Appendix G

Water Supply Assessment and Hydrology Study

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Aramis Solar Energy Generation and Storage Project

Water Supply Assessment

prepared for

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Acronyms and Abbreviations

AFY	acre-feet per year
AC	alternating current
CEQA	California Environmental Quality Act
DC	direct current
DI	deionization
DWR	California Department of Water Resources
gpm	gallons per minute
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWMP	Groundwater Management Plan
kV	kilovolt
PV	photovoltaic
mg/L	milligrams per liter
MW	megawatts
MV	medium voltage
NMP	Nutrient Management Plan
O&M	operations and maintenance
PV	photovoltaic
RO	reverse osmosis
RWMG	Regional Water Management Group
SB	Senate Bill
SGMA	Sustainable Groundwater Management Act
SMP	Salt Management Plan
TDS	total dissolved solids
UWMP	Urban Water Management Plan
WSA	Water Supply Assessment

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1 Introduction

In 2001, California adopted Senate Bill (SB) 610 and SB 221, amending California Water Code to require that certain types of development projects provide detailed assessments of water supply availability and reliability to city and county decision-makers prior to project approval. These Water Supply Assessments (WSAs) identify water supply for an identified project over a 20-year projection under varying climactic (drought) conditions. The primary purpose of these requirements is to promote collaborative planning between local water supply and land use decisions.

SB 610 was not originally clear on whether renewable energy developments are subject to SB 610 and require the preparation of a WSA. SB 267 was signed into law on October 8, 2011, amending California's Water Law to revise the definition of "project" specified in SB 610. Under SB 267, wind and photovoltaic (PV) projects that consumed less than 75 acre-feet per year (AFY) of water were not considered to be a "project" under SB 610; subsequently, a WSA would not be required for this type of project. The renewable energy exclusions provided by SB 267 expired in January 2017. Since the language of SB 610 remains unclear on whether renewable energy projects meet the definition of a "project," this WSA takes a conservative approach and considers renewable energy projects to be subject to the requirements of SB 610.

Water requirements associated with the Aramis Solar Energy Generation and Storage Project ("project") are described in Section 2.3, *Project Water Demands*. The project would source water from either an on- or off-site well in the Livermore Valley Groundwater Basin, or through a local water purveyor. Potential water sources for the project are evaluated in Section 4 of this WSA.

In accordance with California Water Code, a WSA must examine the availability of an identified water supply under normal-year (no drought), single-dry-year (limited drought), and multiple-dry-year (extended drought) conditions, over a 20-year projection. The WSA must account for the projected water demand of the project in addition to other existing and planned future uses of the identified water supply, including agricultural and manufacturing uses, to the extent information is available. A common lack of data for groundwater usage and replenishment rates often makes it difficult to estimate baseline conditions regarding water supply availability; therefore, where data is not available to make quantitative estimates of water supply, reasonable assumptions are made based on available information and data.

The steps followed to ensure compliance of this WSA with California Water Code are described in Attachment A (California Department of Water Resources [DWR] Guidebook for Implementation of SB 610 and SB 221).

2 Project and Property Description

2.1 Location and Setting

The project site is located in the northeast area of unincorporated Alameda County, approximately 2.5 miles north of Livermore, surrounded by low hills of the South Coastal Range to the west, north, and east. Please refer to Figure 1 for the project's geographic location, Figure 2 for the project's location in relation to the groundwater basin, and Figure 3 for the project's location in relation to the water district service area boundaries. In addition, Figure 4 shows the configuration of each of the development areas comprising the project site, as well as the applicable land use designation and zoning for each; as shown and discussed further below, the project development area is zoned for large-parcel agriculture or resource management, with an Agricultural District overlay.

The project site is bound by Manning Road to the north, North Livermore Avenue to the east, and a private driveway to the south. The western project site boundary generally follows the natural topography of Cayetano Creek and the adjacent hills. The project site is comprised of portions of four privately-owned noncontiguous parcels, identified below by their respective County Assessor's Parcel Numbers (APNs) and size in acres:

- APN 903-0006-001-02: 536 acres (of which 150 acres of undevelopable area will be subdivided out of the parcel as part of the project);
- APN 903-0007-002-01: 50 acres;
- APN 903-0006-003-07: 101 acres; and
- APN 902-0001-005-00: 60 acres.

As listed above, the four separate parcels which provide the project site total 747 acres in cumulative size. With implementation of the proposed project, APN 903-0006-001-02 will be subdivided to remove 150 acres of undevelopable land on steep slopes; after this subdivision, the parcels contributing to the project site will total 597 acres in size. These parcels are within Sections 16 and 17 of Township 02 South, Range 02 East and un-surveyed land of the Las Positas Land Grant, Mount Diablo Base and Meridian. The project site is located within the "Tassajara, CA" and "Livermore, CA" United States Geological Survey 7.5-minute quadrangles.

Figure 1 Project Site

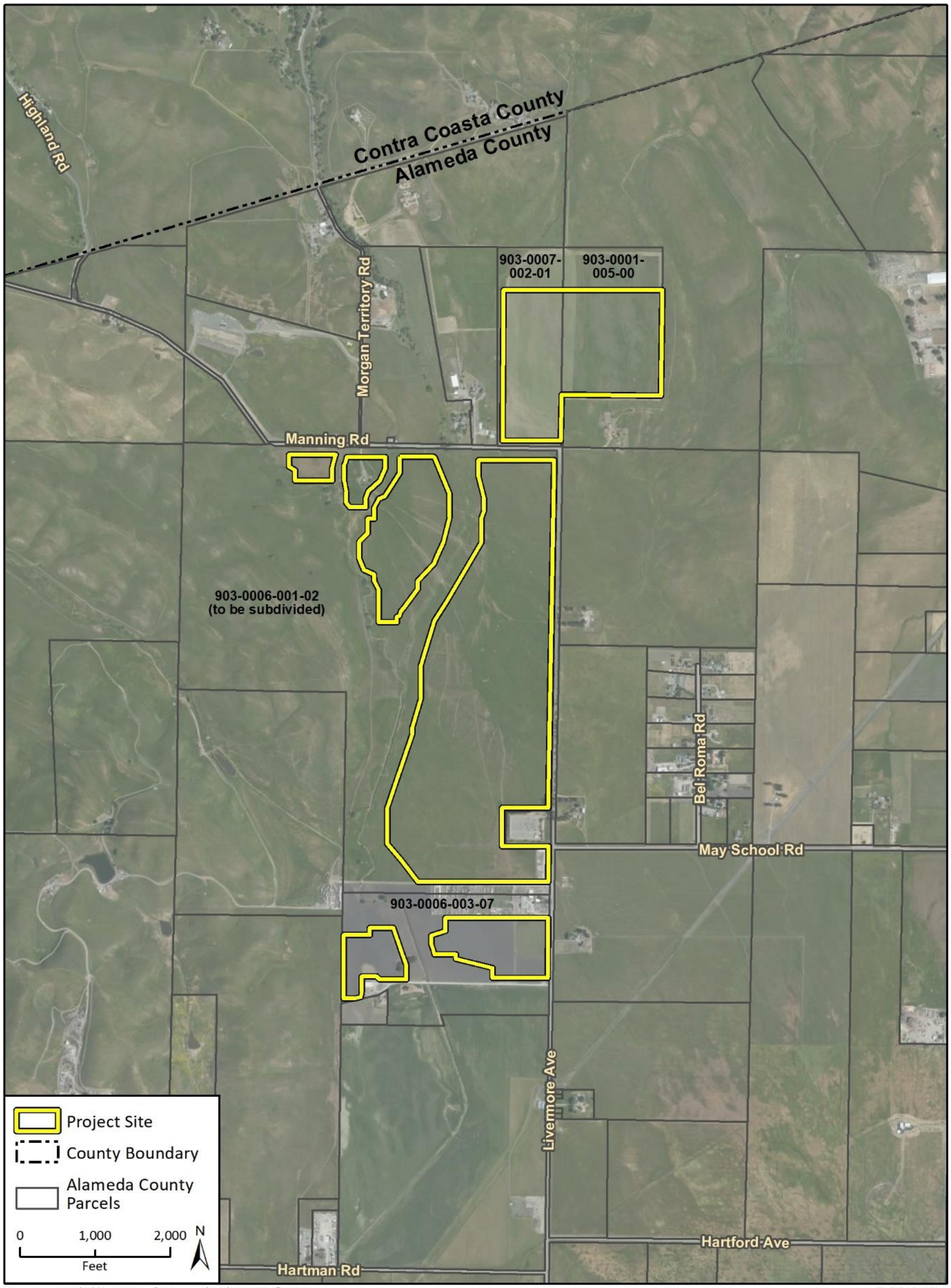

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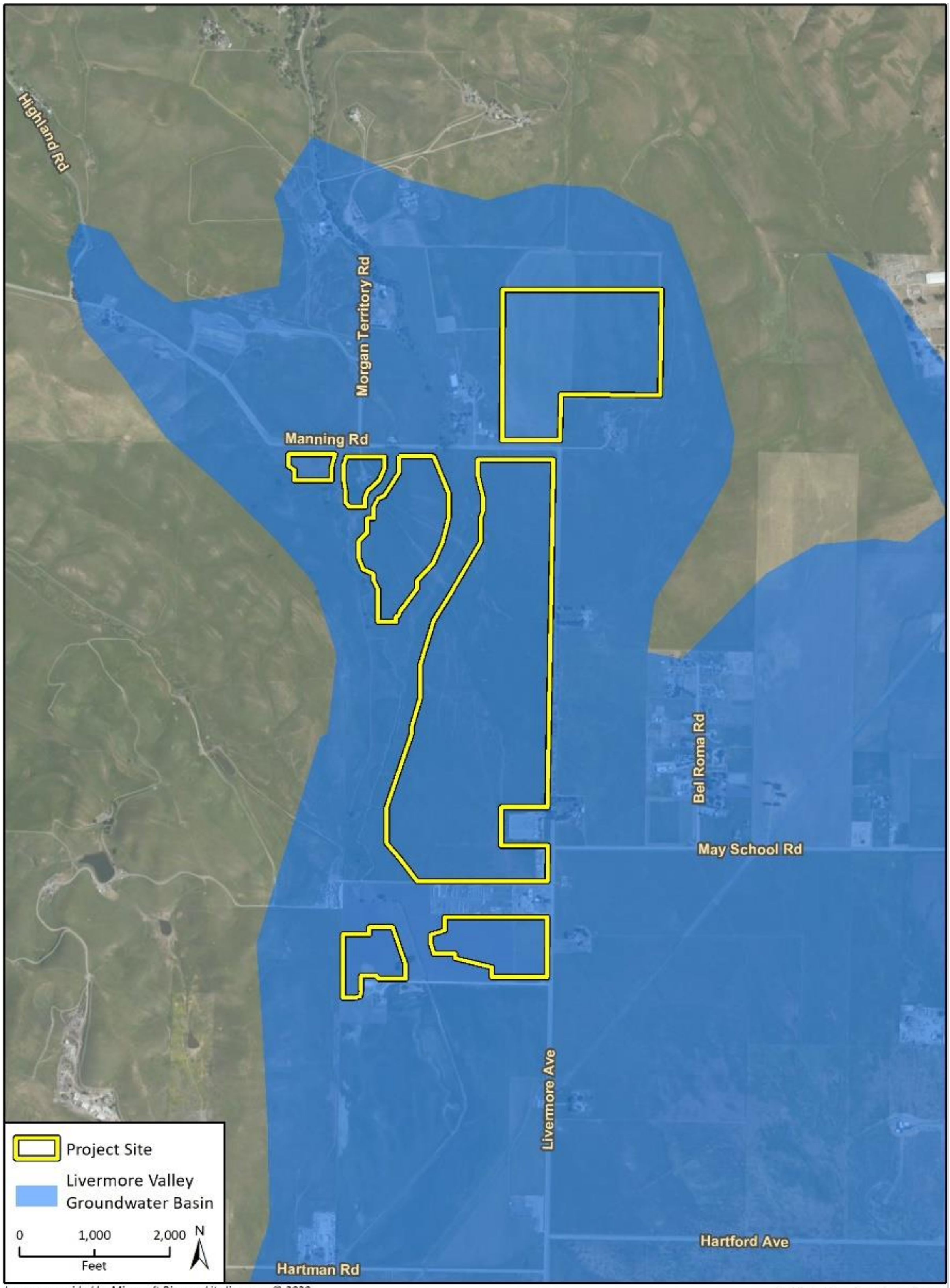
Figure 2 Groundwater Basins



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Groundwater Basin data provided by California Department of Water Resources, 2020.

Figure 3 Water Districts

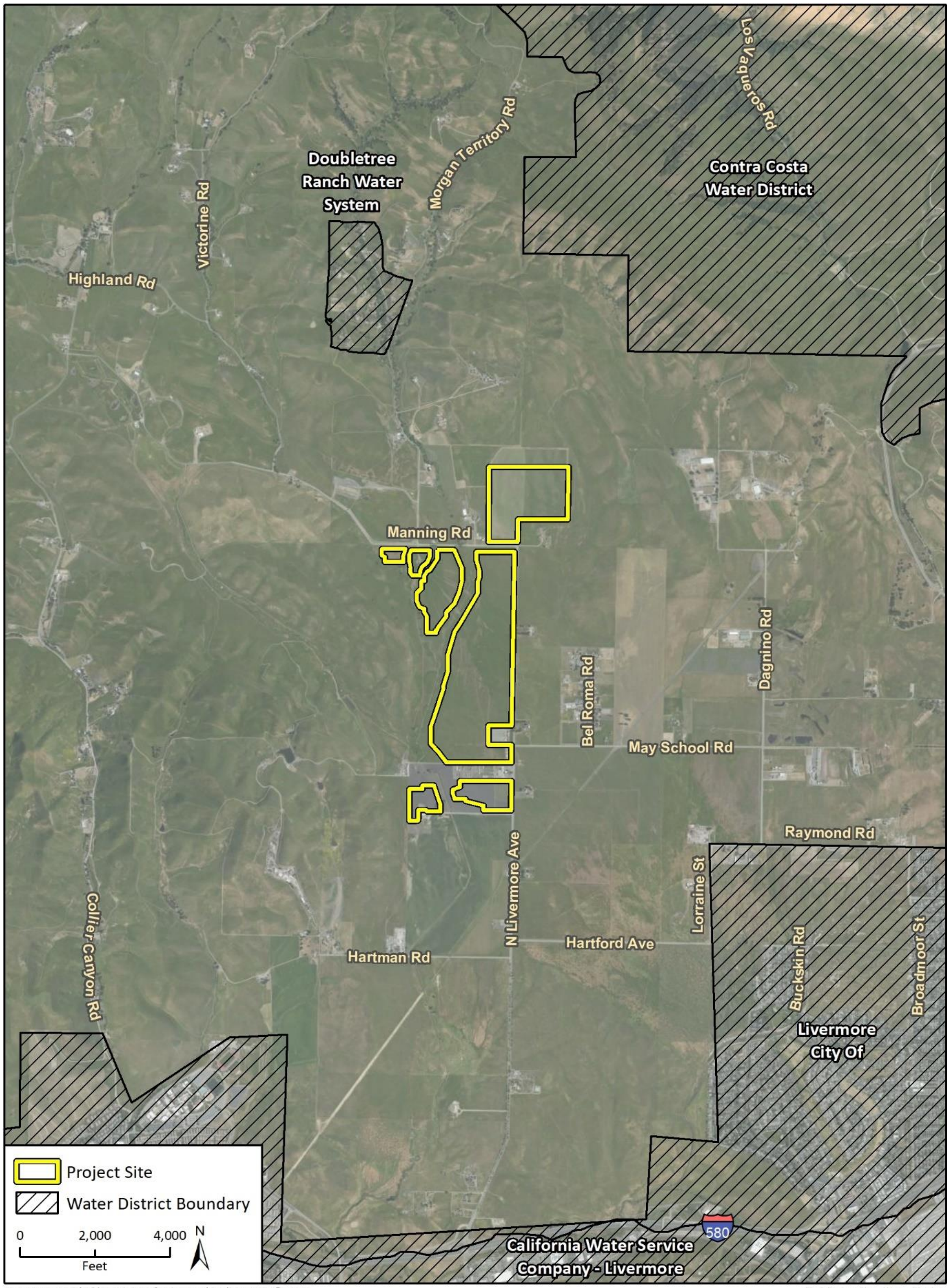

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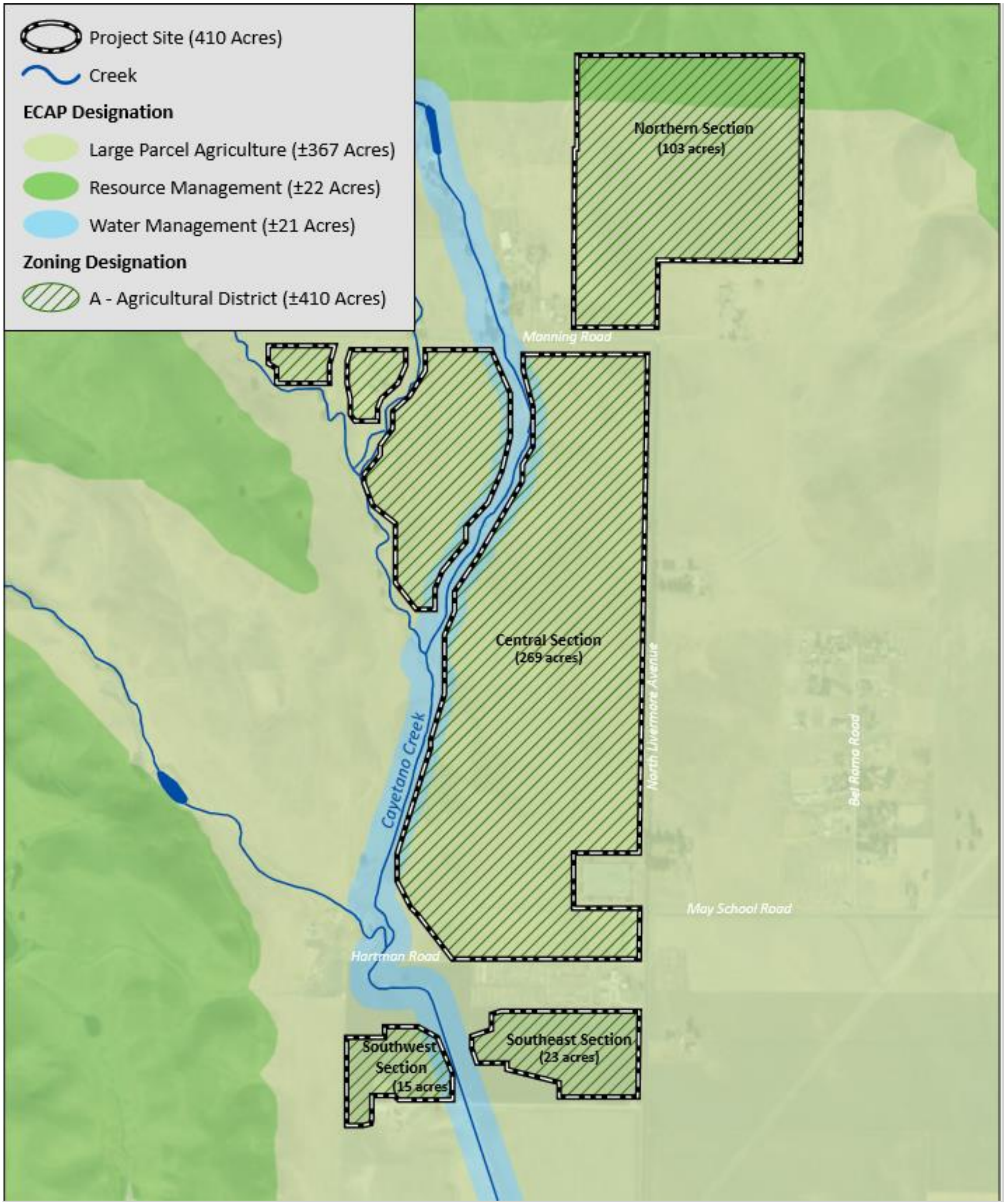
Figure 4 Land Use/Zoning Designation



For planning purposes, four development areas have been identified within the project site. These areas, listed below, do not follow the legal boundaries of the four parcels on which the site is located; rather, the boundaries of these development areas were determined based upon where the project features would be situated, avoiding areas that will be maintained in undeveloped state, such as habitat and stream areas. Accordingly, the project's development area totals 410 acres in size, and is comprised of the four development areas listed below and shown on Figure 1:

- Northern Section (103 acres);
- Central Section (269 acres);
- Southeastern Section (23 acres); and
- Southwestern Section (15 acres).

As discussed above, the four development areas which comprise the project site total 410 acres in size, which is a smaller area than the collective size of the parcels that provide the development area; please see Section 2.2.1 for further discussion of the subdivision.

Figure 4 shows the proposed project's 410-acre development area is zoned for large-parcel agricultural or resource management, with an Agricultural District overlay.

