

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): May 29, 2013

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: SPL-2012-00498(JD-BEM)- Agincourt Solar Project

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State: California County/parish/borough: San Bernardino City: Unincorporated

Center coordinates of site (lat/long in degree decimal format): Lat. 34.397950°N, Long. -116.866526°W.

Universal Transverse Mercator: 512628.27 m E, 3807343.44 m N; Zone 11S

Name of nearest waterbody: Lucerne Dry Lake

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: None

Name of watershed or Hydrologic Unit Code (HUC): Blackhawk Canyon-Cougar Buttes (10 digit HUC: 1810010003)

Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.

Check if other sites (e.g., offsite mitigation sites, disposal sites, etc...) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

Office (Desk) Determination. Date: April 30, 2013

Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "navigable waters of the U.S." within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [Required]

Waters subject to the ebb and flow of the tide.

Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.

Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are no** "waters of the U.S." within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [Required]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply):¹

- TNWs, including territorial seas
- Wetlands adjacent to TNWs
- Relatively permanent waters² (RPWs) that flow directly or indirectly into TNWs
- Non-RPWs that flow directly or indirectly into TNWs
- Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
- Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
- Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
- Impoundments of jurisdictional waters
- Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:

Non-wetland waters: linear feet: width (ft) and/or acres.

Wetlands: acres.

c. Limits (boundaries) of jurisdiction based on: Pick List

Elevation of established OHWM (if known): .

2. Non-regulated waters/wetlands (check if applicable):³

- Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: **The project is located south of the Mojave River in Lucerne Valley . Lucerne Valley is located in what the Mojave Water Agency refers to as the "Este Subarea" (see Attachment 1) of the Morongo Groundwater Basin. On-site intermittent drainages (Drainage W1 through W12) totaling 9.15 acres are non-RPWs that have no downstream connectivity to a TNW, nor do they have a nexus to interstate or foreign commerce (see Attachment 2). The non-RPWs flows north off the project site and then, most likely northwest to Lucerne Dry Lake (see attachments 3 and 4)**

¹ Boxes checked below shall be supported by completing the appropriate sections in Section III below.

² For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).

³ Supporting documentation is presented in Section III.F.

based on adjacent flow patterns and elevation. This flow pattern would be consistent with the Lucerne Valley Groundwater Basin (California Groundwater Bulletin 118, Attachment 4) . Helendale fault transects the southwest portion of the basin, separating the Morongo Groundwater Basin from the Mojave River Groundwater Basin, creating a barrier to groundwater flow (Attachments 3 and 4). A scientific study funded by the Mojave Water Agency entitled “Geologic Insight to Lucerne Valley Groundwater Basin” concluded that the basin is considered a closed watershed with no external surface water flows out from the basin and the topographic low of the basin is Lucerne Dry Lake (Attachment 5). Based on the topography of the area and the groundwater basin information, the Corps concludes Drainages W1 through W12 are non-RPWs, are considered isolated under SWANCC (see III.F.below) and therefore are not jurisdictional water of the United States.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. TNW

Identify TNW: _____ .

Summarize rationale supporting determination: _____ .

2. Wetland adjacent to TNW

Summarize rationale supporting conclusion that wetland is “adjacent”: _____ .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are “relatively permanent waters” (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody⁴ is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. Characteristics of non-TNWs that flow directly or indirectly into TNW

(i) General Area Conditions:

Watershed size: **Pick List**

Drainage area: **Pick List**

Average annual rainfall: _____ inches

Average annual snowfall: _____ inches

(ii) Physical Characteristics:

(a) Relationship with TNW:

Tributary flows directly into TNW.

Tributary flows through **Pick List** tributaries before entering TNW.

⁴ Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

Project waters are **Pick List** river miles from TNW.
 Project waters are **Pick List** river miles from RPW.
 Project waters are **Pick List** aerial (straight) miles from TNW.
 Project waters are **Pick List** aerial (straight) miles from RPW.
 Project waters cross or serve as state boundaries. Explain:

Identify flow route to TNW⁵:
 Tributary stream order, if known:

(b) General Tributary Characteristics (check all that apply):

Tributary is: Natural
 Artificial (man-made). Explain:
 Manipulated (man-altered). Explain:

Tributary properties with respect to top of bank (estimate):

Average width: feet
 Average depth: feet
 Average side slopes: **Pick List**.

