Assessment of the Mineral Potential of Public Lands Located within Proposed Solar Energy Zones in California

July 2012

Assessment of the Mineral Potential of Public Lands Located within Proposed Solar Energy Zones in California

July 2012

CONTENTS

CONTENTS (Cont.)

FIGURES

TABLES

This page intentionally left blank.

NOTATION

The following is a list of acronyms, abbreviations, and units of measure used in this document. Some acronyms used only in tables may be defined only in those tables.

GENERAL ACRONYMS AND ABBREVIATIONS

ACEC	Area of Critical Environmental Concern
BLM	Bureau of Land Management
CBO	Congressional Budget Office
CDCA	California Desert Conservation Area
CFR	*Code of Federal Regulations*
CGS	California Geological Survey
DOE	U.S. Department of Energy
DOGGR	Division of Oil, Gas, & Geothermal Resources (California Department of Conservation)
DOI	U.S. Department of the Interior
FHWA	Federal Highway Administration
FLPMA	Federal Land Policy and Management Act of 1976
FR	*Federal Register*
GEM	Geology-Energy-Minerals
GIS	geographic information system
I	Interstate
IBLA	Interior Board of Land Appeals
KGRA	known geothermal resources area
LR2000	Land and Mineral Legacy Rehost 2000 System
MRDS	Mineral Resource Data System
MRZ	mineral resource zone
MWD	Metropolitan Water District (Los Angeles)
PEIS	programmatic environmental impact statement
P.L.	Public Law
P.M.	Principal Meridian

ROW	right-of-way
SEZ	solar energy zone
SMARA	Surface Mining and Reclamation Act of 1975
U.S.	United States
USC	*United States Code*
USGS	U.S. Geological Survey

UNITS OF MEASURE

ft	foot (feet)
km	kilometer(s)
km^2	square kilometer(s)
m	meter(s)
mi	mile(s)
MW	megawatt

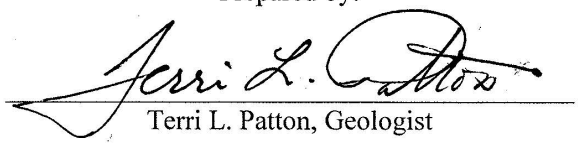
ASSESSMENT OF THE MINERAL POTENTIAL OF PUBLIC LANDS LOCATED WITHIN PROPOSED SOLAR ENERGY ZONES IN CALIFORNIA

LANDS INVOLVED

Imperial East Solar Energy Zone
Covering 5,722 acres of public land in Imperial County, California
T16S, R17E, sections 21 to 28, and 33 to 35
T16S, R18E, sections 29 to 34
San Bernardino P.M.

Riverside East Solar Energy Zone
Covering 159,457 acres of public land in Riverside County, California
T4S, R15E, sections 25 to 27, 34, and 35
T5S, R15E, sections 3, 10, 13 to 15, 22 to 25, and 27
T4S, R16E, section 31
T5S, R16E, sections 1 to 4, 6, 8, 10, 11, 13 to 15, 17 to 30, 34, and 35
T5S, R17E, sections 1 to 3, 5 to 11, 14, 15, 17 to 23, 26 to 29, and 31 to 35
T6S, R17E, sections 1 to 6
T6S, R18E, sections 1 to 4, 7, 9, 10, 11 to 14, 17, 18, 23, and 24
T6S, R19E, sections 3 to 15, 17 to 29, 34, and 35
T6S, R20E, sections 3, 5, 7 to 10, 15 to 35
T7S, R20E, sections 1, 2, 11 to 13, 24, and 25
T4S, R21E, sections 2 to 5, 8 to 15, and 21 to 35
T5S, R21E, sections 1 to 15, and 17 to 30, 32, 35
T6S, R21E, sections 4, 5, 8, 9, 15, 19, 22, 23, 26, 27, and 29 to 32
T7S, R21E, sections 2 to 15, and 17 to 35
T4S, R22E, sections 7, 8, and 17 to 20, 29 to 33
T5S, R22E, sections 2 to 15, and 17 to 33
T6S, R22E, sections 3 to 10, 17, and 18
T7S, R22E, section 18
San Bernardino P.M.

Prepared by:



Terri L. Patton, Geologist

This page intentionally left blank.

ASSESSMENT OF THE MINERAL POTENTIAL OF PUBLIC LANDS LOCATED WITHIN PROPOSED SOLAR ENERGY ZONES IN CALIFORNIA

SUMMARY

The report that follows presents an assessment of the mineral resource potential of public lands located within two proposed solar energy zones (SEZs) in southern California, on behalf of the U.S. Department of the Interior (DOI), Bureau of Land Management (BLM). The assessment was conducted in consultation with several BLM mineral specialists: Mr. Matt Shumaker, Chief Mineral Examiner (Division of Solid Minerals); Mr. Steve Kupferman, Geologist and Supervisory Physical Scientist (California State Office), Mr. Marc Springer, Geologist (California State Office); Mr. James Haerter, Geothermal Program Lead (California State Office), Mr. Sean Hagerty, Geologist (California State Office), Mr. Rob Waiwood, Mineral Specialist (California Desert District Office); Mr. Peter Godfrey, Geologist (California Desert District Office); and Cheryl Martinez (Palm Springs South Coast Field Office). Mr. Jeff Holdren, Senior Realty Specialist (Division of Lands, Realty and Cadastral Survey), prepared the legal descriptions for the SEZs.

The subject lands are located within two SEZs in southern California: Imperial East (Imperial County) and Riverside East (Riverside County). The mineral resource potential for each of these sites is summarized below.

S.1 IMPERIAL EAST SEZ

There are no documented occurrences of locatable mineral deposits within the Imperial East SEZ. Most of the locatable minerals in the region occur in the Cargo Muchacho Mountains to the northeast. These deposits are associated with Mesozoic granitic intrusions and andesitic dikes. The nearest occurrences of locatable minerals are in gold- and kyanite-producing mines in the Cargo Muchacho District. The SEZ is in a region where basin-fill sediments have an estimated thickness of about 13,400 ft (4,080 m) (based on well logs). The presence of mineralized zones beneath the site is possible (though not documented) as a result of heat and migrating fluids generated by the active geothermal systems at depth; however, if present, these zones would likely be several thousand feet below the surface. Therefore, the potential for locatable minerals to occur within the SEZ is low (level of certainty A).[1]

[1] Definitions of mineral potential are from the mineral potential classification system outlined in *BLM Manual 3031* (BLM 1985). Mineral potential ratings of low, moderate, or high are assigned where the geologic environment and inferred geologic processes indicate low, moderate, or high potential for accumulation of mineral resources. Levels of certainty are defined as follows: A = available data are *insufficient* to support or refute the occurrence of mineral resources; B = available data provide *indirect* evidence to support or refute the occurrence of mineral resources; C = available data provide *direct but quantitatively minimal* evidence to support or refute the occurrence of mineral resources; and D = available data provide *abundant direct and indirect* evidence to support or refute the occurrence of mineral resources.

The Imperial East SEZ is an area with a high potential for occurrence of sand, gravel, and clay (level of certainty D). There are two pending free use permits (for common clay) within the SEZ, both in the southeast quadrant of section 32 in T16S, R18E. The permitted area for clay overlaps the wetland area designated as non-development for solar projects.

There are no active oil and gas leases within the Imperial East SEZ; a good portion of the land within the site was leased in the past, but these leases were closed in the late 1980s and early1990s. Relative to more favorable areas for oil and gas accumulation in the state (concentrated in counties to the northwest), the SEZ is an area with low potential for oil and gas development (level of certainty B). There are no producing oil fields in Imperial County, and because of ongoing extensional faulting in the region (which disrupts hydrocarbon traps and pressure seals), the prospects for oil and gas in Imperial Valley are considered to be poor. While the area has not been fully assessed, no source rocks have been identified to date.

The SEZ is located in the East Mesa Known Geothermal Resource Area (KGRA), an area of high geothermal potential. There is an authorized geothermal lease covering 37,714 acres (153 km^2) of BLM-administered land in the region; it crosses most of the site (sections 21 to 28 of T16S, R17E; and sections 29 to 34 of T16S, R18E) and the adjacent area to the northwest. Several producing geothermal wells and two producing geothermal power plants are located within the lease area; this activity is concentrated in sections 1 and 2 of T16S, R16E and sections 5 to 8 in T16S, R17E to the northwest of the SEZ. A geothermal unit agreement (CACA 016692X), overlapping the northwest corner of the SEZ (in sections 21 and 28 of T16S, R17E), was closed in 1994. The nearest nominated public lands for geothermal sale are located in the Glamis Dunes (T13S, R17E) more than 15 mi (24 km) to the north. The potential for geothermal development within the site is high (level of certainty D).

S.2 RIVERSIDE EAST SEZ

The Riverside East SEZ contains known deposits of locatable minerals, most of which occur along the margins where site boundaries overlap the base of adjacent mountain ranges. The assessment of potential for locatable minerals to occur within the SEZ is based on a combination of the mineral resource zones mapped by California Geological Survey (CGS; formerly the California Division of Mines and Geology) and the mineral potential areas mapped in the BLM as part of the California Desert Conservation Area (CDCA) Geology-Energy-Materials (GEM) assessment. The potential ratings for various mineral resources to occur within the SEZ are summarized as follows:

- *Iron.* Potential is high for the portion of the SEZ within the northwest corner that lies to the east of the Eagle Mountains (level of certainty C) and for those portions along the northernmost boundaries (eastern end) at the base of the Little and Big Maria Mountains (level of certainty C).

- *Gold and silver.* Potential is moderate for the portion of the SEZ within the northwest corner that lies to the east of the Eagle Mountains (level of

certainty C) and for the portion along the southern boundary at the base of the Mule Mountains (level of certainty C).

- *Uranium and thorium.* Potential is high for the central portion of the SEZ immediately south of the McCoy Mountains (level of certainty C).

- *Copper, gold, silver, tungsten, lead, zinc, gypsum, silica, and wollastonite.* Potential is high for those portions of the SEZ along the northernmost boundaries (eastern end) at the base of the Little and Big Maria Mountains (level of certainty C).

Based on the existing notices and plans of operations filed with the BLM, the only locatable minerals with a high development potential within the SEZ are gypsum (in section 27 of T4S, R21E) and gold (in section 30 of T6S, R21E).

The Riverside East SEZ is an area with a high potential for occurrence of sand and gravel (level of certainty D) and a moderate to high potential for limestone (level of certainty D). There are four authorized Federal Highway Administration (FHWA) material sites within the SEZ. Two are located near the site's east end, along Interstate 10 (I-10), about 8 mi (12.8 km) west of Blythe (in section 35 of T6S, R21E), and two are located near the site's west end, also along I-10, a few miles east of Desert Center (in section 25 of T5S, R15E and section 29 of T5S, R16E). Limestone has been mined in the Little and Big Maria Mountains (to the north of the site's east end); site boundaries overlap moderate and high potential areas along the base of these mountains in this region. There is a pending plan of operation for limestone mining on 91 acres (0.37 km^2) along the northeast-facing boundary of the site's east end (along the base of the Big Maria Mountains). There is a pending notice for stone materials (CACA 040809) on 1 acre (0.0040 km^2) in the same region (section 34 of T4S, R22E). The demand for local aggregate is increasing due in part to the construction of solar projects in the region; some of this demand is being met using mine tailings and waste rock from the inactive Eagle Mountain Mine site (located mainly in the southern half of T3S, R14E).

There are no active oil and gas leases within the Riverside East SEZ; most of the land within the site was leased in the past, but these leases were closed in the 1980s. Relative to more favorable areas for oil and gas accumulation in the state (concentrated in counties to the northwest), the SEZ is an area with low potential for oil and gas development (level of certainty B). There are no oil and gas fields in Riverside County, and there have been no test wells drilled within or near the SEZ.

Most of the SEZ is prospectively valuable for geothermal resources, and its potential for development is moderate (level of certainty B). A total of 36,522 acres (148 km^2) of land within the site is located within a high-potential area for geothermal resources (level of certainty B); of this total, 6,339 acres (26 km^2) are on lands designated as non-development for solar projects. These areas occur at the western and eastern ends of the site.

The Ford Dry Lake area in the central portion of the SEZ is a high-potential area for leasable salt (sodium and potassium) (level of certainty B). Most of this area overlaps the area within the SEZ designated as non-development for solar projects.

1 INTRODUCTION

1.1 PURPOSE OF REPORT

The purpose of this report is to assess the mineral resource potential of 165,179 acres (668 km^2) of public lands within two SEZs in southern California, which the Secretary of the Interior may decide to withdraw from potentially conflicting uses through the issuance of a Public Land Order. If approved, the public lands within the SEZs would be withdrawn, subject to valid existing rights, from settlement, sale, location, or entry under the general land laws, including the mining laws, as follows:

- New mining claims could not be filed on the withdrawn lands; however, valid mining claims filed prior to the date the lands were segregated (i.e., withdrawal application notice was published in the *Federal Register*) would take precedence over future solar energy development right-of-way (ROW) application filings.

- Lands could not be sold, exchanged, or otherwise disposed of during the term of the withdrawal.

- Withdrawn lands would remain open to mineral leasing, geothermal leasing, and mineral material laws; the BLM could elect to lease the oil, gas, coal, or geothermal steam resources, or to sell common-variety mineral materials such as sand and gravel, if the authorized officer determined there would be no unacceptable impacts on future solar energy development.

- Withdrawn lands would remain open to ROW authorizations and land leases or permits authorized under Section 302 of the Federal Land Policy and Management Act of 1976 (FLPMA).

The public lands are currently segregated under BLM's Interim Temporary Final Rule, which was published on April 26, 2011, and is in effect until June 30, 2013 (Vol. 76, pp. 23198–23205 of the *Federal Register* [76 FR 23198–23205]).

1.2 LEGAL DESCRIPTION OF THE SUBJECT LANDS

There are two SEZs in California: Imperial East, which is located in the El Centro Resource Area in Imperial County, and Riverside East, which is located in the Palm Springs–South Coast in Riverside County. Two other proposed SEZs, Pisgah and Iron Mountain (both in San Bernardino County), were dropped from further consideration on the basis of public comments received on the Draft Solar Programmatic Environmental Impact Statement (PEIS) (BLM and DOE 2011). The locations of the SEZs are shown in Figure 1. Their full legal descriptions are provided in Appendix A.

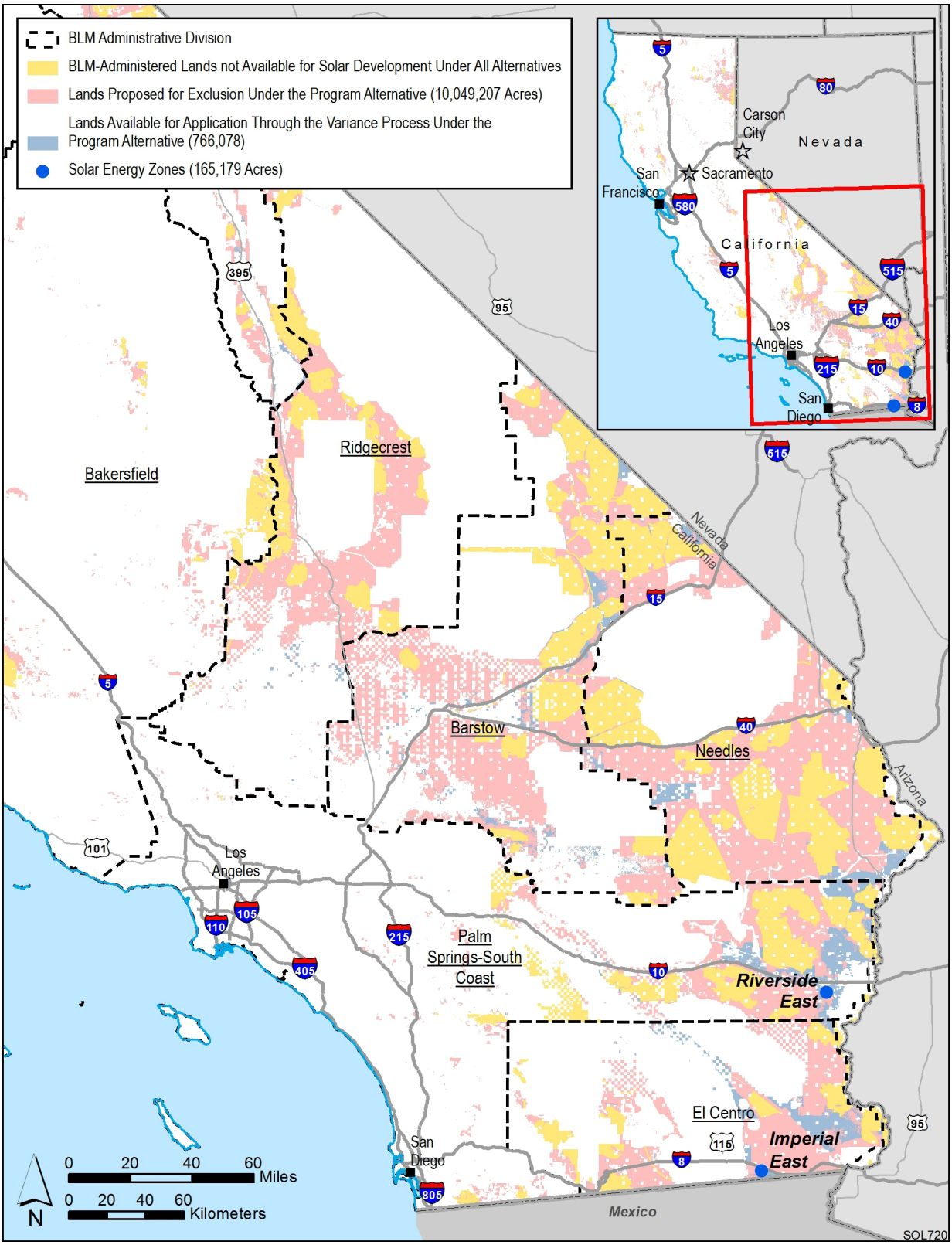


FIGURE 1 BLM-Administered Lands in California Available for Application for Solar Energy Right-of-Way Authorization (SEZs are represented by the blue dots)

1.3 METHODOLOGY AND RESOURCES

The assessment presented in this report focuses on locatable (including those classified as strategic and critical), saleable, and leasable mineral resources within two proposed SEZs in California. The conclusions concerning mineral occurrence and development potential (and levels of certainty) follow the methodology outlined in *BLM Manual 3031* (BLM 1985) and are based on a review of topographic maps, geologic maps, mineral resource maps and reports, the scientific literature on the geology and mineral resources of California, and consultation with BLM mineral specialists. No mapping or field sampling was conducted as part of this assessment.

The CGS mineral land classification maps and reports (as mandated by the Surface Mining and Reclamation Act [SMARA] of 1975) were also consulted. These included the aggregate availability map for California (Kohler 2006) and the mineral land classifications mapped and described by Kohler-Antablin and Higgins (1994) for eastern Riverside County. There has been no SMARA classification for Imperial County.

Digital data for the geologic maps in Figures 2 and 5 were obtained from the U.S. Geological Survey (USGS) (Ludington et al. 2007); the dataset was digitized from previously published geologic maps ranging in scale from 1:100,000 to 1:1,000,000. Detailed map unit descriptions for these maps are based on the published state geologic map by Gutierrez et al. (2010). Site-specific geologic maps were prepared from the San Diego–El Centro and Salton Sea 1:250,000 quadrangle maps prepared by Strand (1962) and Jennings (1967). The CGS is currently preparing geologic maps at 1:24,000 and 1:100,000 scales as part of the Regional Mapping Project; however, maps at these scales are not yet available for the eastern portions of Riverside County or Imperial County. The large-scale folded maps (Map 1 and 2) provided in the back of this report show the public land survey system grid (township and range) and should be consulted to locate mines and other features discussed in the text. In addition, the Solar PEIS Web site (http://solareis.anl.gov/sez/index.cfm) contains mapped photographs of the SEZs.

