 5/24/24
163	Prepare Opinion of Constructic	1 mon	Mon 4/29/24	Fri 5/24/24
164	Internal QA/QC Review	3 wks	Mon 5/27/24	Fri 6/14/24
165	MAGSA Review	2 wks	Mon 6/17/24	Fri 6/28/24
166	Value Engineering Workshop	1 wk	Mon 7/1/24	Fri 7/5/24
167	**90% Design Documents**	**90 days**	**Mon 7/8/24**	**Fri 11/8/24**
168	Review and reconcile commen	1 wk	Mon 7/8/24	Fri 7/12/24
169	Update Project Calculations	1 mon	Mon 7/15/24	Fri 8/9/24
170	Prepare Plans	3 mons	Mon 7/15/24	Fri 10/4/24
171	Prepare Contract Specification	3 mons	Mon 7/15/24	Fri 10/4/24
172	Prepare Opinion of Constructic	2 mons	Mon 8/12/24	Fri 10/4/24
173	Internal QA/QC Review	3 wks	Mon 10/7/24	Fri 10/25/24
174	MAGSA Review	2 wks	Mon 10/28/24	Fri 11/8/24
175	**100% Design Documents**	**70 days**	**Mon 11/11/24**	**Fri 2/14/25**
176	Review and reconcile commen	1 wk	Mon 11/11/24	Fri 11/15/24
177	Update Project Calculations	1 mon	Mon 11/18/24	Fri 12/13/24
178	Prepare Plans	2 mons	Mon 11/18/24	Fri 1/10/25
179	Prepare Contract Specification	2 mons	Mon 11/18/24	Fri 1/10/25
180	Prepare Opinion of Constructic	1 mon	Mon 12/16/24	Fri 1/10/25
181	Internal QA/QC Review	3 wks	Mon 1/13/25	Fri 1/31/25
182	MAGSA Review	2 wks	Mon 2/3/25	Fri 2/14/25
183	**Recovery System Design**	**595 days**	**Mon 8/21/23**	**Fri 11/28/25**
184	**30% Design Documents**	**85 days**	**Mon 8/21/23**	**Fri 12/15/23**
185	Update Project Calculations	3 mons	Mon 8/21/23	Fri 11/10/23
186	Prepare Plans	3 mons	Mon 8/21/23	Fri 11/10/23
187	Prepare Opinion of Construction	1 mon	Mon 10/16/23	Fri 11/10/23
188	Internal QA/QC Review	3 wks	Mon 11/13/23	Fri 12/1/23
189	MAGSA Review	2 wks	Mon 12/4/23	Fri 12/15/23
190	**Phase 1 Recovery**	**255 days**	**Mon 12/18/23**	**Fri 12/6/24**
191	**60% Design Documents**	**95 days**	**Mon 12/18/23**	**Fri 4/26/24**
192	Review and reconcile commen	1 wk	Mon 12/18/23	Fri 12/22/23
193	Update Project Calculations	1 mon	Mon 12/25/23	Fri 1/19/24
194	Prepare Plans	3 mons	Mon 12/25/23	Fri 3/15/24
195	Prepare Technical Specificatior	2 mons	Mon 1/22/24	Fri 3/15/24
196	Prepare Opinion of Constructic	1 mon	Mon 2/19/24	Fri 3/15/24
197	Internal QA/QC Review	3 wks	Mon 3/18/24	Fri 4/5/24
198	MAGSA Review	2 wks	Mon 4/8/24	Fri 4/19/24
199	Value Engineering Workshop	1 wk	Mon 4/22/24	Fri 4/26/24
200	**90% Design Documents**	**90 days**	**Mon 4/29/24**	**Fri 8/30/24**
201	Review and reconcile commen	1 wk	Mon 4/29/24	Fri 5/3/24
202	Update Project Calculations	1 mon	Mon 5/6/24	Fri 5/31/24
203	Prepare Plans	3 mons	Mon 5/6/24	Fri 7/26/24
204	Prepare Contract Specification	3 mons	Mon 5/6/24	Fri 7/26/24
205	Prepare Opinion of Constructic	2 mons	Mon 6/3/24	Fri 7/26/24