Primary tributary substrate composition (check all that apply):

<input type="checkbox"/> Silts	<input type="checkbox"/> Sands	<input type="checkbox"/> Concrete
<input type="checkbox"/> Cobbles	<input type="checkbox"/> Gravel	<input type="checkbox"/> Muck
<input type="checkbox"/> Bedrock	<input type="checkbox"/> Vegetation. Type/% cover:	
<input type="checkbox"/> Other. Explain:		

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain:

Presence of run/riffle/pool complexes. Explain:

Tributary geometry: **Pick List**

Tributary gradient (approximate average slope): %

(c) Flow:

Tributary provides for: **Pick List**

Estimate average number of flow events in review area/year: **Pick List**

Describe flow regime:

Other information on duration and volume:

Surface flow is: **Pick List**. Characteristics:

Subsurface flow: **Pick List**. Explain findings:

Dye (or other) test performed:

Tributary has (check all that apply):

<input type="checkbox"/> Bed and banks	
<input type="checkbox"/> OHWM ⁶ (check all indicators that apply):	
<input type="checkbox"/> clear, natural line impressed on the bank	<input type="checkbox"/> the presence of litter and debris
<input type="checkbox"/> changes in the character of soil	<input type="checkbox"/> destruction of terrestrial vegetation
<input type="checkbox"/> shelving	<input type="checkbox"/> the presence of wrack line
<input type="checkbox"/> vegetation matted down, bent, or absent	<input type="checkbox"/> sediment sorting
<input type="checkbox"/> leaf litter disturbed or washed away	<input type="checkbox"/> scour
<input type="checkbox"/> sediment deposition	<input type="checkbox"/> multiple observed or predicted flow events
<input type="checkbox"/> water staining	<input type="checkbox"/> abrupt change in plant community
<input type="checkbox"/> other (list):	
<input type="checkbox"/> Discontinuous OHWM. ⁷ Explain:!!!!.	

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):

<input type="checkbox"/> High Tide Line indicated by:	<input type="checkbox"/> Mean High Water Mark indicated by:
<input type="checkbox"/> oil or scum line along shore objects	<input type="checkbox"/> survey to available datum;
<input type="checkbox"/> fine shell or debris deposits (foreshore)	<input type="checkbox"/> physical markings;
<input type="checkbox"/> physical markings/characteristics	<input type="checkbox"/> vegetation lines/changes in vegetation types.

⁵ Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

⁶A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.

⁷Ibid.

- tidal gauges
- other (list):

(iii) Chemical Characteristics:

Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).

Explain:

Identify specific pollutants, if known:

(iv) Biological Characteristics. Channel supports (check all that apply):

- Riparian corridor. Characteristics (type, average width):
- Wetland fringe. Characteristics:
- Habitat for:
 - Federally Listed species. Explain findings:
 - Fish/spawn areas. Explain findings:
 - Other environmentally-sensitive species. Explain findings:
 - Aquatic/wildlife diversity. Explain findings:

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:

Properties:

Wetland size: acres

Wetland type. Explain:

Wetland quality. Explain:

Project wetlands cross or serve as state boundaries. Explain:

(b) General Flow Relationship with Non-TNW:

Flow is: **Pick List**. Explain:

Surface flow is: **Pick List**

Characteristics:

Subsurface flow: **Pick List**. Explain findings:

- Dye (or other) test performed:

(c) Wetland Adjacency Determination with Non-TNW:

- Directly abutting
- Not directly abutting
 - Discrete wetland hydrologic connection. Explain:
 - Ecological connection. Explain:
 - Separated by berm/barrier. Explain:

(d) Proximity (Relationship) to TNW

Project wetlands are **Pick List** river miles from TNW.

Project waters are **Pick List** aerial (straight) miles from TNW.

Flow is from: **Pick List**.

Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain:

Identify specific pollutants, if known:

(iii) Biological Characteristics. Wetland supports (check all that apply):

- Riparian buffer. Characteristics (type, average width):
- Vegetation type/percent cover. Explain:
- Habitat for:
 - Federally Listed species. Explain findings:
 - Fish/spawn areas. Explain findings:
 - Other environmentally-sensitive species. Explain findings:
 - Aquatic/wildlife diversity. Explain findings:

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**

Approximately () acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N) Size (in acres) Directly abuts? (Y/N) Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .
2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .
3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:

- TNWs: linear feet width (ft), Or, acres.
 Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**

- Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
 Tributaries of TNW where tributaries have continuous flow “seasonally” (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):

- Tributary waters: linear feet width (ft).
 Other non-wetland waters: acres.

Identify type(s) of waters: .

3. Non-RPWs⁸ that flow directly or indirectly into TNWs.

- Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):

- Tributary waters: linear feet width (ft).
 Other non-wetland waters: acres.

Identify type(s) of waters: .

4. Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.

- Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
 Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .
 Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.

- Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.

- Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. Impoundments of jurisdictional waters.⁹

As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.

- Demonstrate that impoundment was created from "waters of the U.S.," or
 Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
 Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):¹⁰

- which are or could be used by interstate or foreign travelers for recreational or other purposes.
 from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
 which are or could be used for industrial purposes by industries in interstate commerce.
 Interstate isolated waters. Explain: .
 Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

⁸See Footnote # 3.

⁹To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

¹⁰Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA Memorandum Regarding CWA Act Jurisdiction Following Rapanos.

Provide estimates for jurisdictional waters in the review area (check all that apply):

- Tributary waters: linear feet width (ft).
- Other non-wetland waters: acres.
Identify type(s) of waters: .
- Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

- If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
- Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
 - Prior to the Jan 2001 Supreme Court decision in "SWANCC," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
- Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
- Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):

- Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
- Lakes/ponds: acres.
- Other non-wetland waters: acres. List type of aquatic resource: .
- Wetlands: .

