Table of Contents

3.1 Introduction **1**

3.2 Geology **1**
3.2.1 Introduction/Geomorphology 1
3.2.2 Geologic History 2
3.2.3 Structural Features 5
3.2.4 Physiography 6
3.2.5 Lithology 6

3.3 Soils **9**
3.3.1 Introduction 9
3.3.2 General Desert Soil Characteristics 9
3.3.3 Soil Classification and Mapping 10
3.3.4 Soil Erodibility 18

3.4 Water Resources **21**
3.4.1 Surface Water 21
3.4.2 Groundwater 21
3.4.3 Wetlands 22
3.4.4 Water Quality 22
3.4.5 Water Rights 22

3.5 Biological Resources **24**
3.5.1 Sensitive Species Definitions 24
3.5.2 Vegetation 26
3.5.3 Wildlife 45
3.5.4 Introduced Wildlife Species 78
3.5.5 Summary of the Biological Assessment and Opinion 78

3.6 Cultural Resources and Paleontology **82**
3.6.1 Cultural Resources 82
3.6.2 The National Register of Historic Places 89
3.6.3 Predictive Model 89
3.6.4 Paleontology 90
3.6.5 Programmatic Agreement 92

3.7 Air Quality **94**
3.7.1 Meteorological and Climatic Conditions 94
3.7.2 Air Quality Standards 99
3.7.3 Baseline Air Quality 100
3.7.4 Non-attainment Areas 109
3.7.5 Significant Emission Thresholds 109

3.8 Noise **110**
3.8.1 Description of Resource 110
3.8.2 Region of Influence 111
3.8.3 Noise Regulations 111
3.8.4 Existing Noise Environment 115

3.9 Land Use **128**
3.9.1 Land Ownership 128

3.9.2 Other Federal Lands 137
3.9.3 Aesthetics and Visual Resources 138

3.10 Recreation 143
3.10.1 Barstow Extensive Recreation Management Area 145
3.10.2 Recreation Areas in the Study Area 146

3.11 Mining 152
3.11.1 Mineral Deposits 152
3.11.2 Mineral Interest 154
3.11.3 Mining Activity 157

3.12 Utilities 159
3.12.1 Bureau of Land Management Utility Corridor D 159
3.12.2 Bureau of Land Management Utility Corridor Q 161
3.12.3 Other Regional Utilities 161

3.13 Transportation 162
3.13.1 National and State Road Systems 162
3.13.2 Secondary Road System 162
3.13.3 Railroad System 163

3.14 Socioeconomics 165
3.14.1 Region of Influence 165
3.14.2 Demographics 165
3.14.3 Economics 165

3.15 Wilderness Areas 166
3.15.1 Wilderness Areas and Wilderness Study Areas 166
3.15.2 Wilderness Areas 168
3.15.3 Adjacent Wilderness Areas and Wilderness Study Areas 168

3.16 Airspace 172
3.16.1 Airspace Description 172
3.16.2 Participating Military Operations 175
3.16.3 Non-Participating Military Operations 177
3.16.4 Non-Military, Commercial Operations 189
3.16.5 Non-Military, General Aviation Operations 192
3.16.6 Other Federal Operations 193

3.17 Hazardous Materials and Solid Waste 196
3.17.1 Hazardous Waste and Materials 196
3.17.2 Environmental Investigations of Study Area 197
3.17.3 Hazardous Materials Education 197
3.17.4 Solid Waste Management 198

3.18 Health and Safety 198
3.18.1 Naturally Occurring Health and Safety Conditions 198
3.18.2 Manmade Health and Safety Conditions 199
3.18.3 Environmental Health and Safety of Children 200
3.18.4 Naval Air Weapons Station, China Lake Spectrum 201

3.19 Environmental Justice 202
3.19.1 Region of Influence 202
3.19.2 Minority Populations and Low-Income Populations 202
3.19.3 Public Notices 202

3.20 Cumulative Impacts.....203
3.20.1 Introduction 203
3.20.2 Past, Present, and Reasonably Foreseeable Actions.....203

List of Tables

Table 3.3-1: Total Acreages and Percentages of Total Coverage of the Study Area, by Soil Series 13
Table 3.3-2: Relationship Between Predicted Military Use and Erodibility Acreage 19
Table 3.5-1: Sensitive Plant Species 35
Table 3.5-2: Total Recorded Plants and Acreages of Known Lane Mountain Milk-vetch Populations....42
Table 3.5-3: Lane Mountain Milk-vetch Population Estimates, Adjusted by Observability....43
Table 3.5-4: Sensitive Wildlife Species 48
Table 3.5-5: Estimated Number of Adult Tortoises in the Study Area 60
Table 3.5-6: Tortoises Killed or Relocated During Military Maneuvers on the NTC, since 1994....63
Table 3.6-1 Summary of Investigations 88
Table 3.6.5.1: Prioritizing Historic Property Identification and Evaluation 94
Table 3.6.5.2 Surveys: Current and Projected....94
Table 3.7-1: Climatic Averages at Fort Irwin NTC – Years 1999 - 2001....98
Table 3.7-2: Ambient Air Quality Standards 99
Table 3.7-3: Exceedance of Air Quality Standards for the Barstow (B) and Trona (T) Monitoring Stations 102
Table 3.7-4: Highest Recorded PM-10 Concentrations: PM-10 Monitoring Stations at Fort Irwin Sorted by Season....105
Table 3.7-5: Highest Recorded PM-10 Concentrations: PM-10 Monitoring Stations at Fort Irwin, Sorted by Monitoring Site by Quarter 105
Table 3.7-6: Highest Recorded PM-10 Concentrations: PM-10 Monitoring Stations at Fort Irwin, Sorted by Activity 106
Table 3.7-7: Criteria Thresholds....109
Table 3.8-1: Army Land Use Noise Compatibility Guidelines....113
Table 3.8-2: Impulsive Noise Guidelines for Assessing the Risk of Complaints from Noise 114
Table 3.8-3: Hourly Noise Level Performance Standards—Stationary Sources (Locally Regulated Noise*) 115
Table 3.8-4: Interior/Exterior Noise Level Standards—Mobile Sources 115
Table 3.8-5: Peak Sound Pressure Levels from Artillery Used at the NTC 121
Table 3.8-6: Peak Sound Pressure Levels from Artillery Used at the NTC 126
Table 3.9-1: Breakdown of Land Acreages by Ownership or Administrating Agency....128
Table 3.9-2: Summary of VRM Classifications and Rating in the Study Area 139
Table 3.10-1: 2001 Recreational Uses within the Barstow Extensive RMA....145
Table 3.11-1: BLM Manual 3031 Mineral Potential Classification System....153

Table 3.11-2: Un-Patented Mining Claims 155
Table 3.11-3: Patented Mining Claims 157
Table 3.15-1: Wilderness Study Areas 167
Table 3.20-1: Interference Limits 209

List of Figures

Figure 3.2-1: Geologic Qualities of the Study Area 4
Figure 3.2-2: Seismic Hazards 7
Figure 3.3-1: Soil Mapping Units 12
Figure 3.3-2: Soil Erodibility 20
Figure 3.4-1: Hydrologic Resources 23
Figure 3.5-1: Vegetation Communities 30
Figure 3.5-2: Lane Mountain Milk-Vetch Populations 44
Figure 3.5-3: Range-wide Distribution of the Desert Tortoise 56
Figure 3.5-4: Current Core Tortoise Populations in the West Mojave Region 57
Figure 3.5-5: Results of Non-BLM Desert Tortoise Abundance Studies Prior to 2001 58
Figure 3.5-6: Mohave Ground Squirrel Range 77
Figure 3.6-1: Cultural Resource Survey Areas 86
Figure 3.6-2 Fort Irwin Expansion Survey Study Areas 88
Figure 3.6-3: Potential Paleontological Resources 93
Figure 3.7-1: Four Corners, Fort Irwin, CA Wind Rose, Year 2000 96
Figure 3.7-2: Four Corners, Fort Irwin, CA Wind Rose, Year 2001 97
Figure 3.7-3: Mixing Height, by Type – Daggett, CA 98
Figure 3.7-4: Air Quality Monitoring Stations 108
Figure 3.8-1: Typical A-Weighted Sound Pressure Levels 112
Figure 3.8-3: Barstow-Daggett Airport Noise Contour 118
Figure 3.8-3: Barstow-Daggett Airport Noise Contour 119
Figure 3.8-4: Estimated Peak Sound Pressure Levels, DBP for Small Caliber Arms Ranges 122
Figure 3.8-5: MPRC Noise Level Contours, CDNL for Large Caliber Arms Ranges 123
Figure 3.8-6: Air Warrior Bomb Drop Noise Level Contours, CDNL 124
Figure 3.9-1: Map of Land Ownership in the Study Area 130
Figure 3.9-2: Visual Resource Management Classes for Areas within the Study Area 141
Figure 3.9-3: Key Observation Point 1 142
Figure 3.9-4: Key Observation Point 2 143
Figure 3.9-5: Key Observation Point 3 143
Figure 3.10-1: Barstow Extensive Recreation Management Area with Special Recreation Management Areas 148
Figure 3.11-1: Mineral Potential 156
Figure 3.11-2: Mining Activity in the Study Area 158

Figure 3.12-1: Utility Corridors 160
Figure 3.13-1: Transportation Network 164
Figure 3.15-1: Wilderness Areas 169
Figure 3.16-1: Participating Military Operations Airspace 176
Figure 3.16-2: Military Training Routes 178
Figure 3.16-3: R-2524 Airspace 180
Figure 3.16-4: Superior Valley Flight Paths 182
Figure 3.16-5: R-2515 Airspace Areas 184
Figure 3.16-6: R2515 Air Refueling Areas 185
Figure 3.16-7: Low Altitude Rotary-Wing Training Area 186
Figure 3.16-8: Military Operations Areas 188
Figure 3.16-9: Low Altitude Airways 190
Figure 3.16-10: High Altitude Airways 191
Figure 3.16-11: Daggett Shelf 192
Figure 3.16-12: Goldstone Deep Space Communications Complex 193
Figure 3.16-13: Goldstone Radiation Avoidance Area 195

This page intionally left blank.

3.1 Introduction

This chapter describes the existing conditions within the Study Area (which is the area comprising all the alternatives), the Region of Influence (ROI) (which will be defined by the resources being investigated in the sections), and adjacent areas associated with the proposed addition of maneuver training lands at the NTC at Fort Irwin. This chapter establishes the existing conditions and serves as the baseline by which the action alternatives are evaluated.

The Study Area includes the southern portion of the Avawatz Mountains, the South Avawatz Mountains, the Alvord Mountains, the Coyote Basin, the Paradise Mountains, and the Superior Valley. The total Study Area consists of approximately 249,520 acres of state, federal, and private lands. The breakdown of the land ownership and acreages may be seen in Figure 3.9-1. The Study Area includes land within the current Fort Irwin boundaries that are currently off-limits to mechanized training and are designated as desert tortoise critical habitat by the USFWS. These lands, designated as the UTM 90 Area, consist of two parcels: the critical habitat located south of the UTM 90 gridline and the critical habitat in the southwest corner of Fort Irwin above the UTM 90 gridline. The Affected Environment Sections include geology, soils, water resources, biological resources, cultural resources and paleontology, air quality, noise, land use, recreation, mining, utilities, transportation, socioeconomics, wilderness areas, airspace, hazardous materials and solid waste, health and safety, and environmental justice, in accordance with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations,* dated February 11, 1994 (EO 1994).

3.2 Geology

3.2.1 Introduction/Geomorphology

The Study Area is the ROI for determining impacts to this resource as defined in Section 1.1.5 and shown in Figure 1.1-1. The California Division of Mines and Geology has divided California into a number of geomorphic provinces. The desert region in California contains three geomorphic provinces. The Study Area is located within the Mojave Desert province. The Mojave block is a triangular shaped region located between the Garlock and San Andreas fault zones on the north and south, respectively, and the eastern Mojave shear zone, to the east. The Mojave Desert province is bounded by a series of mountains formed by the Garlock Fault in the north, the southern Sierra Nevada Mountain range to the northwest, and the Transverse ranges to the southwest and south. The Basin and Range province occurs north and east of the Mojave Desert province, and the Colorado Desert province occurs to the south (Norris and Webb 1990).

All three desert geomorphic provinces are arid at the lower elevations, but each region varies greatly in the mass and height of their mountain ranges. The project area is located in the central portion of the Mojave block. This region is characterized by many low ranges and small valleys, and has many closed valleys or basins with playa lakes, with either clay or saline beds. The elevation of the lakebeds is generally over 1,000 feet above mean sea level (AMSL) in this region. The lakebeds contained water during the ice ages and became dry during the interglacial periods. Although none of

the valleys presently contain permanent water, groundwater exists at relatively shallow depths.

Few permanent streams occur in any of the desert geomorphic provinces. The Mojave River is the largest drainage system in the central Mojave Desert. It begins in the San Bernardino Mountains near Lake Arrowhead and flows as a permanent stream to the base of the mountains. A subsurface river flows for over 100 miles until it drains into the Silurian Valley along the eastern border of the Mojave block. The stream reaches the surface at only two places: in the narrows east of Victorville and in Afton Canyon. The river supported a riparian forest of cottonwoods from Victorville to Camp Cady until the stream was dammed in the 1920s. The cottonwoods died in Barstow around 1925, but a few groves still exist at Victorville and Camp Cady. The river occasionally flows when water is released from the dams in high rainfall years.

3.2.2 Geologic History

3.2.2.1 Introduction

Northeastern North America began as a stable plate forming a continent. Western North America began under ocean water, with the western portion being forced (subducted) below the eastern portion. The eastern portion (Farallon tectonic plate) then melted and provided enough material to force the western portion of North America above water. The subduction also resulted in the upward movement of melted continental and sea floor crusts to the surface as explosive volcanics or slowly cooling plutons of granitic-type rocks throughout the Mesozoic Era.

During the Paleozoic Era, the only land in western North America was a line of volcanoes. Evidence of a continental margin forming in the Victorville area occurred sometime after 170 million years ago (Schermer and Busby 1994). The slow uplifted, upwelling of lava that began forming during the Triassic Period occurred in waves of activity throughout the Mesozoic Era. The result was that all granitic ranges throughout southwestern North America are of the same geologic process over a period of several hundred million years. As subduction of the plate continued, upwelling lava formed a series of coalesced granitic domes of different height (plutons), which slowly cooled below the surface but were uplifted until they formed mountain ranges. Occasionally, evidence of earlier marine deposition exists as caps on the crest of mountains from the Transverse and Sierra Nevada ranges east. Marine carbonates are much more common as isolated outcrops in mountains east of the ROI. These are important because they often contain fossils.

The Farallon plate was completely subducted in the Southern California area approximately 30 million years ago, leaving two small plates to the north and south of the ROI. At that time, subduction was replaced by two different movements—one caused by the spreading zone that represents the end of the Farallon plate, and the other, movement of a new western plate (Pacific Plate) north to its zone of subduction in the Alaska area. The northern movement of the western plate resulted in the molten rock being dragged north but divided and slowed by the roots of the Sierran batholith. This drag formed an eddy that pushed on the Mojave block from the north. The relative

northern movement of the western plate also put pressure on the Mojave block from the south. The stress squeezed the Mojave block from both directions, causing the eastern and widest part to move east. This resulted in objects within the Mojave block being pulled away from each other. The stresses from change in movement of the plates resulted in the creation or reactivation of the two major fault zones forming the Mojave block.

The primary result was the area within the Mojave block being pushed east in a stretching motion. As the crust stretched, it got thinner, and the pinching caused minor faulting to occur, and blocks (terranes) of previously formed rock between the faults to separate and be uplifted or dropped down to form grabens. This stress also caused renewed volcanism that peaked 20 million years ago, with material coming from both deep below the surface and from near the surface. Parent material moved directly from deep below the surface, and formed rocks such as plutons and basalt. Mixed magma (intermediate) or upper crustal rocks resulted in tuff, andecite, and dacite (a pinkish-purple rock, commonly known as rhyolite). Cracks that formed during stretching were filled with molten material, and the veins of intruded material (known as dikes) are younger than the material they intrude. This is the source of mineralization that resulted in gold and silver being found in the Calico area.

The tectonic forces also resulted in some compression and folding (anticlines and synclines). A major syncline—the Barstow trough—existed between the El Paso Mountains in the west and Needles in the east. Another syncline runs northwest to southeast from Death Valley to Silurian Valley. During the Pleistocene Epoch, some of these synclines became filled with hundreds of feet of fresh water. As they dried and became isolated into smaller lakes, an extensive drainage system formed. During the last 100,000 years, the region has become warmer and drier.

3.2.2.2 Proterozoic Era (3.5 billion to 750 million years ago)

As shown in Figure 3.2-1, the first three-quarters of geologic time left no rocks in the California desert provinces. The oldest rocks in the region are 1.7 billion year old metamorphic rocks (Norris 1995). They represent marine sediments and granitic intrusive rocks that were subject to great heat and pressure and were recrystalized. Examples include the Pelona schist and Waterman gneiss. The region has been influenced by the collision of a tectonic plate from the west that was subducted below a more stationary plate to the east. The subducted crust was then melted and used as the raw material for the Mesozoic mountain building processes that are so common in today's desert mountain ranges. Most Proterozoic rocks occur as caps on mountaintops in the northern Sierra Nevada and western Transverse ranges. Beginning about 1.2 billion years ago, a stable marine shelf formed. The Mojave Desert area was a trough that accumulated marine sediments until 220 million years ago.

3.2.2.3 Paleozoic Era (750 to 230 million years ago)

During the Paleozoic Era, a slowly subsiding sediment-filled trough occurred along the western edge of the North American continent. Most fossil-bearing rocks that formed in this region during this era occur to the north and east of the ROI.

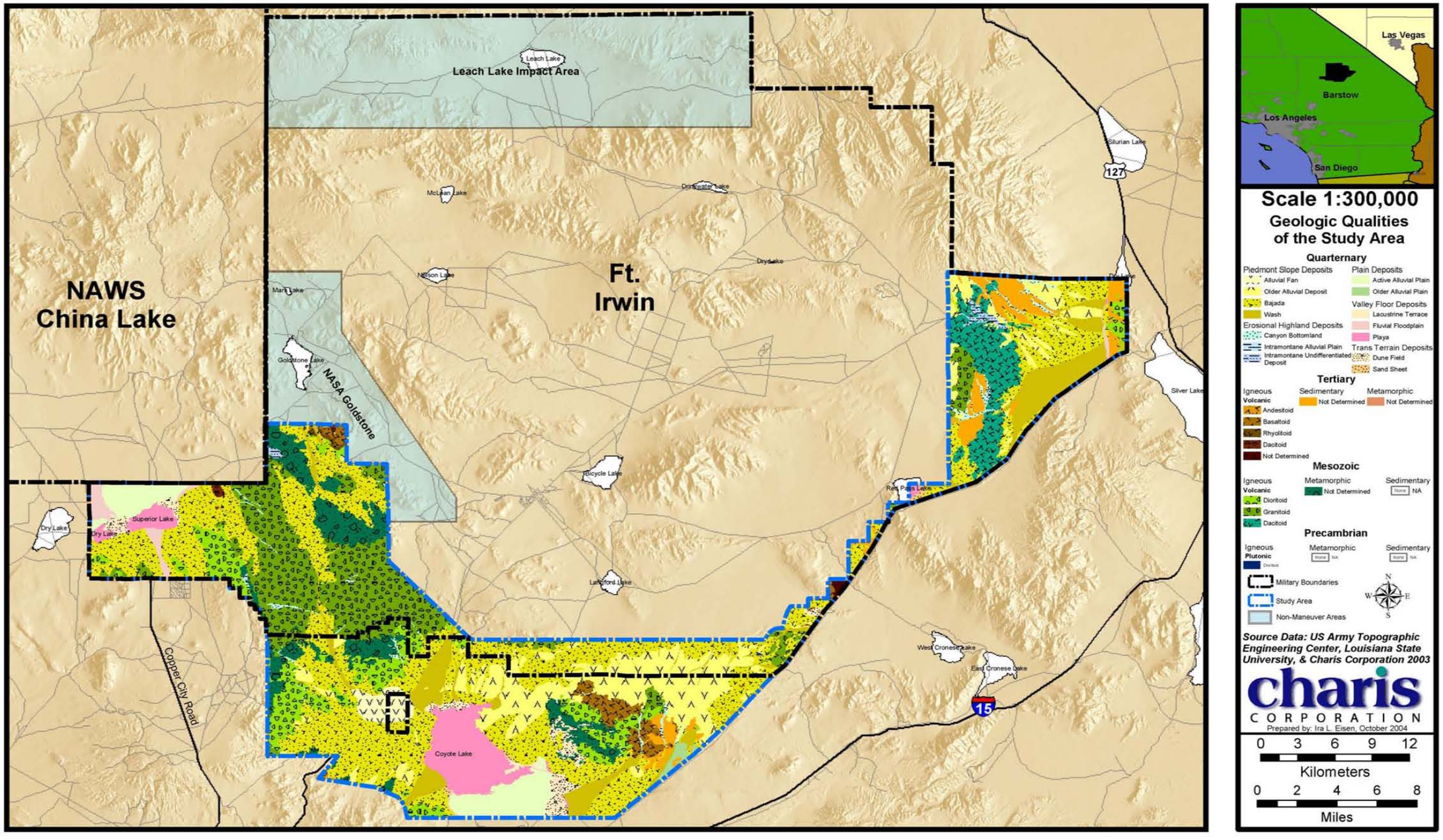

Figure 3.2-1: Geologic Qualities of the Study Area

By the close of the Paleozoic Era, the California desert region was near the edge of the continental shelf. Just off the coast was a chain of volcanic islands. Some interruptions of deposition occurred during the Antler and Sonoran Mountain building periods.

3.2.2.4 Mesozoic Era (230 to 65 million years ago)

During the Mesozoic Era, the region was dominated by three mountain building periods known as the Nevadean Orogeny. The great majority of the exposed granitic mountains seen today in the Mojave Desert were formed during this era. As the magma cooled below the surface, mountain-building forces from the colliding plates caused the plutons to be uplifted above the soil surface. The Nevadean Orogeny represented the end of 1 billion years of marine deposition in the Cordilleran geocline (Norris and Webb 1990).

3.2.2.5 Cenozoic Era (65 million years ago to present)

Recent erosion of the mountains has resulted in the valleys being filled with thousands of feet of sediments. Geologic events such as the connection of Central America and South America 10 million years ago, and the formation of the Sierra Nevada Range 2 million years ago, have resulted in drastic changes in the region's weather. The recent rise of the Sierra Nevada Range and the formation of the Humboldt Current along the California coast have resulted in a reduction in rainfall in the ROI, especially in the summer, and an increase in coastal fog.

Although cinder cones occur only southeast of the ROI, recent lava flows on the surface are common within the ROI. Both rhyolitic and basaltic flows are present. Colorful lake deposits of red, purple, brown, green, and yellow occur from the Mud Hills east to the Calico Mountains. Colorful deposits also occur in the Alvord and Avawatz Ranges. Borax and gypsum deposits are more common to the west and east of the ROI.

3.2.3 Structural Features

The Garlock Fault forms the northern boundary of the Mojave block. The Garlock and San Andreas faults meet near Tejon and form the western boundary of the Mojave Desert. The Garlock Fault is a horizontal left-slip fault, meaning most movement is lateral. The Garlock Fault branches in the western Mojave, with one branch following the base of the Tehachapi Range and the other forming the Tehachapi Valley. The fault branches combine near Red Rock Canyon and form the southern scarp of the El Paso Range.

The Garlock Fault then forms the northern boundary of the Avawatz Range, which is the boundary between the central and eastern Mojave Desert subdivisions. The Garlock Fault has zones of heavy, moderate, and low activity. As much as 40 miles of displacement can be seen just north of the ROI in Searles Valley.

The San Andreas Fault is not within the Study Area but affects the region because it is a right-slip fault. The effect of the two faults moving in the same direction results in the western Mojave block moving eastward, away from the junction of the two faults. Figure 3.2-2 shows the seismic hazards in the region.

Figure 3.2-3 shows the minor faults within the central Mojave Desert. Most of these are buried by alluvium and don't appear to be active. However, as recently as October of 1999, a strong earthquake occurred in the Hector railroad siding area, causing damage and surface displacement just south of the Study Area.

Sandy washes and springs are often evidence of fault zones. A line of springs exists through Paradise, Jack, Garlic, and Bitter Springs. Another exists to the north between Two Springs and Leach Springs, north of the Granite Range. Another row of springs occurs on the east side of the Avawatz Range.

3.2.4 Physiography

For descriptive purposes, the Study Area has been divided into the western, central, and eastern portions. The western portion consists of Superior Valley. The Superior Valley drainage terminates at several playa lakebeds. The Superior Valley drainage is separated from the Paradise Valley drainage by a rise. Most of the mountain ranges and drainage systems here are unnamed.

The central portion includes Paradise Valley, the Alvord Range, and a portion of the main above ground utility corridor. Paradise Valley drains Lane Mountain and the Paradise Range east to Coyote dry lakebed and south from the Alvord Mountains. The lowest point in the central portion drains from Bitter Springs south toward Afton Canyon.

The eastern portion includes portions of two valleys that drain east and south into Silver dry lakebed north of Baker. The Eastgate area is drained by several unnamed sandy washes that become a series of braided washes before emptying into Silurian Valley. Drainage east of the Soda Mountains ends in a sandy valley floor that drains into Red Pass Lakebed. Silurian Valley is separated from this drainage by several minor hills. Minor isolated hills also occur south of the proposed expanded maneuver training area between the utility corridor (See Section 3.12.) and Interstate (I)-15. Washes drain between the hills into the Mojave River system south of the proposed expansion area.

3.2.5 Lithology

The hills within the expansion area are made of various parent materials. The most common is granitic; however, basalts, andesite, and dacite plugs also occur in the western portion. Granitics vary from light-colored diorite to dark-colored gabbros in the southwestern portion. The central portion is dominated by the Alvord Range, which has a complicated lithic history. Many of the hillsides in this region contain carbonates or tuff, with the carbonates continuing east to the Silurian Hills, just east of the Study Area. Multicolored lake deposits can be seen in Spanish Canyon, one of the major drainages in the Alvord Range. The main range in the southeastern portion of the Study Area is the Soda Mountains—a granitic range with some carbonates.

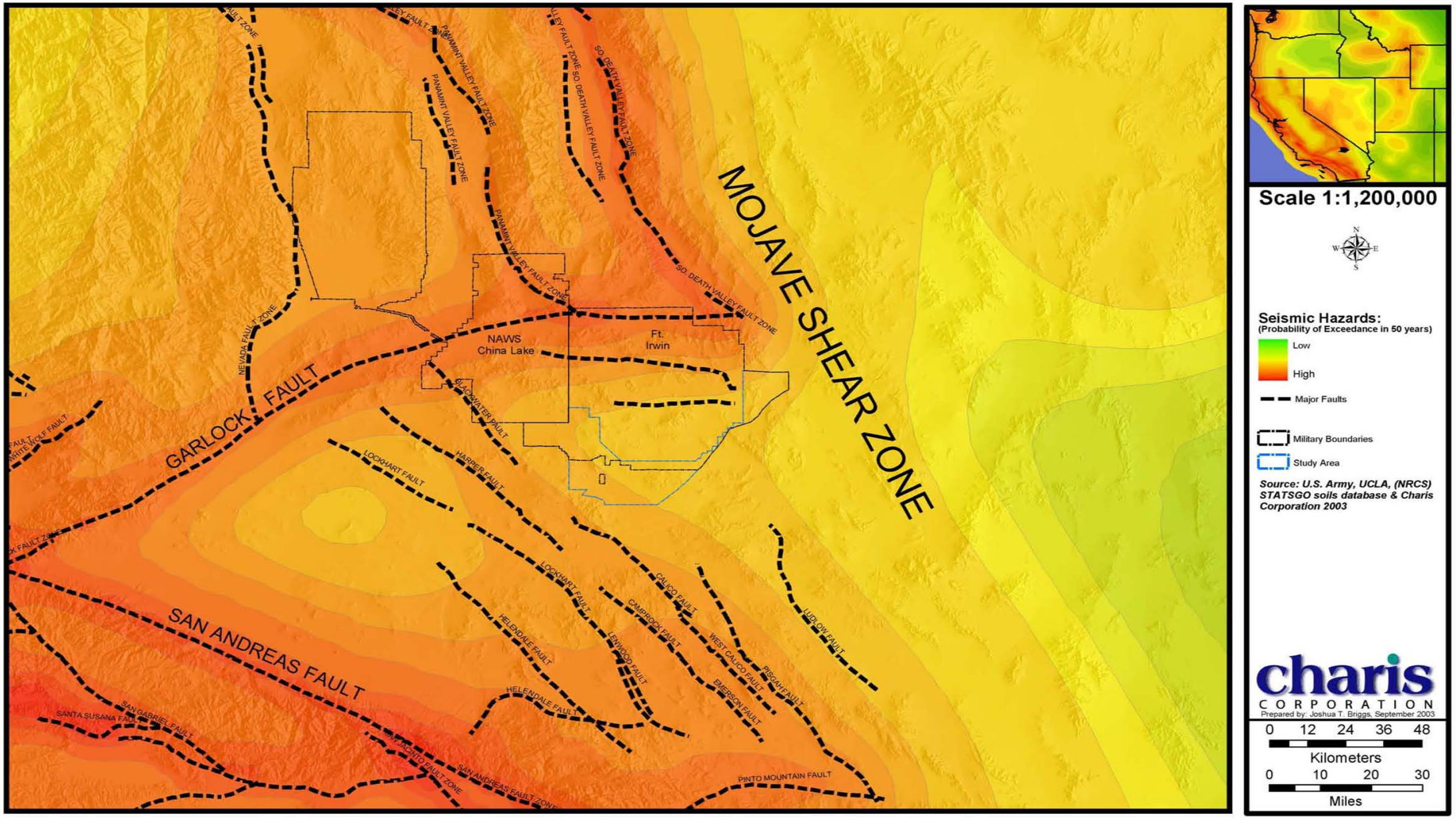

Figure 3.2-2: Seismic Hazards

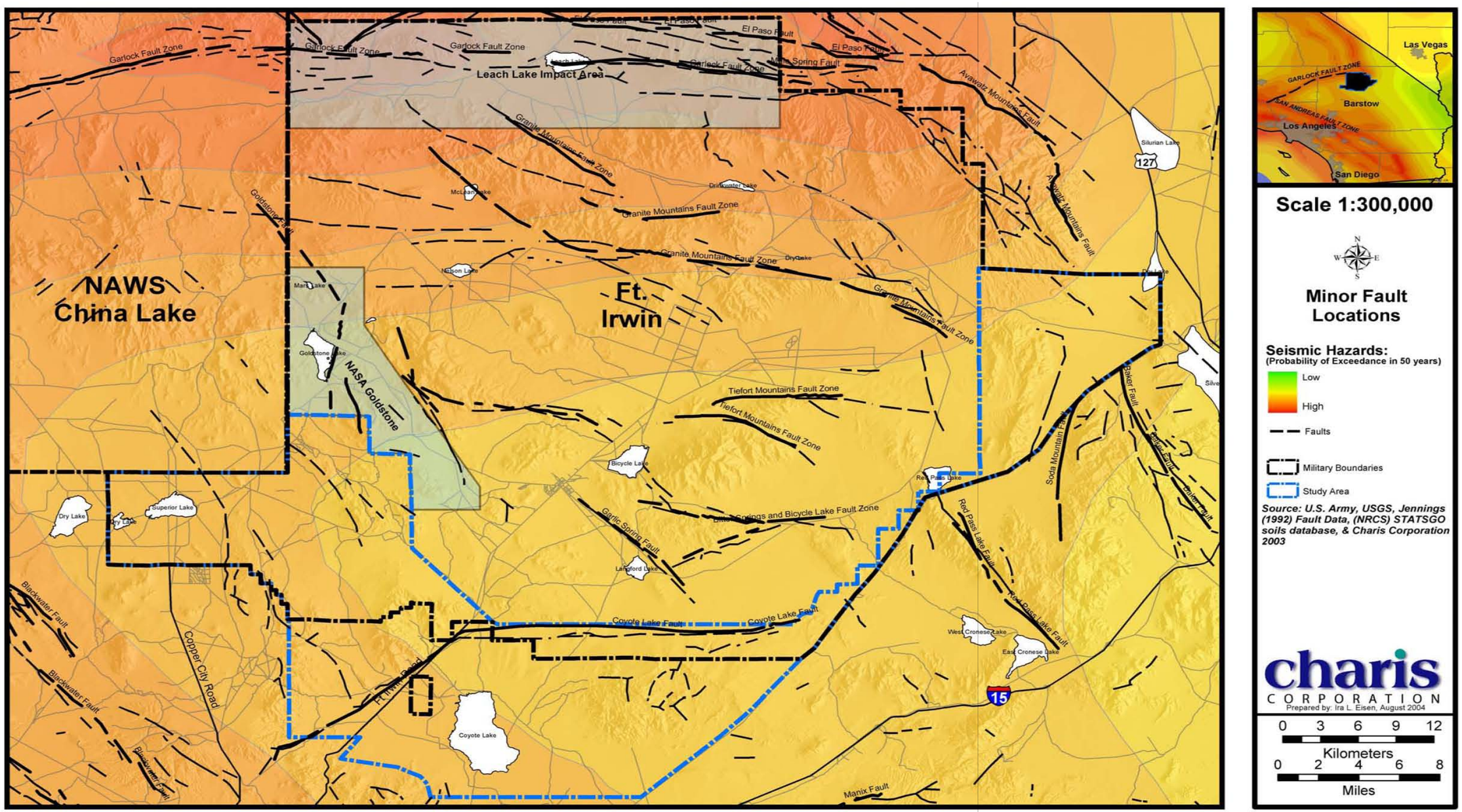

Figure 3.2-3: Minor Fault Locations

Seven basic rock types have been identified within the central Mojave Desert. They are:

1. Precambrian metamorphic rocks
2. Paleozoic marine sediments
3. Mesozoic marine and island arch rocks
4. Mesozoic granitic batholith rocks
5. Older Cenozoic intermediate, explosive volcanics, and freshwater sedimentary rocks
6. Younger Cenozoic freshwater sedimentary and intermediate crustal volcanics
7. Quaternary volcanics and recent unconsolidated sediments

3.3 Soils

3.3.1 Introduction

The ROI for soils is the Study Area. Soils form from erosion and bedrock decomposition. Bedrock breaks down into various-sized particles, ranging from boulders to colloids. Various-sized rocks on the ground surface can form a layer impervious to erosion, unless the surface is disturbed. Over time, a brown varnish often forms on the rock surface. An area containing a surface of rocks coated with this varnish is known as desert pavement.

Particles smaller than rocks are intimately involved in soil formation. The main sizes are classified as sand, silt, and clay. Decomposing organic matter eventually acts as glue, causing clumping of the mineral particles, and is the primary factor in soil structure formation.

Water is the main climatic limiting factor in soil development in the Mojave Desert. Under hot, dry climate conditions and sparse vegetation, a lack of organic matter results in slow soil horizon development. Low rainfall also results in the buildup of highly soluble calcium and sodium salts in the soils' plant root zone. Other toxic chemicals, such as arsenic, selenium, and boron, can also build up in desert soils.

3.3.2 General Desert Soil Characteristics

In general, desert soils found on slopes are coarse-textured, light in color, and well drained. Clay soils that form in playas are fine-textured, darker in color, and poorly drained. Soil structure is poor due to the lack of organic matter; this usually reduces drainage when clay content is high. Desert soils often have chemical surface crusts, caused by lack of leaching action in low rainfall areas.

The average level of downward water movement often results in an impervious subsurface caliche layer that forms by the buildup of calcium compounds. Some desert soils also develop hydrophobic properties, making them slow to wet.

Many native desert plant species develop relationships between the root hairs and bacteria and fungi, known as mycorrhizal relationships. The association of bacteria and fungi with a plant's roots increases the ability of the plant to absorb water, minerals, and non-mineral nutrients. This relationship has been shown to break easily by intense soil surface disturbance (Allen 1991).

Certain areas in the ROI have patches of primitive surface plants that increase the ability of the soil surface to resist erosion by wind or water during windstorms or intense rainfall periods. These patches are combinations of algae and fungi and are known as cryptogrammic, or macrobiotic, crusts. These crusts significantly increase nitrogen cycling in the soil environment and, despite their small size, are important contributors to the nutrient cycling in desert ecosystems. They are also very fragile, and hundreds of years of growth can be fragmented or destroyed by foot or vehicle traffic.

The presence of desert pavement, mychorrhizal relationships, and cryptogrammic crusts contributes to the fragile nature of the desert's soil surface. The sparse vegetation, often intense rainfall, large amounts of sand, and low amounts of organic matter result in desert soils being highly susceptible to erosion.

Topographic variation and differences in parent material are the primary factors in desert soil composition. Most parent material within the ROI is granitic. Granite is made up of several minerals, including quartz, feldspar, and ferromagnesian minerals. These generally break down into decomposed granite and finally form a coarse-textured, well-drained soil. Other, more fine-grained parent materials occur in the ROI, including limestone (carbonates), tuff, rhyolite, and basalt. Soils formed from these parent materials have significantly different properties than granitic soils. These materials are transported and mixed by water and wind, forming a jigsaw puzzle of soil types that transition gradually or abruptly. These changes are mapped as accurately as possible on soil maps at the series level.

Differences in topography cause lighter clay particles to become concentrated in drainless sinks and valley bottoms. Heavier sand and rock material is found on alluvial fans. Rocky hillsides contain thin soils, except as the hillsides progess into the canyons and drainages.

3.3.3 Soil Classification and Mapping

Soil classification is based on a hierarchical system, beginning at the order; progressing through the suborder, great group, subgroup, and family; and ending at the series level. Soil maps become more useful as the detail increases. A description of each soil series is a necessary part of a complete soil survey, which includes measuring the depth of soil layers and describing the soil color, texture, and chemistry. A general description of vegetation and climate conditions is included in soil survey reports, and recommendations are made on the best use of each soil.

Soil classification and mapping is a function of the federal government, and all areas of the U.S. have been mapped, in varying degrees of detail. Soil maps are available to the public from the Department of Agriculture's Soil Conservation Service (SCS), through Agricultural Extension Agent Offices. Soil maps are made by compiling weather data, geology maps, vegetation data and satellite imagery. More detailed data collection includes digging trenches and taking measurements of the different soil layers. The standard soil map for the Study Area is the 1993 SCS State Soil Geographic (SATATSGO) GIS data layer (USGS 1999). It contains units mapped at the series level or contains transitions of two or three soil series together. Figure 3.3-1 shows these soil-mapping units. California, Nevada, and Arizona State SCS offices provided descriptions of each soil series. This information is available on the Internet.

The SATATSGO soils map contains 23 series, grouped into 14 different mapped polygons. Other non-soil units include rock outcrops and sand dunes. The Natural Resources Conservation Agency maps soils at three different scales. In the finest scale, each polygon represents a different soil series. This scale is usually used only in agricultural areas. Much of the Mojave Desert is mapped at a grosser scale, because agricultural uses in the desert are limited, by a lack of water and soil fertility, to grazing and wildlife habitat.

Soil surveys conducted in the Mojave Desert are less detailed than the soil series level. Each polygon on the soils map (See Figure 3.3-1.) contains several soil series. Each series has been determined to occur within the polygon, but the actual boundaries have not been determined. A list of the soil series, acreages, and percentages of each are provided in Table 3.3-1.

Soil description includes listing a portion of its taxonomy or classification. A description of a soil series should include the family, the subgroup, and a description of the soil profile. The family includes the soil texture, the amount of transportation of the elements to the site, and the climate regime in which the soil is formed. An example would include "coarse-loamy, mixed, thermic." The subgroup consists of a two-word description in Latin that lists the specific desert conditions in which the soil formed. For example, lithic means the soil formed under rocky conditions; xerofluvent means the soil formed under dry conditions in a wash environment.

A soil profile is a result of soil formation over time. A series of layers can be distinguished and measured based on differences in color and chemical properties. Typical soils consist of three layers: the A, B, and C horizons. The A horizon is the soil surface and contains the most organic matter. This usually makes the A horizon the darkest. The C horizon is the subsoil and is least affected by weathering. Minor changes within each horizon are labeled as A1, B3, etc. Data collected in the field will measure the width of the layer, its color, soil chemistry, and texture. Layers high in calcium will be noted in the horizon designation, such as Btca.

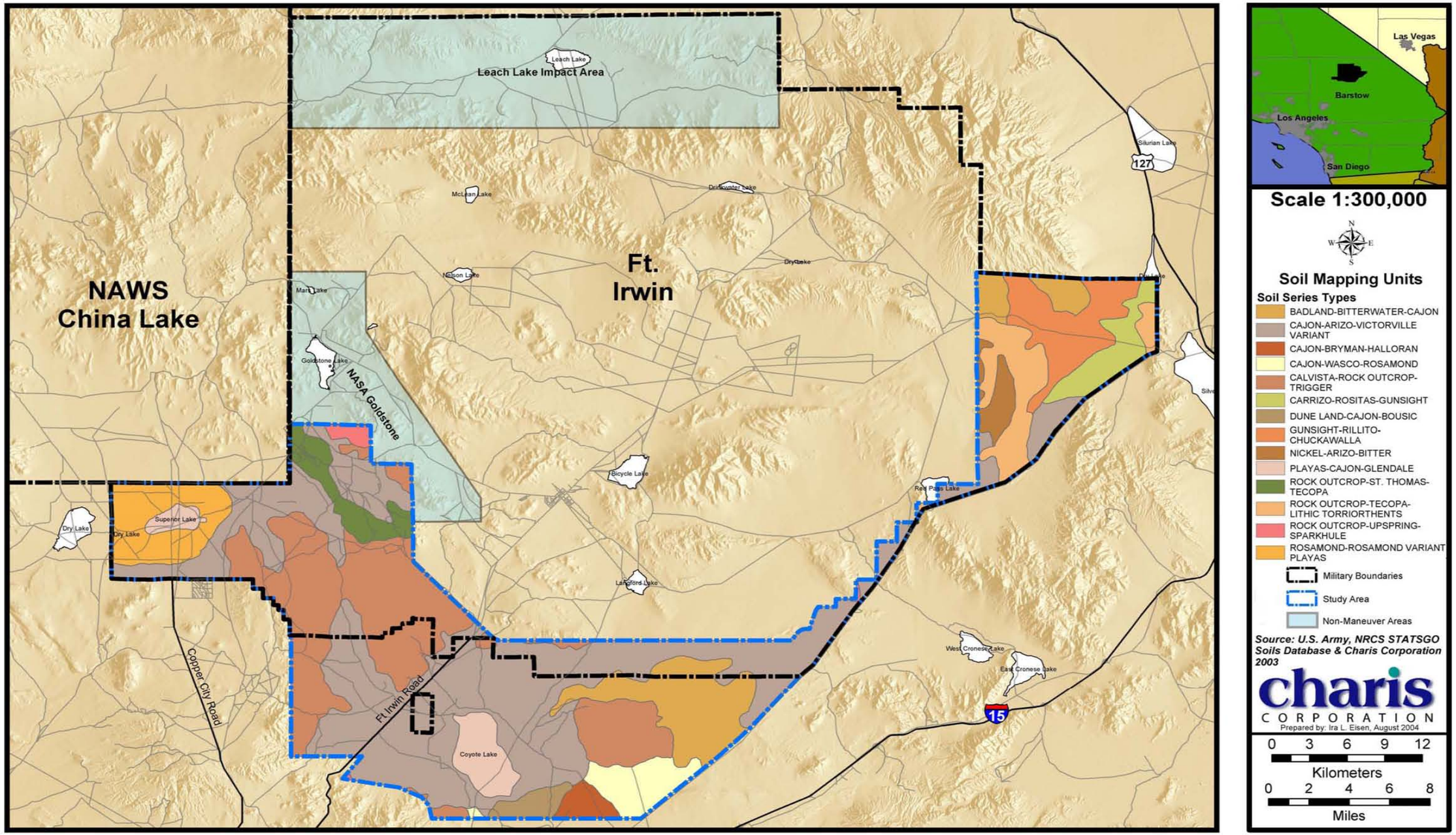

Figure 3.3-1: Soil Mapping Units

Table 3.3-1: Total Acreages and Percentages of Total Coverage of the Study Area, by Soil Series

DOMINATING SOIL SERIES	ACRES	PERCENT
Badland-Bitterwater-Cajon	21,720	9
Cajon-Arizo-Victorville	99,950	40
Cajon-Bryman-Halloran	2,630	1
Cajon-Wasco-Rosamond	7,230	3
Calvista-Rock Outcrops-Trigger	52,100	21
Carrizo-Rositas-Gunsight	6,880	3
Duneland-Cajon-Bousic	2,900	1
Gunsight-Rillito-Chuckwalla	12,650	5
Nickel-Arizo-Bitter	3500	
Playas-Cajon-Glendale	8,020	3
Rock Outcrops-St. Thomas-Tecopa	6,760	3
Rosamond-Rosamond Variant-Playas	12,270	5
Rock Outcrops-Tecopa-Lithic Torriorenth	11,460	5
Rock Outcrops-Upspring-Sparkhule	1,450	1
Total	**249,520**	**100.0**

3.3.3.1 Arizo Soils

The Arizo series was established in Clark County, Nevada in 1971. Arizo soils form on recent alluvial fans, inset fans, fan aprons, fan skirts, stream terraces, and wash floodplains. Arizo soils are a sandy, mixed thermic Typic Torriorthenth, with a gravelly, fine sand surface. They are neutral to strongly alkaline, often with thin lime coatings on the undersides of rock fragments. Arizo soils contain A, C1, and C2 horizons. Rock fragments make up 35-85 percent of the soil. Arizo soils occur between 750-4,500 ft AMSL and form from mixed alluvium. They are excessively drained, with medium runoff and high to very high permeability. They generally support creosote bush scrub vegetation in southern Nevada, California, Arizona, and New Mexico.