The BLM's Legacy Rehost System (LR2000) was queried on June 14, 2012, for information on active and historical (unpatented) mining claims and various leases and permits, including oil and gas leases, geothermal leases and land nominations, free use permits, and mineral materials contracts, issued on public lands within and around the two SEZs. Another key BLM resource consulted was the GEM assessment for the CDCA) (BLM 2012a) provided by Mr. Rob Waiwood and Mr. Peter Godfrey (California Desert District Office).

Mines and mineral prospects and occurrences (shown on Figures 4 and 9 and on foldout Maps 1 and 2) and their descriptions are based on the USGS's Mineral Resource Data System (MRDS; USGS 2011a; Lipin 2000) and supplemented with information provided by BLM mineral specialists from the districts and field offices in which the proposed SEZs are located. The MRDS is a large database containing historical records of the USGS and the U.S. Bureau of Mines (which is now part of the USGS). These records are of variable quality and currency, so it is possible that some information will be found to be out of date (the revision and refinement of the database is an ongoing effort at the USGS). The mining activity maps in Figures 4 and 9

were generated from the MRDS database. The maps are intended to provide a general picture of the location and nature of mining activity in the vicinity of each of the California SEZs. Refinements with regard to the status of particular mines are included in the text as warranted based on conversations with BLM mineral specialists.

Digital data for mining districts in California could not be located; however, the mining districts originally listed in Hill (1912), Morton (1977), Shumway et al. (1980), and Kohler-Anatablin and Higgins (1994) are easily identified on maps as areas of clustered mining activity, and they are acknowledged in the discussions of locatable minerals for each of the SEZs in this report, as applicable. Information on oil, gas, and geothermal drilling in California's District 1, including oil and gas production statistics, was obtained from the California Department of Conservation Division of Oil, Gas, & Geothermal Resources (DOGGR). Well records for oil and gas exploratory wells drilled in District 1, however, were not available online.

1.4 LOCATABLE MINERALS

Under United States (U.S.) mining laws, minerals fall into three categories: locatable, leasable, and saleable. Because these categories were created by acts of Congress, they do not fall into simple economic or mineralogical divisions. Creating an exact and thorough list of locatable minerals (e.g., those subject to appropriation by locating mining claims) is therefore difficult. Metallic minerals (e.g., gold, silver, copper, mercury, aluminum, antimony, lithium, molybdenum, tungsten, uranium, vanadium, and rare earths) are considered to be locatable. Numerous uncommon varieties of nonmetallic minerals may also be locatable, depending on their chemical content, quality, uses, and characteristics, as well as certain associated economic and legal matters. These nonmetallic minerals could include barite, calcite, specialty clays, bentonite, diatomite, feldspar, some gemstones (e.g., opals and diamonds), gypsum, chemical-grade limestone, perlite, chemical-grade silica sand, specific types of stone, talc, zeolites, and specific and uncommon types of dolomite. The determination of the actual locatability of uncommon varieties of nonmetallic minerals and the validity of mining claims for them is complex and relies on Public Law (P.L.) 84-167 (*United States Code*, Title 30, Section 601 et seq. [30 USC 601 et seq.]) and applicable case law (e.g., *U.S. vs. Kenneth McClarty*, 17 Interior Board of Land Appeals [IBLA] 20, 1974 [81 Interior Department (I.D.) 472]) (Shumaker 2011).

California's nonfuel raw mineral production in 2008 was down by about 5% over that in 2007 (which was down by about 7.5% from that in 2006). Industrial minerals (construction sand and gravel, portland and masonry cement, boron minerals, crushed stone, and soda ash) accounted for more than 95% of the state's nonfuel mineral production value in 2008. The remaining value was from the production of gold, iron ore, and silver. Significant increases in the production values of gold, boron minerals, crushed stone, and soda ash occurred in 2008. Smaller increases in the production values of diatomite, fuller's earth clays, and salt and decreases in those of pumice, pumicite, crude gypsum, fire clays, and dimension stone were also noted. In 2008, California was the only state to produce boron. It was the lead U.S. producer of sand, gravel, and diatomite, and it remained the second lead producer of portland cement, soda ash, and pumice. California also produced significant quantities of common clays, crushed stone, and

dimension stone. In 2010, California was the nation's top producer of diatomite and natural sodium sulfate and the only producer of boron minerals and rare earth minerals. It ranked second in portland cement production. The only metals it produced were gold and silver. Other minerals commercially produced in 2010 included sand and gravel, portland cement, common clay, bentonite clay (including hectorite), crushed stone, dimension stone, feldspar, fuller's earth clay, gemstones, gypsum, iron ore, kaolin clay, lime, magnesium compounds, perlite, pumice, pumicite, salt, soda ash, and zeolites. In terms of dollar value, the leading industrial mineral commodities in 2010 were sand and gravel, boron minerals, and portland cement (USGS 2011b; Clinkenbeard and Smith 2011).

1.5 STRATEGIC AND CRITICAL MINERALS

Table 1 lists the nonfuel strategic and critical nonfuel minerals that are imported by the United States for its National Defense Stockpile, as authorized by the Strategic and Critical Materials Stock Piling Act (50 USC 98 et seq.). None of the main locatable minerals currently produced in California (gold and silver) are classified as strategic and critical minerals. However, minor minerals produced in the state, such as copper, fluorite, manganese, tungsten, and zinc, would fall within this classification.

TABLE 1 Strategic and Critical Nonfuel Minerals

Antimony	Copper	Platinum group
Asbestos	Diamonds (industrial)	Quartz crystals
Bauxite and alumina	Fluorspar	Rutile (titanium)
Beryllium	Graphite	Silicon
Bismuth	Iodine	Tantalum
Cadmium	Manganese	Thorium
Chromium	Mercury	Tin
Cobalt	Mica sheet	Tungsten
Columbian	Nickel	Vanadium
		Zinc

Source: CBO (1983).

This page intentionally left blank.

2 IMPERIAL EAST SEZ

2.1 SUMMARY AND CONCLUSIONS

This chapter assesses the mineral resource potential of 5,722 acres (23.2 km^2) of public lands within an area known as the Imperial East SEZ, located in Imperial County near the United States–Mexico border in southeastern California. The SEZ is about 10 mi (16 km) southeast of the community of Holtville.

There are no documented occurrences of locatable mineral deposits within the Imperial East SEZ. Most of the locatable minerals in the region occur in the Cargo Muchacho Mountains to the northeast. These deposits are associated with Mesozoic granitic intrusions and andesitic dikes. The nearest occurrences of locatable minerals are in gold- and kyanite-producing mines in the Cargo Muchacho District. The SEZ is in a region where basin-fill sediments have an estimated thickness of about 13,400 ft (4,080 m) (based on well logs). The presence of mineralized zones beneath the site is possible (though not documented) as a result of heat and migrating fluids generated by the active geothermal systems at depth; however, if present, these zones would likely be several thousand feet below the surface. Therefore, the potential for locatable minerals to occur within the SEZ is low (level of certainty A).

The Imperial East SEZ is an area with a high potential for occurrence of sand, gravel, and clay (level of certainty D). There are two pending free use permits (for common clay) within the SEZ, both in the southeast quadrant of section 32 in T16S, R18E. The permitted area covers land that falls within wetlands that have been designated as a solar energy non-development area. The permitted area for clay overlaps the wetland area designated as non-development for solar projects.

There are no active oil and gas leases within the Imperial East SEZ; a good portion of the land within the site was leased in the past, but these leases were closed in the late 1980s and early 1990s. Relative to more favorable areas for oil and gas accumulation in the state (concentrated in counties to the northwest), the SEZ is an area with low potential for oil and gas development (level of certainty B). There are no producing oil fields in Imperial County, and because of ongoing extensional faulting in the region (which disrupts hydrocarbon traps and pressure seals), the prospects for oil and gas in Imperial Valley are considered to be poor. While the area has not been fully assessed, no source rocks have been identified to date.

The SEZ is located in the East Mesa KGRA, an area of high geothermal potential. There is an authorized geothermal lease covering 37,714 acres (153 km^2) of BLM-administered land in the region; it crosses most of the site (sections 21 to 28 of T16S, R17E; and sections 29 to 34 of T16S, R18E) and the adjacent area to the northwest. Several producing geothermal wells and two producing geothermal power plants are located within the lease area; this activity is concentrated in sections 1 and 2 of T16S, R16E and sections 5 to 8 in T16S, R17E to the northwest of the SEZ. A geothermal unit agreement (CACA 016692X), overlapping the northwest corner of the SEZ (in sections 21 and 28 of T16S, R17E), was closed in 1994. The nearest nominated public lands for geothermal sale are located in the Glamis Dunes (T13S, R17E) more than 15 mi

(24 km) to the north. The potential for geothermal development within the site is high (level of certainty D).

2.2 LANDS INVOLVED

The Imperial East SEZ is located on BLM lands within the California Desert District (El Centro Field Office), in Imperial County. The site lies within Township 16 south, Range 17 east (T16S, R17E), sections 21 to 28 and 33 to 35; and T16S, R18E, sections 29 to 34 (San Bernardino Principal Meridian). Within this area, 5 acres (0.020 km^2) of wetlands along the southern border of the SEZ have been designated as non-development areas (BLM and DOE 2011). The SEZ and the non-development areas within it are shown on the location map in the back of this report (Map 1). The full legal description of the SEZ is provided in Appendix A.

2.3 LAND STATUS

According to the LR2000, accessed on June 14, 2012, there are no active or historical locatable mining claims within the Imperial East SEZ (BLM 2012b). The land within the SEZ was first segregated from locatable mineral entry in June 2009, pending the outcome of the Draft Solar PEIS (BLM and DOE 2010), and is currently segregated under an Interim Temporary Final Rule, which is in effect until June 30, 2013 (76 FR 23198–23205).

There are no mineral materials contracts within the SEZ. Two free use permits for common clay (CACA 028628 and CACA 053120) are pending on 20 acres (0.081 km^2) in section 32 of T16S, R18E (BLM 2012b). The site remains open for the disposal of saleable mineral materials.

There are no active oil and gas leases within the SEZ; however, the site was leased for oil and gas in the past (eight oil and gas leases covered most of the site but were closed in the late 1980s and early 1990s).The SEZ is located within the East Mesa KGRA. One authorized geothermal lease (CACA 017574) involving 37,714 acres (153 km^2) crosses most of the SEZ and the region to the northwest. A geothermal unit agreement (CACA 016692X), overlapping the northwest corner of the SEZ (in sections 21 and 28 of T16S, R17E) was closed in 1994. The nearest nominated public lands for geothermal sale are located in the Glamis Dunes (T13S, R17E) more than 15 mi (24 km) to the north (BLM 2012b; Haerter 2012). The site remains open for discretionary mineral leasing for oil and gas, geothermal, and other leasable minerals.

2.4 GEOLOGIC SETTING

The Imperial East SEZ is located in the Imperial Valley, part of the Salton Trough, a sediment-filled structural basin that lies within the Basin and Range physiographic province in southern California. The Salton Trough is the landward extension of the East Pacific Rise as it emerges from the 1,000-mi (1,609-km) long trough occupied by the Gulf of California and continues northward to Palm Springs. The East Pacific Rise is a crustal spreading center

characterized by a series of northwest-trending transform (strike-slip) faults, the northernmost being the San Andreas Fault System. The tectonic activity of the East Pacific Rise has downwarped, downfaulted, extended, and laterally translated the sediments within the Salton Trough. Although the basin is geologically complex, its surface is relatively featureless (Riney et al. 1982; Mase et al. 1981; Morton 1977).

Located in the south–central part of Imperial County, the Imperial Valley lies at or below sea level and has an area of about 989,450 acres (4,004 km^2) in the United States. It is bounded to the north by the Salton Sea and extends south into Mexico. To the east are the Algodones Dunes and Sand Hills; to the west (from north to south) are the Fish Creek Mountains, Superstition Hills, Superstition Mountain, and Coyote Mountains. The Yuha Desert lies to the southwest. The Imperial Valley is separated from the Gulf of California by the ridge of the Colorado River delta (in Mexico), which has an elevation of about 30 ft (9 m) above mean sea level at its lowest point (Morton 1977; Zimmerman 1981).

The Salton Trough has received a continuous influx of sand, silt, and clay from the Colorado River, which created ephemeral lakes in the basin until about 300 years ago. Underlying this alluvial cover is a succession of late Tertiary and Quaternary sediments composed mainly of marine and nonmarine sandstones and clays and lake deposits. The depth to basement rock ranges from 11,000 to 15,400 ft (3,353 to 4,694 m), although metamorphism of sedimentary deposits is known to occur at depths as shallow as 4,000 ft (1,219 m) because of the high heat flows associated with crustal spreading. High heat flows also give rise to geothermal steam, and several KGRAs occur throughout the valley (Riney et al. 1982; Mase et al. 1981; Morton 1977; Robinson et al. 1976). Exposed sediments near the Imperial East SEZ consist mainly of modern alluvium, lake, and playa deposits and dune sands.

As recently as 300 years ago, a freshwater lake, called Lake Cahuilla, filled the Imperial Valley basin to the elevation of the Colorado River delta. The ancient lake was actually a succession of lakes that periodically overflowed and covered a major portion of the Salton Trough during the late Pleistocene and Holocene epochs. Muds and silts of this ancient lake form the top 197 to 328 ft (60 to 100 m) of strata within the Imperial Valley (Mase et al. 1981). The former shoreline marking the maximum Holocene water level of Lake Cahuilla is well preserved around the margins of the Imperial Valley at an elevation of about 40 to 48 ft (12 to 15 m) above sea level (Blake 1914; Stanley 1963). At this maximum level, Lake Cahuilla would have been more than 300 ft (91 m) deep, 105 mi (170 km) long, and 35 mi (56 km) across at its widest point (Hubbs and Miller 1948; Waters 1983). The Salton Trough is currently occupied by the Salton Sea, which lies 200 ft (61 m) below sea level (Riney et al. 1982). The geology of the Imperial Valley region near the proposed Imperial East SEZ is shown in Figure 2.

2.5 PHYSICAL FEATURES AND ACCESS

The Imperial East SEZ is located between the east side of the Lake Cahuilla lakebed and the Algodones Sand Hills on a desert plain, called the Imperial East Mesa, a terrace of the Colorado River delta. Its terrain is relatively flat, with a gentle slope to the west. Elevations

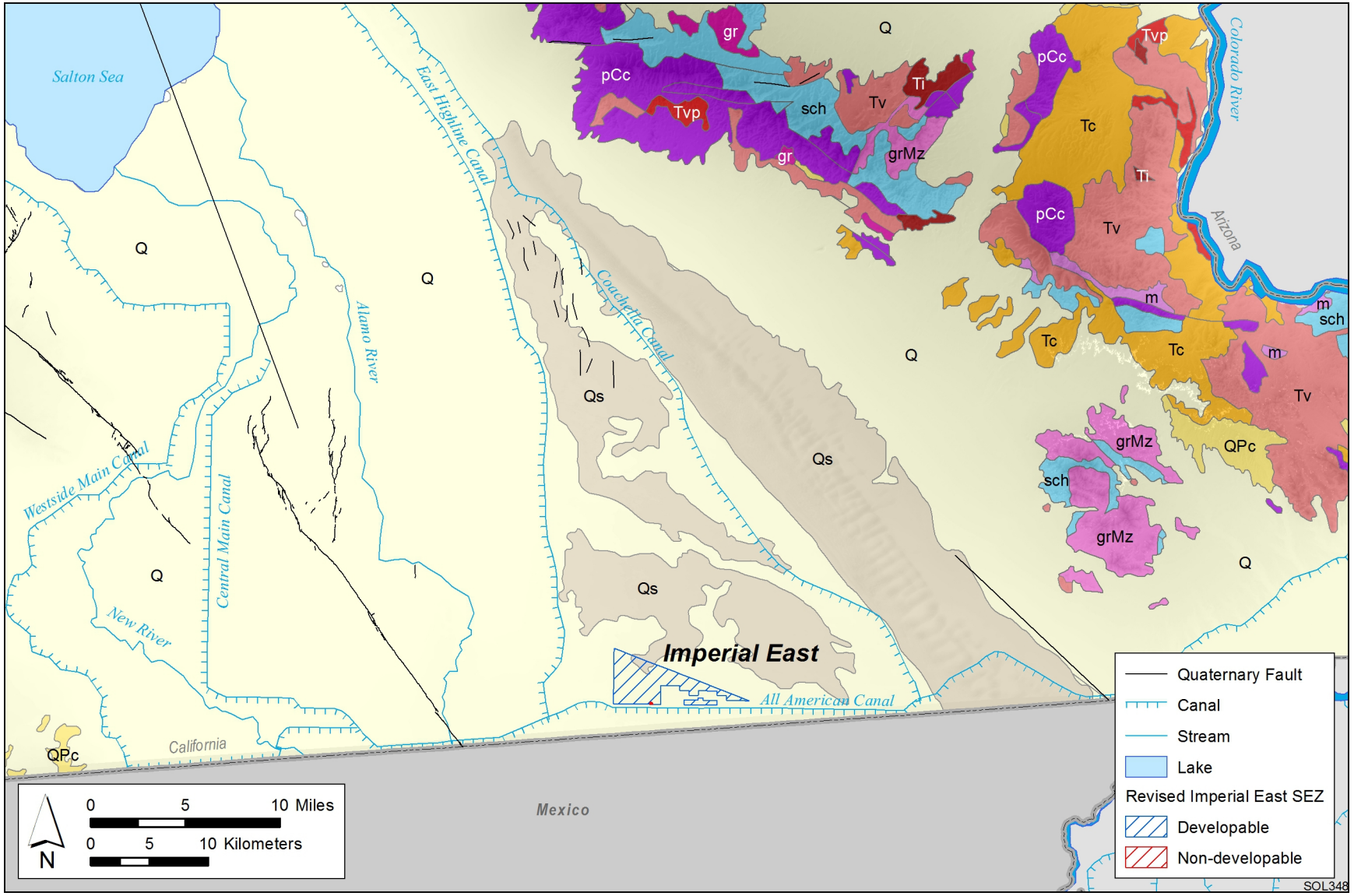


FIGURE 2 Geologic Map of the Imperial Valley Region (Sources: Ludington et al. 2007; Gutierrez et al. 2010)

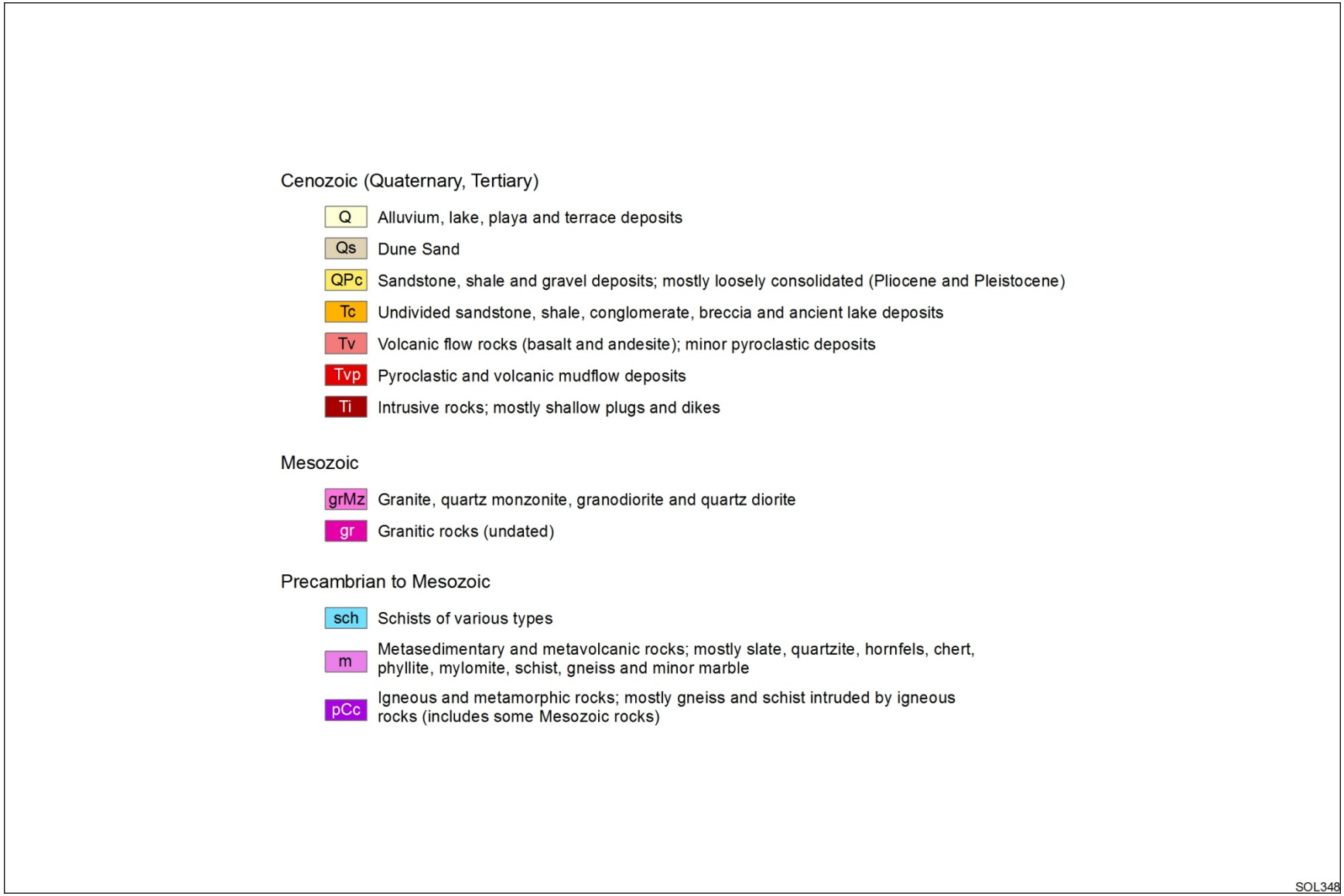


FIGURE 2 (Cont.)

range from about 40 ft (12 m) near the southeastern corner of the site to less than 20 ft (6.1 m) along its western boundary.