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):

- Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
- Lakes/ponds: acres.
- Other non-wetland waters: acres. List type of aquatic resource: .
- Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

- Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: .
- Data sheets prepared/submitted by or on behalf of the applicant/consultant.
 - Office concurs with data sheets/delineation report.
 - Office does not concur with data sheets/delineation report.
- Data sheets prepared by the Corps: .
- Corps navigable waters' study: .
- U.S. Geological Survey Hydrologic Atlas: .
 - USGS NHD data. NHD data from Corps Maps.
 - USGS 8 and 12 digit HUC maps.
- U.S. Geological Survey map(s). Cite scale & quad name: .
- USDA Natural Resources Conservation Service Soil Survey. Citation: USDA U.S. General Soil Map (Soil Survey Staff 2012).
- National wetlands inventory map(s). Cite name: .
- State/Local wetland inventory map(s): .
- FEMA/FIRM maps: .
- 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
- Photographs: Aerial (Name & Date): .
or Other (Name & Date): Google Earth imagery, USGS EHP Quaternary Fault map.
- Previous determination(s). File no. and date of response letter: .
- Applicable/supporting case law: .
- Applicable/supporting scientific literature: "Geologic Insight to Lucerne Valley Groundwater Basin", Blazevic, M., Laton, W.R., and Foster, J. (<http://www.grac.org/lucerne.pdf>, 22 March 2006).
- Other information (please specify): CA Groundwater Bulletin #118 Lucerne Valley, Mojave Water Agency Maps, USGS basin map.

B. ADDITIONAL COMMENTS TO SUPPORT JD: N/A

ATTACHMENT 1

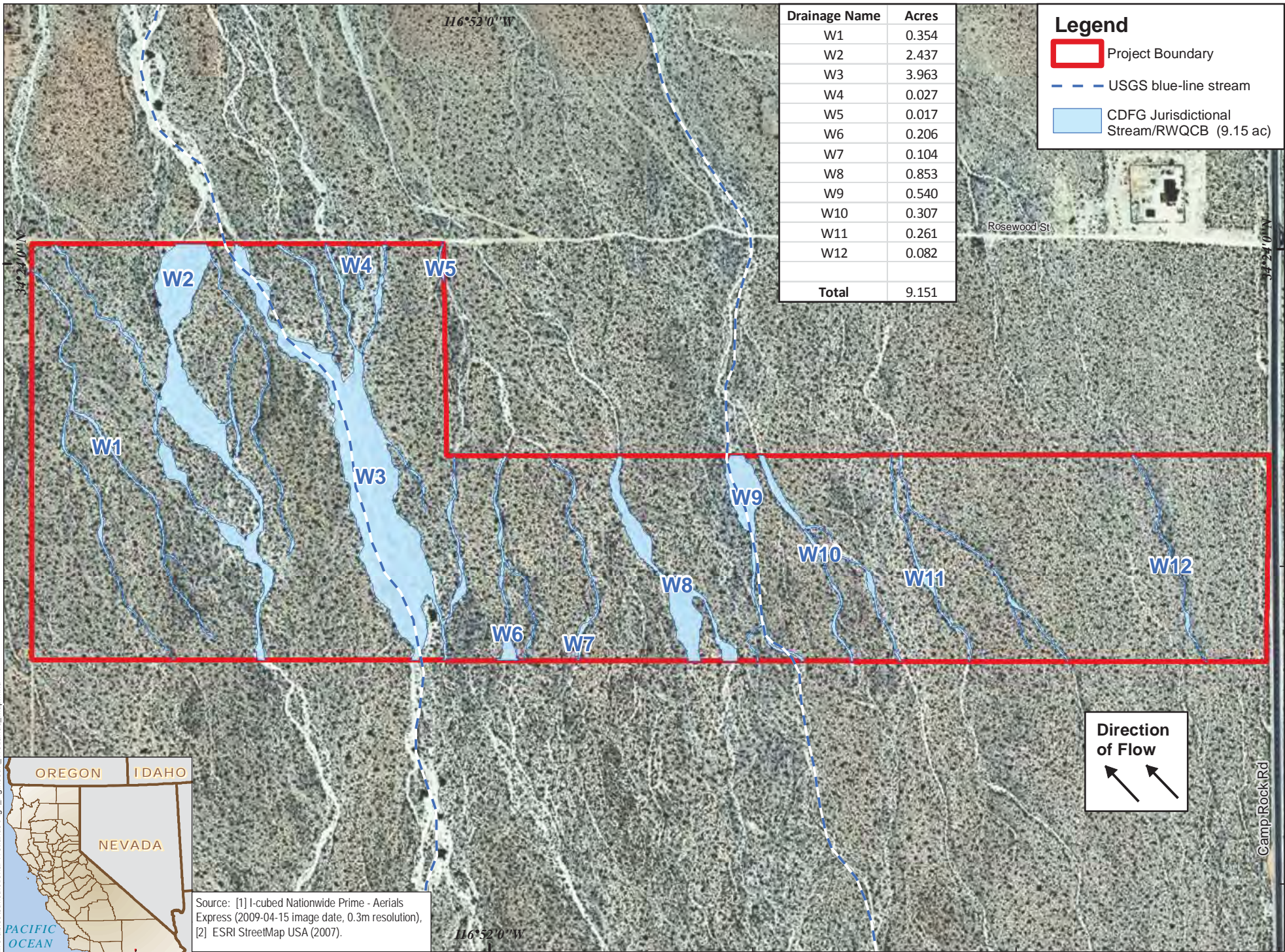
Mojave Water Agency Adjudicated Boundary



