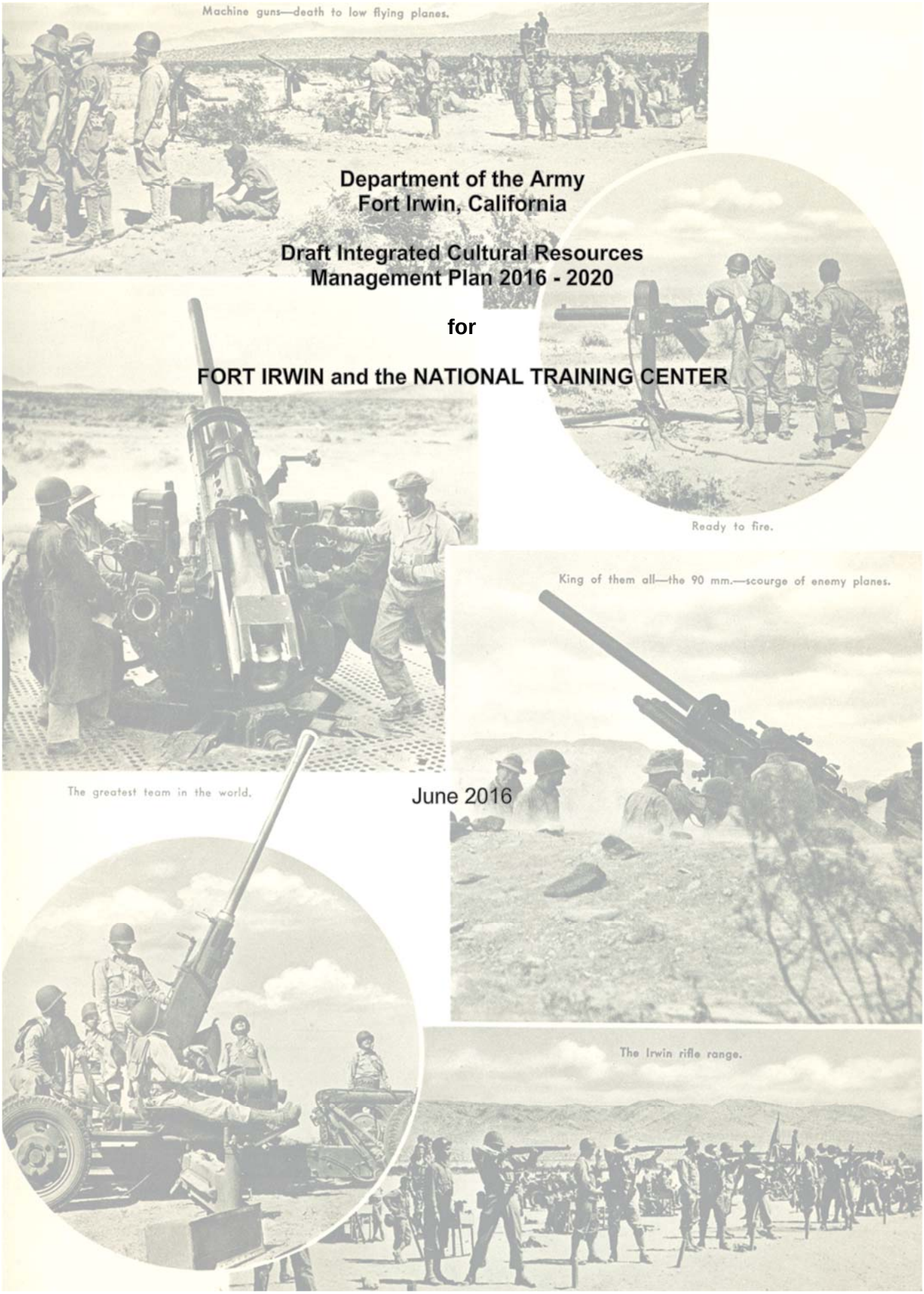

Department of the Army
Fort Irwin, California

Draft Integrated Cultural Resources Management Plan 2016 - 2020

for

FORT IRWIN and the NATIONAL TRAINING CENTER

June 2016

DEPARTMENT OF THE ARMY
FORT IRWIN, CALIFORNIA

DRAFT INTEGRATED CULTURAL RESOURCES MANAGEMENT PLAN 2016 – 2020 FOR FORT IRWIN AND THE NATIONAL TRAINING CENTER

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EXECUTIVE SUMMARY

Fort Irwin, located within San Bernardino County, California, houses the headquarters for the the U.S. Army Garrison, Fort Irwin and the National Training Center (NTC). It is home for the 11th Armored Cavalry Regiment, the 916th Support Brigade, the National Aeronautics and Space Administration (NASA) Goldstone Deep Space Communications Complex (GDSCC) and numerous other tenant units and organizations. The NTC at Fort Irwin serves as the United States Army's premier field combat training facility. The National Training Center conducts tough, realistic, Unified Land Operations with our Unified Action Partners to prepare Brigade Combat Teams and other units for combat while taking care of Soldiers, Civilians, and Family members.

Department of Defense Instruction (DoDI) 4715.16, Cultural Resource Management, and Army Regulation (AR) 200-1, Environmental Enhancement and Protection, specify Army policy for cultural resources management. The Installation Management Command (IMCOM) directs and assists its installations in the conduct of installation cultural resources programs consistent with AR 200-1. The IMCOM Commander will:

- Monitor the installation cultural resources management program
- Forward appropriate documentation (Integrated Cultural Resources Management Plan [ICRMP], Programmatic Agreement [PA], Memorandum of Agreement [MOA], Native American Graves Protection and Repatriation Act [NAGPRA] Comprehensive Agreement [CA]) to Headquarters, Department of the Army (HQDA) for review when required
- Ensure that cultural resources are properly evaluated when conducting environmental assessments pursuant to AR 200-1
- Program appropriate funding for cultural resources compliance purposes

The Garrison Commander has direct responsibility for establishing an installation cultural resources management program by means of an ICRMP that successfully integrates cultural resources management within the process of achieving daily mission objectives. The Garrison Commander will serve as the signatory of the ICRMP after IMCOM and HQDA comments have been addressed.

This document follows the requirements for the preparation of an ICRMP as defined in DoDI 4715.16 and Army Regulation (AR) 200-1. This text is designed to serve as a five-year plan for the integrated management of the historic properties and archaeological resources contained within the limits of Fort Irwin, San Bernardino County, California, for fiscal years 2016 – 2020 and continues the initiative set forth in the Fort Irwin ICRMP of 2011. This plan provides the Garrison Commander, and those responsible for implementing the Commander's decisions, with information and processes necessary for the treatment of cultural resources at Fort Irwin. As a result, Fort Irwin personnel involved in planning activities are the intended audience of this document. This includes, in particular, the Cultural Resources Manager (CRM) who is the individual responsible for the day-to-day management of cultural resources at Fort Irwin.

The ICRMP contains a series of goals, objectives and standard operating procedures (SOPs) that will enable Fort Irwin to meet its legal responsibilities for the management of cultural resources. In addition to specific SOPs, this document also provides SOPs for routine activities that may

have an impact on cultural resources. It also provides cultural resources management goals that would benefit Fort Irwin. These goals include:

- Inventory additional acreages that under represent archaeological sites or historic properties.
- Conduct National Register of Historic Places (NRHP) eligibility evaluations of known cultural resources.
- Consult with affiliated tribes to determine the presence or absence of properties of traditional religious and cultural importance at Fort Irwin.
- Continue consultation with federally affiliated Native American tribes that have a historical association with the geographic region.
- Evaluate buildings and structures that are either 50 years of age or will be within the next five years.
- Continue reorganization of the Fort Irwin curation system so that data are available and objects and material are properly conserved and protected.
- Continue to integrate the Geographic Information System (GIS) cultural resources database into the day-to-day management of resources at Fort Irwin.

1.0 INTRODUCTION

1.1. Intent and Purpose of the Integrated Cultural Resources Management Plan

The DoD is responsible for the protection of the United States (U.S.) of America's citizens, land, and resources. This protection extends to natural and cultural resources. As one of the first federal preservation agencies in the country, in the 1870s the War Department was given responsibility for protecting the nation's first national park, Yellowstone. All federal agencies are now required by law to take necessary measures to identify, preserve, and protect significant cultural resources under their jurisdiction and to carefully consider the effects that their actions will have on these properties. This ICRMP is intended to serve as the planning and guidance document that will assist Fort Irwin in complying with federal preservation requirements, U.S. Army regulations, and DoD policy directives. It also serves as the primary tool for the implementation of the installation's cultural resources management program. As a comprehensive plan, this document has been designed to accomplish the following:

- Assist Fort Irwin in supporting its mission by ensuring that activities conducted as part of its mission address cultural resources management issues and legal compliance requirements.
- Serve as a component of the Fort Irwin Master Plan, complement other facility plans such as the Real Property Vision Plan, the Integrated Natural Resources Management Plan (INRMP) and the Range Complex Master Plan. The ICRMP provides the Garrison Commander, or delegated official, with the information necessary to make informed decisions regarding the cultural resources under his/her control.
- Serve as a guide for execution of Section 106 and Section 110, of the former National Historic Preservation Act, compliance activities at Fort Irwin.