3.3.3.2 Bitter Soils

The Bitter series was first described for portions of San Bernardino and Inyo counties in 1979. Bitter soils are deep, well drained soils that form from weathered granite with some metamorphic and carbonate bedrock. Bitter soils form on dissected fan terraces with a slope between 2-20 percent. Bitter soils contain A1, A2, Bt1, Bt2, C1, and 2C2k horizons. Bitter soils occur between 2,500 and 3,600 ft AMSL. They have medium runoff and moderately low permeability. They support creosote bush or Joshua tree woodland vegetation.

3.3.3.3 Bitterwater Soils

The Bitterwater series was first described in the foothills of northwestern Kern County in 1982. Bitterwater soils are deep, well-drained soils that form from sandstone. They occur on hills with slopes between 9-75 percent, between 600 and 2,000 ft AMSL. Bitterwater soils are coarse, mixed, calcareous, loamy Typic Torriorthents. They consist of A121, A122, C1, C2, and C3r horizons. Bitterwater soils are related to several shallower soils from the east side of the southern Central Valley. They have very rapid runoff and moderately high permeability. Bitterwater soils support saltbush scrub and weedy annuals.

3.3.3.4 Bousic Soils

The Bousic series was first described along the Mojave River in 1978. Bousic soils consist of deep, well-drained soils formed in fine-textured alluvium derived from mixed parent material. They are considered fine, mixed, calcareous, thermic Typic Torriorthents. Bousic soils contain Ap, C1, C2, and C3ca soil horizons. Bousic soils occur on basin rim areas adjacent to playas, between slopes of 0-1 percent, and occur between 2,850 and 2,900 ft AMSL. They are related to Lavic and Rosamond soils. Bousic soils have slow runoff and low permeability. Bousic soils are not common and are associated with the Mojave River. Bousic soils support desert sink and shadscale scrub vegetation.

3.3.3.5 Bryman Soils

Bryman soils were first described in Antelope Valley in 1978. Bryman soils consist of deep, well-drained soils formed from granitic bedrock. They occur on terraces and older alluvial fans with slopes between 0-15 percent, between 2,800 and 3,800 ft AMSL. Bryman soils are loamy, fine sands with A11, A12, B1t, B31tea, B32t, B33t, and C horizons. They are fine-loamy, mixed, thermic Typic Haplargids. Bryman soils have slow runoff and moderately slow permeability. They are related to Helendale, Cajon, and Rosamond series and support creosote bush scrub vegetation.

3.3.3.6 Cajon Soils

The Cajon series was first described in 1917. Cajon soils are very deep, excessively drained soils that form from sandy alluvium from mostly granitic bedrock. They are common on alluvial fans, fan aprons, fan skirts, inset fans, and river terraces with slopes of 0-15 percent. This soil series is a mixed, thermic Typic Torripsamment with A, C1, C2, C3, C4, 2C5, 2C6, and 2C7 horizons. Cajon soils occur between 200 and 4,300 ft AMSL from the San Joaquin Valley, east to the Sonora Desert and southern Nevada. Related soils include Adelanto, Arizo, Calcio, Edalph, Goldivide, Gravesumit, Hesperia, Livefire, and Rosamond. They have negligible to low runoff and high permeability. Flooding is rare to never.

3.3.3.7 CalVista Soils

The CalVista series was first described along the border of Los Angeles and San Bernardino counties in 1971. CalVista soils are shallow, well drained, slow runoff, moderately rapid permeability, and derive from granite rock with seams of calcite on mountain ridges on slopes between 2-30 percent. The soils occur between 1,000 and 4,000 feet on mountain ranges. CalVista soils consist of A1, A2, Bk, and R horizons, with

bedrock at depths of 14-20 inches. Gravel and coarse rock fragments are present but do not exceed 35 percent by volume of soil. The soil horizons are weakly expressed, with very little differences between the horizons. CalVista soils support creosote bush scrub and Mojave mixed woody scrub vegetation.

3.3.3.8 Carrizo Soils

Carrizo soils were first described in northwestern Joshua Tree National Park. Carrizo soils are very deep, excessively drained, and form from mixed sources. They occur on floodplains, washes, alluvial fan aprons, and terraces with slopes between 0-9 percent at elevations from 0-2,500 ft AMSL. Carrizo soils are considered mixed, sandy, hyperthermic Typic Torriothents. Carrizo soils contain C1, C2, C3, and C4 horizons and are related to soils from the Salton Sink. They have little runoff and very high permeability. Carrizo soils support desert wash scrub and creosote bush scrub vegetation.

3.3.3.9 Chuckwalla Soils

The Chuckwalla series was first described in Palo Verde Valley in 1971. Chuckwalla soils are very deep, well-drained soils that form in stratified mixed alluvium. These soils are found on fan terraces with slopes of 0-15 percent. Chuckwalla soils are loamy, mixed hyperthermic Typic Calciargids with E, Bat, Bt, Btk, 2Btk2, and 2Ck horizons. Rock fragments make up 35-75 percent of the soil. The surface has a strongly expressed desert pavement with contiguous gravel and a well-developed desert varnish. The undersides of the rocks are stained orange. Calcium carbonate coatings can occur on the rocks or as concretions, pellets, or weak cement. Chuckwalla soils have medium runoff and moderate permeability. Creosote bush is sparse, with some annual cover from woolly plantain and native wildflowers.

3.3.3.10 Glendale Soils

The Glendale series was first described in Arizona in 1946 and consists of very deep, well-drained soils that form from stratified alluvium. Glendale soils form on alluvial fans, floodplains, and stream terraces. They are fine-silty, mixed, superactive, calcareous, thermic Typic Torrifluvents. Glendale soils are well drained, moderately slow permeability and have medium runoff. They occur on slopes between 0-5 percent, between 1,500 and 5,100 ft AMSL. They contain A, Ck1, and Ck2, horizons. Glendale soils are very widespread and support creosote bush scrub vegetation.

3.3.3.11 Gunsight Soils

The Gunsight series was first described in southwest Arizona on stream terraces and fan terraces. Gunsight soils are very deep, excessively drained, strongly calcareous, and form from mixed sources on alluvial fans. They are loamy, poorly developed, superactive, hyperthermic Typic Haplocalcids. They are somewhat excessively drained, have medium runoff, and moderately rapid permeability. Gunsight soils contain A, Bw, Bk1, Bk2, and Bk3 horizons. They form at elevations between 450 and 2,600 ft AMSL on slopes between 1-25 percent. They are related to Rillito and Chuckwalla soils because of their argyllic horizons. Gunsight soils support creosote bush scrub vegetation.

3.3.3.12 Halloran Soils

Halloran soils were first described in the Newberry Springs area and are associated with the Mojave River. They are deep, moderately well drained soils that form from mixed alluvium from granite bedrock. Halloran soils occur on old alluvial terraces and depressions on slopes between 0-2 percent and elevation of 1,800 to 1,850 ft on fans. They are coarse-loamy, mixed, thermic Typic Natrargids that contain A1, B2tca, B3tea, C1, C2, C3, and C4 horizons. They are usually associated with Cajon and Rosamond soils. Halloran soils have slow runoff, moderately low permeability, and pond after flooding. They support creosote bush scrub and four-wing saltbush vegetation.

3.3.3.13 Nickel Soils

The Nickel series is extensive in the southwest and was first described in Clark County, Nevada. Nickel soils consist of deep, well-drained soils that form in alluvium from mixed rock sources. Nickel soils are loamy, poorly developed, superactive, thermic Typic Haplocalcids. They are well drained, low to moderate runoff, and moderately slow permeability. They form on erosional fan remnants and alluvial flats on slopes between 0-35 percent and elevations between 2,000 and 4,000 ft AMSL. They contain Bw1, Bw2, Bk1, and Bk2 horizons and support creosote bush scrub vegetation.

3.3.3.14 Rillito Soils

The Rillito series was first described in southern Arizona and does not occur with related soil series within the ROI. Rillito soils are very deep, excessively well-drained soils that form in mixed alluvium on fan and stream terraces. They are coarse, loamy, mixed, superactive hyperthermic Typic Haplocalcids that contain A, Bw, Bk1, Bk2, and C horizons. The soils are somewhat excessively drained, slow to medium runoff, and moderately permeability. Rillito soils occur on slopes between 0-40 percent and elevations between 400 and 2,200 ft AMSL. They support creosote bush scrub and desert wash scrub vegetation.

3.3.3.15 Rosamond Soils

The Rosamond series was first described in Antelope Valley in 1922. Rosamond soils are deep, well drained, and form from weathered granitic alluvium on the lower margins of fans and playas with a 0-2 percent slope, between 2,200 and 2,900 ft AMSL. They are fine, loamy, mixed, superactive, calcareous, thermic, Typic Torrifluvents and contain C1, C2, 2C3, 3C4, and 4C5 horizons. Rosamond soils are common in the Mojave Desert. They have medium runoff and moderate to moderately low permeability. Rosamond soils support saltbush scrub vegetation.

3.3.3.16 Rositas Soils

The Rositas series was first described in El Centro in 1918 and is widespread. Rositas soils are very deep, excessively well-drained soils that form from sand dunes and sand sheets on slopes of 0-30 percent. Rositas soils are mixed, fine sand, hyperthermic Typic Torripsamments that contain C1 and C2 horizons. They occur from below sea level to 2,000 ft AMSL. They were first described from the Salton Sink. Rositas soils have moderate to negligible runoff and high permeability. They are extensive in the Sonoran Desert and support creosote bush scrub vegetation.

3.3.3.17 St. Thomas Soils

The St. Thomas series was first described along the Colorado-Virgin River Valleys near Overton, Nevada. St. Thomas soils are very shallow, well-drained soils that form from carbonate parent materials. They occur on hills and low mountain slopes between 8-75 percent and elevation between 1,800 and 4,500 ft AMSL. They are loamy, poorly formed, calcareous, thermic Lithic Torriorthents with A, Bk, and R horizons. They have medium to rapid runoff and moderately high permeability. They support creosote bush with galleta grass.

3.3.3.18 Sparkhule Soils

The Sparkhule series was first described in Apple Valley and is associated with the Mojave River. Sparkhule soils are shallow to rocky and form from volcanic (basalt, andecite, and dacite) and granitic parent material. They are loamy, mixed, superactive, thermic Lithic Haplargids that occur on hillsides with slopes between 5-50 percent at elevations between 2,300 and 4,500 ft AMSL. Sparkhule soils are well drained, have high to very high runoff, and moderately slow permeability. They contain A, Bt12, Bt2, Bt3, and R horizons. Sparkhule soils support Joshua tree woodland and creosote bush scrub.

3.3.3.19 Tecopa Soils

The Tecopa series was first described in Inyo County. Tecopa soils are very shallow and form from metamorphic bedrock. Up to 75 percent of the soil's surface is covered with gravel and cobbles. Tecopa soils contain A12, C1, C2ca, and R horizons. Tecopa soils are loamy, poorly formed, mixed, superactive, calcareous thermic Lithic Torriorthents that form on low hills and mountain slopes between at elevation 1,500 and 5,000 ft AMSL. The depth to bedrock is 2-10 inches. They are related to St. Thomas, Arizo, and Bitter soils and support creosote bush scrub and Joshua tree woodland.

3.3.3.20 Trigger Soils

The Trigger series was first described along the Mojave River and is very limited in extent. Trigger soils are shallow, well-drained soils that form from sedimentary rocks on uplands with slopes between 5-50 percent at elevations between 2,400 and 3,800 ft AMSL. They are loamy, mixed, superactive, calcerous, thermic Lithic Torriothents with A1, A1, Bk, and R horizons. They are related to Cajon and Sparkhule soils and are limited to the Mojave Desert. Trigger soils have moderate to rapid runoff and moderately high permeability. Trigger soils support creosote bush vegetation.

3.3.3.21 Upspring Soils

The Upspring series was first described on plateaus, hills, and mountains in Saline Valley in Inyo County. Upspring soils are very shallow, excessively well-drained soils that form from basalt and other igneous and pyroclastic rock. They are loamy, poorly formed, mixed, calcareous, thermic Lithic Torriorthents with A1, A2, Bk, and R horizons. They form on slopes between 8-75 percent at elevations between 1,600 and 4,400 ft AMSL. They form near lava flows in Northern California, where they are fairly extensive. Upspring soils support shadscale scrub vegetation.

3.3.3.22 Victorville Variant Soils

Victorville soils were first identified off Stoddard Valley Road in 1978. They are deep, moderately well drained soils that form from mixed alluvium, primarily from granitic bedrock. They are coarse-loamy, mixed calcareous thermic Mollic Torrifluvents, and contain Ap1, A12, C1ca, C2, and C3 horizons. They form on low river terraces and flood plains with 0-2 percent slopes at elevation between 2,200 to 2,800 ft on fans. Victorville soils have medium runoff and moderately high permeability. Victorville soils support meadow and riparian vegetation. Much of this soil type is now used for agriculture.

3.3.3.23 Wasco Soils

The Wasco series was first described near Wasco in the Central Valley. The ROI does not contain related soils. Wasco soils are very deep, well-drained soils that form in mixed alluvium derived from granitic bedrock. Wasco soils form on recent alluvial fans and floodplains with slopes of 0-5 percent and elevation between 225 and 3,700 ft AMSL. They are coarse loamy, mixed, superactive, nonacid, thermic, Typic Torriorethents with Ap1, Ap2, C1, and C2 horizons. They are well drained, negligible to very slow runoff, and moderately rapid permeability. Wasco soils were historically considered Hesperia soils, but today Wasco soils are divided into warm and cool phases. The cool phase occurs in the Mojave Desert. Wasco soils support saltbush vegetation.

3.3.3.24 Shallow Bedrock Soils

Lithic Torriorthenths are too rocky to be described as a soil series. Lithic Torriorthenths generally occur between rock outcrops in small, depressed areas on relatively stable hillsides with slopes between 15-50 percent. They are shallow to very shallow and are intricately intermingled with the rock outcrops. They range in texture from sandy loam to very gravelly sands. Permeability of the unit is high to very high. Runoff is moderate to rapid, and the water erosion hazard is high.

3.3.3.25 Playa Soils

Clay playas are very poorly drained flats and closed basins at elevations from 1,700-3,250 ft AMSL. Many are also high in soluble chemicals, such as sodium and calcium. This occurs because, after being dissolved and transported to the lakebed by storms, most of the water evaporates, leaving the salts on or near the surface. Playa surfaces lack vegetation or contain only saltbush scrub and become unstable with the use of tracked vehicles. Playa soils have low permeability and medium runoff, and the erosion hazard is high when the soils are dry. Playas recover from damage to a certain extent after rains fill the lakebeds, but are nevertheless off-limits to military vehicles due to erodibility.

3.3.4 Soil Erodibility

Soil series vary in their ability to erode after the surface has been disturbed. The SCS has rated each soil series as low, moderate, or high erodibility. The Army has predicted the amount of soil surface disturbance within the Study Area, based on what has occurred on Fort Irwin. An estimate of the acreage of land that will be subjected to low,

moderate and high disturbance, in relation to erodibility, can be found in Table 3.3-2. The location of maneuver intensity and erodibility levels are shown in Figure 3.3-2.

Table 3.3-2: Relationship Between Predicted Military Use and Erodibility Acreage

EROSION POTENTIAL	NO USE (OFF-LIMITS)	LOW USE (ACRES)	MODERATE USE (ACRES)	HIGH USE (ACRES)
Low	2,740	2,600	17,930	3,270
Moderate	21,500	24,150	44,640	105,180
High	8,840	0	10,500	8,170
Total	**33,080**	**26,750**	**73,070**	**116,620**

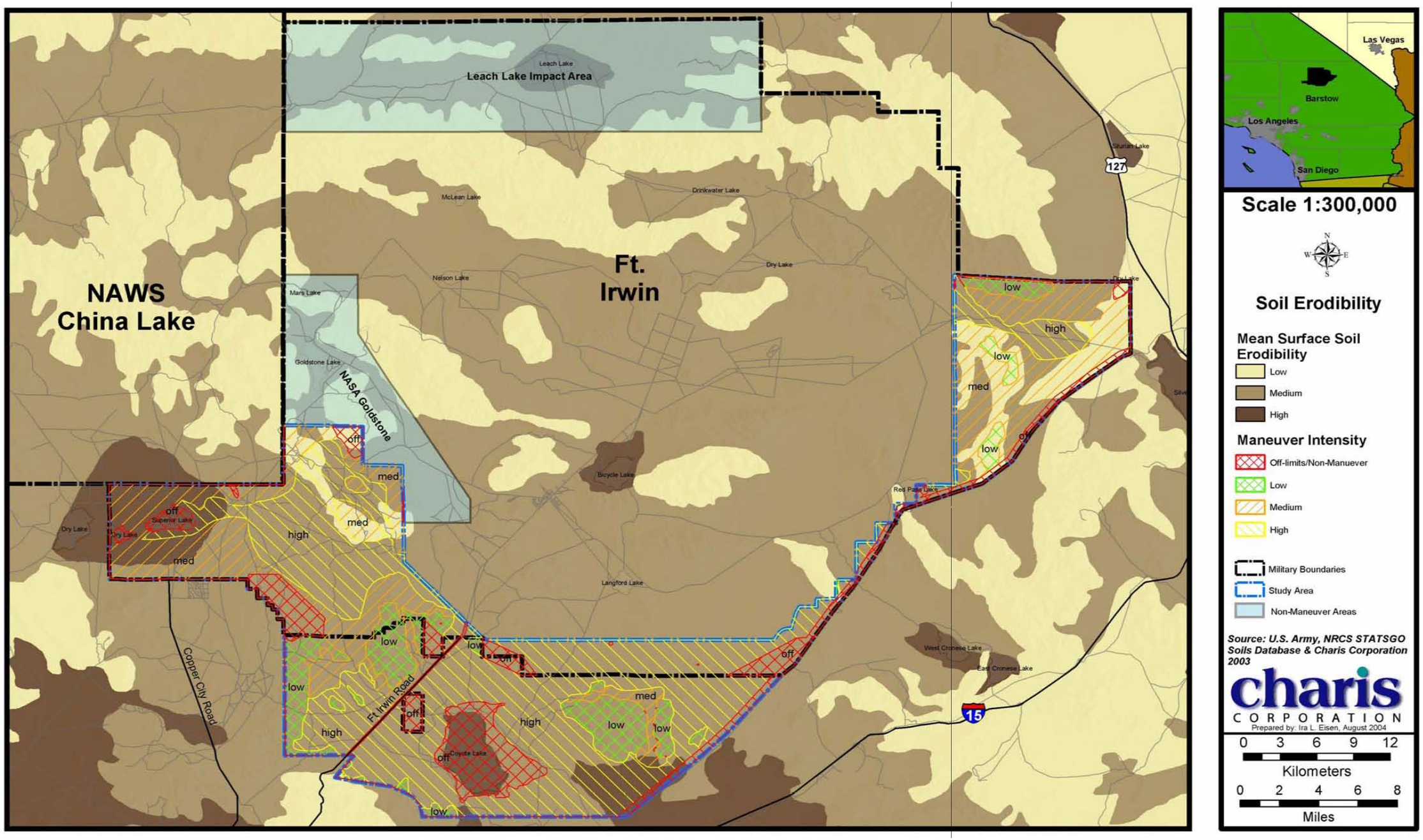

Figure 3.3-2: Soil Erodibility

3.4 Water Resources

3.4.1 Surface Water

The ROI for water resources consists of all ground water basins in the Study Area and the Mojave River drainage, which flows in an easterly direction to its termination at Soda Lake, a few miles southwest of Baker, CA. Surface water sources within the Study Area are scarce due to annual average rainfall being approximately 3.85 inches. Washes descending from elevated landforms form intermittent channels that runoff into playas where temporary lakes form. This type of water accumulation occurs about once every 10 years during greater than average precipitation. During heavy runoff, subsurface flows may occur. Local groundwater recharge may occur along washes due to subsurface water movement. Without a drainage outlet, surface water in shallow ephemeral lakes is lost through groundwater percolation and/or evaporation.

Small springs within the Study Area offer isolated and limited pockets of perennial surface water, but none are of sufficient size to sustain perennial surface watercourses (Chambers 2000). Dry lakes occur within the Study Area. The region contained water during the ice ages and became dry during the interglacial periods. Dry lakebeds do not provide water resources.

3.4.2 Groundwater

Groundwater is stored within the soils and rock strata in the Study Area. Recharge to aquifers underlying the ROI occurs through direct infiltration of precipitation, subsurface flow from adjoining valley groundwater basins, and runoff. Subsequent infiltration of flash flood waters originating in the surrounding mountainous areas also recharges aquifers.

Water-bearing units in the ROI can be broadly divided into two main types: consolidated material (rock) and unconsolidated deposits or sediments (sand, gravel, etc.). The capacity of rocks and sediments as sources of groundwater is extremely variable. The porosity of a rock or sediment is a measure of the percentage of space in the material. Porosity may be as low as 1-3 percent in granitic rock or greater than 50 percent in some sediment. Sediments form the valley floor and contain most of the groundwater that is stored in the area. Consolidated rocks form the surrounding mountains, hills, and aquicludes (impermeable layers which retard groundwater movement) underlying the sediments on the valley floor. Natural groundwater recharge is estimated to be approximately 150 acre-feet per year. Most of the recharge is thought to occur along the margins of the basin or through the channels of washes, following heavy rains. Little recharge occurs on the valley floor (USACE 2002a).

The California Department of Water Resources has divided the state according to major groundwater drainage basins (Chambers 2000). Portions of the Study Area fall within the following groundwater basins:

- Superior Valley Basin
- Coyote Lake Basin/Coyote Basin

- Langford Valley Basin/Langford Basin
- Cronese Valley Basin
- Red Pass Valley Basin
- Riggs Valley
- Goldstone Valley Basin
- Silver Lake Valley Basin
- Lower Mojave River Valley Basin

A number of water wells have been drilled on Fort Irwin; however, few are currently producing water. Bicycle, Irwin, and Langford Basins supply water to Fort Irwin. Coyote Basin may be developed in the future as a groundwater resource for the NTC (USACE 2002a). Figure 3.4-1 illustrates hydrologic resources in the Study Area, including Fort Irwin.

3.4.3 Wetlands

Field investigations conducted by Fort Irwin DPW have identified wetlands, under the EPA definition of wetlands. Section 404 of the Clean Water Act is not applicable, as there will be no impacts to these areas (33 U.S.C. §1251 *et seq.*).

3.4.4 Water Quality

Due to limited development in the Study Area, few studies of water quality have been conducted in the region. No known contamination exists in the surface water of the Study Area. A 2002 Environmental Baseline Study conducted by Charis Corporation found no existing threat of contamination to springs or wells in the Study Area (Charis 2002a).

3.4.5 Water Rights

Surface and ground waters flowing in subterranean streams with a known or definite channel, or known to be inflow or outflow from a spring, are subject to the application and appropriation through the State of California, State Water Resources Control Board (SWRCB). Appropriations for water rights on Fort Irwin property, through application, permit, or license are not indicated by the SWRCB. Underground water not flowing in subterranean streams is not subject to SWRCB jurisdiction. Owners of lands overlying a groundwater basin or other common sources have the right to withdraw water for reasonable, beneficial use on their overlying lands. The right of each owner is equal and correlative to the right of all other owners similarly situated. In the case of insufficient water supply, the available supply is equally appropriated among owners of overlying lands. Surplus water, which may be withdrawn without creating an overdraft on groundwater supply, may be appropriated for use on overlying lands (CEPA 2003). Fort Irwin has water rights to water on property owned by Fort Irwin; any potential use of percolating groundwater in the expansion area would be limited to use by the Army.

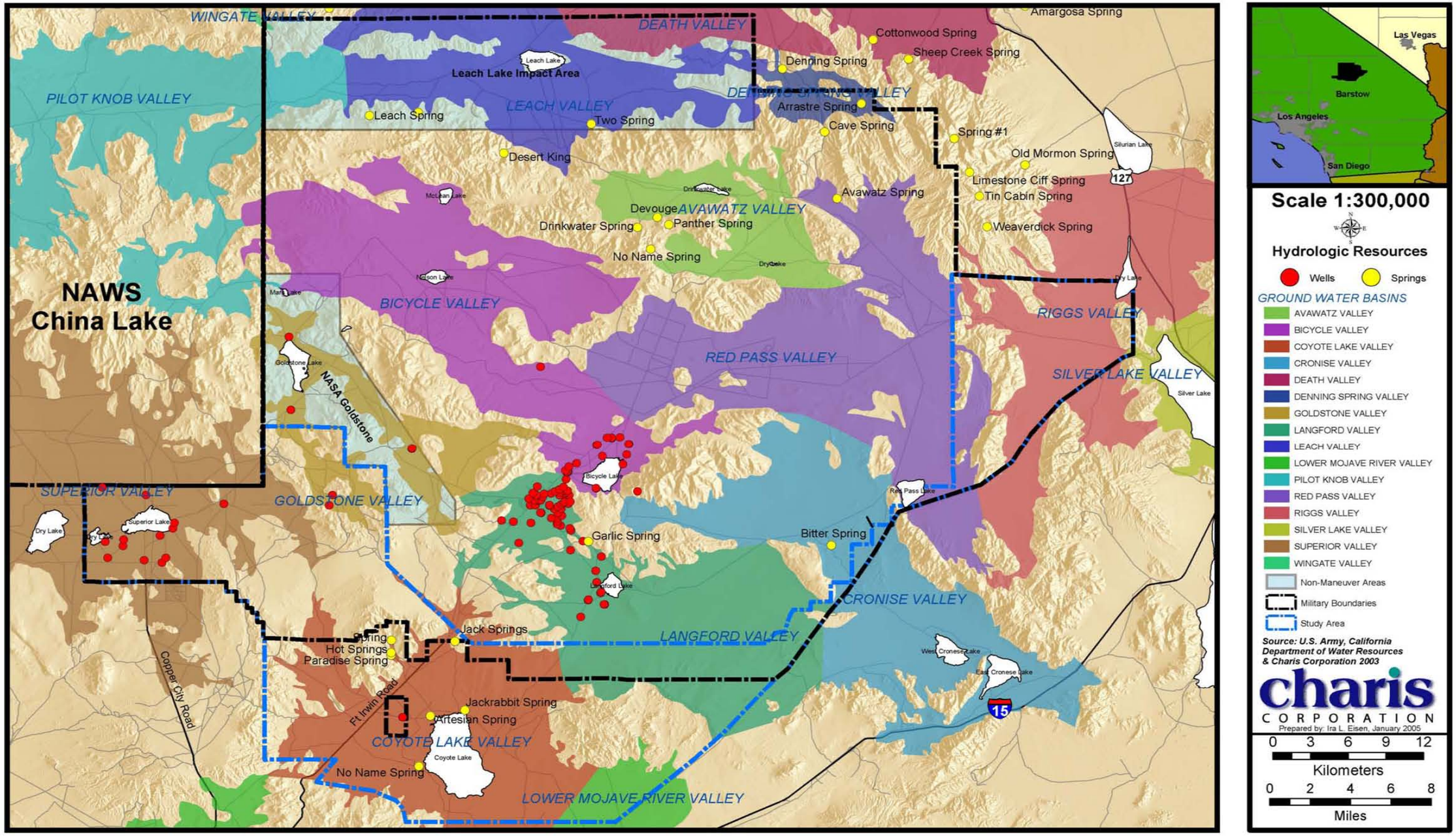

Figure 3.4-1: Hydrologic Resources

3.5 Biological Resources

The Study Area occurs within the western Mojave Desert. The Mojave Desert is the ROI for this section. Low, widely spaced shrubs dominate vegetation in the Mojave Desert (Vasek and Barbour 1977). The species composition of the Mojave Desert has common elements with the Great Basin to the north and many succulent species common to the Sonoran Desert to the south and east. The most widely distributed plant is the creosote bush *(Larrea tridentata),* which covers extensive areas in nearly pure stands, often in close association with burrobush (*Ambrosia dumosa*).

The ROI has a variety of natural vegetation communities and landscape features that offer a diversity of wildlife habitat types. These habitat types are defined by a number of distinct landscape features, such as washes and gullies, rock outcrops, cliffs and talus slopes, cave entrances, springs, and seeps. All contribute to the diversity and abundance of wildlife in the area, as they generally provide a microhabitat for wildlife uniquely adapted to, or dependent on, these features. Most wildlife species within the ROI are adapted to extreme drought conditions, including sparse vegetative cover and limited sources of permanent water. Seeps and springs provide perennial sources of water and a high concentration of vegetation and cover that contribute to increased wildlife diversity in these areas. A variety of invertebrates, reptiles, birds, and mammals occur within the ROI.

A detailed description of Biological Resources in the preferred alternative, Alternative I, is described in the *Biological Assessment for the Proposed Addition of Maneuver Training Land at Fort Irwin, CA*, which is incorporated herein by this reference (Charis 2003a). This document was forwarded to the USFWS on July 3, 2003, with a request for formal consultation under Section 7 of the ESA. An addendum to the Biological Assessment (BA) was forwarded to the USFWS in October 2003 and included the results of a 2003 Lane Mountain milk-vetch pollination study. A No Jeopardy/No Adverse Modification was received during Section 7 Consultation. The BA and addendum can be found in Volume II, Appendix B, and the BO can be found in Volume II, Appendix C. These documents contain details regarding federally listed threatened and endangered species that the proposed project may affect.

3.5.1 Sensitive Species Definitions

The term “sensitive species” is applied to plants or animals that, due to certain manmade or naturally occurring factors, agencies responsible for management and resource protection believe require special monitoring, consideration, and/or management. The following designations are considered sensitive species and are referred to throughout the document: BLM Sensitive, California Native Plant Society (CNPS) List 1B and List 2, state species of special concern, federal species of concern (FSOC), state listed threatened and endangered and federal listed threatened and endangered, and those proposed or candidate for federal or state listing.

The BLM defines sensitive species in the BLM Manual, Section 6840, as “those species that are: 1) under status review by the USFWS/National Marine Fisheries Service; or 2)

whose numbers are declining so rapidly that federal listing may become necessary; or 3) with typically small and widely dispersed populations; or 4) those inhabiting ecological refugia or other specialized unique habitats." There are two conditions that must be met before a species may be considered as BLM sensitive: 1) a significant population of the species must occur on BLM administered lands and 2) the potential must exist for improvement of the species' condition through BLM management. Most species covered in this document that are assigned BLM Sensitive status also have assigned state and/or federal status.

The CNPS is a statewide, non-profit organization that is dedicated to the preservation of California's native flora. The society has created and maintains a CNPS Inventory of *The Rare, Threatened, and Endangered Plants of California*. The CNPS Inventory contains five lists that categorize plants according to the degree of concern. List 1B and List 2 plants are addressed in this document. List 1B includes plants that are rare, threatened, or endangered in California and elsewhere. List 2 includes plants that are rare, threatened, or endangered in California, but more common elsewhere (CNPS 2004).

A State of California Species of Special Concern (CSSC) status, as used by the California Department of Fish and Game (CDFG), applies to plants and animals not listed under the federal ESA or the California Endangered Species Act (CESA), but which nonetheless: 1) are declining at a rate that could result in listing, or 2) historically occurred in low numbers, and known threats to their persistence currently exist. The goal of designating species as CSSC is to halt or reverse their decline by calling attention to their plight and addressing the issues of concern early enough to secure their long-term viability. This designation is also intended to result in special consideration for these animals and to focus attention on the species to help avert the need for costly listing under federal and state endangered species laws and recovery efforts that may ultimately be required. This designation is also intended to stimulate collection of additional information on the biology, distribution, and status of poorly known, at-risk species, and to focus research and management attention on them.

A FSOC is a sensitive species that has not been listed, proposed for listing, nor placed in candidate status. Species of concern is an informal term used by some, but not all, USFWS offices. Species of concern receive no legal protection, and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species. The term indicates that the USFWS has some degree of concern for the future well being of the taxon, but no legal protection under the ESA is afforded.

The CESA is state legislation that establishes the policy of the State to conserve, protect, restore, and enhance endangered or threatened species and their habitat. Endangered species, as defined under CESA, are native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease (CDFG 2003a). Threatened species are native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with

extinction, are likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by this chapter (CDFG 2003a). Candidate species under CESA are species or subspecies that are under review for addition to the list of endangered species or threatened species, or for which a notice of proposed regulation for addition to either list has been published. This document includes both state and federally listed species. State listed species will not be specifically mitigated in this document. Pursuant to the Sikes Act (as amended), such species will be managed by the Fort Irwin Integrated Natural Resources Management Plan (INRMP) (16 U.S.C.§670a-670o).

The ESA, as amended, is federal legislation that protects endangered and threatened species and their critical habitats, and takes steps to recover these species (16 U.S.C. §1531*et seq.*). Endangered species are plant or wildlife species that are in danger of extinction throughout all or a significant portion of their range. Threatened species are those that are likely to become endangered in the foreseeable future. Once a species is listed, all protective measures authorized by the ESA apply to the species and its habitat. Candidate species are plants and animals for which the USFWS has sufficient information to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. Proposed species are those that are proposed in the *Federal Register* to be listed under the ESA. Candidate and proposed species do not receive statutory protection under the ESA; however, conservation measures are encouraged by the USFWS.

3.5.1.1 Methodology for Determining Sensitive Species

The following criteria were used to determine the list of sensitive species covered in the ROI for analysis:

- Species considered in the West Mojave Plan that occur, or have the potential to occur, within the Study Area or a 5-mile zone, an area that extends approximately 5 miles outside of the Study Area boundary;
- Species observed in the Study Area or 5-mile zone, as recorded in the California Natural Diversity Data Base (CDFG 2002b);
- Species that have the potential to occur in the Study Area or 5-mile zone, as determined or suggested by USFWS staff; and
- Species on the *Ventura USFWS Office Listed and Proposed Species that Occur in San Bernardino County, California* that occur or have the potential to occur in the Study Area or 5-mile zone, based on range of the species and location of habitat in the area.

3.5.2 Vegetation

A floristic province is a geographic region with similar plants and general weather conditions. The Study Area is within the central Mojave Desert floristic province (Rowlands et al. 1992). The broadest vegetation classification within a province is

vegetation type, or the plant form of the native dominant vegetation. Vegetation types include grassland, sparse scrub, dense scrub, woodland, forest, and fellfield. Vegetation types that occur in the Study Area are primarily shrubland, with some woodland. Only small portions of the Study Area contain grassland. A plant community is a group of plants that interact and exist under similar environmental conditions. Primary shrubland communities in the Mojave Desert include desert sink scrub, saltbush scrub, creosote bush scrub, Mojave wash scrub, and Mojave mixed woody scrub. Primary woodland communities in the Mojave Desert are Joshua tree and Pinyon-Juniper woodland, and the primary grassland community is alkaline meadow. Vegetation communities in the Study Area include desert sink scrub, creosote bush scrub, desert wash scrub, Joshua tree woodland, Mojave mixed woody scrub, and saltbush scrub.

A series, as defined in this section, is a subdivision of a plant community in which several related dominant species form distinctive variations within the general plant community. The desert sink scrub community and the saltbush scrub community are the only communities in the Study Area that contain several series. The finest (narrowest) vegetation classification is an association. An association is a morphologically uniform group of vegetation that share one or more diagnostic overstory and understory species. An association is described by the name, scientific or common, of the dominant overstory plant species, followed by the dominant understory plant species. However, not all vegetation types in the desert contain both overstory and understory plant species. In these cases, the two most visually dominant plants describe the association. An alliance is a physically uniform-looking group of associations having one or more diagnostic species found in the uppermost stratum of the vegetation. A description and map of the community associations that occur within the Study Area are included in Volume II, Appendix D of this SFEIS.

3.5.2.1 Plant Communities

There are two types of plant communities: zonal and azonal. Zonal communities represent the changes in vegetation from a basin to a mountaintop. Azonal communities are islands of a significantly different plant community within a zonal community, caused by significant differences in soil moisture, soil texture, or bedrock. Azonal communities include springs, seeps, washes, streams, sand dunes and carbonate, or gabbro bedrock.

Vegetation Mapping Classification

Vegetation communities in the Study Area are shown in Figure 3.5-1.

Zonal Plant Communities

Desert Sink Scrub

Desert sink (*Chenopod*) scrub is a uniform to highly variable community rarely containing more than three shrub species. Two series of desert sink scrub were observed in the Study Area and are dominated by inkweed (*Suaeda moquinii*) or alkali goldenbush (*Isocoma acradenia*). Inkweed is the most common member of this community in the western and central Mojave Desert. It is most commonly associated

with desert holly (*Atriplex hymenelytra*), allscale (*Atriplex polycarpa)*, or alkali goldenbush.

Desert sink scrub community consists of members of the Chenopod family that dominate the lower elevations and valley floors of drainless basins in the Mojave Desert and commonly dominate sand dunes adjacent to playa edges. In saline conditions, leaf or stem succulent members, such as inkweed, pickleweed (*Allenrolfea occidentalis*), molly (*Kochia americana*), alkali pink (*Nitrophila occide*ntalis), frankenia (*Frankenia grandifolia*), or greasewood (*Sarcobatus vermiculatus*) dominate as small patches. These species transition with woody shrubs, primarily of the Atriplex genus. The desert sink scrub community occurs around Coyote Lake in the southern portion of the Study Area (Figure 3.5-1).

Saltbush Scrub

Saltbush scrub community is dominated by the following saltbush scrub species: parry saltbush *(Atriplex parryi*), spinescale (*Atriplex spinifera)*, shadscale (*Atriplex confertiflora*), allscale (*Atriplex polycarpa)*, desert holly, or four-wing saltbush (*Atriplex canescens*). The saltbush scrub community is divided into series, based on the dominant saltbush species listed above. Saltbush scrub community is located along a wash in the easternmost portion of the Study Area, at various locations in the southern portion of the Study Area, primarily around Coyote Lake, and in the western portion of the Study Area, primarily around the Superior Lakes (Figure 3.5-1).

Spinescale scrub dominates heavy soils on valley floors of the western and central Mojave floristic zones. Spinescale scrub normally occurs in nearly pure stands but is associated with various other species in limited areas, with one species replacing another as slight changes in topography occur.

Shadscale scrub dominates dry sandy soils on lower bajadas where dune habitats are formed adjacent to dry lakebeds with cheesebush (*Hymenoclea salsola*), galleta grass (*Pleuraphis rigida*), desert alyssum (*Lepidium fremontii*), burrobush (*Ambrosia dumosa)*, and allscale.

Allscale scrub occurs in sterile sandy soils, especially near washes, on rhyolitic rock outcrops, and in disturbed areas on clay playas. It is commonly found around volcanic plugs, where blow sand builds up around the base. Allscale often transitions with shadscale and creosote bush on bajadas where an adequate layer of sand is located. Allscale most often occurs with cheesebush, along long, narrow, sandy washes in the Superior Valley.

This page intentionally left blank.

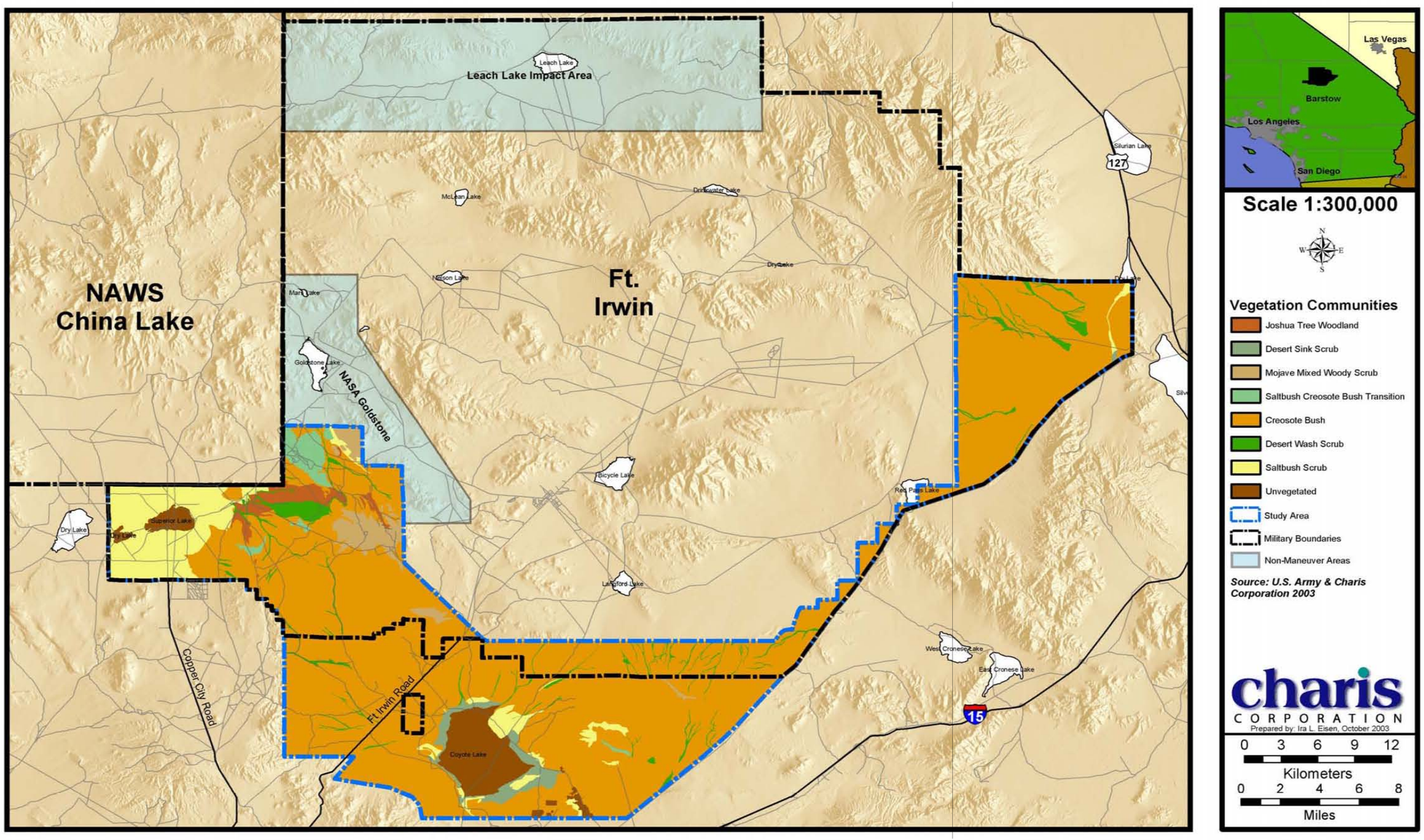

Figure 3.5-1: Vegetation Communities

Four-wing Saltbush scrub is found in deep fluvial or Aeolian sand. It occurs in sand fields with big galleta grass, Joshua trees (*Yucca brevifolia*), cheesebush, goldenheads (*Acamptopappus sphaerocephalus*), felt-thorn (*Tetradymia stenolepis*), peachthorn (*Lycium cooperi*), spiny hopsage (*Grayia spinosa*), and golden cholla (*Opuntia echinocarpa*). This sandfield community usually transitions with creosote bush scrub. Desert Holly Alliance is common at low elevations on hillsides, washes, and in badlands in carbonate-rich soils.