The project site largely overlies the Livermore Valley Groundwater Basin, which is managed by the Zone 7 Water Agency, a wholesale water agency in Alameda County. The water purveyors shown on Figure 3 receive their water supply from Zone 7; the service territory for Zone 7 covers the project site and surrounding area not otherwise covered by water districts shown on Figure 3. The Livermore Valley Groundwater Basin and Zone 7 Water Agency are described below, to provide a background of the region's water supply sources and primary local purveyor. Water supply for the proposed project would be sourced from the underlying groundwater basin, and/or purchased from a local water purveyor and trucked to the site, as discussed in Section 4, *Impact Analysis.*

2.1.1 Livermore Valley Groundwater Basin

The proposed project site and development area overlies the Livermore Valley Groundwater Basin, as shown on Figure 2. The Livermore Valley Groundwater Basin is not adjudicated, and is managed by the Zone 7 Water Agency, which is the designated exclusive Groundwater Sustainability Agency (GSA) in accordance with the Sustainable Groundwater Management Act (SGMA) of 2014. SGMA establishes a framework for local groundwater management and requires local agencies to bring overdrafted basins into balanced levels of pumping and recharge. The DWR uses the California Statewide Groundwater Elevation Model Priority List to rank groundwater basins across the state according to priority levels of High, Medium, Low, or Very Low, and SGMA specifies deadlines for completion of Groundwater Sustainability Plans (GSPs) in order of basin priority. DWR identifies the Livermore Valley Groundwater Basin as a Medium-Priority basin (DWR 2020). In accordance with SGMA, as the GSA for the Livermore Valley Groundwater Basin, Zone 7 is required to prepare a GSP, or an Alternative Plan that is determined by the DWR to meet SGMA's requirements for a GSP, which is a detailed framework for how groundwater basins will reach long-term sustainability. In 2016, Zone 7 adopted an Alternative Plan for the Livermore Valley Groundwater Basin which was approved by the DWR as functionally equivalent to a GSP. Zone 7 is currently preparing a 2022 update to the Alternative Plan. (Zone 7 2016a; Zone 7 2016b)

The Livermore Valley Groundwater Basin spans approximately 69,600 acres (109 square miles) of surface area and underlies portions of Alameda and Contra Costa Counties. The Livermore-Amador Valley, which provides the setting for the Livermore Valley Groundwater Basin, lies about 40 miles east of San Francisco and 30 miles southwest of Stockton within a structural trough of the Diablo Range. The Livermore Valley Groundwater Basin extends from the Pleasanton Ridge east to the Altamont Hills (about 14 miles) and from the Livermore Upland north to the Orinda Upland (about three miles). Additional information on this groundwater basin, as reported in DWR's Bulletin 118, is provided below. (DWR 2004)

Water Bearing Formations. The entire floor of the Livermore Valley and portions of the upland areas on all sides of the valley overlie groundwater-bearing materials. The materials are continental deposits from alluvial fans, outwash plains, and lakes. They include valley-fill materials, the Livermore Formation, and the Tassajara Formation. Under most conditions, the valley-fill and Livermore sediments yield adequate to large quantities of groundwater to all types of wells. The quality of water produced from these formations ranges from poor to excellent, with most waters in the good to excellent range (DWR 2004).

Restrictive Structures. Within the Livermore Valley groundwater basin, faults are the major structural features known to have marked effect on the movement of groundwater. Faults in this region tend to act as barriers to the lateral movement of groundwater. The resulting groundwater levels stand higher on the up-gradient side. The Livermore, Pleasanton and Parks faults act as such barriers, dividing the Quaternary Alluvium into five groundwater subbasins (DWR 2004).

Water Quality. The character of groundwater quality in the Livermore Valley Groundwater Basin is generally sodium cation in the northern extent of the basin, magnesium-sodium as the dominant cation in the western part of the basin near Pleasanton, and magnesium along the eastern portion of the basin beneath Livermore. Nearly the entire basin has bicarbonate as the dominant anion. Total Dissolved Solids (TDS) concentrations range from 300 milligrams per liter (mg/L) to 550 mg/L with an average of 450 mg/L based on analyses from 27 municipal wells (DWR 2004).

Boron is generally the dominant source of groundwater quality impairment in the Livermore Valley Groundwater Basin. Some areas have boron concentrations exceeding 2 mg/L (16 wells of approximately 137 wells sampled in 1982). Boron is generally highest in shallow wells because of marine sediments adjacent to the basin. The most extensive elevated boron concentrations occur in the northeast part of the basin (DWR 2004).

Groundwater Budget. The Zone 7 Water Agency, as part of the Alameda County Flood Control and Water Conservation District, has maintained an annual hydrologic inventory of supply and demand since 1974. The inventory describes the balance between groundwater supply and demand. Under average hydrologic conditions, the groundwater budget is essentially in balance. Groundwater budget inflow components include natural recharge of 10,000 acre-feet (AF), artificial recharge of 10,900 AF, applied water recharge of 1,740 AF, and subsurface inflow of 1,000 AF. Groundwater budget outflow components include urban extraction of 10,290 AF, agricultural extraction of 190 AF, other extraction and evaporation associated with gravel mining operations of 12,620 AF, and subsurface outflow of 540 acre-feet (DWR 2004).

2.1.2 Zone 7 Water Agency

The project site is located within the service territory and management area of the Zone 7 Water Agency, also referred to as "Zone 7". Zone 7 is a division of the Alameda County Flood Control and Water Conservation District and is the primary water wholesaler for the Livermore-Amador Valley. Zone 7 supplies imported treated surface water to four agencies in Alameda County: California Water Service Company – Livermore District; Dublin San Ramon Services District; City of Livermore; and City of Pleasanton. Additionally, Zone 7 owns and maintains approximately 37 miles of local flood control channels, equating to about a third of the Livermore-Amador Valley's flood control system. Zone 7 manages and supplies both imported and local groundwater to its service area. The agency imports raw surface water from the State Water Project (SWP) through the South Bay

Aqueduct (SBA) for treatment, storage, and distribution, as well as for groundwater recharge purposes to improve local groundwater conditions (Zone 7 2015). Additionally, Zone 7 operates 10 municipal supply wells for groundwater access which are distributed throughout the basin. Zone 7 also supplies untreated water for local industry and agriculture (Zone 7 2005).

The SWP is the nation's largest state-built water and power development and conveyance system. The SWP includes approximately 700 miles of aqueduct and conveyance facilities, supplying water to more than 27 million people in northern California, the Bay Area, the San Joaquin Valley, and the central coast and southern portions of California (DWR 2020). Zone 7 receives both direct deliveries and Table A water supplies from the SWP. The SWP is contracted to deliver a maximum of approximately 4.2 million AFY of Table A water to a total of 29 contracting agencies. Table A water is a reference to the amount of water listed in "Table A" of the contract between the SWP and its contractors, which represents the maximum amount of water a contractor may request each year. Zone 7 has an allocation for purchasing up to 80,619 AFY of Table A water from the SWP (DWR 2013). When water supplies are limited, such as during extended drought, SWP deliveries can be curtailed, and water is allocated based on a percentage of full contractual Table A amounts. Zone 7 prepares for single- and multiple-dry year scenarios by storing water imported from the SWP in the Livermore Valley Groundwater Basin through groundwater banking programs (Zone 7 2020b).

Zone 7 is one of Alameda County Flood Control and Water Conservation District's active zones and is therefore included in the County's 2015 Urban Water Management Plan (UWMP). As assessed herein, the project's water supply would either be pumped from the local groundwater basin, or purchased from Zone 7 via one of the four agencies served by Zone 7 (California Water Service Company – Livermore District, Dublin San Ramon Services District, City of Livermore, and City of Pleasanton). For the purposes of this WSA, it is assumed that any water purchased from a local purveyor for the project would be sourced through Zone 7, and therefore this WSA assesses the water supply reliability of the Zone 7 Water Agency as a whole, and does not assess each of the four water purveyors that sources its supply through Zone 7 (and could potentially deliver the project's water supply).

2.2 Description of Project

The proposed project includes a utility-scale solar energy generation and battery energy storage system and a parcel subdivision. The solar facility would generate 100 megawatts (MW) of PV power on approximately 410 developable acres of privately-owned land in unincorporated Alameda County in the North Livermore area (see Figure 1). The project would provide solar power to utility customers by interconnecting to the nearby electricity grid at Pacific Gas and Electric Company's (PG&E) existing Cayetano 230 kilovolt (kV) substation located adjacent and interior to the project site. The project would serve East Bay Clean Energy, Clean Power San Francisco, and/or PG&E customers by providing local generation capacity under a long-term contract. The Applicant proposes to construct, own, and operate the project, and will secure Conditional Use Permits from Alameda County, along with permits from other relevant agencies as required by law.

2.2.1 Project Components

Primary project components, which are discussed in detail in the following section, include the following: parcel subdivision, solar PV system, project substation and gen-ties, energy storage, support facilities and concomitant agricultural uses.

2.2.1.1 Parcel Subdivision

APN 903-0006-001-02 is currently a 536-acre parcel. Approximately 150 acres of the parcel are steeply sloped, and this area is proposed to be subdivided to legally separate it from the real property affiliated with the proposed project development. Four development areas have been identified within the project site totaling approximately 410 acres in size. The four development areas are smaller than the parcels within which they are located, and do not follow the APN boundaries of the four legal parcels that comprise the project site. As noted, the development area for the proposed project is limited to 410 acres, which are comprised of four development areas shown on Figure 1 through Figure 4.

2.2.1.2 Solar Photovoltaic System

The project's individual PV modules would be arranged in rows onto a single-axis tracker racking system, which would in turn be affixed to steel piles. Each row (or array) would track the sun during the day, from east to west, to optimize power generation of the facility. The arrays would be connected by low-voltage underground or above-ground electrical wiring to a central inverter station or to string inverters located throughout the facility, where the electricity would be converted from direct current (DC) to alternating current (AC). The system would then step up the voltage of the electricity to a medium voltage (MV) of 34.5 kV (or lower suitable voltage) to match the collection system voltage. The power output from the inverter station would be conveyed to the on-site substation via collection cables. Medium-voltage lines would be buried for a majority of their length, but would emerge above-ground and be mounted on up to two overhead wooden utility poles on either side of Manning Avenue and up to 20 additional wooden poles to cross Cayetano Creek and its tributaries, to cross an access driveway, and where a connection to the substation must be overhead.

In order to maintain efficiency of the PV panels, they would be cleaned of accumulated dust and debris annually. Operational water demands associated with operation and maintenance of the PV panels are described in Section 2.3.2.

2.2.1.3 Project Substation and Gen-Ties

The project substation would provide the necessary circuit breakers, switches, protection relays, and other necessary equipment to reliably and safely protect the electrical infrastructure. The substation would step up the MV collected energy to the interconnection voltage via one or more step up transformers. The substation would meter and project the energy pursuant to the Interconnection Agreement and Power Purchase Agreement(s) with the utility and off-taker(s), respectively. The substation would occupy an approximately 41,600-square-foot area (approximately one acre).

From the substation(s), power would be transmitted to the existing PG&E Cayetano Substation via overhead and/or underground generation-transmission (gen-tie) line(s). The northern section of the project site (north of Manning Road) would be electrically connected to the central section via medium-voltage distribution lines. Medium voltage distribution line would be routed either overhead or underground.

No water demand is associated with operation of the substation and gen-ties.

2.2.1.4 Energy Storage

A five-acre lithium-ion battery storage system would be located on site adjacent to the west of the PG&E Cayetano Substation (See Figure 3-1). The battery storage system would be designed to accept between 75 and 100 MW of system charging, and subsequently dispatch stored electricity during times of peak demand. The system would either be housed in electrical containers or in up to four 100-foot by 180-foot buildings. Various sizes and numbers of electrical enclosures would be used depending on the final battery vendor selected. Up to 50 large electrical enclosures or up to 1,000 small electrical enclosures would be clustered to make up the battery storage system. Low-voltage wiring from battery enclosures would be underground and converted as a bi-directional inverter station and transformed at the shared transformer.

No water demand is associated with operation of energy storage.

2.2.1.5 Support Facilities

Support facilities for the proposed project include: an operations and maintenance (O&M) building with electrical controls; project entrances and internal driveways; fences, lighting and signage. Each of these support facility components is described below.

O&M Building and Electrical Controls

The project would include the construction and maintenance of one O&M building, with a footprint measuring approximately 400 square feet (approximately 20 feet by 20 feet and 15 feet high at its tallest point). The building would accommodate up to four permanent operation and maintenance staff. The building would be plumbed. Water would be stored in a tank and filled on an as-needed basis. Waste would be held in a tank system and removed routinely.

In addition, the O&M building would include a meteorological station which would collect site-specific weather data. A fiber optic telecommunications line required by the interconnecting utility would be integrated with the gen-tie line. An electrical control enclosure would be included on site for the operations electrician to monitor and manage the system.

Water demands associated with the O&M building are described in Section 2.3.2.

Project Entrances and Internal Driveways

Access to the project site would be provided via all-weather, rocked driveway aprons at four access points along North Manning Road, two access points along North Livermore Avenue and one access point along Hartman Road as shown on the site plan. The project entrances would be designed and constructed in accordance with the Alameda County Improvement Standards.

Internal access roads and narrower pathways within the fence line would provide access for routine maintenance of the system. The primary internal access roads would be designed by a licensed civil engineer to ensure all-weather access by emergency response vehicles, including large fire apparatus. Pending final geotechnical and hydrological evaluations, the primary access roads would be designed to be 16 feet wide and constructed with up to 8 inches of aggregate base or simply compacted soil if soil stability conditions allow. Banked corners and periodic three-point turnaround locations would ensure that large fire trucks may navigate the site safely. The narrower, inter-array pathways would be constructed of compacted dirt and be accessible by smaller maintenance vehicles.

No water demand is associated with project entrances and internal driveways.

Fences, Lighting, Signage

The project components would be enclosed by security fencing. The fencing would be seven feet high. The fence would be set back from the property line at least 50 feet. Locked gates at the project entrances would control ingress/egress.

Shielded, downward directional security lighting would be located at the control enclosure and O&M building for emergency repairs. Night lighting would not be required except during scheduled maintenance periods and emergency repairs.

Signage would be limited to what is required by the interconnecting utility and County and would conform to County guidelines.

No water demand is associated with fencing, lighting, and signage.

2.2.1.6 Concomitant Agricultural Uses

The project applicant would maintain a majority of the site in limited agricultural operation for the duration of the life of the solar facility in a concomitant, or naturally accompanying, manner. Solar facilities have a minimal development footprint, which allows for concomitant sheep grazing. Because the solar panels (modules) are installed on a system of racks, the ground below the modules remains undeveloped.

Agrivoltaic operations were considered for the proposed project site, wherein PV arrays would be raised high enough and spaced in such a way that crops could be grown around and beneath the panels; such operations were determined to be infeasible for the proposed project, due to limited access to irrigation water. As discussed in Section 2.3, *Project Water Demands*, the project would include a short-term demand for irrigation water to establish native and drought-resistant landscaping plants; such plants would be fully established within a maximum period of three years, at which time irrigation on the project site would cease.

Additional areas within the project site include grassy areas between the rows and undeveloped portions of the site that will remain as open space for the life of the project. The undeveloped areas would be available for sheep grazing and may be intermittently grazed or left fallow. Pollinator-friendly plant species would be used in landscaping and seed mixes to promote honeybee forage. Grazing would likely be confined to a two-month period in the late spring and early summer, after the primary blooming period of on-site vegetation, thus allowing for pollinator foraging prior to removal of vegetation by the sheep. It is anticipated that up to 820 sheep would graze on site annually, though the exact number and the exact window of grazing would vary from year to year based on weather conditions and forage productivity.

Water demands associated with the concomitant agricultural uses are described in Section 2.3.2.

2.2.2 Construction

The duration of project construction would be approximately nine months. Project construction activities would consist of site preparation, installation of interconnection facilities and battery storage system, cable installation, pile and skid installation, tracker and module installation, and lastly, site cleanup. Project construction would be completed in four phases, including Phase 1 site preparation (30 days), Phase 2 PV installation (150 days), Phase 3 electrical and gen-tie installation (75 days), and Phase 4 general construction operations, site clean-up and restoration (175 days).

Phase 4 spans the entire construction duration. It is anticipated that the construction of Phases 2, 3, and 4 would overlap for approximately 10 weeks duration. Work for all phases would be conducted Monday through Friday between the hours of 8:00 a.m. and 5:00 p.m. All construction staging areas would be located within the development footprint of the solar facility.

Water demands associated with construction are described in Section 2.3.1.

2.2.3 Operation and Maintenance

The solar facility is anticipated to have an operating life of 50 years (please see Section 2.3.2, *Operational Water Assumptions,* and Section 3.6, *Are There Sufficient Supplies to Serve the Project Over the Next 20 Years?*). This lifespan is 30 years longer than the 20-year projection required by California Water Code (as amended by SB 610) to be considered in a WSA. However, for the purposes of full disclosure and to provide a conservative analysis, this WSA presents all anticipated water demands of the project over the entirety of its anticipated lifespan, including for the final decommissioning or repowering phase.

During the O&M phase, the proposed project would passively generate power during daylight hours seven days per week, 365 days per year. The facility would be tested, maintained, and inspected daily by a remotely dispatched staff of approximately four technicians. The energy storage system would store and dispatch power during both daylight and non-daylight hours as required by grid operators year-round. Regular O&M activities include:

- Solar module washing (once per year)
- Vegetation, weed, and pest management (as needed)
- Agricultural use of the site (sheep grazing - continuous)
- Security (continuous)
- Responding to automated electronic alerts based on monitored data, including actual versus expected tolerances for system output and other key performance metrics (continuous)
- Occasional equipment repair and replacement (as needed)
- Communicating with customers, transmission system operators, and other entities involved in facility operations (as needed)

While daily monitoring of the site would occur remotely, up to four staff could be on the site at a time for as needed facility maintenance and repairs. Once per year, up to 12 workers could be on site to support annual module washing activities. As discussed further below, in Section 2.3.2, solar module washing would include the use of an on-site water truck and high-pressure washer to clean dust accumulated on the solar modules. It is conservatively assumed that an on-site water treatment system would also be implemented to treat locally-sourced groundwater for panel-washing purposes during the O&M period.

The project operations would promote continued agricultural use of the project site, through both sheep grazing and apiary activities, in portions of the site where such uses are compatible with the proposed solar operations. Continued agricultural use of the site would be limited to sheep grazing and apiary uses, and would not include irrigated agriculture (temporary irrigation to establish landscape plants is not considered agriculture). The project site's vegetative cover would generally be kept low to prevent shading of solar panels, minimize buildup of combustible fuel loads which would result in a fire hazard, and to facilitate emergency and maintenance vehicle access. This would be accomplished by using low-growing vegetation species on the site and maintaining vegetation with grazing during the growing season (January through May). Mechanical methods for vegetation management such as mowing, trimming, and hoeing would be implemented as needed to complement the effects of grazing. ~~The project would not include irrigation.~~

Water demands associated with project O&M are described in Section 2.3.2.

2.2.4 Decommissioning or Repowering

Once the functional operating life of the project is over, the facility would either be decommissioned to remove project components and restore the site, or it would be repowered to continue providing solar energy generation and storage. Project decommissioning would occur in accordance with the expiration of the Conditional Use Permit and would involve the removal of above-grade facilities, buried electrical conduit, and all concrete foundations in accordance with a Decommissioning Plan. Equipment would be repurposed off-site, recycled, or disposed of in a landfill as appropriate. It is anticipated that repowering would also require ground-disturbing activities to replace or upgrade project components that were not otherwise replaced or upgraded as part of regular O&M for the project.

If repowering is pursued instead of decommissioning, the facility owner would be required to obtain current permits and approvals for the project, including renewed analysis under the California Environmental Quality Act (CEQA). As described above, the project's operational lifespan is anticipated to be 50 years; it is realistically assumed that resource permits will be updated as needed over the lifetime of the project.

Water demands associated with repowering or decommissioning are described in Section 2.3.3.

2.3 Project Water Demands

The proposed project's water demands include temporary construction activities, temporary irrigation support for landscaping establishment, ~~and~~ long-term O&M activities, ~~as well as~~and temporary decommissioning or repowering activities. For the purposes of this WSA, it is assumed the project's water supply will be obtained from on-site groundwater wells in the Livermore Valley Groundwater Basin, and/or water purchased from an off-site water purveyor and trucked to the project site. As described in Section 2.1.2, *Zone 7 Water Agency*, for the purposes of this WSA, it is assumed that any water purchased from a local purveyor for use on the project site would be sourced through Zone 7, as the primary wholesale water distributer for this portion of Alameda County.

Table 1 details the project's estimated water demands during the construction, landscaping establishment, O&M, and decommissioning/repowering phases. A suite of assumptions were developed to inform the estimates provided in Table 1; these assumptions are detailed in notes at the end of the table, and in Sections 2.3.1 through 2.3.3. As discussed below, in order to identify and characterize all potential water supply impacts of the project, and provide a reasonable assessment of water supply availability and reliability, conservative assumptions were applied to each of the project's water-demanding activities.

