Topock Project Executive Abstract

Document Title: Bat Surveys of the Topock Compressor Station Soil Investigation and Groundwater Remediation Project Areas Final Document? ☒ Yes ☐ No	Date of Document: July 7, 2015 Who Created this Document?: (i.e. PG&E, DTSC, DOI, Other) PG&E
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What does this information pertain to? ☐ Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA)/Preliminary Assessment (PA) ☐ RCRA Facility Investigation (RFI)/Remedial Investigation (RI) (including Risk Assessment) ☐ Corrective Measures Study (CMS)/Feasibility Study (FS) ☐ Corrective Measures Implementation (CMI)/Remedial Action ☐ California Environmental Quality Act (CEQA)/Environmental Impact Report (EIR) ☐ Interim Measures ☒ Other / Explain: Biological Reports	Is this a Regulatory Requirement? ☒ Yes ☐ No If no, why is the document needed?
What is the consequence of NOT doing this item? What is the consequence of DOING this item? This report was requested by DTSC to support the Soil Investigation EIR. Not performing the survey and preparing this report would impeded analysis associated with the Soil Investigation EIR.	Other Justification/s: ☐ Permit ☒ Other / Explain: Requested by DTSC

Brief Summary of attached document:

The purpose of these surveys were to assess the potential for special-status bat species roosting and foraging habitat in the area identified for the Topock Compressor Station Soil Investigation and Groundwater Remediation Project areas. The initial bat survey was conducted on January 29 and 30, 2015 by Dr. Pat Brown and Dr. William Rainey at a time of year when many of the bat species that could be expected in the area would not be present. However, the initial survey was used to assess habitat conditions and to plan more definitive surveys in the spring. Based on the potential bat roosting habitat observations of the winter site visit, acoustic monitoring and mist-netting surveys were conducted from April 27 through May 1, 2015 to identify bats utilizing the Project areas. Possibly eleven bat species were detected acoustically in the project areas including the following special-status species: cave myotis (*Myotis velifer*), Townsend's big-eared bat (*Corynorhinus townsendii*), pallid bat (*Antrozous pallidus*), Pocketed free-tailed bat (*Nyctinomops femorosaccus*), and Western mastiff bat (*Eumops perotis*). The Townsend's big-eared bat is a candidate species with the California Department of Fish and Wildlife. Included in the report is an assessment and recommended mitigation measures.

Written by: PG&E

Recommendations:

This report is for information only.

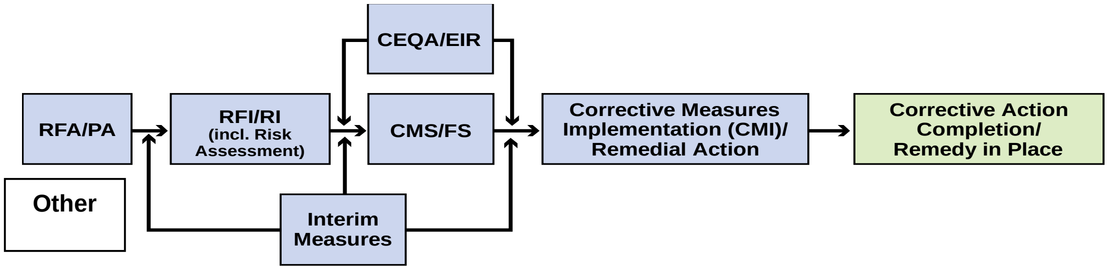
How is this information related to the Final Remedy or Regulatory Requirements:

The survey and this report provides information to support the Soil Investigation EIR and Groundwater EIR analysis.

Other requirements of this information?
None.

Related Reports and Documents:

Click any boxes in the Regulatory Road Map (below) to be linked to the Documents Library on the DTSC Topock Web Site (www.dtsc-topock.com).



Legend
RFA/PA – RCRA Facility Assessment/Preliminary Assessment
RFI/RI – RCRA Facility Investigation/CERCLA Remedial Investigation (including Risk Assessment)
CMS/FS – RCRA Corrective Measure Study/CERCLA Feasibility Study
CEQA/EIR – California Environmental Quality Act/Environmental Impact Report

Version 10

Bat Surveys of the Topock Compressor Station Soil Investigation and Groundwater Remediation Project Areas

San Bernardino County, California

Prepared for:

CH2M HILL, Inc.
2485 Natomas Park Drive, Suite 600
Sacramento, California 95833

Prepared by:

Patricia E. Brown, Ph.D.
134 Eagle Vista
Bishop, CA 93514

William E. Rainey, Ph.D
2556 Hilgard Ave.
Berkeley, CA 94709

June 25, 2015

INTRODUCTION

The goal of the current surveys was to assess the potential for special-status bat species roosting and foraging habitat in the area identified for the Topock Compressor Station Soil Investigation and Groundwater Remediation Project Areas (Figure 1). Townsend's big-eared bat (*Corynorhinus townsendii*) is currently a California Department of Fish and Wildlife Candidate for Threatened or Endangered status. Two lactating female Townsend's big-eared bat were mist-netted within five miles of the Project area at Beal Lake Riparian and Marsh Project on Havasu National Wildlife Refuge (HNWR) by the Bureau of Reclamation (BR) biologists in June 2014 and 2015 (A.Calvert, pers. comm).

Based on research conducted by Dr. Brown along the Lower Colorado River between 1968 to the present utilizing roost surveys, mist netting and acoustic recordings, the bat species listed in Table 1 could occur at some season in the project areas. Many of the species that could occur in the Topock project areas are crevice-roosting species, and potential roosting habitat occurs in locations scattered throughout the project areas, including the sides of Bat Cave Wash, the East Ravine and the red rock exposed adjacent to the Lower Colorado River near the pipeline crossing. The larger cavities in the banks along Bat Cave Wash downstream from the Topock Compressor Station and within the rock face adjacent to the Colorado River near the outlet of the East Ravine could provide roosting habitat for Townsend's big-eared bat. Possible impacts to bats would be largely through removal of foraging habitat or disturbance of roosting habitat. Direct impacts would be to species that roost in rocks or crevices in wash walls during soil or water sampling activities.

SURVEY METHODS

A preliminary winter survey was conducted January 29 and 30, 2015 to assess the potential for bat roosting and foraging habitat on the Project site. The preliminary winter survey visited the Soil Investigation Project Area and the portions of the Groundwater Remediation Project Area that were outside of the Soil Investigation Project Area (Figure 1). Over the course of the two days, we viewed all of the areas that could be potentially affected by the proposed soil investigation and groundwater remediation projects and determined which areas would be the focus of spring studies to evaluate the most likely bat roosting habitats. The weather was cool with rain predicted. Six Anabat SD1 and SD2 ultrasound detectors (Photograph 1) were placed before dark on January 29 in areas with potential for roosting or foraging (Figure 2 and Table 2). Most of the areas where the detectors were placed were close to the sides of washes with potential bat roosting habitat. The detectors were removed after six hours when rain began before midnight, because they were not protected within waterproof containers, and because bat activity is inhibited by rain. The prediction of more rain on January 30 precluded further acoustic surveys.

Based on the potential bat roosting habitat observations of the winter site visit, acoustic monitoring was conducted from April 27-May 1, 2015 to sample bats utilizing the Project Areas. Passive acoustic monitors consisted of a sealed enclosure containing a battery, broadband frequency-dividing ultrasound detector and a programmable data storage device (Anabat II and CF-ZCAIM; Titley Electronics, Ballina, NSW, Australia), with an extension cable to a microphone in a weather shroud with a flat acoustic reflector and bracket. These were deployed in twelve locations for five nights (Figure 2 and Table 2). The microphone and reflector assembly was elevated approximately 3 ft above the terrain on a metal stake (Figures 4-7). The ZCAIM in a unit placed in the East Ravine (Photograph 2) failed and no signals were recorded. In addition to the long-term installations, from two to five short-term SD1 or SD2 Anabat detectors were placed for two to four hours near the mist-net stations or visual observation areas on April 28-May 1, 2015 (Figure 2 and Table 2).

Echolocation is a sensory modality similar in many ways to vision in terms of how information contained in the returning echoes is processed and used. Echolocation is not analogous to communication signals where the information conveyed by the sounds will consistently identify an individual of a species. Within anatomical constraints, a single bat species will typically emit a variety of echolocation signals tailored to the perceptual task (obstacle avoidance, foraging, etc.) in different habitats (cluttered environments, open air, over water; see Schnitzler and Kalko 2001). Different species of bats can use similar echolocation signals in similar tasks. Most species of bats emit some call types that are distinctive within a local species assemblage, but often there is overlap among species using similar call frequencies. The information is still valuable in determining habitat use by bats. Communication signals produced by bats are generally lower in frequency and can be diagnostic of the species (Brown 1976).

Identification of call sequence files combined software filter based screening using Analook W 4.4u (available at www.hoarybat.com/Beta) with user examination and active labeling of the data. Acoustic data sets inevitably contain call sequences of widely varying quality. Some are recognizable as bats in a particular frequency range, but are fragmentary and not assignable to a single species. An issue remaining even when call sequence quality is adequate is that call repertoires of some species overlap substantially, so that some sequences from those taxa are not reliably separable, leading to use of multispecies categories. In this analysis the common multi-species acoustic categories are M50 (typically steep *Myotis* calls that end near 50 kHz) and in the Project Areas could include two species of *Myotis* (California and Yuma myotis); M40 (typically steep *Myotis* calls that end near 40 kHz) and in the Project Areas could include two species of *Myotis* (Arizona and Cave myotis); hoary and pocketed free-tailed bats (Laci/Nyfe) emit relatively flat calls at 16-18kHz); and Q25 calls in the 25-35 kHz range that are attributable to several mid-frequency larger species (mainly Mexican free-tailed, pallid and big brown bats in this area). Call sequences were consistent with those of pocketed free-tailed bats and the rocky cliffs offer good roosting habitat. Though characteristic sequences that would have clearly separated hoary bats were not obtained, they may also have been present. The overlap in call characteristics of these two species make confirmation of the presence of hoary bats unresolved at this time. Diagnostic mid-frequency sequences were recorded for Mexican free-tailed bats, but there were numerous additional non-diagnostic 25-35 kHz (Q25) sequences that could be assigned to this species but may also be from others (e.g., big brown or pallid bats). We have retained the Q25 category in the data table to show relative mid-size bat activity among sites. Values in Table 3 showing species relative activity are counts of one minute intervals during the night that had at least one identified sequence file for a species or multispecies category (activity index of Miller 2001). Further discussion of methods and most filters are available from Rainey *et al*. (2009).