Creosote Bush Scrub

Creosote bush scrub is the dominant upland community on alluvial fans in the Sonora, Mojave, and Chihuahuan Deserts. Creosote bush (*Larrea tridentata*) has a wide ecological tolerance and can occur in rocky or sandy soils and be an important part of the vegetation in either granitic or carbonate substrate. It can make up as much as 70 percent of the vegetative cover of the central Mojave Desert (Prigge 1989a). Creosote bush is relatively tall and broad when compared to other Mojave Desert shrubs and visually dominates the bajadas where it occurs. Creosote bush may be found in pure stands or with various other common and widespread shrubs. Burrobush is the most common shrub found with creosote bush. Other shrub commonly occurring with creosote bush include spiny hopsage, winterfat (*Krashennenikovia lanata*), wolfberry (*Lycium andersonii*), golden cholla, beavertail (*Opuntia basilaris*), Mormon tea (*Ephedra nevadensis* and *E. californica*) and Acton daisy (*Encelia actonii*). The creosote bush scrub community is widespread throughout the Study Area (Figure 3.5-1).

Saltbush-Creosote bush is a transition community that occurs between saltbush scrub community and creosote bush community. It also occurs on carbonate-rich hillsides on upper bajadas at elevations much higher than saltbush associations.

Joshua Tree Woodland

Joshua tree woodland community occurs on upper bajada habitats in the Mojave Desert. The Joshua tree woodland is restricted to the wetter, higher elevations of the Mojave Desert. Joshua trees occur in the upper reaches of the creosote bush scrub zone on deep valley soils or shallower hillsides. Joshua trees can occur as scattered individuals at lower elevations along drainages into saltbush communities near lakebeds. Within the community, the concentration of Joshua trees often increases with an increase in elevation. Joshua trees tend to be smaller when occurring in rocky soils and grow larger in deep sandy soils. The understory shrub diversity also tends to become more diverse in increasingly rocky and sandy soils. The most common understory species are creosote bush and burrobush. In sandy soils, galleta grass and four-wing saltbush become the dominant understory species, which transitions up the bajada to golden cholla, goldenheads, winterfat, spiny hopsage, or shadscale. On rocky ridges, the understory is mixed Mojave woody scrub dominated by Mojave aster (*Machaeranthera tortifolia*), bush buckwheat (*Eriogonum fasciculatum polifolium*), or Pima ratnay (*Karmeria sp.*). The Joshua tree woodland community is in the western portion of the Study Area (Figure 3.5-1).

Azonal Plant Communities

Cheesebush Scrub

Cheesebush scrub community occurs in sandy washes and occasionally in sandy pockets within rock outcrops. This community is not common but occasionally occurs as dense colonies of cheesebush in sand fields. Cheesebush is commonly associated with creosote bush, shadscale, golden cholla, or goldenheads. This community is a seral community in Superior Valley in areas used for cattle corrals. It is expected that non-pioneering species will eventually enter this heavily disturbed area.

Mojave Desert Wash Scrub

Mojave Desert wash scrub community occurs as narrow ribbons of vegetation in ephemeral (lasting only a limited time) water drainages. Three types of washes occur in the Mojave Desert: rocky, gravelly, and sandy. Almost all washes within the Study Area are long, narrow, sandy washes. Some gravelly washes occur near Montana Mine and Eastgate, while rocky washes are very poorly represented within the Study Area. The Mojave Desert wash scrub community occurs in washes in the Mojave Desert. Plant species commonly found within the Mojave Desert wash community include desert senna (*Senna armata*), sandpaper plant (*Petalonyx thurberi*), Mojave indigo bush (*Psorothamnus arborescens arborescens*), California tea (*Ephedra californica*), paper bag bush (*Salazaria mexicana*), and Acton daisy. Mojave Desert wash scrub community is located in washes throughout the entire Study Area (Figure 3.5-1).

Mojave Mixed Woody Scrub

Two types of mixed woody scrub occur within the Study Area, areas with shallow soils due to exposed bedrock and boulder piles. Rocky hillsides are usually a creosote-dominated community that is actually a transition with the mixed woody scrub. The most common and widespread Mojave mixed woody scrub community species is the California, or bush buckwheat. It is commonly found in sterile young soils. Desert trumpet (*Eriogonum inflatum*), Mojave aster, Cliff goldenbush (*Ericameria cuneata*), Cooper's goldenbush (*Ericameria cooperi*), and round leaf rabbitbrush (*Chrysothamnus teretefolius*) are common species generally found in rocky habitats. Species commonly found in rock outcrops include Acton daisy, Cooper's goldenbush, paperbag bush, and bush pea (*Lotus rigidus*). Perennial bunch grasses of the Mojave mixed wood scrub community include desert needle grass (*Acnantherum speciosum*), two species of melic or onion grass (*Melica imperfecta* and *M. frutescens*), Nevada blue grass (*Poa secunda*), three-awn grass (*Aristida* sp.), squirreltail grass (*Elymus elymoides*), and Indian rice grass (*Acnantherum hymenoides*). Mojave mixed woody scrub community is in the southern portion of the Study Area and at four different locations in the western portion of the Study Area, near the current Fort Irwin boundary (Figure 3.5-1).

Freshwater Seep

Freshwater seep, or spring, communities are characterized by a dense growth of perennial herbs, especially sedges and grasses, and are found on permanently moist or wet soils around freshwater seeps (Holland 1986). These habitats are uncommon in the deserts of California. However, there are several freshwater seeps located in the Study

Area. The seeps are dominated by mesquite (*Prosopis* glandulosa) and salt cedar (*Tamarix ramossissima.*), a nonnative tree that has invaded many wetland and riparian communities in the desert. Desert willows (*Chilopsis* linearis) are also common in the freshwater seep associations. Density of the dominant woody species is generally high, with little herbaceous understory.

Several small freshwater seeps occur within the southern portions of the Study Area. These are usually associated with surrounding alkali meadows. They are found at the Artesian Well site (Artesian Spring) and Jackrabbit Spring on the northern end of Coyote Lake, at Jack Spring near the existing Fort Irwin boundary and Fort Irwin Road, and at Paradise Springs at Paradise Mountain. For the location of springs in the Study Area, refer to Figure 3.4-1 (Section 3.4 Water Resources).

Artesian Well and Jackrabbit Spring support cattails (*Typha* sp.) and rushes (*Juncus* sp.). The Jackrabbit Spring complex is also associated with a surrounding area of saturated soils constituting approximately 6 acres.

The Jack Spring area contains two or three small pools of slowly seeping water, surrounded primarily by saltgrass (*Distichlis spicata*). The two largest pools, approximately 4 ft in length and 1 ft in diameter, have been fenced and lined with concrete and contain stagnant water. The remaining pools are less than 1 ft in diameter and may be dry during the hottest times of the year. The spring area has been heavily disturbed, as evidenced by tire tracks, trash, spent ammunition (non-military), and other debris. To decrease disturbance in this area, the Army has removed tamarisk, removed debris, repaired habitat, and erected off-limits signs. Such areas are also considered wetlands, or water of the U.S., by the Federal government.

Paradise Springs, the largest spring complex in the Study Area and possibly in the entire vicinity of Fort Irwin, is almost immediately southwest of the Fort Irwin entrance in a valley in the Paradise Mountains. This spring complex occupies approximately 70 acres. Cemented bathing pools have been developed in two areas, with overflowing water supporting riparian vegetation in the canyon below these pools. The upper springs have not been extensively developed, and outflow continues to pass through the upper wash. Common riparian plant species observed include honey mesquite, black and narrow-leaf willows (*Salix gooddingii* and *S. exigua*), Fremont cottonwoods (*Populus fremontii*), saltgrass, cattails, and the introduced salt cedar. Other species found at Paradise Springs include scaly-stemmed sand plant (*Pholisma arenarium*), hot spring fimbristylis (*Fimbristylis thermalis*), black sedge (*Shoenus nigricans*), Cooper's rush (*Juncus cooperi*), stream orchid (*Epipactis gigantea*), Alkali Mariposa Lily (*Calochortus striatus*), and a thistle (*Circium mohavense*).

Alkali Seep and Meadow

Alkali seep and meadow communities are characterized by a dense growth of perennial herbs, sedges, and grasses. The communities are found on more or less permanently moist or wet soils (Holland 1986). These habitats are scattered throughout the deserts of California but account for only a tiny fraction of the total desert area.

Alkali seep and meadow communities surround the freshwater seeps noted above, as well as in two additional places at the north end of Coyote Lake and at Jack Spring. Characteristic species found in these areas include saltgrass, rushes, yerba mansa (*Anemopsis californica*), common reed (*Phragmites australis*), alkali sacaton (*Sporobolus airoides*), and blue-eyed grass (*Sisyrinchium halophyllum*).

Alkaline Meadow is an azonal grassland vegetation type that occurs at springs and seeps. The saltgrass community is a member of the alkaline meadow vegetation type. Saltgrass is most commonly associated with Mexican wiregrass (*Juncus balticus & J. mexicanus*) and is also associated with parry saltbush, alkali bush aster (*Macheranthera carnosa*), and blunt-leaf stinkweed (*Cleome obtusifolia*). Saltgrass is located on the southwest corner of Coyote Lake in the southern portion of the Study Area.

3.5.2.2 Invasive Non-Native Plants

Invasive plant species are "weeds," or non-native species that have been introduced either accidentally or purposefully into an area. Invasive species are often aggressive and adapted to disturbed areas. They compete with native species for resources, including water, sunlight, and space. Invasive species may become locally dominant within an area. Invasive species in the Mojave Desert are not numerous, but they can form a significant amount of the spring annual biomass. The actual number of invasive species in any one spring is related to the timing and amount of rainfall. Rainfall in December and January tends to favor invasive species, whereas, extremely late rainfall in March, followed by cool weather, tends to result in very little invasive annual seed germination and tends to favor native annual wildflowers. The weeds commonly observed often arrived in North America from Eurasia in crop seed. Most need supplemental water to survive, but some are pre-adapted to relatively sterile soils and the Mediterranean Southern California climate. Invasive annuals can potentially out-compete native annuals due to their ability to sprout after early rains and their lack of a need for mycorrhizal relationships.

The most common and widespread invasive, non-native annual species found in the Mojave Desert include red brome (*Bromus madritensis rubens*), split grass (*Schismus barbatus),* cheat grass (*Bromus tectorum*), red-stemmed filaree (*Erodium cicutarium*), and biennial mustard (*Hirschfeldia incana*). The most recent invasive, non-native species to enter the area is Sahara mustard (*Brassica tournefortii*). Sahara mustard is a weed from the Colorado Desert that has been entering the central Mojave Desert along roadsides and utility corridors.

Certain species of weeds become very common under specific conditions. For example, tumbleweed, or Russian thistle (*Salsola* tragus), can become very common in heavily disturbed, sandy areas in the Mojave Desert. There are two species of tumbleweed common in the Mojave Desert. Tumbleweed can become a dominant weed in disturbed dunes, abandoned agricultural fields, and along road and railroad corridors. Tumbleweed responds well to summer irrigation, and seedlings can germinate after summer storms or man-made floods and irrigation.

There are a large number of invasive weeds that can become locally common as a result of supplemental irrigation within an area. Within the Study Area, disturbed areas of drainage ditches, landscaping, and farm fields can have large populations of as many as 50 species of weeds. These include several species of horseweed (*Conyza sp.*), burgrass (*Cenchrus sp.*), lovegrass (*Eragrostis sp.*), crabgrass (*Digitaria sp.*), sowthistle (*Sonchus sp.*), tumble mustard (*Sisymbrium sp.*), lambsquarter (*Chenopodium sp.*), pigweed (*Amaranthus sp.*), sand-bur (*Ambrosia sp.*), cudweed (*Gnaphalium sp.*), tansy mustard (*Descaurainia sp.*), peppergrass (*Lepidium sp.*), spurge (*Chamaesyce sp.*), plantain (*Plantago sp.*), salt cedar (*Tamarix sp.*), puncture vine (*Tribulus sp.*), rabbits foot grass (*Polypogon sp.*) and several other genera of grasses.

3.5.2.3 Sensitive Plant Species

Table 3.5-1 lists the sensitive plant species within the ROI, excluding those more than 5 miles from the Study Area.

Table 3.5-1: Sensitive Plant Species

Sensitive Species		Protection Status		Potential to Occur or Occurrence in Study Area
Common Name	Scientific Name	Federal	CNPS	
Alkali Mariposa Lily	*Calochortus striatus*	FSOC, BLM - S	List 1B	Located in southwestern portion of Study Area at Paradise Springs
Barstow Woolly Sunflower	*Eriophyllum mohavense*	FSOC, BLM - S	List 1B	Population located less than 5 miles outside of southwestern Study Area boundary
Clokey's Cryptantha	*Cryptantha clokeyi*		List 1B	Populations located in southwestern portion of Study Area
Crucifixion Thorn	*Castela emoryi*		List 2	Population located less than 5 miles outside of southeastern Study Area boundary
Desert Cymopterus	*Cymopterus deserticola*	FSOC, BLM – S, Petitioned for listing found not warranted	List 1B	Population located in the western portion of the Study Area
Lane Mountain Milk-vetch	*Astragalus jaegerianus*	E	List 1B	Populations located in western portion of Study Area
Mojave Monkeyflower	*Mimulus mohavensis*	FSOC	List 1B	Population located less than 5 miles outside of southwestern Study Area boundary.
Parish's Phacelia	*Phacelia parishii*		List 1B	Population located in southern portion of Study Area
Small-Flowered Androstephium	*Androstephium breviflorm*		List 2	Population located in eastern portion of Study Area. Populations located less than 5 miles outside of southeastern Study Area boundary.

BLM-S= Bureau of Land Management sensitive species
E= Endangered species
FSOC= Federal Species of Concern

The **Crucifixion thorn** (*Castela emoryi*) is a species that has been placed on List 2 of the CNPS Inventory. Crucifixion thorn is a seemingly leafless perennial shrub or small tree in the Simaroubaceae family. Plants occur in seasonally moist sites, including washes, non-saline playas, and other drainages (BLM 2002u).

Crucifixion thorn is endemic to the Sonoran Desert and southern Mojave Desert. It is widely scattered in southwestern Arizona, with the westernmost populations occurring in the deserts of southeastern CA. There are several populations in eastern San Bernardino County. A few scattered populations and individuals have been recorded at Lavic, 8 miles west of Ludlow, east of Hector Mine Road in a wash, and at lava beds 25 miles northeast of Daggett. Crucifixion Thorn has also been recorded at the southeast edge of the area at Clark's Pass, east of Twentynine Palms, and at Dale Dry Lake (BLM 2002u). Crucifixion thorn woodland, with a population of approximately 25 plants, is located just a few miles east of the southern portion of the Study Area (CNDDB 2002). The population has been designated as an Unusual Plant Assemblage (UPA) by the BLM (BLM 1999a).

Parish's phacelia (*Phacelia parishii*) has been placed on List 2 of the CNPS Inventory. Parish's phacelia is a small annual of the Waterleaf family (Hydrophyllaceae). Parish's phacelia occurs on sparsely vegetated alkaline flats, generally in dry, cracked mud flats of seasonal pools, such as filled in years of high rainfall (BLM 2002u).

Parish's phacelia occurs in San Bernardino County, California; in Clark, Lincoln, Nye, and White Pine Counties, Nevada; and in Mohave County, Arizona. Parish's phacelia has been observed at three locations in California. Populations at two of these locations are now presumed extinct. The only known existing population in CA, occurs along a string of dry lakes between Manix Trail and Coyote Dry Lake, approximately 12 miles northeast of Yermo. This population is in the southern portion of the Study Area, near the Study Area's southern boundary and the Manix Trail (BLM 2002v and CNDDB 2002). An additional collection near the junction of the utility corridor and Manix trail was verified in 2004 by CNPS. The main population is located over a mile north, on the west side of the lakebeds, approximately a quarter-mile west of the Manix trial. The cracks between the clay polygons are the preferred habitat.

The **small-flowered androstephium** (*Androstephium breviflorm*) is a species that has been placed on List 2 of the CNPS Inventory. Small-flowered androstephium is a white-flowered perennial herb of the Lily Family (Liliaceae). In California, small-flowered androstephium primarily occurs on rises in small populations of 1-10 plants on basin flats and lower bajadas below 2,300 ft AMSL.

Small-flowered androstephium occurs from the deserts of eastern California through southern Nevada. It also occurs in deserts from southeastern Utah to Arizona and western Colorado. In California, this species occurs along I-15, from Midway and Dunn (northwest of Afton Canyon toward Alvord Mountain) to Cave Mountain and Cronese Valley, and in Cadiz Valley, east of Twentynine Palms (BLM 2002u). One population of

small-flowered androstephium occurs in the eastern portion of the Study Area in the southern Avawatz Mountains (CNDDB 2002 and Chambers 1995). During a 1995 Chambers survey, one individual plant was observed at this location. Small-flowered androstephium has also been observed at several locations within a few miles of the southeastern portion of the Study Area. Two of these locations are likely to correspond with populations at sites listed above. Several more are located near State Highway 127, just north of Silver Lake (CNDDB 2002).

Clokey's cryptantha (*Cryptantha clokeyi*) is a species that has been placed on List 1B of the CNPS Inventory. Clokey's cryptantha is a small annual of the Boraginaceae Family. The species' known habitat is in rocky areas. Plants typically occur in gravelly areas of course colluvium substrate and are most frequently found on the upper portions of slopes. The potential distribution of Clokey's cryptantha is located entirely within San Bernardino County. The distribution encompasses an area located just north of Barstow and the I-15, east of U.S. Highway 395 onto the southern half of NAWS China Lake South Range and the eastern half of Fort Irwin (BLM 2002w). Dave Silverman conducted a survey for Clokey's cryptantha in 2001, with a Study Area that included the entire suspected range of Clokey's cryptantha, except for Fort Irwin and the NTC (Silverman 2002). A total of approximately 414,010 plants were estimated for the 20 occurrences identified in the study, of which 8,400 plants were estimated in the expansion area and approximately 405,610 plants on NAWS China Lake. Data collected for the 20 occurrences was used to determine the total number and size of populations in the surveyed area. These occurrences make up an estimated 10 populations, totaling approximately 2.1 million plants and comprising a habitat area of approximately 17,340 acres. Within the western expansion area, the total population size was estimated at approximately 70,400 plants, comprising approximately 1,950 acres. The total population size on NAWS China Lake was estimated at approximately 2 million plants, encompassing approximately 15,390 acres of habitat. Based on collections and extensive potential habitat, a population of more than 10,000 plants, comprising more than approximately 2,000 acres, is expected to occur on Fort Irwin and the NTC (BLM 2002w). The largest population within the western portion of the Study Area extends across the Paradise Range onto Fort Irwin. Three smaller populations were identified, one in the Superior Valley southwest of Goldstone, one in the valley west of the Paradise Range, and one that straddles the boundary between Fort Irwin and the western expansion area north of the Paradise Range (BLM 2002w). Clokey's cryptantha has also been observed outside of the southwestern portion of the Study Area in the Calico Mountains near Irwin Road (CNDDB 2002).

The **alkali mariposa lily** (*Calochortus striatus*) is a FSOC, a BLM sensitive species, and is on List 1B of the CNPS Inventory. Alkali mariposa lily is a perennial of the Liliaceae family. Alkali mariposa lily occurs in calcareous sandy soil in seasonally moist alkaline habitats including alkali meadows, ephemeral washes, vernally moist depressions, and at seeps within saltbush scrub (BLM 2002u).

Alkali mariposa lily is endemic to moist alkaline areas in the arid interior of southern California and southern Nevada. It occurs in the southern Sierra Nevadas; in the western, central, and southern Mojave Desert; at the north base of the San Bernardino Mountains; in the southern San Joaquin Valley; and discontinuously in southern Nevada.

Populations recorded in the region include: the San Bernardino Mountains at Cushenbury Springs and Box "S" Springs; Lucerne Valley (at Rabbit Spring); north of Barstow (which may be the same as the next); Paradise Springs near Fort Irwin; Edwards AFB, north of Lancaster; and Red Rock Canyon State Park (BLM 2002u). Alkali mariposa lily has been observed at springs in the Paradise Mountains in the southwestern portion of the Study Area (CNDDB 2002).

The **Barstow woolly sunflower** (*Eriophyllum mohavense*) is a FSOC, a BLM sensitive species, and has been placed on List 1B of the CNPS Inventory. Barstow woolly sunflower is a small annual in the sunflower family (*Asteraceae*). Barstow woolly sunflower typically occurs in creosote bush scrub that is at times adjacent to, or within, an overstory of Joshua trees and saltbush scrub. It is found in open, flat, barren sites, and is most commonly found on the sandy margins of alkali depressions distributed among the more common creosote bush plant community (BLM 2002u).

The extent of the range of the Barstow woolly sunflower occurs within the west-central Mojave Desert. It is generally found within an area that extends roughly from Edwards AFB in the southwest to the community of Calico (located off of I-15) in the east and near Almond Mountain (east of U.S. Highway 395) in the north. Populations have been recorded near Lead Mountain, Barstow, Stoddard Well, Harper Dry Lake area, Kramer Junction, Boron, Fremont Peak, Almond Cove area, Opal Mountain, and Coolgardie Mesa. The majority of populations occur in the Kramer Junction area (BLM 2002u). All known locations of Barstow woolly sunflower are located south, southwest, and west of the Study Area. The population of Barstow woolly sunflower with the closest proximity to the Study Area is located on Coolgardie Mesa, within a 5-mile zone surrounding the Study Area boundary (CNDDB 2002).

The **Mojave monkeyflower** (*Mimulus mohavensis*) is a FSOC and has been placed on List 1B of the CNPS Inventory. The Mojave monkeyflower is an annual plant and a member of the figwort family (Scrophulariaceae). The Mojave monkeyflower is found in Joshua tree woodland and creosote bush scrub, primarily in granitic soils on gravelly banks of desert washes, in sandy openings between creosote bushes and along badland slopes above washes (areas that are not subject to regular water flows) (BLM 2002u).

The entire range of the Mojave monkeyflower is found within the Mojave Desert of California. Its highest population densities occur in areas just south of Daggett and Barstow. A historic record at Calico Ghost Town represents the northernmost recorded population. The easternmost population occurs at Kane Springs in the Newberry Mountains; however, it is uncertain if the species still occurs at those two sites. The Mojave monkeyflower has not been reported west of the Mojave River. The southernmost population has been recorded at Old Woman Spring east of Lucerne Valley; however, plants have not been observed at this location since 1936. The Mojave monkeyflower was observed in 1992 in the Mitchell Range near Fort Irwin Road, approximately 5 miles north of Barstow. There are numerous existing small populations east of the Mojave River drainage and west of I-15 between Victorville and Barstow (BLM 2002u). All recorded occurrences of the Mojave monkeyflower are outside the Study Area, to the south and southwest.

The **Desert Cymopterus** *(Cymopterus deserticola*) is a BLM sensitive species, a FSOC, and has been placed on List 1B of the CNPS Inventory. The USFWS received a petition to list the desert cymopterus as endangered under the ESA, but, after consideration and analysis, USFWS found that listing was unwarranted. The desert cymopterus is an herbaceous perennial plant in the carrot family (Apiaceae). Desert cymopterus typically occurs on deep, loose, well drained, fine to coarse sandy soils of alluvial fans and basins. It also occurs on stabilized low sand dune areas and occasionally on sandy slopes (BLM 2002u). Desert cymopterus is known to have a highly variable observability from year to year.

Desert cymopterus ranges from Apple Valley northward approximately 55 miles (89 kilometers) to the Cuddeback Lake basin, is San Bernardino County, and westward approximately 45 miles (73 kilometers) to the Rogers and Buckhorn Lake basins on Edwards AFB, in Kern and Los Angeles Counties. However, recent attempts to locate desert cymopterus at historic collection sites in Apple Valley have been unsuccessful. The known extant, or remaining portion of its range, occurs in three adjacent areas: the Rogers Lake basin (including the small Buckhorn Lake area to the west and the Kramer Hills to the east), the Harper Lake basin, and the Cuddeback Lake basin (BLM 2002u).

One population of desert cymopterus is known to occur in the Superior Valley, located in the western portion of the Study Area just south of the NAWS China Lake boundary. Fieldwork in 2004 defined the boundaries of this population. Over 900 plants were recorded during fieldwork. It is estimated that 1,500 plants may occur at this location (Charis 2004).

The **Lane Mountain milk-vetch** (*Astragalus jaegerianus*) was federally listed as endangered on 6 October 1998 (USFWS 1998). The species was first recommended for endangered status in January of 1975. Lane Mountain milk-vetch (LMMV) has appeared in the CNPS Rare Plant Inventory since the list was first compiled in 1968. It is currently on List 1B of the CNPS Inventory. In a decision posted on 8 April 2005, the USFWS designated zero acres of critical habitat for the LMMV (USFWS 2005). The USFWS stated that "... in this final rule, DoD lands at Fort Irwin are being excluded under Section 4(b)(2) for national security" (USFWS 2005). Threats to the LMMV include habitat destruction from dry wash gold mining, rock and mineral collecting, and ORV recreation (USFWS 1998). An in-depth discussion of the biology, range, species status and summary of all available information on the species is included in the *Distribution and Abundance of Lane Mountain Milk-vetch (Astragalus jaegerianus) Report of Spring – Summer Survey 2001* (See Volume II, Appendix I.) (Charis 2002d). Additional studies include a LMMV population survey in 2003, which can be found in Volume II, Appendix J, and a LMMV pollination study in 2003, which can be found in Volume II, Appendix K (Charis 2003b and Charis 2003c). Below is a summary of the findings from these reports.

Lane Mountain Milk-vetch Biological Description

Lane Mountain milk-vetch is a narrowly endemic species in the pea family Fabaceae. The genus *Astragalus* contains between 1,600 and 2,000 species and is considered to be one of the largest genera of flowering plants. Its species are found primarily throughout the northern hemisphere, with approximately 400 species in North America.

Most diversification of the genus has been in arid continental, desert, and Mediterranean climates.

Lane Mountain milk-vetch is a perennial herb, with thin, relatively weak stems that become somewhat woody during the growing season. Plants are usually found growing through and within small desert shrubs. Plants are typically 24 in (60 cm) tall but can be 31 in (80 cm) in height. Leaves are light gray to greenish, sometimes almost dull purple. They are pinnately compound, 1-3 in long (2-6 cm), and have 7-15 narrow leaflets. L-shaped tricomes on the leaves make them look grayish in color. Plant anatomy indicates that the stems are important photosynthetic organs, in addition to the leaves. Flowers are lavender-rose, fading to dull, yellowish-white, and arranged in racemes of 5-15 flowers. Lane Mountain milk-vetch blooms from April to May. Anthidium bees are the major pollinator of LMMV. Anthophora, syrphid flies, and sphinx moths have also been observed visiting the flowers (Charis 2003b). Fruits or pods are small, 0.5-1 in long (16-25 mm) and 0.1-0.2 in wide (3-5 mm). They are cylindrical, non-inflated, and reddish in color. The pods become leathery or stiff papery when mature and split open. Seed dispersal and consumption by native wildlife is unknown.

Research is continuing on the underground parts of LMMV. It is reported that stems arise from a buried root-crown. The root is a long taproot with nitrogen-fixing nodules. The above ground portion of LMMV plants die back each year during summer. It can be assumed that new growth starts either with the onset of winter rains and/or in response to some other seasonal cue, such as temperature or daylight change. It appears that most or all of the above ground plant dies back annually, but in some individuals, new growth starts on stems produced during the previous season(s). There is limited data on longevity, seed dispersal, pollination, herbivory, age structure, or patterns of recruitment of LMMV. Further genetic research is in progress, to determine any genetic variability within the four known populations.

Lane Mountain Milk-vetch Habitat

The physical habitat for LMMV is commonly characterized by shallow soils with granite bedrock near the surface, occurring on gentle slopes in elevations between 3,100 feet AMSL (945 m) and 4,200 feet AMSL (1,280 m). Plants are typically found in patches, often following micro-topographic features such as small ridges.

Plants most commonly grow under and within the canopy of low growing desert shrubs, such as California buckwheat (*Eriogonum fasciculatum* spp. *polifolium*), turpentine broom (*Thamnosma montana*), Mormon tea, and Cooper's goldenbush. A very small percentage of the plants, 3 percent in the Prigge et al. study and 0.5 percent in the Charis study, have been found growing in the open without a shrub canopy (Prigge et al 2001; Charis 2002d). Creosote bush, the most common shrub of the communities in which LMMV is found, is virtually never used as a host plant by LMMV. The effects of the host plant environment on germination and seedling establishment of LMMV are unknown.

Lane Mountain milk-vetch has been found growing within two complementary vegetation types, Mojave creosote bush scrub and Mojave mixed woody scrub. In

both vegetation types, LMMV has been found in areas containing diverse assemblages of small to moderate-sized shrubs and scattered Joshua trees. Plants were most often encountered on shallow ridges where soils were thinner and bedrock much closer to the surface. This suggests that more water was available here as compared to the deep alluvial soils in the intra ridge areas. The physiological measurements of creosote bush (including shoot water potential, assimilation, and transpiration) indicated that LMMV sites had better soil moisture supply than surrounding areas.

Lane Mountain Milk-vetch Range

The discovery and accumulation of knowledge concerning the distribution and abundance of the LMMV are summarized in the Charis LMMV reports, (Charis 2003c and Charis 2002d). Intensive plot and transect surveys by Prigge et al. (Prigge et al. 2000 and Prigge et al. 2001) and Charis (Charis 2003c and Charis 2002d) have covered all areas previously known or suspected to support the species and have resulted in a fairly complete picture of its distribution. Other vegetation work in the region has not resulted in the discovery of additional areas of occurrence, and the investigators most familiar with the plant conclude that it is unlikely that significant new populations will be discovered, although this possibility cannot be ruled out.

Lane Mountain milk-vetch is known to occur in four relatively discrete locations. Each location supports what can be considered a distinct geographic population or subpopulation of the species (IUCN 1994). The populations have been given names, for identification purposes, of Coolgardie Mesa, Paradise Valley, Brinkman Wash – Montana Mine, and NTC-Gemini. Figure 3.5-2 shows total recorded plants and acres of the known populations. The Coolgardie Mesa population is located outside of the Study Area to the southwest. The Brinkman Wash – Montana Mine population is partially located in the Study Area and within the current Fort Irwin boundaries. The Paradise Valley population occurs almost entirely within the Study Area. The NTC-Gemini population occurs entirely within current Fort Irwin boundaries. A portion of the NTC-Gemini population is located on the NASA Goldstone Deep Space Communications Complex, land permitted to NASA for use by the Army. The names and general locations of the areas, other than NTC-Gemini, follow previous usage by the USFWS. Of the four populations, only the NTC-Gemini population was previously unknown. The Coolgardie Mesa population, previously thought to contain approximately 100 plants, was discovered to be the largest known population of the plant, containing nearly 46 percent of the total known habitat.

Surveys for LMMV during the spring and summer of 2001 and 2003 by Charis identified a much larger total population and distribution than was previously known, with a combined distribution of over 22,200 acres (Charis 2002d). Not counting seedlings, a total of 5,744 LMMV plants have been individually recorded and mapped in a geographic information system (GIS) database in non-overlapping surveys (Prigge et al. 2000, Prigge et al. 2001, and Charis 2002d). In 2003, a second LMMV population survey was conducted by Fort Irwin, but it did not significantly alter previous findings for the purpose of analysis or the Section 7 Consultation. Table 3.5-2 presents a breakdown of the findings from these surveys.

Table 3.5-2: Total Recorded Plants and Acreages of Known Lane Mountain Milk-vetch Populations

	NTC-GEMINI	BRINKMAN WASH–MONTANA MINE	PARADISE VALLEY	COOLGARDIE MESA	ALL LOCATIONS COMBINED
Acreage[1]	1,283	5,499	5,316	10,102	22,200
Total Recorded Plants[2]	555	1,487	1,677	2,025	5,744
Transect Acreage	539	2,716	2,026	3,973	9,253
Recorded Plants in Transects[3]	510	1,425	1,556	1,924	5,415
Population Area Covered by Transects	42%	49%	38%	39%	41%
Percentage of Total Known Habitat (approximate)	6%	25%	24%	45%	100%

1 - Total acreage in population polygons.
2 - Mature plants only. Seedlings are excluded from the total. Includes plants from Charis 2003, Chairs 2001, Prigge et al. 2001, and Prigge et al. 2000.
3 - Includes only the mature plants recorded in conjunction with transects surveys of specific areas. Other plants were located on random reconnaissance and were not included in this total.

Population boundaries, as shown in Figure 3.5-2 include every known occurrence of LMMV found during the 2002 study and were constructed so as to depict the species' known distribution reasonably. As discussed in the Charis (2002d) report, a number of considerations led to the reasonable conclusion that less than 100 percent of the plants that were actually present within surveyed plots and transects were detected, tallied, and mapped by the investigators. Because surveyors cannot detect every individual of this cryptic species, the population size was estimated based on the percentage of observed plants, expressed over a range of values.

Without additional information to quantify the actual percentage of plants undetected, the observability factor must be expressed as a range. There are a number of issues relative to LMMV biology, transect design, and surveyor efficiency that must be considered in evaluating the observability factor. Table 3.5-3 shows the estimated population size based on a range of observability. If the data in Table 3.5-3 are adjusted for observability, the estimated total population of LMMV ranges from approximately 13,060 at 100 percent observability to 130,560 plants at 10 percent observability.

Table 3.5-3: Lane Mountain Milk-vetch Population Estimates, Adjusted by Observability

OBSERVABILITY (AS A PERCENTAGE)	NTC-GEMINI	BRINKMAN WASH - MONTANA MINE	PARADISE VALLEY	COOLGARDIE MESA	ALL LOCATIONS COMBINED
100%	1,210	2,880	4,080	4,890	13,060
90%	1,350	3,200	4,530	5,430	14,510
80%	1,520	3,600	5,100	6,110	15,190
70%	1,730	4,110	5,820	6,980	16,320
60%	2,020	4,800	6,800	8,150	18,650
50%	2,430	5,760	8,150	9,770	21,760
40%	3,030	7,200	10,190	12,228	32,640
30%	4,040	9,600	13,590	16,290	43,520
20%	6,070	14,400	20,390	24,440	65,280
10%	12,130	28,790	40,770	48,870	130,560

Environmental factors may increase or decrease LMMV population and habitat size from year to year. Annual rainfall is one environmental variable thought to have an impact on LMMV population and habitat size on a yearly basis. The data provided above is from a survey conducted in 2001. The 2001 season was one of average rainfall, preceded by 2 years of drought. The impact that varying annual rainfall may have on the LMMV population and habitat size is unknown. Consequently, the estimated population in 2001 provides only a single growing season snapshot of a dynamic population.

Lane Mountain Milk-vetch Critical Habitat Designation

On 6 April 2004, the USFWS published the "Proposed Designation of Critical Habitat for Astragalus jaegerianus (Lane Mountain Milk-vetch)" (50 CFR Part 17). The USFWS proposes 29,522 acres as critical habitat for the LMMV. Of this, 15,257 acres are located on Fort Irwin. Figure 4.5-2 shows proposed conservation areas for LMMV and DT layered over the known populations of LMMV.

The USFWS accepted comments on the proposed designation until 7 January 2005. During the comment period, the Army submitted a letter to USFWS requesting that critical habitat not be designated on Fort Irwin due to national security impacts, severe economic impacts, and coverage of the species in the INRMP. By ESA law, if a species is covered by an INRMP, USFWS is not supposed to designate critical habitat on DOD property.

The final designation of critical habitat was published on 8 April 2005. The USFWS designated zero acres of critical habitat for the LMMV due to national security concerns (USFWS 2005).

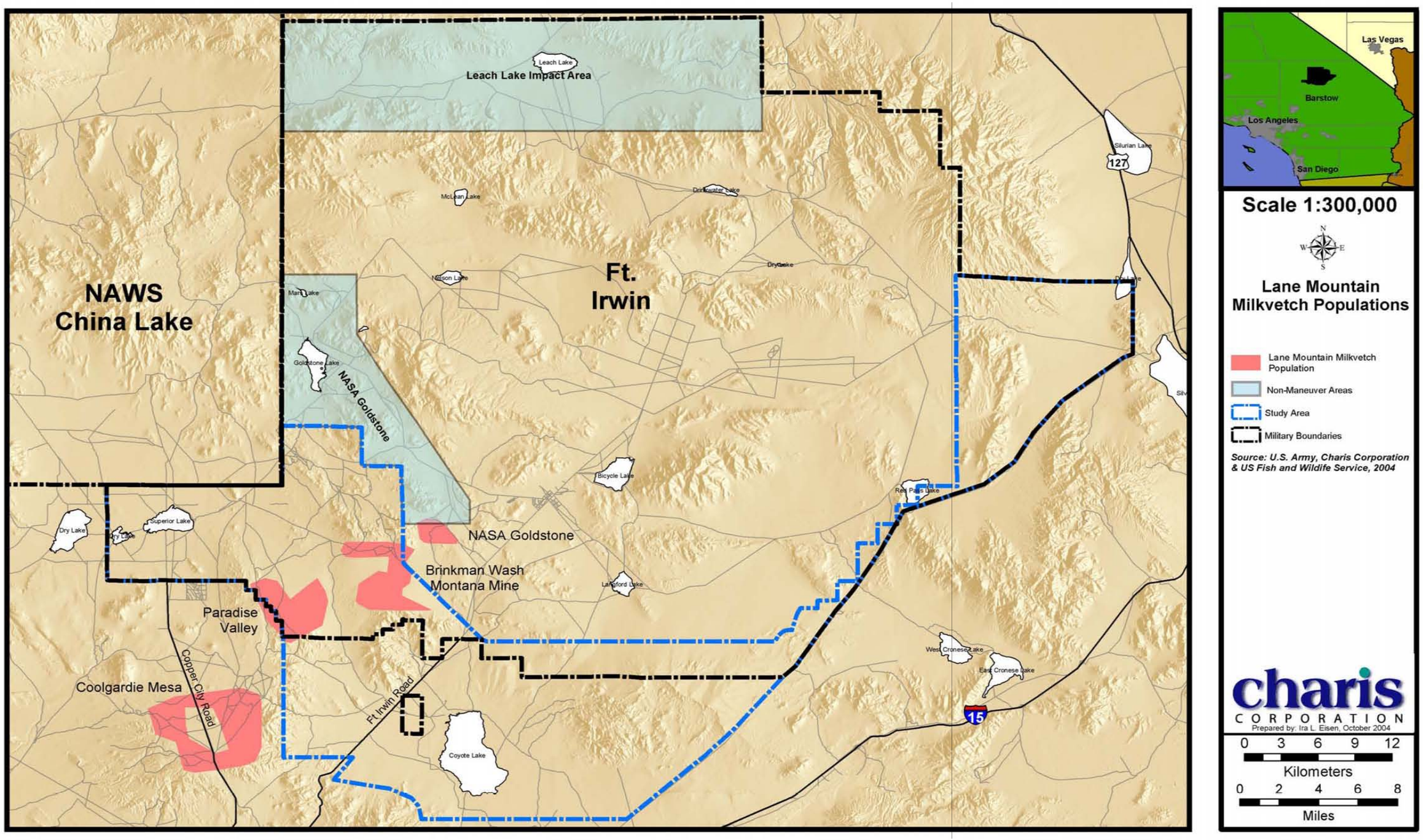

Figure 3.5-2: Lane Mountain Milk-Vetch Populations

3.5.3 Wildlife

Studies conducted in areas south of Fort Irwin include biological studies for the preferred alternative identified in the 1996 DEIS and of the desert tortoise along the northern slope of the Alvord Mountains (MBA 1991). Chambers Group studied the biological resources of the eastern portion of the Study Area in the fall of 1992 (Chambers 1992c). General wildlife studies of the Silurian Valley and vicinity, as well as a survey of desert tortoise populations in the area, were conducted in September and October 1992 (Chambers 1992c; 1992d). Other literature sources referenced for pertinent ecological information include the Peterson field guides to mammals (Burt and Grossenheider 1976); amphibians and reptiles (Stebbins 1985); western birds (Peterson 1990); hawks, eagles, and falcons of North America (Johnsgard 1990); and California's Wildlife, Volumes I thru III (CDFG 1990). The CNDDB was also accessed for information on sensitive wildlife known to occur in the vicinity of the Study Area.

3.5.3.1 Invertebrates

Insects

Several invertebrate species, mostly insects, occur, or are likely to occur, within the ROI. The orthopterans (crickets, grasshoppers, and others) are the most commonly observed insects. Also commonly observed are coleopterans (beetles) and hymenopterans (ants, wasps, and bees). The pallid-winged grasshopper (*Trimerotropis pallidipennis*) is the grasshopper most often observed in the Study Area. Three other Mojave Desert grasshoppers, the creosote bush grasshopper (*Bootettix argentatus*), desert clicker grasshopper (*Ligurotettix coquilletti*), and furnace heat lubber (*Tytthoytle maculata*), also occur within the Study Area, and all are associated with creosote bush. Darkling beetles are the abundant ground-dwelling beetle species within the Study Area. The two most common species are *Cryptoglossa verrucosa* and *Eleodes armata*. Ant species associated with several Mojave Desert vegetation types, including the California harvester ant (*Pogonomyrmex californicus*) and rough harvester ant (*Pogonomyrmex rugosus*), are also common within the Study Area. Butterflies, moths, and skippers are also found in the Study Area. The most common butterfly species observed in the area are painted lady (*Vanessa cardui*), west coast painted lady (*V. annabella*), red admiral (*V. atalanta*), pygmy blue (*Brephidium exile),* monarch (*Danaus plexippus*), and several species of skippers (*Erynnis funeralis, Heliopetes ericetorum, Hylephila phyleus, Hesperopsis libya*), sulphurs, and whites (*Nathalis iole, Pieris rapae*, *Euchloe hyantis*) (Pratt 1999). The ubiquitous cabbage white (*Artogeia rapae*) is found at the alfalfa fields along the Mojave River and may fly over the Study Area. Microlepidoptera, such as yucca moths (*Tegiticula* sp.), are seasonally common in the region when Joshua Trees are in bloom.