The SEZ lies within a triangle bordered by I-8 and State Route 98 on the north and south, respectively, and by the Lake Cahuilla Area of Critical Environmental Concern (ACEC) on the west. The area is rural in character, and the SEZ is largely devoid of development; however, the East Mesa Geothermal Field lies less than 5 mi (8 km) to the north. The area to the south is developed with several transmission lines, the All-American Canal and associated facilities (including two hydropower drop structures), and the international boundary fence. The canal, which originates at the Colorado River, is a major conduit for irrigation and the municipal water supply for the Imperial Valley. Although the SEZ consists only of BLM-administered public lands, there are about 980 acres (4.0 km^2) of Reclamation Withdrawn[2] lands and 640 acres (2.6 km^2) of private lands within the site's boundaries that are not part of the SEZ.

2.6 SITE GEOLOGY

The geology of the Imperial East SEZ is described based on the 1:250,000 map by Strand (1962). The thicknesses of Cenozoic sediments were inferred from a test well, Chevron Wilson-1, located about 17 mi (27 km) to the northwest of the SEZ in section 20 of T14S, R15E (as reported by Barker [1995]); the sediments are described based on Morton (1977) and Mase et al. (1981). Surface sediments at the site are composed mainly of alluvium and dune sand (map units Qal and Qs; Figure 3). Lacustrine sediments associated with Lake Cahuilla, consisting of unconsolidated fine gravel along the ancient shoreline and grading into clay and silt, are exposed just a few miles to the west of the SEZ (map unit Ql). Small wetlands are located along the site's southern boundary.

The SEZ is underlain by basin-fill sediments of late Tertiary (Miocene to Pliocene) and Quaternary age with a thickness of about 13,400 ft (4,080 m). These are predominantly deltaic sediments (sandstone and shale) deposited by the Colorado River. The sediments are interbedded throughout with lacustrine mudstones and underlain by marine sediments of the Imperial Formation consisting of claystone interbedded with sandstone and conglomerate. Holocene muds and silts of Lake Cahuilla occur in the top 200 to 340 ft (60 to 100 m) of the stratigraphic section.

Basement rock below 13,400 ft (4,080 m) is likely composed of metasedimentary rocks (schist and gneiss) of pre-Mesozoic (possibly early Precambrian) age with Mesozoic granitic intrusions and andesitic dikes, similar to rocks in the adjacent mountain ranges.

2 "Reclamation Withdrawal" lands are areas of public land withheld from the operation of the public land laws for the purpose of reserving them for use by the Bureau of Reclamation. Although the Bureau of Reclamation has first priority for use of these lands for its projects, other uses may be approved with the concurrence of the Bureau of Reclamation.

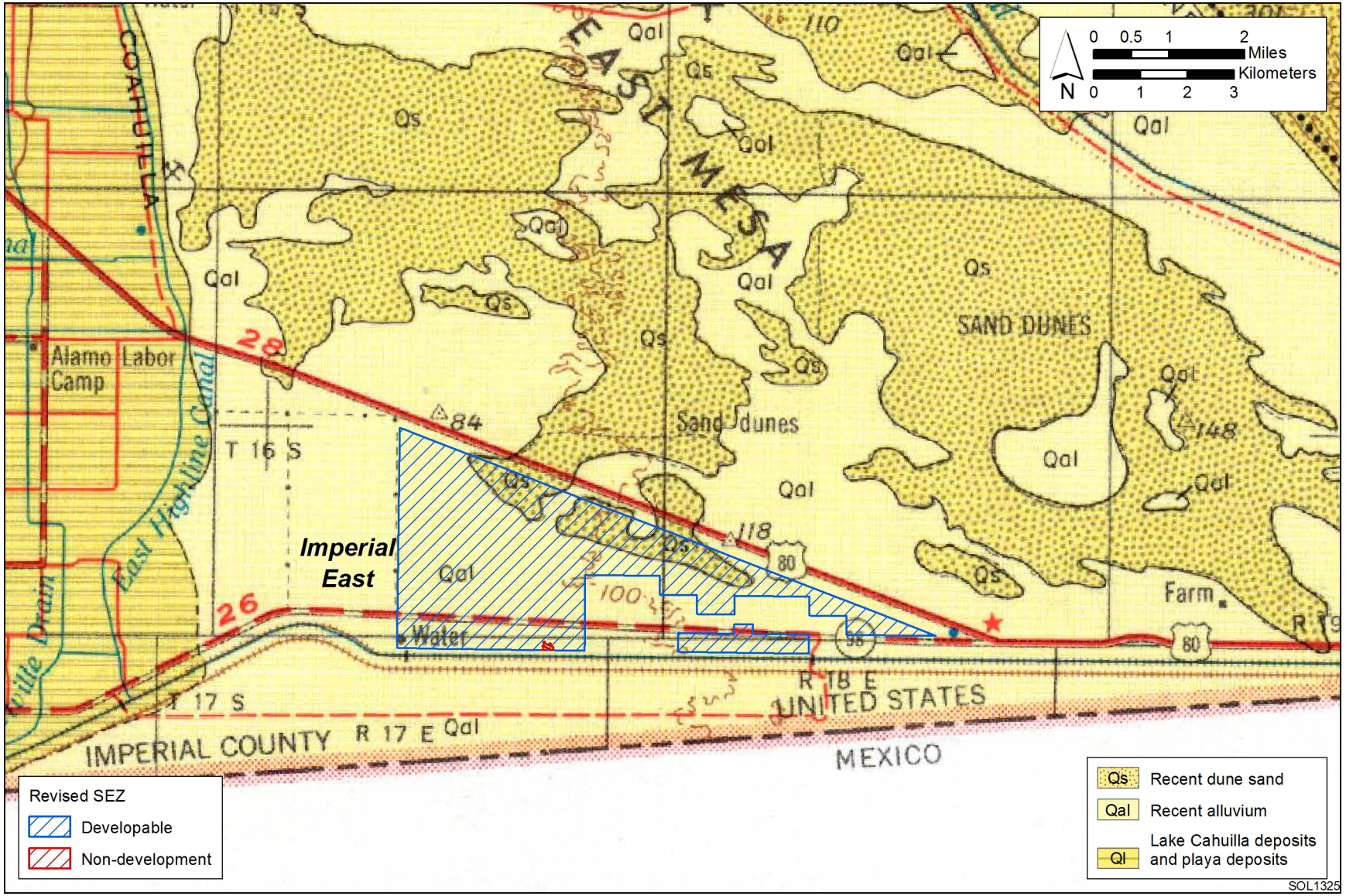


FIGURE 3 Geologic Map of the Imperial East SEZ (Source: Strand 1962)

2.7 MINERAL HISTORY

There has been no documented mining within the Imperial East SEZ. Most of the mining activity in the region has been limited to the extraction of sand and gravel along the western edge of East Mesa and to the northeast near Glamis, and to the past mining of locatable minerals in the Cargo Muchacho Mountains (Figure 4; see also Map 1).

The SEZ is located within the East Mesa KGRA (DOGGR and CGS 2002; DOGGR 2012). According to the LR2000, an authorized geothermal lease (CACA 017574) covers most of the lands within the SEZ and extends to the adjacent public lands northwest of the site (BLM 2012b). There are several producing geothermal wells and two producing geothermal power plants within the lease area (Haerter 2012).

Active mines in Imperial County include the Mesquite Gold Mine, an open-pit mine operated by New Gold, Inc. and located on the southwest flank of the Chocolate Mountains (it is currently the state's largest gold producer). Gold mineralization in this area occurs in Mesozoic gneisses intruded by biotite/muscovite-rich granites and is bound by faulting related to the San Andreas fault system. Exploration at the mine is ongoing (New Gold 2012). Teras Resources, Inc., reports that it is exploring the mineral resources (gold and silver) on 2,100 acres (8.5 km^2) of land in northern Imperial County (near Salton Sea Beach) as part of the Cahuilla Gold Project, a large epithermal, paleo-hot springs system that hosts multiple bonanza-grade gold-silver mineralized veins (Teras Resources, Inc. 2011a,b). There have been no other reports of recent mineral exploration or development activities in Imperial County.

2.7.1 Locatable Minerals

There are no documented occurrences of locatable mineral deposits or prospects within the Imperial East SEZ (Figure 5). Most of the locatable minerals in the region occur in the Cargo Muchacho Mountains, about 19 mi (31 km) to the northeast (known historically as the Cargo Muchacho District). These deposits are associated with Mesozoic granitic intrusions (including biotite granite, quartz monzonite, quartz diorite, and leucogranite; geologic map unit grMz) and andesitic dikes (Morton 1977). The nearest occurrences of locatable minerals are the Big Bear and Little Bear Mines, which produced gold, about 19 mi (31 km) to the northeast at the western base of the Cargo Muchacho Mountains. Kyanite was also once produced in this area. A gold occurrence (Coon Placer) is located on the mesa about 14 mi (23 km) to the northeast in section 24 of T15S, R19E (USGS 2011a).

Mines and mineral prospects in the vicinity of the Imperial East SEZ are shown on the detailed map of the SEZ and surrounding region provided in the back of this report (Map 1). Mining in the Cargo Muchacho District began when placer deposits were exploited in the early 1780s, with the majority of mining taking place between 1877 and 1900. Productive mines during that time were Tumco, American Girl, Cargo Muchacho, and Padre y Madre, which produced gold, copper, kyanite, sericite (mica), and wollastonite (of which only kyanite and sericite were of commercial significance). Known mineral deposits occur predominantly on the southwestern slopes of the mountains where mineralized veins follow east-west-striking faults.

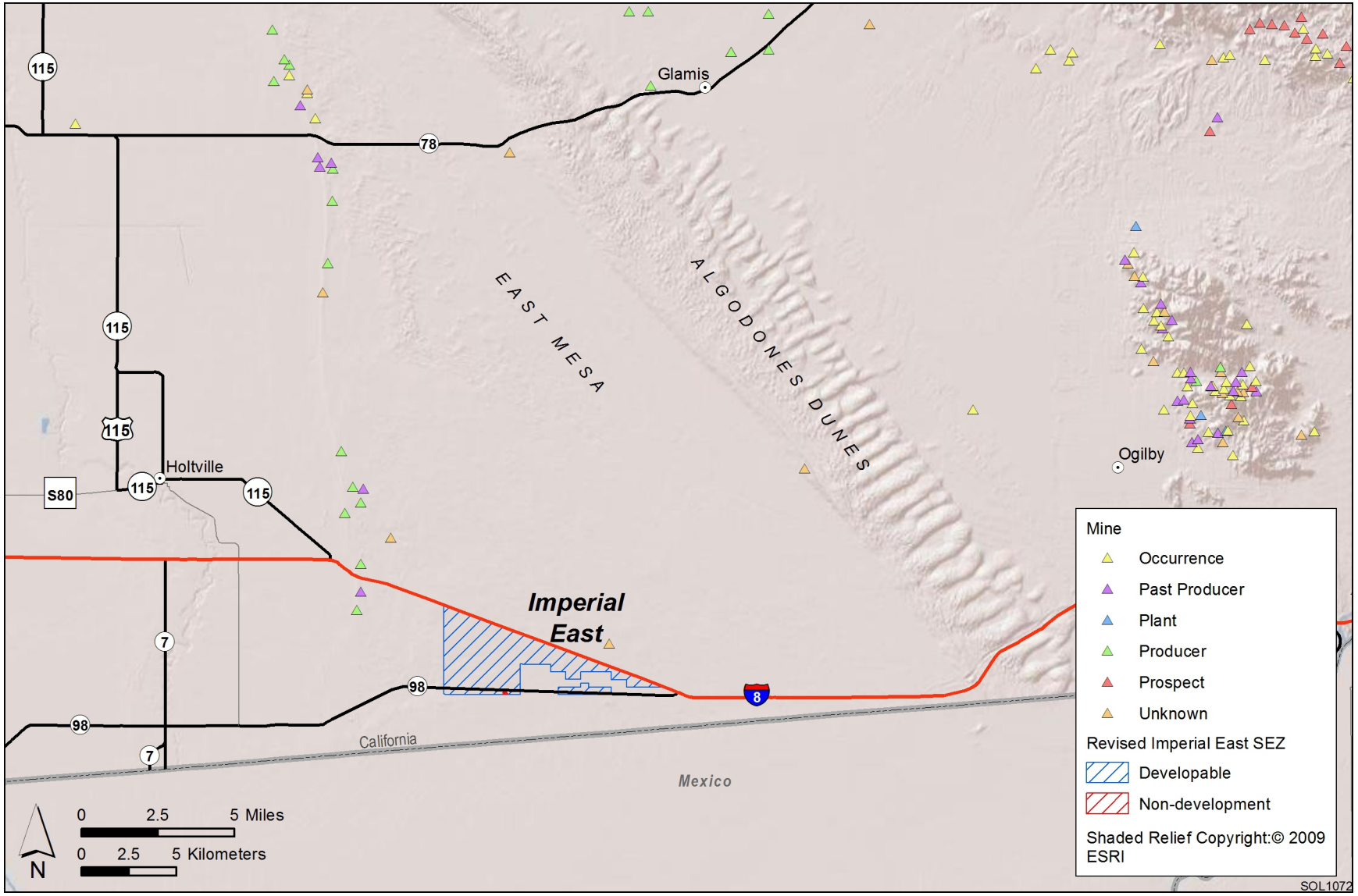


FIGURE 4 Map Showing Mines and Mineral Prospects near the Imperial East SEZ (Source: USGS 2011a)

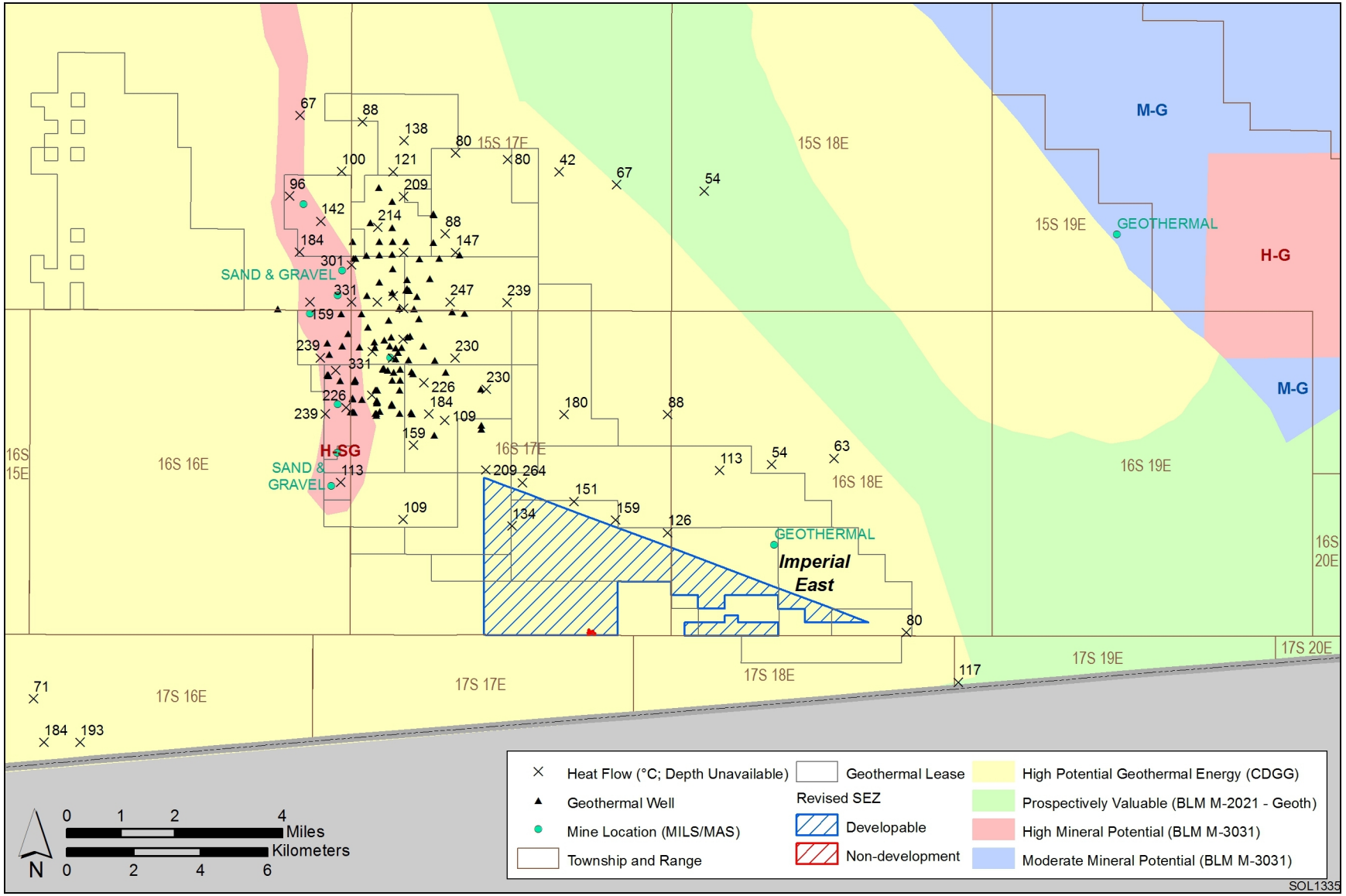


FIGURE 5 Mineral Potential Ratings for the Imperial East SEZ Based on the CDCA GEM Assessment (Source: BLM 2012a)

The most productive deposits are in the metasedimentary rocks of the pre-Mesozoic (possibly early Precambrian) Tumco Formation (geologic unit sch, Figure 2) and intrusive bodies of quartz diorite. The USGS MRDS indicates there are still active mines in the district, producing aluminum, mica, gold, copper, and silver; however, this has not been confirmed by the author (Clark 1970; Morton 1977; Shumway et al. 1980; USGS 2011a).