Table 1 Project Water Demands

Project Phase (Duration of Phase)	Water Demand Annual (AFY)	Water Demand Total (acre-feet)
Construction (9 months [0.75 year])	**45.6~~3.95~~[1]**	**42.00**
Dust Suppression	42.00	42.00
Operation & Maintenance (50 years)[2]	**14.37 (Years 1-3)** **12.85 (Years 4-50)**	**647~~2~~.~~50~~06**
Temporary Irrigation[3]	1.52[4]	4.56
Panel Washing[5]	5.00	250.00
Panel Washing Concentrate[6]	5.00	250.00
Fire Suppression (stored on site for emergency response)[7]	0.04	2.00
Water for Livestock Grazing[8]	2.75	137.50
O&M Building	0.06	3.00
Decommissioning or Repowering (6 months [0.5 year])[9]	**45.93[10]**	**42.00**
Dust Suppression	42.00	42.00
Total Demand	**Not Applicable**	**731~~26~~.~~5~~06**
Amortized Demand[11]	***~~13.97~~14.06 AFY***	

[1] Annual Construction Water: The construction period is limited to nine months, during which the project's full construction water demand of 42 acre-feet would occur~~. This equates to approximately 4.7 acre-feet per month during the nine-month construction period (42 acre-feet / nine months = 4.7 acre-feet per month).~~ In order to quantify realistic water demands on an annual basis, this table assumes that three months of project O&M would occur during the same year as project construction. The project's first three years of O&M would include irrigation water for plant establishment, and water demand for these first three years is accordingly higher than in subsequent years of O&M. Annual O&M water demand during the first three years would be 14.37 AFY, or 1.2 acre-feet per month, which equates to 3.6 acre-feet for the last three months of the year during project construction ~~would occur over the first nine months. shows annual water demand associated with the first year of the project, which consists of nine months of construction plus three months of operation and maintenance (0.65 acre-feet per month). Accordingly~~Therefore, the project's annual water demand for the year during which construction would occur is approximately ~~43.95~~45.6 acre-feet.

[2] O&M Project Phase: The project applicant anticipates the project's operational lifetime being 50 years, which is 30 years longer than the 20-year projection required by California Water Code (as amended by SB 610) to be considered in a WSA. However, for the purposes of full disclosure and to provide a conservative analysis, this table presents all anticipated water demands of the project over the entirety of its anticipated lifespan of 50 years. In addition, the project applicant has determined that operational water demands for the project would be approximately 5 AFY; this estimate has been expanded as described below, in order to provide a conservative analysis for the purposes of the WSA, and to address present uncertainty regarding the ultimate source of water for the project (local groundwater that may be high in TDS content, and/or imported surface water).

[3] Temporary Irrigation: Water for landscaping would be stored in five 25,000-gallon storage tanks, equating to 125,000 gallons total, or approximately 0.38 acre-feet. It is conservatively assumed that the irrigation water tanks would be refilled quarterly, or once every three months. As such, total water demand for temporary irrigation would be approximately 1.52 AFY, which equates to 4.56 acre-feet over three years.

[4] Annual Irrigation Water Demand: Irrigation for plant establishment would be conducted for up to three years following completion of construction, after which time irrigation would cease and landscape plants would be sufficiently established to be supported by the natural environment.

[5] Panel Washing: An industry standard assumption of 0.05 acre-foot of water per MW of solar power generation was applied to the project. The project would generate up to 100 MW of solar energy; accordingly, panel washing would require approximately 5 acre-feet per washing, which is consistent with the operational water demand identified by the project applicant.

[6] Panel Washing Concentrate: The brine discharge water stream produced as a byproduct of the desalination and deionization process. It is conservatively assumed that the recovery rate for a treatment system is 50 percent, such that in order to produce 5 acre-feet of clean/treated water for use in panel washing, 10 acre-feet would need to be pumped from the groundwater basin. This factor is included in potential water demands of the project in order to account for uncertainty in the water source to be used for the project; if groundwater is used as the sole water source for the project, as opposed to surface water purchased from a local purveyor, or a combination of groundwater and imported surface water, it is possible that TDS concentrations in the groundwater would require

treatment. Therefore, this analysis conservatively accounts for the water demands associated with the waste stream from a treatment system. Please see Section 2.3.2 under "Solar PV Panel Washing" for further discussion.

[7] Fire Suppression: Consistent with requirements of similar solar projects and adjusted for the size of the project, a standard of 0.04 AFY was applied to the project.

[8] Water for Livestock Grazing: An industry standard assumption of two sheep per acre and three gallons per sheep was applied to the project (Wikes 2016; Schoenian 2008). Please see Section 2.3.2, under "Water for Livestock Grazing" for further discussion of these assumptions regarding water for livestock grazing.

[9] Decommissioning Water: The project's decommissioning or repowering period is estimated to require approximately six months. If the project is repowered rather than being decommissioned, it is assumed that additional CEQA review and permitting would be conducted at that time, and all water demands associated with operating the project after repowering would be assessed at that time, in a new or updated WSA. Therefore, for the purposes of this analysis, potential water demands associated with operating the project after repowering are not quantified (which will include a new WSA or comparable analysis at that time). Due to the project's lifetime being anticipated at 50 years, it would be highly speculative to characterize water supply or reliability conditions at this time.

[10] Decommissioning Annual Projection: Similar to the annual construction water calculation, the decommissioning or repowering period is limited to six months, during which the project's full construction water demand of 42 acre-feet would occur. This equates to approximately 7 acre-feet per month during the six-month construction period (42 acre-feet / 6 months = 7 acre-feet per month). In order to quantify realistic water demands on an annual basis, this table shows annual water demand associated with the last year of the project, which consists of six months of decommissioning or repowering (water demand of 7 acre-feet per month) plus six months of operation and maintenance (0.65 acre-feet per month). Accordingly, the project's annual water demand for the year during which decommissioning or repowering would occur is approximately 45.93 AFY.

[11] Amortized Demand: This is the project's total estimated water demand averaged over all phases of the project, accounting for 52 years to capture construction and decommissioning or repowering, in addition to 50 years of operation and maintenance. Accordingly, the project's amortized water demand is approximately ~~13.97~~14.06 AFY.

AFY= acre-feet per year

MW= megawatt

As shown in Table 1, the project's amortized annual water demand is ~~13.97~~14.06 AFY, based upon the suite of conservative assumptions listed in footnotes to the table. The amortized water demand is the project's average annual water demand over all project phases, accounting for the construction and decommissioning/repowering phases, as well as the 50-year O&M phase. The amortized water demand is often considered a useful tool in assessing long-term water supply availability, particularly for long projections such as the proposed project's 50-year lifespan. However, for the purposes of this WSA, water supply availability is considered both for each phase's anticipated annual demand, as well as the project's cumulative total demand.

Water demands associated with each project phase are discussed in detail in Sections 2.3.1 through 2.3.3. Water supplies that would be used to meet the project's water demands are discussed in Section 4, *Water Supply Reliability Analysis.*

2.3.1 Construction Water Assumptions

As shown in Table 1, during the project's construction period of approximately nine months, the project would use approximately 42 acre-feet of water for dust suppression. In order to provide annual water demand projections, Table 1 shows the project's water demand during the first full year of the project, which includes nine month of construction plus three months of O&M, assuming the project is charged and operational immediately upon the completion of construction. Construction water uses would primarily be for dust suppression during the nine-month construction period.

The following conservative assumptions were developed for the purposes of this WSA:

- Water supply for project construction would be pumped from on- or off-site groundwater well(s) within the Livermore Valley Groundwater Basin, or it would be purchased from Zone 7 or one of the four purveyors that receive imported surface water supply from Zone 7 (California

Water Service Company – Livermore District, Dublin San Ramon Services District, City of Livermore, and City of Pleasanton);

- If construction water is pumped from an off-site groundwater well, it is assumed such a well would source water from the Livermore Valley Groundwater Basin;
- Drinking water for construction personnel would be provided as bottled water, and would be delivered to the project site via truck;
- Restroom facilities would be provided as portable units to be serviced by licensed providers, and would not require an on-site water source;
- Construction water uses would not require an on-site water quality treatment system, as high TDS concentrations in the local groundwater do not adversely affect the water's effectiveness in use for on-site dust suppression; and
- Construction water demands do not include water for concrete production, because it is assumed that concrete for project features such as but not limited to the footings for solar PV modules would be purchased from a local retailer that would provide pre-mixed concrete, and the retailer would therefore be responsible for ensuring the water supply availability for production of their product.

2.3.2 Operational Water Assumptions

During the project's 50-year O&M period, water demands include annual washing of the solar PV panels to maintain efficiency, potential wastewater associated with water treatment, potential on-site emergency fire suppression storage water, operation of the project's O&M building, and water provided in on-site troughs for sheep grazing. The applicant has determined the project operational water demand would be up to 5 AFY of water, which is consistent with water demands associated with similar solar power developments in similar environments, and is the water demand used to inform the CEQA analysis provided in the project's Environmental Impact Report, which this WSA is provided as an appendix to. For the purposes of this WSA, additional assumptions were developed to provide a conservative analysis respective to the long-term water supply availability and reliability for the project. Based upon these additional assumptions, which are detailed below as well as in the notes to Table 1, this WSA conservatively assesses an operational water demand of up to 14.37 AFY over the first three years of project O&M, and up to 12.85 AFY for each year following the first three years.

Temporary Irrigation

The project would establish landscaping consisting of climate-appropriate drought tolerant plants, to provide visual screening and honeybee forage. These plants would be supported with irrigation water for up to three years, allowing the plants to establish root systems substantial enough to subsist on water provided by the natural environment. Irrigation on the project site would cease once it is determined that landscape plants are sufficiently established, which is conservatively estimated to require a maximum of three years after completion of construction.

Irrigation water for plant establishment would be stored in five 25,000-gallon storage tanks, equating to 125,000 gallons total, or approximately 0.38 acre-feet. It is conservatively assumed that the irrigation water tanks would be refilled quarterly, or once every three months. As such, total water use for temporary irrigation would be approximately 1.52 AFY, which equates to a total of 4.56 acre-feet over three years.

~~Solar PV~~ Panel Washing

In order to maintain energy production efficiency of the PV solar panels, they will be washed with water once per year, to clean accumulated dust from the panel surfaces. This typically requires the wash water to have low concentrations of TDS, or total dissolved solids, so that salts in the wash water aren't deposited on the panel surfaces, which would in turn decrease efficiency of the panels. As discussed throughout this analysis, it is assumed the project's water would be sourced from on- or off-site groundwater wells, or via imported surface water purchased from a local purveyor. In order to address this uncertainty in the project's water source, and to provide a conservative analysis for the purposes of this WSA, it is assumed that the project's water supply will need to be treated to lower TDS concentration prior to use as panel washing water. It is further assumed that the treatment method employed would be an on-site combined reverse osmosis (RO) and deionization (DI) system.

Industrial RO systems typically run between 50 and 85 percent recovery, depending on the feed water characteristics and other design considerations (PureTec Industrial Water 2019). Recovery is the amount of water permeated per unit time, typically measured in gallons per minute (gpm) and expressed as a percentage of the source water flow rate. In other words, an 85 percent recovery rate means that 85 percent of the amount of water fed into a system is produced as treated water, and 15 percent is produced as concentrate for disposal. Source water that has higher concentrations of water quality constituents results in lower recovery rates from a RO/DI system. In order to provide a conservative analysis for the purposes of this WSA, it is assumed that a potential RO/DI system would have a recovery rate of approximately 50 percent. As such, for every 100 gallons of source water that enters the system, 50 gallons would exit the system as low-TDS wash water, and 50 gallons would exit the system as a concentrated brine for off-site transport to an approved waste disposal facility.

The solar PV panel washing analysis relies on an assumed water demand rate of 0.05 acre-feet of water per year per MW, based on other utility-scale solar PV projects in California (Sandia National Laboratories 2013). As discussed in Section 2.2, *Description of Project*, the project is anticipated to produce up to 100 MW. Therefore, operational requirements for solar PV panel washing would be approximately 5 AFY. In addition, based on the conservative 50 percent recovery rate for on-site water treatment, the project's operational water demand has been expanded to capture a potential treatment system, should water treatment become necessary for the project. As noted following Table 1, above, the potential for water treatment is included in this WSA analysis to account for the present uncertainty regarding the project's water source, and to address the potential for the project receiving its full water supply from local groundwater, as opposed to imported surface water or a combination of groundwater and surface water. Accordingly, water demand for panel washing would be approximately 10 AFY, which includes 5 AFY for the wash water plus 5 AFY for wastewater produced by a potential RO/DI system[1].

O&M of the project would require up to approximately 10 AFY of water for panel washing and potential water treatment.

[1] Assuming a 50 percent recovery rate for water treatment, 10 acre-feet of raw water would need to enter the treatment system, so that 5 acre-feet (50 percent of 10 acre-feet) of clean (treated) water will be produced for use in panel washing operations.

Fire Suppression

For the purposes of this WSA, it is conservatively anticipated that the Alameda County Fire Department may recommend as a condition of approval of the project that a supply of emergency fire suppression water is stored on the project site for as needed use. In order to capture that water in this analysis, the CEQA analyses for other recent solar energy developments were reviewed, and it was determined that approximately 28.7 gallons/acre is a typical quantity of fire suppression water stored on site for emergency purposes. Accordingly, this factor was applied to the project's proposed 410 acres of development area, for an estimated total of 0.04 acre-feet of water for emergency fire suppression ~~water that would be stored on the project site for emergency uses as needed~~per year.

The project's fire suppression water would be contained in an on-site storage tank sized for up to 250,000 gallons of water, or approximately 0.77 acre-feet. This size is in excess of the project's required 0.04 AFY for emergency fire suppression, allowing for the storage of excess water not used during a given calendar year, while ensuring that sufficient water remains in storage on site to respond to emergencies as needed.

~~Additionally, although i~~It is unlikely that O&M of the project would require use of the full 0.04 acre-feet of stored fire suppression water every year; however, in the interest of providing a conservative analysis for this WSA, it is assumed that the 0.04 acre-feet of water would be replaced every year. ~~the entire amount of fire suppression water stored on site would actually be needed for fire suppression on an annual basis, for the purposes of this analysis it is conservatively assumed the full amount of fire suppression water would be replaced annually. Therefore, this WSA assumes that O&M phase water demands include 0.04 AFY of water for fire suppression, as a safety precaution.~~ Excess water may ~~also~~ be used for dust suppression as needed. The project would not fill the 250,000-gallon storage tank to capacity on an annual basis; rather, the excess size of the storage tank provides flexibility in how and when excess fire suppression water may be stored on the project site. ~~during project operation and maintenance activities.~~

Water for Livestock Grazing

The project site would be used for sheep grazing during O&M of the project, to maintain on site vegetation and provide for continued agricultural uses of the site. It is not known at this time whether the sheep owner(s) would provide water for grazing, or if the project applicant would provide water for grazing. Therefore, for the purposes of this WSA, it is conservatively assumed that the project applicant would fill water troughs on the project site, using the same water source(s) as used for other project components, for watering of the sheep.

The amount of water required to support sheep grazing depends upon the number of sheep present on site. The number of sheep that can be supported by any given parcel varies depending upon the rate and type of precipitation and the quality of local soils; however, a general rule of thumb is that one acre of land can support two grazing sheep (Wikes 2016). Assuming two sheep per acre, across the proposed project's 410 acres of development area, the project site could potentially support up to 820 sheep. This is a highly conservative estimate, as the number of sheep per acre does not account for the land being cohabitated by sheep and solar; in actuality, the number of sheep that may be supported by the project site after the proposed project is operational will be lower than 820. Nevertheless, 820 sheep are used as the maximum population for the purposes of this WSA, to provide a conservative analysis that captures all potential water demands of the project.

Sheep typically require two to three gallons of water per day per head (Schoenian 2008). Conservatively assuming that the project site would support 820 head of sheep, and each head would require three gallons of water per day, operational water demand of the project for sheep watering would be approximately 2,460 gallons per day, or 2.75 AFY. This estimate is highly conservative, because it assumes sheep would be present on the project site throughout the year; however, it is most likely that sheep grazing on the project site would be limited to a two-month period in the late spring and early summer, after the primary blooming period of on-site vegetation. The actual number of sheep and the exact window of grazing would vary from year to year based on weather conditions and forage productivity.

~~The project does not propose irrigation and would not require any water for irrigation.~~

O&M Building

The project includes one O&M building sized approximately 20 feet by 20 feet. The adjusted water demand factor for a commercial land use type from Dublin San Ramon Service District, a nearby water district in Alameda County, is 0.14 gallon per day per square foot (Dublin San Ramon Services District 2016). The O&M building totals approximately 400 square feet. Accordingly, annual water demand associated with the O&M building is estimated to be approximately 56 gallons per day, which equates to approximately 0.06 AFY. One 5,000-gallon water storage tank would be installed on site near the O&M building, and would be filled on a quarterly basis, equating to 20,000 gallons per year, or approximately 0.06 AFY, which is the estimated demand for the O&M building. During project operation, sanitary waste produced at the O&M building would be held in a tank system and regularly removed and transported via truck to an approved off-site disposal facility.

2.3.3 Decommissioning or Repowering Water Assumptions

Water would be required for dust control during decommissioning or repowering activities. For the purposes of this WSA, it is broadly assumed that water demands would be comparable between the decommissioning/repowering phase and the construction phase, and that such water demands would primarily be associated with dust abatement. As such, it is assumed that approximately 42 acre-feet of water would be required during the project's decommissioning/ repowering phase. As mentioned previously, the decommissioning or repowering phase would occur over approximately six months. Similar to the calculation of construction-period water demands as discussed above in Section 2.3.1, in order to be conservative for the purposes of this analysis, and to provide an estimate of maximum annual water demand for the year during which decommissioning or repowering would occur, it is assumed that during the project's decommissioning/repowering year, decommissioning/repowering activities would account for six months, and operation and maintenance activities would account for six months. Accordingly, during the project's final year, approximately 45.93 acre-feet of water would be required for O&M and decommissioning or repowering. Please see Section 2.3.1, *Construction Water Assumptions,* for additional assumptions applied to the project's water demands for decommissioning/repowering.

3 Senate Bill 610 Applicability

This regulatory setting discussion is specific to the assessment of water supply availability, as required by SB 610 which became effective in 2002 and amended California Water Code to require detailed analysis of water supply availability for certain types of development projects. The primary purpose of SB 610 is to improve the linkage between water and land use planning by ensuring greater communication between water providers and local planning agencies, and guaranteeing land use decisions for certain large development projects are fully informed as to whether sufficient water supplies are available to meet project demands. SB 610 requires the preparation of a WSA for a project that is subject to CEQA and meets certain requirements, each of which is discussed below.

California Water Code, as amended by SB 610, requires a WSA address the following questions:

- Is there a public water system that will service the proposed project? (see Section 3.3)
- Is there a current Urban Water Management Plan that accounts for the project demand? (see Section 3.4)
- Is groundwater a component of the supplies for the project? (see Section 3.5)
- Are there sufficient supplies to serve the project over the next twenty years? (see Section 3.6)

The primary question to be answered in a WSA is:

> *Will the total projected water supplies available during normal, single dry, and multiple dry water years during a 20-year projection meet the projected water demand of the proposed project, in addition to existing and planned future uses of the identified water supplies, including agricultural and manufacturing uses?*

The following sections address the SB 610 WSA questions as they relate to the project.

3.1 Is the Proposed Project Subject to CEQA?

California Water Code Section 10910(a) states any city or county that determines a project, as defined in Section 10912, is subject to CEQA must prepare a WSA. Projects requiring an issuance of a discretionary permit by a public agency, projects undertaken by a public agency, and projects funded by a public agency are subject to CEQA.

The project requires issuance of discretionary permits, consisting of a Conditional Use Permit and parcel subdivision from Alameda County. Therefore, the project is subject to CEQA.

3.2 Is the Proposed Project a "Project" Under SB 610?

California Water Code, as amended by SB 610, states any proposed action that meets the definition of "project" under SB 610 is required to prepare a WSA to demonstrate whether sufficient water supplies are available to meet requirements of the project under normal and drought conditions. Water Code Section 10912 defines a "project" as any one of six different development types with certain water use requirements. Each identified development type and associated water requirements is addressed below.

3.2.1 Residential Development

A proposed residential development of more than 500 dwelling units is defined as a "project" under SB 610.

The project is not a residential development.

3.2.2 Shopping Center or Business Establishment

A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space is defined as a "project" under SB 610.

The project is not a shopping center or business establishment.

3.2.3 Commercial Office Building

A proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space is defined as a "project" under SB 610.

The project is not a commercial office building.

3.2.4 Hotel or Motel

A proposed hotel or motel, or both, having more than 500 rooms is defined as a "project" under SB 610.

The project is not a hotel or motel.

3.2.5 Industrial, Manufacturing, or Processing Plant or Industrial Park

A proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area is defined as a "project" under SB 610.

The project is not a manufacturing plant, processing plant, or industrial park. However, it is an industrial facility occupying more than 40 acres and therefore this analysis conservatively determined the project to be considered a "project" under Water Code Section 10912. Therefore, this WSA has been prepared to satisfy the requirements of SB 610.

3.3 Is There a Public Water System that Will Serve the Proposed Project?

California Water Code Section 10912 defines a "public water system" as a system that has 3,000 or more service connections and provides piped water to the public for human consumption. The project would source water from an on- or off-site groundwater well pumping from the Livermore Valley Groundwater Basin, and/or imported surface water purchased from the Zone 7 Water Agency as the County of Alameda's wholesaler of State Water Project water for the project area.

There is not a public water system that will serve the project.