AR 200-1 and DoDI 4715.16 provide for the preparation of an ICRMP for military installations. The five-year ICRMP is a component of the installation master plan and is the Garrison Commander's summary for cultural resources management decisions, actions and specific cultural resources compliance procedures. The ICRMP is an internal Army compliance and management plan. It integrates the entirety of the installation's cultural resources program with ongoing mission activities, allows for ready identification of potential conflicts between the installation's mission and cultural resources, and identifies compliance actions necessary to maintain the availability of mission-essential properties and acreage. ICRMPs supersede and replace Historic Preservation Plans (HPP) prepared under former AR 420-40 and AR 200-4. This ICRMP for 2016-2020 continues the initiatives set forth in the Fort Irwin ICRMP of 2011.

The ICRMP is the plan to accomplish the cultural resources program's missions. Each year it is reviewed and updated in a continual cycle to improve its effectiveness and extend its reach. Thus, the plan follows a pattern similar to, and integrated with, the rolling five-year fiscal program and budget cycle used by the Department of Defense.

The ICRMP receives a major review from the installation command and staff on a five-year cycle. The ICRMP for Fort Irwin provides a forum to examine long-term cultural resource management goals, to explore the intended focus of efforts on critical cultural resource issues, and to achieve consensus on these matters. Thus, as it evolves, the periodic major reviews intentionally serve as a reference point for relevance to command interests. Confirmation of the ICRMP through command approval of the plan signals confidence in program management and delegates authority and responsibility to the Fort Irwin CRM.

Cultural resources are defined as cultural landscapes, ethnographic resources, historic places, properties of traditional and cultural importance, artifacts and documents, buildings, structures, sites, districts, and objects. Significant cultural resources, defined as Historic Properties (36 CFR 800.16(l)), are those that are listed in or eligible for listing in the NRHP. At Fort Irwin the majority of these properties are archaeological sites. The CRM, in accordance with AR 200-1, provides day-to-day management for cultural resources, helps ensure that all installation activities are in compliance with applicable cultural resources requirements, serves as a liaison between all persons involved in the ICRMP, and coordinates and implements the ICRMP.

The Directorate of Public Works (DPW) at Fort Irwin is charged with managing environmental programs on a day-to-day basis. AR 200-1 requires the impact of major actions on cultural and natural resources be assessed prior to the commencement of those activities.

The Fort Irwin CRM prepares annual work plans that provide for implementation of the ICRMP in the current year. The annual work plan provides details about how the program will meet the long-term goals of the ICRMP. Annual objectives are developed to further the long-range goals, and projects are designed to meet the annual objectives. The daily implementation of the cultural resources management program at Fort Irwin must be flexible and capable of responding to unanticipated changes in the installation's mission.

This ICRMP describes an integrated program designed to lessen or eliminate impacts to the military mission; meet compliance requirements; and identify, enhance, and implement program efficiencies. Cultural resources management becomes integrated when the CRM has established processes to plan for the improvement of the program over the short and long term, maintain the existing program, coordinate with other installation offices that impact cultural resources, consult with outside entities who have a stake in cultural resources on the installation, and monitor the success of the program.

1.2 Organization and Affected Stakeholders

The Fort Irwin ICRMP is designed as a modular document, where various sections of the plan are intended for different stakeholders. It is divided into two major sections, Planning and Cultural Resources Management. The Planning section is intended for use as the decision document for the Command. It describes the intent of the ICRMP, the nature of the mission, compliance requirements, impacts to cultural resources, integration of cultural resources management activities with other installation offices, and provides an overview of known cultural resources on Fort Irwin. The Cultural Resources Management section is intended for use by the cultural resources program and other installation offices that need to coordinate activities with the CRM. It outlines management processes to maintain, monitor, and improve the cultural resources program. The primary users of the ICRMP at the installation level are:

- Directorate of Public Works
- National Training Center G3
- Directorate of Plans, Training, Mobilization, and Security
- Directorate of Contracting
- Directorate of Family, Morale, Welfare and Recreation
- Public Affairs
- Staff Judge Advocate

- Tenant Activities
- Master Planning

Subsets of the above users that also will need to integrate the ICRMP into their plans and daily operations are:

- Natural Resources
- Environmental Compliance
- Real Property
- Pest Management
- National Environmental Policy Act Management Program
- Range Operations
- Integrated Training Area Management (ITAM) Program
- Installation contractors.

1.3 Cultural Resources Management Program

The Garrison Commander or his/her designated Cultural Resources Manager (CRM) has direct responsibility for establishing an installation cultural resources management program. The goal of this program is to successfully integrate cultural resources management compliance within the process of achieving daily mission objectives. The cultural resources management program at Fort Irwin is located within the Environmental Division of the Directorate of Public Works (DPW). The Fort Irwin Garrison Commander has designated the Director, Directorate of Public Works, as the Fort Irwin CRM. The roles and responsibilities of the CRM are described below (Section 1.3.1), followed by a brief discussion of the program's staffing and other program components. This text is intended to provide background information on the Fort Irwin cultural resources management program, its configuration, and operation.

1.3.1 Cultural Resources Manager (CRM) Roles and Responsibilities

Under AR 200-1, the Garrison Commander designates a CRM to coordinate the facility's cultural resources management program. The CRM:

- Serves as the Garrison Commander's designee for compliance with all applicable cultural resources laws and requirements.
- Notifies the Garrison Commander when activities on post do not comply with all applicable laws and requirements in regard to cultural resources.
- Coordinates all correspondence and serves as the point of contact for the State Historic Preservation Office (SHPO), Advisory Council on Historic Preservation (ACHP), and federally recognized Native American tribes.
- Oversees all project review for all facility undertakings in compliance with applicable requirements.
- Develops and maintain files that document completion of the Section 106 review process, to include maps, plans, notes, data forms, photographs, memoranda, journal notes, draft and final reports, or other documentation relating to the identification and resolution of any effects.
- Participates in/coordinates Native American and/or public consultations pursuant to compliance with applicable laws or regulations (such as NPSRPA, NAGPRA, and National Environmental Policy Act [NEPA]).

- Ensures that all technical work affecting historic buildings and structures is prepared by, coordinated, and/or conducted under the supervision of a qualified technical expert(s) (such as a historic architect or architectural historian).
- Determines the NRHP eligibility of cultural resources.
- Develops Memoranda of Agreement (MOAs) and Programmatic Agreements (PAs).
- Oversees the proper curation of artifacts recovered from installation property in accordance with 36 CFR 79.
- Assists Archaeological Resource Protection Act (ARPA) permit applicants.
- Assists the Garrison Commander with developing funding priorities for all cultural resources management program and compliance activities.
- Develops budget requirements for compliance with this ICRMP.

The CRM executes these roles and responsibilities through the Cultural Resources Program Manager (CRPM), Installation Archaeologist (IA), and contracted archaeologists located in the Directorate of Public Works Environmental Division. The CRPM, IA and contract archaeologists provide day-to-day management of cultural resources, ensure that all installation activities are in compliance with applicable cultural resources requirements, coordinate cultural resources management activities with organizational elements and tenant organizations, and oversee implementation of the ICRMP.

1.4 Location and Setting

1.4.1 Present-Day Fort Irwin

President Franklin D. Roosevelt authorized the Mojave Anti-Aircraft Range north of Barstow in 1940 and construction was completed in 1942 (Science Applications International 1996:14). The facility was renamed Camp Irwin in 1942 and, in 1961, designated Fort Irwin Army and the Desert Training Center (Chapman 1997). In 1979, approval was given for the facility to become Fort Irwin and the National Training Center.

Fort Irwin is located in the central Mojave Desert approximately 37 miles northeast of Barstow in San Bernardino County, California. The installation is located midway between Los Angeles, CA to the west and Las Vegas, NV to the east (Figure 1). The Mojave River is 15 miles south of the installation, and Death Valley is 10 miles to the north. Fort Irwin encompasses an area of approximately 753,537 acres or approximately 1,177 square miles. About 170 square miles of this total were added to the original base in December 2001 as a result of Public Law 107-107, enacted by Congress, and the National Defense Authorization Act for Fiscal Year 2002, in which Title XXIX Fort Irwin Military Land Withdrawal, created the “Fort Irwin Military Land Withdrawal Act of 2001.” This Act withdrew approximately 110,000 acres of federally owned public lands in San Bernardino County, of the State of California, to allow the Commanding General, NTC and Fort Irwin, to implement critical training for soldiers. These additional lands are located along the original eastern boundary of the installation and along the southwestern corner of the installation, south of the Goldstone Complex.

Two large areas of the installation have restricted access. The Leach Lake Gunnery Range (LLGR), consisting of 91,330 acres, lies along the northern edge of Fort Irwin and is used by the U.S. Air Force as a target range. The Army also uses a portion of the range as an impact area. The second of these areas is the NASA GDSCC consisting of 32,229 acres on the western side of the installation. This area is under the operational control of NASA and military use is limited

to main roads and an airfield complex. Additionally, natural and cultural resource conservation areas and dry lake playas are off limits for training. Fully 134,315 acres are currently off limits to maneuver training (Figure 2) although that acreage may be reduced in the future as compliance actions for expansion are achieved. Presently, 619,222 acres are available for training. Excluding the two restricted access areas and the cantonment area, Fort Irwin is divided into numerous training areas (Figure 3) and three training corridors (Figure 4) which incorporate the training areas and trend east-west, bounded by mountain range ridgelines and installation or restricted access boundaries. The central corridor has seen the heaviest use for maneuver training and has been the focus of most of the earlier cultural resource inventory surveys. The southern corridor has had the greatest inventory survey coverage, followed by the central corridor. The northern corridor has had the least inventory survey coverage.