206	Internal QA/QC Review	3 wks	Mon 7/29/24	Fri 8/16/24
207	MAGSA Review	2 wks	Mon 8/19/24	Fri 8/30/24
208	**100% Design Documents**	**70 days**	**Mon 9/2/24**	**Fri 12/6/24**
209	Review and reconcile commen	1 wk	Mon 9/2/24	Fri 9/6/24
210	Update Project Calculations	1 mon	Mon 9/9/24	Fri 10/4/24
211	Prepare Plans	2 mons	Mon 9/9/24	Fri 11/1/24
212	Prepare Contract Specification	2 mons	Mon 9/9/24	Fri 11/1/24
213	Prepare Opinion of Constructic	1 mon	Mon 10/7/24	Fri 11/1/24



Project: 2022-0302 AquaTerra S
Date: Tue 4/26/22

Task · Milestone · Project Summary · Inactive Milestone · Manual Task · Manual Summary Rollup · Start-only · External Tasks · Deadline · Critical Split · Manual Progress
Split · Summary · Inactive Task · Inactive Summary · Duration-only · Manual Summary · Finish-only · External Milestone · Critical · Progress

ID	Task Name	Duration	Start	Finish
214	Internal QA/QC Review	3 wks	Mon 11/4/24	Fri 11/22/24
215	MAGSA Review	2 wks	Mon 11/25/24	Fri 12/6/24
216	**Phase 2 Recovery**	**255 days**	**Mon 12/9/24**	**Fri 11/28/25**
217	**60% Design Documents**	**95 days**	**Mon 12/9/24**	**Fri 4/18/25**
218	Review and reconcile commen	1 wk	Mon 12/9/24	Fri 12/13/24
219	Update Project Calculations	1 mon	Mon 12/16/24	Fri 1/10/25
220	Prepare Plans	3 mons	Mon 12/16/24	Fri 3/7/25
221	Prepare Technical Specificatior	2 mons	Mon 1/13/25	Fri 3/7/25
222	Prepare Opinion of Constructic	1 mon	Mon 2/10/25	Fri 3/7/25
223	Internal QA/QC Review	3 wks	Mon 3/10/25	Fri 3/28/25
224	MAGSA Review	2 wks	Mon 3/31/25	Fri 4/11/25
225	Value Engineering Workshop	1 wk	Mon 4/14/25	Fri 4/18/25
226	**90% Design Documents**	**90 days**	**Mon 4/21/25**	**Fri 8/22/25**
227	Review and reconcile commen	1 wk	Mon 4/21/25	Fri 4/25/25
228	Update Project Calculations	1 mon	Mon 4/28/25	Fri 5/23/25
229	Prepare Plans	3 mons	Mon 4/28/25	Fri 7/18/25
230	Prepare Contract Specification	3 mons	Mon 4/28/25	Fri 7/18/25
231	Prepare Opinion of Constructic	2 mons	Mon 5/26/25	Fri 7/18/25
232	Internal QA/QC Review	3 wks	Mon 7/21/25	Fri 8/8/25
233	MAGSA Review	2 wks	Mon 8/11/25	Fri 8/22/25
234	**100% Design Documents**	**70 days**	**Mon 8/25/25**	**Fri 11/28/25**
235	Review and reconcile commen	1 wk	Mon 8/25/25	Fri 8/29/25
236	Update Project Calculations	1 mon	Mon 9/1/25	Fri 9/26/25
237	Prepare Plans	2 mons	Mon 9/1/25	Fri 10/24/25
238	Prepare Contract Specification	2 mons	Mon 9/1/25	Fri 10/24/25
239	Prepare Opinion of Constructic	1 mon	Mon 9/29/25	Fri 10/24/25
240	Internal QA/QC Review	3 wks	Mon 10/27/25	Fri 11/14/25
241	MAGSA Review	2 wks	Mon 11/17/25	Fri 11/28/25
242	**Land / Easement Acquisition**	**210 days**	**Mon 1/23/23**	**Fri 11/10/23**