- Adjudicated Boundary
- Subarea Boundary
- MWA Boundary



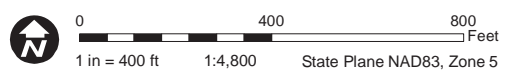
ATTACHMENT 2



T:\WDGCP\deliverables\Jurisdictional Wetlands\Fig4_Agincourt Wetlands_Map.mxd



Source: [1] I-cubed Nationwide Prime - Aerials Express (2009-04-15 image date, 0.3m resolution), [2] ESRI StreetMap USA (2007).

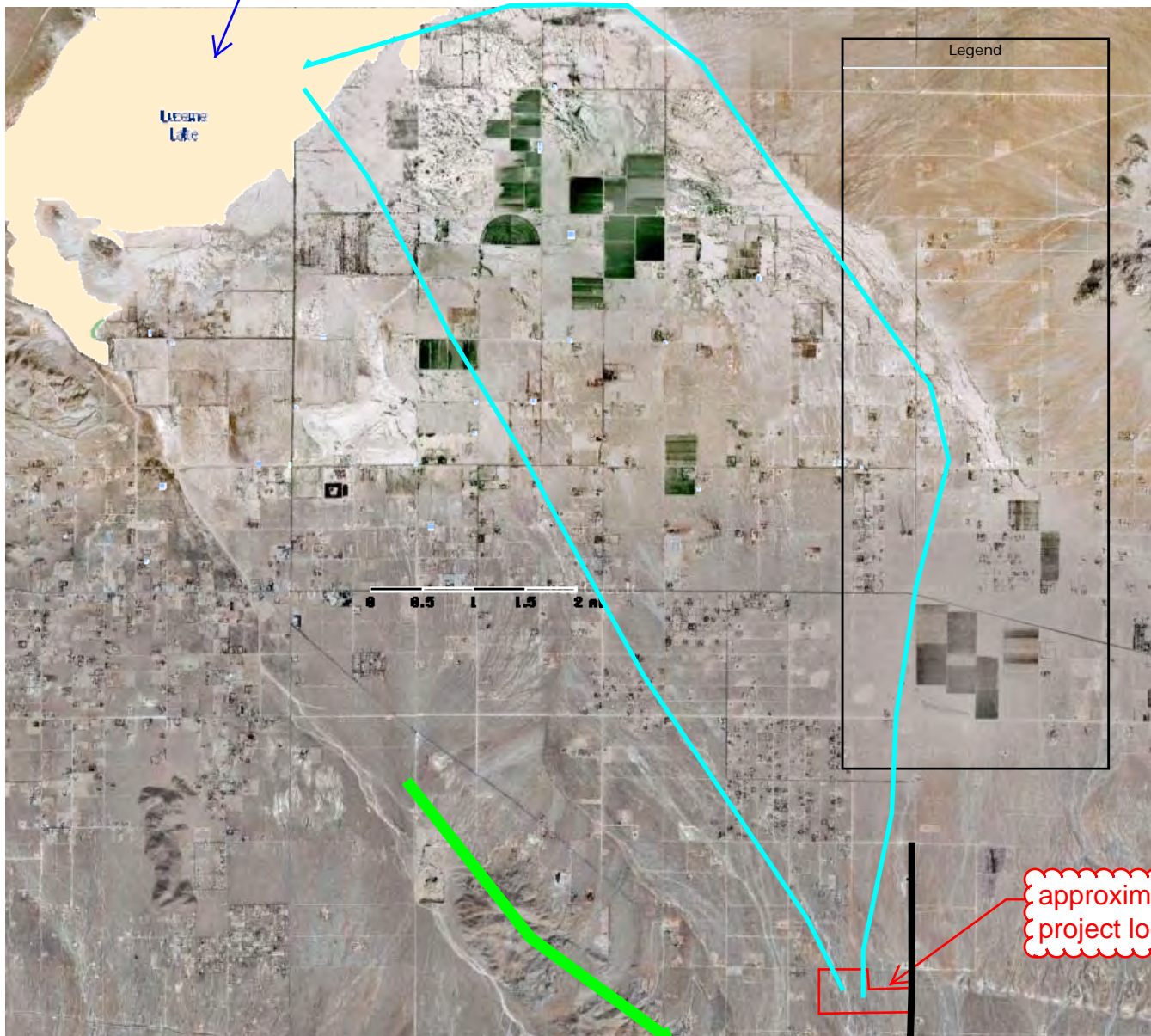





WDG CP Agincourt Solar Project
Jurisdictional Determination Report
San Bernardino County, CA