Mist nets were set on the evenings of April 28-30 for 3-4 hours after sunset in areas that potentially had bat roosting habitat and where the terrain and vegetation would funnel bats (Figure 2). On April 28 and 30, nets were positioned across the south (upstream) side of the four drainage culverts for Bat Cave Wash under Interstate 40 (Photograph 6); on April 28 a mist net was spread across Bat Cave Wash upstream of the Topock compressor station where the canyon narrows; on April 29, four nets were spread in narrow sections of the East Ravine; and on April 30 a net was erected across the large cement conduit under the railroad trestle over Bat Cave Wash (Photograph 7).

Visual observations for emerging bats were conducted on the evening May 1, starting at dusk and continuing for about 90 minutes. Six people using night vision goggles (NVG) augmented with auxiliary infrared lights (IR), watched the steep sections of cliff/banks with cavities and crevices in different areas of Bat Cave Wash.

RESULTS

Possibly eleven bat species were detected acoustically within the Project Areas---four species in January and an additional seven in the April surveys (Tables 1 and 3). Many of the bat species that could use the site for foraging and/or roosting are inactive during the cooler winter months. The 106 call minutes recorded over about six hours on the six detectors during the January surveys probably were predominantly produced by three species that are typically winter active (canyon bats, Mexican free-tailed bats and California myotis). Yuma myotis may have been a source for 50 kHz calls along with California myotis, but winter occurrences of Yuma myotis along the Lower Colorado River (LCR) are rarer. Neither pallid bats nor big brown bats are winter active, so the Q25 calls were most likely produced by Mexican free-tailed bats. The most call minutes (43.3%) representing all species categories were recorded at Station 12 above Bat Cave Wash near the PG&E Compressor Station.

Of the 8892 call minutes for eleven long-term detector stations set on April 27 that could be assigned to a bat species or species group, 1841 call minutes (20.7%) were recorded by the detector at Station 14 at the rocky portion of Bat Cave Wash upstream of the PG&E Compressor Station. Other locations with higher levels of bat activity were Station 4 in Bat Cave Wash north of the railroad crossing (13.4%); Station 13 (Photograph 3) above Bat Cave Wash near the PG&E Compressor Station (12.7%) and Station 19 (Photograph 4) along the LCR near the pipeline crossing (11.4%). Of the detector minutes at all long-term locations, the majority were identified as canyon bats (40.6%) and California or Yuma myotis or M50 (40.2%) sequences. These species were recorded at all stations, with the most call minutes at Station 14 at the upper end of Bat Cave Wash where the rocky canyon opens out into the broader wash and funnels flying bats. The short term detectors deployed at various study locations from April 28-May 1 followed a similar activity detection pattern to the long-term stations, with the most calls/night being recorded at Station 14 or at the stations (5, 7, and 8) next to the railroad and I-40 culverts where bats flying up and down the wash were funneled. Some rarer species on the long-term detectors stations (such as western mastiff bats, M40 or Laci/Nyfe) were not recorded in the short term stations.

Five species and 48 individuals (Townsend's big-eared bat, pallid bat, Mexican free-tailed bat, California and Yuma myotis) were captured in the mist nets in Bat Cave Wash in April (Table 4). Only male Mexican free-tailed bats and one male Townsend's big-eared bat (Photograph 8) were captured, while pregnant and/or lactating females of the other three species were caught in addition to males. The highway and railroad culverts in Bat Cave Wash were regular flight paths and provided excellent locations for low-flying bat capture, while the open terrain in the East Ravine permitted bats to easily avoid the nets. The times in Table 4 next to the name of the netting site refer to the period that the nets were open, while the times next to the species and sex of the different categories of bats refer to the time brackets during which they were captured. Between Bat Cave Wash and the East Ravine, 108 mist net hours (number of nets times the number of hours that the nets were open) were logged over three nights.

During the visual observations with NVGs on the evening of May 1, no mass bat exodus was observed from the banks of Bat Cave Wash. However the limited field of view with the NVGs required constant scanning of the cliff faces, and it would have been easy to miss bats, especially when the viewer was 100 feet or more from the crevices of interest in the wash cliff. Approximately five bats were observed emerging from the cliff immediately upstream (south) of Interstate 40 on the west side of Bat Cave Wash, near where mist nets had been set on previous nights. From the size of the bats and manner of flight, these may have been from the maternity colony of Yuma myotis that were captured just after dusk on both nights of netting.

DISCUSSION

Bat Cave Wash and the East Ravine provide the best foraging habitat for most of the vespertilionid bats (including Townsend's big-eared bat) and California leaf-nosed bats (*Macrotus californicus*) in the microphyllic woodland of palo verde (Photograph 4) and ironwood trees. Several potential species occurring in the Project Areas were not recorded during the current survey (such as California leaf-nosed bats) and it is possible that a longer term acoustic monitoring program may discover them. Skalak *et al*. (2012) analyzed data from a 14 month acoustic monitoring project with 7-9 bat detectors similar to those used in this survey at fixed locations in the Nevada desert separated by several km in order to determine the number of species detected in relation to the number of monitors and duration of sampling. Among their conclusions was that monitoring with multiple detectors at fixed sites for 2-5 nights in summer will yield the 'common' species (60% of number of taxa detected in more extended monitoring). This provides a perspective on the detection rate of the species assemblage found in the brief study conducted for one night in January and five nights in April at the Project Areas. Another five species could occur in the Topock Project Areas at some season, but were not detected in the current survey (Table 1).

Many of the species that occur on the Topock site are crevice-roosting species, and potential roosting habitat occurs in locations scattered throughout the Project Areas, including the sides of Bat Cave Wash, the East Ravine and the red rock exposed adjacent to the Lower Colorado River near the pipeline crossing. The larger cavities in the banks of Bat Cave Wash and in rock faces adjacent to the Lower Colorado River (LCR) near the outlet of the East Ravine could provide roosting habitat for Townsend's big-eared bat. The natural history of the eleven species mist-netted and/or detected acoustically is discussed below, as well as the five additional species that could occur on the project area at some season.

Townsend's big-eared bat (*Corynorhinus townsendii*): The determining factor in the distribution of this species in the Western United States tends to be the availability of cave-like roosting habitat (Pierson, 1998). Population concentrations occur in areas with substantial surface exposures of cavity forming rock (e.g., limestone, sandstone, gypsum or volcanic) and in old mining districts (Genter, 1986; Graham, 1966; Perkins *et al*. 1994; Perkins and Levesque, 1987). From the perspective of many bat species, old mines are cave habitat and are now sheltering many large colonies (Tuttle and Taylor, 1994; Altenbach and Pierson 1995; Brown *et al*., 1992, 1993).

This sensitive species has declined in numbers across the western United States, as documented in the Conservation Assessment and Strategy (Pierson *et al*. 1999) prepared by scientists and land managers for the Idaho Conservation Effort. The Western Bat Working Group (WBWG) rates *Corynorhinus* at high risk of imperilment across its range, and it is currently a CDFW Candidate for Threatened or Endangered status in California. Earlier studies by Pierson and Rainey (1996a) for the California Department of Fish and Game (now Wildlife) showed marked population declines in many areas of California. Although several causative factors are identified, roost disturbance or destruction appears to be the most important reason for the decline. In another report, Pierson (1998) suggested that a combination of restrictive roost requirements and intolerance to roost disturbance or destruction has been primarily responsible for population declines of Townsend's big-eared bats in most areas. The tendency for this species to roost in highly visible clusters on open surfaces near roost entrances makes them particularly vulnerable to disturbance. Additionally, low reproductive potential and high roost fidelity increase the risks for the species. In all but two of 38 documented cases, roost loss in California was directly linked to human activity (e.g., demolition, renewed mining, entrance closure, human-induced fire, renovation, or roost disturbance; Pierson and Rainey, 1996a).

The intense recreational use of caves and mines in California provides one explanation for why most otherwise suitable, historically significant roosts are currently unoccupied. Townsend's big-eared bats are so sensitive to human disturbance that a single entry into a maternity roost can cause a colony to abandon or move to an alternate roost (Graham, 1966; Stebbings, 1966; Stihler and Hall, 1993). Abandoned mines are also at risk from closure for hazard abatement, renewed mining and reclamation. Liability and safety concerns have led to extensive mine closure programs in western states, particularly on public lands, often without consideration for the biological values of old mines. The installation of bat-compatible gates on mines can protect the bats and exclude humans from hazardous mines.

Along the LCR, all known roosts (historic and current) are in abandoned mines. Grinnell (1914) first discovered the "pale lump-nosed bat" in the Riverside Mountains roosting "at the end of a sloping drift in the Steece copper mine". Howell (1920b) visited the Old Senator Mine near the LCR (6 miles north of Potholes) on May 14, 1918 and "found about a hundred females, each with a naked young from a few days old to a quarter grown, clinging to the roof of a gallery at the two-hundred-foot level. They were in close formation, but not touching one another, and, although not as wild as *Macrotus,* they were quite ready to fly. The only way we could capture them was wildly to grab at a bunch with both hands." As noted by Stager (1939), cave myotis in the Alice Mine were "rivaled in numbers by *Corynorhinus rafinesquii pallescens* and *Macrotus californicus* only". Stager (pers. com.) describes a cluster of Townsend's big-eared bats 3 x 12 feet across in the main level of the Alice Mine. The estimated cluster density in most maternity colonies is 100 bats/ square foot (Pierson and Rainey, 1996a). At this density, the colony in the Alice Mine in the 1930s would have been over 3000 bats. The last specimen collected from the Alice was in April 1954. When P. Brown first visited the Alice Mine in August 1968, only piles of old guano remained. Now the guano has been trampled to dust by recreational mine explorers.