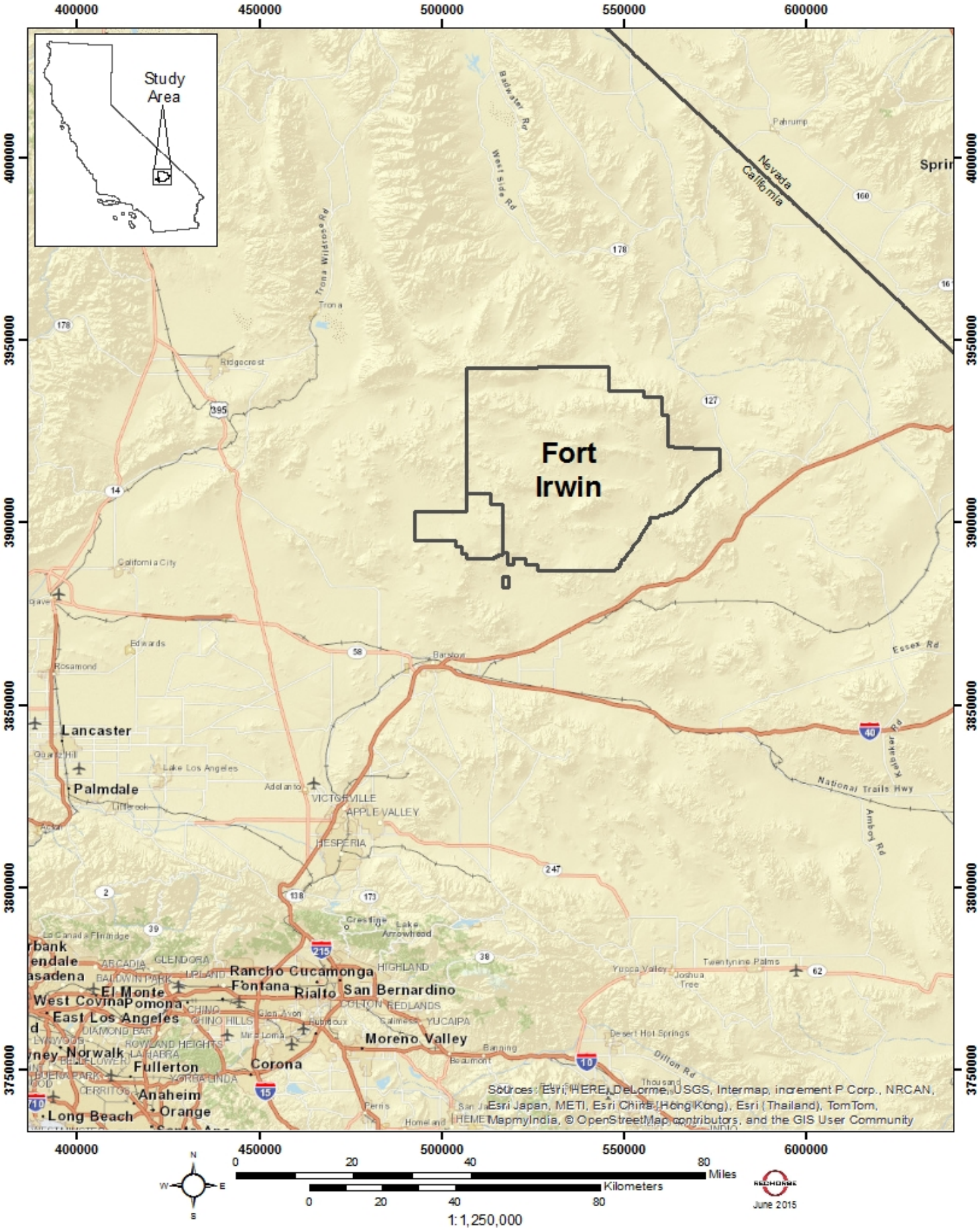

Figure 1: Fort Irwin regional overview

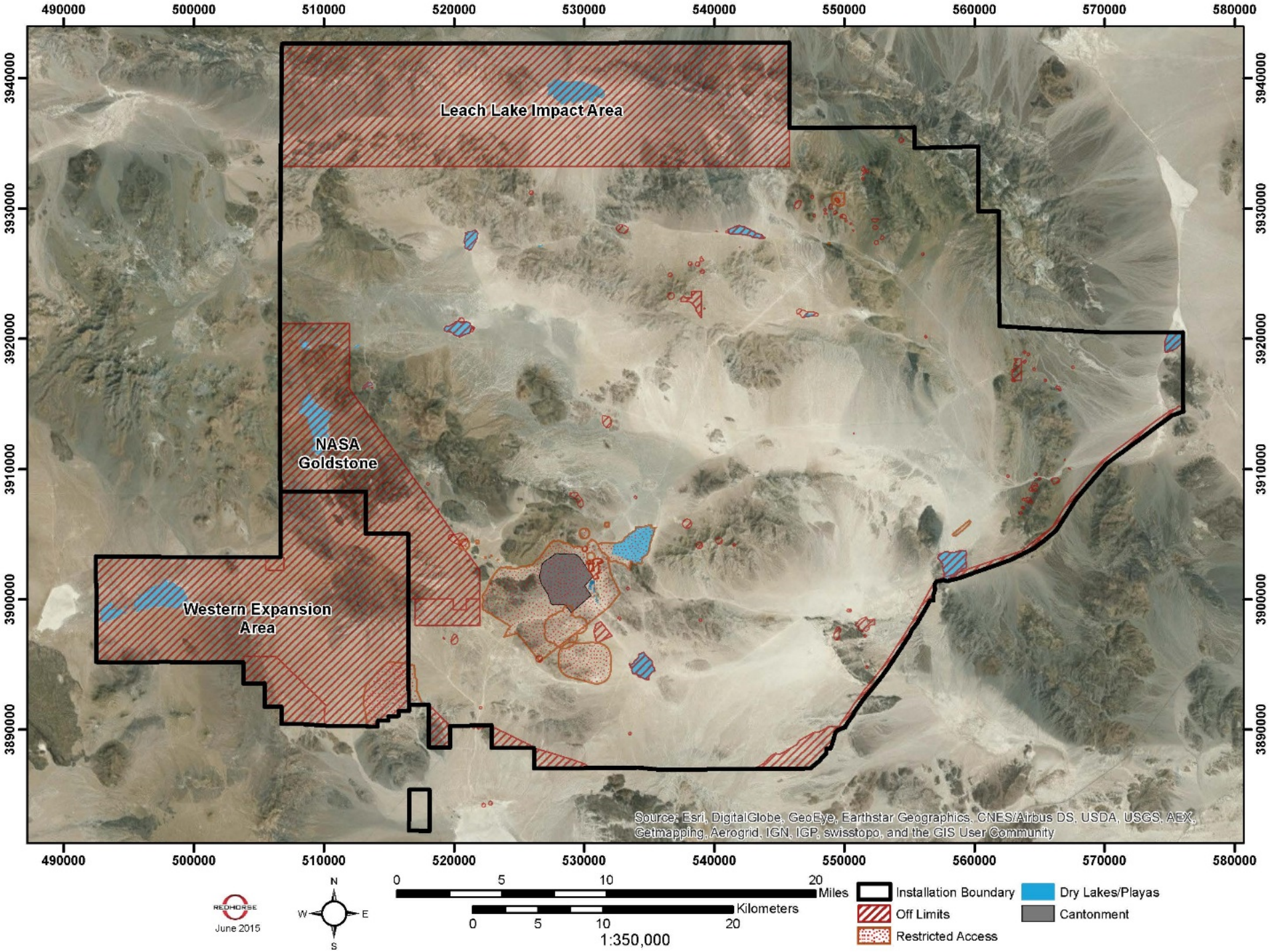

Figure 2: Fort Irwin expansion and off limit areas

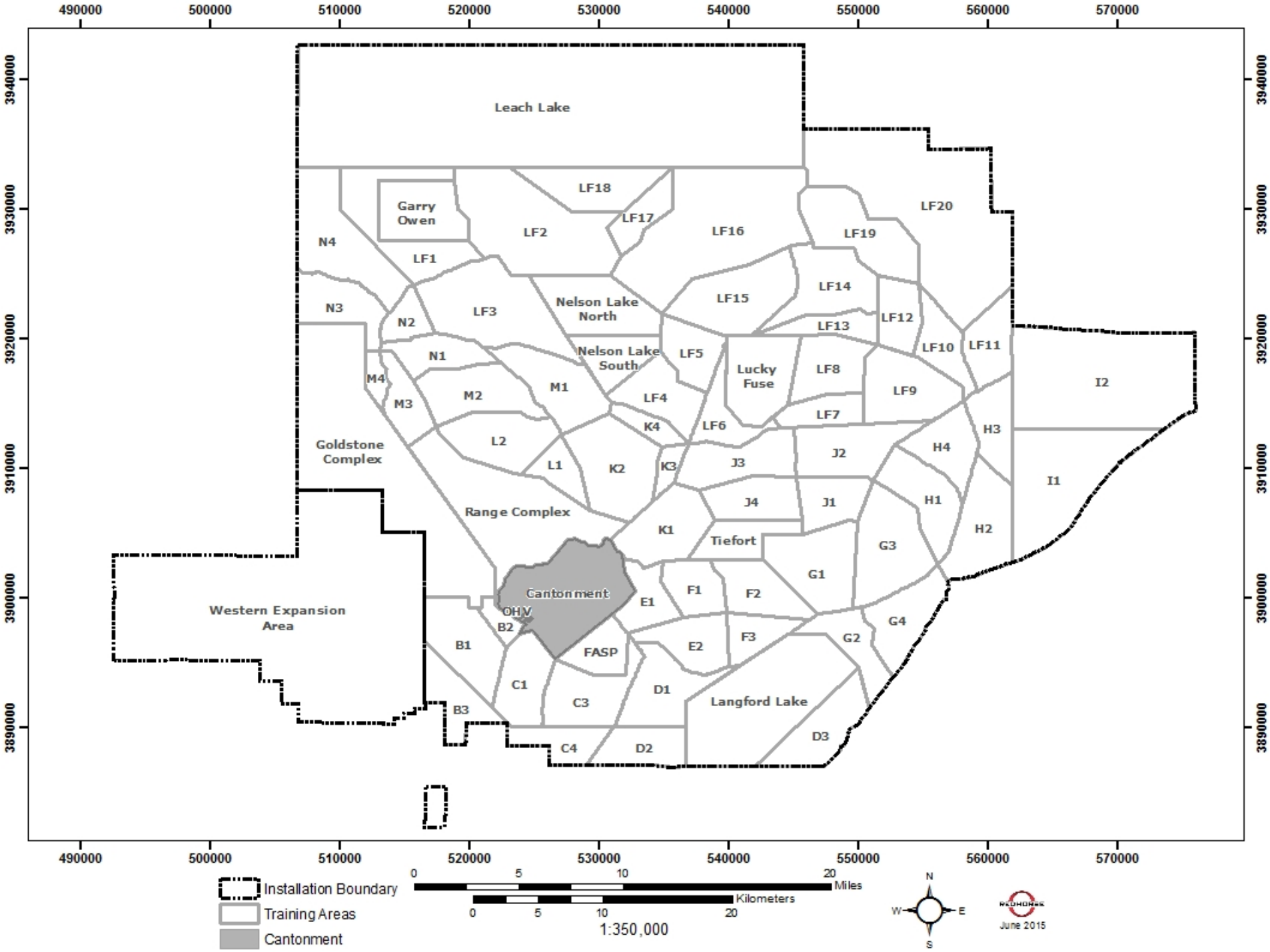

Figure 3: Fort Irwin training areas

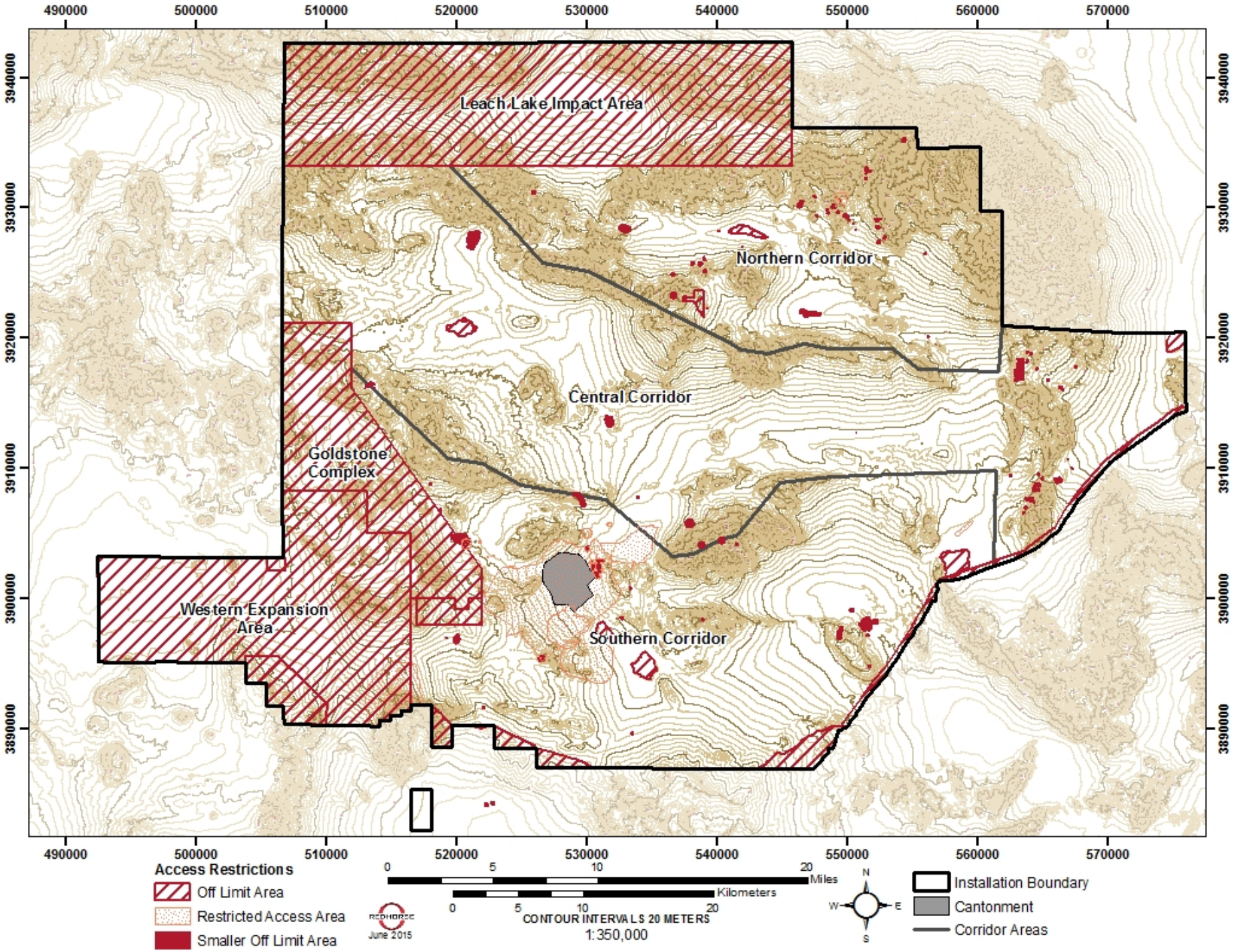

Figure 4: Fort Irwin maneuver corridors

Due to the lack of adequate hangar space for maintenance, the NTC and Fort Irwin lease a portion of the Barstow-Daggett Airport on which it has constructed a military helicopter maintenance facility. Barstow-Daggett Airport is located east of Barstow, about 35 miles southeast of the installation. Fort Irwin and the NTC also lease a portion of Southern California International Airport (former George Air Force Base) as a troop landing facility. Rotational training unit soldiers are flown to Southern California International Airport and then bussed to Fort Irwin.

Federally owned lands immediately to the south, east, and north of the installation are administered by the Bureau of Land Management (BLM), while a portion of the China Lake Naval Air Weapons Station abuts the western edge of the installation. Fort Irwin Road, which is the only paved road that provides access to Fort Irwin, intersects Interstate 15 in the city of Barstow, CA approximately 37 miles south of the installation.

1.4.2 Community Description

The Fort Irwin Community is made up of approximately 4,448 active duty military personnel assigned to the installation, 7,701 family members, and 7,201 civilian employees. In addition, an average of 5,629 soldiers from other installations reside temporarily at Fort Irwin each month while they use the NTC for training on a rotational basis. The installation is a fully operational community with more than 2,468 family housing units. Fort Irwin also has a pre-school, elementary and middle school, adult education center, a library, chapel, hospital, and places for shopping, recreation, and entertainment.

2.0 PLANNING

This section describes the missions of the Installation Management Command, Fort Irwin, and the NTC and describes the nature of mission activities. This section includes cultural resources statutes and regulations, potential impacts to cultural resources, and discusses integration of cultural resources management activities with other installation offices.

2.1 Mission Statements

The missions of U. S. Army Garrison (USAG), Fort Irwin, the NTC, and higher headquarters are defined in the following ways.

2.1.1 Installation Management Command (IMCOM)

IMCOM delivers and integrates base support to enable readiness for a self-reliant and globally-responsive All Volunteer Army.

2.1.2 National Training Center, Fort Irwin

The NTC is the premier training center providing world class training to Unified Action Partners preparing for deployment to any operational environment around the world. Its mission is to conduct tough, realistic, Unified Land Operations with our Unified Action Partners (UAP) to prepare Brigade Combat Teams for combat while taking care of Soldiers, Civilians, and Family members. Priorities to accomplish this mission include train BCTs and their Unified Action Partners across the full range of military operations; attract and integrate the best leaders to support our mission; develop at echelon, agile, adaptive leaders who understand the Army Profession; and create conditions that make Fort Irwin a community of choice.