Figure 4. JURISDICTIONAL AREAS

ATTACHMENT 3

Lucerne Dry Lake



-  likely northwest flows to Lucerne Dry Lake
-  approximate location of Helendale fault, which continues to Camp Rock Road
-  Camp Rock Road



ATTACHMENT 4

Lucerne Valley Groundwater Basin

- Groundwater Basin Number: 7-19
- County: San Bernardino
- Surface Area: 148,000 acres (230 square miles)

Basin Boundaries and Hydrology

Lucerne Valley Groundwater Basin underlies Lucerne and North Lucerne Valleys in the northwest part of the Colorado River Hydrologic Region. The basin is bounded on the south by the San Bernardino Mountains and on the west by the Granite Mountains and the Helendale fault. The Ord Mountains bound the basin on the north. The Camp Rock fault and Kane Wash Area Groundwater Basin bound this basin on the east and the Fry Mountains bound this basin on the southeast. Parts of the eastern and southeastern boundaries are surface drainage divides.

Surface water drains toward Lucerne (dry) Lake in the western portion of the basin, which has an altitude of 2,850 feet above sea level (Schaefer 1979). Average annual precipitation is 4 to 6 inches in the lower part of the valley and 6 to 8 inches in the upper parts of the valley.

Hydrogeologic Information

Water Bearing Formations

The principal water-bearing deposits are Quaternary age alluvium, and dune sand. The deposits are unconsolidated or semi-consolidated and the alluvium is composed of gravel, sand, silt, clay, and occasional boulders. Where saturated, the alluvium yields water freely to wells. The average specific yield for these deposits is 11 percent. Irrigation wells in the basin yield as much as 1,000 gpm (Schaefer 1979).

Thickness of the alluvial deposits varies throughout the basin and reaches at least 1,800 feet along the Helendale fault. Water well and oil well logs indicate that the thickness of the alluvium averages about 600 feet (Schaefer 1979).

Fine-grained playa deposits in the western part of the basin yield little water to wells and the water is usually of poor quality (Schaefer 1979). In the western part of the basin, between Lucerne Lake and Helendale faults, a thick layer of playa deposits separates the groundwater system into an upper unconfined aquifer and a lower, confined aquifer. Throughout the rest of the basin, groundwater is unconfined (Schaefer 1979).

Restrictive Structures

Two northwest-trending faults transect the basin and form barriers to groundwater flow. The Helendale fault is most prominent and crosses the southwestern part of the basin; the Lucerne Lake fault lies about two miles to the northeast (Schaefer 1979). Evidence that these faults impede groundwater flow is shown by water-level differences across the faults ranging from 60 to 100 feet (Schaefer 1979). Along the southern edge of the valley, several small faults form part of the North Frontal fault system of the

San Bernardino Mountains. Springs along the base of the mountain range are associated with some of these faults (Schaefer 1979).

Recharge Areas

The basin is principally recharged by runoff from the San Bernardino Mountains and secondarily by runoff from the Granite, Ord, and Fry Mountains to the north. Groundwater generally flows from areas of recharge toward Lucerne Lake (Schaefer 1979).

Groundwater Level Trends

Depth to water varies from several feet below land surface, near the Helendale fault, to more than 300 feet along the flanks of the San Bernardino Mountains; however, in most parts of the basin, it is about 150 feet (Schaefer 1979).

Water levels have declined in parts of the basin since 1917 (Schaefer 1979). Water level declines of 40 to 100 feet affecting both the unconfined and confined aquifers have occurred in the southwestern part of the basin. Some wells in the basin have declined as much as 100 feet since the early 1950s, indicating that overdraft is occurring (Mendez and Christensen 1997). Land subsidence was noted by 1977 and had apparently been occurring in parts of the basin for many years because of overdraft of the aquifer system (Fife 1977).

Groundwater Storage

Groundwater Storage Capacity. Total groundwater storage capacity for the basin is reported to be about 4,740,000 af (DWR 1975) and 2,000,000 af (Schaefer 1979). The 2,000,000 af capacity was calculated for 1917 water levels, and presumably represents a steady-state full basin (Schaefer 1979).

Groundwater in Storage. Groundwater in storage was estimated to be 1,750,000 af in 1977 (Schaefer 1979).

Groundwater Budget (Type A)

A hydrologic budget for the basin using 1976 data was estimated by Schaefer (1979). Recharge was reported at 1,000 af, discharge was 10,000 af, and change in storage was 9,000 af. Groundwater overdraft of 9,000 af/yr was calculated using this data. Recharge has been estimated to be 1,000 af/yr (DWR 1967).