243	**Conveyance Easements**	**180 days**	**Mon 1/23/23**	**Fri 9/29/23**
244	Identify Easement Needs	1 mon	Mon 1/23/23	Fri 2/17/23
245	Meet with Landowners	1 mon	Mon 2/20/23	Fri 3/17/23
246	Appraisals	1 mon	Mon 3/20/23	Fri 4/14/23
247	Negotiations	3 mons	Mon 4/17/23	Fri 7/7/23
248	Execute Agreements	3 mons	Mon 7/10/23	Fri 9/29/23
249	**Recharge Easements**	**180 days**	**Mon 3/6/23**	**Fri 11/10/23**
250	Identify Recharge Sites	1 mon	Mon 3/6/23	Fri 3/31/23
251	Meet with Landowners	1 mon	Mon 4/3/23	Fri 4/28/23
252	Appraisals	1 mon	Mon 5/1/23	Fri 5/26/23
253	Negotiations	3 mons	Mon 5/29/23	Fri 8/18/23
254	Execute Agreements	3 mons	Mon 8/21/23	Fri 11/10/23
255	**Construction**	**900 days**	**Mon 1/15/24**	**Fri 6/25/27**
256	**Conveyance**	**545 days**	**Mon 1/15/24**	**Fri 2/13/26**
257	**Phase 1 Conveyance**	**290 days**	**Mon 1/15/24**	**Fri 2/21/25**
258	Bidding and Award	6 wks	Mon 1/15/24	Fri 2/23/24
259	Construction	12 mons	Mon 2/26/24	Fri 1/24/25
260	Start-Up and Initial Recharge Ope	1 mon	Mon 1/27/25	Fri 2/21/25
261	**Phase 2 Conveyance**	**290 days**	**Mon 1/6/25**	**Fri 2/13/26**
262	Bidding and Award	6 wks	Mon 1/6/25	Fri 2/14/25
263	Construction	12 mons	Mon 2/17/25	Fri 1/16/26
264	Start-Up and Initial Recharge Ope	1 mon	Mon 1/19/26	Fri 2/13/26
265	**Recharge Basins**	**545 days**	**Mon 2/26/24**	**Fri 3/27/26**
266	**Phase 1 Recharge**	**290 days**	**Mon 2/26/24**	**Fri 4/4/25**
267	Bidding and Award	6 wks	Mon 2/26/24	Fri 4/5/24
268	Construction	12 mons	Mon 4/8/24	Fri 3/7/25
269	Start-Up and Initial Recharge Ope	1 mon	Mon 3/10/25	Fri 4/4/25
270	**Phase 2 Recharge**	**290 days**	**Mon 2/17/25**	**Fri 3/27/26**
271	Bidding and Award	6 wks	Mon 2/17/25	Fri 3/28/25
272	Construction	12 mons	Mon 3/31/25	Fri 2/27/26
273	Start-Up and Initial Recharge Ope	1 mon	Mon 3/2/26	Fri 3/27/26
274	**Recovery System**	**665 days**	**Mon 12/9/24**	**Fri 6/25/27**
275	**Phase 1 Recovery**	**410 days**	**Mon 12/9/24**	**Fri 7/3/26**
276	Bidding and Award	6 wks	Mon 12/9/24	Fri 1/17/25
277	Construction	18 mons	Mon 1/20/25	Fri 6/5/26
278	Start-Up and Initial Recovery Ope	1 mon	Mon 6/8/26	Fri 7/3/26
279	**Phase 2 Recovery**	**410 days**	**Mon 12/1/25**	**Fri 6/25/27**
280	Bidding and Award	6 wks	Mon 12/1/25	Fri 1/9/26
281	Construction	18 mons	Mon 1/12/26	Fri 5/28/27
282	Start-Up and Initial Recovery Ope	1 mon	Mon 5/31/27	Fri 6/25/27



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Task
Split
Milestone
Summary
Project Summary
Inactive Task
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Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Critical
Critical Split
Progress
Manual Progress