2.1.3 U.S. Army Garrison, Fort Irwin

Ensure a ready and resilient community sustained through exceptional customer service resulting in an excellent quality of life.

2.1.4 Fort Irwin Directorate of Public Works, Environmental Division

Conserve, protect and restore our natural and cultural resources in support of the military mission.

2.2 Mission Activities and Impacts to Cultural Resources

The NTC at Fort Irwin serves as the United States Army's premier field combat training facility. It has a single mission, to conduct tough, realistic, Unified Land Operations with our Unified Action Partners (UAP) to prepare Brigade Combat Teams for combat while taking care of Soldiers, Civilians, and Family members. All of the installation's energy and resources, from logistics to operations, are focused on this mission. The overarching activity undertaken at Fort Irwin is the execution of the full spectrum of ground and air combat operations involving armored, mechanized infantry, combat support and combat service support units. The primary organizations at Fort Irwin are the National Training Center Headquarters, 11th Armored Cavalry Regiment (11th ACR), Operations Group and 916th Support Brigade. The mission activities of these organizations conducted in accordance with their stated missions occur throughout the installation in the cantonment area, training areas, areas controlled by other government agencies (NASA) and off limits and restricted areas.

2.2.1 Cantonment Area

The Cantonment Area can be subdivided into six subareas, as follows: (1) residential areas used for family housing; (2) professional/institutional areas used for training support and planning; (3) community zones used for businesses, medical, retail, and public services; (4) industrial zones used for maintenance, logistics, and transportation activities; (5) range/community spaces used for training, recreation, and future development and (6) areas used for housing troops (Figure 5). These built areas usually constitute the primary location of mission potential impacts to historic buildings and structures, although subsurface archaeological resources can also be impacted through digging related to new construction or modifications of existing buildings or infrastructure. At present, no historic buildings have been identified as eligible for listing in the NRHP in the cantonment area. One small archaeological site is recorded in the cantonment area and eight others are in close proximity. The following is a list of potential mission activities within the Cantonment Area that may affect cultural resources:

- Buildings, structures, or landscape modifications
- Buildings, structures, or landscape changes in use
- Facilities closure
- Disabled accessibility programs
- Energy conservation programs
- Hazardous materials removal
- Environmental programs
- Master planning and other planning activities
- Training activities

2.2.2 Areas Controlled by Other Federal Government Agencies

Other federal government agencies currently manage two portions of Fort Irwin (see Figure 2). The largest is the LLGR, which covers most of the northern edge of the installation and the Leach Lake basin. This area is used by the Air Force for air-to-ground gunnery and by the Army for mortar and artillery training with dud-producing munitions.

The Goldstone Deep Space Communication Complex is controlled by NASA. This complex is along the western edge of the installation and includes the areas immediately around Goldstone Lake. Although this facility is within the confines of Fort Irwin, it is an “off limits” area not generally available for Army use. All army vehicle traffic is limited to wheeled vehicles on the developed road running from the NASA security gate to the Pioneer cut-off. The GDSCC executes its cultural resources management responsibilities through NASA but coordinates closely with the Army and Fort Irwin.

2.2.3 Training Areas (Including Live Fire Ranges, Live Fire Exercise Area, and Maneuver Areas)

The lands of Fort Irwin are subdivided into several overlapping zones (see Figures 3 and 4) of use to carry out mission activities. NTC operations at Fort Irwin are organized through the Rotational Training Unit Schedule. The central element of which is a “rotation” defined as an 18 to 22 day period in which visiting units engage in reception, staging, and integration activities followed by intense combat operations, to include live fire operations, and conclude in combat power regeneration activities. These operations will involve all portions of the installation during a typical training rotation.

Rotational units are supplied with all materials they would have in actual combat situations, including satellite photography, detailed maps, and other information. A live opponent, the opposing force or OPFOR, is provided by a tenant unit, the 11th ACR. This unit deploys and engages in ground combat operations for each training rotation at Fort Irwin and is considered one of the best-trained armor units in the world. In the course of a rotation, the rotational unit and the 11th ACR may make use of any portion of the installation that is not off limits. Prior to the commencement of each training rotation, training units are briefed on NTC Range Regulations and provided with maps of the installation, which include restricted and off-limits areas. These off-limits areas include cultural resources sites. Both NTC and Army regulations require protection of specific cultural resources on Fort Irwin. These and other environmental requirements are explained to training units in various presentations and products which are distributed as widely as possible. Presentations at the Pre-Deployment Site Survey and Leader Training Program are designed to inform rotational unit leadership about environmental regulations and sensitive sites that must be protected. A short environmental video is provided for training at home station prior to the unit deploying to Fort Irwin. When the rotational unit arrives on Fort Irwin, Soldiers Field Cards containing critical environmental and safety information are distributed to each soldier along with standard maps showing off limits and restricted areas. The “coaches” for the rotational unit also receive in-depth training on protection of off limits sites, rules about digging, and what to do if cultural artifacts are found. These coaches are embedded with the rotational units and are responsible for enforcing all regulations throughout the training period.

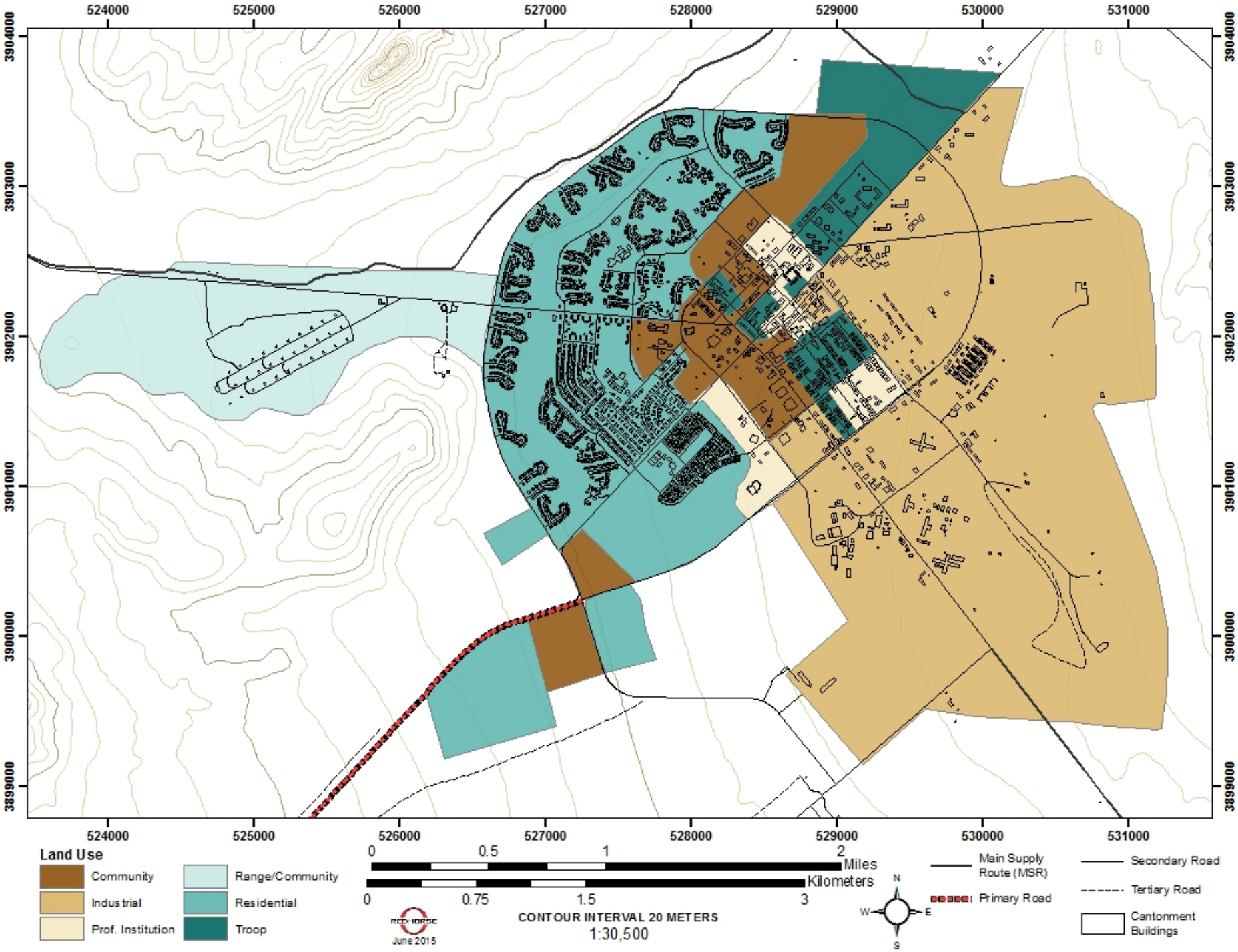

Figure 5: Cantonment area

As a result of the manner in which training is conducted, it is difficult to divide Fort Irwin into discrete areas in which particular activities occur during any particular rotation. Although certain portions of the installation may be relatively unused or used for the same purpose because of topographic factors or other restrictions, the remainder of the facility may host a range of activities. The only limitations that must be honored are the off-limits and restricted-use areas.