3.5.3.2 Amphibians

The only amphibian species observed in the Study Area is the red-spotted toad (*Bufo punctatus)* at Paradise Springs (MBA 1991), in the southwestern portion of the Study Area. They may occur at springs, including those springs that are active for only a portion of the year, and man-made water sources within the Study Area. No other species of frog, salamander, or toad are expected to occur within the Study Area.

3.5.3.3 Fishes

Although there are active perennial springs located in the Study Area, there is no documentation of fish species occurring in any of these springs.

3.5.3.4 Reptiles

The reptilian species observed in the Study Area are characteristic of those found in creosote scrub habitat. Zebra-tailed lizards (*Callisaurus draconoides*), side-blotched lizards (*Uta stansburiana*), and western whiptails (*Cnemidophorus tigris*) are common throughout the Study Area. Other lizard species observed include the desert horned lizard (*Phrynosoma platyrhinos*), long-nosed leopard lizard (*Gambelia wislizenii*), collared lizard (*Crotophytus collaris*), and the desert iguana (*Dipsosaurus dorsalis*). The chuckwalla (*Sauromalus obesus*), a FSOC, was observed in the eastern portion of the Study Area (Chambers 1992b) and in the Alvord Mountains and Goldstone area in the southern and southwestern portions of the Study Area (MBA 1991). It is likely to occur throughout the rocky substrate of the Avawatz, Alvord, and other mountain ranges in the Study Area. The desert tortoise (*Gopherus agassizii*) occurs in varying densities throughout the Study Area. The Mojave fringe-toed lizard (*Uma scoparia*) occurs in the active dune systems and other blow sand habitats in the southern and southeastern portions of the Study Area. Additional information on the desert tortoise and Mojave fringe-toed lizard is presented in Section 3.5.3.7, Sensitive Species.

Sixteen snake species have been documented in the region. The most commonly observed snakes are the gopher snake (*Pituophis melanoleucus*), coachwhip or red racer (*Masticophis flagellum*), Mojave green rattlesnake (*Crotalus scutulatus*), and sidewinder (*Crotalus cerastes*) rattlesnake (MBA 1991, Chambers 1992c, and Charis 2001). Less commonly observed snakes in the area include western patch-nosed snake (*Salvadora hexalepis*), western shovel-nosed snake (*Chionactis occipitalis*), rosy boa (*Lichanura trivirgata*), kingsnake (*Lampropeltis getulus*), and western speckled rattlesnake (*Crotalus mitchellii*).

3.5.3.5 Birds

Birds may have different occurrence patterns; they may be permanent residents, over-winter residents, or nesting residents, or they may occasionally pass through the ROI during migration. The diversity and density of bird species in the Mojave Desert is relatively low, especially at the lower elevations vegetated by saltbush scrub. The low numbers and lack of bird diversity is due to the absence of permanent water sources and lack of a tree overstory that is used by birds for cover and foraging. Seed-eating birds are generally found at lower elevations. The most commonly observed birds in the area include black-throated sparrows (*Amphispiza bilineata*), house finches (*Carpodactus mexicana*), Gambel's quail (*Callipepla gambellii*), ground and mourning doves (*Zenaida macroura*) and other sparrows such as the white crowned sparrow (*Zonotricha leucophrys*) and fox sparrow (*Passerella iliaca*) (Small 1974).

Insect-eating birds are more common at the higher elevations in Joshua tree woodland. Ash-throated flycatchers (*Mylarchus cinerascens*), western kingbirds (*Tyrannus verticalis*), and Scott's oriole (*Icterus parisorum*) are common during spring in

Joshua tree woodland in the Superior Valley, located in the southwestern portion of the Study Area (MBA 1991). Black-tailed gnatcatchers (*Polioptila nigriceps*) and nighthawks (*Chordeiles acutipennis*) are common in the Study Area (Charis 2001). LeConte's thrashers (*Toxostoma lecontei*) have been observed in the Superior Valley area (CNDDB 2002). Loggerhead shrikes (*Lanus ludovicianus*) and roadrunners (*Geococcyx californicus*) have also been observed in the area hunting for lizards and insects. The smaller Mojave race of the raven (*Corvus corax*) forage on road kill and trash or hunt for insects, small mammals, or eggs in the areas around Fort Irwin and the Study Area.

Fall and spring migrants use springs and other sources of water. Riparian and forest dwellers, such as vireos and warblers, may be observed using springs in the ROI during migration periods. Springs are a valuable resource to most resident and migratory bird species. Springs, including the Paradise Springs, in the southwestern portion of the Study Area also support a variety of resident and migratory species (MBA 1991and Chambers 1992c).

Other species of migrants include shore birds, birds of inland waterways, and raptors. Although the numbers are not large, the shear diversity of species is significant. Well over 100 species of birds pass through the Study Area during migration. Costa's hummingbirds (*Calypte costae*) nest in the Mojave Desert, and Anna's hummingbirds (*Calypte anna*) over-winter in the area (Small 1974). Cactus wrens (*Camplylorhynchus brunneicapillus*) use the cholla and Joshua trees in the Superior Valley. Rock wrens (*Salpinctes obsoletus*) and canyon wrens (*Catherpes mexicanus*) use the rocky canyons and boulder piles in the Study Area. Red-tailed hawks (*Falco jamaicensis*) are the most common raptor, while northern harriers (*Circus cyaneus*), golden eagles (*Aguila chrysaetos*), and prairie falcons (*Falco mexicanus*) have also been observed in the area. Hawks and falcons use steep rocky cliffs for nesting sites (MBA 1991and Chambers 1992c). The barn owl (*Tyto alba)* is the most common nocturnal avian predator in the area. It usually roosts in abandoned buildings and large trees on homesteads. Turkey vultures (*Cathartes aura*) may also be observed in the area in the fall during migration. Several species of shore birds may be seen using lakebeds, which often contain standing water after heavy rains. The most common shore birds include black-necked stilts (*Himantopus mexicanus*), long-billed curlew (*Numenius americanus*), and American avocets (*Recurvirostra americana).*

3.5.3.6 Mammals

Numerous mammal species are observed or detected within the Study Area and vicinity. Small mammals are observed throughout the Study Area, including black-tailed hares (*Lepus californicus*) and desert cottontails (*Sylvilagus audubonii*). Hares and cottontails are also a few of the largest and most commonly observed herbivores on valley floors and alluvial fans in the Mojave Desert. Jackrabbits are active at twilight and are commonly seen resting in the shade of shrubs during the heat of the day. Antelope ground squirrel (*Ammospermophilus leucurus*), Mohave ground squirrel (*Spermophilus mohavensis*), and round tailed ground squirrel (*Spermophilus tereticaudus*) have been observed in the Study Area and are active during the day in summer. Merriam's rat (*Dipodomys merriami*), Panamint rat (*Dipodomys panamintinus*), desert kangaroo rat (*Dipodomys deserti*), deer mice (*Peromyscus maniculatus*), and

pocket mice (*Perognathus penicillatus*) are the most numerous nocturnal rodents that are found in the area (MBA 1991 and Chambers 1992c). Desert woodrats (*Neotoma lepida*) are also found in the Study Area, especially in the Paradise Range, and nest in rock outcrops and boulder piles (Charis 2001). Additional information on the Mohave ground squirrel is presented in Section 3.5.3.7, Sensitive Species.

The most common large mammal in the Study Area is the coyote (*Canis latrans*). Other mammals that are widespread throughout the region and are known to occur in the Study Area include kit fox (*Vulpes macrotis*), bobcats (*Lynx rufus*), and badgers (*Taxidea taxus*). Nelson's bighorn sheep (*Ovis canadensis nelsoni*) occur in the higher elevations of the Avawatz Range, which spans the eastern portion of the Study Area (CNDDB 2002). Nelson's bighorn sheep is presented in Section 3.5.3.7, Sensitive Species. Mountain lions (*Felis concolor*) have been observed venturing from the Newberry Springs, Ord Mountain Ranges, and Barstow and may venture north into the Study Area (personal communication with Tom Egan 2001).

Mineshafts, natural caves, and rocky outcrops located throughout the Study Area provide potential roosting and nesting habitat for bats. Springs located in the Study Area provide foraging habitat (Brown 1994, CDFG 2002a). Fourteen bat species were determined to occur potentially on Fort Irwin and surrounding areas, based on the species' known range and habitat requirements (Brown 1996, Brown 1994). Eight of the potential species were observed or detected during field surveys on Fort Irwin. They include the western pipistrelle (*Pepistrellus hesperus*), California myotis (*Myotis californicus*), and the big brown bat (*Eptesicus fuscus*). Also observed where the Pallid bat (*Antrozous pallidus*), California leaf-nosed bat (*Macrotus californicus*), Townsend's big-eared bat (*Corynorhinus* (formerly *Pecotus) townsendii*), Mexican free-tailed bat and western mastiff bat (*Eumops perotis*)(Brown 1996, Brown 1994). These five species are also CSSC. These species may also occur within the Study Area and in the general vicinity surrounding Fort Irwin.

3.5.3.7 Sensitive Species

Table 3.5-4 lists the sensitive wildlife species found in the Study Area.

Table 3.5-4: Sensitive Wildlife Species

Species		Status		Potential to Occur or Occurrence in Study Area
Common Name	Scientific Name	Federal	State	
Reptiles				
Desert Tortoise - Mojave Population	*Gopherus agassizii*	T	T	Occurs throughout Study Area
Mojave Fringe-Toed Lizard	*Uma scoparia*	BLM - S	CSSC	Occurs in dune systems in southern and southeastern portion of Study Area

Species		Status		Potential to Occur or Occurrence in Study Area
Common Name	Scientific Name	Federal	State	
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	T	E	Potential to occur as migrants in the Study Area
Bendire's Thrasher	*Toxostoma bendirei*		CSSC	Potential to occur in western portion of Study Area
Brown-crested Flycatcher	*Myiarchus tyrannulus*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Burrowing Owl	*Athene cunicularia*	FSOC, BLM - S	CSSC	Likely permanent residents within Study Area
California Horned Lark	*Eremophila alpestris actia*		CSSC	Likely permanent residents within Study Area
Cooper's Hawk	*Accipiter cooperi*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Ferruginous Hawk	*Buteo regalis*	FSOC	CSSC	Potential to occur as migrant or winter visitor in Study Area
Gila Woodpecker	*Melanerpes uropygialis*		E	Potential to occur as transients in the Study Area
Golden Eagle	*Aquila chrysaetos*	Fully Protected	CSSC	Potential to occur in Study Area
Gray Vireo	*Vireo vicinior*	BLM - S	CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Least Bell's Vireo	*Vireo bellii pusillus*	E	E	Potential to occur as migrants in Study Area and at Paradise Springs
LeConte's Thrasher	*Toxostoma lecontei*	BLM - S	CSSC	Occur within Study Area, potential permanent resident
Loggerhead Shrike	*Lanius ludovicianus*	FSOC	CSSC	Likely permanent residents within Study Area
Long-eared Owl	*Asio otus*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs

Species		Status		Potential to Occur or Occurrence in Study Area
Common Name	Scientific Name	Federal	State	
Mountain Plover	*Charadrius montanus*	C	CSSC	Potential to occur on dry lakebeds in Study Area
Northern Harrier	*Circus cyaneus*		CSSC	Likely to occur as migrants or winter visitors in the Study Area
Prairie Falcon	*Falco mexicanus*		CSSC	May breed in mountain ranges of the Study Area
Sharp-shinned Hawk	*Accipiter striatus velox*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Short-eared Owl	*Asio flammeus*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Snowy Plover	*Charadrius alexandrinus*	T - Pacific Coast Population	CSSC	Potential to occur on dry lakebeds in Study Area
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E	E	Potential to occur as migrants in Study Area and at Paradise Springs
Summer Tanager	*Piranga rubra*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Swainson's Hawk	*Buteo swainsoni*		T	Potential to occur as migrant in the Study Area
Vermillion Flycatcher	*Pyrocephalus rubinus*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Yellow-billed Cuckoo	*Coccyzus americanus*	C	E	Potential to occur as migrants in Study Area and at Paradise Springs
Yellow-breasted Chat	*Icteria virens*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Yellow Warbler	*Dendroica petechia*		CSSC	Potential to occur as transients in Study Area and at Paradise Springs
Mammals				
California Leaf-nosed Bat	*Macrotus californicus*		CSSC	May occur in the eastern portion of the Study Area
Mohave Ground Squirrel	*Spermophilus mohavensis*		T	Occur in the southwestern portion of the Study Area

Species		Status		Potential to Occur or Occurrence in Study Area
Common Name	Scientific Name	Federal	State	
Nelson's Bighorn Sheep	*Ovis canadensis nelsoni*		Fully Protected	May occur in the eastern portion of the Study Area
Pallid Bat	*Antrozous pallidus*		CSSC	May occur throughout the Study Area
Spotted Bat	*Euderma maculatum*		CSSC	May occur in the eastern portion of the Study Area
Townsend's Big-eared Bat	*Corynorhinus townsendii*		CSSC	May occur throughout the Study Area
Western Mastiff Bat	*Eumops perotis californicus*		CSSC	May occur throughout the Study Area

BLM-S= Bureau of Land Management sensitive species C= Candidate species
CSSC= California Species of Special Concern
E= Endangered species
FSOC= Federal Species of Concern
T= Threatened species

Reptiles

Mojave fringe-toed Lizard

The Mojave-fringe-toed lizard is a CSSC and is a BLM sensitive species. It is highly adapted to the environment in which it is found. Mojave fringe-toed lizards are found in in isolated pockets of fine, wind-blown sand of dunes, on the edges of dry lakebeds and washes, and isolated pockets blown up against hillsides, which are generally located in creosote scrub (BLM 2002u).

The Mojave fringe-toed lizard is endemic to the Mojave Desert, where it is restricted to aeolian, or wind-blown, sand habitats. It occurs in the deserts of Los Angeles, Riverside, and San Bernardino Counties in California, and in a small area of western Arizona. In San Bernardino County, it is found at El Mirage Dry Lake, Harper's Dry Lake, Lenwood, Daggett, Yermo, Newberry Springs, Pisgah, Ludlow, the west slope of Alvord Mountain, Cronese Lake, Silver Lake, Crucero, Sands Siding, Devil's Playground, Coyote Lake, and Kelso Dunes (BLM 2002u). Habitat for the Mojave fringe-toed lizard is located in the southern portion of the Study Area near Coyote Lake and Alvord Mountain, and in the southeastern portion of the Study Area, and at various locations along the southeastern edge of the Study Area parallel to Utility Corridor D. A known population occurs along the west side of a large basaltic outcropping located on Fort Irwin, near the current southeastern boundary. The Mojave Fringe-toed lizard has also been located in dune areas near Coyote Lake. Results from genetic studies show local populations east of the Study Area (in the Cady Mountains area) have significant genetic differences (personal communication with David Morafka 2002). The only population in the Study Area is not in the preferred alternative.

Desert Tortoise

The USFWS emergency-listed the desert tortoise as endangered on August 4, 1989 (USFWS 1989). The Mojave population, which occurs in California, Nevada, Utah, and parts of Arizona (north of the Colorado River), was subsequently down-listed to threatened in the final rule on April 2, 1990 (USFWS 1990). The Sonoran population, which occurs in the remainder of Arizona and over the rest of the species range is not listed and does not have protected status under the ESA. On June 22, 1989, the California Fish and Game Commission listed the species as threatened under the CESA. On February 8, 1994, the USFWS designated critical habitat for the Mojave population of desert tortoise, encompassing approximately 6.4 million acres (USFWS 1994a). The Superior-Cronese Lakes Critical Habitat Unit (CHU), intersects the project area. (See the range in Figure 3.5-3.)

The west Mojave population of the desert tortoise is being managed within the Superior-Cronese DWMA. The west Mojave is a unique place that has many demands on its space.

Listing of the desert tortoise was prompted by perceived precipitous declines in several populations throughout the Mojave portion of the species range (USFWS 1990). The emergency listing package for the desert tortoise identified population declines of at least 10 percent annually for the previous 6 years at eight sites in the western Mojave Desert (USFWS 1989). Concern that an upper respiratory disease, initially labeled Upper Respiratory Disease Syndrome (URDS) now referred to as Upper Respiratory Tract Disease (URTD), was responsible for the declines and could be an epidemic, further prompted the listing. The final rule, listing the desert tortoise as threatened under the ESA, identified habitat loss and degradation, as well as excessive predation and illegal collections as major threats to the continued existence of the tortoise. Specific activities cited as contributing to these factors included urban expansion, mine development, energy generation facilities, waste facilities, military activities, grazing, ORV, and highway construction. The *Desert Tortoise Recovery Plan* (USFWS 1994b) also concluded that the cumulative effects of disease-related mortality, habitat destruction and degradation, and population fragmentation threatened desert tortoise populations in the Mojave region (USFWS 1994b).

Mycoplasma agassizii is the pathogenic agent causing URTD in desert tortoises and gopher tortoises. Mycoplasmosis has become an interchangeable term with URTD. Depending on the virulence of the particular strain, URTD may result in lethargy and anorexia, leading to dehydration, emaciation, and eventual death. Mycoplasmosis is thought to be a major factor in population declines in the Mojave Desert (Charis 2003a).

Drought is a contributing factor to the recent declines in tortoise populations. It directly results in increased mortality and indirectly reduces recruitment into the population. It may contribute to other factors that are directly responsible for tortoise mortality, such as URTD. Predation on adult desert tortoises by coyotes, probably due to prey switching as a result of the drought, was a major source of mortality at the Desert Tortoise Natural Area (DTNA) site in the west Mojave between 1988 and 1990. The Mojave Desert has

been experiencing frequent droughts in the last 14 years. In the west Mojave, 7 of the last 14 years have been spring drought years, with either negligible or well below-average forage production. In the east Mojave, drought has occurred 8 of the last 14 years. In two cases in the west Mojave, the droughts spanned 2 or more years; this has occurred in three cases in the east. While the desert tortoise is adapted to seasonally dry conditions and intermittent annual drought, frequent drought years within a relatively short period result in high desert tortoise mortality; this is especially true where the drought spans 2 consecutive years. The extent to which drought is a factor in desert tortoise mortality is unknown, but it is considered substantial overall (Charis 2003a). Population declines have been observed in the local populations, and the west Mojave population's status has been recommended to be changed from threatened to endangered by two research panels.

An in-depth discussion of the biology, range, natural history, species status, and threats to survival of the species is included in the *Biological Assessment for the Proposed Addition of Maneuver Training Land at Fort Irwin, CA* (Charis 2003a). Presented below is a summary of that information.

Desert Tortoise Biological Description

The desert tortoise is a medium-sized, terrestrial turtle in the family Testudinidae. Its unhinged shell is colored in shades of brown with faint orange or yellow in the centers of some scutes (the keratinized shell cover). Muted mottling is variously present on the plastron (ventral shell), especially in juvenile tortoises. They range in length from about 1.4 in. (35 mm) at hatching to 11-16 in. (28-40 cm) for adults and in weight from 0.04 to 15 lbs (0.02 to 6.8 kg).

Desert tortoises are ectotherms; their body temperatures are not controlled by internal mechanisms but are influenced by ambient (surrounding) temperatures. Their seasonal and daily activity patterns are, in turn, partially and similarly dictated. Desert tortoises are most active in spring and fall, when ambient temperatures remain below lethal thresholds, forage is most available, and reproductive activities occur. Tortoises are active during the day and above ground in the activity season when surface temperatures are below approximately 43°C (109°F). Tortoises are active in the morning and afternoon during the hot summer months. Although tortoises hibernate during the winter, from October or November, emerging in March or April, they may come out of their burrows and bask anytime there are warm days in the winter months. Individual behavior is quite variable. Major differences in behavior can also be caused by sex, age, and health.

Desert tortoises are herbivorous. Forage typically comprises annual forbs and grasses, as well as perennial grasses and succulent perennials, including cacti. Exotic annual grasses (e.g. red brome (*Bromus madritensis rubens*), split-grass (*Schismus barbatus*)) and forbs (red-stem filaree (*Erodium cicutarium*)) comprise a high percentage of most tortoise diets and are preferred forage items. Tortoises tend to eat dry grass in summer. In the past, they ate perennial grasses, but most of these have been replaced by encroaching exotic annuals. Tortoises have been observed to have replaced this food

source with split grass, which has a lower nutrient value and requires a greater use of water to process.

Desert tortoises are opportunistic in their burrowing habits, burrowing into hillsides and utilizing rock caverns where available, and altering the burrows of other species, such as kit and gray foxes, rodents, and hares. Burrows may extend several feet deep, are generally straight, and are dug at a gentle angle. The average number of burrows used in a year of average forage was 6-14 (range: 2-18). In a better forage year, an average of 12 (range: 4-23) burrows were used. An average of five new burrows may be constructed per year. Desert tortoises tend to use a group of burrows, and then move to another group, and so on. Generally, males have been shown to have larger home ranges than females. Home ranges were estimated at approximately 43.5 acres (range: 4.7-143.3 acres) for adult females and approximately 111.6 acres (range: 10.4-487.8 acres) for males. Home ranges for both genders decreased significantly in drought years.

Mojave desert tortoises lay eggs from early May through mid-July. The incubation period is 80-112 days, with hatchlings emerging in late summer and early fall. Annual fertility for Mojave tortoises is correlated with tortoise length (for non-drought years only). In four studies of Mojave tortoises, average annual fertility was reported as 6.6, 7.1, 7.0, 7.3, and 8.2eggs respectively. The smallest size at first reproduction in wild tortoises is 7 in (180 mm), which may be reached when a tortoise is between approximately 16 and 20 years of age. Tortoises continue to reproduce until they die, with no decrease in reproductive output. In fact, reproductive output increases as tortoises continue to grow with increasing age (i.e., indeterminate growth). Annual clutch frequency ranges from 1.5 – 1.8.

Desert Tortoise Habitat

The desert tortoise occupies arid habitats below approximately 4,000 ft AMSL (1,200 m). Common vegetation associations in the Mojave Desert include creosote bush scrub, saltbush scrub, Joshua tree woodland, and Mojave yucca communities. Because of the burrowing nature of desert tortoises, soil type is an important habitat component. In California, desert tortoises typically inhabit soft, sandy loams and loamy sands, although they are also found on rocky slopes and in rim-rock that provide natural cover sites in crevices. In portions of Nevada and elsewhere, where a near-surface durapan limits digging, desert tortoises often occupy caverns in the exposed caliche of wash banks. Hills with round, exfoliating granite boulders often support higher densities of desert tortoise than surrounding flat areas, especially in Arizona. Valleys, alluvial fans, rolling hills, and gentle mountain slopes are also inhabited. Playas and steep, talus-covered slopes are avoided.

Desert Tortoise Range

The desert tortoise is one of four species of North American tortoises, all of which belong to the genus *Gopherus*: *G. agassizii* (desert tortoise), *G. berlandieri* (Texas tortoise), *G. flavomarginatus* (bolson tortoise), and *G. polyphemus* (gopher tortoise). Only the desert tortoise inhabits the southwest, with a current range extending from southwestern Utah, west to the Sierra Nevadas in California and south through Nevada and Arizona

into Sonora and northern Sinaloa, Mexico. Figure 3-5.3 depicts the range of the desert tortoise. The current core densities of desert tortoise within the ROI are depicted in Figure 3.5-4. Core population areas are those considered to contain larger populations of tortoises during periods of favorable environmental conditions.

The Study Area occurs within the range of the desert tortoise. Desert tortoises occur throughout the Study Area, with varying densities. Figure 3.5-5 depicts estimated desert tortoise densities within the Study Area. In response to the need for a more precise estimate of desert tortoises in the proposed project area, an additional study was conducted in 2001 (Karl 2002a). This study included eight mark-recapture plots that were placed in six plots and adjacent to two plots the project area. It also included an intensive survey using the four belt transects per kilometer method that was completed on generally adjacent, square kilometers within the project area. This increased the historic sampling intensity in these areas ten-fold. Additionally, several improvements in data collection and analysis were employed to increase the accuracy and precision for estimating desert tortoise densities that were lacking in the earlier studies. Efforts were concentrated in the area of the Superior Valley, because little was known about desert tortoises there.

Three methods were used to determine desert tortoise densities within the Study Area: plot studies, transects, and line distance sampling. Plot studies use labor-intensive, mark-recapture techniques to determine desert tortoise density (the number of tortoises per unit area), at a single, small site (e.g., 1 square kilometer, 1 square mile). The density estimates are generally assumed to be accurate, although precision of the estimate may be low, especially in low-density populations or due to other sampling artifacts (observer experience, drought, etc.). Because desert tortoise distribution can be extremely patchy, the results obtained at one site cannot be easily extrapolated to surrounding, un-sampled sites (Karl 2001).

The transect method uses belt transects, typically 33 feet (10 meters) wide by 1.5 mile (2.4 kilometers) long, walked at various sampling rates (e.g., one transect per square mile) to sample broad areas. All observed desert tortoise signs are recorded along the belt transect, and the results are correlated to sites of known desert tortoise density. Belt transects, because of a low sampling rate, and biological and statistical reasons, have generally been poor predictors of desert tortoise density (Karl 2001). The value of these transects has been in providing a general idea of regional desert tortoise abundance (i.e. hot spots and low density areas) and distribution to identify areas for further study. For 2001 and 2002, Fort Irwin expansion area transect sampling techniques incorporated several statistical and sampling improvements. The techniques included single mark and recapture Peterson model and Schnabel multiple recapture model- where plots had multiple coverage (Karl 2002a, 2002b).

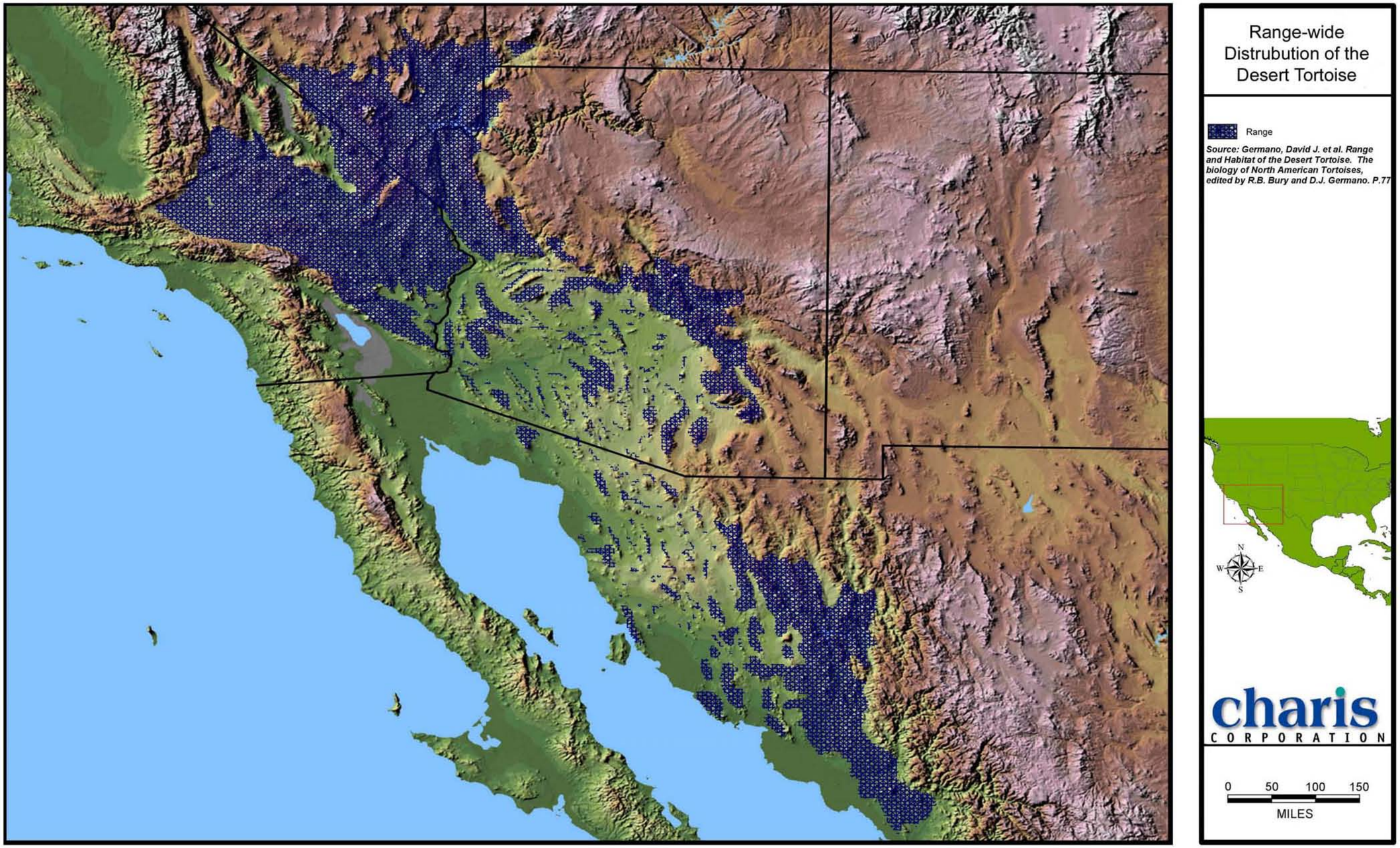

Figure 3.5-3: Range-wide Distribution of the Desert Tortoise

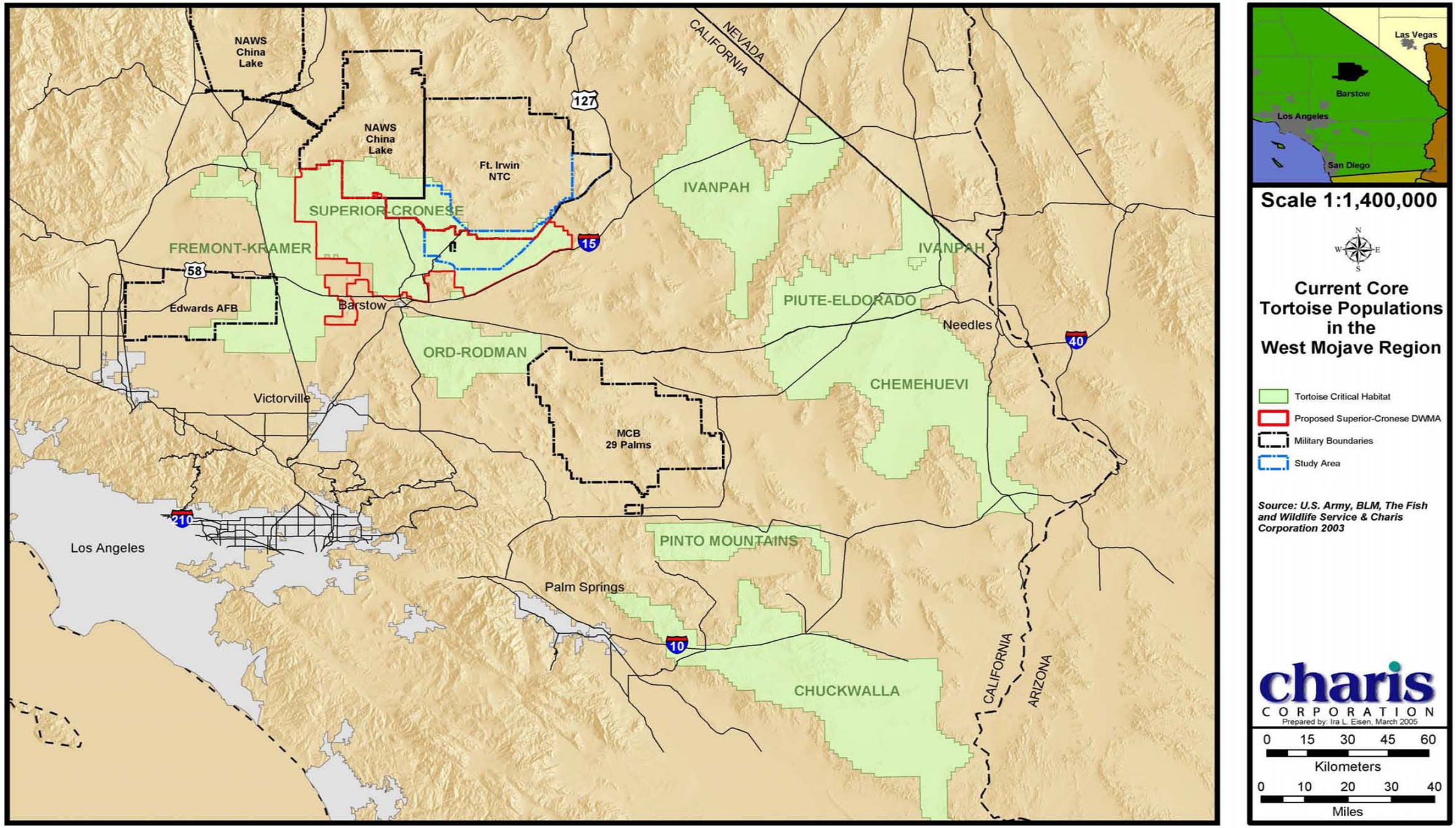

Figure 3.5-4: Current Core Tortoise Populations in the West Mojave Region

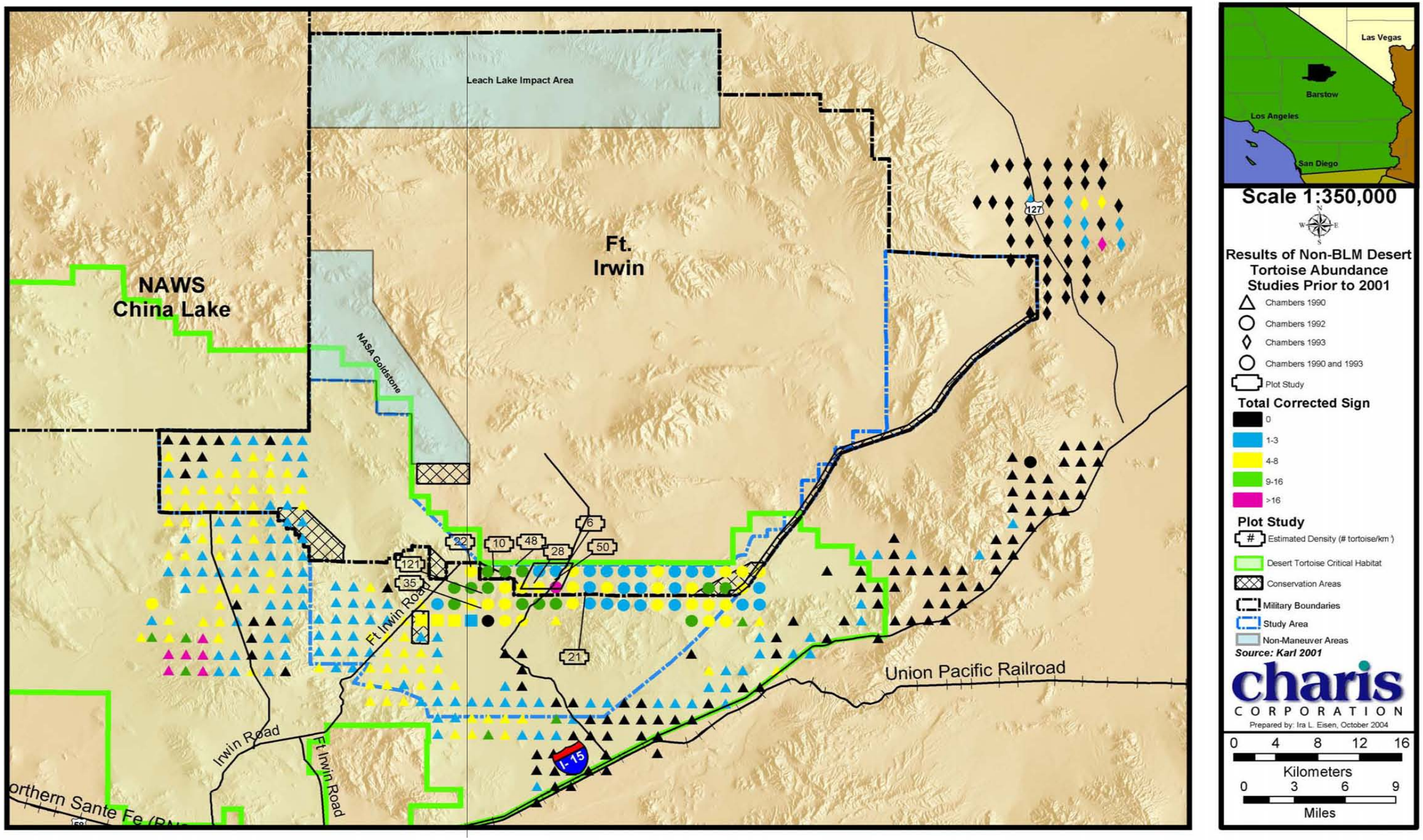

Figure 3.5-5: Results of Non-BLM Desert Tortoise Abundance Studies Prior to 2001

The third method, line distance sampling, uses a different kind of transect and cumulative results to determine the abundance of desert tortoises in a region. This method was adopted by USFWS in 2000 to assess desert tortoise abundance and temporal trends of the Mojave population in CHUs. The method was implemented range-wide in 2001 for this population. While the method has been applied successfully to other species, desert tortoises have presented several species-specific difficulties for the method, largely because tortoises are underground much of the year and more during drought years. Also, densities of this widespread species are low throughout much of its range, especially following the recent declines. Other difficulties occur because population growth rates are naturally low, which makes significant upward trends in population size difficult to detect. As such, the method has undergone several revisions since in its application to desert tortoises. Data for the first few years of the USFWS CHU survey are still being analyzed, and results are not yet available.

Desert tortoise densities and abundance were estimated for different regions or parcels of the Study Area (Table 3.5-5). These areas are the Superior Valley, UTM 90 Area, Eastgate parcel (the eastern portion of the Study Area), Paradise Valley, and Coyote Basin. Based on the studies conducted in 2001 and 2002, current densities in the Superior Valley and surrounding areas are low (Karl 2002a, 2002b). Nearly 50 percent of the Superior Valley area was estimated to have three or fewer desert tortoises/mi^2 (1 tortoises/km^2), with less than 2 percent estimated to have more than 26 desert tortoises/mi^2 (>10 tortoises/km^2). For the entire Superior Valley parcel, the total number of adults was estimated in 2002 at approximately 563-595 tortoises, with an confidence interval of approximately 531-1158 tortoises (Karl 2002b). Due to an adjustment to the final withdrawal boundary not accounted for in these surveys, the final estimate is approximately 626-658 adult tortoises for the Superior Valley parcel.

The Eastgate parcel has low to very low desert tortoise densities. Transects walked by Chambers and the BLM that were in, or adjacent to, the Eastgate Area registered very low sign counts (Chambers 1992b, BLM 2002x). For the Chambers study, 14 of 15 transects on the east side and immediately east of the future Eastgate parcel had no sign counts, while the remaining transect had 1–3 sign. For the BLM transects on the west side of the Eastgate parcel, transects largely registered 0–3 sign, with occasional transects having slightly higher number of sign, 4–8. The biological Study Area represents a combination of all areas considered in the five alternatives. Table 3.5.5 has been imported from the BA and non-withdrawal areas data added (Charis 2003a).

A square mile BLM study plot in the Eastgate area documented approximately 55 tortoises in the best habitat. Based on topography, no desert tortoises were expected on the lower alluvial fan slopes (personal communication with Mark Massar 2003).

Table 3.5-5: Estimated Number of Adult Tortoises in the Study Area

Study Area Regions or Parcels	Total Area (in Acres)[1]	Estimated Number of Adult Tortoises (Abundance)[2, 3]	Approximate Confidence Interval for Abundance Estimate[4]
Superior Valley	70,050	630-660	520-1,140[4]
UTM 90 Area North and West of Alvord Mountain	16,400	430-440	340-640[4]
UTM 90 Area East of Alvord Mountain	6,810	100-120	----[5]
Eastgate	48, 630	290	----[5]
Goldstone	1,470	50	----[5]
Total	143,360	1,410-1490	
Study Area Non withdrawn lands			
Coyote Basin	31,795	345	----[5]
Paradise Valley	40,000	510	----[5]
Total	73,795	855	

[1] Includes all conservation areas in Project Area except those on Fort Irwin (NASA Goldstone) and the Two Square Mile Area off-post.
[2] Source: Karl 2002b, plus additions based on current withdrawal area boundary
[3] See text below for assumptions supporting calculations
[4] Confidence intervals are based on calculated limits for sampled kilometers, plus the total number of tortoises estimated for un-sampled kilometers
[5] Could not be determined based on approximation method used to estimate abundance

While desert tortoise densities cannot be reliably determined from these transect data sets, the data strongly indicate that desert tortoise densities are very low in the Eastgate area.

There are at least 840 acres of non-desert tortoise habitat in the Eastgate area. To estimate the number of desert tortoises in this area, data from the Eastgate transects had to be defined in terms of desert tortoise density. For the eastern half of the Eastgate parcel (approx 23,000 acres), an average of one tortoise/mi^2 was estimated. The extremely mountainous portion in the center of the parcel and the playas, at least 840 acres, were estimated to have no desert tortoises. For the western portion of the Eastgate, the following method was used to estimate density: the BLM transect groupings of 0 and 1-3 sign in Superior Valley (same study as that for Eastgate) corresponded to areas estimated to have 0-3 and 4-13 tortoises/mi^2. Applying the midpoint of this range, 6.5 tortoises/mi^2 to the approximately 24,790 acres of remaining potential tortoise habitat in the Eastgate area yielded a cumulative estimate for the entire parcel of approximately 290 adult tortoises. This estimate is probably quite high due to the large number of transects with zero signs, but is conservation oriented.

The UTM 90 Area has a substantially higher population than is present elsewhere in the Study Area. Estimated densities ranged from approximately 3–85 adult desert tortoises/mi^2 (1–32.9 tortoises/km^2) in 2002, with the highest densities occurring in the southwestern corner (Karl 2002b). The cumulative estimated adult desert tortoise abundance was approximately 430-441 tortoises for the surveyed area, north and northwest of Alvord Mountain. Desert tortoise abundance in the eastern portion of the UTM 90 Area, where transects were not estimated in 2001 and 2002, was estimated in the same manner as for the Eastgate, using sign counts from transects walked there by Chambers (1992b) and the BLM (2003b). The eastern portion of the UTM 90 Area was estimated to have approximately 96-124 desert tortoises.

The UTM 90 Area has moderate densities that are more consistent over the area and better habitat than the Superior Valley area, so it may have supported higher densities in the past. In 1993, Chambers estimated that there were approximately 5,000-6,000 desert tortoises on the north Alvord Slope, the latter encompassing the UTM 90 Area, plus that area south to approximately the UTM 85 gridline and west to Fort Irwin Road (Chambers 1994a). This is substantially higher than the 2001 estimates, when the maximum density predicted for this area was generally less than or equal to 44 adult desert tortoises/mi^2 (17 desert tortoises/km^2). If the differences were accurate and not attributable to differences in techniques and analysis, they would suggest a high, continuous mortality rate or high rates, with pulses of very high rates.