The proximity of good foraging habitat appears to be a determining factor in roost selection. In recent surveys in the Panamint Mountains, mines with suitable temperatures were occupied by large maternity colonies (>100 bats) only if they were within 3.2 km. (2 miles) of a canyon with water (P. Brown, pers. obs.). Brown *et al.* (1994) determined by radio-telemetry that this species on Santa Cruz Island bypassed the lush introduced vegetation near their day roost, and traveled up to 4.8 km. (3 miles) to feed in native oak and ironwood forest. Although the diet of California populations of Townsend's big-eared bats has not been analyzed, elsewhere this species is a lepidopteran specialist, feeding primarily (>90% of the diet) on medium-sized moths (Dalton *et al*., 1986; Ross, 1967; Sample and Whitmore, 1993; Whitaker *et al*., 1997 and 1981; Shoemaker and Lacki, 1993).

The loss of foraging habitat may be a contributing factor to declines in Townsend's big-eared bat populations along the LCR, where the native floodplain community has been subjected to extensive agricultural conversion, residential building and dams. The dense native vegetation has been removed over the past 50 years. Agricultural spraying for lepidopteran pest species may alter the prey base for big-eared bats (Perkins and Schommer, 1991), and pesticide spraying could also be a factor. Along the relatively pristine floodplain of the Bill Williams River (BWR), Townsend's big-eared bats are mist-netted in the warmer months. Two large maternity colonies (>100 bats) are known to roost in mines within sight of the BWR (Brown, 1996).

One of the restoration activities of the US Bureau of Reclamation (USBR) 2004 Lower Colorado River Multi Species Conservation Program (LCR MSCP) has been the planting of cottonwood and willow near Beal's Lake in the Havasu National Wildlife Refuge (HNWR) across the LCR from the Topock Project Area. Lactating Townsend's big-eared bats have been captured here in June 2014 and 2015 and a post-lactating female in August 2013 on USBR mist-netting surveys (A. Calvert, pers. comm). This site is 7 kilometers (4.5 miles) from the mouth of Bat Cave Wash.

Acoustic studies are usually not the preferred method to determine the presence of Townsend's big-eared bats, since they often glean prey from foliage using low intensity calls that may only be detectable within a few meters. On April 30, 2015 a male Townsend's big-eared bat (Photograph 8) was captured in a mist net set across the concrete culvert (Photograph 7) under the railroad bridge in Bat Cave Wash. During this survey, no definitive Townsend's big-eared bat echolocation calls were recorded on any of the Anabat detectors, even those that were positioned close to the culvert where the Townsend's big-eared bat was mist netted.

Pallid bat (*Antrozous pallidus*): In California, Orr (1954) described the species as occurring in a variety of habitats, including coniferous forests, oak woodlands, brushy terrain, rocky canyons, open farm land, and desert. Roosts are apparently selected on the basis of temperature and proximity to foraging habitat. Radio-tracking studies in the Mojave Desert at Camp Cady near Barstow demonstrated that the bats roost in crevices in granite boulders, between rocks in loosely-cemented conglomerate and in mud solution tubes in badlands formations (Brown and Berry, 1998). In another telemetry study near Coso Hot Springs on the Naval Air Weapons Station (NAWS), China Lake, the bats roosted in historic buildings, mines and crevices in granite boulders (Brown pers. obs.). The only day roost discovered (without radio-telemetry) along the LCR is in the Mountaineer Mine in the Riverside Mountains (Brown and Berry 2003). Pallid bats night-roosting in the mines is a more common occurrence. It is assumed that the bats spend the day in rock crevices and congregate for socialization at night (Lewis, 1994). In the Topock Project Site, the crevices in the sides of Bat Cave Wash and East Ravine offer pallid bat roosting habitat. Pallid bats have been mist-netted at Beal Lake by USBR biologists (Calvert 2012).

The relatively powerful jaws of pallid bats are essential to disable their prey, which include scorpions, solpugids, beetles, grasshoppers, cicadas, katydids and sphinx moths (Barbour and Davis, 1969; Hermanson and O'Shea, 1983) captured on or near the ground. Radio-telemetry (Brown and Grinnell, 1980; P. Brown pers. obs.) and the known behavior of favored prey items suggest pallid bats fly close to the ground, and land on the ground to capture prey. Between foraging bouts, pallid bats may congregate in night roosts in mines, buildings and under bridges where they leave guano and the remains of scorpions, katydids, sphinx moths, Jerusalem crickets, and/or beetles. Hirshfeld *et al*. (1977) found with light tags that night roost sites also included willows in wash vegetation.

In the Topock surveys, one male and three pregnant female pallid bats were captured in the mist nets in Bat Cave Wash spread across the I-40 culverts (Photograph 6) on April 28 (Figure 2 and Table 4). Echolocation and communication signals were recorded at half of the long-term stations, with the majority of the 72 call minutes recorded at Station 9 upstream of the I-40 culverts in Bat Cave Wash and at Station 19 in the red rocks along the LCR (Table 3). Some of the Q25 calls recorded at the long and short term detector stations could be high slope non-diagnostic pallid bat signals.

Often the communication sounds of pallid bats (Brown, 1976; Orr, 1954) are better acoustic tools for identification than the echolocation signals, which can resemble those used by Mexican free-tailed and big brown bats. With sufficient moonlight, pallid bats can navigate visually, use prey-produced sounds to hunt (Bell, 1982), and may not emit echolocation signals. Consequently, the activity of this species may be under-estimated based solely on acoustic detections. This may explain why on April 28 at Station 8 next to the culvert where the pallid bats were mist-netted, no definitive pallid bat calls were recorded.

Bat biologists have noted a definite decline in pallid bat populations in recent years in most areas of California (Miner and Stokes, 2001; P. Brown, pers.obs.) prompting the California Department of Fish and Wildlife to list it as a Species of Special Concern. Population declines in coastal California are associated with the loss of roosting and foraging habitat through urban and suburban development. The status of the pallid bat along the LCR is uncertain.

Yuma myotis (*Myotis yumanensis*): This small myotis species has relatively large feet when compared to California myotis (Barbour and Davis 1969). They can vary in color depending of geographic location from golden to dull brown. Yuma myotis are widely distributed throughout western North America, from Mexico to southern Canada, and found throughout much of California. While it occurs from sea level to >2,500 m in the Sierra Nevada, its maternity colonies (which are typically comprised of 300-1,000 females) are generally confined to elevations below 1,000 m. Yuma myotis form large, conspicuous maternity colonies, in a wide variety of roost sites, often in anthropogenic structures, including barns, dams and bridges, although it will also roost in caves, mines, abandoned swallow nests, and under flaking bark of large snags (Barbour and Davis 1969, Dalquest 1947, Evelyn *et al*. 2004, Rainey and Pierson 1996).

Yuma myotis are more highly associated with open water than any other bat species, and are typically observed flying low over relatively calm water (reservoirs, ponds, or slowly flowing reaches and pools of rivers and streams), feeding primarily on small, emergent aquatic insects, such as midges, mayflies and caddis flies (Barbour and Davis 1969, Dalquest 1947, Rainey and Pierson 1996, van Zyll de Jong 1985, Brigham *et al.* 1992). Yuma myotis is probably the bat species that has most benefited by human activities along the LCR, such as the construction of bridges, dams and lakes. Yuma myotis are now the most common bats along most stretches of the LCR (both visually and acoustically), especially in the vicinity of water impoundments.

While Yuma myotis are morphologically distinct from California myotis (the latter smaller with smaller feet), they are usually grouped acoustically as both emit steep frequency-modulated (FM) signals ending near 45-50 kHz. The shape of some Yuma myotis calls is distinctive, but many are very similar to those of California myotis. Both species are common along the LCR and at Topock and are grouped together as M50 in Table 3. M50 sequences were recorded at all acoustic stations in the current survey in both January and April. After canyon bats, the M50 bats were the second most frequently recorded bat at Topock at the long term stations, with the most call minutes detected at Station 14 below the rocky canyon portion of Bat Cave Wash and at stations upstream and downstream of the railroad and I-40 culverts where bat flight in channeled. At the spring short term stations, M50 was the most numerous category represented. As previously noted, Yuma myotis are not as active in January as California myotis, and the signals recorded then were probably the latter species. Yuma myotis were the most numerous bat species mist-netted in Bat Cave Wash (Photograph 6) over two nights, accounting for 75% of the captures (36 of 48). Of these, 27 were reproductive females (Figure 2 and Table 4).

A Yuma myotis maternity colony was observed roosting in a large metal culvert under Interstate 40 to the west of Bat Cave Wash in August 2014 (Brown, pers. obs.), and exits from the north end of the culvert as they head to forage over the LCR. However the bats captured just after dusk in the culverts under I-40 at Bat Cave Wash were coming from the south, or upstream and heading north towards the LCR, and so probably came from another roost in Bat Cave Wash. Later in the evening, Yuma myotis were captured on the downstream or north side of the mist net, likely as they returned to roosts in Bat Cave Wash.

California myotis (*Myotis californicus*): This small myotis is ubiquitous in most habitats in the Southwest below about 7,000 feet elevation (Barbour and Davis 1969; Krutzsch 1954; Simpson 1993). They roost singly or in small groups in crevices in rocks, mines, trees and manmade structures. While Yuma myotis are usually found near open fresh water, California myotis are recorded in drier habitats where they forage in the open for small moths and dipterans. Using light tags, Hirshfeld *et al.* (1977) found that California myotis frequently night roost on small shrubs, presumably for prey digestion, close to the initial capture site.