Land-use patterns change during non-rotational periods, when activities are more spatially restricted. While Operations Group (OPSGRP) manages and is in charge of Fort Irwin training areas and operations during a rotation, Range Operations regulates installation activities between rotations. Although the highest level of activity at Fort Irwin occurs during training rotations, the installation is also heavily used during non-rotational periods for various training activities. In most cases, a non-rotational period of two weeks separates rotations, but this schedule can vary.

Potentially adverse effects to cultural resources on training lands at Fort Irwin are comparable to the types of impacts found at most Army installations that have substantial training missions. These include (1) maneuver damage from tracked and wheeled vehicles; (2) construction and modification of facilities; (3) vandalism and looting of archaeological sites and historic structures (from either the military or the public); (4) explosive ordnance use; (5) excavation and earth-moving activity; (6) natural erosion, including erosion that may be exacerbated by military activities; and (7) reclamation and restoration of natural resources on training lands.

Maneuver damage from either tracked or wheeled vehicles has been commonly recognized on training lands (*see, e.g.* Basgall 2003; Byrd and Pallett 2000; King and Putnam 1994; Lowry et al. 2004; Weston et al. 1995). The severity of the damage depends upon several factors: landscape type (desert terrain versus forest), sediments (e.g., sands versus clays or bedrock), and topography (alluvial valley versus mountains), as well as the frequency and duration of the activity. In deserts, such as the Mojave where Fort Irwin is located, the most commonly used areas are the valley floors. Repeated use of the same valley floors by vehicles can result in reduced vegetative cover and ruts from tires and tracks. Although tracked vehicular damage is typically more evident, both types of traffic can cause rutting and erosion that can adversely affect surface and subsurface archaeological sites.

Vandalism of sites and historic structures is apparent through large, irregular excavated pits, often with evidence of artifacts carelessly tossed around their edges, or through the removal of structural elements of historic buildings. Modern graffiti are sometimes painted or etched onto prehistoric rock art. In some cases, such sites and structures have been repeatedly vandalized. Vandalism of archaeological sites is very rare at Fort Irwin and is mostly limited to graffiti near rock art sites containing petroglyphs.

Other, more common forms of excavation within training areas are mission-related. These include large excavations using earth-moving equipment for the purpose of concealing gun emplacements, tanks, or support equipment, or for defensive purposes. Deep excavations usually accompany the construction of bunkers, shelters, or protective walls and kitchen waste pits. Individual fighting positions (fox holes) are less invasive and smaller, but may include sand bags or rock walls for protection. These activities displace considerable volumes of earth and can severely impact surface and subsurface archaeological sites, especially in areas of high archaeological sensitivity and site density.

Pits and craters resulting from explosive ordnance are almost exclusively limited to artillery impact areas and are seldom mistaken for anything else. Many of these are confined to the mountain

ranges near the Live Fire Ranges and the Live Fire Exercise Area on Fort Irwin. Frequently, the vegetation and soil surrounding them have been burned or scorched, and there are fragments of shells. Although the artillery impact areas are ubiquitous within designated areas, their occurrence on the remaining portions of the installation is sporadic. These can severely impact surface and subsurface archaeological sites. However, the impact areas where they commonly occur are usually off limits for archaeological survey (due to safety considerations). Thus, the extent of their actual impact to cultural resources is frequently unknown in these areas. Artillery impacts on cultural resource sites in the rest of the installation are rarely noted and inconsequential.

As noted above, tactical maneuvers themselves can degrade the vegetation and soils on Fort Irwin. In the interest of good environmental stewardship and to improve and conserve training areas, Fort Irwin has an Integrated Training Area Management (ITAM) Program whose focus is on reclaiming and restoring training lands. Depending on the methods of reclamation and restoration, impacts to surface and subsurface archaeological sites can occur. If the reclamation consists of re-vegetation through reseeding, impacts are low and largely restricted to limited surface displacement of cultural materials. If the reclamation consists of construction of water tanks or other facilities, impacts to cultural materials can be higher, although restricted to the footprint of the construction zone.

2.2.4 Off-Limits and Restricted Areas

The Army has designated certain portions of the installation off limits to almost all activities. Many of these areas are point-specific and related to particular cultural or natural resources (primarily archaeological sites and springs), but two of them encompass relatively large areas. The first of these two large restricted areas is land set aside for desert tortoise conservation (Figure 2). The first of the tortoise conservation areas flanks the southeastern edge of the NASA Goldstone outgrant with the remainder of these sites running along the installations southern boundary east to the basalt outcrop known as the “Whale” near the southeastern boundary of the installation. These areas are off limits to all activities with the exception of research. As a result, these areas also serve as protection for any cultural resources within their boundaries. The second relatively large restricted area is the Multi-Use Recreational Area immediately southwest of the Cantonment Area (see Figure 3). In addition to horseback riding, this area is also available for recreational hiking, camping, and biking. No military training occurs in this area which serves to protect cultural resources located within its boundaries.

The Army also has restricted the range of activities that can occur in other areas. “Restricted Dig Areas” include the former Langford Impact Area, the former Gary Owen Impact Area, the former Nelson Impact Area (below the 200 East-West Gridline), and the former Lucky Fuse Impact Area. All of these areas are considered “restricted use” as they may contain unexploded ordnance from past training activities. Within these areas, no infantry fighting positions may be excavated, and excavations for armored vehicle fighting positions must be done by protected personnel in armored vehicles. Activities in “No Dig Areas” are even more restricted. Those areas include the Leach Lake Range, Old Range 4 (a former Live Fire Range), the former Nelson Impact Area above the 200 East-West Gridline, and an old impact range just to the east of the former Lucky Fuse Impact area. Although foot soldiers may train in these areas, no digging of any kind is allowed.

Given the limitations imposed by the no dig and restricted dig areas, potential impacts to cultural resources in these areas are fewer than elsewhere on the installation. The greatest potential

damages to cultural resources in these areas are from impacts from accidental incursions by tracked and wheeled vehicles.

2.2.5 Coordinated Activities

The following activities at Fort Irwin may have an effect on historic properties and are of concern. Consequently, they are closely coordinated by cultural resources staff and project proponents.

- Military training and testing activities.
- Development and maintenance of administrative and support facilities.
- Erosion management activities.
- Recreational activities by personnel associated with Fort Irwin.

Generally, any ground-disturbing action within the boundary of a National Register eligible archaeological site can affect the integrity of a cultural resource and its setting, resulting in alteration or destruction of those characteristics or qualities that make the resource significant and therefore eligible for inclusion in the NRHP. Although archaeological site destruction can occur in a single event, more often it results from the cumulative effect of recurrent actions over time. Natural forces, such as rodent burrowing or erosion, can impact archaeological site integrity, but it is human actions and their consequences that are a focus of ICRMP regulation.

2.3 Statutes and Regulations

Statutes and regulations that pertain to the management of cultural resources on Army installations are listed in Appendix B. Those that would not apply to the lands of Fort Irwin (such as the Abandoned Shipwreck Act of 1987 [43 United States Code (U.S.C.) 2101–2106]) are not included.

2.3.1 Fort Irwin Regulating Agreement Documents

Some military bases have developed agreement documents that tailor the process the installation uses to comply with the above referenced laws. Fort Irwin signed and implemented a Programmatic Agreement (PA) under Section 106 of the NHPA (now included in the NPSRPA, 54 U.S.C § 300101 et seq.) with the California SHPO in 2005 for its Expansion lands and Southern Corridor. This PA, while expired, differed in several ways from a Memorandum of Agreement (MOA) signed by the ACHP, the SHPO, and Fort Irwin in 1981 and amended by those same parties in 1983. Agreement documents tailor the Section 106 process to a particular project or, in this case, to the installation, its mission, and the extant types of cultural resources.

During the five year period covered by this ICRMP, Fort Irwin may pursue adoption of the Army Alternate Procedures (AAP) to Section 106 through development of a Historic Properties Component (HPC) in consultation with the ACHP and the California SHPO. The HPC will be a compliance document that implements the Army Alternate Procedures in lieu of standard Section 106 requirements. The intent of the HPC is to be a stand-alone document that is sent out for external review and signatory acceptance. The HPC is specific to cultural resources that have been determined to be significant and are considered to be historic properties that are eligible for inclusion in the NRHP.

2.3.2 Failure to Comply with Cultural Resources Management Program Requirements

Military personnel make decisions daily that may enhance, jeopardize, or destroy historic and archaeological resources. These resources are owned by the American people and managed by the U.S. Army. Consequently, it is required for the U.S. Army or any Federal agency to properly review proposed activities before beginning any project that may affect historic properties. Failure to coordinate with the CRM and to undergo the proper compliance procedures may result in litigation against the Garrison Commander, the DA, and the DoD. Litigation has the potential to create costly construction delays, create a negative perception of the installation, and engender animosity between Fort Irwin and its neighbors.

2.4 Fort Irwin Internal Coordination Process: Roles and Responsibilities

AR 200-1 requires the ICRMP identify interface requirements between the cultural resources management program and other program areas including, but not limited to, natural resources management, ITAM, master planning, facilities and housing, and mission related training and testing activities. This ICRMP is a component plan to the installation Master Plan and is prepared in conjunction with:

- master planning (installation development and land uses)
- natural resources management (Integrated Natural Resources Management Plan)
- training area management (ITAM program)
- real property planning, including facilities and housing
- installation operations and maintenance activities
- installation training activities.