3.4 Is There a Current UWMP that Accounts for the Project Demand?

California's urban water suppliers prepare UWMPs to support long-term resource planning and ensure adequate water supplies. Every urban water supplier that either delivers more than 3,000 AFY of water annually or serves more than 3,000 connections is required to assess the reliability of its water sources over a 20-year period under normal, single-dry, and multiple-dry year scenarios. UWMPs must be updated and submitted to DWR every five years for review and approval (DWR 2016).

Zone 7 has a current UWMP in place. The project would transition the project site from the agricultural land uses that were planned for in the UWMP, to solar/commercial uses, which are generally less water intensive than agricultural uses. As a result, water demand for the project site is likely over-estimated in the current (2015) UWMP, when the planned water demands for agricultural land uses are compared to the proposed water demands for solar development.

3.5 Is Groundwater a Component of the Supplies for the Project?

The project's water demands may be met in part or in full by groundwater produced from the underlying Livermore Valley Groundwater Basin.

3.6 Are There Sufficient Supplies to Serve the Project Over the Next Twenty Years?

The sufficiency of water supplies identified as potential sources to serve the project is assessed in Section 4.2, *Water Analysis*. The information and analysis provided in this WSA support the conclusion that there are sufficient water supplies available in the project area to meet the needs of the project over the next 20 years (the assessment period required per SB 610 for a WSA). Conclusions associated with the sufficiency of available water supplies are discussed in Section 5, *Conclusions*.

4 Water Supply Reliability Analysis

This section provides analysis of the availability and reliability of all potential water supply sources that may be used to meet the water demands of the proposed project, including groundwater pumped from the Livermore Valley Groundwater Basin and imported surface water purchased from Zone 7 through one of the four local water purveyors that receive imported surface water supply from Zone 7 (California Water Service Company – Livermore District, Dublin San Ramon Services District, City of Livermore, and City of Pleasanton). Background information is provided in Section 2.1, *Location and Water Supply Setting.*

4.1 Conjunctive Use Management

This section collectively addresses the management of local groundwater resources in the Livermore Valley Groundwater Basin, and the management of imported surface water provided through Zone 7, rather than providing a separate analysis of each resource. This is an appropriate approach for this WSA, because groundwater and surface water resources in the project area are conjunctively managed, meaning that they are managed together toward the purpose of long-term water supply reliability. This includes groundwater banking programs that facilitate the storage of excess water during surplus years, for pumping and use during dry years when imported surface water supplies are typically curtailed. The following sections provide discussion of these management efforts as they relate to water supply reliability.

4.1.1 Groundwater Management Plan

Groundwater Management Plans (GWMPs) were initially required to be developed and submitted to DWR under legislation including Assembly Bill 359, Assembly Bill 3030, and SB 1938. The Livermore-Amador Valley Groundwater Basin GWMP was developed in 2005 to compile and document all of Zone 7's current groundwater management policies and programs in a single document and to satisfy the requirements set forth in the California Groundwater Management Planning Act (Water Code Sections 10750, et seq.). The GWMP provides a detailed description of Zone 7's groundwater management practices and a description of the regulatory setting that involves a GWMP. In addition, the GWMP contains the Zone 7 management plan elements, which involve the GWMP goals, basin management objectives, and stakeholder involvement. A large portion of the document addresses monitoring programs and protocols related to groundwater and conjunctive use of regional water supplies, ranging from groundwater level monitoring to recharge monitoring to groundwater quality monitoring to climatological monitoring to surface water flow and surface water quality monitoring.

With adoption of SGMA in 2014, GWMP requirements were largely replaced by GSPs, discussed in detail below. Per SGMA, no new GWMPs were adopted in Medium- or High-priority basins after January 1, 2015, and existing GWMPs remain in effect until GSPs are adopted in their place (for Medium- or High-priority basins). The Livermore Valley Groundwater Basin is designated as a Medium-priority basin, and is therefore subject to SGMA requirements for implementation of a GSP. Because a GWMP was already in place for the Livermore Valley Groundwater Basin at the time of SGMA codification in 2014, Zone 7, as the SGMA GSP for this groundwater basin, applied to the DWR for approval of the GWMP as functionally equivalent to a GSP. The DWR provided this approval, and Zone 7 adopted the GWMP as a SGMA Alternative Plan, discussed below.

4.1.2 Alternative Groundwater Sustainability Plan

In September 2014, California Governor Jerry Brown signed a three-bill package known as SGMA into law. SGMA establishes a framework for local groundwater management and requires local agencies to bring overdrafted basins into balanced levels of pumping and recharge. The California Statewide Groundwater Elevation Model Priority List ranks groundwater basins across the state with assessment rankings of High, Medium, Low, or Very Low. DWR identifies the Livermore Valley Groundwater Basin as a Medium-Priority groundwater basin; and as such is required to prepare either a GSP or an Alternative Plan. Such an Alternative Plan must cover the entire groundwater basin, be functionally equivalent to a GSP, and demonstrate that the entire basin has been operating within its sustainable yield for at least 10 years, where "sustainable yield" is defined by SGMA as the maximum quantity of water (calculated over a base period representative of long-term conditions in the basin and including any temporary surplus) that can be withdrawn annually from a groundwater supply without causing an undesirable result.

Acting as the exclusive GSA for the Livermore Valley Groundwater Basin, Zone 7 has prepared and implemented a SGMA Alternative Plan for the Livermore Valley Groundwater Basin, providing compliance with SGMA and GSP requirements.

4.1.3 Salt and Nutrient Management Plans

The 2004 Salt Management Plan (SMP) includes a cooperative effort to address the increase in TDS observed in some portions of the groundwater basin, and the 2015 Nutrient Management Plan (NMP) was developed as an addendum to the SMP. Together, the NMP and SMP fulfill requirements of a joint Master Water Recycling Permit and the General Water Reuse Order adopted by the San Francisco Bay Regional Water Quality Control Board (RWQCB), and are consistent with the provisions of the State's Recycled Water Policy. Implementation of the SMP and NMP involves ongoing monitoring of nitrate in groundwater and coordination with land use agencies to manage nitrogen loading to the basin. The SMP and NMP also require coordination with Alameda County Environmental Health for development of a Local Agency Management Program for on-site wastewater treatment systems that addresses certain high-nitrate areas.

Salt and nutrient management in the local groundwater basin is essential to long-term water supply reliability, as the usability of any given water supply is determined by its quality. Groundwater banking programs help to manage TDS loading in the basin, for example by diluting higher-TDS areas with injection of surplus surface water supplies.

4.1.4 Urban Water Management Plan

The California Urban Water Planning Act requires urban water suppliers that have 3,000 or more service connections or supply 3,000 or more acre-feet of water per year to develop an UWMP, which is submitted to DWR for review and approval every five years. The UWMP is required to describe and evaluate water deliveries and uses, water supply sources, efficient water uses, demand management measures and water shortage contingency planning. Zone 7 maintains an UWMP for its jurisdiction; the current UWMP was adopted in 2015 and is currently being updated.

Projections for future deliveries of SWP water are provided in the UWMP based on DWR's 2015 update of the State Water Project Delivery Capability Report (DCR), a biennial report to assist SWP contractors and local planners in assessing the near and long-term availability of supplies from the SWP. In the 2015 DCR, DWR provides SWP supply estimates for SWP contractors to use in their planning efforts, including for use in their 2015 UWMPs. The 2015 DCR includes DWR's estimates of

SWP water supply availability under both current and future conditions. Long-term water demand and supply projections from the UWMP are discussed in Section 4.2.

4.2 Water Availability Projections

SB 610 requires that a WSA include the consideration of water supply availability under varying climatic (drought) conditions, including normal [water] year, single-dry year, and multiple-dry year scenarios. The conjunctive use planning information discussed above was used to inform this analysis of supply reliability, which includes review of the ongoing and planned management activities for each water supply source, in addition to analysis of long-range supply reliability projections as applicable to the proposed project. As discussed, the project's water supply may be sourced from an on- or off-site groundwater well in the Livermore Valley Groundwater Basin, or it may be sourced as imported surface water purchased through Zone 7.

As discussed above, there are multiple active groundwater management efforts in place in the Livermore Valley Groundwater Basin, including the GWMP, the SGMA Alternative Plan, and the SMP and NMP. In addition, Zone 7 actively conducts and contributes to groundwater banking operations, both in the Livermore Valley Groundwater Basin, and in groundwater banks in Kern County, as noted below in Table 3 and Table 4. Zone 7 primarily uses groundwater to supplement imported SWP surface water supply during drought years, or to meet the area's water supply needs when the SBA, which conveys SWP water to the region, is out of service due to maintenance or in response to emergency conditions. However, Zone 7's primary purpose in groundwater pumping is typically to contribute to the agency's artificial recharge programs, which store excess surface water supplies in the subsurface during surplus years, for use during dry years. Under the SMP, Zone 7 also conducts strategic groundwater pumping during normal water years, targeting areas of high TDS concentration to help reduce salt loading.

Water supply reliability in the project area is provided via Zone 7's diversified water supply portfolio, which includes local groundwater resources, imported SWP supply, and active groundwater banking programs. This section presents a series of tables with supply availability projections, which are used to inform this WSA's conclusion presented in Section 5. Table 2 illustrates Zone 7's projected extraction values from the Livermore Valley Groundwater Basin through the year 2035, which is the maximum projection range of the current (2015) UWMP.

Table 2 Actual and Projected Artificial Recharge and Groundwater Extraction for 2015-2035 during Normal Water Years

	Actual	Projected: Normal Years	Projected: Normal Years	Projected: Normal Years	Projected: Normal Years	Projected: Normal Years
Amount (Acre-Feet)	2015	2020	2025	2030	2035	2040
Artificial Recharge	4,230	9,200	9,200	9,200	9,200	9,200
Groundwater Extraction	2,056	9,200	9,200	9,200	9,200	9,200

Units in acre-feet per year

Source: Zone 7 2016

As shown in the table above, Zone 7 plans to recharge 9,200 AFY on average to the Livermore Valley Groundwater Basin through the year 2035. This rate of artificial recharge allows Zone 7 to pump an equivalent of 9,200 AFY on average from the Livermore Valley Groundwater Basin. Water supply availability projections for Zone 7 are more quantifiable than for the Livermore Valley Groundwater Basin, because there is more data available for imported surface water supplies than for groundwater supplies, which are largely unmonitored with the exception of artificial recharge operations. Table 3 illustrates Zone 7's current water demand.

Table 3 Zone 7 Current Water Demands

			2015 Actual (Acre-Feet)
Water Supply	**Additional Description**	**Level of Treatment When Delivered**	**Volume**
Sales to other agencies	Retailer Demand	Drinking Water	23,500
Agricultural Irrigation	Untreated Water Demand	Raw Water	5,600
Retail demand for use by agencies that are primarily wholesalers with a small volume of retail sales	Direct Retail Demand	Drinking Water	300
Groundwater Recharge	Local Groundwater Basin	Raw Water	4,100
Other	Kern County Groundwater Banking Program	Raw Water	-
Other	Surface Water Storage – SWP Carryover or Other Storage	Raw Water	14,000
Losses	Transmission System	Drinking Water	2,000
Total			**49,500**

Units in acre-feet per year
Source: Zone 7 Water Agency 2016

As shown above in Table 3, about 18,100 acre-feet of water supply is used for groundwater recharge activities, which includes groundwater recharge to the underlying Livermore Valley Groundwater Basin (4,100 AFY), storage in the SWP system as carryover[2] in San Luis Reservoir (14,000 AFY), storage in groundwater banks in Kern County, and storage of local water in Lake Del Valle. The table above indicates that approximately 5,600 acre-feet of water supply is used for agricultural irrigation. The project site is designated and zoned for agriculture, as shown on Figure 4, and the water demand projections shown in Table 3 account for agricultural uses within Zone 7's service territory, which includes agricultural use of the project site. The main crop grown in Alameda County is wine grapes; other dominant crops include fruits and nuts such as olives, pistachios, walnuts, and persimmons (Alameda County 2019). The region is also home to cattle ranches owned and operated for generations by local families (Alameda County 2019). Wine grapes in hot and dry climates have been reported to need as much as eight to ten gallons of water per day per vine (University of

[2] "Carryover" refers to the right to an unused portion of an annual Production Right or a right to Imported Water Return Flows in a year after the year in which the right was originally available.

California 2020). Fruit and nut trees are also very water-intensive and, while the exact amount of water required depends upon the tree size and site-specific characteristics such as soil moisture and drainage, one medium-sized semi-dwarf tree may require 16 to 19 gallons of water per day (University of California 2020). These respective water demands for the County's dominant crop types are substantially higher than the water demands for solar energy development, as discussed in Section 2.3, *Project Water Demands*. Because solar energy development is generally less water intensive that agriculture, the water demands forecast for agriculture on the project site are likely greater that the actual water demands associated with the project's solar energy development.

Table 4 and Table 5 outline Zone 7's projected demands and supplies, respectively, through the year 2035, which is the maximum projection range provided in the 2015 UWMP. SB 610 requires that a WSA consider water supply availability over a 20-year projection, which is longer than the range available in the current (2015) UWMP. However, SB 610 also allows that the analysis provided in a WSA is based upon the best available information. For the purposes of this analysis, the 2015 UWMP provides the best available information to make informed conclusions about water supply availability for the project. Reasonable assumptions are discussed in Section 5, regarding water supply availability projections for years beyond the 2035 projections in the UWMP, as well as the project's anticipated operational lifespan of 50 years, which is longer than any currently available water supply availability and reliability projections.

Table 4 Zone 7 Projected Water Demands

Use Type	Additional Description	Projected Water Demands (Acre-Feet) 2020	Projected Water Demands (Acre-Feet) 2025	Projected Water Demands (Acre-Feet) 2030	Projected Water Demands (Acre-Feet) 2035
Sales to other agencies	Retailer Demand	41,300	44,700	46,600	47,600
Agricultural Irrigation	Untreated Water Demand	6,200	6,600	7,800	8,300
Retail demand for use by agencies that are primarily wholesalers with a small volume of retail sales	Direct Retail Demand	300	300	300	300
Groundwater Recharge	Local Groundwater Basin	9,200	9,200	9,200	9,200
Other	Kern County Groundwater Banking Programs	0	300	7,300	9,000
Other	Surface Water Storage – SWP Carryover or Other Storage	10,000	10,000	10,000	10,000
Losses	Transmission System	2,100	2,200	2,300	2,400
Losses	Storage Losses	3,000	4,000	6,000	6,000
Total		**72,100**	**77,300**	**89,500**	**92,800**

Units in acre-feet per year
Source: Zone 7 Water Agency 2016

As shown above, Zone 7's existing water demands are projected to increase by approximately 29 percent through the year 2035. During that time, agricultural water uses are projected to increase from 6,200 AFY to 8,300 AFY, resulting in a total increase of 2,100 acre-feet for agricultural uses over the next 15 years. During this same timeframe, water demands for groundwater recharge are projected to stay constant at 9,200 AFY; this is likely because groundwater banking is a manual process that involves injecting excess supplies into the subsurface during wet years, when surplus supply is available, for use during drought years, when imported surface supplies are often curtailed. Drought year conditions are addressed in the tables below.

Table Table 5 provides an overview of all water supplies projected to be available to Zone 7 during a normal water year, through the year 2035.

Table 5 Zone 7 Available Supply – SWP Table A Water

Water Supply	Supply Notes	2020 Reasonably Available Volume (AFY)	2025 Reasonably Available Volume (AFY)	2030 Reasonably Available Volume (AFY)	2035 Reasonably Available Volume (AFY)
Purchased or Imported Water	State Water Project (Existing Conveyance – Early Long-Term	50,000	50,000	50,000	50,000
Purchased or Imported Water	Yuba Accord	145	145	N/A	N/A
Purchased or Imported Water	Byron Bethany Irrigation District	2,000	2,000	2,000	2,000
Purchased or Imported Water	California Water Fix	n/a	n/a	8,000	8,000
Surface Water	Arroyo Valle	7,300	7,300	10,300	10,300
Other New Water Supplies	Per WSE Update, could include desalination and/or potable use	n/a	10,000	10,000	10,000
Supply from Storage	Groundwater	9,200	9,200	9,200	9,200
Supply from Storage	State Water Project – Carryover	10,000	10,000	10,000	10,000
Total		**78,645**	**88,645**	**99,500**	**99,500**

Source: Zone 7 Water Agency 2016

As shown in the table above, the SWP is the main source of Zone 7's water supplies; see the first four rows, for "Purchased or Imported Water", as well as the last row which show carryover SWP water. Currently, the supplies derived from the SWP represent nearly 80 percent of Zone 7's supplies. The UWMP accounts for climate change impacts based on 2025 emission levels and a projected sea level rise of 15 centimeters; therefore, external factors such as climate change impacts have been incorporated into Zone 7's water supply planning efforts. In addition, although the available supply projections account for groundwater stored via recharge and banking programs, they do not account for the overall sustainable yield of the Livermore Valley Groundwater Basin, as that is managed through implementation of the SGMA Alternative Plan, which was developed to provide sustainable groundwater conditions throughout the basin.

The supply projections provided above indicate that the amount of water available to Zone 7 during a normal water year is projected increase by approximately 27 percent through the year 2035. In comparison with Table 6, which shows water demands increasing by approximately 29 percent through the year 2035, this indicates that projected supplies increase by slightly less than projected demands increase. However, the total amount of projected demand (92,800 acre-feet in 2035) remains lower than the total amount of projected supply (99,500 acre-feet in 2035), indicating a projected surplus in available water supply during a normal water year. Varying climatic conditions are addressed below in Table 6, which summarizes Zone 7's supply and demand projections under single-dry and multiple-dry years in addition to normal water year conditions.

Table 6 Zone 7 Projected Supplies and Demand

		2020	2025	2030	2035
Normal Year					
Supply Totals		78,645	88,645	99,500	99,500
Demand Totals		72,100	77,300	89,500	92,800
Difference		**6,545**	**11,345**	**10,000**	**6,700**
Single Dry Year					
Supply Totals		67,676	81,676	88,200	88,200
Demand Totals		42,400	45,700	48,500	49,800
Difference		**25,276**	**35,976**	**39,700**	**38,400**
Multiple Dry Years					
First Year	Supply Totals	67,626	77,626	76,950	76,950
	Demand Totals	48,000	52,100	56,000	58,300
	Difference	**19,626**	**25,526**	**20,950**	**18,650**
Second Year	Supply Totals	61,396	71,396	70,720	70,720
	Demand Totals	48,700	53,00	56,600	58,400
	Difference	**12,696**	**18,386**	**14,120**	**12,320**
Third Year	Supply Totals	64,626	74,626	73,950	73,950
	Demand Totals	49,900	53,800	57,000	58,600
	Difference	**14,726**	**20,826**	**16,950**	**15,350**

Units in acre-feet per year
Source: Zone 7 Water Agency 2016

Table 6 shows that under all considered drought scenarios, including normal water year, single-dry water year, and multiple-dry year conditions, the projected water supply available to Zone 7 exceeds the projected demands. These projections do not account for potential voluntary and mandatory water conservation savings. In addition, these projections do not account for implementation of the SGMA Alternative Plan for the Livermore Valley Groundwater Basin, which will provide additional and continued water supply reliability for the region. The implications of these projections on water supply availability for the proposed project are discussed below in Section 5, Conclusions.

5 Conclusions

In accordance with California Water Code, as amended by SB 610, this WSA identifies and characterizes all known and potential water demands of the project, in comparison to the water supplies available to the project over a 20-year projection, with consideration to varying drought conditions and ongoing long-term supply management activities. Water supplies considered for the purposes of this WSA include groundwater pumped from the Livermore Valley Groundwater Basin via an on- or off-site groundwater well, surface water imported to the project area and distributed via the Zone 7 Water Agency, and local groundwater banking operations that receive surplus water supplies during wet years and provide supply reliability during dry years.

The project's amortized annual water demand is ~~13.97~~14.06 AFY; this is the project's total maximum water demand averaged over all phases of the project, accounting for 52 years to capture construction and decommissioning or repowering occurring during years that O&M activities also may occur, in addition to 50 full years of project O&M. During a normal O&M year for the project, water demands would include a minimum of 5 AFY for panel washing activities, to maintain maximum efficiency of the project's technology. In order to provide a conservative analysis of water supply availability and reliability, this WSA considers a maximum operational water demand of up to 14.37 AFY over the first three years of O&M, and up to 12.85 AFY for each year following the first three years. The elevated water demand during the first three years of O&M is attributable to temporary irrigation of landscape and pollen forage plants. The project's O&M water demands ~~, which~~ account~~s~~ for factors including a possible need to treat water for high TDS concentrations before ~~it is used~~use in ~~for~~ panel washing, and ~~accounts for the option of storing a supply~~on-site storage of emergency fire suppression water~~on site~~.

Long-term water supply availability projections provided in the Zone 7 2015 UWMP were reviewed and assessed in this WSA, in comparison to the anticipated water demands of the project. As discussed in Section 4, *Water Supply Reliability Analysis*, Zone 7's UWMP projects a surplus water supply under all considered drought scenarios, including normal-year, single-dry year, and multiple-dry year conditions. This is likely due to Zone 7's diversified water supply portfolio consisting of local groundwater recharge and banking efforts as well as imported surface water supplies, in addition to other proactive management efforts including salt and nutrient management of the local groundwater resources, to maximize their potential for future use. Consistent with ongoing activities, it is anticipated that Zone 7 will respond to anticipated dry-year water shortages by pumping banked groundwater that is actively managed for this purpose, and by implementing management actions including but not limited to conservation actions.