Grinnell (1914) only collected four specimens from two localities (at the Needles and upstream of there) near the start of the Lower Colorado Expedition, but believed he "saw the same species at other localities along down the river. Those obtained were shot at late dusk, considerably later in the evening than most of the appearances of *Pipistrellus hesperus*. Instead of flying high, against the sky, as in the case of the latter species, *M.c. pallidus* was almost always foraging low over the bushes of the second bottom, or along shallow washes between clumps of mesquite. "

As noted above, there is extensive structural overlap in the calls of Yuma and California myotis, and both are included in the M50 designation (Table 3). In the current survey, after canyon bats, M50 bats were the second most frequently recorded bat at Topock at the long term stations, with the most call minutes detected at Station 14 below the rocky canyon, and at stations upstream and downstream of the railroad and I-40 culverts where bat flight is channeled. At the spring short term stations, M50 was the most numerous category represented. As previously noted, Yuma myotis are not as active in January as California myotis, and the winter records are probably California myotis. They are generally the "second wave" of bats recorded and observed at Topock, appearing about 30 minutes after the first canyon bat. On April 28, three male and two lactating California myotis were mist-netted at the culverts (Photograph 6) under I-40 (Figure 2 and Table 4).

Mexican free-tailed bat (*Tadarida brasiliensis*): Mexican free-tailed bats can forage over large areas each night, ranging as far as 25 miles from their roosts. They roost in crevices in cliff faces or manmade structures such as bridges and dams (Barbour and Davis 1969; Wilkins 1989). Musgrove (Cockrum *et al.*, 1996) noted 500 Mexican free-tailed bats roosting in crevices above the spillway at Davis Dam in April 1962, with the number increasing to 10,000 in September 1962. This colony was subsequently removed by pest control operators. Musgrove also visited a maternity colony of 400-500 Mexican free-tailed bats in a "sinkhole" 8 miles NE of Topock in Mohave County, AZ on May 13, 1961. Grinnell (1914) reported "seeing this bat at almost every station, as a rule flying high and squeaking loudly". Probably due to their high flight pattern they were difficult to shoot or retrieve, and he only took three specimens during his float trip---two at Mellen (Topock) and one in the Chemehuevi Valley. In appropriate habitat, they can be mist-netted. In the current Topock Project survey, on April 28, 2015 two males were captured in the mist nets set across the I-40 culverts (Figures 2, Photograph 6 and Table

4). This was surprising since the prediction would be that high-flying Mexican free-tailed bats would fly over the freeway rather than in a long culvert under it.

Acoustically, Mexican free-tailed bats often appear to be one of the most ubiquitous bat species, in part due to their loud, low frequency echolocation signals that are detectable over large distances. This species is present on the project area, and echolocation and communication signals were recorded at all long-term stations in the spring. The Q25 designation (Table 3) includes less diagnostic calls of this and other (e.g. pallid and big brown bats) 25-30 kHz mid-frequency species that overlap in signal characteristics. Long-term Stations 13 (Figure 5) and 14 below the rocky portions of Bat Cave Wash had the greatest number of call minutes (Figure 2 and Table 3), with 70 call minutes recorded via the short term detector placed there on April 28. Under a dry waterfall upstream (south) of these stations is a crevice with guano of Mexican free-tailed bats. This species was possibly responsible for the naming of Bat Cave Wash.

Big brown bat (*Eptesicus fuscus*): Big brown bats are relatively large, with glossy deep brown fur and a blunt tragus, a feature which distinguishes it from all *Myotis* species (Barbour and Davis 1969). They are one of the most widely distributed species in the Western Hemisphere, occurring from western South America to northern Canada, and throughout the United States (Hall 1981), and found in almost all habitats in California, from sea level to high elevation (Barbour and Davis 1969). They roost primarily in crevices in trees (particularly snags), old buildings, bridges, rock crevices, caves, and mines (Barbour and Davis 1969, Brigham 1991, Kurta and Baker 1990).

Big brown bats are foraging habitat generalists, feeding aerially over both water and land, in forested and edge situations. They often emerge early (prior to dark) and can be seen foraging high (up to 50 m above the ground), descending later in the evening to 10-15 m (Whitaker et al. 1977). In some habitats they feed predominantly on beetles (Coleoptera), including important forest and agricultural pests (Whitaker 1995).

They are a common species captured by USBR biologists in most or the LCR MSCP restoration sites, including being the most common bat captured in the 2011 surveys at Beal Lake (Calvin 2012). All call sequences were recorded by Brown and Berry (2003) during the warmer months (April-October). This species appears to be locally abundant in restored riparian and agricultural habitats along the LCR drainage. Big brown bats typically echolocate at ca. 25 kHz, and, while some of its calls are distinctive, many are not separable from other 25 kHz species (pallid and Mexican free-tailed bats) that have been included in the Q25 acoustic category. This category was recorded at all long-term detector sites with the greatest number of call minutes at Stations 13 (Photograph 3) and 14 below the rocky portions of Bat Cave Wash (Figure 2 and Table 3).

Canyon Bat (*Parastrellus hesperus*): This common species along the LCR is the smallest of all North American bats, and can be distinguished from California myotis by the club-shaped tragus, compared to the pointed tragus of myotis (Barbour and Davis, 1969). They are often associated with rocky canyons and outcrops (usually at elevations below 2,000 meters), where they can roost in small crevices (Stager, 1943b; Cross, 1965). Grinnell (1914) noted that canyon bats were the most common species observed, and collected (74 specimens) during his 1910 expedition, beginning in February when "ice formed in suitable places----and swarming in the vicinity of The Needles on March 1 to 3. Thenceforth, they were seen at nearly every station all the way down the river. One thing was conspicuously noticeable in regard to occurrence, namely that this bat varied directly in degree of abundance with nearness to cliffs, or hillsides with outcroppings of fractured rock."

Canyon bats have been observed at dusk flying over creosote bush scrub several miles from rocky areas, and it is postulated that they may also roost under rocks or in rodent burrows (Von Bloeker 1932). They emerge early in the evening, often before sunset, and may be active after sunrise. Near rocky canyons, their small fluttery forms can fill the sky in the fading desert light. They are often the first bats captured in the evening in mist nets set over isolated desert water holes (O'Farrell and Bradley, 1970) or across mine entrances. Stomach content analysis suggests that they feed on small swarming insects such as flying ants and mosquitoes (Hayward and Cross, 1979). During cooler winter months, canyon bats hibernate in rock crevices, although on warm winter days, they may emerge to forage during the day. It is reported that females give birth to twins in late May through June, and mothers with their young may roost alone or in groups of less than 10 individuals. The young are volant within a month.

During the current acoustic studies, 3616 distinctive canyon bat call minutes were recorded at all long-term stations, with the most (693) above Bat Cave Wash near the PG&E Compressor Station. Most of the short-term stations in January and April also recorded this species. In fact, this species represented 40% of all call minutes recorded (Table 3). Like Grinnell (1914), we noted an increase in number of calls near rocky habitat. Unexpectedly, they were not captured in mist nets during the April survey.

Western mastiff bat (*Eumops perotis*): Western mastiff bats belong to the free-tail family Molossidae, and are the largest bat species found in North America. They have a 60 cm wingspan and large bonnet-like ears, which extend forward over the eyes and are connected at the midline (Barbour and Davis, 1969; Best *et al*., 1996). Unlike most other North American bat species that mate in the fall, free-tailed bats breed in the early spring and give birth to a single young in the early to mid-summer. Most western mastiff bats give birth by early July (Krutzsch 1955), in colonies generally containing fewer than 100 animals (Barbour and Davis 1969; Howell 1920). Adult males and females may roost together at all times of year (Krutzsch 1955) in contrast to other North American bat species.

Western mastiff bats, a CDFW Species of Special Concern, are found in a variety of biotic environments from low desert scrub to chaparral, oak woodland and ponderosa pine. However, the abiotic components appear to determine their distribution. This crevice-dwelling species predominantly selects cliff faces (granite, sandstone, or columnar basalt) or exfoliating granite boulders (Dalquest 1946; Krutzsch 1955; Vaughan 1959), but also occupies cracks in buildings (Howell 1920; Barbour and Davis 1969) or compact silt on stream channel faces (Daquest 1946). All roosts located in California by Pierson and Rainey (1996b, 1998a) were in crevices at least 10 feet above the ground.

The species appears to forage over open areas (Vaughan 1959; Pierson and Rainey 1998a), and many individuals have been heard feeding over agricultural fields in the Imperial Valley (P. Brown, pers. obs.). In California, western mastiff bats appear to feed primarily on moths (Lepidoptera), but may also take beetles and crickets (Whitaker *et al*., 1977). Western mastiff bats emit a human-audible echolocation call (6.5.-12 kHz and can be detected flying throughout the night. These strong, fast fliers cover an extensive foraging area in the evening. The species has been heard in open desert, at least 24 km from the nearest possible roosting site (Vaughan, 1959). From telemetry of several captured mastiffs, Siders *et a*l. (1999) estimated the capture site to roost distances of 28-29 km in northern Arizona. Often multiple animals are detected together, and this species may travel or forage in groups (E. Pierson, pers. comm, P. Brown pers. obs.). Unlike Mexican free-tailed bats that undertake long seasonal migrations, western mastiff bats move relatively short distances seasonally. Although capable of lowering their body temperatures for short periods of time, they do not undergo prolonged hibernation, and may be periodically active throughout the winter. In Southern California, mastiff bats have been detected at all seasons, although they may change roost sites (Howell, 1920; Krutzsch, 1948 and 1955; Leitner 1966; Barbour and Davis, 1969).

Along the LCR, capture records exist from Yuma (Cockrum, 1960); south of Palo Verde (Eger, 1977), Parker (Sanborn, 1932) and the Bill Williams River (BWR, Brown, 1996). The echolocation calls of western mastiff bats were heard or recorded all along the LCR (Brown and Berry 2003) from Davis Dam to Imperial National Wildlife Refuge (INWR). The bats emitting the calls heard near Davis Dam may be from the large colony located by Musgrove at Keyhole Cave, just south of Union Pass (Cockrum *et al*., 1996). Most calls along the LCR are detected during the warmer months (Brown and Berry 2003).