Groundwater Quality

Characterization. Calcium-magnesium bicarbonate water is found in the southwestern part of the basin. TDS content range from 200 to 500 mg/L in the southwestern part of the basin except near Rabbit Springs where they are as high as 2,000 mg/L (Schaefer 1979). In the southeastern part of the basin, there is a mixture of calcium bicarbonate and magnesium-sodium sulfate water. Where magnesium-sodium sulfate water predominates, TDS concentrations range from 300 to 1,200 mg/L and average about 800 mg/L. Groundwater near Lucerne Lake is sodium chloride in character and has TDS concentrations that range from 1,200 to 7,000 mg/L and average about 5,000 mg/L (Schaefer 1979). In a shallow aquifer zone, TDS concentrations

average about 2,700 mg/L; whereas, in the deeper aquifer zone, they average about 1,300 mg/L (Schaefer 1979).

Impairments. High nitrate and TDS concentrations associated with irrigation are found in the shallow aquifer (Schaefer 1979).

Water Quality in Public Supply Wells

Constituent Group ¹	Number of wells sampled ²	Number of wells with a concentration above an MCL ³
Inorganics – Primary	5	0
Radiological	4	0
Nitrates	6	0
Pesticides	4	0
VOCs and SVOCs	4	0
Inorganics – Secondary	5	0

¹ A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).

² Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.

³ Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: 10 – 1,000 gal/min (Schaefer 1979)	Average:
	Total depths (ft)	
Domestic	Range: 85-314 ft (Schaefer 1979)	Average:
Municipal/Irrigation	Range: 209-778 ft (Schaefer 1979)	Average:

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
USGS	Water Quality	9
Department of Health Services	Title 22 Water Quality	3
USGS	Water Levels	22

Basin Management

Groundwater management: A Regional Water Management Plan has been in use since 1994.

Water agencies

Public Mojave Water Agency

Private

References Cited

- California Department of Water Resources (DWR). 1967. *Mojave River Ground Water Basins Investigation*. Bulletin No. 84. 151 p.
- _____. 1975. *California's Groundwater*. Bulletin No. 118. 135 p.
- Fife, D.L. 1977. *Engineering Geologic Significance of Giant Desiccation Polygons, Lucerne Valley Playa, San Bernardino County, California*. Geological Society of America, Cordilleran Section 73rd. Sacramento, California. p. 419.
- Mendez, M.O., and A.H. Christensen. 1997. *Regional Water Table (1996) and Water-Level Changes in the Mojave River, the Morongo, and the Fort Irwin Ground-Water Basin, San Bernardino County, California*. U.S. Geological Survey Water-Resources Investigations Report 97-4160. 34 p.
- Schaefer, D.H. 1979. *Ground-Water Conditions and Potential for Artificial Recharge in Lucerne Valley, San Bernardino County, California*. U.S. Geological Survey Water-Resources Investigations 78-118. 37 p.

Additional References

- California Department of Public Works. 1954. *Ground Water Occurrence and Quality, Colorado River Basin Region*. Water Quality Investigations Report No. 4.
- Mabey, D.R. 1960. *Gravity Survey of the Western Mojave Desert, California*. U.S. Geological Survey. Professional Paper 316-D. p. 51-73.
- Riley, F.S. 1956. *Data on Water Wells in Lucerne, Johnson, Fry, and Means Valleys, San Bernardino County, California*. U.S. Geological Survey Open-File Report. 150 p.
- South Coast Geological Society. 1976. *Geologic Guide to Southwestern Mojave Desert Region, California*. Tustin: South Coast Geological Society. 122 p.

Errata

Changes made to the basin description will be noted here.

ATTACHMENT 5

Geologic Insight to Lucerne Valley Groundwater Basin

¹Blazevic, M., ²Laton, W.R., and ²Foster, J.

The Lucerne Valley groundwater basin is considered a closed watershed basin in that no external surface water flows from the basin. It is typified by large mountain ranges surrounding the basin with protruding hills of basement rocks exposed throughout the region. Its borders are defined by the Ord, Rodman and Stoddard Mountains to the north, the Granite Mountains and crests of alluvial fans in the west, Fry and Cougar Buttes Mountains to the east, and the large San Bernardino Mountains to the south. Adjacent to the mountain fronts, large alluvial fans slope towards the center of the basin where ephemeral (seasonal) streams deposit alluvial materials. The Lucerne Valley groundwater basin has a topographic low of 2,848 feet (ft) (amsl) in Lucerne (dry) Lake and rises to 8,248 ft in the San Bernardino Mountains (Fig. 1).

Materials that comprise the basin are derived from the weathering and erosion of surrounding mountains and consist of igneous, metamorphic, sedimentary rocks, and alluvial deposits. Alluvial materials adjacent to mountain fronts and in the central valley consist of Tertiary formations, Quaternary stream alluvium, alluvial fan deposits, playa deposits, landslide deposits, and dune sand [Gardner, 1941; Hewett, 1954; Dibblee, 1964a and 1964b; DWR, 1967; and Sadler, 1982a]. The Tertiary formations and stream or alluvial fan deposits are permeable, consisting of varying porosities, with high specific yields, and comprise the aquifers in the basin. They are designated water-bearing units; typically composed of gravel and sand, with minor silt, clay, and occasional boulders that are unconsolidated to semiconsolidated. The total thickness of the water-bearing units is estimated to be approximately 1,000-1,400 ft throughout most of the Lucerne Valley groundwater basin.