The water supply planning efforts discussed above, including Zone 7's UWMP, rely upon General Plan land use designations and zoning, in order to predict water demands based upon known and anticipated land uses. In this case, the project site is designated and zoned for agriculture (see Figure 4), and although agriculture would continue to occur on the project site in the form of sheep grazing and apiary uses, the site's primary land use after project implementation will be solar energy development, which is generally less water intensive than agricultural land uses. Therefore, with implementation of the proposed project, the actual water demands that will occur on the project site will likely be lower than planned for this site in the UWMP for the area. This suggests that the water demands that will occur on the project site with implementation of the project are accounted for in the supply availability projections provided in the UWMP.

As discussed throughout this WSA, the operational lifetime of the proposed project is anticipated to be up to 50 years, which is 30 years longer than the 20-year projection required in a WSA. Further, the water supply analysis in Zone 7's 2015 UWMP projects water availability through the year 2035, which only provides a 15-year projection from the time of preparation of this WSA, in late 2020. However, SB 610 acknowledges that there is commonly a lack of consistent, reliable information on water supply availability, and SB 610 therefore allows for use of the "best available" data sources in WSA analyses. This WSA does not attempt to quantify water supply availability beyond the projections provided through 2035 in Zone 7's 2015 UWMP, because doing so would be highly speculative, and would not be based on actual data. Rather, conclusions are based upon the surplus availability projections discussed above, the ongoing and active management of the Livermore Valley Groundwater Basin, and the diverse water supply portfolio of the Zone 7 Water Agency.

This WSA concludes that sufficient water supply is available to meet the project's maximum potential water demands over a 20-year projection, and that water supply is reliable under normal-year, single-dry-year, and multiple-dry-year conditions. This conclusion is based upon conservative water demand factors assumed for the proposed project, and allows for the project's use of local groundwater pumped from the underlying Livermore Valley Groundwater Basin, which is managed by Zone 7 in accordance with SGMA, and/or the project's use of imported surface water purchased from Zone 7 or from one of the four local water purveyors that receive their imported surface water supply through Zone 7 (California Water Service Company – Livermore District, Dublin San Ramon Services District, City of Livermore, and City of Pleasanton). Although regional water shortages may occur during the project's lifetime, such conditions may occur regardless of the proposed project, and are accounted for in UWMP supply availability projections.

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Appendix A

DWR Guidebook for Implementation of Senate Bill 610

The Water Supply Assessment (WSA) for the proposed Aramis Solar Energy Generation and Storage Project (project) was prepared using guidance contained in the California Department of Water Resources' (DWR) Guidebook for Implementation of Senate Bill (SB) 610 and SB 221 of 2001 (DWR Guidebook). The California DWR prepared the Guidebook to assist water suppliers in preparation of the water assessments and the written verification of water supply availability required by SB 610 and SB 221; the DWR has no regulatory or permitting approval authority concerning water assessments or verifications of sufficient water supply, and provides the Guidebook purely as an assistance tool (DWR 2003). The following table provides a detailed description of how the DWR Guidebook was used in preparing the project's WSA.

Table A-1 Aramis Solar Energy Project WSA - Consistency with DWR Guidelines

Guidelines Section Number and Title (DWR 2003)	Guidelines Direction	Relevant WSA Section and Response
Section 1 (page 2). Does SB 610 or SB 221 apply to the proposed development?	Is the Project subject to SB 610? Is the Project subject to CEQA (Water Code §10910(a))? If yes, continue.	WSA Section 3.1 Yes, the project subject to CEQA.
	Is it a "project" as defined by Water Code §10912(a) or (b)? If yes, to comply with SB 610 go to Section 2, page 4.	WSA Section 3.2 Yes, the project is considered to meet the definition of "project" per Water Code §10912(a) or (b).
	Is the project subject to SB 221? Does the tentative map include a "subdivision" as defined by Government Code §66473.7(a)(1)? If no, stop.	No, the project does not include a "subdivision;" SB 221 does not apply to the project, and no further action relevant to SB 221 is required.
Section 2 (page 4). Who will prepare the SB 610 analysis?	Is there a public water system ("water supplier") for the project (Water Code § 10910(b))? If no, go to Section 3, page 6.	WSA Section 3.3 No, there is no public water system for the project.
Section 3 (page 6). Has an assessment already been prepared that includes this project?	Has this project already been the subject of an assessment (Water Code §10910(h))? If no, go to Section 4, page 8.	No, the project has not been the subject of an assessment.
Section 4 (page 8). Is there a current Urban Water Management Plan?	Is there an adopted urban water management plan (UWMP) (Water Code §10910(c))? If yes, continue. If yes, information from the UWMP related to the proposed water demand for the project may also be used for carrying out Section 5, Steps 1 and 2, and Section 7; proceed to Section 5, page 10 of the Guidelines.	WSA Section 3.4 Zone 7 Water Agency, the water wholesaler that provides water to the project area, has an adopted UWMP. Information from the UWMP was used for this WSA.
	Is the projected water demand for the project accounted for in the most recent UWMP (Water Code §10910(c)(2))? If no, go to Section 5, page 10.	WSA Section 3.4 Zone 7 Water Agency's current UWMP generally accounts for the project's water demands by assuming the project site would be used for agriculture, which is generally more water intensive than solar energy development.

Guidelines Section Number and Title (DWR 2003)	Guidelines Direction	Relevant WSA Section and Response
Section 5 (page 10). What information should be included in an assessment?	Step One (page 13). Documenting wholesale water supplies.	Zone 7 Water Agency, the water wholesaler that provides water to the project area, has an adopted UWMP. Information from the UWMP was used for this WSA.
	Step Two (page 17). Documenting Supply if Groundwater is a Source*.	The project's water demands may be met with groundwater supplies from the Livermore Valley Groundwater Basin.
	Specify if a groundwater management plan or any other specific authorization for groundwater management for the basin has been adopted and how it affects the water supplier's use of the basin.	WSA Section 4.1 There is the Livermore Valley Basin Groundwater Management Plan, the Salt Management Plan and Nutrient Management Plan, and Alternative Groundwater Sustainability Plan for the Livermore Valley Groundwater Basin that assessed conditions in the Livermore Valley Groundwater Basin and were used to inform the WSA.
	The description of the groundwater basin may be excerpted from the groundwater management plan, from DWR Bulletin 118, California's Ground Water, or from some other document that has been published and that discusses the basin boundaries, type of rock that constitutes the aquifer, variability of the aquifer material, and total groundwater in storage (average specific yield times the volume of the aquifer).	WSA Sections 2.1 and 4.1 provide description of the groundwater basin characteristics using available resources, including DWR Bulletin 118.
	In an adjudicated basin the amount of water the urban supplier has the legal right to pump should be enumerated in the court decision.	The project is not located in an adjudicated groundwater basin.
	The Department of Water Resources has projected estimates of overdraft, or "water shortage," based on projected amounts of water supply and demand (basin management), at the hydrologic region level in Bulletin 160, California Water Plan Update. Estimates at the basin or subbasin level will be projected for some basins in Bulletin 118. If the basin has not been evaluated by DWR, data that indicate groundwater level trends over a period of time should be collected and evaluated.	WSA Section 4.1.2 discusses groundwater level trends.
	If the evaluation indicates an overdraft due to existing groundwater extraction, or projected increases in groundwater extraction, describe actions and/or program	The evaluation does not indicate an overdraft due to existing groundwater extraction.

Guidelines Section Number and Title (DWR 2003)	Guidelines Direction	Relevant WSA Section and Response
	designed to eliminate the long term overdraft condition.	
	If water supplier wells are plotted on a map, or are available from a geographic information system, the amount of water extracted by the water supplier for the past five years can be obtained from the Department of Health Services, Office of Drinking Water and Environmental Management.	Water pumping for the project would not initiate until the onset of construction activities; site-specific historical records are not available.
	Description and analysis of the amount and location of groundwater pumped by the water supplier for the past five years. Include information on proposed pumping locations and quantities. The description and analysis is to be based on information that is reasonably available, including, but not limited to, historic use records from DWR.	Section 4.2 addresses available historical groundwater pumping data for the Zone 7 Water Agency.
	Analysis of the location, amount, and sufficiency of groundwater that is projected to be pumped by the water supplier.	WSA Sections 4.1 and 4.2 discuss location, amount, and sufficiency of groundwater supplies from the Livermore Valley Groundwater Basin.
	Step 3 (page 21). Documenting project demand (Project Demand Analysis).	WSA Section 2.3 Construction of the project would require up to approximately 42 acre-feet of water. Operational water demands, which include water used for fire suppression, solar PV panel washing and concentrate, livestock grazing, and operation of the proposed O&M building, would total approximately 12.85 AFY. Water demand during the first three years of O&M would be up to 14.37 AFY, accounting for temporary irrigation to establish landscape plants. In addition, decommission or repowering of the project would require up to approximately 42 acre-feet of water.
	Step 4 (page 26). Documenting dry year(s) supply.	WSA Section 4.2 discusses water supply reliability including during dry year scenarios.
	Step 5 (page 31). Documenting dry year(s) demand.	WSA Section 4.2 discusses water supply reliability including during dry year scenarios.
Section 6 (page 33). Is the projected water supply sufficient or insufficient for the proposed project?		WSA Section 4 summarizes why the identified water supply/supplies are considered sufficient for the project.

Guidelines Section Number and Title (DWR 2003)	Guidelines Direction	Relevant WSA Section and Response
Section 7 (page 35). If the projected supply is determined to be insufficient.	Does the assessment conclude that supply is "sufficient"? If no, continue.	WSA Section 5 It is reasonably anticipated that sufficient water supplies are available for the project.
Section 8 (page 38). Final SB 610 assessment actions by lead agencies.	The lead agency shall review the WSA and must decide whether additional water supply information is needed for its consideration of the proposed project. The lead agency "shall determine, based on the entire record, whether projected water supplies will be sufficient to satisfy the demands of the project, in addition to existing and planned future uses."	The WSA for the project will be included as part of the Draft EIR for the project. Per SB 610, the lead agency will approve or disapprove a project based on a number of factors, including but not limited to the water supply assessment.

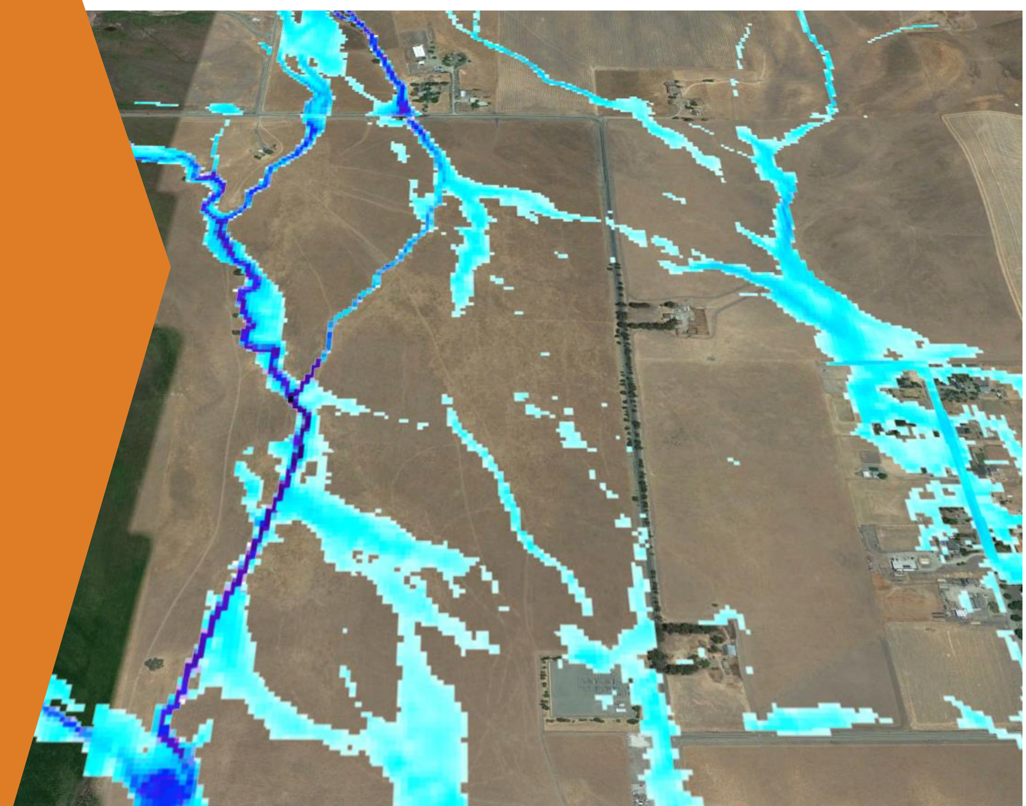
Westwood

Preliminary Hydrology Study

Aramis Solar Project

Alameda County, CA

April 2020



Prepared For: Intersect Power, Inc.

Intersect Power

Westwood

Preliminary Hydrology Study for

Aramis Solar Project

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Updated: 04/28/2020

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OVERVIEW

The purpose of the study is to describe the hydrology of the proposed Aramis Solar Project ("the project") and any impacts that the hydrology may play in the design of the solar array and for use in Alameda County permitting.

The project covers approximately 540 acres of land in Alameda County, CA, approximately 2.5 miles north of the city of Livermore, CA. (Exhibit 1). At the time of this report, the project consists approximately 258 acres of solar panels, access roads, and associated infrastructure, although the layout is not finalized.

With the project being located within Alameda County, the stormwater requirements for Alameda County were researched and applicable regulations described in the Clean Water Program will need to be followed.

The project site generally slopes to the southeast. The watershed area encompasses ~12.8 square miles and includes an area starting primarily to the north of the project. The project area is on a generally flat area just downslope of a series of ridges to the north and west.

FEMA has completed a study to determine flood hazard for the selected location. The project area is covered by panels 06001C0332G, 06001C0331G and 06001C0170G. The project has some areas that are FEMA flood hazards (Exhibit 2).

The hydrologic modeling in this report was created using FLO-2D modeling software. Because of the complex and distributary nature of flow paths upstream and through the project site, FLO-2D hydrologic/hydraulic modeling software was utilized to determine flow depths and velocities throughout the site.

Overall, the analysis shows low water depths and velocities (Exhibits 6 and 7) across the majority of the site. During a 100 year storm the flood depths across the majority of the project area are less than 2 feet with velocities less than 2 foot/second. Areas with higher flood depths and velocities exists and are generally located along or near defined flow paths. The current site layout avoids all areas of high flow and FEMA floodplains. See Exhibits 6 and 7 for areas within the project with higher flood depths and velocities. Based on experience on other similar projects, the site is suitable for the planned development.

DATA SOURCES

The models and methods for this project utilize a combination of public and private data as shown in Table 1.

Table 1: Data Sources

Data Type	Format	Source	Use
Elevation	3-Meter Digital Elevation Model (DEM)	USGS Data Gateway	Offsite FLO-2D Model Elevations
Elevation	Aramis_Surface and Aerial.dwg	Intersect Power	Onsite FLO-2D Model Elevations
Crop Data	Shapefile	USDA 2013 Crop Data Layer	Landcover
Soils	Shapefile	USGS SSURGO Dataset	Curve Numbers
Precipitation	PDF File	NOAA Atlas 14 Website	Design storms
HUC-12 Drainage Boundary	Shapefile	USGS	Define Model Extents
Site Boundary	Shapefile	Terra-Gen, LLC	Define Model Extents
2015 Aerial Photography	ArcGIS Map Service	USDA FSA	Reference

PROJECT HYDROLOGY

The 540 acre project area is located in western California, approximately 2.5 miles north of the city of Livermore. The project site is located on a generally flat area just downslope of a series of ridges to the north and west. The area was modeled using a watershed area of ~12.8 square miles and includes the areas with ridges to the north and west of the project. The project area generally slopes to the southeast. The potential hydrologic issues in this general landscape are flooding and erosive velocities.

FLO-2D MODELING

FLO-2D is a physical process model that routes rainfall runoff and flood hydrographs over flow surfaces or in channels using the dynamic wave approximation to the momentum equation. FLO-2D offers advantages over 1-D models and unit hydrograph methods by allowing for breakout flows and visualization of flows across a potential site. This is particularly useful on a moderately and steeply sloped distributed area such as the project site. The primary inputs are a DTM (elevation data), curve numbers and precipitation. A grid system is set up within the FLO-2D software in which the FLO-2D grid cells were optimized at 30'. Major culverts impacting the site were modeled based on aerial imagery provided by Google Earth.

Precipitation data was downloaded from NOAA Atlas 14 (Appendix A) for a 24 hour, 100 year rain event. The 100 year rain depth was 5.53". By using the 100-year rainfall event for design purposes, it allows for the best initial analysis in order to determine the worst areas of flooding and erosion.

The elevation data input into the FLO-2D model was 1-foot contours for onsite elevations and 3-meter USGS Data Gateway Digital Elevation for offsite elevations. These surfaces were combined and incorporated into the DTM using the export to xyz file function in Global Mapper. These XYZ files are read directly into FLO-2D.

USDA-NRCS SSURGO soil data provides soil types within the project boundary and full coverage of the contributing watershed. Soils in the area are primarily classified as hydrologic groups C & D (Exhibit 3). Land cover was obtained from the USDA 2013 Crop Data Layer. Exhibit 4 displays the Land Cover Classes for the entire watershed. The majority of land in this area is assumed to be prairie/pasture with smaller portions consisting of forest, shrubland or cultivated land. Curve numbers were applied to each grid cell in the FLO-2D model (Exhibit 5). The majority of the project area has a curve number between 70 and 79. Areas with a higher curve number will have more runoff and areas with a lower curve number will have less runoff. This is based on the type of soils, "A" soils have the highest infiltration rates and "D" soils have the lowest infiltration rates.

RESULTS AND DESIGN INFORMATION

Overall, the analysis shows that the channels on the site convey most of the flow from a 100-year event with small breakout flows causing low water depths and velocities (Exhibits 6 and 7) across the majority of the site. The project area is located in a valley downslope of a series of ridges, which could cause localized flooding on a large portion of the project area. The FLO-2D results indicate that during a 100 year storm the flood depths across the majority of the project area are less than 2 feet with velocities less than 2 foot/second. See Exhibits 6 and 7 for areas within the project with higher flood depths and velocities.

The channel running along the western boundary of the central parcel shows breakout flows during the 100-year event. HECRAS 1-D modeling was utilized to confirm that while the channel can hold the 100-year flow rate the possibility of these breakout flows should be considered likely during large storm events.

In order for the elevation sources to line up properly at the match line a blending process was used. Overall the blending was successful at merging the two sources together with the exception of the southern flown elevation boundary (Exhibit 6A). Along this line the blending was extensive and not entirely successful in accurately representing flow conditions. For example, the ponding is likely larger in surface area than if would be otherwise. It is likely that the bulk of the blending effects on flow characteristics do not occur within the project boundary with the exception of the slight tail in the southwest corner of the southern project parcel. Flood depths and velocities within the highlighted box on exhibit 6A should not be considered accurate enough for design purposes.

FEMA has completed a study to determine flood hazard for the selected location. The project area is covered by panels 06001C0332G, 06001C0331G and 06001C0170G. The project has some areas that are FEMA flood hazards (Exhibit 2).

Based on experience on other similar projects, the overall site is suitable for the planned development by avoiding areas of high flood depths and velocities.

NEXT STEPS

1. Design stormwater facilities to meet Alameda County Requirements
2. Facilities to be elevated 1’ above the higher of the 100-year peak flood elevation.
3. Crossing types (low water crossing or culvert) should be determined for each crossing location as determined based on field conditions.

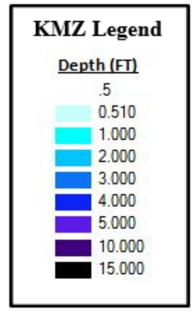
Included Output Files:

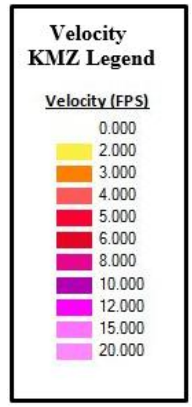
1. Shapefile of Flow Depth
   2020-04-27_Aramis_PrelimFlowDepthatCell_100yr.shp
   Attribute "ID" = Grid Cell Number
   Attribute "VAR" = Max Flow Depth (Feet)

2. KMZ of Flow Depth
   2020-04-27_Aramis_PrelimFlowDepth_100yr.kmz
   Overlay in Google Earth for graphical representation.