The Imperial East SEZ crosses no known mineralized areas or historical mining districts. Most of the locatable minerals in the region occur in the Cargo Muchacho Mountains to the northeast. These deposits are associated with Mesozoic granitic intrusions and andesitic dikes. The nearest occurrences of locatable minerals are in gold- and kyanite-producing mines in the Cargo Muchacho District. The SEZ is in a region where basin-fill sediments have an estimated thickness of about 13,400 ft (4,080 m) (based on well logs). The presence of mineralized zones beneath the site is possible (though not documented) as a result of heat and migrating fluids generated by the active geothermal systems at depth; however, if present, these zones would likely be several thousand feet below the surface. Therefore, the potential for locatable minerals to occur within the SEZ is low (level of certainty A).

2.7.2 Saleable Mineral Materials

Saleable mineral materials in the region are mainly limited to construction sand and gravel, crushed stone (aggregate), and common clay. Sand and gravel are produced from several small pits within a few miles to the west and northwest of the SEZ along the East Highline Canal (in T16S, R16E and T15S, R16E; Map 2). There are also several producers of sand and gravel to the northeast of the site (north of Glamis in T13S, 17E; T13S, R18E; and T13S, R19E). The Imperial East SEZ is an area with a high potential for occurrence of sand, gravel, and clay (level of certainty D). According to the LR2000, there are two pending free use permits (for common clay) within the SEZ, both in the southeast quadrant of section 32 in T16S, R18E (BLM 2012b). The permitted area covers land that falls within wetlands that have been designated as a solar energy non-development area (marked in red on Figure 4 and Map 1). The permitted area for clay overlaps the wetland area designated as non-development for solar projects.

2.7.3 Leasable Minerals

There are no active oil and gas leases within the Imperial East SEZ (BLM 2012b). Most of the area within the site was leased in the past, but these leases were closed in the late 1980s and early 1990s. Relative to more favorable areas for oil and gas accumulation in the state (concentrated in counties to the northwest), the SEZ is an area with low potential for oil and gas development (level of certainty B). There are no producing oil fields in Imperial County, and because of ongoing extensional faulting in the region (which disrupts hydrocarbon traps and pressure seals), the prospects for oil and gas in Imperial Valley are considered to be poor (DOGGR 1992; Popov et al. 2001; Barker 1995). Barker (1995) notes also that of the 100 or more geothermal wells drilled in the U.S. part of the Salton Trough, there have been no oil shows and only a few shows of hydrocarbon gas. While the area has not been fully assessed, no source rocks have been identified to date. A few test wells were drilled near the SEZ

(one to the northwest of the site in section 16 of T16S, R17E; and the other to the east of the site in section 29 of T16S, R18E). These wells are categorized by DOGGR as plugged/inactive, but the dates of their installation and their well logs were not available through the DOGGR online well records database.

The SEZ is located in the East Mesa KGRA, an area of high geothermal potential, where the current generation capacity is 73.2 megawatts (MW) (DOGGR and CGS 2002; Sison-Lebrilla and Tiangco 2005; BLM and EERE 2003; BLM 2012a). There is an authorized geothermal lease covering 37,714 acres (153 km^2) of BLM-administered land in the region, crossing most of the site (sections 21 to 28 of T16S, R17E; and sections 29 to 34 of T16S, R18E) and the area to the northwest (Figure 5). There are several producing geothermal wells and two producing geothermal power plants in the lease area (concentrated in sections 1 and 2 of T16S, R16E and sections 5 to 8 in T16S, R17E) (DOGGR 2012). A geothermal unit agreement (CACA 016692X), overlapping the northwest corner of the SEZ (in sections 21 and 28 of T16S, R17E), was closed in 1994 (BLM 2012b). The nearest nominated public lands for geothermal sale are located in the Glamis Dunes (T13S, R17E) more than 15 mi (24 km) to the north (BLM 2012b; Haerter 2012). The potential for geothermal development within the site is high (level of certainty D).

3 RIVERSIDE EAST SEZ

3.1 SUMMARY AND CONCLUSIONS

This chapter assesses the mineral resource potential of 159,457 acres (645 km^2) of public lands within an area known as the Riverside East SEZ, located in Riverside County in southeastern California. The SEZ is about 6 mi (10 km) northwest of and 45 mi (72 km) east of the towns of Blythe and Indio, respectively. The small town of Desert Center is located at the far southwestern edge of the SEZ, along I-10.

The Riverside East SEZ contains known deposits of locatable minerals, most of which occur along the margins where site boundaries overlap the base of adjacent mountain ranges. The assessment of potential for locatable minerals to occur within the SEZ is based on a combination of the mineral resource zones mapped by CGS (formerly the California Division of Mines and Geology) and the mineral potential areas mapped by the BLM as part of the CDCA GEM assessment. The potential ratings for various mineral resources to occur within the SEZ are summarized as follows:

- *Iron.* Potential is high for the portion of the SEZ within the northwest corner that lies to the east of the Eagle Mountains (level of certainty C) and for those portions along the northernmost boundaries (eastern end) at the base of the Little and Big Maria Mountains (level of certainty C).

- *Gold and silver.* Potential is moderate for the portion of the SEZ within the northwest corner that lies to the east of the Eagle Mountains (level of certainty C) and for the portion along the southern boundary at the base of the Mule Mountains (level of certainty C).

- *Uranium and thorium.* Potential is high for the central portion of the SEZ immediately south of the McCoy Mountains (level of certainty C).

- *Copper, gold, silver, tungsten, lead, zinc, gypsum, silica, and wollastonite.* Potential is high for those portions of the SEZ along the northernmost boundaries (eastern end) at the base of the Little and Big Maria Mountains (level of certainty C).

Based on the existing notices and plans of operations filed with the BLM, the only locatable minerals with a high development potential within the SEZ are gypsum (in section 27 of T4S, R21E) and gold (in section 30 of T6S, R21E).

The Riverside East SEZ is an area with a high potential for occurrence of sand and gravel (level of certainty D) and a moderate to high potential for limestone (level of certainty D). There are four authorized FHWA material sites within the SEZ. Two are located near the site's east end, along I-10, about 8 mi (12.8 km) west of Blythe (in section 35 of T6S, R21E), and two are located near the site's west end, also along I-10, a few miles east of Desert Center (in section 25

of T5S, R15E and section 29 of T5S, R16E). Limestone has been mined in the Little and Big Maria Mountains (to the north of the site's east end); site boundaries overlap moderate and high potential areas along the base of these mountains in this region. There is a pending plan of operation for limestone mining on 91 acres (0.37 km^2) in sections 27 and 34 of T4S, R22E (CACA 050739) along the northeast-facing boundary of the site's east end (along the base of the Big Maria Mountains). There is a pending notice for stone materials (CACA 040809) on one acre (0.0040 km^2) in the same region (section 34 of T4S, R22E). The demand for local aggregate is increasing due in part to the construction of solar projects in the region; some of this demand is being met using mine tailings and waste rock from the inactive Eagle Mountain Mine site (located mainly in the southern half of T3S, R14E).

There are no active oil and gas leases within the Riverside East SEZ; most of the land within the site was leased in the past, but these leases were closed in the 1980s. Relative to more favorable areas for oil and gas accumulation in the state (concentrated in counties to the northwest), the SEZ is an area with low potential for oil and gas development (level of certainty B). There are no oil and gas fields in Riverside County, and there have been no test wells drilled within or near the SEZ.

Most of the SEZ is prospectively valuable for geothermal resources and its potential for development is moderate (level of certainty B). A total of 36,522 acres (148 km^2) of land within the site is located within a high-potential area for geothermal resources (level of certainty B); of this total, 6,339 acres (26 km^2) are on lands designated as non-development for solar projects. These areas occur at the western end and eastern ends of the site.

The Ford Dry Lake area in the central portion of the SEZ is a high-potential area for leasable salt (sodium and potassium) (level of certainty B). Most of this area overlaps the area within the SEZ designated as non-development for solar projects.

3.2 LANDS INVOLVED

The Riverside East SEZ is located on BLM lands within the California Desert District (Palm Springs–South Coast Field Office), in Riverside County. The site lies within T4S, R15E; T5S, R15E; T4S, R16E; T5S, R16E; T5S, R17E; T6S, R17E; T6S, R18E; T6S, R19E; T6S, R20E; T7S, R20E; T4S, R21E; T5S, R21E; T6S, R21E; T7S, R21E; T4S, R22E; T5S, R22E; T6S, R22E; and T7S, R22E. Within this area, 11,457 acres (46.7 km^2) within the SEZ boundaries have been identified as non-development areas. These areas consist of intermittent lakes, major washes, and areas identified for non-development through investigations for approved projects (BLM and DOE 2011). The SEZ and the non-development areas within it are shown on the location map in the back of this report (Map 2). The full legal description of the SEZ is provided in Appendix A.

3.3 LAND STATUS

According to the LR2000, accessed on June 12 through 14, 2012, there are 93 active locatable mining claims (66 lode claims and 27 placer claims), eight active mill site claims, and

numerous closed lode, placer, and mill site claims within and immediately adjacent to the Riverside East SEZ (BLM 2012b). The lands within the SEZ were first segregated from locatable mineral entry in June 2009, pending the outcome of the Draft Solar PEIS (BLM and DOE 2010). They are currently segregated under an Interim Temporary Final Rule, which is in effect until June 30, 2013 (76 FR 23198–23205).

Active lode claims are concentrated in the southern McCoy Mountains region and overlap the SEZ in sections 2, 14, and 23 of T6S, R20E and sections 17 to 19 and 30 of T6S, R21E; there are also lode claims on the east side of the Little Maria Mountains (in sections 5 and 6 of T4S, R21E). Active placer claims are located mainly along the Big Maria Mountains (along the northeast-facing site boundary) in sections 20 to 23, 25 to 29, 33, and 35; there are also placer claims to the south of the McCoy Mountains (in sections 29 and 30 of T6S, R21E). All the active mill site claims are located in section 22 of T4S, R21E to the north of the gypsum mining operations in section 27 of T4S, R21E.

There are two plans of operation and one pending notice within the Riverside East SEZ, concentrated in the east end of the site (BLM 2012b). Two gypsum mining operations on 4 acres (0.016 km^2) in section 27 of T4S, R21E at the southeastern end of the Little Maria Mountains were authorized in 1998 (Superior Gypsum, CACA 039526) and 2004 (GF Gypsum, CACA 045768). A notice for mining of gold (placer) deposits (CACA 053230) at the south end of the McCoy Mountains (in section 30 of T6S, R21E) was filed in 2011.

There are no active free use permits or mineral materials contracts within the SEZ (BLM 2012b). There are four authorized FHWA material sites within the SEZ: two are located near the site's east end, along I-10, about 8 mi (12.8 km) west of Blythe (in section 35 of T6S, R21E), and two are located near the site's west end, also along I-10, a few miles east of Desert Center (in section 25 of T5S, R15E and section 29 of T5S, R16E). There are several closed free use permits along the southern boundary of the SEZ, about 10 mi (16 km) west of Blythe (in sections 30, 31, and 34 of T6S, R21E). The site remains open for the disposal of saleable mineral materials

There are no active oil and gas leases within the SEZ; however, a good portion of the site was leased for oil and gas in the past (numerous oil and gas leases covered most of the site but were closed in the 1980s) (BLM 2012b). There was a geothermal lease within the SEZ in Chuckwalla Valley (in sections 22 to 27 and 33 to 25 of T6S, R19E); it was closed in 1982 (BLM 2012b). There are no nominated lands for geothermal sale within the SEZ. The site remains open for discretionary mineral leasing for oil and gas, geothermal, and other leasable minerals.

3.4 GEOLOGIC SETTING

The Riverside East SEZ lies within the eastern Mojave Desert region of the Basin and Range physiographic province in southeastern California. The western part of the SEZ covers land north of I-10 along the entire length of the Chuckwalla Valley and the southern part of Palen Valley. The Chuckwalla Valley is a 40-mi (64-km) long, northwest-trending alluvial basin

that is bounded on the northwest by the Eagle Mountains and on the southwest by the Chuckwalla Mountains. The north–northwest-trending Coxcomb, Palen, and McCoy Mountains are to the north. The western part of the SEZ extends northward from Chuckwalla Valley into Palen Valley, a 20-mi (32-km) long, northwest-trending basin bounded on the southwest by the Coxcomb Mountains and on the northeast and east by the Granite and Palen Mountains, respectively.

The eastern part of the SEZ sits on the Palo Verde Mesa, covering land both north and south of I-10. The mesa is bounded on the west–southwest by the McCoy Mountains and on the north and northeast by the Little Maria and Big Maria Mountains. The Palo Verde Valley, a river valley of the Colorado River, lies to the east. The geology of the region near the SEZ is shown in Figure 5.

3.5 PHYSICAL FEATURES AND ACCESS

The Riverside East SEZ spans the length of the Chuckwalla Valley; its western end covers portions of the northern Chuckwalla and Palen Valleys, and its eastern end covers a good portion of the Palo Verde Mesa. The northern part of the Chuckwalla Valley (between the Eagle and Coxcomb Mountains) slopes to the southeast, with elevations ranging from more than 820 ft (250 m) on the alluvial fan surfaces flanking the surrounding mountains to less than 660 ft (200 m) in the center of the valley. The Palen Valley slopes to the south–southeast and is rimmed with alluvial fans that coalesce in the center of the valley. Streams discharging to the valley drain to the lowest elevation (about 430 ft [130 m]) at Palen Lake.

The central part of the Chuckwalla Valley trends to the east–southeast and is nearly flat. The lowest elevations, generally less than about 360 ft (110 m), occur within Ford Dry Lake.

Palo Verde Mesa is situated between the McCoy, Little Maria, and Big Maria Mountains. It slopes to the southeast and ranges in elevation from 820 ft (250 m) along the flanks of the surrounding mountain to less than 330 ft (100 m) along the its southeast-facing edge, which borders the Mesa Verde (Colorado River) Valley. The mesa is drained by the McCoy Wash, a perennial stream that flows to the southeast and discharges to a series of canals in the Mesa Verde Valley.

The SEZ is the largest of the sites being considered for solar energy development in the PEIS (BLM and DOE 2010). It stretches for about 45 mi (72 km) east to west and measures about 25 mi (40 km) north to south. The towns of Blythe and Desert Center mark the approximate eastern and western limits of the SEZ (respectively), and the western border of the SEZ lies close to the eastern border of Joshua Tree National Park. The SEZ is located along a critical east–west corridor that contains I-10, numerous pipelines, and transmission lines and surrounds a portion of the Los Angeles Metropolitan Water District (MWD) Colorado River Aqueduct. Most of the pipelines are south of I-10 and outside of the SEZ. State Route 177 passes through the west side of the SEZ in a northeasterly direction, and the Midland-Rice Road and a railroad pass through the eastern portion of the site in a northwesterly direction.

Most of the BLM-administered lands in the region, especially those north of I-10 in the east, those between I-10 and the Palen-McCoy Mountains in the central part of the SEZ, and those on the west side of the Palen-McCoy Mountains and around Palen Lake, have an undeveloped character. BLM lands in the western portion of the SEZ near I-10 and Desert Center and northwest of State Route 177 are also largely undeveloped, but the presence of developed private land, including some residences, the state highway, extensive MWD facilities, a small airport, and the inactive Kaiser Mine and related facilities give the area a more developed character.

The SEZ is located only on BLM land; however, numerous parcels of private land are scattered throughout the site, with additional private lands in near proximity to its boundaries. There is one section of state land surrounded by the SEZ. The city of Blythe, on the eastern side of the SEZ, is surrounded by an extensive block of agricultural lands irrigated with water from the Colorado River.

3.6 SITE GEOLOGY

The geology of the Riverside East SEZ is described based on the 1:250,000 map by Jennings (1967). The thicknesses of Cenozoic sediments were inferred from a test well, Hopkins Well, located in Chuckwalla Valley along the southern boundary of the SEZ (section 34 of T6S, R19E), as shown on Jennings (1967) and described by Rotstein et al. (1976).

The majority of the SEZ covers land north of I-10 along the entire length of the Chuckwalla Valley, the southern part of Palen Valley, and the Palo Verde Mesa. Exposed sediments in this region consist mainly of modern alluvium, playa deposits, and dune sands (Figures 6 through 9). A good portion of the SEZ is covered by dune sand (map unit Qs), especially along the central Chuckwalla Valley. Playa lake sediments (map unit Ql), associated with Palen and Ford Dry Lakes, occur in the western and central parts of the SEZ. These sediments are underlain by basin-fill deposits of alluvium and fanglomerate of the Pinto (Pleistocene) and Bouse (Pliocene) Formations and older nonmarine and marine sedimentary rocks with a total thickness of about 1,200 ft (365 m). The surrounding mountains are composed of pre-Tertiary igneous and metamorphic rocks covered by younger residual material. Transform faults are extensive on all the mountain ranges in the region; some of these faults have a vertical (dip-slip) component. Thrust faulting is extensive along the Big Maria Mountains and in the Palen and McCoy Mountains.

Basement rock below 1,200 ft (365 m) is likely composed of metasedimentary and igneous intrusive rocks ranging in age from Precambrian to Tertiary, similar to that composing the adjacent mountain ranges.