The predominant structural features in the Lucerne Valley groundwater basin that affect the subsurface distribution of water-bearing materials include a set of northwest trending, right-lateral, strike-slip faults: the Helendale, Lenwood, Camp Rock, and Old Woman Springs faults. These faults comprise the younger expression (late Cenozoic to early Quaternary) of the Eastern California shear zone [Dokka and Travis, 1990a and 1990b]. The Helendale, Lenwood, and Camp Rock faults also intersect a zone of thrust faults parallel to the northern front of the San Bernardino Mountains. This zone is known as the North Frontal thrust system of the San Bernardino Mountains and acts as a boundary to the basin aquifer at the southern edge of Lucerne Valley.

In assessing the subsurface geology of the Lucerne Valley groundwater basin, the following methods were applied: (1) geologic maps of Lucerne Valley [Dibblee, 1964; Sadler, 1982a; and Miller and Matti, 2003] were used to construct preliminary cross-sections; (2) all available and applicable driller's water well logs, oil well logs, and USGS monitoring well data were reviewed with respect to well location, depth of well, and detail of well log; and (3) based on well information and location of wells, 14 wells were gamma logged using a MGX II Portable Logger with the MGX II Console (Fig. 2).

The Old Woman Sandstone, of Shreve [1968] is exposed sporadically by faulting along the northern base of the San Bernardino Mountains. The unit is unconformable on plutonic pre-

Tertiary rocks and is estimated to reach thicknesses between 600 to 1,000 ft underlying most of Lucerne Valley groundwater basin [Dibblee, 1964a]. Its age has been estimated by several workers to lie between the late Miocene and the Pliocene. Dibblee [1964a] estimates the age of Old Woman Sandstone to be late Miocene, based on the unit lying unconformably on pre-Tertiary rocks. May and Repenning [1982] suggest the age of the Old Woman Sandstone to be Pliocene in age, based on mammalian fossils (rodent and horse teeth) found 8 miles southeast of Lucerne Valley in sandy material. Shreve [1968] and Riley [1956] also suggest the unit might be middle to late Pliocene in age.

The lithology of the Old Woman Sandstone varies within the Lucerne Valley groundwater basin, but generally consists of a succession of interbedded units of arkosic sandstone, conglomerate, limestone, silt and clay, and scattered basalt [Dibblee, 1964a; Shreve, 1968; and Sadler, 1982b]. Conglomerate is composed of cobbles and pebbles of granitic rocks, quartzite, schist, gneiss, vein quartz, Tertiary andesite and basalt, and rarely Furnace limestone, in order of decreasing abundances, within a sandy matrix [Dibblee, 1964a and Shreve, 1968]. This rock unit is identified in well logs by driller comments such as: "cementation" or "black rock." These terms refer to compaction and cementation of material or volcanic rock and cobbles found in the Old Woman Sandstone.

The older fanglomerate and older alluvium are unconformable above the Old Woman Sandstone and are exposed along the foot of the San Bernardino Mountains. The older alluvium deposits underlie most of Lucerne Valley, whereas the older fanglomerate unit pinches out to the north, grading into older and younger alluvium [Dibblee, 1964a]. The older fanglomerate is composed of poorly sorted, subrounded fragments of quartzite, granite, and Furnace Limestone approximately 500 ft in thickness [Dibblee, 1964a and Goodrich, 1978]. The older alluvium consists of gravels and sand fragments derived from surrounding hills. Dibblee [1964a] estimated the deposits to be of Pleistocene in age and reach thicknesses up to several hundred feet.

The unconsolidated surficial sediments consist of younger fanglomerates, younger alluvium, and playa deposits that are unconformable above older formations. The fanglomerates are exposed along the base of the San Bernardino Mountains and along other mountains as large fragments derived from surrounding hills which grade into younger alluvial deposits. The alluvium is composed of gravel, sand, and clay that is also derived from adjacent hills. Younger surficial deposits range in thickness from a few inches to approximately 100 ft [DWR, 1967]. The playa deposits, which are concentrated in the Lucerne (dry) Lake and Rabbit Springs (dry) Lake regions, consist predominantly of fine sand, clay, and silt approximately 100 to 150 ft thick [Brose, 1987].

Depth to basement, based on water-well logs and two oil-test holes, suggest bedrock is encountered approximately 1,200 ft below ground surface (bgs) in Lucerne Valley groundwater basin [Division of Oil and Gas, 1964]. Along the Helendale fault, the Division of Oil and Gas [1964] suggest basement rock is reached approximately 1,800 ft bgs.

Conclusions:

Old Woman Sandstone varies slightly in thickness throughout the groundwater basins, with an approximate thickness between 600 to 1,400 ft, where the deepest portion of the basin is through the center of Lucerne Valley. The estimated volume of the Old Woman Sandstone is 3.39×10^{12} ft³. Lucerne Valley groundwater basin appears to be dominated by a single aquifer system, but displays both unconfined and confined conditions. Towards the north and south edges of the basin the aquifer displays unconfined conditions with gravels and gravelly sand deposits. Towards Lucerne (dry) Lake, the aquifer displays semi-confined conditions with silty clay deposits incised by stream gravels and sand deposits.