2.4.1 United States Army Garrison (USAG), Fort Irwin

Fort Irwin's ICRMP is fully integrated with the mission by being well coordinated with all installation offices and plans that can impact cultural resources, including master planning, natural resources management, range operations and training. This ICRMP includes information about how these offices address cultural resources issues, how they share information, and the cultural resources management priorities as a result of mission activities.

2.4.1.1 Directorate of Public Works

Most offices that require cultural resources integration fall under the DPW. The DPW is responsible for managing roads, buildings, and natural and cultural resources at Fort Irwin. DPW maintains and manages land to conserve biodiversity, and ensure that the installation complies with federal and state environmental laws and regulations. DPW has the responsibility to implement the ICRMP and INRMP.

2.4.1.2 Master Planning

Master Planning is a Division housed in the DPW. The installation Real Property Vision Plan (RPVP) is an official statement of the installation's long-range plans from a real property standpoint. The RPVP and attendant Planning Guide provide information on existing conditions and future requirements for individual facilities and activities at the installation. The plans are integrally tied to the mission.

Each military installation plays a particular role in the national defense mission. Real property master planning links the Department of the Army mission to the installation's real property required to accomplish the mission. The master planning process serves two primary purposes.

1. It provides a systematic approach to defining the missions and operations at an installation in terms of the facilities and land area requirements.

2. It provides a foundation for developing and implementing a strategy to use, acquire and manage those assets.

The primary goal of the RPVP is to plan facilities that support the long-range goals of the Army and the missions and personnel assigned to an installation in an efficient, economical, and environmentally responsible manner. The Fort Irwin RPVP is a dynamic plan intended to provide the installation with a comprehensive development vision for the future. The Plan is comprised of five primary components:

1. existing condition maps, to include training areas, and cantonment land use, site, transportation, utility, and storm drainage maps,
2. land use plan, including analysis of functional relationships and future land uses,
3. transportation plan,
4. utilities plan,
5. future development plans, showing all relocations of training into new areas of the NTC, expected demolition and replacement beyond the current five-year Defense Plan, and major new construction expected in the long-range period.

In addition, the RPVP will consist of a series of supplemental documents including, but not limited to, the Landscape Development Plan and Capital Improvement Program. The Range Complex Management Plan (RCMP) is complimentary to the RPVP and addesses current and future development of installation ranges and training areas. The CRPM advises the RPVP and RCMP planning processes as necessary, particularly in matters relating to the site of new construction, planned building renovations and demolitions, proposed changes to vehicular and pedestrian traffic and utility construction specific to issues regarding potential impacts to cultural resources.

2.4.1.3 Work Management Center

The Work Management Center (WMC) manages the flow of work orders and service orders through the DPW. All construction and demolition projects at Fort Irwin, with the exception of Military Construction Army (MCA) projects, go through the WMC. All work requests are submitted on DD Form 4283 and are reviewed weekly.

Each request is passed through the Environmental Division NEPA Planner. The NEPA Coordinator determines the proper level of NEPA analysis for each project which includes an assessment of the proposed work for potential impacts to cultural resources. To accomplish this assessment, projects are passed to the cultural resources staff to conduct the assessment of project impacts to cultural resources. The area of potential effects for such projects is typically inspected by the cultural resources staff. A report of the inspection and any recommendations for further work are completed by that office and submitted back to the NEPA Planner. Consultation, if required, is then conducted with the State Historic Preservation Office and affiliated federally recognized Native American tribes.

All MCA and Non Appropriated Funds (NAF) projects are also passed to the NEPA Planner for NEPA analysis. The same process, described above for DD Form 4283 projects, applies for all NAF projects.

2.4.1.4 Real Property

The Real Property office has two primary functions: (1) real property accountability; and (2) real estate actions. Under real property accountability, the office maintains the accounts of assets, or real property; maintains the disposal files; and receives and maintains documentation on any new construction. Real property is defined as land, structures, and monuments permanently affixed to the land. Real estate actions include Records of Availability (ROA), Records of Excess (ROE), leases or permits for non-Army usage of Fort Irwin facilities, and annexation and jurisdiction issues. All real estate actions undergo NEPA analysis which includes evaluation of the effects of real estate actions on cultural resources. Consultation, if required, is conducted with the State Historic Preservation Office and affiliated federally recognized Native American tribes.

2.4.1.5 National Environmental Policy Act (NEPA) Planner

The Environmental Division within DPW is responsible for ensuring that Fort Irwin complies with the requirements of NEPA. NEPA requires that federal agencies give appropriate consideration to the environmental effects of proposed actions in their planning process, and prepare detailed statements for public review of major federal actions significantly affecting the quality of the human environment. Regulation 32 CFR 651 outlines the procedural requirements for completion of NEPA compliance for Army actions. Army regulations require proponents of Army actions to complete the appropriate level of NEPA analysis prior to taking proposed actions.

The NEPA evaluation process evaluates proposed actions on Fort Irwin and determines the appropriate level of analysis required for the action. These include:

- **Exemption by Law:** The law must apply to DoD and/or the Army and must prohibit, exempt or make impossible full compliance with the procedures of NEPA.

- **Emergencies:** In the event of an emergency, the Army will, as necessary, take immediate actions that have environmental impacts, such as those to promote national defense or security or to protect life or property, without the specific documentation and procedural requirements.

- **Categorical Exclusion (CX):** These are categories of actions that normally do not require an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). The Army has determined that they do not individually or cumulatively have a substantial effect on the human environment.

- **Environmental Assessment (EA):** An EA is a concise public document which has three defined functions. (1) It briefly provides sufficient evidence and analysis for determining whether to prepare an EIS; (2) it aids an agency's compliance with NEPA when no EIS is necessary, i.e., it helps to identify better alternatives and mitigation measures; and (3) it facilitates preparation of an EIS when one is necessary.

- **Environmental Impact Statement (EIS):** An EIS is a public document designed to ensure that NEPA policies and goals are incorporated early into the programs and actions

of federal agencies. An EIS is intended to provide a full, open and balanced discussion of significant environmental impacts that may result from a proposed action and alternatives, allowing public review and comment on the proposal and providing a basis for informed decision-making.

The NEPA Planner serves as a conduit to the cultural resources staff for all actions occurring on the installation. The cultural resources staff screens all actions provided by the NEPA Planner. The cultural resources staff is responsible for conducting the appropriate level of analysis of the effects of proposed actions on cultural resources.

2.4.1.6 Fort Irwin Cultural Resources Program Staff

The cultural resources staff at Fort Irwin provides oversight and management in archaeology, historic buildings/landscapes, Native American affairs, and paleontology. Staff responsibilities extend from Fort Irwin to its sub-installations. The cultural resources staff focuses on archaeological, historical, and traditional resources and functionally has responsibilities to eliminate impacts to military missions, meet compliance requirements, and identify, enhance, and implement program efficiencies.

2.4.2 National Training Center G3

The NTC G3 is the link between cultural resources and soldiers training in the field. The NTC G3 is responsible for training lands management, military training coordination, and release of training areas for land restoration and other uses in accordance with NTC Regulation 350-3.

The G3 has developed a Dig Permit Request process to identify and inform the CRPM of any training or other land-use activities on the installation's ranges and training lands involving ground-disturbing actions or that have the potential to impact cultural resources. The NTC G3 executes this process though the G3 Training Support Division (TSD) Range Operations and ITAM Programs. The Fort Irwin CRPM provides the G3 ITAM Program with current data regarding cultural resources inventories. The CRPM ensures the data are kept current as cultural resources work/assessment/research activities are accomplished.

The NTC G3 Range Operations Office is responsible for informing the CRPM of any training or other land-use activities on the installation's range lands that involve ground-disturbing activities or may have impacts on cultural resources. The CRPM reviews proposed actions on training lands and consults with the Range Officer to avoid or reduce impacts to cultural resources.

Sustainable training lands on Army installations are essential to effective and realistic training. The ITAM Program establishes a systematic framework for decision making regarding the use of training lands by integrating elements of operational, environmental, master planning, and other programs to identify and assess land use alternatives. Four key components comprise the ITAM Program: Land Condition Trend Analysis, Training Requirements Integration, Land Rehabilitation and Maintenance, and Environmental Awareness. The ITAM Coordinator derives from these components projects required to support ITAM plans for the installation and consults with the CRM on projects that may affect cultural resources. The CRPM provides the ITAM Coordinator with data on cultural resources and activities.

Just as the DPW WMC manages the flow of work orders and service orders through the DPW for all construction and demolition projects at Fort Irwin, the G3 ITAM program manages the flow of

Dig Permit Requests for activities occurring on ranges and in training areas on Fort Irwin. All Dig Permit Requests are submitted in a digital work management system and reviewed weekly.

Each dig permit request is passed through the Environmental Division NEPA Planner. The NEPA Planner determines the proper level of NEPA analysis for each project which includes an assessment of the proposed work for potential impacts to cultural resources. To accomplish this assessment, projects are passed to the cultural resources staff to conduct the assessment of project impacts to cultural resources. The area of potential effects for such projects is typically inspected by the cultural resources staff. A report of the inspection and any recommendations for further work are completed by the cultural resources staff. Consultation, if required, is then conducted with the State Historic Preservation Office and affiliated federally recognized Native American tribes.