3. Shapefile of Velocity
   2020-04-27_Aramis_PrelimVelocityatCell_100yr.shp
   Attribute "ID" = Grid Cell Number
   Attribute "VAR" = Velocity (FPS)

4. KMZ of Velocity
   2020-04-27_Aramis_PrelimVelocity_100yr.kmz
   Overlay in Google Earth for graphical representation





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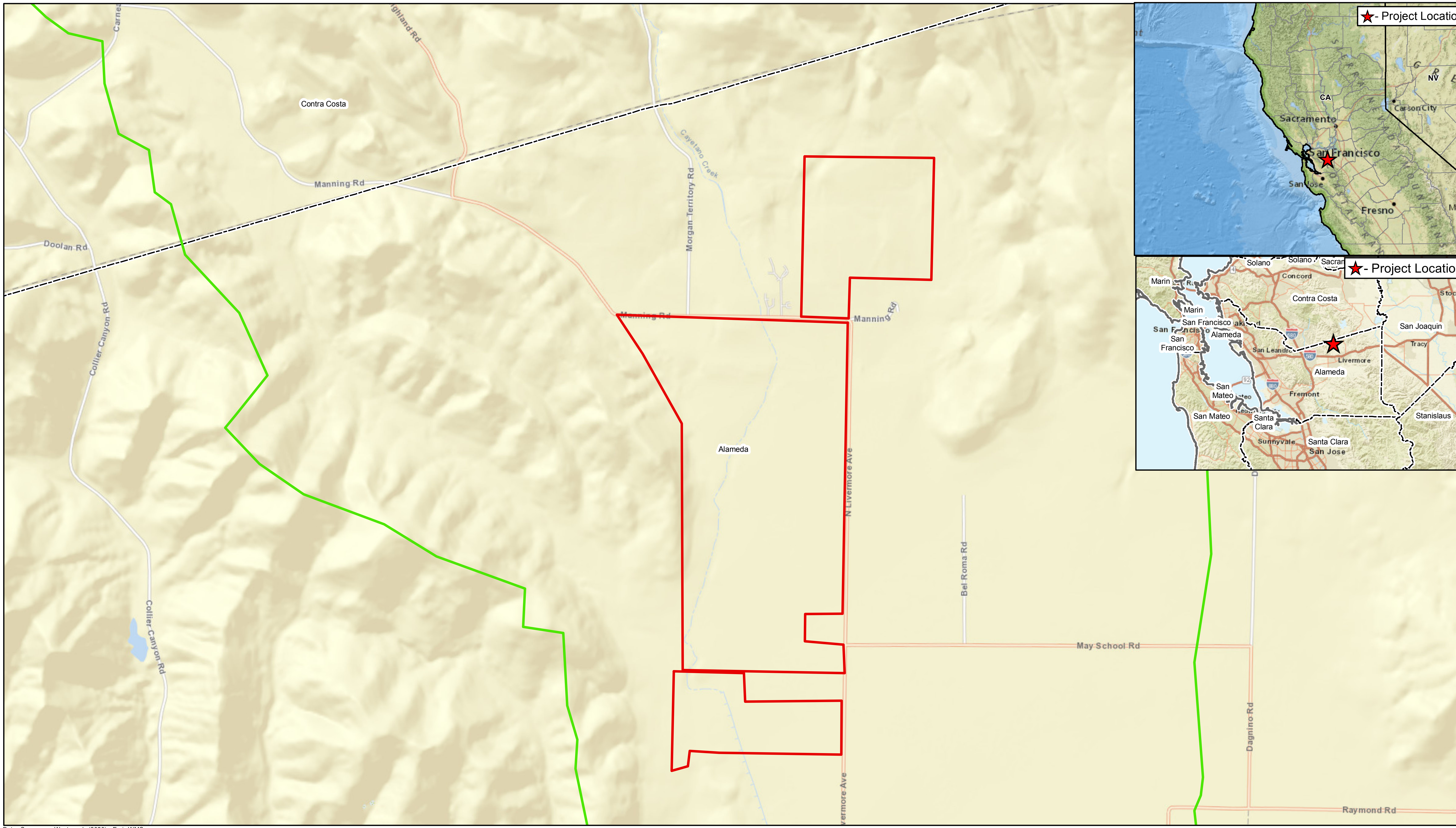
Exhibits



Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary

N

0 1,500 Feet

Aramis Solar Project

Alameda County, California

Exhibit 1: Location Map

April 28, 2020

Westwood

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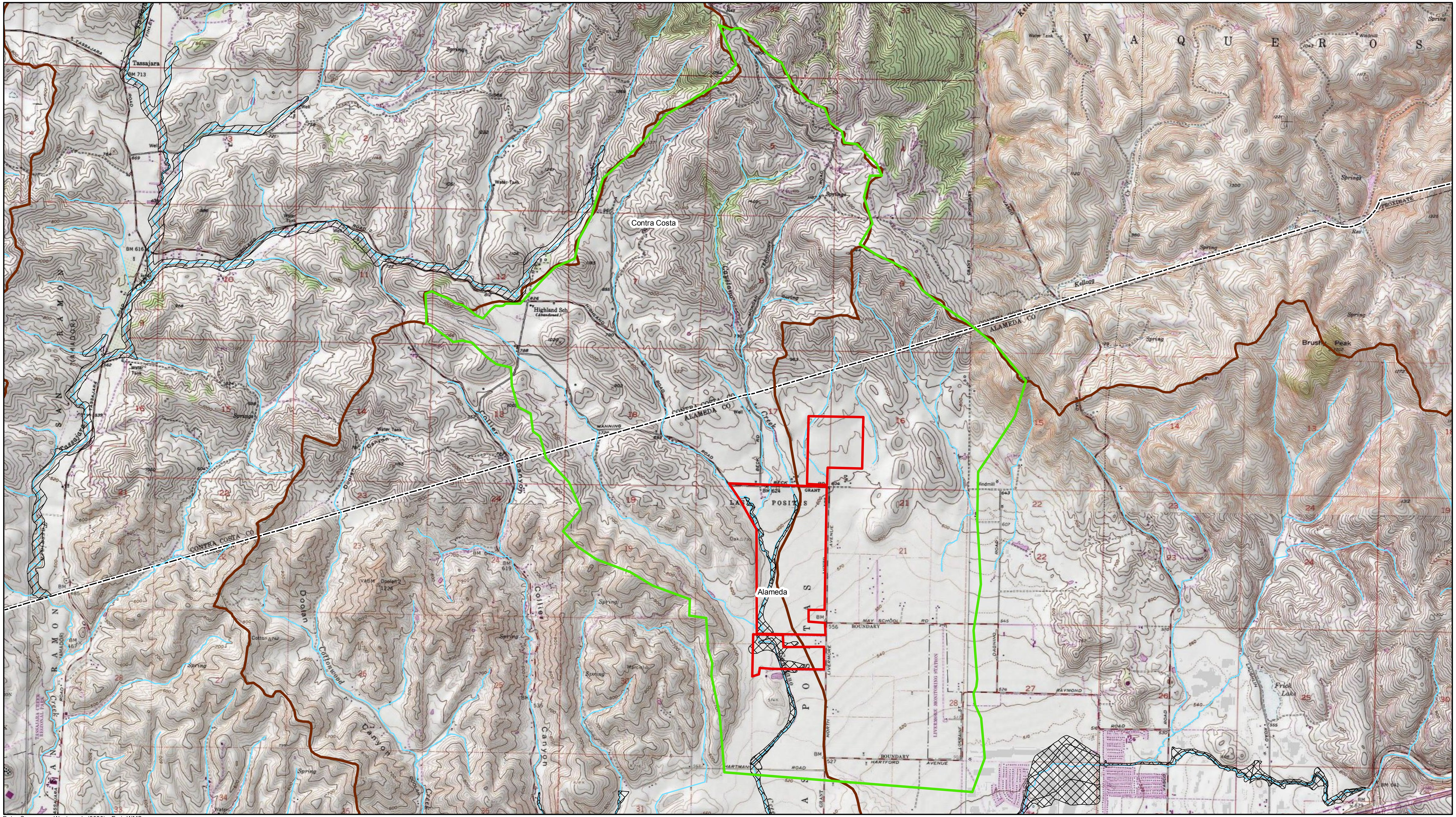
Westwood Professional Services, Inc.

Map Document: N:\0014542.00\GIS\Hydro Exhibits\AramisSolar_EX1_Location_180625.mxd 4/28/2020 11:57:18 AM mmhealy



Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary
- HUC12 Boundary
- NHD Flowline
- FEMA Zone A
- FEMA Zone AE

N

0 — 3,500 Feet

Aramis Solar Project

Alameda County, California

Exhibit 2: Base Hydrology Map

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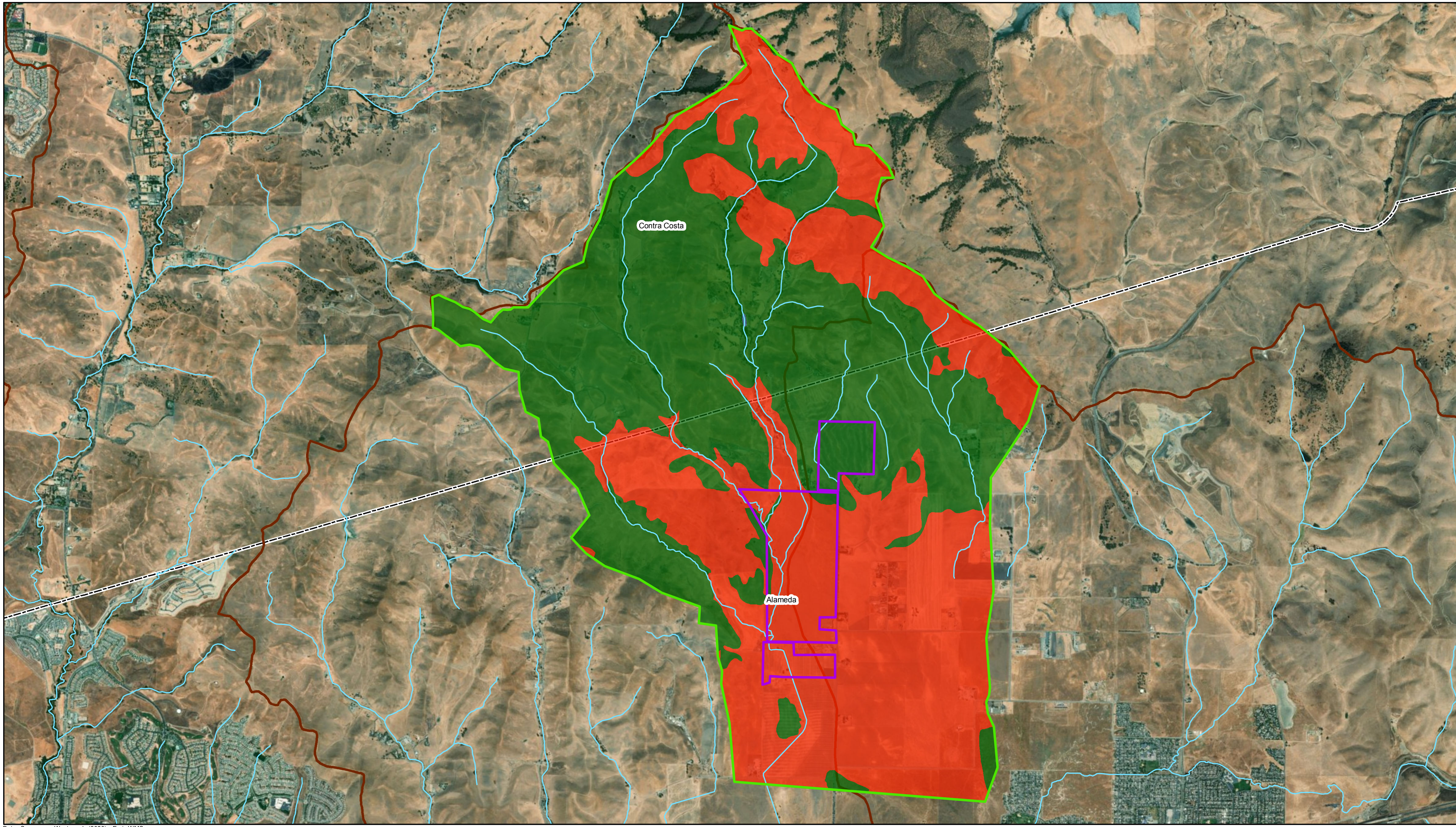

Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary
- HUC12 Boundary
- NHD Flowline

Hydrological Soils Group

- C
- D
- W

N

0 — 3,500 Feet

Aramis Solar Project

Alameda County, California

Exhibit 3: Hydrologic Soils Map

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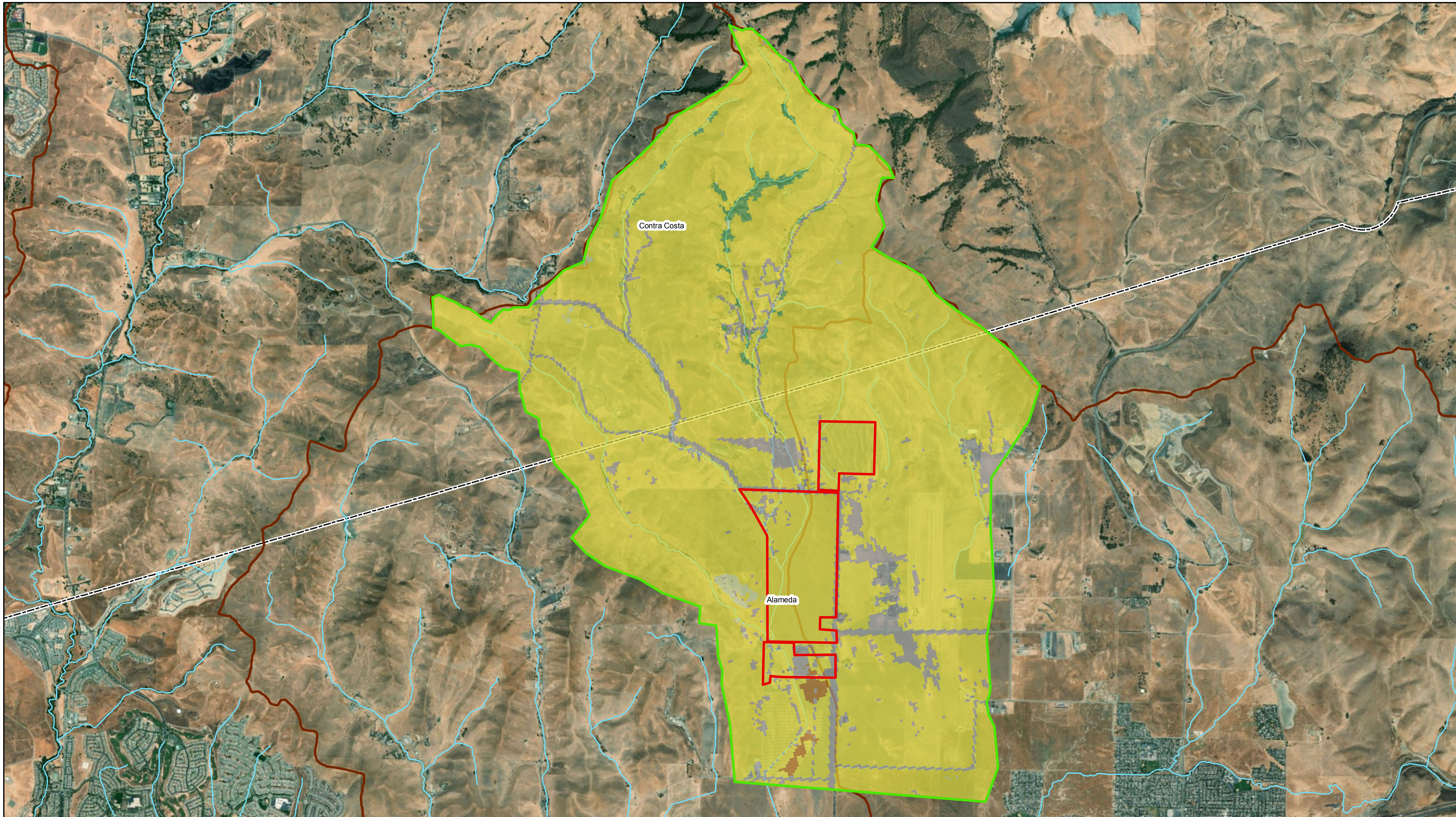
Map Document: N:\0014542.00\GIS\Hydro Exhibits\AramisSolar_EX3_Soils_180625.mxd 4/28/2020 11:59:46 AM mmhealy



Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary
- HUC12 Boundary
- NHD Flowline

Landcover

- Cultivated
- Developed
- Forested
- Prairie/Pasture
- Shrubland

N

0 — 3,500 Feet

Aramis Solar Project

Alameda County, California

Exhibit 4: Landcover Map

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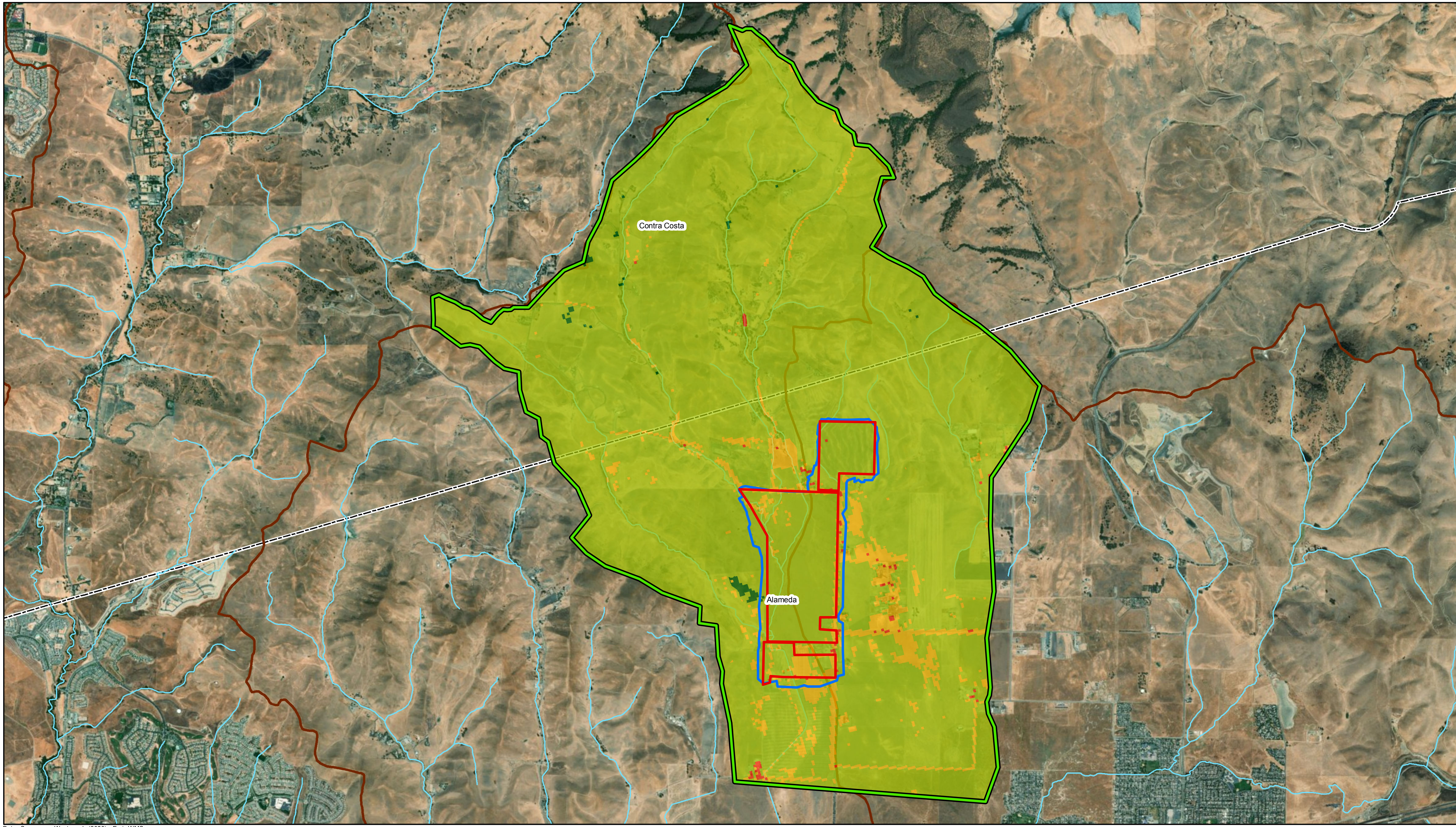
Map Document: N:\0014542.00\GIS\Hydro Exhibits\AramisSolar_EX4_Landcover_180625.mxd 4/28/2020 12:03:56 PM mmhealy



Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary
- HUC12 Boundary
- NHD Flowline
- 1-foot Contour Extents
- 3-meter DEM Extents