3.7 MINERAL HISTORY

Mining in Riverside County has been intermittent, with small-scale mining of gold, silver, lead, copper, uranium, fluorite, and manganese and with a few, sustained, large-scale

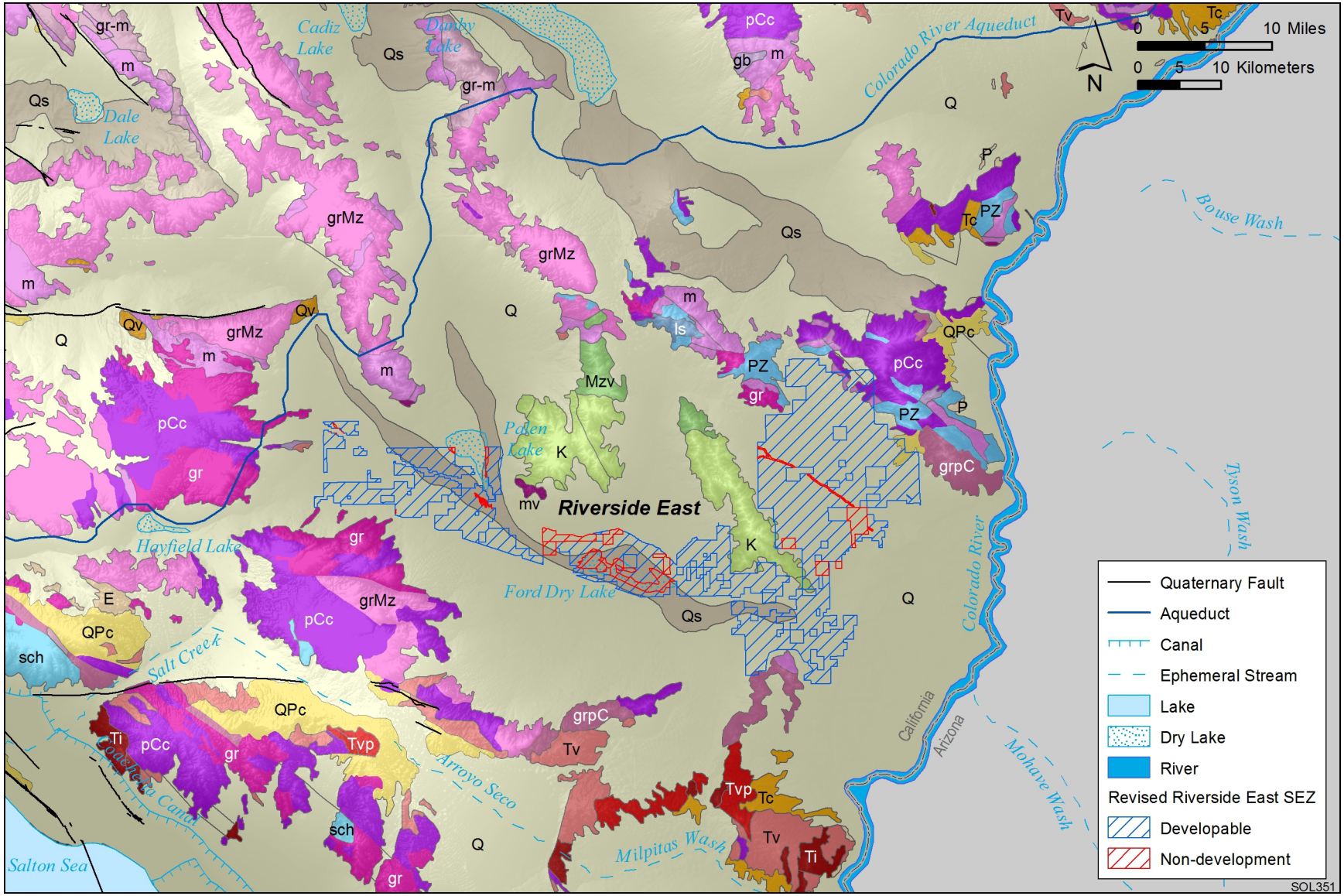


FIGURE 6 Geologic Map of the Riverside East SEZ Region (Sources: Ludington et al. 2007; Gutierrez et al. 2010)

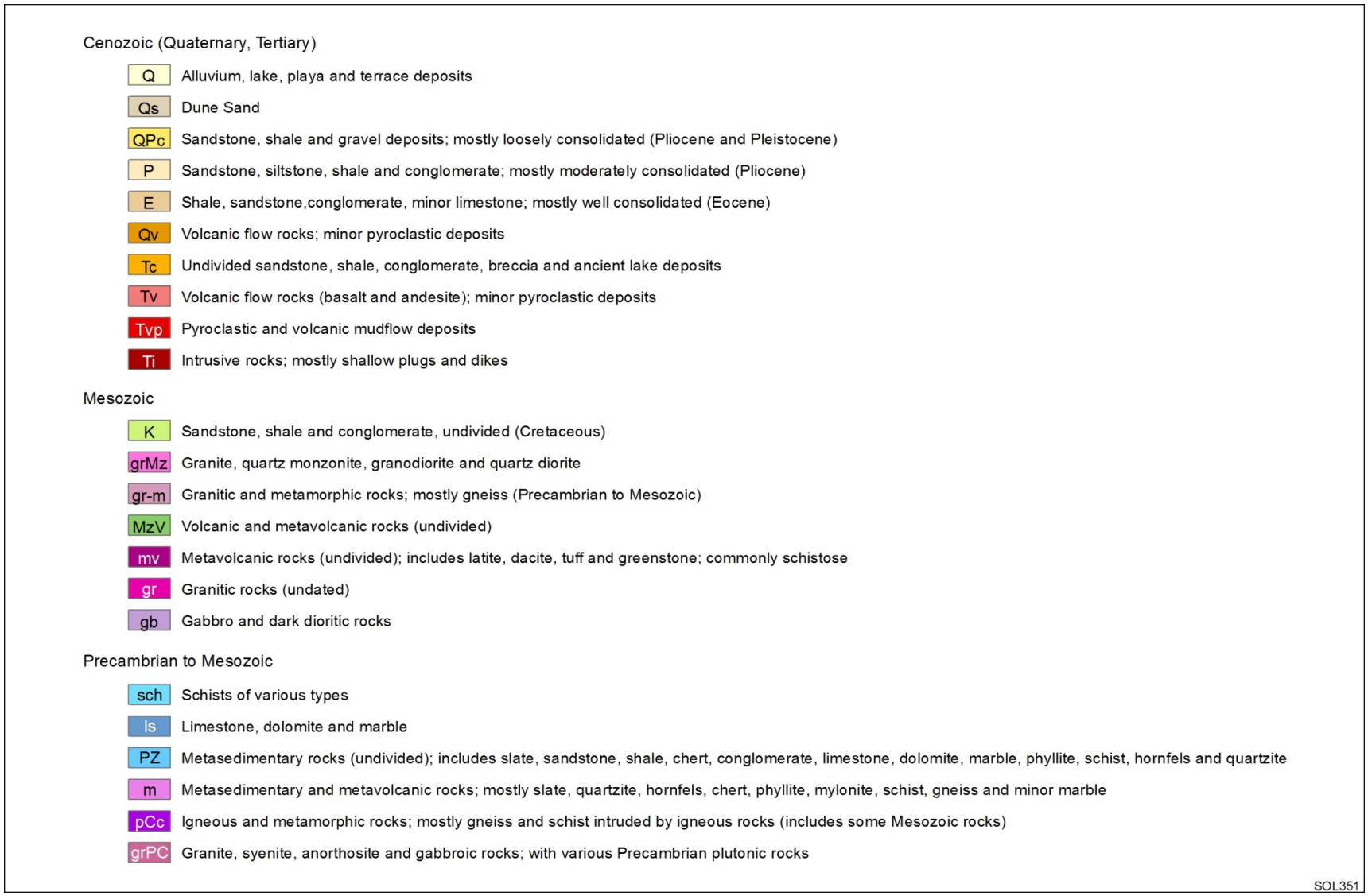


FIGURE 6 (Cont.)

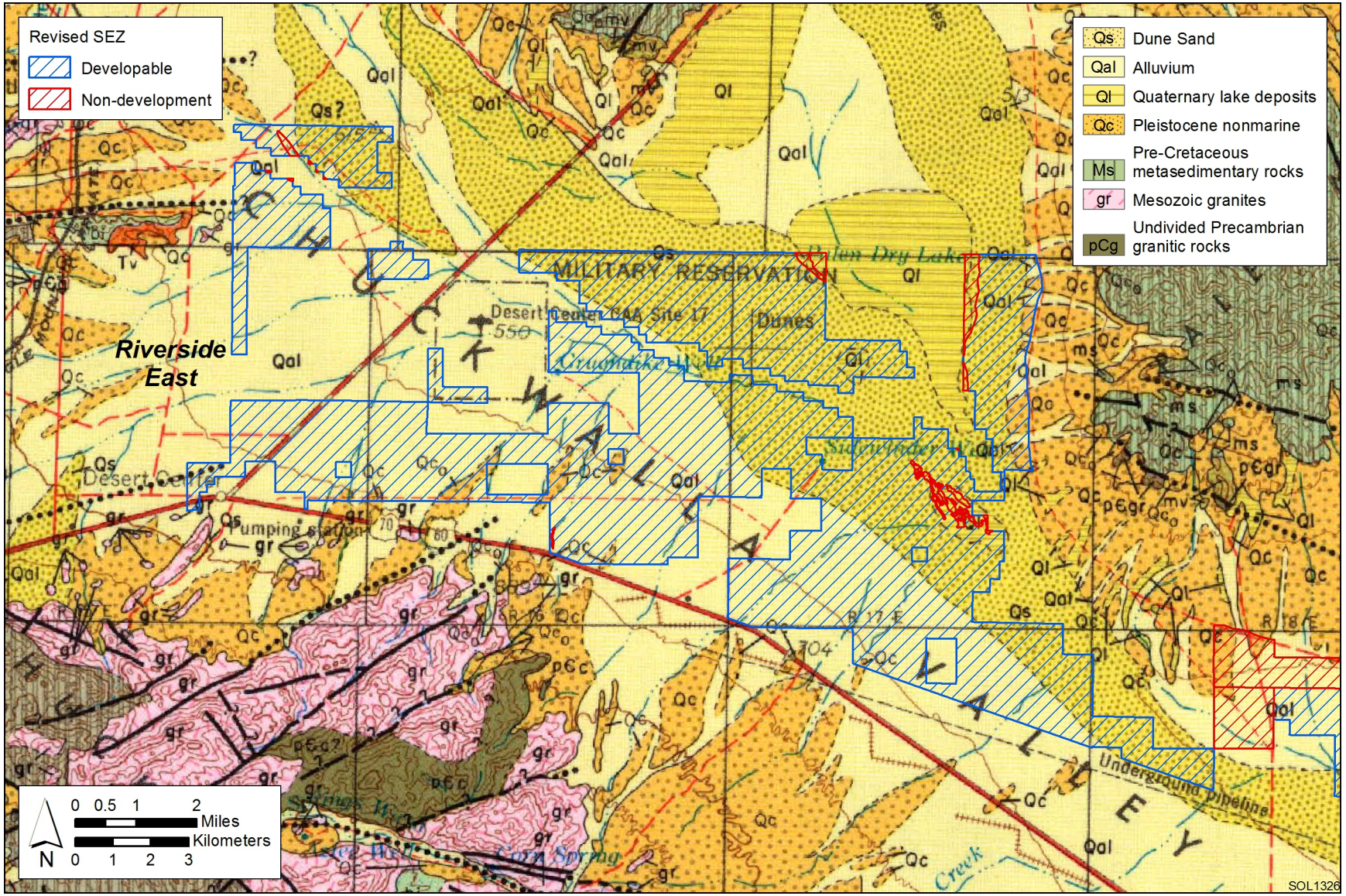


FIGURE 7 Geologic Map of the West End of the Riverside East SEZ (Source: Jennings 1967)

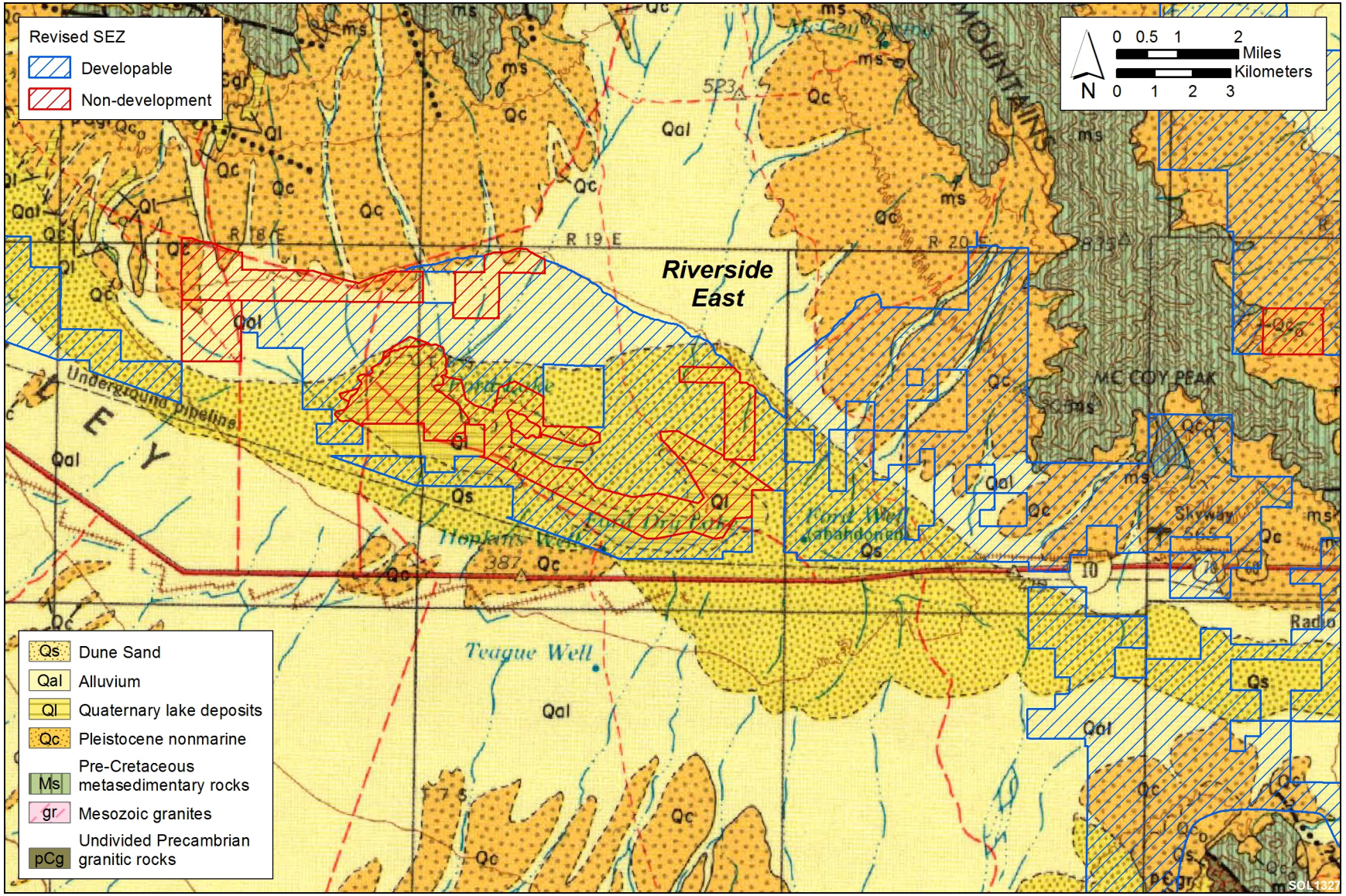


FIGURE 8 Geologic Map of the Central Portion of the Riverside East SEZ (Source: Jennings 1967)

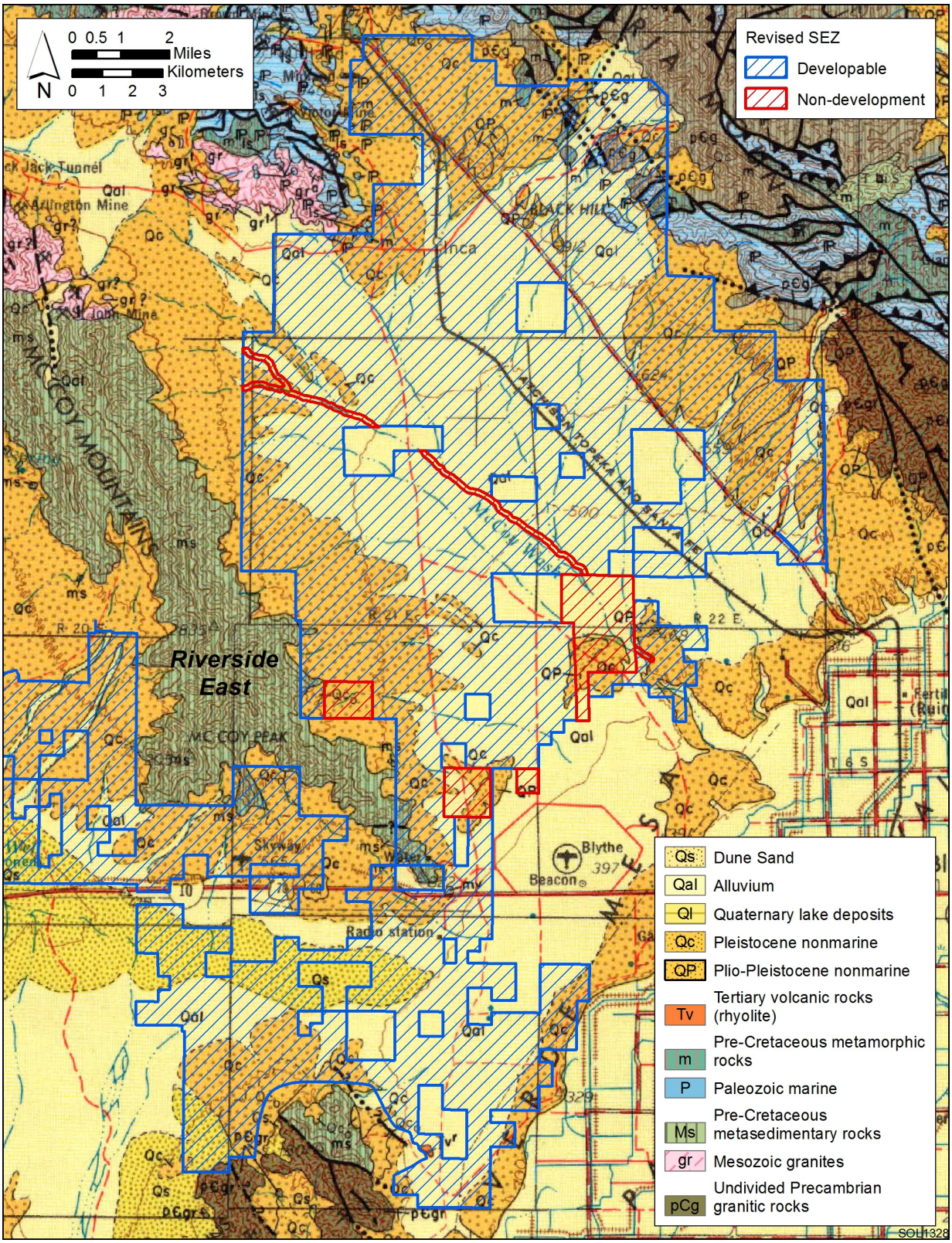


FIGURE 9 Geologic Map of the East End of the Riverside East SEZ on Palo Verde Mesa (Source: Jennings 1967)

operations at Midland (for gypsum) near the northern border of the Riverside East SEZ and in the Eagle Mountains to the west (for iron). In the late 1880s, gold and silver discoveries in the Chuckwalla Mountains caused the greatest gold rush in the county (Vredenburgh et al. 2010).

There has been some documented mining within the SEZ, mainly along its northern border, at the base of the Little and Big Maria Mountains (Schellenger Mine, producing gold; USG Wollastonite, producing wollastonite), to the south of the McCoy Mountains (Caproni-Woock Groups and North East No. 1 Claim, producing uranium), and on its western end, near Desert Center (H&K Mine, producing talc-soapstone) (USGS 2012). There are also four FHWA material sites within the SEZ, located along I-10 near Desert Center (west end) and Blythe (east end) (BLM 2012b). Several active and closed sand and gravel pits and a dimension stone quarry are clustered along the easternmost site boundary (mainly in section 25 of T5W, R22E). Most of the mining activity in the region has been limited to small-scale mining of industrial minerals (sand and gravel, crushed stone, and dimension stone) on the mesa and along the Colorado River valley, and the mining of locatable minerals in the adjacent mountain ranges.

No mineral exploration or development work is currently being conducted within the SEZ. American Energy Fields, Inc., reports that as part of its Blythe Uranium Project, it is exploring 66 federal mining claims (including three historic mines) covering 1,320 acres (5.3 km^2) in the southern McCoy Mountains in Riverside County, about 15 mi (24 km) west of Blythe. The project would develop an ore body potentially containing 2 million pounds (907 metric tons) of uranium (U_3O_8) by putting past producing mines back into production (Street Research 2011). However, there has been no plan of operation filed with the BLM to date (BLM 2012b). (A notice for uranium mining [CACA 049484] in sections 26, 27, 34 and 35 of T5S, R20E and section 2 of T6S, 20E was closed in 2007). There have been no other reports of recent exploration or development activities in Riverside County.