In the current Topock survey, 19 call minutes of western mastiff bats were detected at seven detector locations (Figure 2 and Table 3), with seven sequences recorded at Station 15 above the East Ravine. No sequences were recorded on the short term detectors in January or April. They could roost up the canyon in Bat Cave Wash or in the Needles formations to the south.

Cave myotis (*Myotis velifer*): The largest myotis species in North America occurs in large colonies (100s to 1000s) in caves and mines across the southwestern United States (Barbour and Davis, 1969). In California, the cave myotis is a CDFW Species of Special Concern, and most records are from the mountains bordering the LCR, with a few isolated specimens from Southern California (Constantine, 1998) and the Kingston Mountains (LACMNH). This species was first collected along the LCR was in 1909 from a warehouse in Needles (Grinnell, 1918). Joseph Grinnell (1914) did not take any cave myotis on his 1910 survey down the LCR. In 1935, Ken Stager (1939) studied this species in several mines in the Riverside Mountains. In the Alice Mine, "*Myotis velifer* was observed throughout the mine in countless hundreds, and was by far the commonest of the seven species known to be occupying the mine. It was rivaled in numbers by *Corynorhinus rafinesquii pallescens* and *Macrotus californicus* only". Vaughan (1954 and 1959), studied California leaf-nosed bats and cave myotis in the Riverside Mountains in the same mine "tunnels" reported by Stager, where "each of several tunnels contained roughly 1000 cave myotis, and each of the other tunnels was inhabited by several hundred individuals".

Several large cave myotis maternity colonies roost in mines bordering the BWR in the vicinity of Planet, Rankin and Lincoln Ranches (Brown, 1996). Here the cottonwoods stretch along the banks of the river, although the trees are not as large or the floodplain as wide as described by Grinnell (1914) or Stager (1939) for the LCR. In 1953, Vaughan (1954 and 1959) noted that "in the Riverside Mountains area, after leaving their daytime retreats, cave myotis usually flew directly down the eastern slope of the range to the floodplain of the Colorado River where they foraged…and where they pursue foraging beats over low vegetation, along files of dense vegetation that line the oxbows and main channel of the river, between the scattered thick patches of vegetation that dot the floodplain, or above bodies of water." Evidently, the insects associated with floodplain riparian habitat are important to cave myotis, and the loss of this habitat is reflected in the decline of the species along the main stem of the LCR.

The Jackpot Mine on the Arizona side in Havasu NWR within a wilderness area south of Needles is the northernmost cave myotis maternity roost on the LCR. Currently about 700-800 cave myotis occupy the site in the warm season. The Jackpot Mine is 6 km (4 miles) southeast of the mouth of Bat Cave Wash. Cave myotis have been mist-netted at Beal Lake by USBR biologists (Calvert 2012). Possibly those bats have commuted about 12 km (8 miles) to the foraging habitat of the restoration area from the Jackpot Mine. During the current acoustic survey of the Topock Project Areas, eighteen M 40 call minutes attributable to cave myotis (steep FM calls ending frequency 40 KHz) were recorded at two locations (Figure 2 and Table 3) primarily at the fenced well enclosure (Station 22, Photograph 5) in Arizona on HNWR (Figure 2 and Table 2) with a few calls recorded along the LCR at site 19 (Photograph 4).

Hoary bat (*Lasiurus cinereus*): This solitary tree-roosting bat species is morphologically and acoustically distinct, at least in many areas of North America. Hoary bats migrate seasonally, both altitudinally and latitudinally, apparently often in aggregations (Grinnell 1918; Krutzsch 1948; Shump and Shump 1982b; Bradley *et al* 1965). A continent wide analysis is provided by Cryan (2003). Most historic California specimen based records are from the winter, with fewer in the spring and fall, and none in the summer (Grinnell, 1918; Vaughan and Krutzsch, 1954). Grinnell (1914) did not collect this species along the LCR, however the current mist-netting program of the USBR biologists capture them in the restoration areas along the LCR, including Beal Lake (Calvert 2012).

In the BWR survey (Brown, 1996), four adult male hoary bats were captured in mist nets at two locations just downstream from Planet Ranch in October. During the telemetry study, the bats were tracked to roosts in the foliage of the cottonwood and willow trees, and even in a palo verde tree in a dry desert wash. Some hoary bat echolocation calls are acoustically distinct, while others not readily distinguishable from those of pocketed free-tailed bats (see below). In the current Topock Project Areas, 32 Laci/Nyfe call minutes were recorded in nine stations, with the most signals detected near the LCR or on the sides of Bat Cave Wash and East Ravine.

Pocketed free-tailed bat (*Nyctinomops femorosaccus*): This slightly larger relative of the Mexican free-tailed bat differs from that species by having its ears joined at the midline (Constantine 1958; Kumirai and Jones 1990). A shallow fold of skin or “pocket” on the uropatagium, near the knee, is usually difficult to locate, and is not a good distinguishing field characteristic. Pocketed free-tailed bats are found at lower elevations in a variety of plant associations (Barbour and Davis 1969; Easterla 1973), and in proximity to roosting habitat in granite boulders, cliffs or rocky canyons. In California, it is associated primarily with creosote bush and chaparral habitats of Lower and Upper Sonoran life zones (Krutzsch, 1948). This crevice-dwelling species has occasionally been found in caves (Dalquest and Hall 1947), and in buildings under roof tiles (Gould 1961). All roosts in California have been in crevices in cliff faces or granite boulders located at least 10 feet (3.5 meters) above the ground (Pierson and Rainey 1998a; K. Miner, pers. comm.; P. Brown, pers. obs.). At one site the, pocketed free-tailed bats share a larger crevice with western mastiff bats, although they appear to be roosting separately. With only a limited number of records for pocketed free-tailed bats from California, it is a CDFW Species of Concern. Krutzsch (1948) documented their occurrence in California from March through August, however recent records from late November suggests the species over-winters in San Diego County (Pierson and Rainey 1998a; K. Miner pers. comm.).

This species was not documented from the LCR drainage until August 1963 when six bats were captured in a mist net at Alamo Crossing along the Bill Williams River (Cockrum *et al.*, 1996). Subsequently, five bats (including a pregnant female and two juveniles) were captured at four locations along the Bill Williams River (Brown, 1996). A suspected roost was located in a cliff face upstream of Planet Ranch; however it was impossible to capture emerging bats. The cliff faces in the Needle Mountain area southeast of Topock could provide ideal roosting habitat.

When emerging from their roosts in the evening, this species frequently makes audible “chattering” communication signals (Krutzsch 1944, 1948; Pierson and Rainey 1998a; K. Miner pers. comm.; P. Brown pers. obs.). It’s possible that these sounds were those attributed to Mexican free-tailed bats by Grinnell (1914), however he did not take any specimens during his survey. The frequencies of the calls extend from the upper human audible range (~16 KHz) into the ultrasonic so that some open air search phase calls are audible to people with undamaged hearing. Some pocketed free-tailed are not distinguishable from a subset of hoary bat sequences, so this species can be overlooked in acoustic surveys in areas of possible species distribution overlap such as may occur on the Topock Project Areas. In the current Topock Project area, 32 Laci/Nyfe call minutes were recorded in nine stations, with the most signals detected near the LCR or on the sides of Bat Cave Wash and East Ravine.

Potentially occurring species not definitively detected in current survey

California leaf-nosed bat (*Macrotus californicus*): The California leaf-nosed bat is the most northerly representative of the Phyllostomidae, a predominantly Neotropical family. The type locality of the California leaf-nosed bat is Ft. Yuma, California (Grinnell 1918). This species occurs in the Lower Sonoran life zone in the deserts of California, southern Nevada, Arizona and south to northwestern Mexico (Sonora and Sinaloa) and Baja California (Hall, 1981; Hoffmeister, 1986).

California leaf-nosed bats prefer caves, mines or large cavities for roosting habitat. While they have been found night roosting in buildings or bridges (Hatfield 1937; Brown and Berry, 1998, 2003 and 2004), all major maternity and over-wintering sites are in mines or caves. California leaf-nosed bats neither hibernate nor migrate, and have a narrow thermal-neutral zone. They are incapable of lowering their body temperature to become torpid. No special physiological adaptations occur in this species for desert existence, and behavioral adaptations such as foraging methods and roost selection contribute to their successful exploitation of the temperate zone desert even during the cooler months (Bell *et al*.1986). To remain active yearlong in the temperate zone deserts, California leaf-nosed bats use warm diurnal roosts in caves, mines and buildings with temperatures that often exceed 80º F. Depending on the season, they roost singly or in groups of up to several hundred individuals, hanging separately from the ceiling, rather than clustering. Often the bats hang from one foot, using the other to scratch or groom themselves. Most diurnal winter roosts are in warm mine tunnels at least 100 meters long. At this season, the large colonies of over 1000 bats may contain both males and females, although the sexes may also roost separately. The consistent feature of the areas in the mines used by the bats is warmth and high humidity with no circulating air currents. The temperature of the mines is usually warmer than the annual mean temperature, and the mines may be located in geothermally-heated rock formations (Higgins and Martin 1980). Except for the nightly foraging period, in winter this species inhabits a stable warm environment. Although longevity of California leaf-nosed bats does not approach the 30 or more years documented for temperate zone vespertilionid bats, banded individuals in California have been recaptured after 15 years (Brown and Berry, 1998).

Females congregate in large (>100 bats) maternity colonies in the spring and summer, utilizing different mines or areas within a mine separate from those occupied in the winter, although colonies of only 6-20 bats are also found (Barbour and Davis, 1969; Vaughan, 1959; Brown and Berry, 1998). Within the larger colonies, clusters of five to 25 females will be associated with a single “harem” male that defends the cluster against intruding males (Berry and Brown, 1995). Large male roosts may also form. The single young (weighing 25-30% of the mother’s mass) is born between mid-May and early July, following a gestation of almost 9 months. This species exhibits "delayed development" following ovulation, insemination and fertilization in September (Bradshaw, 1962). In March, with increased temperatures and insect availability, embryonic development accelerates. Since the newborn bats are poikilothermic, the maternity colony is located fairly close to the entrance, where temperatures exceed 90º F and daytime outside temperatures can reach over 120º F in the summer. This allows the bats to use shallow natural rock caves that would be too cold for a winter roost. Maternity colonies disband once the young are independent in late summer (Brown and Berry, 1998).