Note: Funding was supported by a grant from the Mojave Water Agency.

References:

- Brose, R.J., 1987. Hydrogeologic Investigation of the Lucerne Valley Groundwater Basin San Bernardino County, California [Masters Thesis]: California State University, Los Angeles, 71 p.
- Dibblee, T. W. Jr., 1964a. Geologic map of the Lucerne Valley quadrangle San Bernardino County, California: United States Geological Survey, in cooperation with the California Division of Mines and Geology, miscellaneous geologic investigations MAP I-426.
- Dibblee, T. W. Jr., 1964b. Geologic map of the Ord Mountains quadrangle San Bernardino County, California: United States Geological Survey, in cooperation with the California Division of Mines and Geology, miscellaneous geologic investigations MAP I-427.
- Dokka, R.K., and Travis, C.J., 1990a. Late Cenozoic strike-slip faulting in the Mojave Desert, California: *Tectonics* 9, no. 2, pp. 311-340.
- [DWR] California Department of Water Resources, 1967. Mojave River groundwater basins. Sacramento: Bulletin 84, 150p.
- Gardner, D.L, 1941. Geology of the Newberry and Ord Mountains, San Bernardino County, California: California Division of Mines and Geology Journal, Vol. 36, pp. 257-304.
- Hewett, D. F., 1954. General geology of the Mojave Desert region, California: California Division of Mines and Geology, Bulletin No. 170, pp. 5-20.
- Miller, F. K. and Matti, J. C., 2003. Geologic map of the Fifteenmile Valley 7.5 Quadrangle, San Bernardino County, California: United States Geological Survey.
- Sadler, P.M., 1982a. Geology of the San Bernardino Mountains, San Bernardino County, California: California Department of Conservation Division of Mines and Geology Open-File Report 82-18.
- Sadler, P.M., 1982b. Provenance and structure of late Cenozoic sediments in the Northeast San Bernardino Mountains: in Sadler, P.M., and Kooser, M. A., eds., Late Cenozoic stratigraphy and structure of the San Bernardino Mountains, field trip 6 of Cooper, J.D., compiler, Geologic excursions in the Transverse Ranges, Southern California: Geologic Society of America, Cordilleran Section, 78th Annual Meeting, Anaheim, California, 1982, Volume and Guidebook, pp. 82-91.
- Schaefer, Donald H., 1979. Groundwater conditions and potential for artificial recharge in Lucerne Valley, San Bernardino County, California: United States Geological Survey, in cooperation with the Mojave Water Agency.
- Shreve, R.L., 1968. The Blackhawk Landslide: Geological Society of America, Special Paper 108, 47 p.

¹ Undergraduate Student, Department of Geological Sciences California State University, Fullerton. Portion of Undergraduate Thesis.

² Assistant Professor of Hydrogeology, Department of Geological Sciences California State University, Fullerton.

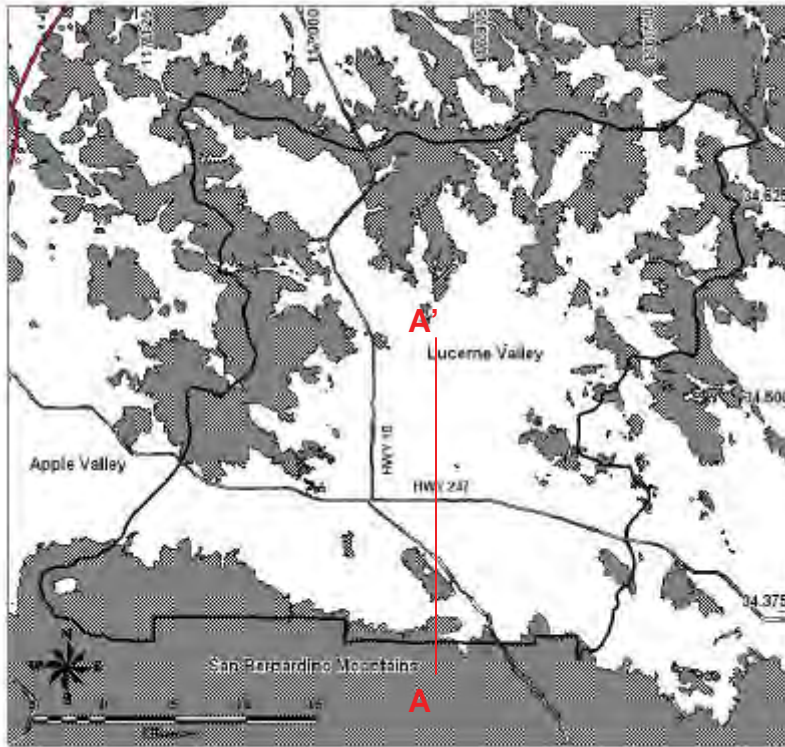


Figure 1. Location map of Lucerne Valley, San Bernardino County, California showing cross-section (A-A') profile.