3.7.1 Locatable Minerals

The principal locatable minerals produced near the Riverside East SEZ are gold, copper, lead, silver, zinc, fluorite, gypsum, manganese, iron, and tungsten. Most of the locatable minerals in the region come from the adjacent mountains: the Eagle, Coxcomb, and Palen Mountains, to the west; the Big Maria, Little Maria, and McCoy Mountains, to the east; and the Chuckwalla and Mule Mountains to the south. Mineralization occurs within metasomatic contact zones between metasedimentary rocks and Mesozoic intrusive bodies and within related veins and fault zones.

There are 66 active lode claims and 27 active placer claims within the SEZ (BLM 2012b). Active claims occur mainly in the foothills of mountains along the margins of the site boundary, for example, in sections 23 to 26 of T6S, 20E and sections 18, 19, 29, and 30 of T6S, R21E in the southern McCoy Mountains in the central portion of the SEZ and in sections 20, 29, and 33 of T4S, R22E in the Big Maria Mountains at the eastern end of the SEZ (see Map 2). Numerous closed lode and placer claims occur within and adjacent to the site and are concentrated in T5S, R17E; T6S, R18E; T6S, R19E; T6S, R20E; T4S, R21E; and T4S, R22E. There are also eight active mill site claims within the SEZ, located in section 22 of T4S,

R21E to the north of the gypsum mining operations in section 27 of T4S, R21E (BLM 2012b). Seven patented mining (placer) claims are located in the foothills of the Little Maria and Big Maria Mountains, just outside the northern boundary of the SEZ (on the east end of the site), in sections 2, 5 to 7, and 18 of T4S, R21E.

There are two plans of operation and one pending notice within the Riverside East SEZ, concentrated in the east end of the site (BLM 2012b). Two gypsum mining operations on 4 acres (0.016 km^2) in section 27 of T4S, R21E at the southeastern end of the Little Maria Mountains were authorized in 1998 (Superior Gypsum, CACA 039526) and 2004 (GF Gypsum, CACA 045768). A notice for mining of gold (placer) deposits (CACA 053230) at the south end of the McCoy Mountains (in section 30 of T6S, R21E) was filed in 2011.

3.7.1.1 Mining Activity in the Vicinity of the Riverside East SEZ

Mines in the vicinity of the Riverside East SEZ are clustered within and around the adjacent mountain ranges, and these clusters generally correspond to the mineralized zones mapped by Kohler-Anatablin and Higgins (1994) and to the historical mining districts identified in other published reports. Mines and mineral prospects are shown in Figure 10 and on the detailed map of the SEZ and surrounding region in the back of this report (Map 2). Some of the minerals produced in the region (silica, carbonate rock, and perlite) are classified as industrial minerals. The mining districts and geographic reference numbers for mineral resource zones (MRZs) designated as 3a (known mineral occurrences) by Kohler-Anatablin and Higgins (1994) (listed in parentheses) are as follows:

- Eagle Mountains (Eagle Mountain District): iron, gold, silver, copper (s-1, h-21, and h-22), and industrials (silica, carbonate rock, roofing granules); to the west and northwest of the western end of the SEZ;

- Chuckwalla Mountains (Chuckwalla or Pacific District): gold, silver, copper, lead, and tungsten (h-1 and h-11), and perlite; immediately south of the western part of the SEZ;

- Coxcomb Mountains: gold and silver (h-7 and h-20); immediately north of the western part of the SEZ;

- Palen Mountains (Ironwood Manganese District): gold, silver, copper, and iron (h-28, h-32, and h-43), and pyrophyllite; north of the central part of the SEZ;

- McCoy Mountains (Ironwood Manganese District): gold, silver, copper, and manganese (h-9, h-24, h-37, and h-39); immediately west of the eastern part of the SEZ;

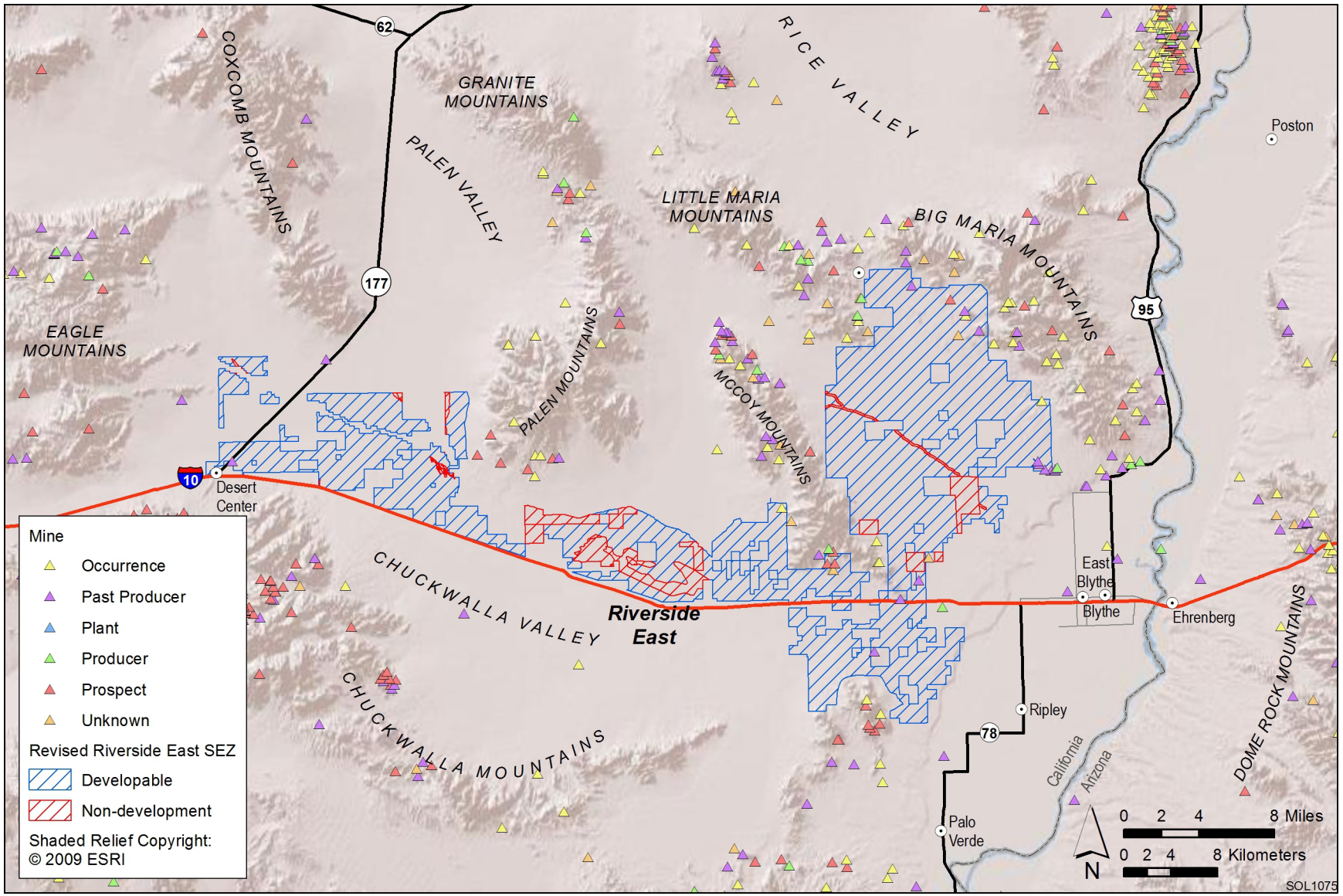


FIGURE 10 Map Showing Mines and Mineral Prospects near the Riverside East SEZ (Source: USGS 2011a)

- Little and Big Maria Mountains (Ironwood Manganese District): copper, iron, gold, silver, tungsten, lead, and fluorite (s-2), and industrials (gypsum, silica, carbonate rock, and wollastonite); immediately northwest of the eastern part of the SEZ; and

- Mule Mountains: gold and silver (h-8, h-16, and h-17); immediately south of the eastern part of the SEZ.

The Eagle Mountains District is in the Eagle Mountains, part of the eastern Transverse Ranges province. Mining in the district began in the 1860s with the discovery of iron and gold. Iron deposits make up the main economic mineral commodity in the district, especially in the northeastern part of the range. These deposits are thought to be skarns developed by metasomatic replacement of dolomite in the contact zone between Proterozoic metasediments (marble and quartzite) and intrusive igneous bodies of Jurassic age (Kohler-Anatablin and Higgins 1994; Powell et al 1984a). The inactive Eagle Mountain Iron Mine was the largest iron mine in the western U.S. from 1948 to 1982; principal iron ore minerals mined were hematite and magnetite (Force 2001; Kohler-Anatablin and Higgins 1994; Vredenburgh et al. 2010). Gold, silver, and copper mineralization occurs in shear zones and quartz stringers in the southern and northeastern Eagle Mountains. Host rocks are Jurassic and Cretaceous granite and quartz monzonite (to the south) and Proterozoic gneiss and schist (to the north) (Kohler-Anatablin and Higgins 1994). The mine consists of two deep open pits in Paleozoic metasedimentary rocks; iron ore occurs in interbedded carbonate rocks and quartzite intruded by quartz monzonite (Calzia et al. 1983). The Eagle Crest Energy Company filed an application with the Federal Energy Regulatory Commission (FERC) in 2009 for a proposed 1,300-MW pumped storage hydroelectric project to be located in the inactive mining pits at the mine (FERC 2010). A landfill and recycling center project has also been proposed for the mine (involving a land exchange); the landfill project is currently undergoing NEPA review.

Mining for silver and gold in the Chuckwalla Mountains (Chuckwalla or Pacific District) dates back to the 1870s. Mineralization in this region occurs in quartz veins and shear zones hosted in gneiss and batholithic rocks, especially near mafic to intermediate dikes. Several past mines produced gold, silver, lead, copper, zinc, and tungsten. The largest of the mines in this region was the Red Cloud Group, which mined silver, copper, and lead along a quartz-filled shear zone (between 1899 and 1944). Historic claims and prospects occur in the southeastern Chuckwalla Mountains where numerous steeply dipping to vertical shear zones contain mineralized quartz veins. The Desert Center and Aztec Mines are located in this area; both mines produced silver and gold at one time. The district is currently inactive (Kohler-Anatablin and Higgins 1994; Powell et al. 1984b; Vredenburgh et al. 2010; USGS 2011a).

Gold-bearing rock was first discovered in the Coxcomb Mountains in 1911 (although stories of a gold discovery on the northeast side of the mountains cite the 1880s). Mineralization in the district occurs at the contact between the Coxcomb granodiorite (Jurassic and Cretaceous) and the metasedimentary rocks (schist and phyllite) of the McCoy Mountains Formation. The only recorded production was from the Moser Mine, which produced gold, silver, and lead in 1947 and 1948. The Lone Hunt #1 and #2 Mines are located in a mineralized shear zone (containing a gold- and silver-bearing quartz vein) in the central Coxcomb Mountains; but there

are no production records for these mines (Kilburn et al. 1983; Calzia et al.1983; Kohler-Anatablin and Higgins 1994; Vredenburgh et al. 2010; USGS 2011a).

Copper was discovered in the Palen Mountains (part of the Ironwood Manganese District, which spans the Palen and McCoy Mountains and Little/Big Maria Mountains) in about 1880. Iron (mainly magnetite) was discovered in the early 1900s and was produced from deposits known as Iron King and Iron Queen. However, high apatite content makes the deposits less suitable for steel manufacturing. As it is in other mountain ranges in the region, mineralization is related to plutonic bodies and faulting. Disseminated copper occurs in the McCoy Mountains Formation, in the rocks of an andesite-diorite complex, and in quartz veins that cross the McCoy Mountains Formation. Past mines in the Palen Mountains have produced copper (Homestake Group), manganese (Black Ace), and fluorite (Fluorspar Group). Only the Black Ace Mine is reported by the USGS MRDS as currently active (Stone et al. 1985; Kohler-Anatablin and Higgins 1994; Vredenburgh et al. 2010; USGS 2011a).

Copper mining in the McCoy Mountains dates back to the early 1900s. The Black Jack Mine, in the northwestern part of the mountains (Ironwood Manganese District), was the most productive manganese mine in southern California (operating at intervals between 1915 and 1958). Mineralization occurs within an extensive group of steeply dipping, brecciated shear zones hosted by Jurassic volcanic rocks of the Dome Rock Sequence. Manganese veins, formed by low-temperature hydrothermal replacement of calcite-filled fault and fracture zones, are several feet thick in this region. To the south of the district, gold, silver, and copper mineralization occurs along shear zones in highly fractured metasediments of Jurassic age. The only production in this region was from the Eagles Nest Mine (silver, gold, and copper), between 1907 and 1909, and the St. John Mine (copper only), sometime before 1916. A small quantity of manganese ore was produced from the George (Red Rock) Mine (Vredenburgh et al. 2010; Kohler-Anatablin and Higgins 1994; USGS 2011a). While Kohler-Anatablin and Higgins (1994) report no known mineral occurrences in the southeastern part of the McCoy Mountains (portions of which lie adjacent to and within the SEZ), the CDCA's GEM assessment identifies that region as having high potential for uranium and thorium deposits (BLM 2012a).

The Little and Big Maria Mountains lie within a northwest-trending zone of skarn-related deposits where Paleozoic carbonate rocks (calcite, dolomite marble, and carbonaceous sediments) have been intruded by rocks of Jurassic to Cretaceous age (ranging in composition from granite to granodiorite). Mineralization occurs along faults, fractures, and bedding planes along these contacts. There are a few inactive mines and numerous prospects within the skarn zone; past mines include the Bald Eagle Mine, which produced lead, silver, zinc, copper, and gold between 1950 and 1951, and the Red Ocher Mine, which produced tungsten in 1954. Although iron has not been produced in the region, the Iron Cap claim is estimated to contain about 682,000 short tons of iron ore (64% iron). U.S. Gypsum Company has mined gypsum in the Little Maria Mountains and currently holds several patented claims in the region. Other known mineral occurrences include silica, wollastonite, and carbonate rock (Kohler-Anatablin and Higgins 1994).

There are several areas of mineralized quartz veins (hosted in granite and/or gneiss) in the Big Maria Mountains with known gold and silver occurrences; these include the Schellenger

Mine area (h-23) and the Valley View area (h-30). There has been little or no production in these areas (Kohler-Anatablin and Higgins 1994).

Gold was first discovered in the Mule Mountains in 1861, but it was not mined until the early 1900s. Gold and silver were produced from the Hidden Treasure Mine (formerly the American Flag Mine) until at least 1911. Other mines in the region include Hodge, Stone House, Grandaddy, and Grubstake Mines; however, there are no production records for these mines. The district is currently inactive, but there are several gold and copper claims and at least one documented occurrence of uranium there (Vredenburgh et al. 2010; Kohler-Anatablin and Higgins 1994; USGS 2011a).

3.7.1.2 Known Locatable Minerals within the Riverside East SEZ

The Riverside East SEZ contains known deposits of locatable minerals, most of which occur along the margins where site boundaries overlap the base of adjacent mountain ranges (Figures 11 through 13). The assessment of potential for locatable minerals to occur within the SEZ is based on a combination of the mineral resource zones mapped by Kohler-Anatablin and Higgins (1994) and the mineral potential areas mapped by the BLM as part of the CDCA GEM assessment (BLM 2012a). The potential ratings for various mineral resources to occur within the SEZ are summarized as follows:

- *Iron.* Potential is high for the portion of the SEZ within the northwest corner that lies to the east of the Eagle Mountains (level of certainty C) and for those portions along the northernmost boundaries (eastern end) at the base of the Little and Big Maria Mountains (level of certainty C).

- *Gold and silver.* Potential is moderate for the portion of the SEZ within the northwest corner that lies to the east of the Eagle Mountains (level of certainty C) and for the portion along the southern boundary at the base of the Mule Mountains (level of certainty C).

- *Uranium and thorium.* Potential is high for the central portion of the SEZ immediately south of the McCoy Mountains (level of certainty C).

- *Copper, gold, silver, tungsten, lead, zinc, gypsum, silica, and wollastonite.* Potential is high for those portions of the SEZ along the northernmost boundaries (eastern end) at the base of the Little and Big Maria Mountains (level of certainty C).

Based on the existing notices and plans of operations filed with the BLM, the only locatable minerals with a high development potential are gypsum (in section 27 of T4S, R21E) and gold (in section 30 of T6S, R21E).

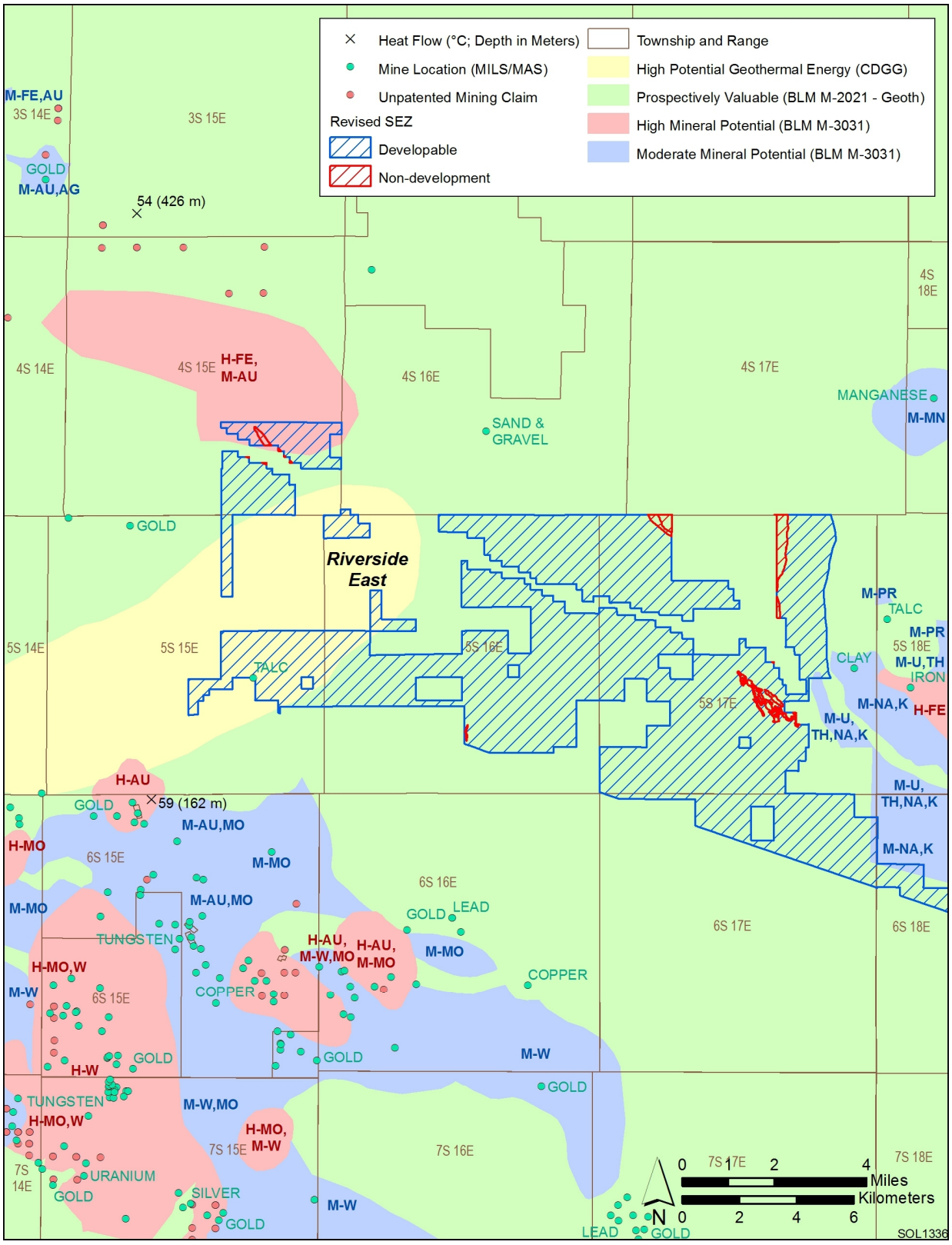


FIGURE 11 Mineral Potential Ratings for the West End of the Riverside East SEZ Based on the CDCA GEM Assessment (Source: BLM 2012a)