California leaf-nosed bats feed primarily on large moths and immobile diurnal insects such as butterflies, grasshoppers and katydids which they glean from surfaces (Huey, 1925; Vaughan, 1959). Although they can echolocate, these bats appear to forage by utilizing prey-produced sounds and vision, even at low ambient light levels. The strategy of gleaning larger prey from the substrate as compared to aerial insectivory appears to reduce the total time and energy necessary for foraging (Bell, 1985; Bell and Fenton, 1986). Radio-telemetry studies of California leaf-nosed bats in the California and Arizona deserts indicate that the bats forage among desert wash vegetation within ten miles of their roosts (Brown *et al.* 1993; Dalton *et al.* 2000). The close proximity of foraging areas to the roost is most important in winter, when the bats forage closer to the roost and are above ground for shorter periods than in the summer. The bats emerge from their roosts 30 or more minutes after sunset, and fly near the ground or vegetation in slow, maneuverable flight (Vaughan, 1959; Brown *et al.,* 1993). Shallow caves and mines, buildings and bridges are used by both sexes as night roosts between foraging bouts at all seasons, except for the coldest winter months. Wings and other culled prey parts are found under night roosts.

Within the past 50 years, the range of California leaf-nosed bats has contracted by 50%, and the species no longer occurs outside of desert habitats in California (Brown and Berry 1998 and 2004). It is a CDFW Species of Concern and an evaluation species for the USBR LCR MSCP. The primary factors responsible for the declines are roost disturbance, the closure of mines for renewed mining and hazard abatement, and the destruction of foraging habitat. The combination of limited distribution, restrictive roosting requirements, and the tendency to form large, but relatively few colonies make this species especially vulnerable. The numbers of California leaf-nosed bat appear to be stable in mines near the LCR, as judged by exit counts and banding studies conducted over the last 45 years (Brown and Berry, 2003).

California leaf-nosed bats are primarily visually-orienting, using prey-produced sounds while foraging. When echolocation signals are used, they are of relatively low intensity. Therefore acoustic surveys may not detect this species, and would potentially underestimate their abundance. This species could have been captured in mist nets or detected acoustically in the current Topock Project Areas surveys. Appropriate foraging habitat occurs in Bat Cave Wash, and the nearby Jackpot Mine is a major winter and summer roost. They have been captured in mist nets at Beal Lake by USBR biologists (Calvert 2012).

Arizona myotis (*Myotis occultus*): Like cave myotis, Arizona myotis also emit steep FM calls ending at 40 kHz. However, we have attributed the M40 calls to cave myotis in the current surveys. Arizona myotis had been considered by some to be a subspecies of the little brown bat (*Myotis lucifugus*), and as such was considered to have a much expanded geographic range (Findley and Jones, 1967; Valdez *et al*., 1999). Recent genetic analysis has assigned it specific status (Piaggio *et al*., 2002). When first described in 1905 (Hollister, 1909), it was named Hollister’s bat, and the topotype was collected in May 1905, ten miles north of Needles at Ft. Mojave on the California side of the LCR in the “dense cottonwood bottomlands of the Colorado River”. In fact, H W Henshaw of the Wheeler Expedition in 1875 had collected a specimen in the “Mojave Desert” and deposited in the U. S. National Museum (Cockrum *et al*. 1996). In May 1910, Joseph Grinnell (1914) on a float trip on the LCR from Needles to Yuma, collected a female Hollister bat four miles south of Potholes “shot at late dusk close to the riverbank between files of cottonwoods, in just the same location as those taken by Hollister”. The next five specimens were collected “four miles northeast of Yuma, California” and were “shot over water in a back eddy of the river. Here the bats arrived in considerable numbers at early dusk to drink, flitting down to the water's surface and dipping several times before flying off among the willows and cottonwoods." Grinnell "used a boat in shooting and retrieving the specimens".

In August 1937, Stager (1943a) collected a male Arizona myotis in a mine in the Riverside Mountains, and in 1939 discovered a large maternity colony (~800 bats) roosting between horizontal support beams of a bridge on the LCR at Blythe. Between 1939 and 1945, Drs. Ken Stager and Denny Constantine collected 87 specimens (primarily females) from this bridge (deposited in the LA County Museum of Natural History). The bridge was torn down in the 1950s, and the colony has never been rediscovered.

Since 1945, no more Arizona myotis have been observed or collected from the LCR until mist netting surveys by USBR LCR MSCP biologists captured reproductive females in the cottonwood willow restoration site on the Colorado River Indian Tribes (CRIT) Ahakav Preserve south of Parker (Calvert and Neiswenter 2012). Through telemetry, the bats were tracked to a roost in the skirt of a mature palm tree near the Preserve. Although no Arizona myotis have been captured yet at Beal Lake, as the foraging habitat at restoration area matures the species could be re-colonizing this part of its historic range. However, until the capture of an Arizona myotis, the M40 signals recorded in the Topock Project Areas should probably be attributed to cave myotis.

Western red bat (*Lasiurus blossevillii*): This foliage-roosting species is easily identified both visually and acoustically (Corben pers. comm.). Red bats can generally be distinguished by fur color that can vary from intense red to yellow-brown. There is some sexual dimorphism in the color with males being more intensely colored than females. The lasiurine bat species are distinctive in giving birth to multiple young (Barbour and Davis 1969; Shump and Shump 1982a). Red bats forage on a number of insect taxa, flying at both canopy height and low over the ground (Shump and Shump 1982a). One diet sample from California suggests this species feeds primarily on small moths, but takes a variety of other insects, particularly orthopterans (Ross 1961). Historically associated with sycamore and cottonwood willow riparian systems in California, red bats have become rare as their roosting and foraging habitats have declined throughout the state (Pierson *et al.* 1999). It is a CDFW Species of Concern, and received a high rating for imperilment from the WBWG. Red bats are designated as covered species for the USBR LCR MSCP and have been captured in several of the restoration sites (Calvert 2012; Diamond *et al.* 2013).

This species emits a distinctive echolocation call, which is typified by a "ping-pong" pattern of the terminal frequency from pulse to pulse, generally around a characteristic frequency of ca. 45 kHz. Short sequences can be confused with those of canyon bats. No red bat calls were recorded in the Topock Project Areas during the current survey, but they could fly over the site since roosting and foraging habitat exist along adjacent areas of the LCR.

Western yellow bat (*Lasiurus xanthinus*): This species roost in trees, with preference given to palm trees with intact skirts, although some reports show use of hackberry and sycamore, and even yucca (Higginbotham *et al*., 2000). There is some evidence to support the hypothesis that this species has expanded its range northward in response to the planting of palms along the LCR, using the river as a corridor. Constantine (1966) collected the first yellow bat along the LCR at Yuma, with a subsequent specimen turned in for rabies testing in 1980 from Blythe (Constantine 1998). During the BWR bat survey, Brown (1996) captured one juvenile and two adult male yellow bats near Planet Ranch in October. Williams (2001) studied a resident population in the palm groves of the upper Moapa Valley, where it was the second most abundant bat captured and acoustically detected. Yellow bats are also a covered species for the USBR LCR MSCP and have been captured in several of the restoration sites (Calvert 2012;

Diamond *et al.* 2013). Some palm trees at Moabi Regional Park and Topock Marina could provide roosting habitat.

IMPACTS and MITIGATION

Based on review of the proposed Soil Investigation Project and primarily the location of soil investigation activities, the project is not anticipated to have a significant adverse impact on bats, if done to avoid the maternity season. The noise and vibration generated by the soil investigation activities has not been addressed as part of this study, and therefore the impact to bats at a given distance was not evaluated.

Even though we did not capture a reproductive female, a maternity colony of Townsend's big-eared bats could be present in Bat Cave Wash. This species is difficult to survey due to their low intensity echolocation calls, and their ability to avoid mist nets. The reason that this species is a candidate for listing is mostly due to their intolerance to roost disturbance, especially during the maternity season. When disturbed by human entry into a roost, females have flown away and left their non-volant young to starve. Attempting to find and study a roost site in the largely friable cliff walls of Bat Cave Wash would be difficult and can be potentially disturbing. Most bats change roosts during the maternity period in response to temperature requirements, even without disturbance. Therefore a colony located and designated in one month may have moved to another location by the time that the soil investigation is initiated in that area.

To insure that impacts remain less than significant, it is recommended that any potentially noisy soil investigation activities, in the vicinity of the sides of Bat Cave Wash and within the East Ravine should be scheduled to avoid the maternity season when noise and vibration could be disturbing to the bats, especially Townsend's big-eared bats, unless these activities are critical to meeting the project objectives. If the activities must be done during the maternity period, then the procedures for reducing impacts to bats through monitoring are identified in the next paragraph. The maternity period extends from when pregnant females first aggregate through the weaning of the juvenile bats and dispersal of the colony. Since multiple bat species are involved, with asynchronous reproductive timing, the maternity season in the Topock area is mid-March through August. If spring is "late" and the temperatures are cool through March, the onset of the maternity season may be delayed until around April 1. Since the maternity "season" usually encompasses five months, if the warm spring temperatures begin in mid-March, the maternity season will probably end around mid-August.

If noisy soil investigation activities need to be conducted during the maternity season, the steep wash sides with crevices and possible cavities within 100 feet of the proposed work activity should be watched from sunset for 90 minutes for exiting bats, by a trained observer using a thermal imaging camera. The observations should be made on a night with wind speed less than 10 mph and no rain. If bats are observed exiting from the semi-consolidated sediment or rock, no soil investigations should be conducted the next day. If bats are not observed exiting then the proposed work may proceed the next day. During the current surveys, night vision goggles did not give a wide enough field of view, nor was a permanent record available for later review. For this reason, a thermal imaging camera is recommended. Acoustic recordings are low value for precisely locating an actual roost in a cliff, especially if Townsend's big-eared bats are the target.