Desert tortoise abundance in Coyote Basin, where transects were not estimated in 2001 and 2002, was estimated in the same manner as for the Eastgate, using sign counts from transects performed by BLM (2003b). For the Coyote Basin Area, the following method was used to estimate density: the mean density grouping of 6 adult desert tortoises/mi^2 (2.5 tortoises/km^2) from the BLM transect groupings of 0-3 sign in Superior Valley was applied to approximately 17,860 acres, for an estimated 183 adults. The mean density grouping of 14 adult desert tortoises/mi^2 (5.5 tortoises/km^2) from the BLM transect groupings of 1-16 sign in Superior Valley was applied to approximately 4,460 acres, for an estimated 98 adults; a mean density grouping of 9 adult desert tortoises/mi^2 (3.5 tortoises/km^2) from the BLM transect groupings of 1-8 sign in Superior Valley was applied to another approximately 4,460 acres, for an estimated 63 adult tortoises. Alvord Mountain and Coyote Dry Lake were estimated to have no tortoises. The cumulative estimate for the entire Coyote Basin parcel was approximately 345 adult tortoises.

Desert tortoise abundance in the Paradise Valley where transects were not estimated in 2001 and 2002, was estimated in the same manner as for the Eastgate, using sign counts from transects performed by BLM (2003b). For the Paradise Valley parcel, the following method was used to estimate density: the mean density grouping of 14 adult desert tortoises/mi^2 (5.5 tortoises/km^2)from BLM transect groupings of 4-16 signs in Superior Valley was applied to approximately 10,000 acres, for an estimated 226 adults. The mean density grouping of 9adult desert tortoises/mi^2 (3.5 tortoises/km^2) from BLM transect groupings of 1-8 signs in Superior Valley was applied to approximately 20,000 acres, for an estimated 284 adults. The mountainous areas, including Paradise

Mountain, and Coyote Dry Lake were estimated to have no tortoises. The cumulative estimate for the Paradise Valley parcel was approximately 510 adult tortoises.

Historically, high desert tortoise densities in the range of the Mojave population were considered to exceed 200 desert tortoises/mi^2 (77 tortoises/km^2), with medium densities exceeding 50–100 desert tortoises/ mi^2 (19–39 tortoises/km^2). In the Study Area, current desert tortoise densities are low. They are very low in Eastgate – an average estimated 4 adult desert tortoises/mi^2 (1.5 tortoises/km^2), with a range of 0–13 desert tortoises/mi^2 (1–5 desert tortoises/km^2) – and in Superior Valley – an average of 6 adult desert tortoises/mi^2 (2.3 tortoises/km^2), with over 50 percent of the area estimated to have 3 or fewer desert tortoises/mi^2 (1 desert tortoises/km^2) and less than 2 percent estimated to have more than 26 desert tortoises/mi^2 (>10 desert tortoises/km^2). Densities have probably never been high in Superior Valley, based on environmental factors. This is somewhat supported by the results of several surveys since 1988 that have not identified medium to high densities in Superior Valley or surrounding areas. In the Coyote Basin and Paradise Valley parcels, densities are also low. Approximately 67 percent of desert tortoise habitat in the Coyote Basin parcel was estimated to have 1-5 desert tortoises/km^2, while approximately 17 percent was estimated at 2-9 desert tortoises/km2 and another 17 percent was estimated at 2-5 desert tortoises/km^2. Approximately 67 percent of desert tortoise habitat in the Paradise Valley parcel was estimated to have 2-5 tortoises/km^2, while the remaining 33 percent was estimated to have 0-3 desert tortoises/km^2. Localized areas near the interface between the foothills and alluvial fans might have moderate densities. A study plot in the South Avawatz Mountains had 40 desert tortoises/mi^2 (personal communication with Mark Massar 2003). In the Study Area, the highest current densities, still comparatively low, are in the UTM 90 Area west of Alvord Mountain, a mean of 17 desert tortoises/mi^2 (7 desert tortoises/km^2). While densities could not be derived from earlier survey techniques, surveys in 1988 and the 1990s suggested that densities in this portion of the UTM 90 Area might have been higher before the drought. Still, no portions of the project area or areas adjacent to it encompass historic or current core desert tortoise populations.

Desert Tortoises on Fort Irwin

The population on the remainder of Fort Irwin, minus the UTM 90 Area and Congressionally withdrawn lands, is estimated to be approximately 1,000-2,000 tortoises. Currently on Fort Irwin, the Biological Opinion for the ongoing mission requires halting military training activities whenever a tortoise is encountered, with subsequent relocation of the animal before military maneuvers resume. Since 1994, records have been kept of tortoises removed or killed during military activities on the NTC. Every year, some mortality takes have occurred, a total of 43 between 1994 and 2004 (Table 3.5-6). Moving animals out of harm's way has occurred 92 times.

Desert Tortoises on NAWS, China Lake

NAWS has implemented a Desert Tortoise Habitat Management Plan (DTHMP) at China Lake since 1992. A BO for the implementation of the Plan was issued by the USFWS on 3 December 1992. The NAWS DTHMP encompasses approximately 200,000 acres located in portions of in the Superior Valley, Randsburg Wash, and Mojave B North areas of

China Lake. Approximately 77,000 acres of the DTHMA is designated as Critical Habitat by USFWS.

Table 3.5-6: Tortoises Killed or Relocated During Military Maneuvers on the NTC, since 1994

FISCAL YEAR	MORTALITY TAKES	RELOCATED TORTOISES
1994	2	5
1995	4	6
1996	4	21
1997	7	19
1998	6	6
1999	2	13
2000	2	6
2001	6	6
2002	3	3
2003	6	4
2004	1	3
TOTALS	**36**	**85**

Source: Personal communication with Mickey Quillaman 2002, Lynn 2005

In conclusion, the tortoise population in the Study Area represents a very low percentage of the entire Mojave population. At known peak historic densities, the Study Area's population likely still represented a low percentage of the entire population, although it is unclear what populations were in the UTM 90 Area of Fort Irwin, or on the remainder of the post, prior to military training maneuvers.

Desert Tortoise Critical Habitat

Designated critical habitat in the southern and southwestern portion of the Study Area totals approximately 203,520 acres. This habitat is shown in Figure 3.5-3. Critical habitat located in the Study Area is part of the Superior-Cronese CHU. In the ROI, the West Mojave, there is approximately 6.4 million acres of designated desert tortoise critical habitat. This is approximately 3.17 percent of all designated critical habitat currently in the Mojave.

The West Mojave Plan and Desert Wildlife Management Areas

The WMP is a multi-species conservation plan being developed by the BLM for an area of some 9.3 million acres designated as the WMP Area. Upon completion, the WMP is intended to amend the California Desert Conservation Act (CDCA) and to function as a Habitat Conservation Plan (HCP) under Section 10 of the ESA. The BLM, in cooperation with the USFWS and the CDFG, is leading this multi-agency coordinated management planning effort. The WMP was specifically designed to set management prescriptions for desert tortoise, as well as over 80 other sensitive plant and animal

specials. An important feature of the WMP is the creation of Desert Wildlife Management Areas (DWMAs) for the conservation of the desert tortoise.

Four tortoise DWMAs in the WMP area would be established. They are referred to as tortoise DWMAs because this name is consistent with the terminology used by the *Desert Tortoise (Mojave Population) Recovery Plan*, and has been adopted by other regional planning efforts throughout the listed range of the tortoise. The boundaries of the proposed DWMAs correspond to the general boundaries identified by the *Desert Tortoise (Mojave Population) Recovery Plan*: the Fremont-Kramer (779 mi^2) and Superior-Cronese (980 mi^2) DWMAs, which are adjacent, the Ord-Rodman DWMA (388 mi^2), and the Pinto DWMA (173 mi^2) (USFWS 1994b). The proposed tortoise DWMAs would be managed for tortoise conservation and recovery until which time the tortoise may be de-listed as per criteria set forth in the recovery plan. All BLM-administered public lands within tortoise DWMAs would be managed as BLM Category I tortoise habitat. All public lands outside of the proposed tortoise DWMAs that are within the range of the tortoise would be managed as BLM Category III tortoise habitat. Approximately 107,770 acres of the southern portion of the Study Area is located within the proposed Superior-Cronese DWMA.

Birds

In addition to laws and regulations discussed in the SFEIS, the proposed project is subject to regulation under the Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703-711). The MBTA prohibits the taking, killing, possession, transportation, sale, and importation of migratory birds, any of their parts, their eggs, or nests, except when specifically authorized by the DOI, or unless permitted by regulations. All sensitive bird species covered in the SFEIS are listed in, and protected by, the MBTA. Exemptions include permitted seasonal game hunting and raven control at the sanitary landfill (personal communication with Mark Massar 2003).

The sensitive bird species listed below have the potential to occur as transients in the Study Area and at Paradise Springs.

The **brown-crested flycatcher** (*Myiarchus tyrannulus magister*) is a CSSC. Within California, the brown-crested flycatcher is found in riparian woodland or forest habitats dominated by cottonwoods and willow, usually in the climax stage. The brown-crested flycatcher winters from northern Mexico, south through Central America and southern Florida. Within the region, they nest along the Colorado River and at a few scattered locations throughout the desert. Nest sites that occur south of the Study Area include the following locations: the Mojave River at Victorville, Cushenberry Springs and Morongo Valley (San Bernardino County), and Mecca (Riverside County). Nest sites at locations north of the Study Area include Tecopa (Inyo County) and the South Fork Kern River Preserve at Weldon (Kern County) (BLM 2002u). The brown-crested flycatcher may occur as a migrant through the Study Area and may occur at Paradise Springs, located in Paradise Mountain in the southwestern portion of the Study Area.

The **Cooper's hawk** (*Accipiter cooperii*) is a CSSC. The Cooper's hawk is the middle-sized North American accipiter. Nesting habitat for the bird includes deciduous,

conifer, and mixed woodlands. The Cooper's hawk's breeding range extends throughout the contiguous United States, southern Canada, and northern Mexico. Cooper's hawks primarily winter throughout the southern portion of their range and into northern Central America. Cooper's hawks have been observed in winter months west of the Study Area at NAWS China Lake, and south and southwest of the Study Area in the Mojave River Valley, Joshua Tree National Park, Morongo Valley, and Lancaster. Within the region, nesting sites have been documented at Mojave Narrows Regional Park and Morongo Valley (BLM 2002u). The Study Area does not contain habitat that is likely to support Cooper's hawks. Cooper's hawks may occur as migrants or winter visitors in the Study Area.

The **gray vireo** (*Vireo vicinior*) is a CSSC and is a BLM sensitive species. The gray vireo is a small songbird. Its breeding range extends from southern California and parts of other southwestern states to northwestern Baja California, central and southeastern Arizona, southern New Mexico, western Texas, and Mexico. Habitats occupied by the gray vireo are arid slopes of mountain ranges dominated by short and densely branched shrubs. Within the Mojave Desert, the gray vireo breeds in the Kingston, Clark, and New York Mountains located east and northeast of the Study Area. Gray vireos winter primarily in Mexico and are not known to winter in California (BLM 2002u). The Study Area does not contain habitat that is likely to support the gray vireo, however, it may occur as a migrant in the Study Area.

The **long-eared owl** (*Asio otus*) is a CSSC. It is a medium-sized owl and one of the most strictly nocturnal of all owls. Long-eared owls use bottomland habitats, with tall willows and cottonwoods or belts of live oaks, adjacent to stream courses and open land. Within the desert, long-eared owls are generally found resting and/or roosting in willows, cottonwoods, junipers, native live oak, dense plantings of tamarisk, elms, and conifers. Within North America, the long-eared owl is found across central Canada, south across the northeastern U.S., and within most of the western U.S. The long-eared owl winters in the southern part of its breeding range. While there is some influx of wintering owls that occurs in California deserts, it is not clear if the majority of these birds are winter visitors. Long-eared owls have been observed in a tract of cottonwoods and willows along the Mojave River near Victorville (BLM 2002u). The long-eared owl may occur as a migrant in the Study Area and may also occur at Paradise Springs.

The **sharp-shinned hawk** (*Accipiter striatus velox*) is a CSSC. It is the smallest of the North American accipiters. The breeding range of the sharp-shinned hawk includes the boreal forests of Canada and Alaska, and both deciduous and evergreen forest habitats throughout much of the remaining United States. There are no breeding records for the sharp-shinned hawk in the west Mojave Desert. Most sharp-shinned hawks migrate south in the winter to the southern United States, northern Mexico, and as far south as Central America. They have been observed in winter at NAWS China Lake, in Lancaster, in the Mojave River Valley, in Joshua Tree National Park, and in the Morongo Valley (BLM 2002u). Sharp-shinned hawks may occur as migrants or winter visitors in the Study Area.

The **short-eared owl** (*Asio flammeus*) is a CSSC. Short-eared owls are medium-large owls that are primarily crepuscular, or active at twilight. Short-eared owls are

widespread and breed throughout much of the northern portion of North America. Most populations are migratory and winter south to Baja California, northern Mexico, and Florida. Typical breeding habitat of the owl is open country, which may include prairies, coastal grasslands, salt and freshwater marshes, shrub-steppe, or agricultural lands. Occupied winter habitats are similar to those occupied during breeding season, but more often include marshes and weedy fields. Short-eared owls have been observed in winter at Harper Lake, Cronese Lake, NAWS China Lake, and the Piute Ponds on Edwards AFB (BLM 2002u). They have also been observed along the Amargosa River and Salt Creek north of the eastern portion of the Study Area (Chambers 1992c). The Study Area does not contain habitat that is likely to support short-eared owls however; they may occur as migrants in the Study Area.

The **summer tanager** (*Piranga rubra cooperi*) is a CSSC, and one of four tanagers of the genus *Piranga* that regularly occurs north of Mexico. Western populations of the summer tanager are found in riparian woodland habitats or forests dominated by cottonwoods and willows, usually in a climax stage. The breeding range extends throughout much of the U.S., south into Florida and Mexico. The subspecies found in California breeds from southern California east to western Texas and south into Mexico and winters from southern Baja California south into other parts of Mexico. Within the Mojave Desert, nesting by the summer tanager has been documented at the Mojave River at Victorville, Cushenbury Springs, Morongo Valley, and Yucca Valley, all located south and southwest of the Study Area. One immature summer tanager was also observed at Camp Cady, south of the Study Area. Other breeding locations include Tecopa, Soledad Canyon, Whitewater Canyon, and South Fort Kern River Preserve at Weldon. Within the region, wintering birds have been observed at Twentynine Palms and near Morongo Valley (BLM 2002u). The summer tanager may occur at Paradise Springs and as a migrant throughout the Study Area.

The **vermilion flycatcher** (*Pyrocephalus rubinus*) is a CSSC. The vermilion flycatcher uses habitat characterized by low-lying, open riparian areas with accessible water, dominated by mesquite, with willow and Fremont cottonwood. It also uses parkland or golf courses throughout the desert. The species range includes the tropics, but extends into the southwest U.S. Locally the vermilion flycatcher breeds in southeastern California and southern Nevada. The winter range is largely that of the breeding range, with birds withdrawing toward the tropics in winter months. Within the region, vermilion flycatchers are known to breed in Yucca Valley, Apple Valley, and at Fort Irwin, in San Bernardino County. They are also known to breed in Ridgecrest, NAWS China Lake, the South Fork of the Kern River Preserve (Kern County), the Antelope Valley, Leona Valley (Los Angeles County), and Lake Tamarisk in Desert Center (Riverside County) (BLM 2002u). The vermilion flycatcher may be found at Paradise Springs or as a migrant throughout the Study Area.

The **yellow-breasted chat** (*Icteria virens*) is a CSSC. The yellow-breasted chat is the largest wood warbler. Within the southwestern deserts, it occupies riparian woodland and forest and scrub habitats dominated by cottonwoods, willow, arrow weed, tamarisk, and mulefat. Yellow-breasted chats breed from southern Canada, south through the U.S and into Mexico. They winter in various parts of southern U.S. states, including Texas, Louisiana, and Florida, south into Mexico and Central America. In

California yellow-breasted chats nest in riparian habitats and in several locations in the desert. Breeding locations within the Mojave Desert include the Mojave River at Victorville, Camp Cady, Morongo Valley, Cushenbury Springs, and Afton Canyon, all south of the Study Area. Yellow-breasted chat also nest at South Fork Kern River Preserve near Weldon (Kern County) northwest of the Study Area (BLM 2002u). They may occur at Paradise Springs or as migrants throughout the Study Area.

The **yellow warbler** (*Dendroica petechia brewsteri*) is a CSSC. The yellow warbler is a wood warbler. Within the California desert, yellow warblers occupy riparian woodland or forest habitat dominated by cottonwoods and willows. Yellow warblers have a vast range that extends throughout most of North America, and they winter in the tropics. Three subspecies of yellow warblers nest in California: *D. p. brewsteri* along the Pacific coast and a few desert locations; *D. p. morcomi* from the Sierra Nevadas to the Great Basin; and *D. p. sonorana* along the Colorado River. Yellow warblers are common migrants through southeastern California. Within the Mojave Desert, yellow warblers are known to nest at the Mojave River at Victorville, Camp Cady, and Morongo Valley. They also nest west and northwest of the Study Area, along Big Rock Creek of the Angeles National Forest (Los Angeles County), at Tecopa (Inyo County), and in South Fork River Preserve at Weldon (Kern County) (BLM 2002u). Yellow warblers are found at springs on the installation all summer during breeding (personal communication with Mark Massar 2003). The yellow warbler may occur at Paradise Springs and as a migrant throughout the Study Area.

The **ferruginous hawk** (*Buteo regalis*) is a CSSC and a FSOC. It is the largest member of the genus *Buteo* in North America. The ferruginous hawk breeds in open, arid country in the western U.S. and southern Canada. It winters from the central and southern portions of the breeding range, southwest through much of California, northern Mexico and other parts of the southwest U.S. It nests in sagebrush/shrub-steppe, grassland, mixed shrub/grassland; lone trees or sparse groves, primarily in pinyon-juniper woodland; and the transition zone between woodland and shrub or grassland habitats. There are no breeding records of ferruginous hawks in the western Mojave Desert. Wintering and migratory habitat is generally the same as breeding habitat, without the need for trees and other elevated sites for nests. Within the Mojave Desert, the ferruginous hawk occurs as a migrant and winter visitor. It has been observed at Harper Lake, in Helendale, and in Victorville, southwest of the Study Area (BLM 2002u).

The **mountain plover** (*Charadrius montanus*) is a candidate for federal listing and a CSSC. The mountain plover is a fairly large shorebird. It does not nest in mountains, but at relatively high elevations of 2,000-8,500 ft AMSL (640-2580 m), in short-grass prairies and plains. It is seldom found near water, and dense and tall cover is avoided in all seasons (BLM 2002u).

The mountain plover is endemic to open, sparsely vegetated habitats in North America. The breeding range includes the dry tablelands of the western Great Plains and the Colorado Plateau. The winter range extends from northern California through southern California, southern Arizona, and central and coastal Texas to northern Mexico. Mountain plovers do not breed in California, but a large portion of them (approximately 70 percent) winter in the state. The major wintering areas in California are the

Sacramento, the San Joaquin, and the Imperial Valleys. Smaller numbers are known to winter in the Mojave Desert, San Jacinto Valley, Santa Maria Valley, Salinas Valley, the Carrizo Plain, Seal Beach, Tijuana River Valley, and the lower Colorado River. Mountain plovers are recorded annually in the fall and winter in the agricultural lands east of Lancaster and at Harper Lake, southwest of the Study Area. The species may occur, at least irregularly, in Lucerne Valley and on dry lakebeds throughout the Mojave Desert (BLM 2002u). Mountain plovers have the potential to occur, at least irregularly, on dry lakebeds next to, or in, the Study Area.

The **snowy plover** (*Charadrius alexandrinus*) is a CSSC, and the Pacific Coast population of the species is federally listed as threatened. Pacific coast populations are those occurring within 50 miles of the coast. The interior populations are treated as discrete from coastal ones and lack any special status. Snowy plovers are relatively small shorebirds. On the coast, snowy plovers use sandy beaches, lagoons, and salt evaporating ponds for nesting and feeding. In the interior, they inhabit salt flats around playa lakes and evaporation ponds. In the interior, they also use diked sewage treatment ponds and ponds managed for wintering waterfowl (BLM 2002u).

The species, as a whole, breed over much of Europe, Africa, Australia, parts of Asia, South America, and western, south-central, and southeastern North America. On the Pacific Coast, snowy plovers nest as far north as northern Washington and south to southern Baja California, including the northern Gulf of California. Interior populations in the west breed at playa lakes and other shallow water habitats from east-central Oregon, south to the Salton Sea (Imperial County), and east through the Great Basin. Snowy plovers nest on certain playas, or dry lakes, in the Mojave Desert region. Most appear to depart in the winter, but migrants and wintering birds are known from a few locations as well. Small, relatively stable breeding populations have been recorded at China, Koehn, and Rosamond Dry Lakes. Higher counts were recorded at Harper Lake. During the breeding season, snowy plovers are regularly observed at the salt evaporator ponds at Dale Dry Lake and at the Edison Solar I ponds near Daggett. However, it is unlikely that they nest at these sites. Snowy plovers are generally absent from the region in winter. However, a few do winter at Piute Ponds and the Lancaster Sewage Ponds. They have also been recorded at Harper Lake in late October, and one record is reported for a single plover at East Cronese Lake in mid-November (BLM 2002u). All of the above-mentioned sites are outside the Study Area. Snowy plovers have the potential to occur on dry lakes next to, or in, the Study Area.

The **Swainson's hawk** (*Buteo swainsoni*) is state listed as threatened. Swainson's hawk breeds regularly from southwestern Canada to northern Mexico, and winters in South America. The habitat requirements of breeding Swainson's hawks include suitable foraging habitat with adequate prey, nest sites, and isolation from disturbances that may disrupt breeding activities. Within the western Mojave Desert, Joshua tree woodland, riparian woodland, and ornamental plantings provide nesting opportunities. Within the region, Joshua trees have been used for nest sites (BLM 2002u). Flocks of Swainson's hawks may be found in the Mojave Desert during spring or fall migration. They have been observed near Adelanto (San Bernardino County), and Lancaster (Los Angeles County), southwest of the Study Area (BLM 2002u). Swainson's hawks may occur as migrants in the Study Area.

The **gila woodpecker** (*Melanerpes uropygialis*) is state listed as endangered. The gila woodpecker is found in mature cottonwood-tree willow riparian forest and mesquite riparian woodland habitat at locations along the lower Colorado River between Needles, California and Yuma, Arizona and near Brawley (Imperial County), California. It resides in California throughout the year but may wander during non-breeding seasons (CDFG 2002a). The gila woodpecker has been observed near Sheep Creek Spring in the Avawatz Mountains northeast of Fort Irwin (Chambers 1992c). The gila woodpecker has been observed on Fort Irwin and may occur as a transient in the Study Area.

The **southwestern willow flycatcher** (*Empidonax traillii extimus*) is federally listed as endangered. It breeds in dense riparian habitats along rivers, streams, or other wetlands across the southwestern U.S. The riparian woodland used by willow flycatchers typically is next to, or over, water and has a canopy and understory of shrub and sapling vegetation. The vegetation composition of occupied habitats varies between sites and may include one or more of the following: native willows, ash, alder, coast live oak, mature nonnative tamarisk, cottonwoods, box elders, and nonnative Russian olive (AGFD 2002, BLM 2001f, USGS 2002).

The southwestern willow flycatcher breeds widely across temperate North America and migrates to middle and northwestern South America for the winter. Although the wintering range of southwestern willow flycatcher is uncertain, it is known to winter from the west coast of central Mexico to northern South America. They breeds in southern California, southern Nevada, southern Utah, Arizona, New Mexico, and extreme western Texas. Southern Californian populations are found at the following principle sites: along the South Fork Kern River near Weldon, along the Santa Ynez River from Vandenberg AFB to Buellton, the Prado Basin on the Santa Ana River, along the Santa Margarita River from Camp Pendleton to Fallbrook, the Luis Rey River, and La Jolla Indian Reservation to Lake Henshaw. In the Mojave Desert, the southwestern willow flycatcher is known from two locations: Big Morongo Wildlife Preserve and along the Mojave River at Mojave Narrows Regional Park and near the I-15 crossing (AGFD 2002, BLM 2001f, USGS 2002). Preliminary results from a 2003 survey indicate a southwest willow flycatcher was found at Cave Springs (Galvin 2003). The southwestern willow flycatcher may occur at Paradise Springs and as a migrant in the Study Area.

The **yellow-billed cuckoo** (*Coccyzus americanus occidentalis*) is state listed as endangered and a candidate for federal listing. Yellow-billed cuckoos have one of the most restrictive suites of macro-habitat requirements of any bird species. The habitat type, size, and configuration are extremely important. During the breeding season in California, yellow-billed cuckoos are confined to cottonwood-willow riparian habitat (BLM 2002u).

Yellow-billed cuckoos have a wide distribution throughout North America. They breed from the West Indies and the northern third of Mexico, north to extreme southern Canada, and winter from northern South America, south to northern Argentina, primarily east of the Andes. The western subspecies, the California yellow-billed cuckoo (*C.a. occidentalis*), has a much smaller range and more restrictive habitat requirements. It breeds in California, Idaho, Utah, Arizona, New Mexico, Texas, possibly

Nevada, and western Colorado at dispersed locations where suitable habitat is located. The majority of yellow-billed cuckoos in California are found along the upper Sacramento River and at the South Fork Kern River, with the remaining cuckoos at other various locations, including the Mojave River near Hodge, southwest of the Study Area. Cuckoos have been observed during the breading season along the Mojave River between Victorville and Barstow. However, there are no confirmed nesting areas within this region of the Mojave Desert. Yellow-billed cuckoos could occur at any desert oasis with willow and cottonwoods, although there are very few records of migrant yellow-billed cuckoos in the vicinity (BLM 2002u). Yellow-billed cuckoos have the potential to occur at Paradise Springs or as migrants throughout the Study Area.

The **bald eagle** (*Haliaeetus leucocephalus*) is state listed as endangered, federally listed as threatened, and fully protected by the Bald and Golden Eagle Protection Act (16 U.S.C. §§668-668d). It was proposed for de-listing from federal status on July 6, 1999. The bald eagle is our national symbol and one of North America's largest birds. In California, bald eagles may be found throughout the state at lakes, reservoirs, rivers, and some rangelands and coastal wetlands during the winter months. In the winter, they roost communally in dense, sheltered remote conifer stands. The breeding habitats in California are mainly in mountain and foothill forests and woodlands near lakes, rivers, and reservoirs. Most breeding territories are in northern California; however, bald eagles also nest at a few scattered locations in the Sierra Nevada Mountains and foothills, at several locations, from the central coast to inland southern California, and on Santa Catalina Island. Bald eagles perch high on large limbs in tall trees, in broken-topped trees, on snags, or on rocks near water (CDFG 2002a).

The range of the bald eagle occurs entirely within North America, including Alaska, Canada, the lower 48 states, and northwest Mexico. Bald eagles are fairly common as local winter migrants at a few favored inland waters in southern California, which include Big Bear Lake, Cachuma Lake, Lake Mathews, Nacimiento Reservoir, San Antonio Reservoir, and along the Colorado River (CDFG 2002a). The bald eagle has been observed at Harper Lake, at the Piute Ponds on Edwards AFB, along the Mojave River, and in the Cady Mountains southwest and south of the Study Area (BLM 2002v, CDFG 2002a). The Study Area does not contain habitat that is likely to support bald eagles. The bald eagle may occur as a migrant in the Study Area. <u>The likelihood of occurance of the bald eagle in the study area is low.</u>

The **least bell's vireo** (*Vireo bellii pusillus)* is federally listed as endangered and state listed as endangered. The least Bell's vireo is a small songbird associated with riparian habitats. The least Bell's vireo typically breeds in willow riparian forest supporting a dense, shrubby understory of mulefat and other mesic species. They have also been observed to use oak woodland with a willow riparian understory. Individuals sometimes enter adjacent chaparral, coastal sage scrub, or desert scrub habitats to forage. The least Bell's vireos in California occur in riparian forest dominated by willows and tend to avoid riparian areas dominated by non-native salt cedar (*Tamarisk ramosissima*) (BLM 2002u).

The least Bell's vireo breeds in southwestern California and adjacent northwestern Baja California. It largely occurs in southern California, but it does extend into areas along

the western flank of the Anza-Borrego Desert (San Diego County), in the vicinity of Palm Springs (Riverside County), in Leona Valley (Los Angeles County), in Morongo Valley (San Bernardino County), and along the Mojave River. There are breeding records for this subspecies north in the southern Owens Valley (Inyo County), and it regularly breeds just northwest at the South Fork Kern River Preserve. Elsewhere in the West Mojave Desert, the least Bell's vireo is an occasional migrant (BLM 2002u).

The eastern limit of the range of the least Bell's vireo in California is contentious, in that the ranges of the least Bell's vireo and the Arizona Bell's vireo (*V. b. arizonae*) in California are based more on supposition than on direct evidence. It is generally believed that the Arizona Bell's vireo is confined to the Lower Colorado River Valley, whereas the least Bell's vireo occurs in cismontane southern California and on the western edge of the deserts, extending north up the Mojave River into the Owens Valley, and eastward into Death Valley National Park, along the Amargosa River (Inyo County) and at Fort Piute in the East Mojave Desert (BLM 2002u). The breeding population along the Mojave River is south of the Study Area. The least Bell's vireos are potential migrants across the Study Area. They also have the potential to occur at Paradise Springs.

The sensitive bird species listed below have the potential to occur, or are known to occur, in the Study Area.

The **Bendire's thrasher** (*Toxostoma bendirei*) is a CSSC. It is found in desert scrub habitat. Within the Mojave Desert, it resides and breeds in flat areas of desert succulent shrub containing cactus, Mojave yuccas, and Joshua tree woodlands. The Bendire's thrasher breeding range includes southeastern California, southern Nevada, Arizona, and western New Mexico, and it winters from southern Arizona south into Mexico (BLM 2003b, CDFG 2003b, Udvardy and Farrand 1995). Occupied habitat within the Mojave Desert in 1986 consisted of six disjunct populations: Yucca Valley, Kelso Valley, Coolgardie Mesa, Joshua Tree National Park, southeastern Apple Valley, and northern Lucerne Valley. However, surveys conducted in 2001 failed to detect Bendire's thrasher at most of these locations or at a control site in the east Mojave Desert. Nesting birds were observed at Fort Irwin, Coolgardie Mesa, and Joshua Tree National Park (BLM 2001f). Bendire's thrashers may occur within the western portion of the Study Area.

The **California horned lark** (*Eremophila alpestris actia*) is a CSSC. California horned larks are resident to a variety of open habitats with low, sparse vegetation, typically without trees and large shrubs. The range of California horned larks includes most of North America. California horned larks are yearlong residents within the state and are found from grasslands along the coast and deserts near sea level to alpine dwarf-shrub habitat above the tree-line. They are less common in the North Coast mountain regions and in coniferous or chaparral habitats. Flocks of the desert lowlands and other areas of California are augmented by winter visitants, many migrating from outside of the state (CDFG 2002a). California horned larks have been observed within the Study Area and are likely permanent residents (BLM 1996a).

The **northern harrier** (*Circus cyaneus*), formerly called the marsh hawk, is a CSSC. Northern harriers breed in open wetlands, pastures, fallow fields, uplands, prairies,

agricultural lands, and desert shrub-steppe habitats. Habitats occupied in their wintering range are slightly broader and include both wetland and a variety of upland habitats with low vegetation. The northern harrier's breeding range extends across North America and Eurasia, south into the U.S. to Baja California, the southern Great Plains, and the mid-Atlantic Coast. The northern populations are migratory, with a winter range extending south throughout the breeding range to Central America. It is a widespread migrant and winter visitor in California. Documented northern harrier breeding sites in the area include the Piute Ponds on Edwards AFB, Fort Irwin, and Harper Lake, southwest of the Study Area. Wintering birds have been observed in Lancaster, NAWS China Lake, and along the Mojave River near Victorville (BLM 2002u). The northern harrier was observed foraging in the eastern portion of the Study Area and is expected to occur throughout the area (Chambers 1992c). The northern harrier is commonly observed in the alfalfa fields between Hinkley and Newberry Springs. It is likely to occur as a migrant and winter visitor in the Study Area.

The **prairie falcon** (*Falco mexicanus*) is a CSSC. Prairie falcons breed from Canada south through the western half of the U.S. into Mexico and winter throughout their breeding range. Habitat for the falcon includes barren mountains, prairies, perennial grasslands, savannahs, rangeland, some agricultural fields, and desert scrub (CDFG 2003b, Udvardy and Farrand 1995). Prairie falcons nest on cliffs in rugged mountain ranges, usually within a half-mile of a water source. They are found throughout the western Mojave Desert (BLM 2003b). Prairie falcons have been observed foraging near the eastern portion of the Study Area in the Avawatz Mountains (Chambers 1992c). Prairie falcons are likely residents, as well as winter visitors, in the Study Area. Prairie falcons may roost and nest in the mountain ranges of the Study Area.

The **LeConte's thrasher** (*Toxostoma lecontei*) is a CSSC and is a BLM sensitive species. LeConte's thrasher inhabits desert flats; washes and alluvial fans characterized with scant vegetation, usually cholla and creosote bush, and sandy or alkaline soils. If available, golden cholla is preferred for nest sites. However, in some areas, allscale is the only suitable host plant for nesting. LeConte's thrasher is a non-migratory bird that is endemic to southern California, southern Nevada, southwestern Utah, western and central Arizona, and northwestern Mexico. It is found in desert scrub across the Mojave Desert of California. It occurs in the Antelope Valley (Los Angeles County), north to Ridgecrest and NAWS China Lake (Kern County). It also occurs along the northern base of the San Bernardino and San Gabriel Mountains, throughout Joshua Tree National Park and into the Owens and Panamint valleys (BLM 2002u, Udvardy and Farrand 1995). It has been observed throughout the Study Area (Chambers 1992c, BLM 2002v, CNDDB 2002). LeConte's thrashers occur within the Study Area and are potential resident year round.

The **loggerhead shrike** (*Lanius ludovicianus*) is a FSOC and a CSSC. It occupies arid and semi-arid habitat throughout lowlands with suitable hunting perches. Densely vegetated areas are avoided. The loggerhead shrike's range extends across North America, from Canada to southern Mexico. Breeding birds in California deserts probably remain as residents, while migrating loggerhead shrikes arrive in these areas in winter. Loggerhead shrikes are widely distributed throughout the Mojave Desert (BLM

2002u). Loggerhead shrikes were observed throughout the Study Area (BLM 1996a). The entire Study Area lies within the species' range, and it is likely a permanent resident.

The **burrowing owl** (*Athene cunicularia*) is a BLM sensitive species, a CSSC, and a FSOC. Within California, burrowing owls are found in open dry habitats, including grasslands, prairie, and desert floors. Burrowing owls breed from Canada south through most of the western U.S. and Central America, to the southern tip of South America. Northern populations migrate to the southern extent of their breeding range, while southern populations are largely non-migratory. Burrowing owls within the Mojave Desert are largely resident. The burrowing owl has been observed at locations south and southwest of the Study Area, including Harper Lake, Edwards AFB, Fort Irwin, and several locations along the Mojave River near Barstow. It has also been observed within the Study Area and is most likely a permanent resident (BLM 1996a, BLM 2002u, BLM 2002v, Chambers 1992c). The burrowing owl was petitioned for state listing as threatened or endangered by a coalition of conservation groups in April of 2003.

The **golden eagle** (*Aquila chrysaetos*) is a CSSC and fully protected under the federal Golden Eagle Protection Act of 1962. Golden eagles are found in open terrain habitats, including grasslands, deserts, savannahs, and early successional stages of forest and shrub habitats. They nest on cliffs and in large trees in open areas. Golden eagles breed from Alaska east across northern Canada and south to Mexico. They winter in the southern part of their breeding range (CDFG 2002a, Udvardy and Farrand 1995). Golden eagles have been observed southwest of the Study Area in the Cady Mountains and may occur to forage or roost throughout the Study Area (BLM 2002v).

Mammals

Nelson's bighorn sheep (*Ovis canadensis nelsoni*), or Desert bighorn sheep, is a fully protected state status species. Nelson's bighorn sheep have light brown fur, permanent horns, and generally have a stocky build, with short legs and a low center of gravity. These traits enable them to escape predators in rocky and mountainous terrain. Desert bighorn sheep inhabit rocky areas that are generally sparsely vegetated and characterized by steep slopes, canyons, and washes, primarily above the desert floor, on or near mountainous terrain (BLM 2002u).

In the region surrounding the Study Area, there are three meta-populations, with geographic boundaries now formed by major fenced highways. The North Mojave Desert meta-population occurs north of I-15; the Central Mojave Desert meta-population occurs between I-15 and I-40; and the South Mojave Desert metapopulation occurs south of I-40. The North Mojave meta-population includes an augmented native population in the Avawatz Mountains, with a range of approximately 51-100 individuals (BLM 2002u). The Avawatz Mountains span the northeast corner of Fort Irwin, with the southern portion of the Avawatz Mountains in the eastern portion of the Study Area. Nelson's bighorn sheep have been observed in the Avawatz Mountains within current Fort Irwin boundaries (CNDDB 2002). Nelson's bighorn sheep may occur in the eastern portion of the Study Area.

The **California leaf-nosed bat** (*Macrotus californicus*) is a CSSC. California leaf-nosed bats roost in rocky, rugged terrain, with mines and caves, and forage on neighboring flats and washes. Day roosts include deep mine tunnels or caves, and occasionally, buildings or bridges. Day roosts must provide shelter from heat and aridity. Night roosts include mines, rock shelters, buildings, bridges, or other sites with overhead protection. California leaf-nosed bats are found in lowland desert areas and coastal basins. Inhabited desert associations include desert riparian, desert wash, desert scrub, desert succulent shrub, alkali desert scrub, and palm oasis habitats. The California leaf-nosed bat range extends from southern Nevada, southern California, and western Arizona south through Baja California Sur and Sonora, Mexico. Within southern California, the California leaf-nosed bats are found in Riverside, Imperial, San Diego, and San Bernardino counties. California leaf-nosed bats are active yearlong and inhabit different roost sites in winter and summer. Some individuals are yearlong residents, whereas other individuals probably migrate to Mexico in the winter (CDFG 2003b). California leaf-nosed bats were observed and/or detected in several mines in the Avawatz Mountains (Brown 1996). This documented location represents a northward extension of the species' known range by approximately 100 miles. The California leaf-nosed bat may occur in mines or caves throughout the Avawatz Range in the eastern portion of the Study Area.

The **pallid bat** (*Antrozous pallidus pallidus*) is a CSSC. Pallid bats are found in desert and grassland habitat. Day roosts include crevices in rocks, mines, and manmade structures, and the pallid bat often uses shallow caves, cliff overhangs, or other shelters as night roosts. The pallid bat's range extends from southern British Columbia to central Mexico along the western U.S. and east to Kansas and Oklahoma (Sevilleta 2003). The desert subspecies (*A. p. pallidus*) occurs on Fort Irwin (Brown 1994). Pallid bats were also observed in the area during a study conducted in 1995 (Brown 1996). Bats were observed at night roosting in three different mine shafts in the vicinity of Silurian Valley northeast of the Study Area and Fort Irwin. A maternity colony of at least 20 pallid bats was observed in a mine in the Silurian Hills northeast of the Study Area. Pallid bats have been documented at Sheep Creek in the Avawatz Mountains and at Amargosa Springs. Pallid bats were found at night roosting in mines on or near the boundaries of Fort Irwin and Goldstone. One potential maternity roosting site was identified in a mine west of Denning Springs in the Avawatz Mountains just north of the Fort Irwin boundary (Brown 1994). Pallid bats may be found in various mines throughout the Study Area and may roost in areas with granite boulders and cliff faces, such as the Avawatz Mountains in the eastern portion of the Study Area, the Alvord Mountains in the southern portion of the Study Area, and throughout Goldstone, adjacent to the western portion of the Study Area.

The **spotted bat** (*Euderma maculatum*) is a CSSC. Spotted bat roosting sites include crevices in cliff faces. Spotted bats have a scattered distribution in California, with recorded locations at Mecca in Riverside County, Yosemite, and the Sierra Nevada. The spotted bat was listed as a species potentially occurring on Fort Irwin and the proposed maneuver expansion area but was not detected in the 1993-1994 or 1995 surveys (Brown 1996). Spotted bats may occur in the steep cliffs of the Avawatz Mountains.

The **Townsend's big-eared bat** (*Corynorhinus townsendii = Plecotus townsendii*) is a CSSC. Townsends's big-eared bats use caves, mines, tunnels, buildings, and other manmade structures for roosting. Separate sites are often used for day, night, hibernation, and maternity roosts. Hibernating roosting sites are cold but not below freezing, whereas, maternity roosting sites are warm. Townsend's big-eared bats are found throughout California in all but sub-alpine and alpine habitats and are most common in mesic sites (CDFG 2003b). The Townsend's big-eared bat was listed as a species potentially occurring on Fort Irwin and was detected in the area in a 1994 survey. Townsend's big-eared bats were observed during the day, roosting in the summer and hibernating in the winter, in various mines on or near the boundaries of Fort Irwin and Goldstone (Brown 1994). During the 1995 survey, Townsend's big-eared bats, several males and a small maternity colony of females, were observed during the day roosting in mines in the vicinity of Amargosa Springs. Townsend's big-eared bats may occur at various mines throughout the Study Area.

The **Western (California) mastiff bat** (*Eumops perotis californicus*) is a CSSC. The western mastiff bat roosts in crevices in cliff faces or granite boulders (Brown 1994). It resides in open, semi-arid habitats, including conifer and deciduous woodlands, coastal scrub, annual and perennial grasslands, palm oases, chaparral, desert scrub, and urban areas. The range of the western mastiff bat extends from central California south to central Mexico. Western mastiff bats have been recorded in Butte County, southward in western lowlands, through southern California coastal basins and the western portions of the southeastern desert region (CDFG 2003b). The western mastiff bat was listed as a species potentially occurring on Fort Irwin and was detected in a 1994 survey (Brown 1994). It was also listed as potentially occurring on the proposed Fort Irwin and NTC maneuver expansion area at the time but was not detected in the 1995 survey (Brown 1996). Western mastiff bats may occur in the Study Area and may roost in areas with granite boulders and cliff faces, such as the Avawatz Mountains in the eastern portion of the Study Area, the Alvord Mountains in the southern portion of the Study Area, and throughout Goldstone adjacent to the western portion of the Study Area.

The **Mohave ground squirrel** (*Spermophilus mohavensis*) is listed by the State of California as threatened. It is a medium-sized ground squirrel that is diurnal, exhibits a seasonal cycle of activity, and uses burrows for cover. The Mohave ground squirrel occupies all major desert scrub habitats in the western Mojave Desert. It has been observed in the following habitats, which are found throughout its range: Mojave creosote scrub, desert saltbush scrub, desert sink scrub, desert greasewood scrub, shadscale scrub, and Joshua tree woodland. In the northern portion of its range, the Mohave ground squrriel is found in Mojave mixed woody scrub. It inhabits areas with flat to moderate terrain and is not generally found in steep contours. The species has been found most frequently in sandy, alluvial soils; it is also found in gravelly, and occasionally rocky soils. Specific habitat requirements include the availability of food resources and soils with appropriate composition for burrow construction. The presence of shrubs that provide a reliable food source during drought years may be critical for a population to persist in a particular area (BLM 2002u, CDFG 2002a). Please see Figure 3.5-6 for a map of the Mohave ground squirrel range and known populations.

The Mohave ground squirrel occupies portions of Inyo, Kern, Los Angeles and San Bernardino counties in the western Mojave Desert. The species ranges from Palmdale (Los Angeles County) in the southwest to Olancha (Inyo County) in the north. The northern extent of its range includes the Coso Range and the Argus Range (Inyo County) in the northwest and the Avawatz Mountains and the Soda Mountains (San Bernardino County) in the northeast. The southern extent of its range includes Palmdale in the southwest and the Mojave River in the southeast. The San Bernardino and San Gabriel Mountains limit the species' distribution further south. The Study Area is in the range of the Mohave ground squirrel. Mohave ground squirrels have been observed in the southern and southwestern portions of the Study Area (BLM 2002u, CNDDB 2003).