Curve Number

- 60-69
- 70-79
- 80-89
- 90-99

N

0 — 3,500 Feet

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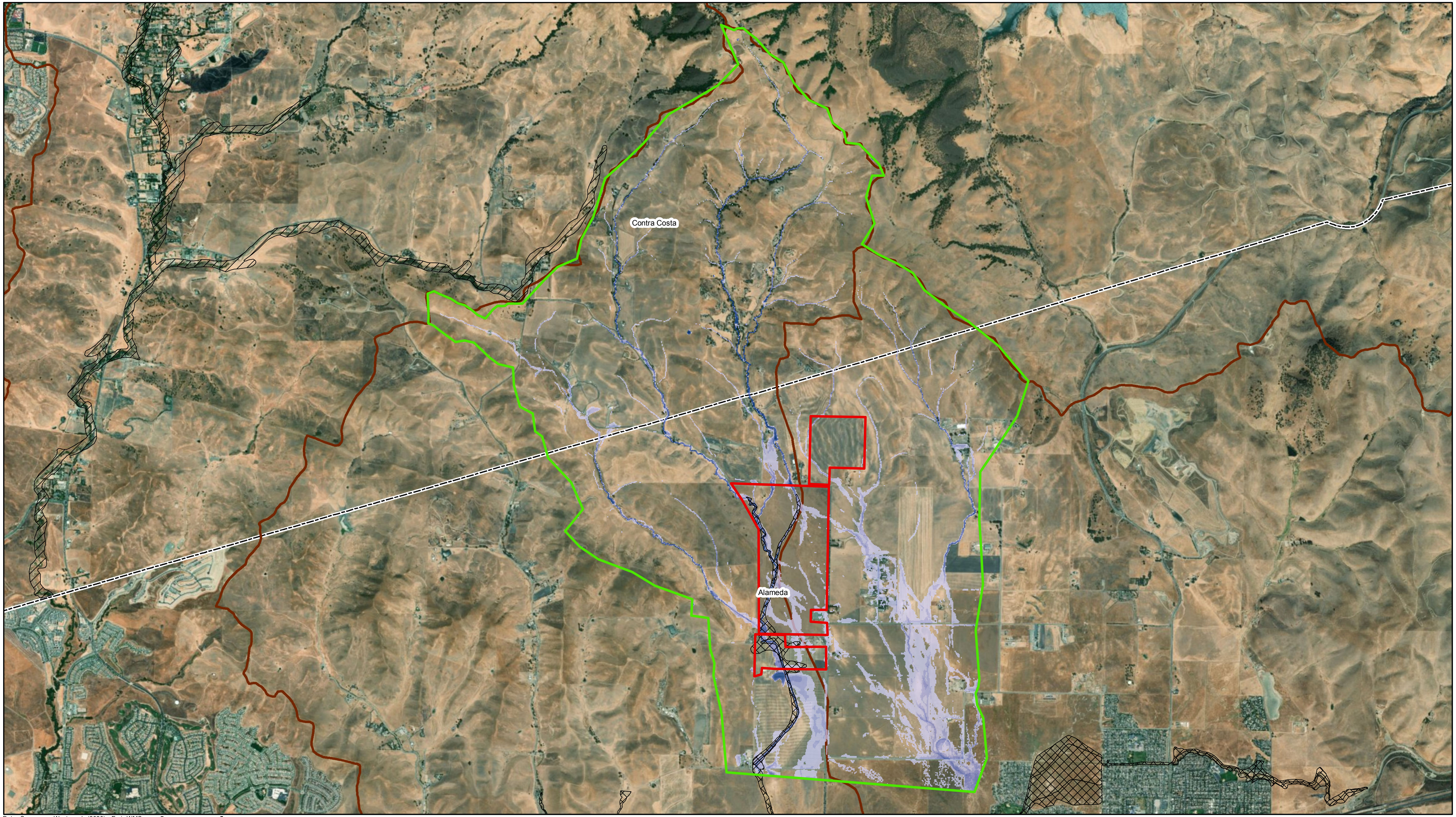
Alameda County, California

Exhibit 5: Curve Number and Topographic Extents Map

April 28, 2020

Map Document: N:\0014542.00\GIS\Hydro Exhibits\2020-04-28 Flown Onsite exhibits 6-7\2020-04-28_AramisSolar_EX5_CurveNumber.mxd 4/28/2020 1:59:37 PM mmhealy



Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- Project Boundary
- FLO-2D Boundary
- County Boundary
- HUC12 Boundary
- FEMA Zone A
- FEMA Zone AE

Max Flow Depth (ft)

0.50 - 1.00
1.01 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 4.00
4.01 - 6.00
6.01+

N

Feet
0 3,500

Aramis Solar Project

Alameda County, California

Exhibit 6: 100-Year Max Water Depth Map

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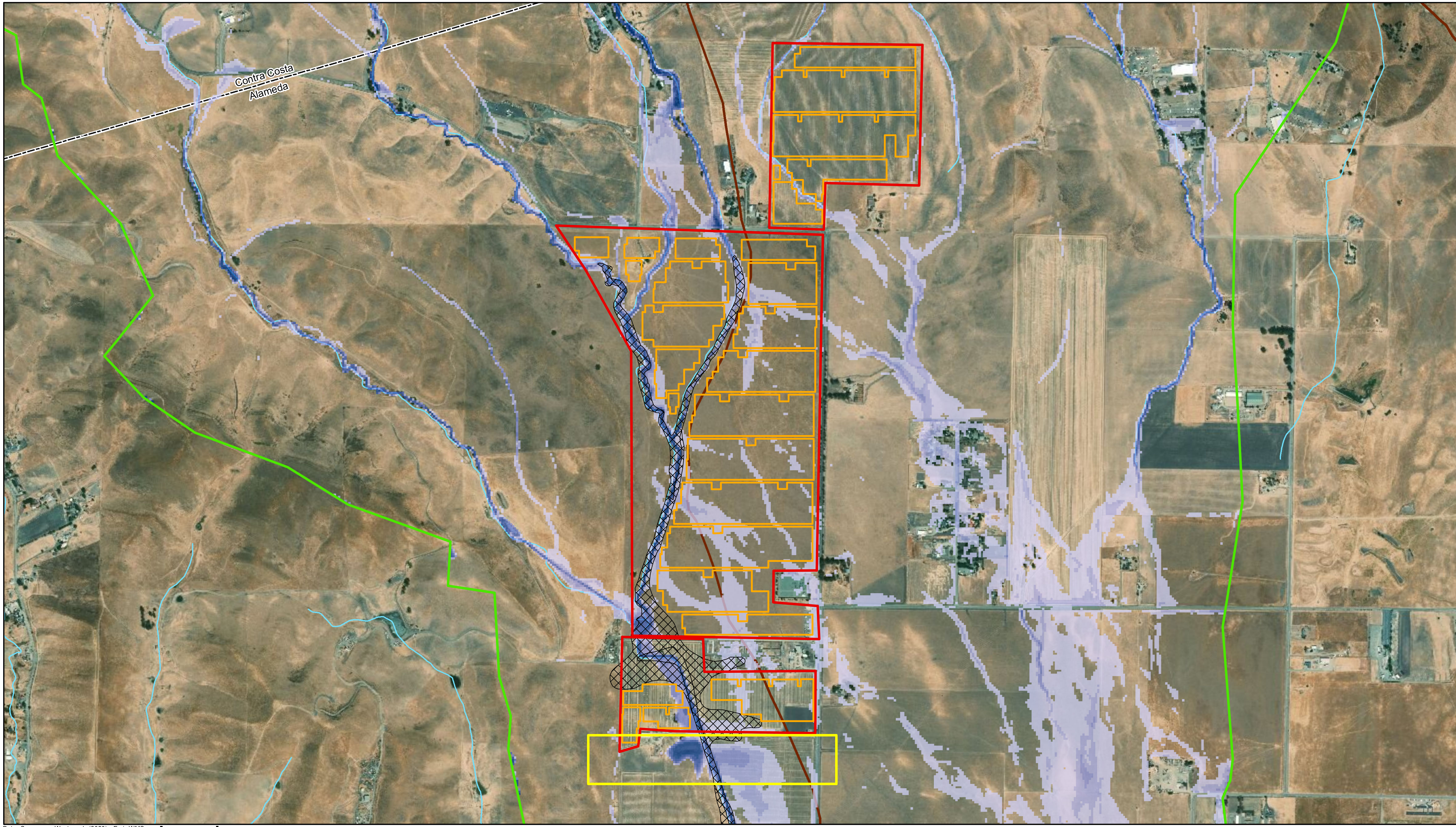
Map Document: N:\0014542.00\GIS\Hydro Exhibits\2020-04-28 Flown Onsite exhibits 6-7\2020-04-28_AramisSolar_EX6_100YearMaxDepth.mxd 4/28/2020 12:27:29 PM mmhealy



Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- County Boundary
- Project Boundary
- County Boundary
- FLO-2D Boundary
- Array Outline
- Large Elevation Blend Area
- FEMA Zone A
- FEMA Zone AE
- HUC12 Boundary
- NHD Flowline

Max Flow Depth (ft)

0.50 - 1.00
1.01 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 4.00
4.01 - 6.00
6.01+

N

0 1,300 Feet

Aramis Solar Project

Alameda County, California

Exhibit 6A: 100-Year Max Flood Depth Project Area Map

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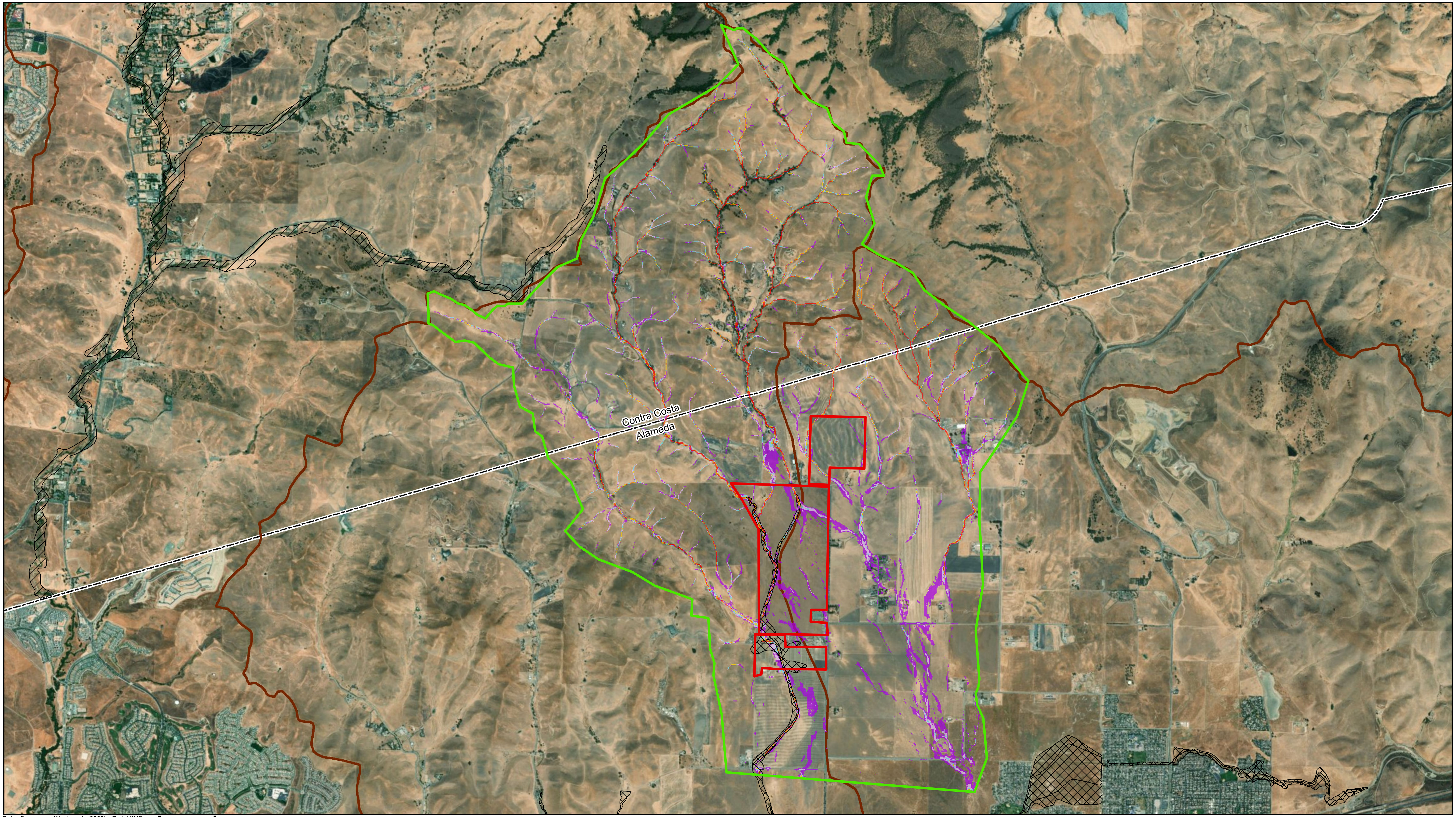
Map Document: N:\0014542.00\GIS\Hydro Exhibits\2020-04-28 Flown Onsite exhibits 6-7\2020-04-28_AramisSolar_EX6A_100YearMaxDepthZOOM.mxd mmhealy 4/28/2020 1:13:06 PM



Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- County Boundary
- Project Boundary
- County Boundary
- FLO-2D Boundary
- FEMA Zone A
- FEMA Zone AE
- HUC12 Boundary

Peak Velocity (fps)

1.00 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 4.00
4.01+

N

0 3,500 Feet

Aramis Solar Project

Alameda County, California

Exhibit 7: 100-Year Peak Velocity Map

April 28, 2020

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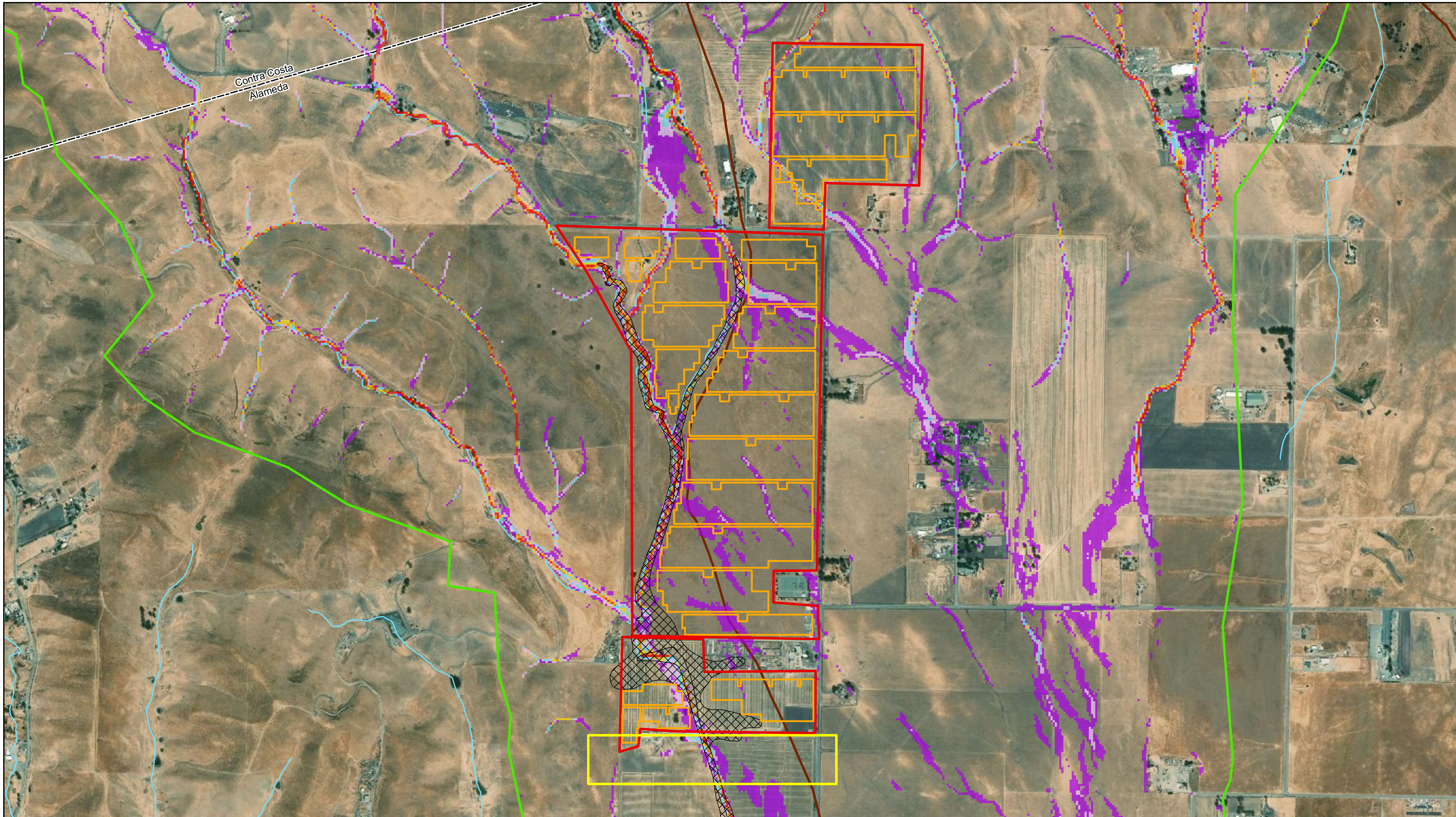
Map Document: N:\0014542.00\GIS\Hydro Exhibits\2020-04-28 Flown Onsite exhibits 6-7\2020-04-28_AramisSolar_EX7_100YearPeakVelocity.mxd mmhealy 4/28/2020 1:38:39 PM



Data Sources: Westwood (2020); Esri WMS Basemap Imagery (Accessed 2020); USGS (2020); FEMA (2020); USDA (2020)

Legend

- County Boundary
- Project Boundary
- County Boundary
- FLO-2D Boundary
- Array Outline
- Large Elevation Blend Area
- FEMA Zone A
- FEMA Zone AE
- HUC12 Boundary
- NHD Flowline

Peak Velocity (fps)

- 1.00 - 1.50
- 1.51 - 2.00
- 2.01 - 2.50
- 2.51 - 3.00
- 3.01 - 4.00
- 4.01+

N

0 1,300 Feet

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Aramis Solar Project

Alameda County, California

Exhibit 7A: 100-Year Peak Velocity

Project Area Map

April 28, 2020

Map Document: N:\0014542.00\GIS\Hydro Exhibits\2020-04-28 Flown Onsite exhibits 6-7\2020-04-28_AramisSolar_EX7A_100YearPeakVelocityZOOM.mxd mmhealy 4/28/2020 1:25:05 PM