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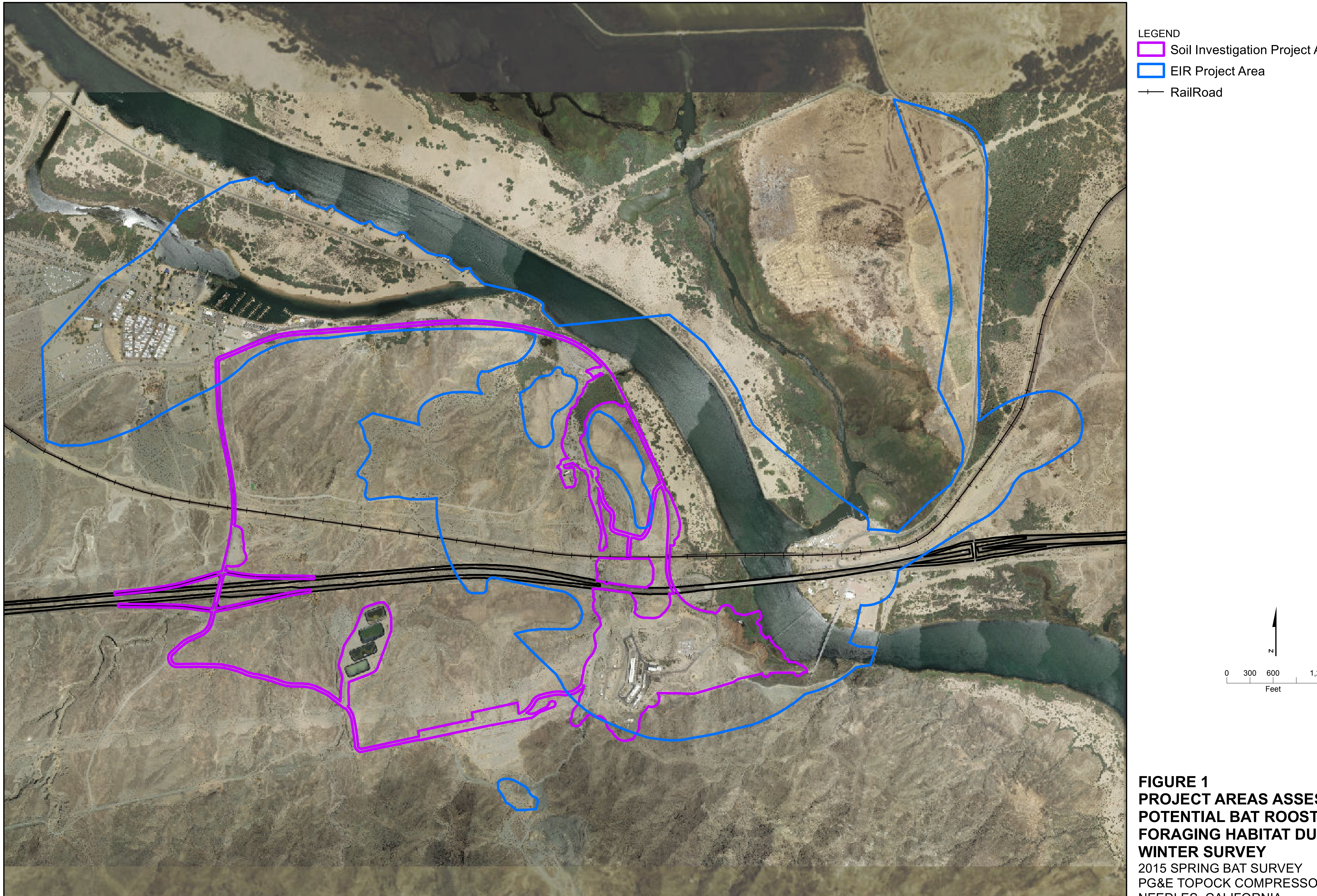

FIGURE 1
PROJECT AREAS ASSESSED FOR POTENTIAL BAT ROOSTING AND FORAGING HABITAT DURING THE WINTER SURVEY
2015 SPRING BAT SURVEY
PG&E TOPOCK COMPRESSOR STATION, NEEDLES, CALIFORNIA

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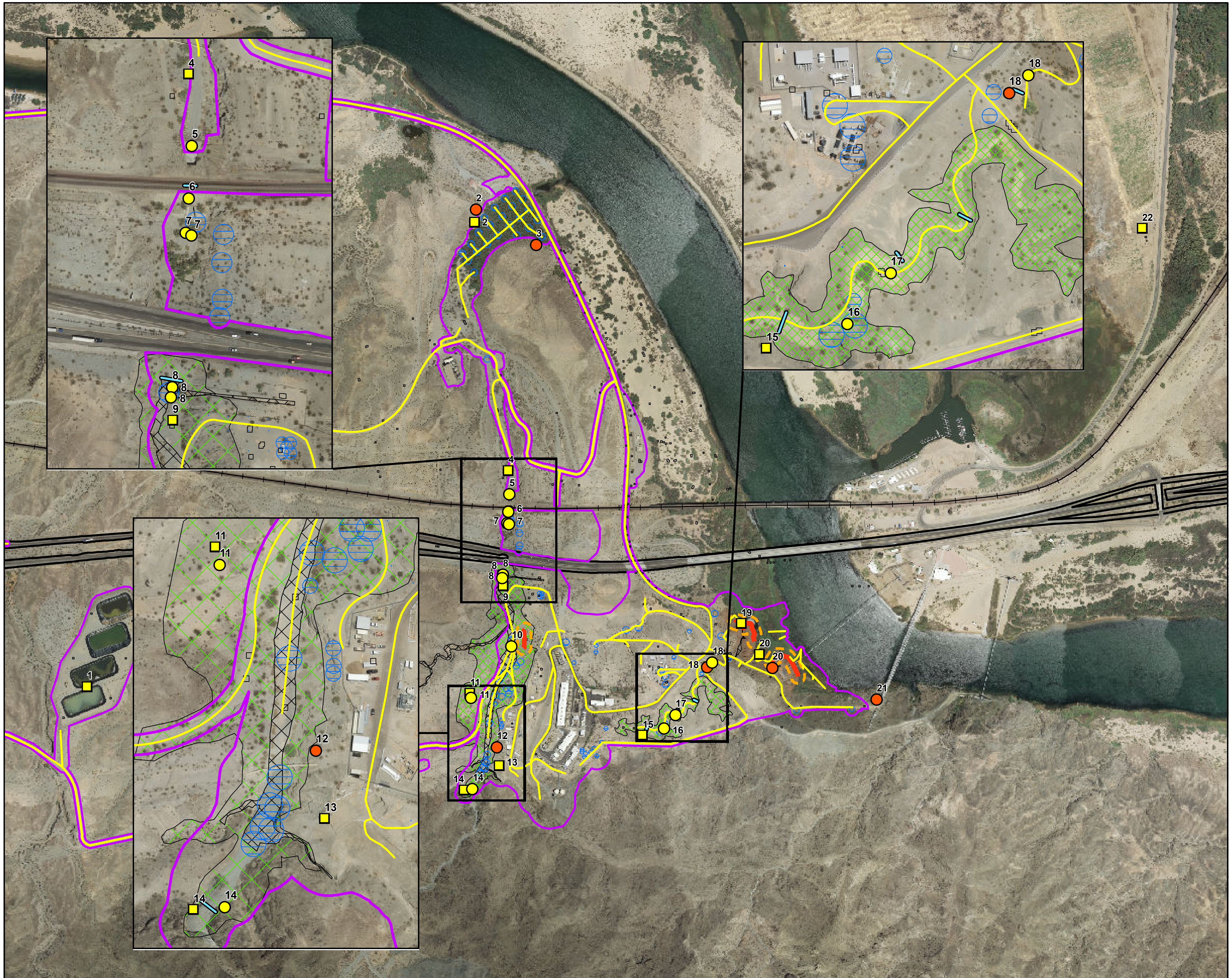

Notes:

1. Potentially Sensitive Maternal Bat Roosting Habitat includes areas where cavities appeared large enough to accommodate Townsend's big-ear bat and pallid bats among others. These are the specific locations referred to in the letter report 'Preliminary Habitat Analysis for Bat Use at PG&E Topock Remediation Project, San Bernardino County, CA' (Dr. Pat Brown, dated March 2, 2015)
2. Proposed access routes and sampling locations are taken from the Draft Soil Investigation EIR (DTSC, 2014).

FIGURE 2
TOPOCK PROJECT AREAS AND ACOUSTIC MONITORING STATIONS
2015 SPRING BAT SURVEY
PG&E TOPOCK COMPRESSOR STATION,
NEEDLES, CALIFORNIA

Table 1. Bats Potentially Occurring near the PG&E Topock Remediation Site

Family/Scientific Name	Common Name	USFWS	CDFW
Chiroptera (Bats)			
Phyllostomidae (American leaf-nosed bats)			
Macrotus californicus	California leaf-nosed bat	SC	CSC
Vespertilionidae (Vesper bats)			
Myotis yumanensis	**Yuma myotis**	SC	-
Myotis velifer	**Cave myotis**	SC	CSC
Myotis occultus	Arizona myotis	SC	CSC
Myotis californicus	**California myotis**	-	-
Parastrellus hesperus	**Western canyon bat**	-	-
Eptesicus fuscus	**Big brown bat**	-	-
Lasiurus blossevillii	Western red bat	-	CSC
Lasiurus xanthinus	Southern yellow bat	-	-
Lasiurus cinereus	**Hoary bat**	-	-
Corynorhinus townsendii	**Townsend's big-eared bat**	SC	Candidate T/E
Antrozous pallidus	**Pallid bat**	-	CSC
Molossidae (Free-tailed bats)			
Tadarida brasiliensis	**Mexican free-tailed bat**	-	-
Nyctinomops femorosaccus	**Pocketed free-tailed bat**	-	CSC
Nyctinomops macrotis	Big free-tailed bat	SC	CSC
Eumops perotis	**Western mastiff bat**	SC	CSC