Various Environmental Assessments (EA), BAs, EISs, and Conservation Plans have considered a number of sensitive plant and animal species as potentially occurring within the region. Additional species can be found in Volume II, Appendix D.

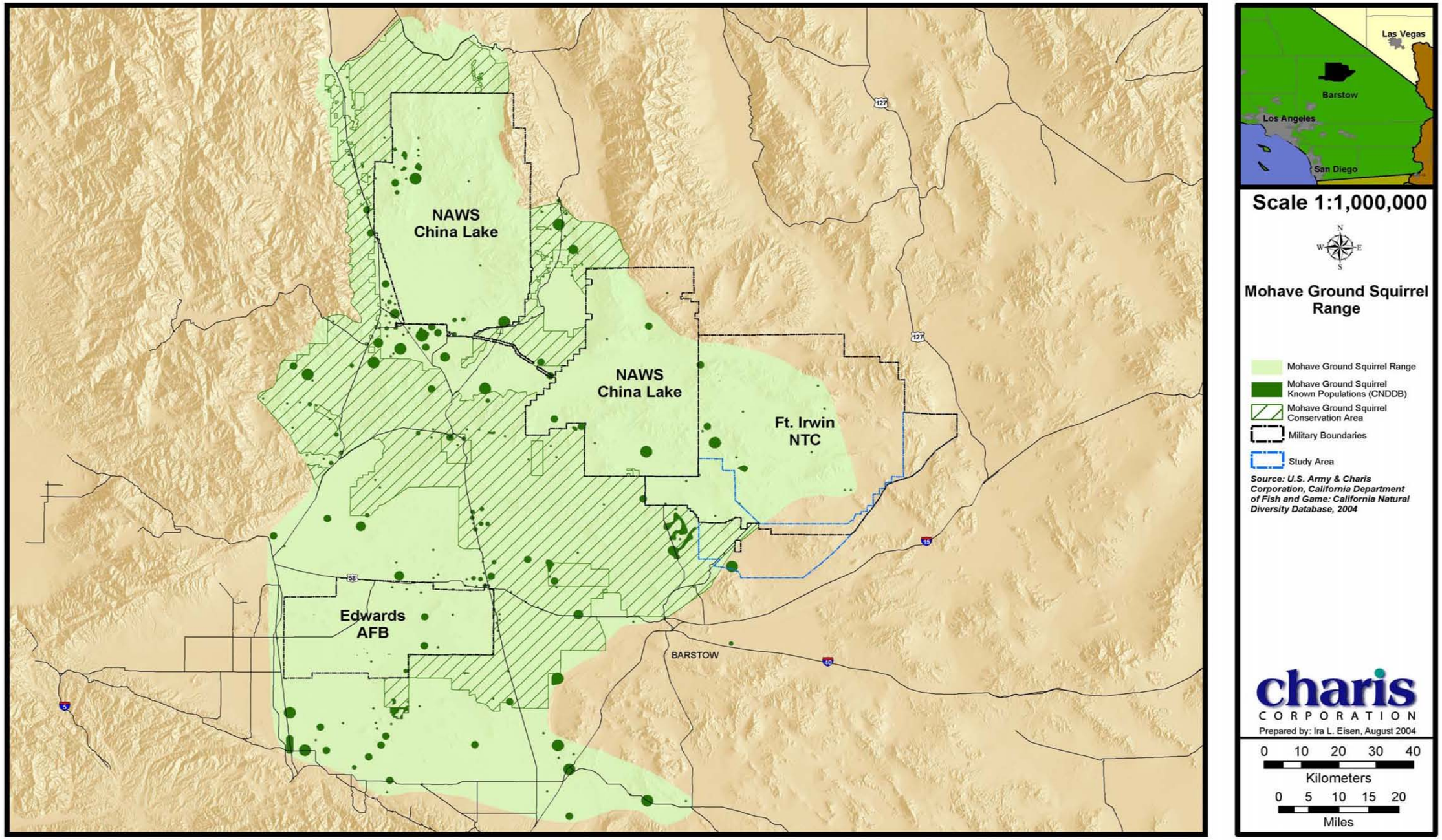

Figure 3.5-6: Mohave Ground Squirrel Range

3.5.4 Introduced Wildlife Species

Birds

The **Chukar** (*Alectoris chukar*) was introduced to the desert as a game bird. It is a quail-like ground dwelling bird that relies on surface water. It has been introduced at various Goldstone and Fort Irwin facilities, where it survives near leaking water pipes.

Mammals

Burros were introduced to the Mojave Desert in the late 1800s. There is an estimated population of 100 burros in the northern portion of Fort Irwin and the NTC (personal communication with Mickey Quillman 2002). Free-roaming burros have the potential to occur within the Study Area outside of Fort Irwin borders. Burros were observed, and their tracks were seen, in Superior Valley during plant surveys in 2003 (personal communication with Mark Hessing 2003).

The Wild Free Roaming Horse and Burro Act of 1971 (16 U.S.C. §1331-1340 *et seq.*) protects "unbranded and unclaimed horses and burros on public lands of the United States" from capture, branding, harassment, or death. As dictated by the law, the BLM manages wild horses and burros on public rangelands and is responsible for protecting and preserving wild horses and burros and maintaining healthy rangelands. Public lands include those administered by the Secretary of the Interior through the BLM or by the Secretary of Agriculture through the Forest Service, but does not include DoD lands.

3.5.5 Summary of the Biological Assessment and Opinion

3.5.5.1 Biological Assessment

The complete findings of the Biological Assessment can be found in Volume II, Appendix B, as only a brief summary is provided here. The Biological Assessment estimated a take of approximately 1,000 desert tortoise (including translocated animals) and possible impacts to approximately 120,770 acres of potential desert tortoise habitat near the edge of the species range of which approximately 87,300 acres are designated critical habitat. The Biological Assessment estimated a take of approximately 6,660 acres of known habitat to include habitat degradation and potential loss of Lane Mountain milk-vetch plants. Based on projected intensity of training in Lane Mountain milk-vetch habitat areas, the expected loss is approximately 25 percent of the known habitat. The project was found to likely adversely affect the desert tortoise and Lane Mountain milk-vetch and desert tortoise designated critical habitat. The USFWS desginated zero acres of habitat as critical habitat. However, proposed mitigation, conservation, and compensation measures incorporated into the project would mitigate for impacts and contribute to the long-term survival and recovery of these species.

The Biological Assessment included proposed mitigation to offset the potential impacts of the proposed project. Proposed desert tortoise mitigation includes: consolidating land ownership by purchasing private lands for protection of the species by focusing on lands in the DWMAs; avoiding direct impacts to approximately 16,900 acres of desert

tortoise habitat on Fort Irwin by designating it as conservation or off-limits areas from training; eliminating direct impacts of cattle grazing on desert tortoise habitat and permitting its recovery by acquiring fee owned ranch property with associated relinquishment of grazing privileges; assisting towards closure and rehabilitation of dirt roads and trials to increase the habitat values associated with the adjacent DWMAs and critical habitat; placing fencing in critical locations; implementing a translocation program for the desert tortoise; and providing education. Proposed Lane Mountain milk-vetch mitigation includes: preservation of occupied habitat on Fort Irwin by designating them as conservation areas and the proposed land acquisition outside of the Fort Irwin boundaries to place all known Lane Mountain milk-vetch habitat into public ownership. Importantly, each conservation area also includes buffer zones where plants may occur but have not been detected. This is important because buffer zones not only address survival of the species, but also allow for recovery. In addition, closure and rehabilitation of dirt roads and trails on BLM managed lands focused in the proposed Lane Mountain milk-vetch ACEC on Collgardie Mesa will provide for the recovery of the species.

3.5.5.2 Biological Opinion

The USFWS service issued a Biological Opinion in March 2004 (1-8-03-F-48). The Biological Opinion estimated that approximately 1,150 to 1,200 adult desert tortoise occupy the withdrawn area. The USFWS found that the Army's proposal to search the Superior Valley and UTM 90 parcels may make approximately 910 adult desert tortoise available for translocation. The USFWS estimates that approximately 425 adult desert tortoise may be killed as a result of the proposed action. They do not expect those 425 desert tortoise to "... appreciably reduce the ability of the species to survive and recover in the Western Mojave Recovery Unit" (USFWS 2004). There may be an impact to approximately 5.15 percent of designated critical habitat in the Western Mojave Recovery Unit (USFWS 2004). To offset this loss of critical habitat, the Army proposes to acquire private lands within DWMAs and fee owned ranch lands with associated relinquishment of grazing privileges. In regards to Lane Mountain milk-vetch, the USFWS found that the three occurrences on Fort Irwin (The NTC-Gemini, Brinkman Wash – Montana Mine, and the Paradise Valley occurrences) total approximately 11, 390 acres on Fort Irwin. Of that, approximately 6,790 acres will be placed off-limits to Army training. Proposed training lands would result in the loss of approximately 4,600 acres or approximately 21.5 percent of the known habitat for the species (USFWS 2004). The USFWS, while noting that the impacts of training to Lane Mountain milk-vetch and its habitat are substantial, found that the remaining populations support a "dense aggregate of plants and is sufficiently large enough for the ecosystem to persist" (USFWS 2004).

The Biological Opinion found that "...the addition of training lands at Fort Irwin is not likely to jeopardize the continued existence of the desert tortoise and Lane Mountain milk-vetch or to destroy or adversely modify critical habitat of the desert tortoise" (USFWS 2004). The USFWS decision was based on the following reasonable and prudent measures:

- The Army must ensure that only qualified personnel are allowed to handle desert tortoise.
- The Army must develop procedures to reduce the take of desert tortoise during the preparation of the new training lands for military exercises.
- The Army must ensure that all personnel using vehicles to mark boundaries within habitat of the desert tortoise receive instruction on their responsibilities with regard to protection of the species.
- The Army must provide specific information on the procedures that will be implemented to translocate desert tortoises.
- The Army must develop a set of procedures that would be followed is a desert tortoise is encountered during military exercises (USFWS 2004).

In addition to the obligatory reasonable and prudent measures, the USFWS suggested non-obligatory conservation measures which can be found on page 65 of the Biological Opinion in Appendix C. Fort Irwin has proposed most of the non-obligatory conservation measures as mitigation measures to offset impacts of the proposed action.

After the USFWS issued a Biological Opinion, and pursuant to the *Key Elements Report* to Congress, a Working Group, comprising staff from the Army, USFWS, CDFG, USGS, and the BLM was formed to evaluate proposals for land acquisition and other conservation measures. This was done to ensure that appropriate criteria are met to provide for adequate conservation of species and reduce or offset the impacts of the proposed expansion. Mitigation measures that are being evaluated by the group include; land acquisition, a translocation plan for the desert tortoise, fencing, route closures and rehabilitation, research and data collection, land management assistance, conservation set-asides, limiting factor control, adaptive management, and desert tortoise management group funding.

3.5.5.3 Current Situation after Key Court Decisions

After successful completion of formal consultation on the proposed action, in which the US Fish and Wildlife Service (Service), through the Ventura Fish and Wildlife Office, issued a No-jeopardy *Biological Opinion for the Proposed Addition of Maneuver Training Lands at Fort Irwin, California (1-8-03-F-48)* (BO), court decisions in the United States Court of Appeals for the Ninth Circuit, Gifford Pinchot Task Force v. United States Fish and Wildlife Service, No. 03-35279 (9th Cir. 2004) and the Federal District Court for the northern district of California, Center for Biological Diversity v. US Fish and Wildlife Service, Civ No. 03-03807/ 03-02509 SI (N.D. CA 2004), have invalidated the Service's definition of "adverse modification" of critical habitat published at 50 CFR 402.02 (2004). In both cases, the courts also invalidated the BOs at issue since they were developed in reliance upon the invalid "adverse modification" standard, and such reliance did not amount to "harmless error." The BO invalidated in American Motorcycle Association involved consideration of the effects to DT designated critical habitat associated with the

Bureau of Land Management's (BLM) proposed amendment to the California Desert Conservation Area Plan.

None of the conditions requiring reinitiation of formal Section 7 consultation for the proposed action set forth in the BO's reinitiation notice have occurred. The BO, and the administrative record upon which it is based, including the Army's Biological Assessment (Charis Professional Corporation 2003) (BA), continue to reflect the best available commercial and scientific information concerning the biological status of the DT and LMMV and the effects of the proposed action on both species and designated critical habitat for the DT. The Army has not amended the proposed action. It has not exceeded permitted incidental take of DT. No new species has been listed; nor has new critical habitat been designated.

While we remain confident that the BO accurately discloses the effects of the proposed action on the listed species and designated critical habitat and reaches well-supported conclusions, the Service does not clearly state whether it used its existing "destruction or adverse modification" standard or the more protective recovery-based standard in reaching its conclusions in the Ft. Irwin BO. For this reason, the Army is currently reviewing what steps it must take in regard to the existing Biological Opinion and its administrative record, including the Army Biological Assessment (BA). The Army seeks re-affirmation that the proposed action is not likely to result in a direct or indirect alteration of DT critical habitat in a manner that will appreciably diminish the value of that habitat for either survival or recovery.

3.6 Cultural Resources and Paleontology

This section presents the existing conditions that can be found in the Study Area for cultural and paleontological resources. The ROI for cultural and paleontological resources is the west Mojave Desert in California and the western and eastern banks of the Colorado River that lie within the Mojave Desert. The information provided in Section 3.6 and 4.6 of this document were gathered from a variety of sources including: the Fort Irwin Cultural Resources Database, the California Historic Resources Inventory System (CHRIS), record and literature reviews conducted at the BLM Resource Area Office in Barstow and the Archaeological Information Center at the San Bernardino County Museum. The information presented is largely based on a number of cultural and paleontological resource studies conducted on behalf of the U.S. Army by Far Western Anthropological Group, Inc.; Brian F. Mooney Associates of San Diego, CA; ASM Affiliates of Encinitas, CA; and TRC of Salt Lake City, Utah (TRC 2003, Byrd 1998, Byrd and Pallette 1994).

3.6.1 Cultural Resources

Department of Defense Instruction 4715-3 defines cultural resources as buildings, structures, sites, districts, and objects that are eligible to be or included on the National Register of Historic Places (NRHP) (DoD 1996).

The statutes and regulations that pertain to the management of cultural resources on U.S. Army installations are listed below:

Statutes

- American Indian Religious Freedom Act of 1978 (42 U.S.C. §1996)
- American Antiquities Act of 1906 (16 U.S.C. § 431-433; 36 C.F.R. § 79)
- Archaeological and Historic Data Preservation Act of 1974 (16 U.S.C. § 469-469c)
- Archaeological Resources Protection Act of 1979 (16 U.S.C. § 470aa-470ll; 36 C.F.R. § 79)
- Historic Sites, Buildings and Antiquities Act of 1935 (16 U.S.C. 461 *et seq.*)
- National Environmental Policy Act (42 U.S.C. § 4321 *et seq*)
- National Historic Preservation Act of 1966 (16 U.S.C. § 470-470w)
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001-3013)
- Public Building Cooperative Use Act of 1976 (40 U.S.C. § 601-619)

Executive Orders

- EO 11593 – Protection and Enhancement of the Cultural Environment
- EO 13007 – Indian Sacred Sites
- EO 13175 – Consultation and Coordination With Indian Tribal Governments
- EO 13327 – Federal Real Property Management

Presidential Memoranda

- Government-to-Government Relations with Native American Tribal Governments

Federal Regulations and Guidance

- Advisory Council on Historic Preservation (ACHP), Protection of Historic Properties, (36 C.F.R. § 800)
- Council on Environmental Quality, Regulations Implementing the Procedural Provisions of the National Environmental Policy Act, (40 C.F.R. §§ 1500-1517)
- Department of the Interior, Curation of Federally-owned and Administered Archaeological Collections, (36 C.F.R. § 79)
- Department of the Interior, Determinations of Eligibility for Inclusion in the National Register of Historic Places, (36 C.F.R. § 63)
- Department of the Interior, National Historic Landmark Program, (36 C.F.R. § 65)
- Department of the Interior, National Register of Historic Places, (36 C.F.R. § 60)
- Department of the Interior, Preservation of American Antiquities, (43 C.F.R. § 3)
- Department of the Interior, Supplemental Regulations [per ARPA], (43 C.F.R. § 7)
- Department of the Interior, Waiver of Federal Agency Responsibility under Section 110 of the National Historic Preservation Act, (36 C.F.R. § 78)
- Department of the Interior, The Secretary of the Interior's Standards for the Treatment of Historic Properties, (36 C.F.R. § 68)

Military Regulations and Guidance

- Department of Defense, Protection of Archaeological Resources, (32 C.F.R. § 229)

- Department of Defense, American Indian and Alaskan Native Policy (DoD 1998)
- Army Regulation 200-1, Environmental Protection and Enhancement (DA 1997a)
- Army Regulation 200-4, Cultural Resources Management (DA 1998)
- Department of Defense Instruction 4715-3, Environmental Conservation Program, Under Secretary of Defense for Acquisition and Technology (DoD 1996).

Of the 506 sites within the Study Area, 20 different site type varieties have been identified. Prehistoric resource types include lithic scatters, lithic reduction sites, lithic quarries, campsites, habitation sites, food processing sites, rockshelters, rock art, rock alignments, stone circles, cleared circles, hearths, and trails. Historic resource types include mining sites, military sites, ranching sites, homestead sites, refuse disposal sites, campsites, rock alignments, roads, and trails.

Cultural resources located within the Study Area are fragile, nonrenewable resources representing thousands of years of human history. The importance of these sites lies in their ability to contribute information that can be used to develop a better understanding of human adaptation to an arid, marginal environment over a long period of time. Fort Irwin and the NTC manage the resources under their purview according to all applicable cultural resources laws and regulations.

3.6.1.1 Archaeological Investigations

The DA sponsored archaeological investigations within the current expansion Study Area and previously considered areas. The studies were completed to ensure compliance with the federal historic preservation laws and regulations noted above regarding the transfer and management of cultural properties. Investigations were also conducted to gain a more refined understanding of the cultural resources located in the project area and the roles these resources might have played within past human behavioral systems, so as to prepare properly an impact analysis for the action.

3.6.1.2 Inventories

Figure 3.6-1 shows the areas that have been inventoried for cultural resources within the Study Area. Cultural resource inventories have been conducted on Fort Irwin on a case-by-case basis based on training needs, with the majority of survey work conducted within the Installation's active training areas – areas where cultural resources are at a greater risk of significant ground disturbance. These areas are primarily situated within basins and areas of moderate to low topographic relief. The vast majority of cultural resources work (inventory and evaluation) performed within the Study Area have been conducted on behalf of the DA.

Archaeological surveys previously conducted within the proposed Study Area have been sample surveys, covering only a portion of the Study Area (Figure 3.6-1). As a

result, the sites known and recorded as part of these surveys represent an undetermined portion of those that may be present.

Inventory History

Five primary phases of fieldwork have been conducted for the proposed project effort between 1988 and 2003, including three phases presented in stand-alone reports, and two phases of fieldwork reported by Byrd (1998a,b and 1994).

The geographical location of these studies is highly variable, but all were conducted adjacent to portions of the current Installation. A brief description of each of these studies is presented below.

Phase I

In 1988, Far Western Anthropological Group, Inc. (FWARG) of Davis, California, completed an overview of historic cultural resources and an archaeological survey design for the proposed Fort Irwin land expansion (Hall 1987b). A cultural resources survey was also undertaken by FWARG in an effort to generate reliable expectations regarding the distribution and composition of prehistoric and historic cultural resources within the proposed expansion area. Work consisted of a 24,000-acre survey of public lands within a 365,000-acre area adjacent to Fort Irwin. One prehistoric/historic site, 130 prehistoric sites, and 26 historic sites were recorded during the survey (Mikkelsen and Hall 1990).

Phase II

In 1993, Brian F. Mooney Associates (BFM) of San Diego, California conducted a survey in response to a change in alternatives proposed for the expansion. Approximately 150,000 acres, primarily within the Silurian Valley, were added to the Study Area (Byrd and Pallette 1994). Seven thousand acres, or approximately 4.7 percent of the Phase II Study Area, were surveyed.

The project area was divided into a series of geo-topographical sub-areas to ensure sampling within a variety of environmental regimes. This survey was largely conducted within lower lying alluvial contexts, although selected mountainous areas also were surveyed. Phase II resulted in the discovery and recording of 33 new sites: 14 prehistoric sites, 18 historic sites, and 1 prehistoric/historic site.

Phase III

In 1995, BFM was contracted to conduct approximately 16,130 acres of additional inventory within the Silurian Valley area. Using the Phase II methodology, the project area was divided into 23 geo-topographic domains to ensure sampling over a wide variety of environmental regimes. These domains were then classified into high, medium, low, or unknown sensitivity with respect to the distribution of archeological sites (Byrd et al. 1998). These categories were constructed using site distribution data from previous surveys and geomorphological mapping, which classified land surfaces with respect to type, age, and potential stability.

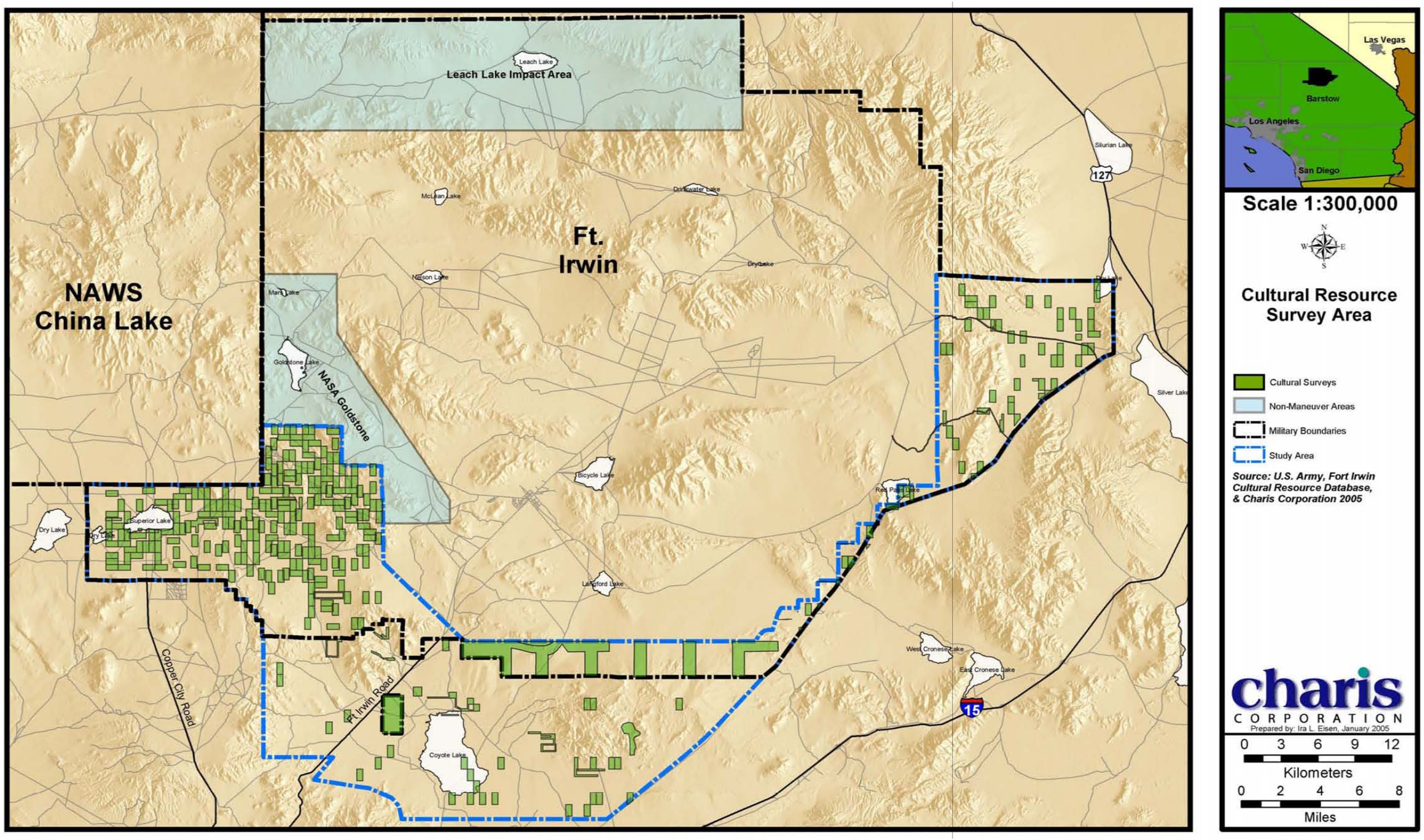

Figure 3.6-1: Cultural Resource Survey Areas

This work, which was completed and reported by ASM Affiliates, recorded 137 additional sites: 125 prehistoric sites, and 12 historic sites. A record and literature search of sites within the project area were also conducted (Byrd 1998).

Phase IV

In 1996, an additional approximately 39,800 acres within the Silurian Valley area was surveyed by ASM Affiliates. The primary objective of this survey was to refine the results obtained in previous phases by increasing the sample percentage to 25 percent for the unknown, low, and medium sensitivity areas created during the Phase III project (Byrd et al. 1988). Phase IV resulted in the recording of 199 new archaeological sites: 195 prehistoric sites; and 4 historic sites.

Phase V

In 2002, a cultural resource inventory and geomorphic characterization were conducted by TRC, Salt Lake City, Utah, in conjunction with the U.S. Army Corps of Engineers, Engineer Research and Development Center-Construction Engineering Laboratory (ERDC-CERL), Land and Heritage Conservation Branch. The study included an inventory of approximately 24,230 acres of the congressionally withdrawn land of Alternative I, to supplement surveys already done in the Silurian and Coyote portions of the Study Area.

At the time of publishing the SFEIS, Phase V represented the most recent and comprehensive cultural resources work done within the Study Area, as it combined intensive inventory with site evaluation in a single fieldwork phase. Phase V had four primary objectives: 1) refine and test an Archaeological Predictive Model (APM) constructed for use on all Fort Irwin and NTC managed land (Section 3.6.3); 2) obtain concrete archaeological and geoarchaeological data, including NRHP eligibility evaluation of all cultural resources within the project quadrants; 3) collect archaeological data that can be used by Fort Irwin to address significant archaeological research questions; and 4) provide other data and recommendations relevant to future management of cultural properties within the project area (TRC 2003).

Phase V recorded 231 new archaeological sites: 1,701 archaeological isolates and 2,043 military isolates. Military isolates are resources of military origin that are clearly older than 50 years. Eleven additional previously recorded sites were re-recorded during Phase V.

The fieldwork conducted as part of the five phases discussed above has significantly contributed to the understanding of the cultural resources located within the vicinity of Fort Irwin and the NTC. Four of the five phases (Phases I, III, IV, and V) have examined large portions of the current Study Area. The area examined during Phase II largely lies outside of the current Study Area within an alternative that is no longer under consideration. A small section of the Phase II project area does, however, lie within the current Study Area. Table 3.6-1 and Figure 3.6-2 provide a summary of the five phases.

Table 3.6-1 Summary of Investigations

TYPE OF SITE	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V
Prehistoric sites	130 sites	14 sites	125 sites	195 sites	166 sites
Historic sites/Roads	26 sites	18 sites	12 sites	4 sites	44 sites
Prehistoric/historic	1site	1 site	0 sites	0 sites	11sites
Military	0 sites	0 sites	0 sites	0 sites	9 sites
Historic/prehistoric/military	0 sites	0 sites	0 sites	0 sites	1 sites
Total Sites	**157**	**33**	**137**	**199**	**231**

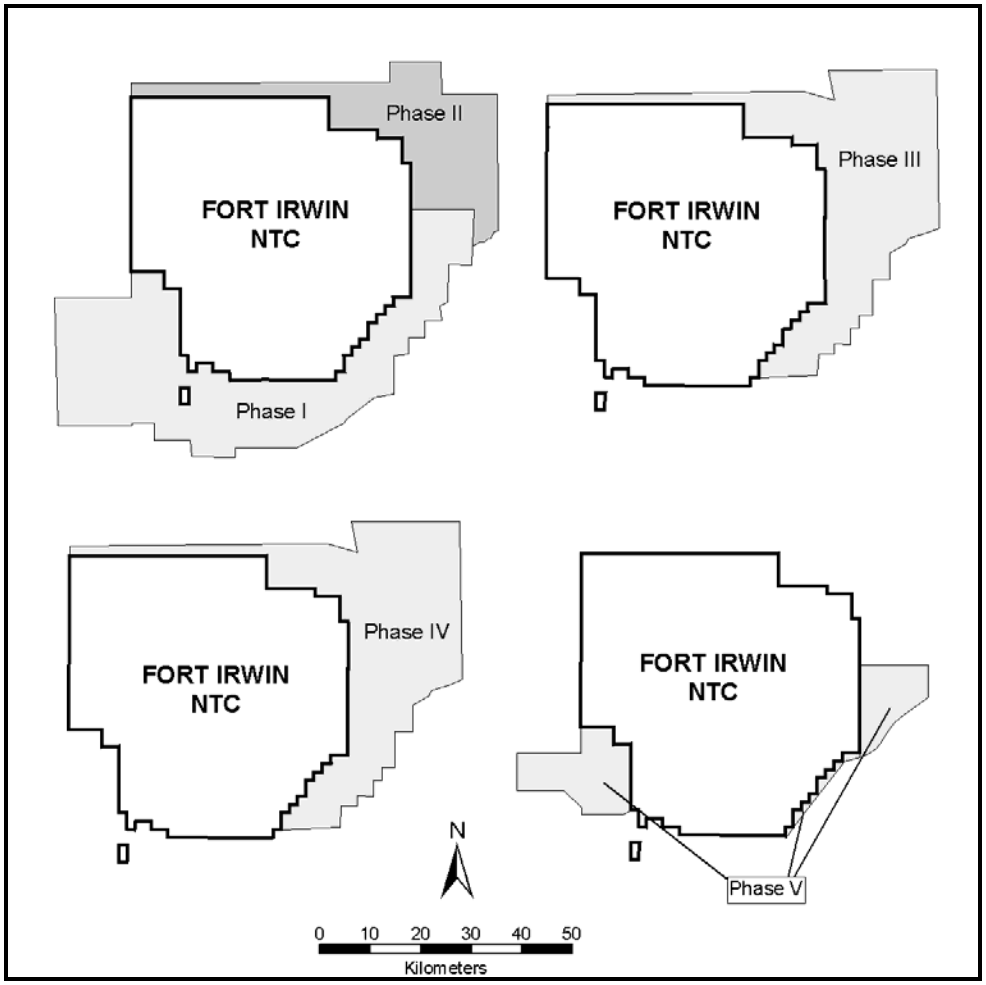

Figure 3.6-2 Fort Irwin Expansion Survey Study Areas

(Byrd et al 1998, Fort Irwin Cultural Resources 2003)

3.6.2 The National Register of Historic Places

The NRHP is authorized under the National Historic Preservation Act of 1966 (as amended), and administered by the National Park Service. The NRHP is part of a national program to identify, evaluate, and protect our cultural heritage.

The NRHP criteria serve as the basis for evaluating the significance of cultural resources. The NRHP eligibility criteria, as published in the *Federal Register* (November 16, 1981, 46(220): 50189) are:

- "The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
- that are associated with events that have made a significant contribution to the broad patterns of our history; or
- that are associated with the lives of persons significant in our past; or
- that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- that have yielded, or may be likely to yield, information important in prehistory." (36 CFR 60.4)

Cultural resource inventories often provide valuable archaeological data and provide clues for interpreting the age, cultural affiliation, function, and overall condition of archaeological sites.Those sites determined eligible for the NRHP in consultation with the State Historic Preservation Office (SHPO) are considered significant. Future mitigation will be required only for the historic properties determined eligible for the NRHP.

The NRHP eligibility must take into consideration regional research questions, resource integrity, the regional history, and the current status of knowledge (Hardesty and Little 2000).

3.6.3 Predictive Model

The DA is required to conduct cultural resource surveys and evaluations and implement appropriate mitigation measures to comply with federal cultural resource laws and regulations prior to the use of any acquired property. To facilitate cultural resource compliance activity with Fort Irwin managed land (which includes the congressionally withdrawn lands), an APM was developed by the U.S. Army Corps of Engineers (ERDC-CERL), in cooperation with Fort Irwin archaeologists and Desert Research Institute geomorphologists.

This tool was designed to streamline projects by characterizing favorable locales for archeological site potential and prioritizing areas for cultural resources investigation. The APM predicts areas where sites would have high, medium, or low probability of occurrence, based on key geomorphic variables relating to characteristics of the land surface that would have affected the initial placement and subsequent survival of cultural features. The development of the APM for Fort Irwin requires consideration of a variety of geomorphic factors that have potentially affected and constrained human use of the Mojave Desert landscape for at least 10,000 years. Ground truthing of the predictive model on Fort Irwin has shown it to have a greater than 70 percent accuracy.

3.6.4 Paleontology

Paleontological resources are fossils or assemblages of fossils that are unique, unusual, rare, uncommon, or diagnostically or stratigraphically important. Fossils are remains of prehistoric animal and plant life and are nonrenewable resources of scientific and educational value. These resources contribute important information that can be used to develop an understanding of the evolutionary history of living organisms. Paleontological resources are recognized as significant to our culture and are given federal, state, and local protection by the American Antiquities Act of 1906 (16 U.S.C. §§ 431-433).

Fossiliferous sediments in the Study Area date to the Triassic Era through the Pleistocene Era, from about 200 million to about 9,000 years ago. Most of the important fossil-bearing sediments were deposited during the Cenozoic Era, which is divided into two periods: the Tertiary Period (66 to 1.6 million years ago) and the Quaternary Period (1.6 million to 10,000 years ago); and the recent, or Holocene Period. The Tertiary Period is well represented in the Study Area, as is the Quaternary Period. Twenty-one million years of Tertiary Period history are recorded in sediments deposited in the basins created during that time as a result of crustal deformation related to activities along the San Andreas and Garlock faults.

Of the important fossil-bearing formations, the Barstow Formation is the most widely distributed. This formation has a high potential for yielding fossils. The Avawatz, Pickhandle, and Jackhammer Formations, while less extensive, also have the potential for yielding important vertebrate fossils: the Avawatz fossils of Pliocene age, and the Pickhandle and Jackhammer of Miocene age. The Moenkopi/limestone and the Aztec sandstone formations found in the Soda Mountains have the potential of yielding fossils dating to the early Triassic Era and Jurassic Era.

In addition to fossil-bearing formations, a number of basin sediment and gravel deposits have been identified that have yielded, or could potentially yield, important Pliocene and Pleistocene fossils. These include North Soda Mountains, volcanic and granitic gravels of the Alvord Mountains, Bitter Springs, Red Pass Lake outflow sediments, Avawatz, Superior Valley sediments, Coolgardie sediments, Paradise Springs silts and tufa, Coyote Basin and Coyote Lake sediments, Silver Lake Road sediments, and Red Pass Lake sediments.

3.6.4.1 Paleontological Investigations

Literature and records research was compiled for the 1996 DEIS Study Area. This research identified a number of potentially sensitive fossiliferous areas within the 1996 DEIS Study Area. These potentially sensitive areas include portions of the Soda Mountains, the Mud Hills, the Alvord Mountains, Coyote Lake, Day Wash, Bitter Springs Wash, Red Pass Lake, and Superior Lake sediments.

In addition to fossil-bearing formations, a number of basin sediment and gravel deposits have been identified in the 1996 DEIS Study Area (and the current Study Area) that have yielded or could potentially yield important Pliocene and Pleistocene fossils. These include North Soda Mountains, volcanic and granitic gravels of the Alvord Mountains, Bitter Springs, Red Pass Lake outflow sediments, Avawatz, Superior Valley sediments, Coolgardie sediments, Paradise Springs silts and tufa, Coyote Basin and Coyote Lake sediments, Silver Lake Road sediments, and Red Pass Lake sediments.

There is only one documented paleontological site within the Fort Irwin boundary. The site is adjacent to a dry Pleistocene Period lakebed. Excavations conducted at this site recovered 8,332 specimens from 24 different taxa of plant and animals. This included the remains of tortoise, large camel, small and large horse, mammoth, dire wolf, short-faced bears, coyotes, rabbits, rats, and mice. While the age of some of the fossilized specimens may be as much as 1.8 million years old, it is believed that the majority of the specimens date between 450,000 and 10,000 years before present. The fossil collection is curated at the San Bernardino County Museum in Redlands.. Robert E. Reynolds of San Bernardino County Museum identified and mapped paleontologically sensitive areas of the Mojave Desert. Figure 3.6-3 shows the paleontological potential within Fort Irwin and the current project Study Area.

Calzia and Troxel (1997) also examined the geology and paleontological resources potential within the Silurian Valley – the Phase III and IV project area. In this study, rocks were classified as having high, low, or no paleontological resources potential based on their fossil content and depositional environment. The information gathered during the project was combined with paleontological data from the Regional Paleontologic Localities Inventory provided by R.E. Reynolds at the San Bernardino County Museum.

3.6.4.2 Paleontological Resource Potential

Various areas within the ROI have the potential to contain vertebrate and invertebrate fossils. Underlying geology or rock units for a given area are assessed for their potential to contain fossils and are classified as High Potential or Low Potential. Those areas that have not been assessed are classified as Undetermined Potential. Areas determined to have High Potential contain rock units in which vertebrate or significant invertebrate fossils have been determined by previous studies to be present or likely to be present. The High Potential classification is further broken down into two categories: A and B. The sensitivity of paleontological resources in High A is based on formations or mappable rock units that are known to contain, or have the correct age and depositional conditions to contain, significant paleontological resources, whereas the sensitivity in High B is based on topography, mountain mass, and rock type. Areas that were classified as Low Potential were determined by a qualified vertebrate

paleontologist, following a literature and records search and a field survey. Areas in which literature and unpublished studies were not available are classified as having Undetermined Potential (University of Redlands 1999).

Figure 3.6-3 shows the classification potential for paleontological resources. A large portion of the Study Area has been classified as Low Potential. Smaller areas at various locations throughout the Study Area have been classified as High Potential. The Study Area also contains multiple smaller areas that have Undetermined Potential (University of Redlands 1999).

3.6.5 Programmatic Agreement

The National Training Center (NTC), Fort Irwin, and the California State Historic Preservation Officer (SHPO) are engaged in consultation regarding a Programmatic Agreement (PA) to guide Fort Irwin's cultural resource management activities within the land expansion areas. The "Programmatic Agreement among the Department of the Army National Training Center, Fort Irwin, California, and the California State Historic Preservation Officer Regarding the Identification, Evaluation, and Management of Historic Properties Affected by Military Training Exercises and Required Support Operations within the Proposed National Training Center Expansion Areas" requires that the Army proceed with the identification and evaluation of cultural resources on lands subject to military use and establishes a mitigation process for affected historic properties. This PA standardizes ongoing consultation with the SHPO and provides an opportunity for interested parties to comment on that process, including the 14 federally recognized Indian Tribes with traditional ties to the NTC. A final draft of the PA is included in Volume II, Supplemental Appendices, Appendix O.

The need for the identification of significant cultural resources on the proposed Expansion Lands within the NTC provided the motivation for the development of an Archeological Predictive Model (APM). The purpose of the APM is to increase the efficiency of survey efforts by delineating the areas most likely to contain archaeological sites based on a suite of environmental variables and, from that, to prioritize cultural resources work for the next five years within the land expansions. This approach also takes into account the fact that various types of training exercises and support operations have different levels of effects on historical properties.

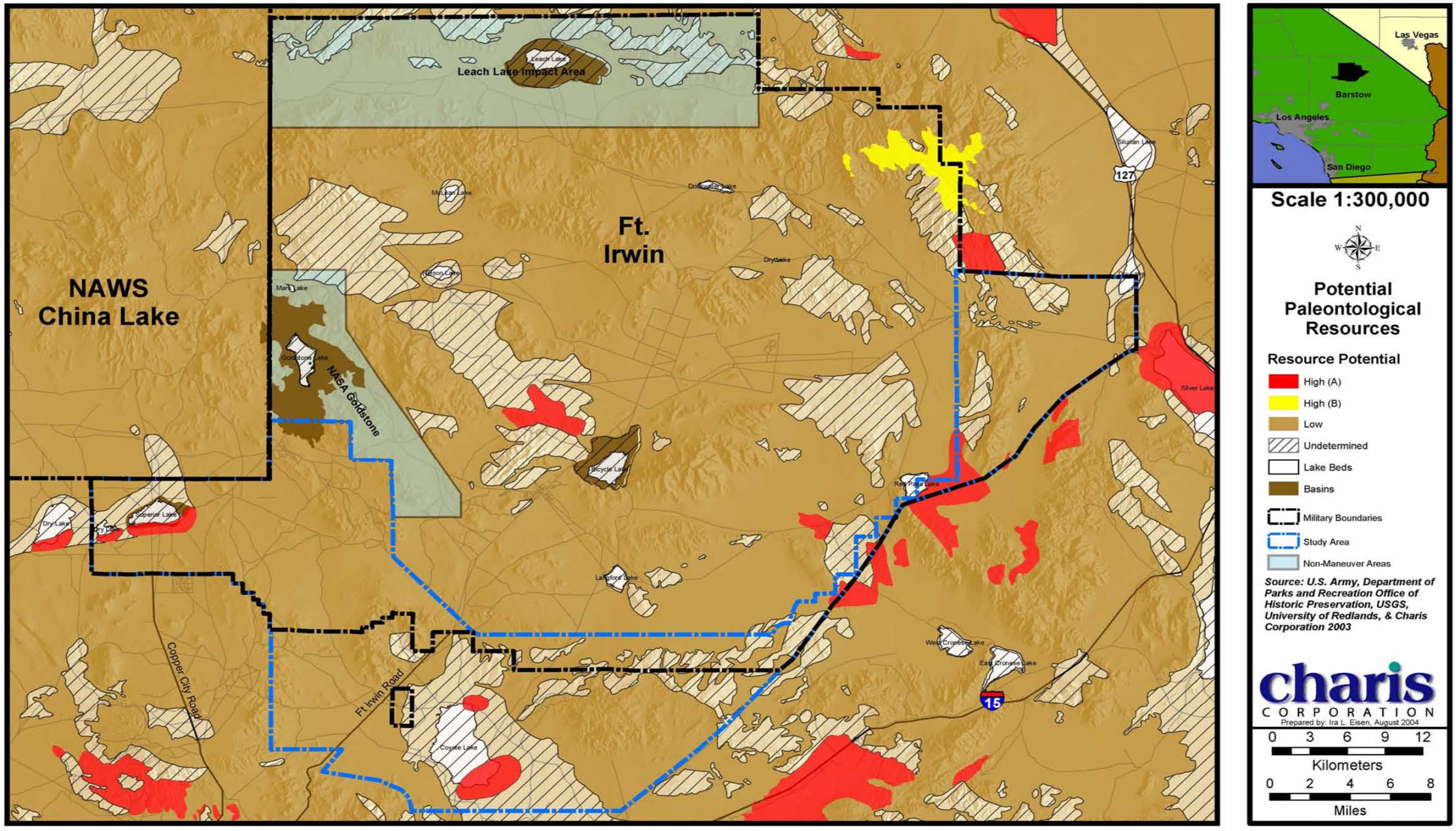

Figure 3.6-3: Potential Paleontological Resources

Identification and evaluation of historic properties within the Eastern Expansion Area (Avawatz) will be completed within one year of the date of execution of this PA. Identification and evaluation of historic properties within the Western Expansion Area (Superior) will be completed within five years of the execution of this PA.