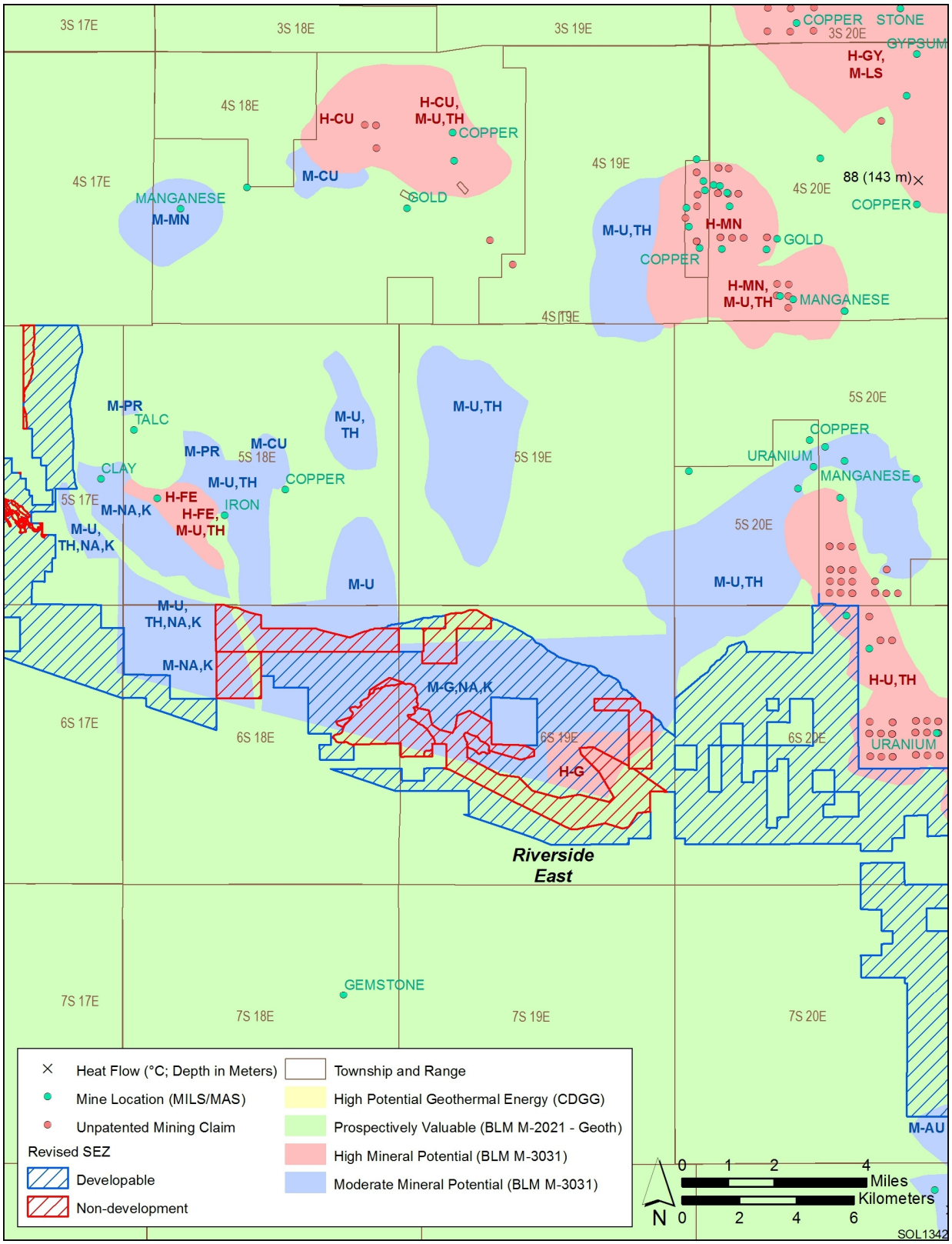


FIGURE 12 Mineral Potential Ratings for the Central Portion of the Riverside East SEZ Based on the CDCA GEM Assessment (Source: BLM 2012a)

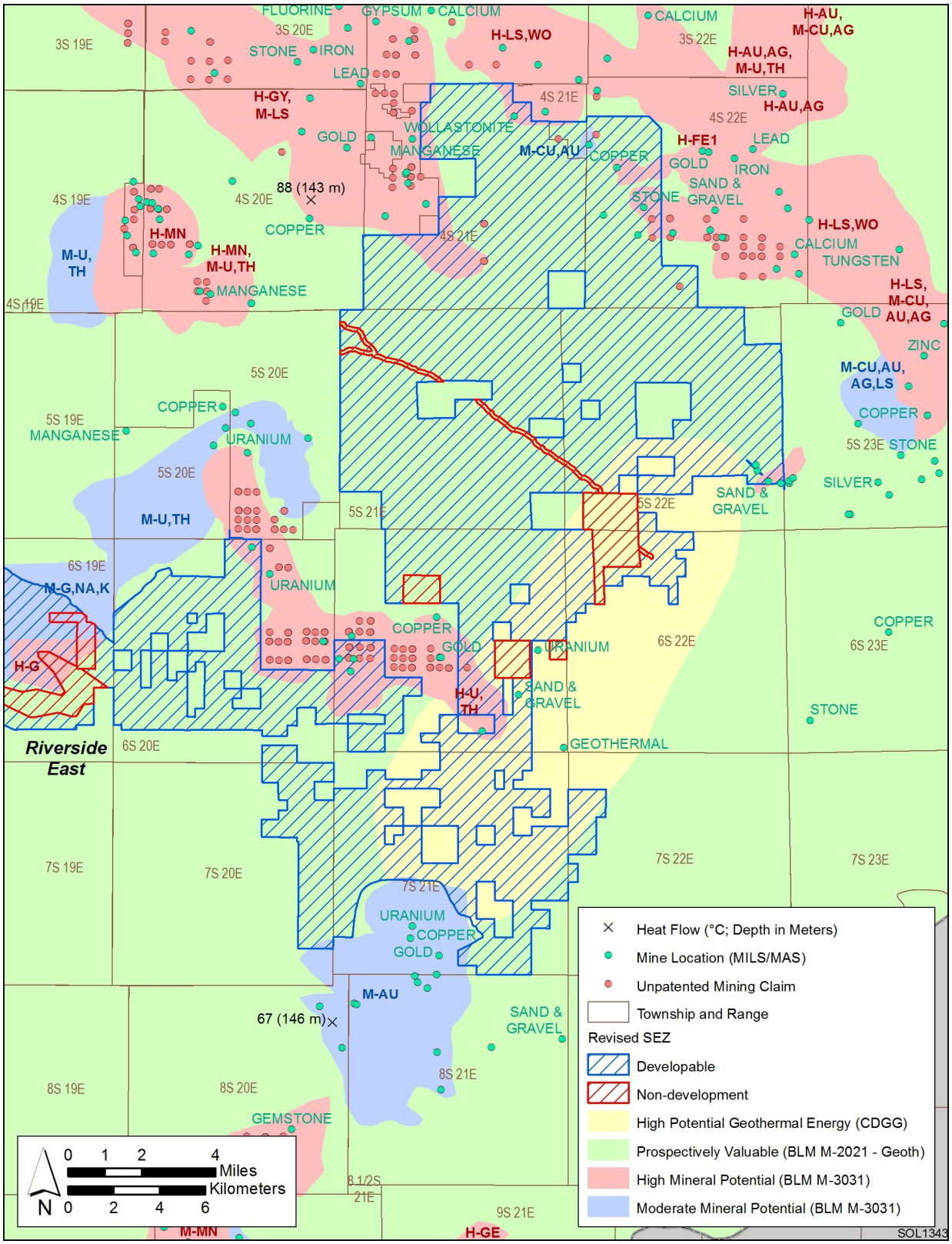


FIGURE 13 Mineral Potential Ratings for the East End of the Riverside East SEZ Based on the CDCA GEM Assessment (Source: BLM 2012a)

3.7.2 Saleable Mineral Materials

Saleable mineral materials in the region include sand and gravel, limestone, crushed stone, and dimension stone. Sand and gravel, crushed stone, and dimension stone have been produced from near the easternmost boundary of the SEZ (in section 25 of T5W, R22E; Map 2) and to the southeast toward the Palo Verde Valley (in sections 26 and 30 of T5S, R23E). The Riverside East SEZ is an area with a high potential for occurrence of sand and gravel (level of certainty D) and a moderate to high potential for limestone (level of certainty D). According to the LR2000, there are four authorized FHWA material sites within the SEZ. Two are located near the site's east end, along I-10, about 8 mi (12.8 km) west of Blythe (in section 35 of T6S, R21E), and two are located near the site's west end, also along I-10, a few miles east of Desert Center (in section 25 of T5S, R15E and section 29 of T5S, R16E) (BLM 2012b). Limestone has been mined in the Little and Big Maria Mountains (to the north of the site's east end); site boundaries overlap moderate and high potential areas along the base of these mountains in this region. There is a pending plan of operation for limestone mining on 91 acres (0.37 km^2) in sections 27 and 34 of T4S, R22E (CACA 050739) and along the northeast-facing boundary of the site's east end (along the base of the Big Maria Mountains). There is a pending notice for stone materials (CACA 040809) on one acre (0.0040 km^2) in the same region (section 34 of T4S, R22E). The demand for local aggregate is increasing due in part to the construction of solar projects in the region; some of this demand is being met using mine tailings and waste rock from the inactive Eagle Mountain Mine site (mainly in the southern half of T3S, R14E) (Springer 2012; Martinez 2012). According to Kohler (2006), aggregate production in this region is less than 0.5 million tons per year.

3.7.3 Leasable Minerals

There are no active oil and gas leases within the Riverside East SEZ (BLM 2012b). Most of the land within the site was leased in the past, but these leases were closed in the 1980s. Relative to more favorable areas for oil and gas accumulation in the state (concentrated in counties to the northwest), the SEZ is an area with low potential for oil and gas development (level of certainty B). There are no oil and gas fields in Riverside County (DOGGR 1992), and there have been no test wells drilled within or near the SEZ (based on a search of DOGGR online well records database).

Most of the SEZ is prospectively valuable for geothermal resources (Figures 11 through 13) and its potential for development is moderate (level of certainty B). A total of 36,522 acres (148 km^2) of land within the site is located within a high-potential area for geothermal resources (level of certainty B); of this total, 6,339 acres (26 km^2) are on lands designated as non-development for solar projects. These areas occur at the western end and eastern ends of the site (Figures 11 and 13).

The Ford Dry Lake area in the central portion of the SEZ (Figures 6 and 8) is a high-potential area for leasable salt (sodium and potassium) (level of certainty B) (Figure 12). Most of this area overlaps the area within the SEZ designated as non-development for solar projects.

4 REFERENCES

Barker, C.E., 1995, "Salton Trough Province (016)," in *1995 National Assessment of United States Oil and Gas Resources—Results, Methodology, and Supporting Data*, Gautier et al. (editors), U.S. Geological Survey Digital Data Series DDS-30, Release 2.

Blake, W.P., 1914, "The Cahuilla Basin and Desert of the Colorado," in *The Salton Sea: A Study of the Geography, the Geology, the Floristics, and the Ecology of a Desert Basin*, D.T. MacDougal (editor), Carnegie Institution of Washington, Washington, D.C.

BLM (Bureau of Land Management), 1985, *BLM Manual 3031—Energy and Mineral Resource Assessment,* U.S. Department of the Interior, June 19.

BLM, 2012a, *Geology, Energy, and Minerals (G-E-M) Resources Database for the California Desert Conservation Area (CDCA),* California Desert District Office, unpublished.

BLM, 2012b, *Land and Mineral Legacy Rehost 2000 System–LR 2000*, last updated Sept. 23, 2011. Available at http://blm.gov/lr2000/. Accessed June 12 to 14, 2012.

BLM and DOE (U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 10-59, DOE/EIS-0403, Dec.

BLM and DOE, 2011, *Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 11-49, DOE/EIS-0403D-S, Oct.

BLM and EERE (BLM and Energy Efficiency and Renewable Energy), 2003, *Assessing the Potential for Renewable Energy on Public Lands*, Feb.

Calzia, J.P., et al., 1983, *Mineral Resource Potential of the Coxcomb Mountains Wilderness Study Area (CDCA-328), San Bernardino and Riverside Counties, California—Summary Report*, MF-1603-A, U.S. Geological Survey.

CBO (Congressional Budget Office), 1983, *Strategic and Critical Nonfuel Minerals: Problems and Policy Alternatives,* A.M. Rivlin (Director), Washington, D.C., Aug.

Clark, W.B., 1970, *Gold Districts of California*, Bulletin 193, California Division of Mines and Geology, San Francisco, Calif.

Clinkenbeard, J., and J. Smith, 2011, *California Non-Fuel Minerals 2010*, California Geological Survey. Available at http://www.conservation.ca.gov/cgs/geologic_resources/mineral_production/Pages/Index.aspx. Accessed June 19, 2012.

DOGGR (California Department of Conservation Division of Oil, Gas, & Geothermal Resources), 1992, *California Oil and Gas Fields, Volume I—Southern, Central Coastal, and Offshore California Oil and Gas Fields (Contour maps, cross sections, and data sheets for California's oil and gas fields)*.

DOGGR, 2012, *East Mesa Geothermal Field (Imperial County) Map G2-5*. Available at http://www.conservation.ca.gov/dog/geothermal/maps/Pages/index.aspx. Accessed June 20, 2012.

DOGGR and CGS (DOGGR and California Geological Survey), 2002, *Geothermal Map of California (Scale 1:500,000) Map S-11*. Available at ftp://ftp.consrv.ca.gov/pub/oil/maps/Geothermal/MapS-11.pdf. Accessed June 20, 2012.

FERC (Federal Energy Regulatory Commission), 2010, *Draft Environmental Impact Statement for Hydropower License─Eagle Mountain Pumped Storage Hydroelectric Project—FERC Project No. 13123-002, California*, FERC/DEIS-D-0238, Dec.

Force, E.R., 2001, *Eagle Mountain Mine─Geology of the Former Kaiser Steel Operation in Riverside County, California*, Open File Report 01-237, U.S. Geological Survey.

Gutierrez, C., et al., 2010, *2010 State Geologic Map of California (Scale 1:750,000)*, Geologic Data Map 2, California Geological Survey. Available at http://www.consrv.ca.gov/cgs_history/Pages/2010_geologicmap.aspx. Accessed Oct. 4, 2010.

Haerter, J., 2012, personal communication from Haerter (Geothermal Program Lead, U.S. Department of the Interior, Bureau of Land Management, California State Office, Sacramento, Calif.) to T. Patton (Argonne National Laboratory, Argonne, Ill.), Aug. 1.

Hill, J.M., 1912, *The Mining Districts of the Western United States*, Bulletin 507, U.S. Geological Survey.

Hubbs, C.L., and R.R. Miller, 1948, "The Great Basin with Evidence on Glacial and Postglacial Times. II. The Zoological Evidence," *University of Utah Bulletin* 38:103–112.

Jennings, C.W., 1967, *Geologic Map of California: Salton Sea Sheet (Scale 1:250,000)*, California Division of Mines and Geology.

Kilburn, J.E., et al., 1983, *Chemical and Statistical Analysis of Stream Sediments, Panned Heavy-Mineral Concentrates, and Rocks of the Coxcomb Mountains Wilderness Study Area (CDCA-328), Riverside and San Bernardino Counties, California*, Open File Report 83-112, U.S. Geological Survey.

Kohler-Anatablin, S., and C. Higgins, 1994, *Mineral Land Classification of the Eastern Half of Riverside County, California,* Open File Report 94-11, California Geological Survey.

Kohler, S.L., 2006, *Aggregate Availability in California—Fifty Year Aggregate Demand Compared to Permitted Aggregate Resources*, Map Sheet 52, Department of Conservation, California Geological Survey, Dec.

Lipin, B.R., 2000, *Mineral Resource Databases*, Fact Sheet FS-122-00, U.S. Geological Survey, Sept.

Ludington, S., et al., 2007, *Preliminary Integrated Geologic Map Databases for the United States—Western States: California, Nevada, Arizona, Washington, Oregon, Idaho, and Utah*, Open File Report 2005-1305, Version 1.3, U.S. Geological Survey, original file updated in Dec. 2007. Available at http://pubs.usgs.gov/of/2005/1305/index.htm.

Martinez, C., 2012, personal communication from Martinez (Palm Springs–South Coast Field Office, U.S. Department of the Interior, Bureau of Land Management, Palm Springs, Calif.) to T. Patton (Argonne National Laboratory, Argonne, Ill.), July 10.

Mase, C.W., et al., 1981, *Shallow Hydrothermal Regime of the East Brawley and Glamis Known Geothermal Resource Areas, Salton Trough, California*, Open-File Report 81-834, U.S. Geological Survey.

Morton, P.K., 1977, *Geology and Mineral Resources of Imperial County, California*, County Report 7, California Division of Mines and Geology.

New Gold, 2012, *Geology and Mineralization (Mesquite District)*. Available at http://www.newgold.com/Properties/Operations/mesquite/GeologyandMineralization/default.aspx. Accessed June 19, 2012.

Popov, M., et al., 2001, *Basin-Centered Gas Systems of the U.S.*, Open File Report 01-135, Version 1.0, U.S. Geological Survey.

Powell, R.E., et al., 1984a, *Mineral Resource Potential of the Eagle Mountains Wilderness Study Area (CDCA-334), Riverside County, California—Summary Report*, Open File Report 84-631, U.S. Geological Survey.

Powell, R.E., et al., 1984b, *Mineral Resource Potential of the Chuckwalla Mountains Wilderness Study Area (CDCA-348), Riverside County, California—Summary Report*, Open File Report 84-674, U.S. Geological Survey.

Riney, T.D., et al., 1982, *Integrated Model of the Shallow and Deep Hydrothermal Systems in the East Mesa Area, Imperial Valley, California*, Open-File Report 82-980, U.S. Geological Survey.

Robinson, P.T., et al., 1976, "Quaternary Volcanism in the Salton Sea Geothermal Field, Imperial Valley, California," *Geological Society of America Bulletin* 87(3):347–360.

Rotstein, Y., et al., 1976, "Gravity Investigation in the Southeastern Mojave Desert, California," *Geological Society of America Bulletin* 87(7):981–993.

Shumaker, M., 2011, "Locatable Minerals and Strategic and Critical Minerals," personal communication from Shumaker (BLM Chief Mineral Examiner. U.S. Department of the Interior, Bureau of Land Management, Division of Solid Minerals, Phoenix, Ariz.) to T. Patton (Argonne National Laboratory, Argonne, Ill.), April 28.

Shumway, G.L., et al., 1980, *Desert Fever: An Overview of Mining in the California Desert Conservation Area*, prepared for the U.S. Department of the Interior, Bureau of Land Management, Desert Planning Staff, Feb.

Sison-Lebrilla, E., and V. Tiangco, 2005, *California Geothermal Resources–Staff Paper in Support of the 2005 Integrated Energy Policy Report*, CEC-500-2005-070.