Appendix A

Atlas 14 Rainfall Data

NOAA Atlas 14, Volume 6, Version 2
Location name: Livermore, California, USA*
Latitude: 37.7664°, Longitude: -121.7815°
Elevation: 721.43 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.114 (0.103-0.127)	0.141 (0.128-0.158)	0.179 (0.161-0.201)	0.211 (0.188-0.240)	0.257 (0.218-0.306)	0.295 (0.243-0.361)	0.335 (0.267-0.425)	0.378 (0.290-0.499)	0.441 (0.319-0.616)	0.493 (0.341-0.721)
10-min	0.164 (0.148-0.182)	0.203 (0.183-0.226)	0.256 (0.231-0.288)	0.303 (0.269-0.343)	0.369 (0.313-0.439)	0.422 (0.348-0.518)	0.480 (0.382-0.609)	0.542 (0.415-0.715)	0.632 (0.457-0.882)	0.707 (0.488-1.03)
15-min	0.198 (0.179-0.220)	0.245 (0.222-0.274)	0.310 (0.279-0.348)	0.366 (0.326-0.415)	0.446 (0.378-0.531)	0.511 (0.421-0.626)	0.580 (0.462-0.736)	0.656 (0.502-0.865)	0.764 (0.553-1.07)	0.855 (0.590-1.25)
30-min	0.270 (0.245-0.301)	0.335 (0.303-0.374)	0.423 (0.381-0.475)	0.500 (0.445-0.567)	0.609 (0.517-0.724)	0.697 (0.575-0.855)	0.792 (0.631-1.00)	0.895 (0.686-1.18)	1.04 (0.755-1.46)	1.17 (0.806-1.71)
60-min	0.382 (0.346-0.426)	0.474 (0.429-0.529)	0.600 (0.540-0.672)	0.708 (0.630-0.803)	0.862 (0.732-1.03)	0.988 (0.814-1.21)	1.12 (0.893-1.42)	1.27 (0.971-1.67)	1.48 (1.07-2.06)	1.65 (1.14-2.42)
2-hr	0.556 (0.504-0.620)	0.684 (0.619-0.764)	0.861 (0.776-0.965)	1.01 (0.901-1.15)	1.23 (1.04-1.46)	1.40 (1.16-1.72)	1.59 (1.27-2.02)	1.80 (1.38-2.37)	2.09 (1.51-2.91)	2.33 (1.61-3.41)
3-hr	0.695 (0.630-0.775)	0.855 (0.773-0.955)	1.08 (0.969-1.21)	1.26 (1.13-1.43)	1.53 (1.30-1.83)	1.75 (1.44-2.15)	1.98 (1.58-2.52)	2.24 (1.71-2.95)	2.60 (1.88-3.63)	2.90 (2.00-4.24)
6-hr	0.967 (0.876-1.08)	1.20 (1.09-1.34)	1.52 (1.37-1.70)	1.79 (1.59-2.03)	2.17 (1.84-2.58)	2.48 (2.04-3.04)	2.81 (2.24-3.56)	3.16 (2.42-4.17)	3.66 (2.65-5.11)	4.07 (2.81-5.96)
12-hr	1.25 (1.14-1.40)	1.60 (1.45-1.79)	2.07 (1.87-2.32)	2.46 (2.19-2.80)	3.01 (2.56-3.59)	3.45 (2.84-4.23)	3.91 (3.11-4.96)	4.39 (3.36-5.79)	5.07 (3.67-7.08)	5.62 (3.88-8.22)
24-hr	1.66 (1.54-1.84)	2.19 (2.02-2.42)	2.89 (2.66-3.20)	3.46 (3.17-3.86)	4.26 (3.79-4.89)	4.88 (4.26-5.71)	5.53 (4.73-6.59)	6.20 (5.18-7.58)	7.14 (5.75-9.04)	7.88 (6.17-10.3)
2-day	2.12 (1.96-2.34)	2.77 (2.56-3.07)	3.63 (3.34-4.03)	4.34 (3.97-4.85)	5.32 (4.72-6.10)	6.07 (5.30-7.10)	6.85 (5.86-8.18)	7.67 (6.40-9.37)	8.78 (7.08-11.1)	9.67 (7.57-12.6)
3-day	2.42 (2.24-2.68)	3.15 (2.91-3.48)	4.10 (3.78-4.55)	4.89 (4.47-5.45)	5.96 (5.30-6.84)	6.80 (5.94-7.94)	7.66 (6.55-9.13)	8.55 (7.14-10.4)	9.77 (7.88-12.4)	10.7 (8.40-14.0)
4-day	2.70 (2.49-2.98)	3.48 (3.21-3.85)	4.51 (4.15-5.00)	5.36 (4.90-5.98)	6.52 (5.79-7.48)	7.42 (6.48-8.67)	8.34 (7.14-9.95)	9.30 (7.77-11.4)	10.6 (8.56-13.4)	11.7 (9.12-15.2)
7-day	3.35 (3.10-3.71)	4.27 (3.94-4.72)	5.47 (5.03-6.06)	6.45 (5.89-7.20)	7.79 (6.93-8.95)	8.84 (7.72-10.3)	9.92 (8.48-11.8)	11.0 (9.22-13.5)	12.6 (10.1-15.9)	13.8 (10.8-18.0)
10-day	3.77 (3.48-4.17)	4.77 (4.40-5.27)	6.06 (5.58-6.72)	7.12 (6.51-7.94)	8.56 (7.61-9.82)	9.68 (8.45-11.3)	10.8 (9.26-12.9)	12.0 (10.0-14.7)	13.7 (11.0-17.3)	15.0 (11.7-19.5)
20-day	4.97 (4.59-5.49)	6.25 (5.77-6.92)	7.88 (7.25-8.73)	9.17 (8.39-10.2)	10.9 (9.68-12.5)	12.2 (10.6-14.2)	13.5 (11.5-16.1)	14.8 (12.4-18.1)	16.6 (13.4-21.0)	18.0 (14.1-23.5)
30-day	5.99 (5.54-6.62)	7.54 (6.96-8.34)	9.46 (8.71-10.5)	10.9 (10.0-12.2)	12.9 (11.4-14.8)	14.3 (12.5-16.7)	15.7 (13.4-18.7)	17.1 (14.3-20.9)	19.0 (15.3-24.0)	20.4 (16.0-26.6)
45-day	7.39 (6.82-8.16)	9.31 (8.59-10.3)	11.6 (10.7-12.9)	13.4 (12.2-14.9)	15.6 (13.8-17.9)	17.1 (15.0-20.0)	18.7 (16.0-22.3)	20.1 (16.8-24.6)	22.1 (17.8-27.9)	23.5 (18.4-30.6)
60-day	8.80 (8.13-9.72)	11.1 (10.2-12.3)	13.8 (12.7-15.3)	15.8 (14.4-17.6)	18.2 (16.2-20.9)	20.0 (17.4-23.3)	21.6 (18.4-25.7)	23.1 (19.3-28.2)	25.1 (20.2-31.7)	26.5 (20.7-34.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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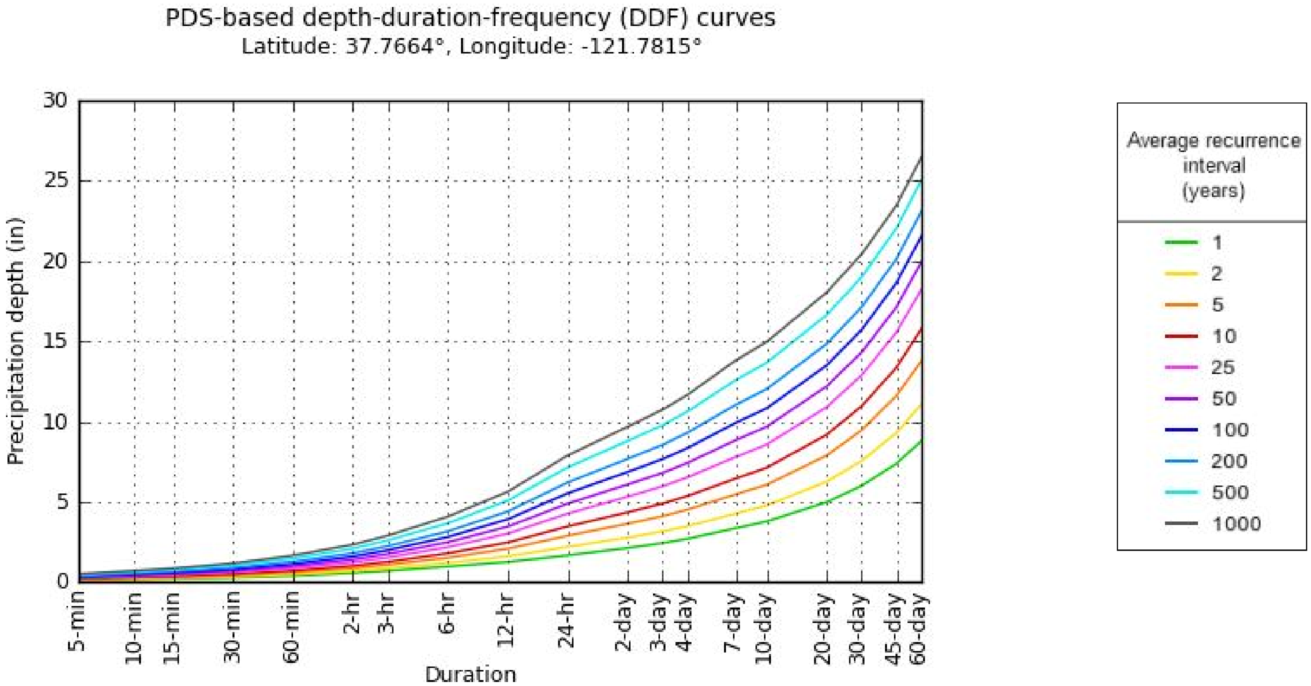
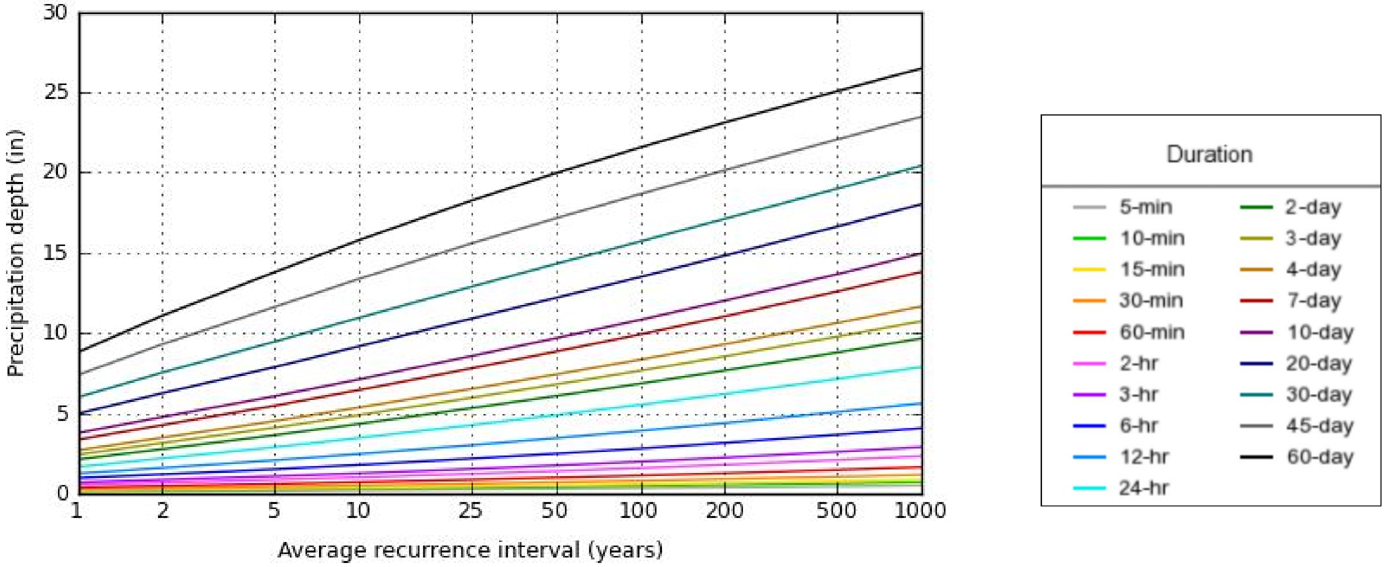
PF graphical





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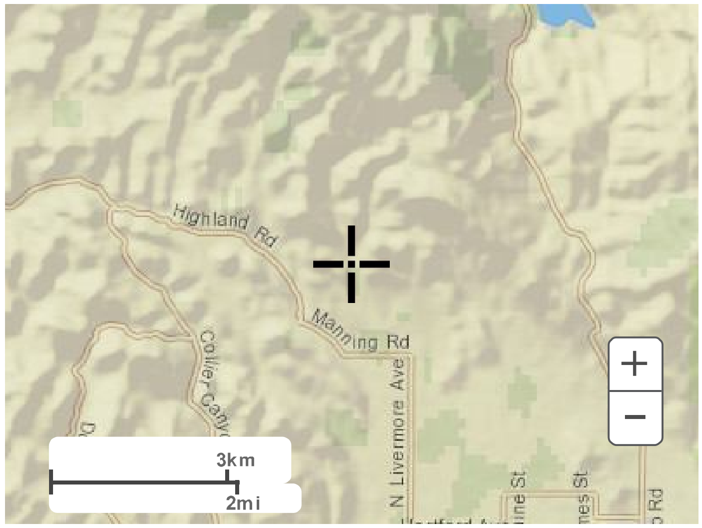
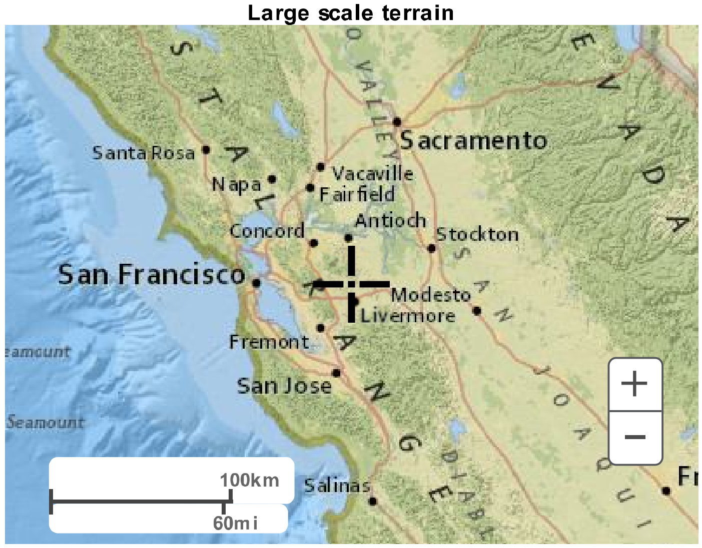
Maps & aerials

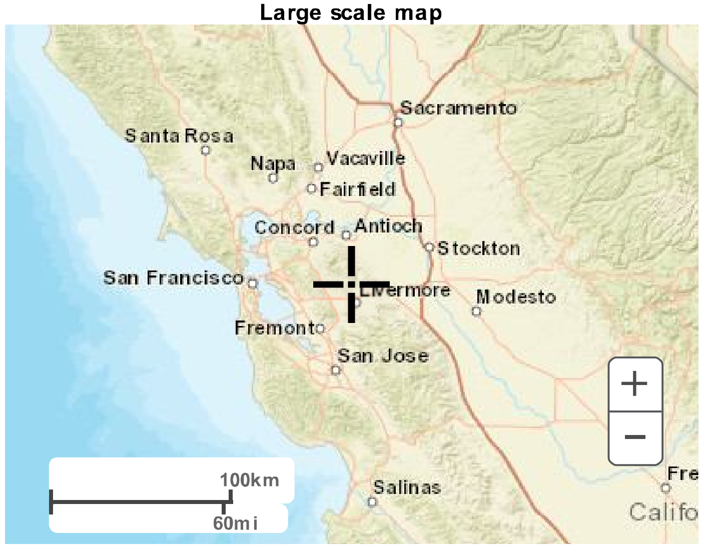
Small scale terrain



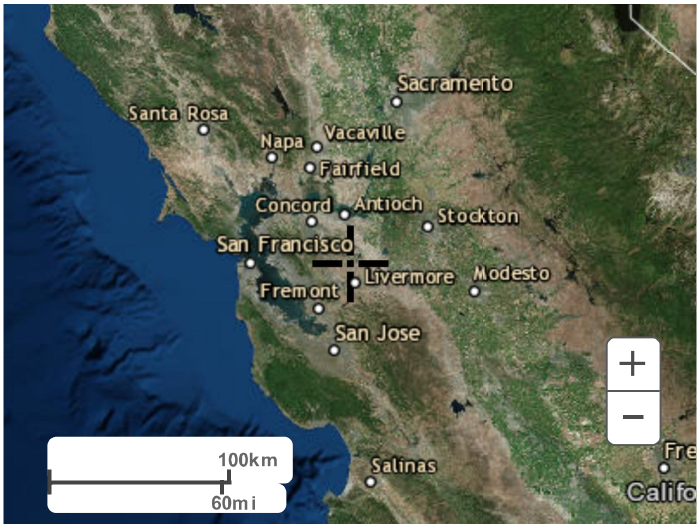
Large scale terrain



Large scale map



Large scale aerial



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[National Weather Service](#)
[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Appendix B

Curve Number Table

Table 1. Standard Curve Numbers

Class	Value	Classification Description [NLCD 2006]	Curve Number Soil Type* A	B	C	D	W
Water	11	Open Water - areas of open water, generally with less than 25% cover of vegetation or soil.	98	98	98	98	100
	12	Perennial Ice/Snow - areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.	98	98	98	98	100
Developed	21	Developed, Open Space - areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes	46	65	77	82	100
	22	Developed, Low Intensity - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.	61	75	83	87	100
	23	Developed, Medium Intensity – areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.	77	85	90	95	100
	24	Developed High Intensity -highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.	89	92	94	95	100
Barren	31	Barren Land (Rock/Sand/Clay) - areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	77	86	91	94	100
Forest	41	Deciduous Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.	43	55	70	77	100
	42	Evergreen Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.	43	55	70	77	100
	43	Mixed Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.	43	55	70	77	100
Shrubland	51	Dwarf Scrub - Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.	43	48	65	73	100
	52	Shrub/Scrub - areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.	43	48	65	73	100
Herbaceous	71	Grassland/Herbaceous - areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.	43	58	71	78	100
	72	Sedge/Herbaceous - Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.	43	58	71	78	100
	73	Lichens - Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.	43	48	65	73	100
	74	Moss - Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.	43	48	65	73	100
Planted/Cultivated	81	Pasture/Hay – areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.	43	58	71	78	100
	82	Cultivated Crops – areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.	67	78	85	89	100
	83	Small Grains	63	75	83	87	100
Wetlands	91	Woody Wetlands - areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	45	66	77	83	100
	92	Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	45	66	77	83	100

*A/D, B/D and C/D soils lumped as D soils, W denotes water

**Curve Numbers for NLCD Codes 41-81 have been increased from 30 to 43 as many of these areas are partially grazed Woods-grass combination.

Appendix C

FEMA Maps

NOTES TO USERS

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The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 10. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

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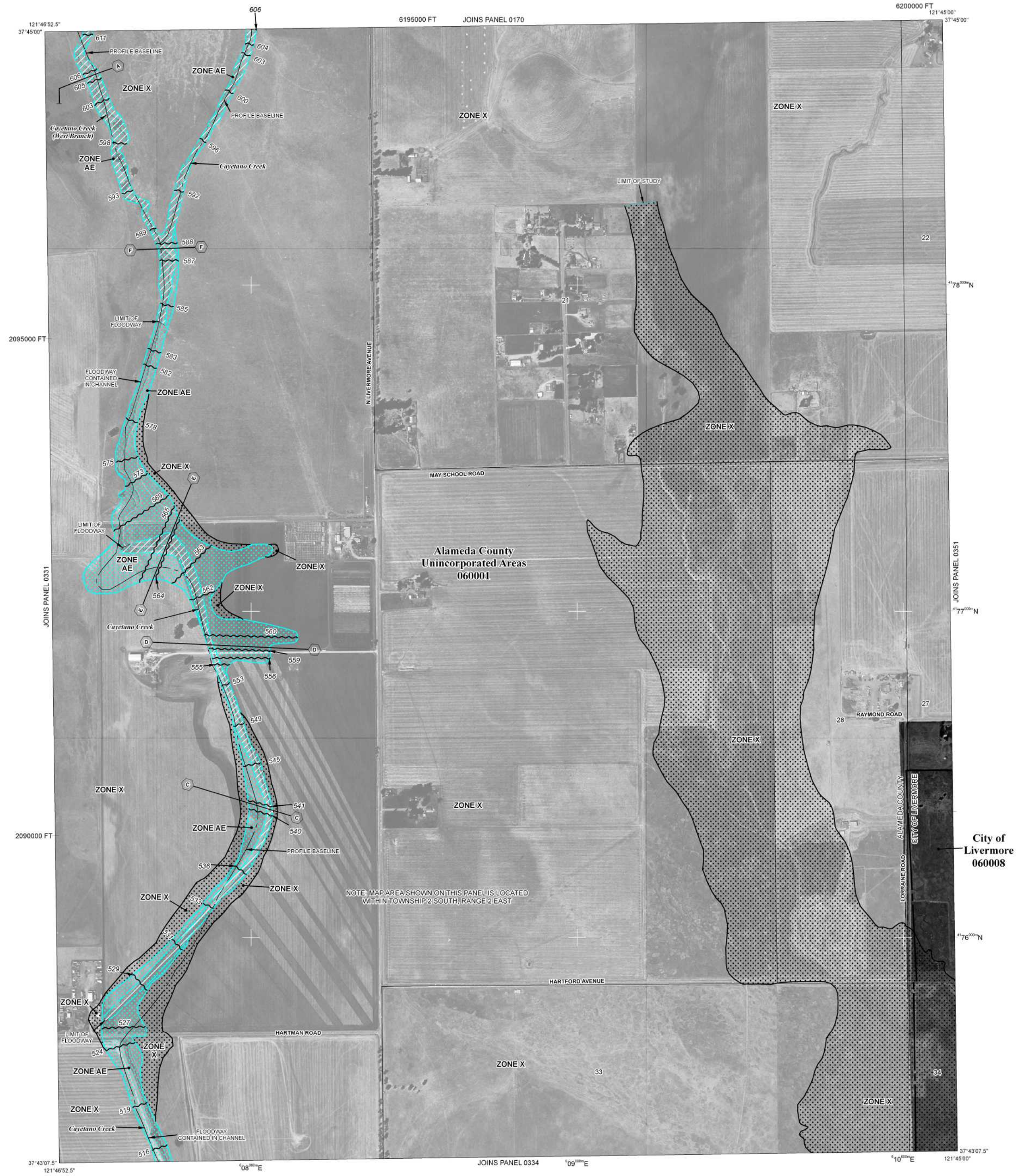

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
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ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- ~~~ 513 ~~~ — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)——(A)	Cross section line
(23)- - - -(23)	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
2476000mN	1000-meter Universal Transverse Mercator grid values, zone 10N
600000 FT	5000-foot grid ticks: California State Plane coordinate system, zone III (FIPSZONE 0403), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 3, 2009

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0332G

FIRM
FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 332 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ALAMEDA COUNTY	060001	0332	G
LIVERMORE, CITY OF	060008	0332	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06001C0332G

EFFECTIVE DATE
AUGUST 3, 2009

Federal Emergency Management Agency

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N

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NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0331G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 331 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

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ALAMEDA COUNTY	060001	0331	G

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MAP NUMBER
06001C0331G

EFFECTIVE DATE
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Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 10. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Within the City of Livermore, base map information was derived from digital orthophotos provided by the City of Livermore Engineering Department. This information was produced at scales of 1:1,200 and 1:2,400 with 1-foot pixel resolution from photography dated May 7, 2001. Within the City of San Leandro, base map information was derived from digital orthophotos provided by the City of San Leandro Information Services Department. This information was produced at a scale of 1:2,400 with 1-foot pixel resolution from photography dated April 19, 2003. Additional information was derived from U.S. Geological Survey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1991 or later.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)——(A)	Cross section line
(23)- - - - -(23)	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
²⁴76⁰⁰⁰ᵐN	1000-meter Universal Transverse Mercator grid values, zone 10N
600000 FT	5000-foot grid ticks: California State Plane coordinate system, zone III (FIPSZONE 0403), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 3, 2009

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

N

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0170G

FIRM

FLOOD INSURANCE RATE MAP

ALAMEDA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 170 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ALAMEDA COUNTY	060001	0170	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06001C0170G

EFFECTIVE DATE
AUGUST 3, 2009

Federal Emergency Management Agency