Evaluation priorities will be as follows:

Table 3.6.5.1: Prioritizing Historic Property Identification and Evaluation

ARCHAEOLOGICAL PROBABILITY	INTENSITY OF USE	PERCENT/LOCATION TO BE SURVEYED
High	High	100
High	Medium	Focus on road and staging areas
High	Low or No Use	Focus on roads

Table 3.6.5.2 defines the extent of previously surveyed areas in the Eastgate and Western Expansion Areas and the projected additional survey required under the PA.

Table 3.6.5.2 Surveys: Current and Projected

AREA	CURRENT	PROJECTED	TOTAL (PERCENT)
Avawatz	10,134 acres	6,910 acres	17,044 (42)
Western	28,276 acres	1,050 acres	29,236 (52)

Archaeological sites considered to be eligible for inclusion in the National Register of Historic Places (NRHP) that are subject to adverse effects from training exercises and support operations will be protected in place to the greatest extent feasible through notation in the electronic operations control system, fencing, signing, or other means, provided necessary NTC operations and operations of users of NTC lands are not unreasonably impeded. Where protection in place is not possible and an adverse effect cannot be avoided, NTC will consult with the SPHO pursuant to 36 CFR § 800.6 to resolve the adverse effects on historic properties.

3.7 Air Quality

The ROI is the high desert, which includes Fort Irwin, and the Los Angeles Air Basin.

3.7.1 Meteorological and Climatic Conditions

The climate of the ROI is generally characterized as fair weather. The area experiences hot summers, mild winters, infrequent precipitation, and moderate afternoon breezes. The nearest town and cities consist of Baker (70 miles from Fort Irwin), Barstow (50 miles from Fort Irwin), and Yermo (40 miles from Fort Irwin). The Sierra Nevada and Transverse Mountain ranges primarily influence the regional winds. Coastal northwest winds do not affect the Study Area as much as the high desert plain winds from the Los Angeles Basin, due to the Study Area's distance inland. Typical regional winds have an average speed of approximately 13 knots (15 mph) and are from the southwest direction, as

monitored at Four Corners, a station located in the center of Fort Irwin. Figures 3.7-1 and 3.7-2 show wind roses generated for 2000 and 2001 at the Four Corners station.

Local winds in the valleys among the Alvord, Avawatz, Calico, Granite, and Soda Mountains occur when regional winds are low to calm. Differential heating and cooling of the air in the complex mountain terrain generate local winds in the valleys. Radiative cooling during the night and early morning hours causes air close to the ground to cool and become denser. As the air becomes denser, it drains down predominant watercourses, producing slope/valley drainage winds. After sunrise, solar radiation warms the ground and the air above rises, reversing the flow by later afternoon and producing upslope/valley winds.

This local generation of winds is further complicated by temporal and seasonal differences in sunrise/sunset times due to slope steepness, topographical shading, and orientation (aspect). Depressed areas, such as the many local dry lakes and valleys, allow air drainage pooling to occur at night and early morning. In the Study Area, local winds are light, proceeding down the slopes of the ridges of the local mountains during the evening and early morning hours. Air is drawn through the local basin areas by stronger afternoon upslope/valley winds.

Additionally, winds may shift due to local topographical configurations. Regional wind patterns analyzed during the multi-agency Research on Operations Limiting Visual Extinction Project indicate that the areas east of Fort Irwin are often affected by the Mojave Desert convergence zone, which sometimes shifts westward far enough to allow Imperial Valley emissions to affect the region east of Fort Irwin (NAWS 1988). The airflow in the Study Area is typically to the east. Channeled topography, however, may cause some components to move south to north toward the Death Valley National Park.

Mixing height of the atmosphere is another factor that contributes to air pollutant dispersion patterns. The lowest stable mixing height measured near the Study Area was 656 ft (200m). Figure 3.7-3 shows the mixing height, by type. This measurement was taken at the site of the Southern California Edison Cool Water Coal Gasification Plant, located at Daggett, California, approximately 15 miles south of the Study Area.

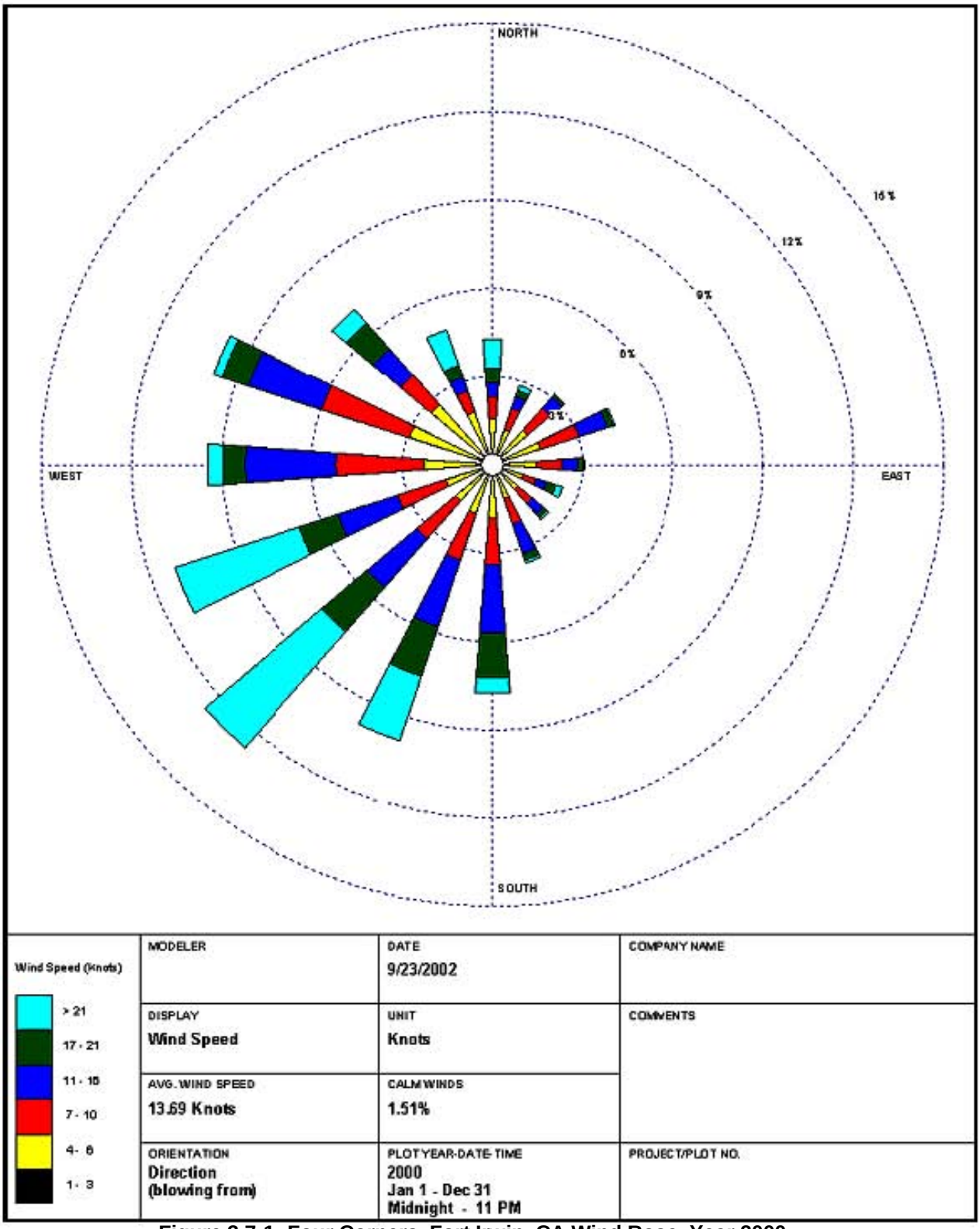

Figure 3.7-1: Four Corners, Fort Irwin, CA Wind Rose, Year 2000

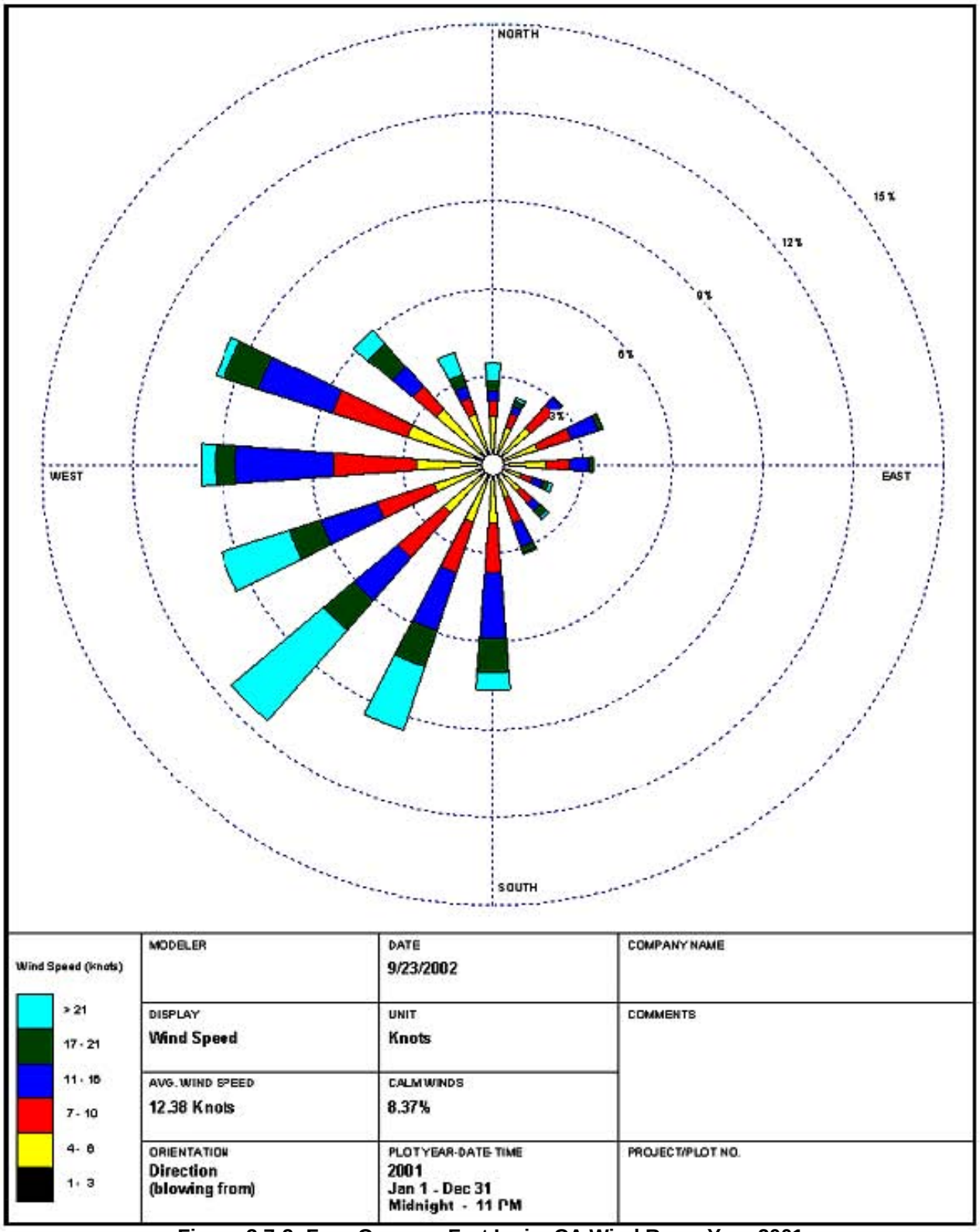

Figure 3.7-2: Four Corners, Fort Irwin, CA Wind Rose, Year 2001

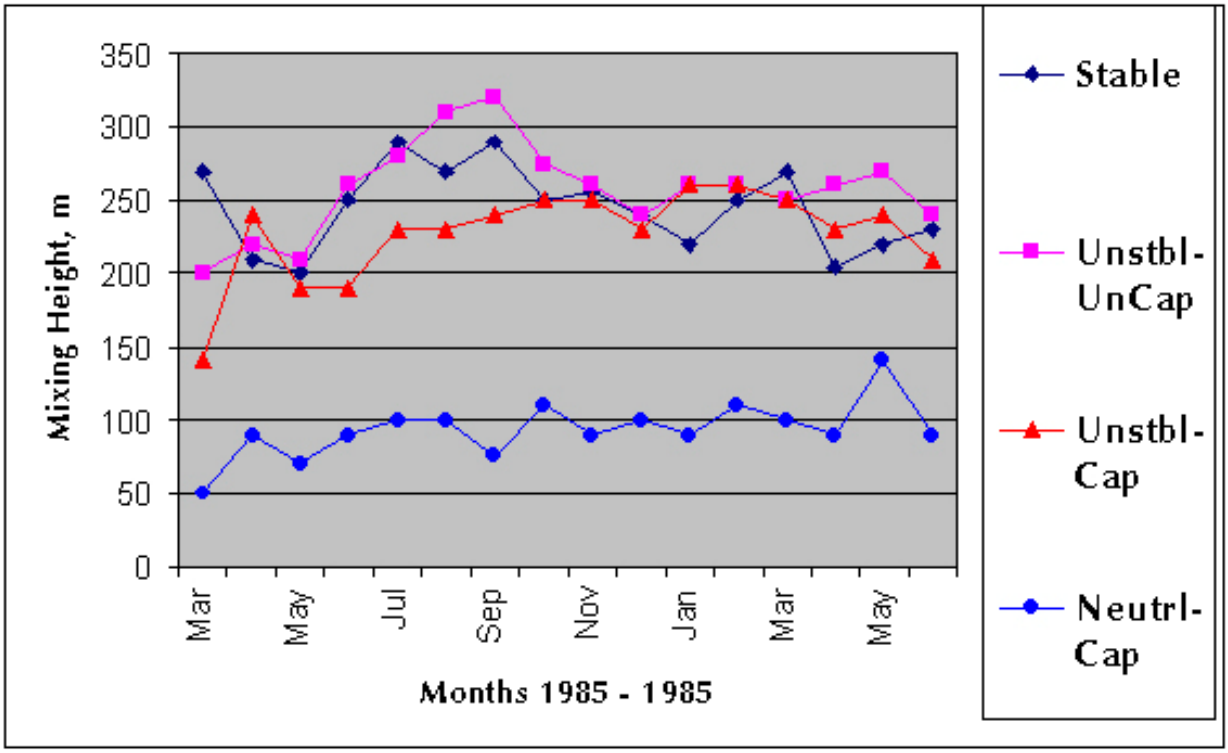

Figure 3.7-3: Mixing Height, by Type – Daggett, CA

Monthly temperatures near the Study Area ranged from 14°F to 118°F. These values were determined from climatic data recorded at 15 different Fort Irwin meteorological stations 1999 through 2001. The climatic averages at Fort Irwin are in Table 3.7-1.

Table 3.7-1: Climatic Averages at Fort Irwin NTC – Years 1999 - 2001

Month	Temperature (°F)		PPT (inches)	Wind (knots)		Relative Humidity (%)
	Maximum	Minimum	Monthly	Average	Peak Gust	Average
January	83	18	0.39	8	66	44
February	81	14	0.72	9	73	56
March	90	16	0.42	9	65	51
April	99	24	0.53	11	64	40
May	108	32	0.03	9	67	20
June	114	30	0.21	11	56	25
July	118	54	0.84	10	48	20
August	113	51	0.32	9	56	21
September	108	41	0.23	8	54	21
October	103	36	0.05	7	56	23

MONTH	TEMPERATURE (°F)		PPT (INCHES)	Wind (knots)		Relative Humidity (%)
	MAXIMUM	MINIMUM	MONTHLY	AVERAGE	PEAK GUST	AVERAGE
November	90	18	0.09	6	65	30
December	77	19	0.04	7	61	31

Source: 15 meteorological stations at Fort Irwin (1999-2001).

Most of the annual rainfall is produced by mid-latitude storms from August to April. During the summer months, precipitation occurs as a result of widely scattered thunderstorms. Annual average rainfall is approximately 3.87 inches.

Relative humidity is typically high in winter and low in summer. Based on data taken at Fort Irwin's monitoring stations, the average monthly relative humidity, during the 1999–2001 timeframe, ranged from a high of 56 percent in February to a low of 20 percent in May.

3.7.2 Air Quality Standards

Air quality at a given location can be described by the concentrations of various pollutants in the atmosphere. Units of concentration are generally expressed in parts per million (ppm) or micrograms per cubic meter (µg/m^3). The significance of a pollutant concentration is determined by comparing the concentration to an appropriate federal and/or state ambient air quality standard. The standards represent the allowable atmospheric concentrations and a reasonable margin of safety to protect the public health, welfare, and the more sensitive receptors in the population. Federal standards, established by the EPA, are termed the National Ambient Air Quality Standards (NAAQS). The NAAQS for all averaging periods other than annual are defined as the maximum acceptable concentrations that may not be exceeded more than once per year. The annual NAAQS may never be exceeded. The state standards, established by the California Air Resources Board (CARB), are termed the California Ambient Air Quality Standards (CAAQS). The CAAQS are defined as the maximum acceptable pollutant concentrations that are not to be equaled or exceeded, depending on the specific pollutant. In all cases, the state standards are more stringent than the federal standards. The NAAQS and CAAQS are presented in Table 3.7-2.

Table 3.7-2: Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	CALIFORNIA STANDARDS CONCENTRATION	NATIONAL STANDARDS CONCENTRATION
Ozone	1 Hour	0.09 ppm	0.12ppm
	8 Hour*	—	0.08 ppm (3-year average of annual 4th highest daily maximum)

POLLUTANT	AVERAGING TIME	CALIFORNIA STANDARDS CONCENTRATION	NATIONAL STANDARDS CONCENTRATION
Carbon Monoxide	8 Hour	9 ppm	9 ppm
	1 Hour	20 ppm	35 ppm
Nitrogen Dioxide	Annual Average	—	0.053 ppm
	1 Hour	0.25 ppm	—
Sulfur Dioxide	Annual Average	—	0.03 ppm
	24 Hour	0.04 ppm	0.14 ppm
	3 Hour	—	0.5 ppm
	1 Hour	0.25 ppm	—
Suspended Particulate Matter (10 micron)			
	24 Hour	50 µg/m^3	150 µg/m^3
	Annual Arithmetic Mean	20 µg/m^3	50 µg/m^3
	Annual Arithmetic Mean	12 µg/m^3	15 µg/m^3 (3-year average)
	—	—	65 µg/m^3 (3-year average of 98th percentile)
Particulate Sulfates	24 Hour	25 µg/m^3	—
Lead	30 days	1.5 µg/m^3	—
	Calendar Quarter	—	1.5 µg/m^3

**** Standards not currently in effect***
Source: CARB a thru h

3.7.3 Baseline Air Quality

The air quality in the Study Area is typical of open desert. No major sources of air pollutants, such as large industrial power plants or refining plants, are located in the area. Air pollution from the Los Angeles Basin and particulate matter from desert windstorms dominate the air quality in the Study Area. The most reliable documentation of existing ambient air quality, historical trends, and projections for the Study Area were taken at two of the Mojave Desert Air Management Quality District (MDAQMD) air monitoring stations on Fort Irwin property. Additional data for particulate matter less than 10 microns (PM-10) and PM less than 2.5 microns (PM-2.5) was generated at the Fort Irwin site only.

Two MDAQMD air-monitoring stations are located at Barstow, CA, approximately 20 miles south of the Study Area, and at Trona, approximately 30 miles northwest of the Study Area. The data for gaseous emissions are available from Barstow and Trona only. As a result, these emissions probably overestimate the Study Area conditions since the site is not located near any population centers.

Data from the Barstow monitoring station indicates inland transport of air pollutants from the Los Angeles Basin. Monitored pollutants include ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), hydrogen sulfide (H_2S) and PM-10. Table 3.7-2 shows the ambient air quality standards.

These measurements indicate that photochemical smog levels (mainly ozone) have exceeded the CAAQS 1-hour average of 0.09 ppm every year from 1995 to 2001 at the Barstow monitoring station. Barstow ozone level exceedances appear to have peaked in 1997, although the highest concentration was recorded in 1996. Concentrations have remained fairly steady during the 7-year period between 1995 and 2001. The Trona monitoring station ozone levels exceeded the CAAQS 1-hour standard from 1996 through 1999, peaking in 1996. Maximum concentrations have remained steady during the 7-year period. The federal ozone 1-hour limit of 0.12 ppm was exceeded only once at the Barstow monitoring station during the 7-year period. No federal 1-hour exceedances were reported at the Trona monitoring station. Exceedances of the federal 8-hour level of 0.08 ppm follow a similar pattern to the exceedances of the state 1-hour levels; however, the maximum concentrations reported at both sites remained fairly constant over the 7-year period.

Carbon monoxide, nitrogen dioxide, and sulfur dioxide had no exceedances of either state or federal limits. Carbon monoxide was monitored at the Barstow station only. Nitrogen dioxide was monitored at both stations. Sulfur dioxide was monitored at the Barstow location during 1995 only, and at the Trona station during the entire 7-year period.

Hydrogen sulfide was monitored at the Trona site only. The hydrogen sulfide levels have exceeded the state 1-hour standard every year during the 7-year period. The highest maximum concentration was observed in 2001. The data suggests that gaseous air quality problems are primarily due to pollutant transport into the area from outside sources.

The PM-10 level was measured at the Barstow and Trona locations and numerous sites at Fort Irwin. Both the Barstow and Trona locations exceeded the state 24-hour 50 $\mu g/m^3$ limit during the 7-year period, except for 1995 in Barstow and 1999 in Trona. Neither site exceeded the federal 24-hour standard of 150 $\mu g/m^3$ during the 7-year period. Table 3.7-3 shows the exceedances of air quality standards at the Barstow and Trona monitoring stations.

Table 3.7-3: Exceedance of Air Quality Standards for the Barstow (B) and Trona (T) Monitoring Stations

POLLUTANT/ STANDARD		1995	1996	1997	1998	1999	2000	2001
Ozone								
Number of Days Exceeding Ozone State 1-hour > 0.09 ppm	B	7	11	15	9	10	9	5
	T	0	8	1	4	1	0	0
Number of Days Exceeding Ozone Federal 8-hour > 0.08 ppm	B	1	9	11	5	10	6	5
	T	0	8	0	4	2	0	0
Number of Days Exceeding Ozone Federal 1-hour > 0.12 ppm	B	0	1	0	0	0	0	0
	T	0	0	0	0	0	0	0
Ozone Maximum 1-hour Concentration (ppm)	B	0.116	0.132	0.114	0.108	0.123	0.114	0.109
	T	0.094	0.103	0.098	0.109	0.099	0.091	0.086
Ozone Maximum 8-hour Concentration (ppm)	B	0.103	0.109	0.106	0.09	0.107	0.088	0.099
	T	0.083	0.093	0.083	0.102	0.088	0.083	0.076
RESPIRABLE PARTICULATE MATTER (PM-10)								
Number of Days Exceeding State 24-hour Standard	B	0	1	2	1	1	2	NA
	T	1	4	3	1	0	1	NA
Number of Days Exceeding Federal 24-hour Standard	B	0	0	0	0	0	0	NA
	T	0	0	0	0	0	0	NA
Respirable Particulate Matter (PM-10) Maximum 24-hour Concentration ($\mu g/m^3$)	B	34	78	58	53	69	69	NA
	T	51	138	85	53	44	58	NA
FINE PARTICULATE MATTER (PM-2.5)								
Number of Days Exceeding Fine Particulate Matter Federal 24-hour > 65 $\mu g/m^3$	B	NM	NM	NM	NM	NM	NM	NM
	T	NM	NM	NM	NM	NM	NM	NM
Number of Days Exceeding Fine Particulate Matter Annual Arithmetic Mean > 15 $\mu g/m^3$	B	NM	NM	NM	NM	NM	NM	NM
	T	NM	NM	NM	NM	NM	NM	NM

POLLUTANT/ STANDARD		1995	1996	1997	1998	1999	2000	2001
CARBON MONOXIDE								
Number of Days Exceeding Carbon Monoxide State 8-hour > 9.0 ppm	B	0	0	0	0	0	0	0
	T	NM	NM	NM	NM	NM	NM	NM
Number of Days Exceeding Carbon Monoxide State 1-hour > 20 ppm	B	NM	NM	NM	NM	NM	NM	NM
	T	NM	NM	NM	NM	NM	NM	NM
Number of Days Exceeding Carbon Monoxide Federal 8-hour > 9.0 ppm	B	0	0	0	0	0	0	0
	T	NM	NM	NM	NM	NM	NM	NM
Number of Days Exceeding Carbon Monoxide Federal 1-hour > 35 ppm	B	NM	NM	NM	NM	NM	NM	NM
	T	NM	NM	NM	NM	NM	NM	NM
Carbon Monoxide Maximum 8-hour Concentration (ppm)	B	2.14	2.3	1.64	2.21	1.38	1.48	1.2
	T	NM	NM	NM	NM	NM	NM	NM
Carbon Monoxide Maximum 1-hour Concentration (ppm)	B	NM	NM	NM	NM	NM	NM	NM
	T	NM	NM	NM	NM	NM	NM	NM
NITROGEN DIOXIDE								
Number of Days Exceeding Nitrogen Dioxide Annual Arithmetic Mean > 0.053 ppm	B	NM	NM	NM	NM	NM	NM	NM
	T	NM	NM	NM	NM	NM	NM	NM
Number of Days Exceeding Nitrogen Dioxide State 1-hour > 0.25 ppm	B	0	0	0	0	0	0	0
	T	0	0	0	0	0	0	0
Nitrogen Dioxide Maximum 1-hour Concentration (ppm)	B	0.118	0.086	0.107	0.196	0.106	0.105	0.102
	T	0.048	0.06	0.066	0.062	0.053	0.052	0.055
LEAD								
Number of Days Exceeding Lead State 30 days average > 1.5 $\mu g/m^3$	B	NM	NM	NM	NM	NM	NM	NM
	T	NM	NM	NM	NM	NM	NM	NM

POLLUTANT/ STANDARD		1995	1996	1997	1998	1999	2000	2001
Number of Calendar Quarters Exceeding Lead Federal > 1.5 µg/m^3	B	NM	NM	NM	NM	NM	NM	NM
	T	NM	NM	NM	NM	NM	NM	NM
SULFUR DIOXIDE								
Number of Days Exceeding Sulfur Dioxide State 1-hour > 0.25 ppm	B	NM	NM	NM	NM	NM	NM	NM
	T	0	0	0	0	0	0	0
Number of Days Exceeding Sulfur Dioxide Federal 24-hour > 0.14 ppm	B	0	NM	NM	NM	NM	NM	NM
	T	0	0	0	0	0	0	0
Sulfur Dioxide Maximum 1-hour Concentration (ppm)	B	0.001	NM	NM	NM	NM	NM	NM
	T	0.007	0.007	0.005	0.01	0.006	0.006	0.007
HYDROGEN SULFIDE								
Number of Days Exceeding Hydrogen Sulfide State 1-hour > 0.03 ppm	B	NM	NM	NM	NM	NM	NM	NM
	T	196	53	75	40	117	70	88
Hydrogen Sulfide Maximum 1-hour Concentration (ppm)	B	NM	NM	NM	NM	NM	NM	NM
	T	0.148	0.101	0.096	0.101	0.142	0.168	0.233

Upper and lower values represent the Barstow and Trona Air Monitoring Stations, respectively
NM: Not Monitored NA: Not Available
Source: Air Quality Data. CARB 2002a.

At Fort Irwin, PM-10 data was obtained during 1998 through 2001. The Fort Irwin data is presented in Table 3.7-4, Table 3.7-5 and Table 3.7-6. Table 3.7-4 presents PM-10 concentrations from all monitors over the 4 years, by quarter. Table 3.7-5 presents the PM-10 highest concentrations and wind speeds, by monitor site. Table 3.7-6 presents PM-10 concentrations, by activity, at Fort Irwin. The data provided by Fort Irwin was summarized but not fully validated; however, general trends can be observed. The highest PM-10 concentrations in Table 3.7-6 did not occur during training days. Figure 3.7-4 also depicts the locations of the air quality monitoring stations at Fort Irwin.

Table 3.7-4: Highest Recorded PM-10 Concentrations: PM-10 Monitoring Stations at Fort Irwin Sorted by Season

SEASON	STATISTICAL PARAMETER	WIND SPEED (KNOTS)	PM-10 CONCENTRATION ($\mu G/M^3$)
Winter	Minimum	8	55
	Maximum	33	245
	Average	22	97
Spring	Minimum	12	51
	Maximum	48	302
	Average	29	101
Summer	Minimum	16	51
	Maximum	34	302
	Average	22	94
Fall	Minimum	8	51
	Maximum	23	215
	Average	17	106

Source: Quarterly summary spreadsheets for seven PM-10 ambient air monitoring sites at Fort Irwin from 9/2/1998 through 6/6/2001, provided by the Department of Public Works, Fort Irwin.

Table 3.7-5: Highest Recorded PM-10 Concentrations: PM-10 Monitoring Stations at Fort Irwin, Sorted by Monitoring Site by Quarter

DATA	MAXIMUM CONCENTRATION, ($\mu G/M^3$)	MAXIMUM WIND SPEED, (KNOTS)
Cemetery	215	40
Eastgate	94	40
Echo	148	28
Gary Owen	245	26
Goat Mountain	159	48
RUFMA	302	37
School	58	33

Source: Quarterly summary spreadsheets for seven PM-10 ambient air monitoring sites at Fort Irwin from 9/2/1998 through 6/6/2001, provided by the Department of Public Works, Fort Irwin.

Table 3.7-6: Highest Recorded PM-10 Concentrations: PM-10 Monitoring Stations at Fort Irwin, Sorted by Activity

Activity	No. of Events	Freq. Sampled During Event	Avg. Wind Speed (Knots)	Max. Wind Speed (Knots)	Avg. PM-10 Conc. ($\mu g/m^3$)	Max. PM-10 Conc. ($\mu g/m^3$)	Over 150 ($\mu g/m^3$)	Over 50 ($\mu g/m^3$)
No Activity Listed	2	2.6%	14	20	93	130	No	Yes
BRD Day 2	1	1.3%	33	33	133	133	No	Yes
BRD Day 3	1	1.3%	20	20	81	81	No	Yes
BRD Day 4	1	1.3%	18	18	301	301	Yes	Yes
Comp.	2	2.6%	34	34	62	67	No	Yes
Arrive	1	1.3%	23	23	115	115	No	Yes
Leave	3	3.8%	22	29	93	147	No	Yes
No Training	18	23.1%	29	22	159	302	Yes	Yes
RSOI Unassigned	3	3.8%	25	30	103	142	No	Yes
RSOI Day 2	1	1.3%	21	21	51	51	No	Yes
RSOI Day 4	4	5.1%	15	13	111	160	Yes	Yes
Unassigned Training	15	19.2%	22	23	95	214	Yes	Yes
Training Day 2	3	3.8%	19	16	66	87	No	Yes
Training Day 3	1	1.3%	33	33	57	57	No	Yes
Training Day 4	5	6.4%	16	8	127	185	Yes	Yes
Training Day 5	3	3.8%	29	22	104	115	No	Yes
Training Day 8	5	6.4%	29	40	71	94	No	Yes
Training Day 10	1	1.3%	27	27	149	149	No	Yes
Training Day 11	1	1.3%	33	29	192	192	Yes	Yes
Training Day 12	1	1.3%	26	26	245	245	Yes	Yes
Training Day 14	6	7.7%	22	10	104	215	Yes	Yes

Source: Quarterly summary spreadsheets for seven PM-10 ambient air monitoring sites at Fort Irwin from /2/1998 through 6/6/2001, provided by the Department of Public Works, Fort Irwin.

This page intentionally left blank.

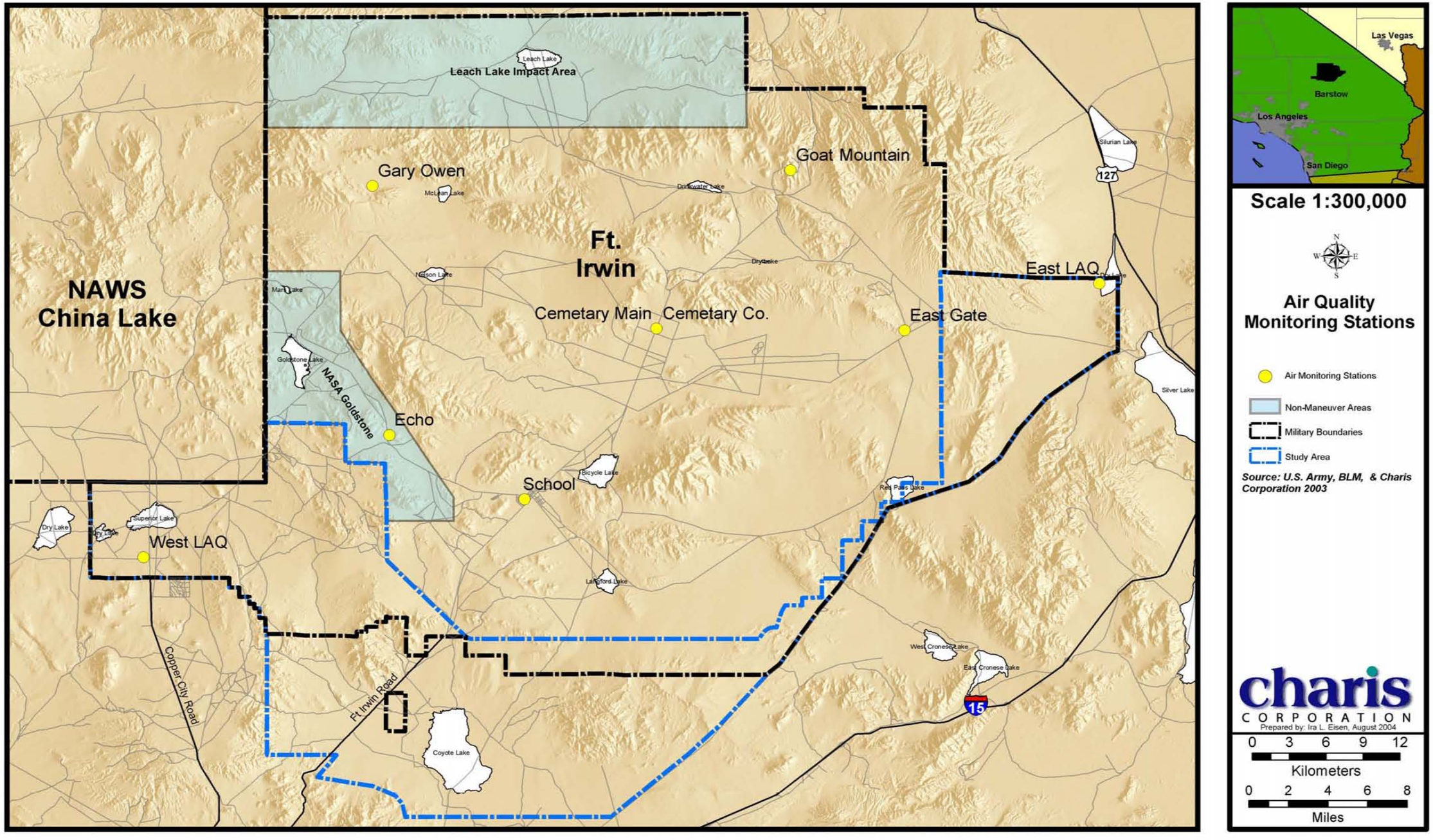

Figure 3.7-4: Air Quality Monitoring Stations

3.7.4 Non-attainment Areas

The EPA designates areas of the U.S. in "attainment" if the air quality is better than the NAAQS; "non-attainment" if the air quality is worse than the NAAQS; and "unclassified in areas where insufficient data exists . An area is often designated as "unclassified" when the EPA lacks data to form a basis of "attainment" status. The Study Area is "non-attainment" for ozone, according to the state standards. It is "non-attainment" for the federal 1-hour standard only below the UTM 90 gridline. The Study Area is "attainment" for both the state and federal carbon monoxide standards. The Study Area is "attainment" for sulfates and "unclassified" for hydrogen sulfide at the state and federal levels. The Study Area is "non-attainment" for both the state and federal PM-10 standards.

The Federal Clean Air Act Amendments of 1990 and the California Clean Air Act of 1988 both require the "non-attainment" areas to develop plans for attaining these standards no later than 2010. As a result, MDAQMD drafted the *Final 1991 Air Quality Attainment Plan* (MDAQMD 1991). The Federal Clean Air Act does not require PM-10 plans for all federally designated "non-attainment" areas. Areas determined to have serious PM-10 problems are expected to attain the federal standard no later than December 31, 2002. The MDAQMD submitted the *Final Federal Particulate Matter (PM-10) Attainment Plan* in 1995. Regardless, extensions and waivers may be granted on a case-by-case basis for areas where PM-10 data are incomplete and precursor sources, such as sulfates and nitrates, comprise a relatively small portion of the PM-10 emissions in the area.

3.7.5 Significant Emission Thresholds

The EPA established conformity thresholds in 40 CFR 51.853(c)(2)(xx). These thresholds apply to areas that are not in attainment with NAAQS. The Mojave Air Basin is "non-attainment" for PM-10. The Mojave Air Basin is "non-attainment" for ozone only below the 90 UTM gridline.

The MDAQMD established daily and annual threshold levels to attain or prevent exceedance of federal and state ambient air quality standards. The MDAQMD thresholds apply to all areas under the MDAQMD jurisdiction. Table 3.7-7 presents the EPA and MDAQMD thresholds.

Table 3.7-7: Criteria Thresholds

THRESHOLD	UNITS	VOC	CO	NOX	SO_2	PM-10
Conformity Annual	Tons	25	—	25	—	100
MDAQMD Annual	Tons	25	100	25	25	15
MDAQMD Daily	Pounds	137	548	137	137	82

3.8 Noise

This section describes basic noise terminology, regulations, and existing conditions at Fort Irwin.

In response to comments received during the public comment period, the need for a noise study was addressed. The decision from the U.S. Army Center for Health Promotion and Preventive Medicine was that a noise study was not warranted as there are no plans to change range firing points or range firing activities (USACHPPM 2005).

3.8.1 Description of Resource

Noise is usually defined as sound that is unwanted or undesirable because it interferes with speech communication and hearing, or is otherwise annoying. Under certain conditions, noise may cause hearing loss, interfere with human activities, and in various ways, may affect people's health and well-being.

The decibel (dB) is the accepted standard unit for measuring the amplitude of sound, because it accounts for the large variations in sound pressure amplitude. When describing sound and its effect on a human population, A-weighted (dBA) sound pressure levels (SPL) are typically used to account for the response of the human ear. The term "A-weighted" refers to a filtering of the noise signal in a manner corresponding to the way the human ear perceives sound. The A-weighted noise level has been found to correlate well with people's judgments of the loudness of different sounds and has been used for many years as a measure of community noise. Figure 3.8-1 illustrates typical dBA SPLs for various noise sources. Humans can detect changes in sound levels of approximately 3 dBA. Changes of less than 3 dBA are generally not discernable by humans with normal hearing sensitivity.

The C-weighting (dBC) of SPLs is also used when evaluating the effects of noise that contain predominantly low-pitched frequencies such as cannon fire and sonic booms. Low-frequency noises such as these are typically felt, as well as heard, and can result in noise vibrations that shake windows and buildings.

Community noise levels change moment by moment during a typical hour, and some noise environments exhibit more change than others. A common method that has been devised to rate time-varying noise is the, "equivalent-continuous sound pressure level," or Leq. A Leq is calculated by averaging the acoustic energy over a period of time. The maximum noise level (Lmax) would be the greatest instantaneous sound pressure level that occurred during the specified time period. The peak noise level (Lpk) differs from the Lmax in that Lpk uses specialized, ultra-fast detectors for measuring impulsive noise, such as weaponry fire. The Lpk noise metric normally does not contain any special frequency weighting such as dBA or dBC, and the peak decibel units are often abbreviated dBP. Because humans are typically more sensitive to unwanted sound during evening and nighttime hours, the "Day-Night average sound pressure Level" (DNL) was developed to evaluate community noise over a 24-hour period. The DNL is calculated by applying a 10-decibel weighting to the nighttime hourly Leq from 10pm to 7am and averaging the total acoustic energy for the 24-hour period. The nighttime 10 dB weighting is used to account for the increased sensitivity to nighttime

noise affecting a community. The "Community Noise Equivalent Level" (CNEL) is sometimes used in the state of California, and is similar to DNL, but includes an additional 5-decibel weighting that is applied to the evening hours between 7pm to 10pm. A-weighted DNL is abbreviated ADNL, while C-weighted DNL is abbreviated CDNL.

3.8.2 Region of Influence

The ROI, or noise Study Area, extends approximately 20 miles in each direction from the boundary of Fort Irwin. The ROI includes Harvard, Baker, Yermo, and Barstow. The Study Area is mainly characterized by open desert and rocky hills. Sensitive receptors, within 10 miles of the Fort Irwin boundary, including those within Fort Irwin, include 1,103 family housing units, a school, a religious facility, and a hospital. The nearest sensitive receptor areas, in the Study Area, are 150 residents within 1-7 miles from the existing Fort Irwin boundaries. Animals and animal habitats are also included in the noise impact analysis. Several sensitive animal species are in the ROI. (See Section 3.5, Biological Resources, for a listing of sensitive animal species.) Species in the ROI that are most susceptible to noise disturbances include ground squirrels, desert tortoises, bats, raptors, and bighorn sheep. Current existing noise impacts are sonic booms from overflying aircraft, an occasional OHV, recreational shooting, and occasional low-altitude over-flights. There is limited knowledge of physical or behavioral effects of noise and vibration on desert tortoises. Other studies regarding the effects of noise on desert lizards suggested that extended exposure to 100 dB and 115 dB resulted in temporary hearing loss, which provides a base with which to determine effects on desert tortoise in the absence of data.

3.8.3 Noise Regulations

3.8.3.1 Regulatory Setting

Noise levels generated by Army installations are regulated by Army Regulation (AR) 200-1 (DA 1997a). Army Regulation 200-1 implements Federal laws concerning environmental noise for DA activities. These laws include the Quiet Communities Act of 1978, the Noise Control Act of 1972, and Federal regulations, such as EPA Procedures for Reporting Proposed Pollution Abatement Projects for Federal Facilities. The DA has established noise level limitations for military activities that are in close proximity to noise-sensitive land uses, such as residences, schools, and hospitals. The DA's primary strategy is to protect humans and animals from environmental noise impacts through land use planning. The Environmental Noise Management Plan (ENMP) implements DA policy for the purpose of land use planning (DA 2000). Housing, schools, and medical facilities are considered noise-sensitive land uses under this policy. Noise complaints are reported to the Public Affairs Office (PAO) and addressed in accordance with AR 360-1. The G3 Aviation office investigates and reports information to the PAO and briefs the staff on all reports. The last complaint based on NTC aircraft was in 2002 and inside the normal traffic pattern of the Barstow Dagget airport (personal communication with CWO John Lund 2005).