Springer, M., 2012, personal communication from Springer (California State Office, U.S. Department of the Interior, Bureau of Land Management, Sacramento, Calif.) to T. Patton (Argonne National Laboratory, Argonne, Ill.), July 9.

Stanley, G.M., 1963, "Prehistoric Lakes in Salton Sea Basin," *Abstracts for 1962,* Special Paper 73, Geological Society of America.

Stone, P., et al., 1985, *Mineral Resources of the Palen-McCoy Wilderness Study Area, Riverside County, California,* Bulletin 1710-A, U.S. Geological Survey.

Strand, R.G., 1962, *Geologic Map of California: San Diego–El Centro Sheet (Scale 1:250,000)*, California Division of Mines and Geology.

Street Research, 2011, *American Energy Fields, Inc*. Available at http://streetresearch.com/clients/aefi. Accessed May 9, 2011.

Teras Resources, Inc., 2011a, *Cahuilla Gold Project, Imperial County, California, USA*. Available at http://www.nafinance.com/Listed_Co/english/teras_e.htm. Accessed May 7, 2011.

Teras Resources, Inc., 2011b, *Teras Moves Forward to Earn in on the Cahuilla Gold Project and Issues Shares to Consolidate*, press release, Feb. 16. Available at http://teras.ca/media/pdf/TERAS%20-%20Press%20Release%20Teras%20Moving%20Forward%20on%20the%20Cahuilla%20Gold%20Project%202-16-11PL.pdf. Accessed May 7, 2011.

USGS (U.S. Geological Survey), 2011a, *Mineral Resource Data System: Conterminous U.S.,* Mineral Resources On-Line Spatial Data. Available at http://mrdata.usgs.gov/mineral-resources/mrds-us.html. Accessed May 6, 2011.

USGS, 2011b, *2008 Minerals Yearbook—California (Advance Release),* March.

Vredenburgh, L.M., et al., 2010, *Desert Fever: An Overview of Mining in the California Desert Conservation Area,* 2010 update of Shumway et al. 1980, prepared for U.S. Department of the Interior, Bureau of Land Management, Desert Planning Staff. Available at http://vredenburgh.org/desert_fever/index.html#Story. Accessed May 10, 2010.

Waters, M.R., 1983, "Late Holocene Lacustrine Chronology and Archaeology of Ancient Lake Cahuilla, California," *Quaternary Research* 19(3):373–387.

Zimmerman, R.P., 1981, *Soil Survey of Imperial County, California: Imperial Valley Area*, U.S. Department of Agriculture, Soil Conservation Service, Oct.

This page intentionally left blank.

5 LIST OF PREPARERS

Table 2 lists the BLM management team members and mineral specialists consulted during the preparation of this assessment. Table 3 lists the names, education, and expertise of the report preparers.

TABLE 2 BLM Management Team and Mineral Specialists Consulted

Name	Office/Title
Linda Resseguie	Minerals and Realty Management Directorate, Realty Specialist
Shannon Stewart	Renewable Resources and Planning Directorate, Senior Planning and Environmental Analyst
Matt Shumaker	Division of Solid Minerals, Chief Mineral Examiner
Jeff Holdren	Division of Lands, Realty and Cadastral Survey, Senior Reality Specialist (legal descriptions)
Jason Powell	Division of Solid Minerals, Geologist
Steve Kupferman	California State Office, Geologist and Supervisory Physical Scientist
Marc Springer	California State Office, Geologist
James Haerter	California State Office, Geothermal Program Lead
Sean Hagerty	California State Office, Geologist
Rob Waiwood	California Desert District Office, Mineral Specialist
Peter Godfrey	California Desert District Office, Geologist
Cheryl Martinez	Palm Springs–South Coast Field Office, Geologist

TABLE 3 Report Preparers

Name	Education/Expertise	Contribution
Linda Graf	Desktop publishing specialist; 41 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production
Heidi Hartmann	M.S., Environmental Toxicology and Epidemiology; 25 years of experience in environmental assessment, exposure and risk analysis, and environmental impact assessment.	Solar PEIS Project Manager
Irene Hogstrom	M.A., Geography and Environmental Studies; B.L.A., Landscape Architecture; 23 years of experience in landscape architecture, including design, regional planning, and ecological restoration.	LR2000 queries
Patricia Hollopeter	B.A., Religion; M.A., Philosophy; 27 years of experience in technical editing and environmental assessment document production.	Editor
James E. May	M.S., Water Resources Management, B.A., Zoology; 34 years of experience in natural resources management; 8 years of consulting experience in resource management, land use planning, and NEPA compliance.	Lands and realty; and mineral review
Greg McGovern	M.S., B.S., Geology (Hydrogeology); 23 years of experience in environmental site assessment and contaminant fate and transport studies.	Site-specific geology
Mary R. Moniger	B.A., English; 35 years of experience in editing and writing.	Lead editor
Michele Nelson	Graphic designer; 35 years of experience in graphical design and technical illustration	Report cover design and foldout map layout
Terri L. Patton	M.S., B.S., Geology (Igneous Petrology and Mineral Chemistry); 24 years of experience in environmental research and assessment.	Lead author; geology and mineral assessment
Kurt Picel	Ph.D., Environmental Health Sciences; 33 years of experience in environmental health analysis and 18 years in environmental assessment.	Environmental analysis and review
Lorenza Salinas	Desktop publishing specialist; 30 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production

TABLE 3 (Cont.)

Name	Education/Expertise	Contribution
Barbara Simmons	B.A., technical writing; E.L.S. certification by the Board of Editors in the Life Sciences; Fellow of the Society for Technical Communication; 45 years of experience in technical editing and publications management	Editor
Karen P. Smith	M.S., B.A., Geology; B.S., Anthropology; more than 23 years of experience in energy and environmental regulatory and policy analysis.	Solar PEIS Program Manager
Emily A. Zvolanek	B.A., Environmental Science; 4 years of experience in GIS mapping	GIS mapping

This page intentionally left blank.

APPENDIX A:

LEGAL DESCRIPTIONS OF CALIFORNIA SOLAR ENERGY ZONES

This page intentionally left blank.

APPENDIX A:

LEGAL DESCRIPTIONS OF CALIFORNIA SOLAR ENERGY ZONES

This appendix presents the full legal descriptions for the two SEZs in California.

San Bernardino Meridian

Imperial East SEZ

T. 16 S., R. 17 E.,
secs. 21 to 28, inclusive, those portions lying south of the southerly ROW of I-8 and east of Lake Cahuilla No. 5 ACEC;
sec. 33, except that portion lying in Lake Cahuilla No. 5 ACEC;
secs. 34 and 35.

T. 16 S., R. 18 E.,
secs. 29 and 30, those portions lying south of the southerly ROW of I-8;
sec. 31, lot 3, NE¼, NE¼NW¼, SE¼SW¼, and S½SE¼;
sec. 32, that portion of the N½N½ lying south of the southerly ROW of I-8, S½NW¼SW¼, and S½S½;
sec. 33, that portion of the N½ lying south of the southerly ROW of I-8 and N½SE¼;
sec. 34, those portions of the N½SW¼ and the NW¼SE¼ lying south of the southerly ROW of I-8.

The areas described aggregate approximately 5,722 acres (23 km^2).

Riverside East SEZ

T. 4 S., R. 15 E.,
sec. 25, NE¼NE¼, W½NE¼, W½, W½SE¼, and SE¼SE¼, excluding fee easement CARI 07041;
sec. 26, N½, S½SW¼SW¼, SW¼SE¼SW¼, NE¼SE¼, NE¼NW¼SE¼, NE¼SE¼SE¼, excluding fee easements CALA 053581 and CARI 07041;
sec. 27, N½NE¼, N½SE¼ NE¼**,** N½NE¼NW¼, SE¼NE¼SW¼, E½SE¼SW¼, S½SE¼, and S½NW¼SE¼, excluding the Chuckwalla DWMA and fee easements CALA 053581 and CARI 07041;
sec. 34, E½ and E½E½W½, excluding the Chuckwalla DWMA;
sec. 35, lot 2, SW¼NE¼NE¼, S½NW¼NE¼, S½NE¼, SE¼SE¼NE¼, W½, N½SE¼, and SW¼SE¼, excluding fee easements CALA 053581, CARI 07041, and CALA 057221.

T. 5 S., R. 15 E.,
sec. 3, lot 1 in the NE¼, E½ lot 2 in the NE¼, and E½SE¼, excluding the Chuckwalla DWMA;
sec. 10, E½NE¼ and NE¼SE¼, excluding the Chuckwalla DWMA;
sec. 13, S½;
sec. 14, S½;
sec. 15, E½SE¼, excluding the Chuckwalla DWMA;
sec. 22, E½NE¼, N½S½, SW¼SW¼, N½SE¼SW¼, and SW¼SE¼SW¼, excluding the Chuckwalla DWMA;
sec. 23, N½ and SE¼;
sec. 24, N½, SW¼, NE¼SE¼, S½SE¼;
sec. 25, those portions of N½N½ and NW¼SW¼NW¼, northerly of CARI 07303;
sec. 27, NW¼NW¼, northerly of the northern ROW boundary CARI 07303, excluding the Chuckwalla DWMA.

T. 4 S., R. 16 E.,
sec. 31, S½ of lot 3 in the SW¼, excluding fee easement CALA 053581.

T. 5 S., R 16 E.,
secs. 1 and 2;
sec. 3, lots 1 and 2 in the NE¼, lots 1 and 2 in the NW¼, and SE¼, excluding fee easement CALA 053581;
sec. 4, lots 1 and 2 in the NE¼, excluding fee easement CALA 053581;
sec. 6, lots 1 and 2 in the NE¼ and lots 1 and 2 in the NW¼, excluding fee easement CALA 053581;
sec. 8, S½NW¼SW¼ and SW¼SW¼;
sec. 10, 11, and 13, excluding fee easement CALA 053581;
sec. 14, E½;
sec. 15, S½;
sec. 17, S½NE¼, NW¼NW¼, and S½NW¼;
sec. 18, lots 1 and 2 in the SW¼, and SE¼;
sec. 19 and 20;
sec. 21, N½;
sec. 22;
sec. 23, NE¼, N½NW¼, SE¼NW¼, and S½;
sec. 24;
sec. 25, W½;
sec. 26;
sec. 27, northerly of the northern ROW boundary CARI 05498;
sec. 28, N½N½ N½;
sec. 29, N½N½ N½;
sec. 30, lot 1 in the NW¼, N½ of lot 2 in the NW¼, and N½NE¼;
sec. 34, those portions of N½N½NE¼, and NE¼NE¼NW¼, lying northerly of the northern ROW boundary CARI 05498;
sec. 35, N½N½N½.

T. 5 S., R. 17 E.,
secs. 1 and 2, excluding the Palen McCoy Wilderness Area CACA 35105;
sec. 3, excluding fee easement CALA 053588;
sec. 5, lots 1 and 2 in the NW¼, and SW¼;
sec. 6;
sec. 7, excluding fee easement CALA 053581;
sec. 8, W½ and SE¼;
sec. 9, SW¼, W½SE¼, SW¼NE¼SE¼, W½SE¼SE¼, and SE¼SE¼SE¼;
sec. 10, E½E½E½, excluding fee easement CALA 053581;
sec. 11, excluding the Palen McCoy Wilderness Area CACA 35105;
sec. 14, excluding the Palen McCoy Wilderness Area CACA 35105 and excluding fee easement CALA 053588;
sec. 15, NE¼NE¼NE¼, SW¼NW¼SW¼, W½SW¼SW¼, SE¼SW¼SW¼, and S½SE¼SW¼, excluding fee easement CALA 053588;
secs. 17 and 18, excluding fee easement CALA 053581;
sec. 19, lots 1 and 2 of the NW¼, lots 1 and 2 of the SW¼, and NE¼;
sec. 20, W½NW¼, SE¼NW¼, and S½;
sec. 21;
sec. 22, excluding fee easement CALA 053588;
sec. 23, excluding the Palen McCoy Wilderness Area CACA 35105 and fee easement CALA 053588;
sec. 26, SW¼NW¼ and SW¼;
sec. 27, N½, N½SW¼, SE¼SW¼, and SE¼;
sec. 28;
sec. 29, NE¼ and S½;
secs. 31 to 34, inclusive;
sec. 35, N½NW¼ and SW¼NW¼.

T. 6 S., R. 17 E.,
sec. 1, lots 1 and 2 in the NW¼, and S½;
sec. 2;
sec. 3, E½ lot 1 in the NE¼, lot 2 in the NE, W½ lot 1 in the NW¼, lot 2 in the NW¼, W½SW¼, and E½SE¼;
sec. 4, that portion lying north of the northern ROW of CARI 05498;
sec. 5, lot 2 in the NE¼, and lot 2 in the NW¼;
secs. 6 and 9 to 12, inclusive, those portions north of the northerly ROW of CARI 05498.

T. 6 S., R. 18 E.,
sec. 1 to 4 inclusive, excluding the Palen McCoy Wilderness area CACA 35105;
sec. 7, lots 1 and 2 in the SW¼, and SE¼;
sec. 9, entire section;
sec. 10, N½, NE¼SW¼, and N½SE¼;
secs. 11, 12, and 13;
sec. 14, N½, N½SW¼, and SE¼;
secs. 17 and 18, those portions lying north of the northerly ROW of CARI 05498;

sec. 23, N½NE¼, NE¼NW¼, and that portion of the N½SE¼, lying north of the northerly ROW of CARI 05498;
sec. 24, that portion of the S½, lying north of the northerly ROW of CARI 05498.

T. 6 S., R. 19 E.,
sec. 3 to 6 inclusive, excluding the Palen McCoy Wilderness area CACA 35105;
secs. 7, 8 and 9;
sec. 10 to 13 inclusive, excluding the Palen McCoy Wilderness area CACA 35105;
secs. 14, 15, 17, and 18;
sec. 19, N½ lots 1 and 2 in the NW¼, S½ lots 1 and 2 in the SW¼, NW¼NE¼, and SE¼;
secs. 20 to 24, inclusive
sec. 25, W½;
secs. 26 and 27;
secs. 28, 29, 34, and 35, lying north of the northerly ROW of CALA 0107395.

T. 6 S., R. 20 E.,
sec. 3, partially unsurveyed;
secs. 5, 7 and 8, excluding the Palen McCoy Wilderness area CACA 35105;
secs. 9, 10, and 15;
sec. 16, NE¼NW¼ and S½NW¼;
sec. 17, N½ and SE¼;
sec. 18 ;
sec. 19, lots 1 and 2 in the SW¼, and W½E½;
sec. 20, W½, NE¼SE¼, and S½SE¼;
sec. 21, NE¼, N½NW¼, SW¼NW¼, and SE¼;
sec. 22, N½ and SE¼, partly unsurveyed;
sec. 23, S½;
sec. 24, S½;
sec. 25, N½ and SE¼;
sec. 26;
sec. 27, N½NW¼, SW¼ NW¼, and S½;
sec. 28, NE¼, NE¼SW¼, S½SW¼, and SE¼;
secs. 29 and 30;
sec. 31, N½ of lot 1 in NW¼, and N½N½NE¼;
sec. 32, N½N½N½;
sec. 33, N½N½N½;
sec. 34, N½N½N½;
sec. 35, NW¼NE¼, N½NW¼, and S½.

T. 7 S., R. 20 E.,
sec. 1, lots 1 and 2 in the NE¼, lots 1 and 2 in the NW¼, and SW¼;
sec. 2, lots 1 and 2 in the NE¼, lots 1 and 2 in the NW¼, and SE¼;
sec. 11, NE¼NE¼, S½NE¼, and S½;
secs. 12, 13, 24, and 25.

T. 4 S., R. 21 E.,
sec. 2, SW¼, partly unsurveyed;
secs. 3 and 4;
sec. 5, E½ of lot 1 in the NE¼ lots 5 to 12, inclusive, and SE¼;
sec. 8, E½;
secs. 9 to 15, inclusive, partly unsurveyed;
secs. 21 to 35, inclusive.

T. 5 S., R. 21 E.,
secs. 1 to 14, inclusive;
sec. 15, S½;
secs. 17 to 23, inclusive, partly unsurveyed;
sec. 24, S½;
secs. 25 to 30, inclusive;
secs. 32 to 35, inclusive, partly unsurveyed.

T. 6 S., R. 21 E.,
secs. 4, 5, 8, and 9;
sec. 15, lots 1, and 2, SW¼, and W½SE¼;
secs. 19 and 22;
sec. 23, lots 2, 3, 5, and 6, and W½W½;
sec. 26, lot 1;
sec. 27;
sec. 29, N½ and SW¼;
sec. 30;
sec. 31, lots 5, 6, 9, to 12, inclusive, 17, and 18, S½NE¼, and SE¼;
sec. 32, tracts 37 to 47, inclusive, 49 to 56, inclusive, 58, 59, 61, 62, 68, 69, 71, 73 to 78 A, inclusive, and 78 B to 80, inclusive and NW¼.

T. 7 S., R. 21 E.,
sec. 2, lots 3 to 6, inclusive, S½N½, E½SW¼, and NW¼SE¼;
sec. 3;
sec. 4, lots 3 and 4, S½NE¼, and S½;
sec. 5, S½S½;
sec. 6, SE¼;
sec. 7;
sec. 8, SW¼;
sec. 9, NE¼ and S½;
sec. 10;
sec. 11, N½ and SW¼;
sec. 12, NW¼ and N½SW¼;
sec. 13;
sec. 14, S½NE¼, W½, and SE¼;
sec. 15, W½ and SE¼;
sec. 17, NE¼, SE¼NW¼, and S½;
sec. 18;

secs. 19, 20, and 21, excluding the Mule Mountain ACEC;
sec. 22, N½ and SW¼;
secs. 23 and 24;
sec. 25, S½NW¼ and N½SW¼;
sec. 26, E½;
sec. 27 to 34, inclusive, excluding the Mule Mountain ACEC;
sec. 35.

T. 4 S., R 22 E.,
sec. 7, unsurveyed;
sec. 8, excluding the Big Maria Mtn. Wilderness Area CACA 35061, unsurveyed;
secs. 17 to 20, inclusive;
secs. 29 to 33 inclusive, unsurveyed.

T. 5 S., R. 22 E.,
secs. 2 to 6, inclusive;
sec. 7, lots 1 and 2 in the NW¼, and E½;
secs. 8 to 14, inclusive;
sec. 15, E½;
sec. 17;
sec. 18, lots 1 and 2 in the NW¼, lots 1 and 2 in the SW¼, and NE¼;
secs. 19 and 20;
sec. 21, S½;
secs. 22, 23, and 24;
sec. 25, W½NE¼, NW¼, N½SW¼, excluding Midland Road as designated on record of survey map on file in Book 11 pages 49 and 50 of record of survey, Records of Riverside County California;
sec. 26, N½;
sec. 27, N½ and SW¼;
sec. 28, S½;
sec. 29, N½ and SW¼;
sec. 30;
sec. 31, E½;
sec. 32;
sec. 33, SW¼.

T. 6 S., R. 22 E.,
sec. 3, lots 1 and 2 in the NW¼;
secs. 4 to 7, inclusive;
sec. 8, lots 1 to 6, inclusive, N½NE¼, and NW¼;
sec. 9, NE¼, N½NW¼, SE¼NW¼, and E½SE¼;
sec. 10, NW¼NW¼;
sec. 17, lot 1;
sec. 18, lots 1 to 6, inclusive.

T. 7 S., R. 22 E.,
  sec. 18, lot 4,
  tract 62;
  tract 63, lot 1;
  tracts 64, 113, and 115.

The areas described aggregate approximately 159,457 acres (645 km^2).

This page intentionally left blank.