USFWS
U.S. Fish and Wildlife Service
Federal Species of Concern
SC = Former Category 2 candidate

CDFW
California Department of Fish and Wildlife
CSC = California Species of Concern

Bold = Detected in current acoustic survey
RED = Captured in mist nets

Table 2. Anabat Detector Stations During Winter and Spring Surveys, Topock Compressor Station					
map ID	Site Name	lat (N)	long (W)	elev (m)	date(s)
	January short term				
2	N Margin Mouth of Bat Cave Wash by tamarisk [AOC1]	34.724390	114.494880	143	1/29/2015
3	S Margin Mouth of Bat Cave Wash by tamarisk [AOC7] BCW18	34.723630	114.493420	145	1/29/2015
12	Bat Cave Wash slope above pipe crossing	34.713400	114.494830	181	1/29/2015
18	East Ravine margin [AOC-10D]	34.714890	114.489560	149	1/29/2015
20	On LCR rocky slope N of pipe crossing [ERPW7]	34.714830	114.487950	155	1/29/2015
21	On LCR rocky slope N of Trails Bridge crossing [near 28A]	34.714110	114.485400	148	1/29/2015
	April long term				
1	Evaporation Ponds	34.714940	114.504910	195	4/27-5/1/2015
2	Mouth of Bat Cave Wash by tamarisk	34.724140	114.494930	143	4/27-5/1/2015
4	Bat Cave Wash N of RR crossing	34.719050	114.494310	146	4/27-5/1/2015
9	Bat Cave Wash S of I-40 crossing	34.716700	114.494540	158	4/27-5/1/2015
11	Bat Cave Wash west of compressor station	34.714530	114.495450	173	4/27-5/1/2015
13	Bat Cave Wash, above pipe crossing	34.713030	114.494790	190	4/27-5/1/2015
14	Bat Cave Wash mouth of rocky cyn	34.712560	114.495676	172	4/27-5/1/2015

Table 2. Anabat Detector Stations During Winter and Spring Surveys, Topock Compressor Station					
map ID	**Site Name**	**lat (N)**	**long (W)**	**elev (m)**	**date(s)**
15	Above East Ravine	34.713550	114.491220	163	4/27-5/1/2015
19	On LCR backwater rocky slope S of I-40 bridge	34.715760	114.488680	138	4/27-5/1/2015
20	On LCR rocky slope N of pipe crossing	34.715120	114.488260	138	4/27-5/1/2015
22	Arizona fenced enclosure HNWR	34.723540	114.478430	141	4/27-5/1/2015
April short term					
8	Bat Cave Wash nr S portal I-40 culverts net site	34.716923	114.494532	160	4/28/2015
14	Bat Cave Wash nr dry waterfall at net site	34.712566	114.495468	172	4/28/2015
16	East Ravine arroyo junction from ESE	34.713665	114.490678	164	4/29/2015
17	East Ravine below E side slope with cavities	34.713933	114.490382	158	4/29/2015
18	East Ravine near net site 1	34.714983	114.489428	153	4/29/2015
5	Bat Cave Wash N apron RR culvert	34.718557	114.494302	155	4/30/2015
7	Bat Cave Wash floor trees S of RR culvert	34.717970	114.494377	149	4/30/2015
8	Bat Cave Wash nr S portal I-40 culverts net site	34.716923	114.494532	160	4/30/2015
6	Bat Cave Wash inside S portal of RR culvert	34.718201	114.494341	158	5/1/2015
7	Bat Cave Wash floor trees S of RR culvert	34.717950	114.494332	152	5/1/2015
8	Bat Cave Wash below W side slope with potential roost cavities	34.716853	114.494545	156	5/1/2015

Table 2. Anabat Detector Stations During Winter and Spring Surveys, Topock Compressor Station					
map ID	**Site Name**	**lat (N)**	**long (W)**	**elev (m)**	**date(s)**
10	Bat Cave Wash below slope with potential roost cavities	34.715450	114.494380	157	5/1/2015
11	Bat Cave Wash below E side slope with potential roost cavities	34.714430	114.495423	172	5/1/2015

Table 3. Station number and minutes with acoustical activity for species/acoustic categories, Topock Compressor Station										
Station #	**Date**	**Pahe**	**M50**	**Q25**	**Tabr**	**M40**	**Anpa**	**Laci/Nyfe**	**Eupe**	**Station Total**
January 29 2015 (approx 6hr per station)										
2	1/29/2015	3	21	1	2					27
3	1/29/2015		4	2	3					9
12	1/29/2015	8	4	5	29					46
18	1/29/2015		6							6
20	1/29/2015	1	7	2	2					12
21	1/29/2015	2	3	4	3					12
Species Total		**14**	**45**	**14**	**39**					**112**
April 27-May 1 2015 (5 nights)										
1	4/27-5/1/15	489	227	28	11				1	756
2	4/27-5/1/15	334	83	42	29			1		489
4	4/27-5/1/15	360	741	41	40		3	2	1	1188
9	4/27-5/1/15	144	643	29	5		28			849
11	4/27-5/1/15	182	28	63	51		1	4	1	330
13	4/27-5/1/15	693	30	182	217			9		1131
14	4/27-5/1/15	381	1022	258	179			1		1841
15	4/27-5/1/15	282	63	29	25			5	7	411
19	4/27-5/1/15	389	445	88	53	5	32	2	1	1015
20	4/27-5/1/15	194	93	51	59		7	6	4	414
22	4/27-5/1/15	168	201	64	16	13	1	1	4	468
Species Total		**3616**	**3576**	**875**	**685**	**18**	**72**	**31**	**19**	**8892**

Table 3. Station number and minutes with acoustical activity for species/acoustic categories, Topock Compressor Station										
Station #	**Date**	**Pahe**	**M50**	**Q25**	**Tabr**	**M40**	**Anpa**	**Laci/Nyfe**	**Eupe**	**Station Total**
April 27-May 1 2015 (approx 4 hours per station)										
8	4/28/2015	2	127	14	5					148
14	4/28/2015	12	84		70		2	1		169
16	4/29/2015	22	2							24
17	4/29/2015	15	2							17
18	4/29/2015	45	25		1					71
5	4/30/2015	100	107	6	2					215
7	4/30/2015	88	73	6						167
8	4/30/2015	34	75	2			1			112
6	5/1/2015		55							55
7	5/1/2015	59	53							112
8	5/1/2015	17	38							55
10	5/1/2015	15	40	3						58
11	5/1/2015	11	10	1						22
Species Total		**420**	**691**	**32**	**78**		**3**	**1**		**1225**
Notes:										
Pahe = Parastrellus Hesperus; **M50** = Myotis yumaensis and M. californicus; **M40** = likely M. vellifer; **Anpa** = Antrozous pallidus; **Laci/Nyfe** = Lasiurus cinereus and Nyctinomops femorosaccus; and **Eupe** = Eumops perotis.										

Table 4. Bat Species Observations from Mist Netting Activities - April 28 to 30, 2015, Topock Compressor Station

Location	Date	Time (Hrs)	Species	Number	Sex	Reproductive Status	# Nets	Notes
Culverts under I-40	4/28/2015	1930-2330						
		1946-2317	Myyu	9	F	lactating	4	Most bats heading from south to north (downstream)
		1946-2317	Myyu	8	F	pregnant		All nets placed across upstream side of culverts
		1946-2317	Myyu	2	F	none		
		2200-2317	Myyu	5	M	none		all males captured after 2200
		2008-2109	Myca	2	F	pregnant		
		2116-2157	Myca	3	M	none		
		2148-2223	Anpa	3	F	pregnant		
		2102	Anpa	1	M	testes descended		
		2115-2223	Tabr	2	M	none		
Upper Bat Cave Wash	4/28/2015	1914-2238						
			none				1	below rocky alcove
East Ravine	4/29/2015	1930- 2315						
			none				1	Near large paloverde
			none				1	At turn in wash
			none				1	At crest of berm

Table 4. Bat Species Observations from Mist Netting Activities - April 28 to 30, 2015, Topock Compressor Station								
Location	**Date**	**Time (Hrs)**	**Species**	**Number**	**Sex**	**Reproductive Status**	**# Nets**	**Notes**
			none				1	Across wash
Culverts under 1-40	4/30/2015	1930-2245						
		1945-2145	Myyu	10	F	lactating	4	All nets placed across upstream side of culverts
		1945-2145	Myyu	1	F	none		
		1945-2145	Myyu	1	M	none		
Culvert under BNSF Railroad	4/30/2015	1930-2245					2	2 nets stacked vertically
		2145	Coto	1	M	testes descended		
Total				**48**				
Notes:								
1. Times are based on 24 hour clock (military). Time next to location name = total time nets set. Time next to bat categories=bracket of time when that species category captured								
2) Mist net locations are shown on Figure 2.								
3) Bat species abbreviations: **Myyu** = Yuma myotis; **Myca** = Myotis californicus; **Anpa** = Antrozous pallidus; **Tabr** = Tadarida brasiliensis; and **Coto** = Corynorhinus townsendii.								
4) Other Abreviations: M = male; F = Female.								

PHOTOGRAPH 1
Anabat acoustical detection device.

PHOTOGRAPH 2
Setting up long-term Anabat station in East Ravine, April 27, 2015.

PHOTOGRAPH 3
Long-term Anabat Monitoring Station 13 above Bat Cave Wash near the compressor station. April 27, 2015.

PHOTOGRAPH 4
Long-term Anabat Monitoring Station 19 along Colorado River north of the pipe bridge. April 27, 2015.

PHOTOGRAPH 5
Long-term Anabat Monitoring Station 22 near HNWR-1 well in Sacramento Wash. Moved to inside of closure on following day. April 27, 2015.

PHOTOGRAPH 6
Mist net setup on upstream side of I-40 culverts within Bat Cave Wash. April 28, 2015.

PHOTOGRAPH 7
Mist net setup beneath BNSF railroad crossing over Bat Cave Wash. April 30, 2015.

PHOTOGRAPH 8
Captured Townsend's big-eared bat. April 30, 2015.