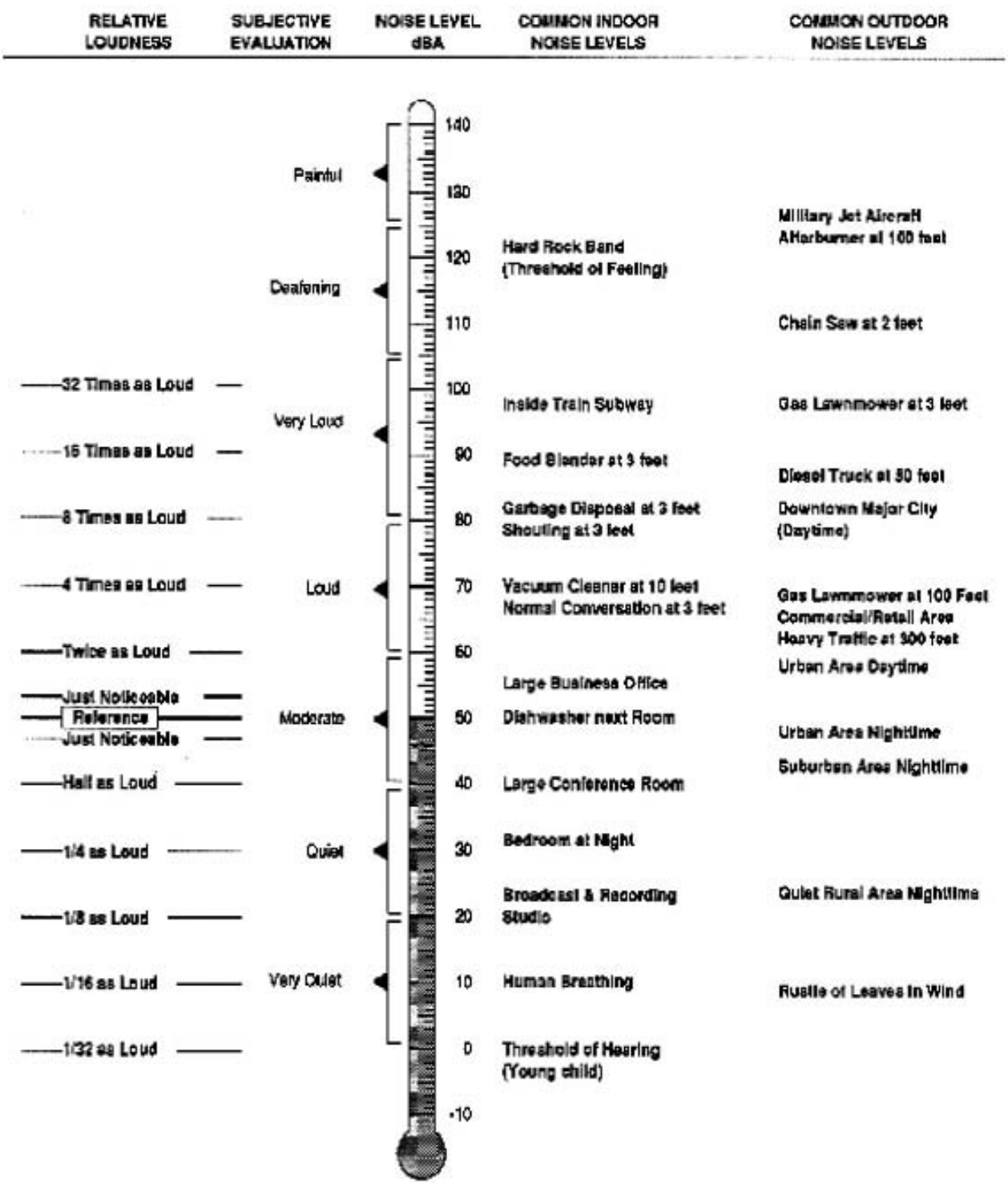

Figure 3.8-1: Typical A-Weighted Sound Pressure Levels

Army Regulation 200-1 identifies three noise zones for determining land use compatibility with Army noise environs: Zone I (compatible), Zone II (normally incompatible), and Zone III (incompatible). Table 3.8-1 provides details of the three noise zones.

Table 3.8-1: Army Land Use Noise Compatibility Guidelines

NOISE ZONE	POPULATION ANNOYED	POPULATION HIGHLY-ANNOYED	TRANSPORTATION SOURCES, ADNL*	IMPULSIVE ARTILLERY, CDNL**	SMALL FIRE ARMS, PEAK SPL***
I - Compatible	< 15%	< 1%	< 65 dBA	< 62 dBC	< 87 dBP
NOISE ZONE	**POPULATION ANNOYED**	**POPULATION HIGHLY-ANNOYED**	**TRANSPORTATION SOURCES, ADNL***	**IMPULSIVE ARTILLERY, CDNL****	**SMALL FIRE ARMS, PEAK SPL*****
II - Normally Incompatible	15% to 39%	1- 13%	65 to 75 dBA	62 to 70 dBC	87 to 104 dBP
III - Incompatible	> 39%	> 13%	> 75 dBA	> 70 dBC	> 104 dBP

**** A-weighted day-night level (ADNL) closely resembles the frequency response of human hearing (helicopters, vehicles).***
***** C-weighted day-night level (CDNL) measures the low-frequency component of noise (i.e., noise responsible for causing windows and buildings to shake, e.g., some forms of artillery firing and supersonic over flights).***
****** Un-weighted peak sound pressure level (dBP).***
Source: DA 1997a; DA 2000

Noise Zone I is generally consistent with the County of San Bernardino's noise standards, which are discussed below. Exposure to Noise Zone I results in a population annoyance of less than 15 percent, and less than 1 percent are highly annoyed. Some degree of annoyance will occur in all noise surveys since a small percentage of the population will have a greater sensitivity to noise than others. In the survey conducted by the DA, the results showed that 15 percent of the population expressed a feeling of annoyance to the noise when exposed to an ADNL of 65 dBA, and 1 percent was highly annoyed, while 85 percent of the population did not report any type of annoyance when exposed to that same level (DA 1997a).

Based on these factors, the DA considers Zone I noise levels, where the noise is below an ADNL of 65 dBA, a CDNL of 62 dBC, or a peak SPL below 87 dBP to be acceptable for noise-sensitive land use compatibility with army noise environs. For impulse noise, such as weapons fire, the Naval Surface Warfare Center in Dalhgren, Virginia developed guidelines to evaluate the potential of noise complaints from impulse noise, based on 10 years of community research (Pater 1976). Table 3.8-2 shows the guidelines for impulse noise produced by weapons fire.

Table 3.8-2: Impulsive Noise Guidelines for Assessing the Risk of Complaints from Noise

PREDICTED PEAK SOUND PRESSURE LEVEL, dBP	RISK OF COMPLAINTS	ACTION TO TAKE
< 115	Low risk of noise complaints.	Proceed with all weaponry fire programs.
115 to 130	Moderate risk of noise complaints.	Proceed only with important tests. Non-critical tests should not be conducted.
130 to 140	High risk of noise complaints; possibility of physiological or structural damage.	Only extremely important or extremely critical tests should be conducted.
> 140	Threshold for permanent physiological damage to unprotected human ears. High risk of physiological and structural damage claims.	Do not proceed with tests that produce impulse noise over 140 dBP at sensitive receptors.

Source: Pater, 1976 Note: For Rapid-Fire test programs and/or programs that involve many repetitions of impulse noise, reduce the above sound levels by 15 dBP.

The Noise Element of the San Bernardino County General Plan presents noise level standards for both stationary and mobile sources (SBC 1999). The overall purpose of the Noise Element is to protect County citizens from the harmful and annoying effects of exposure to excessive noise. It also protects the economic base of the County by preventing the encroachment of incompatible land uses within areas affected by existing noise-producing uses. Under the San Bernardino County General Plan, stationary noise sources (or locally regulated noise) are regulated under the Hourly Noise Level Performance Standards, which limit the amount of noise that can be transmitted from one site to another. The noise level limits between the hours of 7am and 10pm for residential and other noise-sensitive areas are not to exceed the following:

Stationary Sources (locally regulated sources):

- an Leq of 75 dBA for any length of time;
- an Leq of 70 dBA for more than (1) minute in any hour;
- an Leq of 65 dBA for more than (5) minutes in any hour;
- an Leq of 60 dBA for more than (15) minutes in any hour;
- an Leq of 55 dBA for more than (30) minutes in any hour.

The nighttime noise limits between 10pm and 7am are more restrictive: 10 dB below the above limits for each time duration listed above. When the standards are exceeded, the county designates the land use as “noise-impacted,” and mitigation measures are required. Table 3.8-3 is taken from San Bernardino County’s Noise Element of the General Plan (SBC 2002b), which allows for the use of either the DNL or CNEL noise descriptor.

Table 3.8-3: Hourly Noise Level Performance Standards—Stationary Sources (Locally Regulated Noise*)

LAND USE CATEGORY	7AM – 10PM		10PM – 7AM	
	LEQ	LMAX	LEQ	LMAX
Residential or other noise-sensitive receivers (dBA)	55	75	45	65

**** Noise sources that are stationary and not preempted from local noise control. Preempted sources include vehicles operated on public roadways, railroad line operations, and aircraft in flight.***
Source: SBC 2002b

San Bernardino County's noise standards for mobile sources are provided in Table 3.8-4. Noise sensitive land uses, such as residential, commercial, institutional, and park areas, are not to be impacted by an exterior ADNL that is greater than 60 to 65 dBA. The interior ADNL is not to exceed 45 to 50 dBA due to project related noise.

Table 3.8-4: Interior/Exterior Noise Level Standards—Mobile Sources

LAND USE		DNL (OR CNEL), DB	
CATEGORY	USES	INTERIOR*	EXTERIOR**
Residential	Single-family and multifamily, duplex, mobile homes	45	60***
Commercial	Hotel, motel, transient lodging Commercial, retail, bank, restaurant Office building, research and development, professional offices Amphitheater, concert hall, movie theater	45 50 45 45	60*** n/a 65 n/a
Institutional/ Public	Hospital, nursing home, school classroom, church, library	45	65
Open Space	Park	n/a	65

**** Indoor environment excluding bathrooms, kitchens, toilets, closets, and corridors.***
***** Outdoor environment limited to private yard of single-family dwellings, hospital/office building patios, multifamily private patios or balconies, park picnic areas, hotel and motel recreation areas, school playgrounds, and mobile home parks.***
****** An exterior noise level of up to 65 dB (CNEL) will be allowed, provided exterior noise levels have been substantially mitigated through a reasonable application of the best noise reduction technology and interior noise exposure does not exceed 45 dB DNL (or CNEL) with windows and doors closed. Requiring that windows and doors remain closed to achieve an acceptable interior noise level will necessitate the use of air conditioning or mechanical ventilation.***
Source: SBC 2002b

3.8.4 Existing Noise Environment

3.8.4.1 Baseline Noise Environment

Military operations within the ROI primarily determine the ambient noise environment. Military training exercises conducted at the NTC include ground maneuvers by Army vehicles (including heavy vehicles and tanks), artillery firing, air operations, air-to-ground gunnery and firing, and transportation to, from, and within Fort Irwin during and after maneuvers. Military aircraft in the ROI also contribute to the existing noise environment. They operate routinely within the Military Operations Areas (MOA) and established airspace corridors. The airspace corridors are discussed in Section 3.16, Airspace. Fixed

wing aircraft that support NTC exercise training (Air Warrior) fly from Nellis AFB near Las Vegas, Nevada. The aircraft that fly in restricted area R-2515 generally fly from Edwards AFB near Lancaster, California. Air operations in restricted area R-2524 generally fly out of NAWS China Lake near Ridgecrest, California. Aircraft flying in R-2515 and R-2524 contribute to the ambient noise produced in the western portion of the ROI. Occasional sonic booms are generated from the supersonic corridor located in R-2515, designated the Black Mountain Supersonic Corridor and the High Altitude Supersonic Corridor (see Figure 3.16-5 and Appendix G, Figure 1.3-5). Secondary contributors to the noise environment include commercial and private aircraft that fly outside Fort Irwin's existing boundaries, and vehicular traffic along I-15 and State Highway (SH) 127.

3.8.4.2 Aircraft Noise

Aerial operations at the NTC include Army helicopters and Air Force aircraft. In a typical simulated combat situation, approximately 34 helicopters and 25 fixed-wing aircraft are flown on a daily basis. Some of these operations occur during the night. Figure 3.8-2 shows 12 Standard Army Aircraft Flight Routes (SAAFR) in use within Fort Irwin (DA 2000). The width of the Noise Zone II contours (> 65 dBA) along these routes varies from 0-600 ft (0-182 m) wide. Some of the flight corridors shown on Figure 3.8-2 are very near to, or outside the boundary of Fort Irwin. However, because of the low number of flight operations on those corridors, the impact of a Noise Zone II or III beyond Fort Irwin boundaries for these operations will be minimal.

The NTC also bases some of its flight operations out of Barstow-Daggett Airport (BDA), which is a municipal airport 40 miles (64.3 km) south of Fort Irwin. The noise contours for the aircraft operations that utilize BDA are shown in Figure 3.8-3. The Noise Zone II contour is 500 ft wide consistently from Fort Irwin to BDA and does not impact noise sensitive land uses. No significant noise impacts are expected from aircraft that use BDA outside of Fort Irwin.

3.8.4.3 Military Vehicle Noise

Military vehicles at Fort Irwin also produce noise in the ROI. Fort Irwin vehicle operations include tanks and other tracked vehicles, and wheeled vehicles. Approximately 120 tanks, 520 tracked vehicles, 1,400 wheeled vehicles, and 50 fuel tankers are used on a typical day's operation at Fort Irwin.

Noise for tank operations was studied in an EA for Fort Huachuca, Arizona (Chambers 1994b). This study addressed the noise from maneuvering and firing of M1-A1 and M1-IP tanks. Excluding impulse noise from cannon fire (since live-fire exercises will not be conducted in the any of the alternatives), M1-A1 and M1-IP tanks are anticipated to generate a noise level of approximately 88 dBA at 66 ft (20 m) or 84 dBA at 100 ft (30 meters) (DA 1986). This is reasonably consistent with EPA data, which shows that noise from heavy construction vehicles is approximately 83 dBA at a distance of 100 ft (30 meters) (EPA 1971).

Due to their size and operating procedures, these vehicles do not operate in close quarters such that their noise is strictly additive. Thus, it was assumed that no more than two tanks would operate together such that the noise would be additive, producing a

combined noise of 87 dBA at a distance of 100 ft (30 m). Additional noise is associated with the use of ancillary vehicles, including tracked vehicles, wheeled vehicles, and fuel trucks. However, most of these ancillary vehicles are considerably quieter than the tanks. Because of the spacing involved in maneuvers, the combined noise level would not be expected to exceed 90 dBA at any given point in excess of 100 ft (30 m) from the nearest vehicles of a maneuver. At noise-sensitive land uses, this would result in an ADNL well below 55 dBA, based on the number of operating military vehicles.

3.8.4.4 Non-Military Vehicle Noise

Service vehicles along Powerline Road and Silverlake Road currently produce non-military vehicle noise. These are unpaved access roads used by commercial trucks and service vehicles associated with the various mines, quarries, substations, and off-road activities in the ROI. Off-road vehicles would be expected to average 40 to 50 vehicles per day.

Roadway vehicles that pass by the Study Area on I-15, and through the ROI on SH 127 produce noise. The estimated ADNL noise levels from roadway traffic in the ROI is estimated to be less than 55 dBA at a distance of 100 ft (30 m) from the centerline of the SH 127. Interstate-15 is approximately 3,280 ft (1 km) from the Study Area. The ADNL noise from I-15 at the boundary of the Study Area is estimated to be less than 55 dBA.

3.8.4.5 Small Arms, Impulsive Artillery, and Bomb Drop Noise

Another source of discernable noise in limited areas of the ROI is from firing small and large caliber guns, and from Air Warrior bomb drops. Smaller caliber arms, such as 12.7 mm (0.50 caliber) and 7.62 mm (0.30 caliber) machine guns are used at the NTC and produce a peak sound pressure level of 140 dBP at 105 ft (32 m) and 50 ft (15 m), respectively. Table 3.8-5 shows the calculated peak sound pressure levels at various distances for artillery used at the NTC. Using the data in Table 3.8-5, peak sound pressure level contours were estimated for the Small Arms Range Complexes (SARC), based on the use of 12.7 mm (0.50 caliber) firearms at each of the ranges shown. (See Figure 3.8-4.) Noise Zone II for the SARC does not extend beyond the existing Fort Irwin boundaries and there are no new SARC areas planned for any of the alternatives.

The DA prepared noise contours for large caliber arms that are used at the NTC. Figure 3.8-5 shows the annualized noise levels for the multi-purpose firing ranges (MPFR, >20-mm projectiles) for Ranges 1 – 11 and 25. Noise Zone II for MPFR does not extend beyond the existing Fort Irwin boundaries. Figure 3.8-6 shows the noise levels for the Air Warrior bomb drops at NTC. Noise Zone II for the bomb drops does not extend beyond the existing Fort Irwin boundaries. No MPFR or bomb drop areas are planned for any of the alternatives.

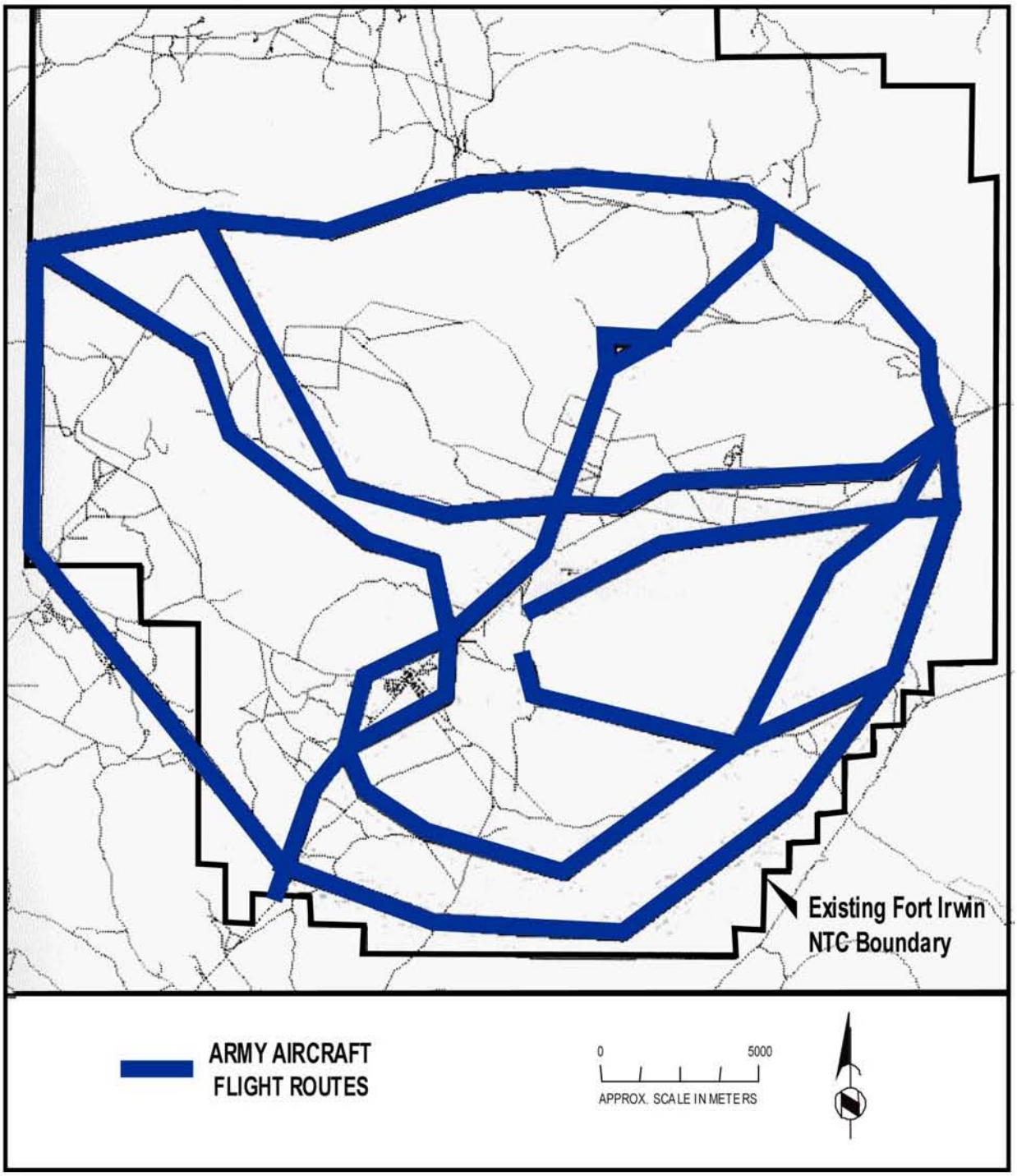

Figure 3.8-2: Fort Irwin Army Aircraft Flight Routes

Source: DA 2000

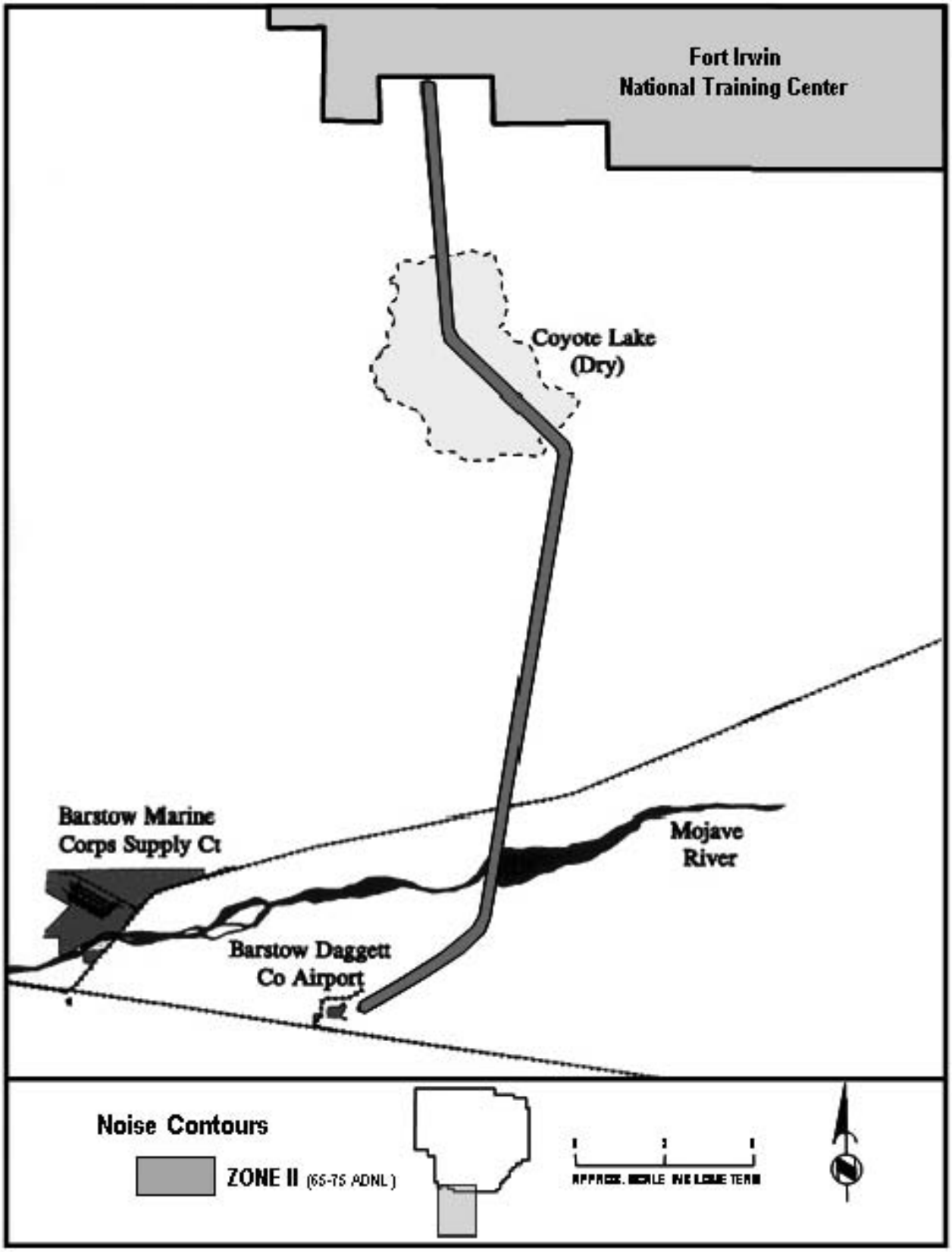

Figure 3.8-3: Barstow-Daggett Airport Noise Contour

Source: DA 2000

A noise contour map for large caliber arms used in the live-fire portion of the rotational training was not prepared, as the distances from the live-fire area to any noise sensitive receptors indicated noise produced would be *de minimus*.

Peak noise levels created by impulse noise, such as artillery fire and bomb drop explosions, were also evaluated for their effects on the surrounding noise environment. Table 3.8-5 presents the peak noise level produced from firing tank artillery used during maneuvers. Note that the data presented in this table are based on un-weighted peak decibels (dBP).

The impulse noise produced from artillery fire attenuates with distance at an approximate rate of 9.5 dBP per each doubling of the distance. Studies have found that variation of temperature and wind velocity can cause very large fluctuations in the noise level over large distances of 3,280 ft (1,000 m) or more from the source. Wind blowing toward the general direction of a noise-sensitive location, away from the noise source, can cause an increase in noise levels far away from the source. Temperature inversion layers in the atmosphere within several hundred feet of the ground surface may also cause this condition. Normally, the air temperature decreases steadily as the altitude increases. A temperature inversion layer is caused by cooling air close to the ground surface, while the air at higher altitudes remains warm. The wind and temperature conditions cause the sound waves to "bend" in a downward direction back toward the ground surface, and thus propagate out farther.

Wind blowing toward the general direction of a noise source, away from the noise-sensitive location, may cause a decrease in noise levels at locations far away from the source. Temperature lapses in the atmosphere within several hundred feet of the ground surface may also cause this condition. Opposite to an inversion layer, a lapse in the air temperature decreases more than normal as the altitude increases. This occurs when there is ground warming of the air close to the surface of the ground. These wind and temperature conditions cause the sound waves to "bend" in an upward direction away from the ground surface, and thus produces a noise shadow zone near the ground. Table 3.8-6 presents scenarios of unfavorable, normal, and favorable atmospheric conditions that have affects on noise propagation, and should be applied to the peak levels shown in Table 3.8-5.

The overall difference in noise levels between favorable atmospheric conditions and unfavorable atmospheric conditions can be 30 to 40 dB or more. This means that under favorable weather conditions, the noise may be inaudible at a specific location, whereas the same noise under an unfavorable weather conditions could be highly annoying at the same location. The effects of atmospheric conditions on noise propagation become less as the distance from the source becomes shorter.

Table 3.8-5: Peak Sound Pressure Levels from Artillery Used at the NTC

Distance (meters)	Peak Sound Pressure Level, dBP at Degrees Off-Axis From the Direction of Fire					Standard Deviation (dBP)
	0°	45°	90°	135°	180°	
155-mm Howitzer Firing						
500	122	125	124	125	126	±5
1000	110	113	112	113	114	±5
2000	101	104	103	104	102	±6
3000	95	98	97	98	99	±7
4000	91	94	93	94	95	±7
5000	88	91	90	91	91	±7
120-mm Tank Gun Firing						
500	141	136	140	136	135	±5
1000	132	127	131	127	126	±5
2000	122	117	121	117	116	±6
3000	117	112	116	112	110	±7
4000	113	107	112	108	106	±7
5000	109	104	109	105	103	±7
105-mm Tank Gun Firing						
500	137	135	134	127	122	—
1000	127	126	124	118	112	—
2000	118*	116*	115*	108*	102*	—
3000	112*	111*	109*	103*	97*	—
4000	108*	107*	105*	99*	93*	—
5000	105*	104*	102*	96*	90*	—
12.7-mm (0.50 Caliber) Machine Gun Firing						
500	102*	—	—	—	—	—
1000	93*	—	—	—	—	—
2000	83*	—	—	—	—	—
3000	77*	—	—	—	—	—
4000	73*	—	—	—	—	—
5000	70*	—	—	—	—	—
7.62-mm (0.30 Caliber) Machine Gun Firing						
500	92*	—	—	—	—	—
1000	82*	—	—	—	—	—
2000	73*	—	—	—	—	—
3000	67*	—	—	—	—	—
4000	63*	—	—	—	—	—
5000	60*	—	—	—	—	—

* *Noted noise levels were calculated based on the relationship: Measured Level, dBP + 31.74(Log (Measured Distance / New Distance).*
— *Data not available.*
Source: DOI 1996; DA 2000

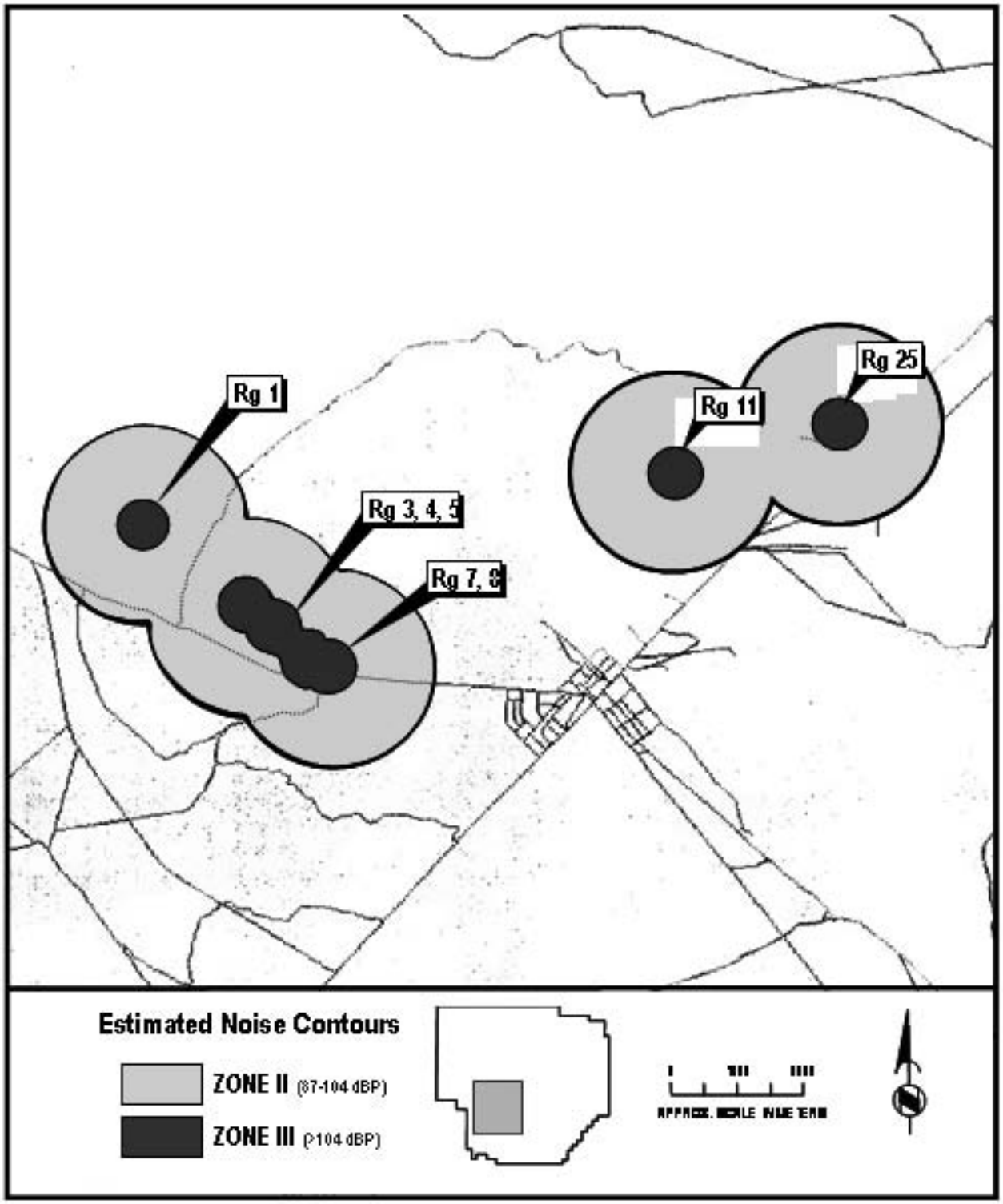

Figure 3.8-4: Estimated Peak Sound Pressure Levels, DBP for Small Caliber Arms Ranges

Source: DA 2000

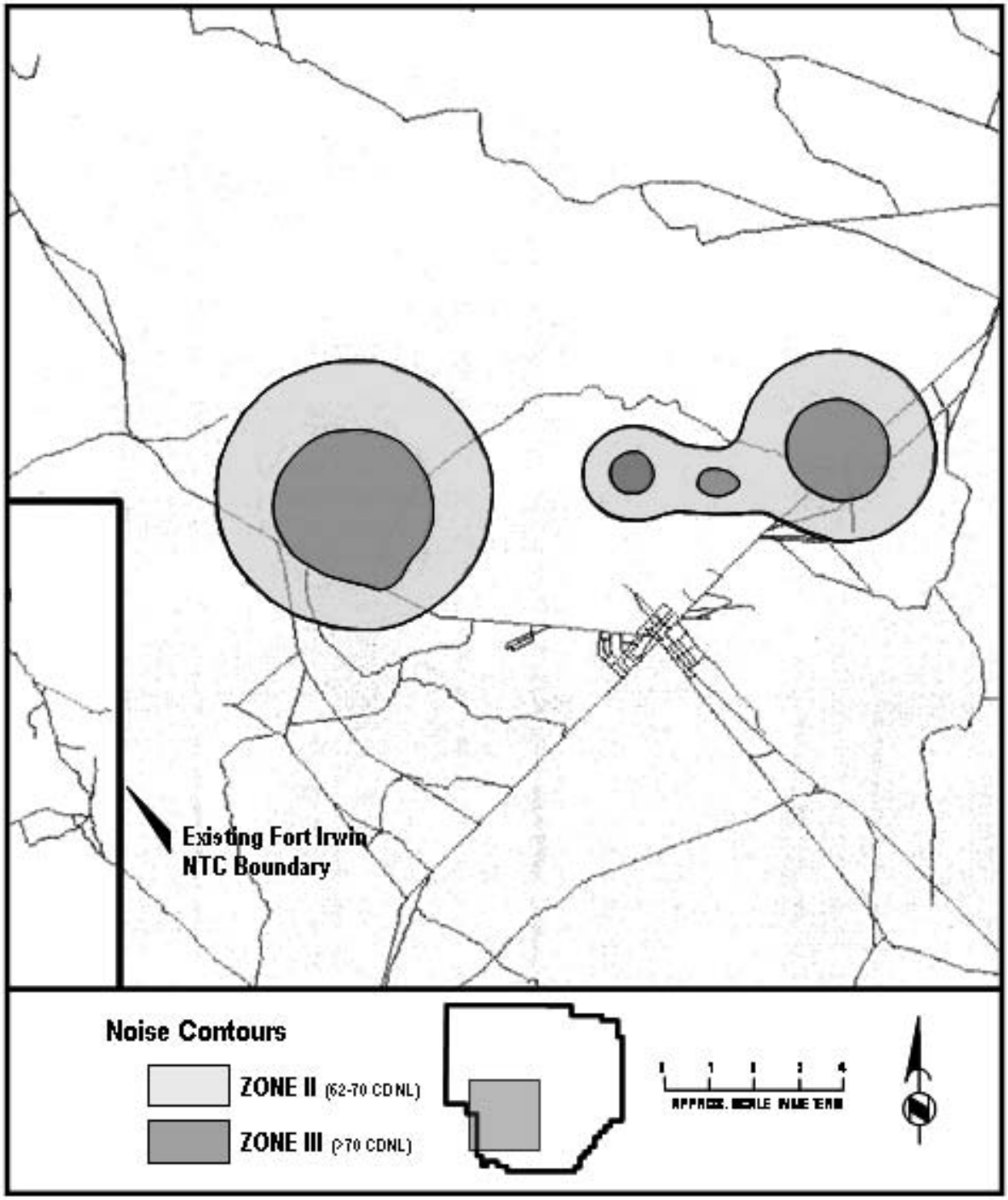

Figure 3.8-5: MPRC Noise Level Contours, CDNL for Large Caliber Arms Ranges

Source: DA 2000

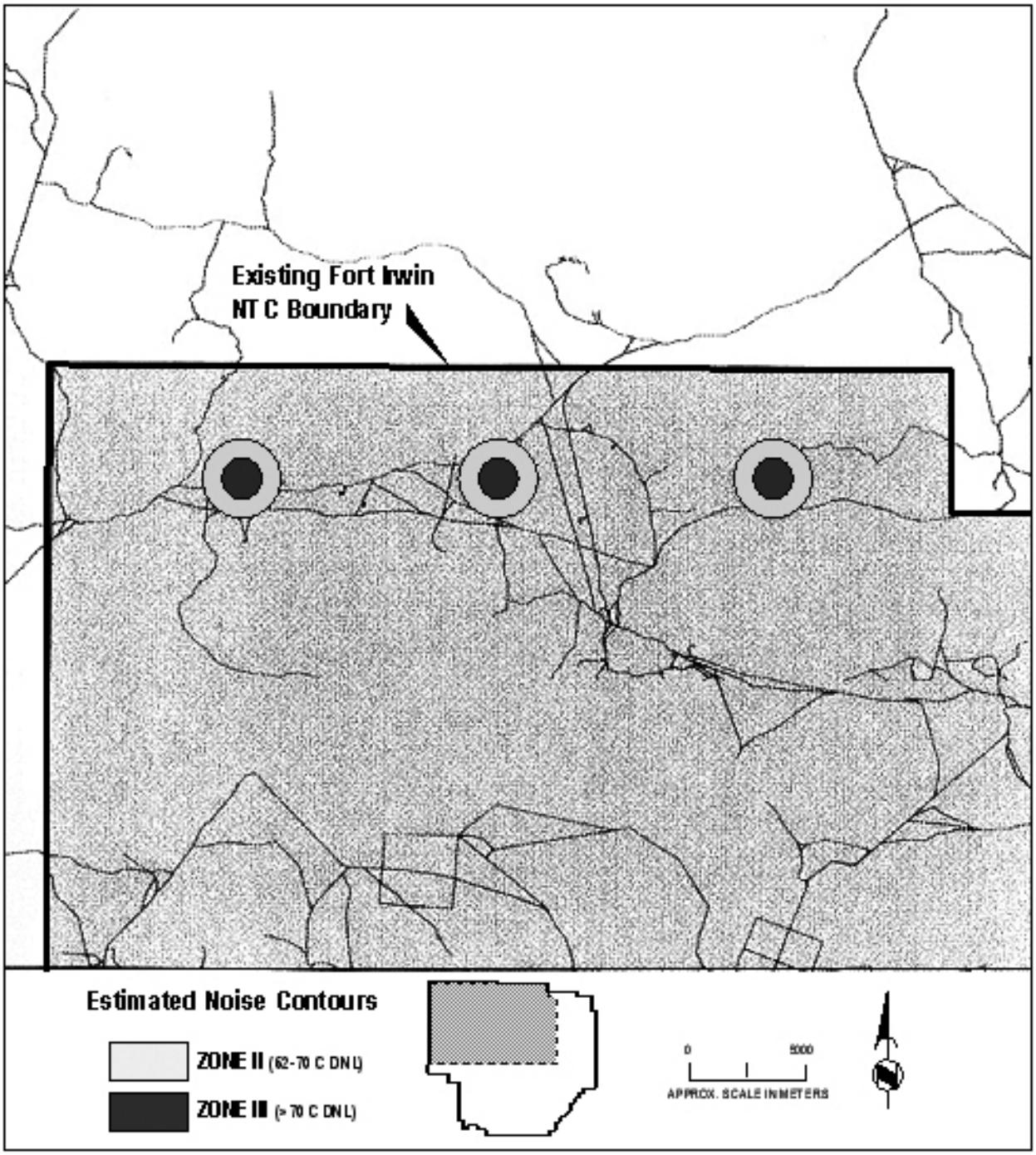

Figure 3.8-6: Air Warrior Bomb Drop Noise Level Contours, CDNL

Source: DA 2000

A minimum distance of approximately 47,500 ft (14.5 km) from the nearest point of artillery fire to any of the noise-sensitive land uses was assumed as a minimum distance to noise-sensitive areas, for this analysis. The peak noise level produced at the noise-sensitive areas using the data in Table 3.8-5 and assuming normal atmospheric conditions, would range from 45 to 94 dBP, depending on the artillery being used. This represents the noise level produced by a single firing. The peak level would increase by 3 dB each time the number of simultaneous firings doubles. Thus, the simultaneous use of two guns of the same type would raise the peak level in the nearest population areas from 48 to 97 dBP, while four simultaneous guns would raise the peak level to 51 to 100 dBP, and so on.

In addition to the noise produced by firing the main gun, the projectile also produces noise as it progresses through the air. The projectile travels at a speed approximately 4.5 times the speed of sound; consequently, the projectiles produce a “sonic boom” similar to that produced by aircraft that fly at supersonic speeds. Although this is a very real effect, the noise levels from projectile sonic booms have not been quantified.

Table 3.8-6: Peak Sound Pressure Levels from Artillery Used at the NTC

UNFAVORABLE ATMOSPHERIC CONDITIONS		NORMAL ATMOSPHERIC CONDITIONS		FAVORABLE ATMOSPHERIC CONDITIONS	
DESCRIPTION	ADJUSTMENT TO APPLY TO TABLE 3.8-5	DESCRIPTION	ADJUSTMENT TO APPLY TO TABLE 3.8-5	DESCRIPTION	ADJUSTMENT TO APPLY TO TABLE 3.8-5
Wind: Days of steady winds blowing in a direction from the artillery test area toward the noise-sensitive area: Wind speed 5-10 mph Wind speed 10-20 mph Wind speed > 20 mph	+10 dB +15 dB +20 dB	Wind: Days of fairly calm winds of less than 5 mph, with occasional gusts below 20 mph.	+0 dB	Wind: Days of steady winds blowing in a direction from the noise sensitive area toward the artillery test area: Wind speed 5-10 mph Wind speed 10-20 mph Wind speed > 20 mph	-10 dB -15 dB -20 dB
Temperature: Days when there is a temperature inversion in the atmosphere within several hundred feet of the ground surface, the air temperature increases steadily as altitude increases. Occurs when there is radiation cooling of the air close to the surface of the ground; can occur during a daytime period when the nighttime temperature is more than 20 degrees Celsius below the following daytime temperature.	+5 dB to +10 dB	Temperature: Days when the air temperature decreases normally and steadily as altitude increases; normal when nighttime temperature is less than 20 degrees Celsius below the following daytime temperature.	+0 dB	Temperature: Days when there is a temperature lapse in the atmosphere within several hundred feet of the ground surface, the air temperature decreases more rapidly than normal as altitude increases. Occurs when there is ground warming of the air close to the surface of the ground; can occur when there is a sudden fall in air temperatures within about 100 to 300 feet above the ground surface.	–5 dB to –10 dB

Unfavorable Atmospheric Conditions		Normal Atmospheric Conditions		Favorable Atmospheric Conditions	
Description	**Adjustment to apply to Table 3.8-5**	**Description**	**Adjustment to apply to Table 3.8-5**	**Description**	**Adjustment to apply to Table 3.8-5**
Other Conditions: Clear days on which "layering" of smoke or fog are observed. Cold, hazy or foggy mornings. Generally high barometer readings with low temperatures.	+5 dB to +10 dB	Other: Days that do not have "Other Conditions" listed as favorable or unfavorable.	+0 dB	Other Conditions: Clear skies with billowy cloud formations, especially during warm periods of the year. A rising barometer immediately following a storm.	–5 dB to –10 dB

***Note:** The adjustments shown in this table apply to sound propagation over large distances (>1000 meters). The combined affect of wind, temperature, and other conditions can be additive, but should not exceed a total adjustment of ±25 dB.*

***Source:** DA 2000; Harris 1979.*