2.4.3 Staff Judge Advocate General

The office of the Staff Judge Advocate General performs all legal functions. The Environmental Law attorney serves as legal advisor to the Commander and the CRM, reviews draft historic properties documents, and serves as counsel for the Army in appropriate administrative cases, hearings, and enforcement actions.

2.4.4 Public Affairs Office

The Public Affairs Office is the interface between Fort Irwin and the public. The office plays a major role in informing the public on the installation's history and prehistory and informing residents and visitors of laws and regulations protecting historic properties.

2.4.5 Directorate of Emergency Services

The Directorate of Emergency Services provides historic properties law enforcement for the Archaeological Resources Protection Act and other historic property laws and regulations.

2.4.6 State Historic Preservation Officer (SHPO)

The SHPO, pursuant to NPSRPA, 54 U.S.C. § 30101 et seq. (formerly National Historic Preservation Act), must be provided the opportunity to review and comment on all undertakings and actions that have the potential to affect historic properties at Fort Irwin. Section 106 of the former NHPA, now 54 U.S.C. § 30108, and its implementing regulations (36 CFR 800) requires consultation with the SHPO.

2.4.7 Advisory Council on Historic Preservation (ACHP)

The ACHP is an independent Federal agency created by the NHPA, and is the major policy advisor to the Government in the field of historic preservation. The ACHP is composed of 23 members from various federal agencies, local and state governments, the public and outside organizations. All but two of the members are appointed by the President of the United States. A small professional staff serves its office in Washington, D.C. The ACHP has delegated certain aspects of its authority to the SHPOs.

2.4.8 Federally Recognized Indian Tribal Governments

Fort Irwin consults with affiliated federally recognized tribal governments about the management of cultural resources on its lands. Twelve federally recognized tribes consider portions of present-day Fort Irwin to be included in their aboriginal territories. This association with Fort Irwin lands is documented in historic and ethnographic literature, and tribal testimony. Tribes affiliated with Fort Irwin lands are identified in Appendix C, SOP 9: "Government-to-government consultation with tribes." NAGPRA, the American Indian Religious Freedom Act (AIRFA) and 54 U.S.C. § 30108, formerly Section 106 of the NHPA, contain Native American consultation requirements for individual undertakings carried out on federal land.

3.0 FORT IRWIN CULTURAL RESOURCE OVERVIEW

Since the 1960s, 1,454 archaeological sites have been identified on Fort Irwin. The installation encompasses approximately 753,537 acres or approximately 1,177 square miles. Of this acreage, 91,330 acres are in the Leach Lake Gunnery Range, a restricted access area not available for cultural resource inventory. Approximately 301,263 acres, 45 percent, of the total Fort Irwin acreage available for survey (662,207), has been surveyed for cultural resources (Figure 6). Portions of Fort Irwin, in addition to Leach Lake Gunnery Range are off limits to training including the Western Expansion area (WEA). However, archaeological inventory has already taken place in portions of the WEA in preparation for future use of this currently off limits area for training. Additionally, due to the basin and range topography of Fort Irwin, there are many mountainous areas, approximately 180,526 acres, where slope exceeds 20 percent. Slopes of more than 20 percent are avoided for vehicle maneuver training.

Many of the earlier surveys conducted on Fort Irwin simply located sites, but did not evaluate their significance. Over the years, many other sites have been recommended eligible or not eligible for NRHP listing. Fort Irwin has worked to assess the possible significance of recorded sites. There are only 12 recorded sites on Fort Irwin that have not been evaluated. More recent inventories include assessment of recorded sites to identify those that are important at local, regional or national levels pursuant to the NRHP criteria. At Ft. Irwin, one archaeological site and one structure are listed in the NRHP.

Buildings and structures, combined with the historic landscape as a whole, provide evidence of the historical progression of events important to the Army throughout its significant history in the west. Historic buildings and structures may encompass a wide variety of historic resources. No historic-age structures or buildings in the Fort Irwin cantonment or ranges have been determined eligible for listing in the NRHP.

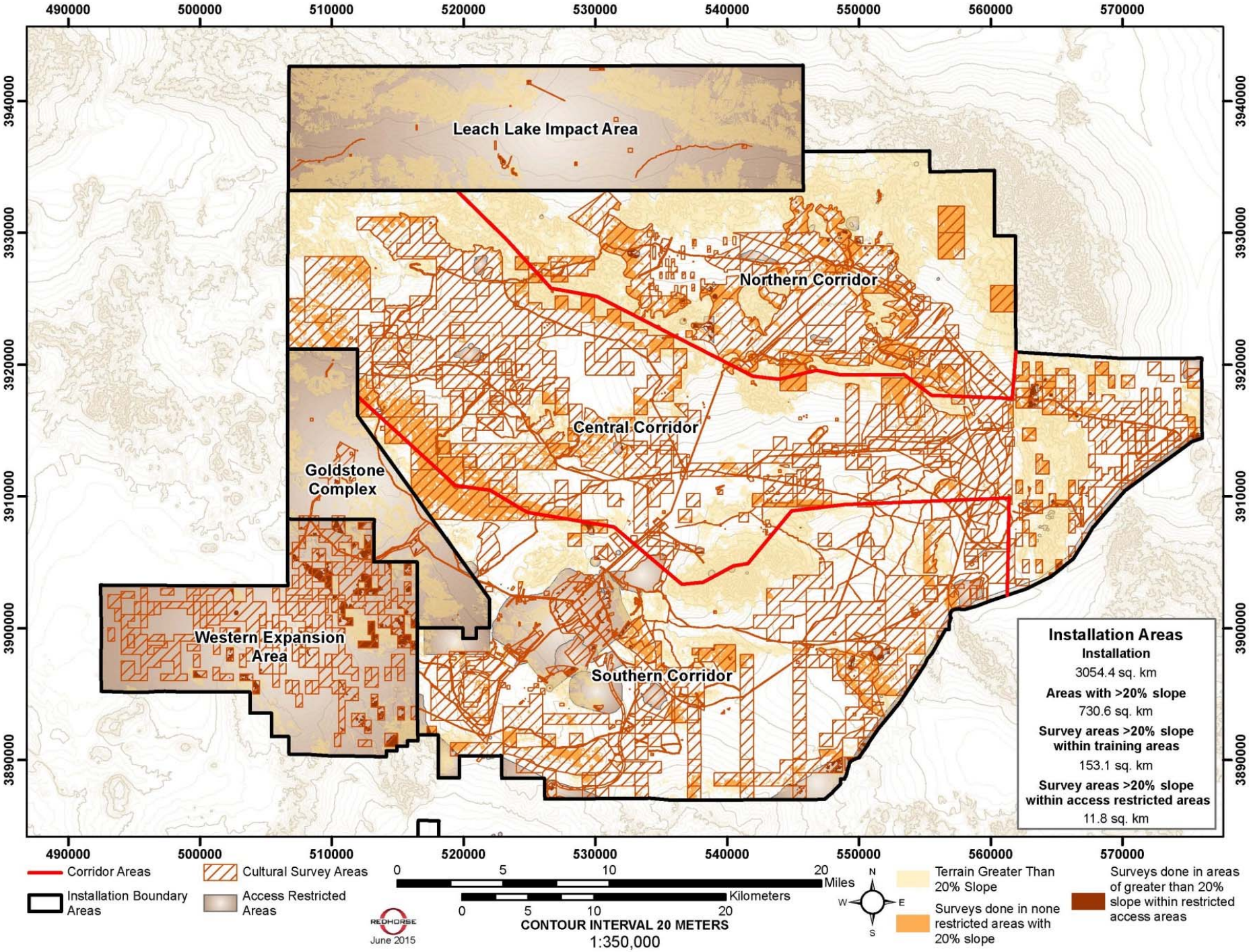

Figure 6: Surveyed acreage

Fort Irwin completed an inventory and assessment of historical buildings and structures in 1996 (Science Applications International Corporation1996). Based on that assessment, Fort Irwin, in consultation with the California SHPO, evaluated many historic-age buildings and structures on base and at NASA's Goldstone Pioneer Deep Space Station Site.

The NASA Pioneer antenna in the Goldstone Deep Space Communication Complex, and only the antenna, was listed as a National Historic Landmark in 1985, and hence listed in the NRHP, as part of the National Park Service's Man in Space theme. The Pioneer Deep Space antenna is off-limits, protected by fences, vehicle barriers and restrictions against training in the Goldstone complex.

No objects or places of traditional religious and cultural importance (referred to by the National Park Service as Traditional Cultural Properties) to Native American tribes or other cultural groups have been identified, to date, at Fort Irwin.

In 2002, Fort Irwin invited federally recognized tribes affiliated with the lands of Fort Irwin to attend a conference to discuss, among other things, resources or places of concern to the tribes. Subsequently, Fort Irwin had a tribal affiliation study completed for the installation. As part of that study, certain general locations were identified (Earle 2004).

At present, no potential historic landscapes have been identified at Fort Irwin. A historic (or cultural) landscape is defined as "a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values" (Birnbaum 1994:1). The historic landscape must be considered as a holistic collection of the character-defining features, not simply the individual elements.

4.0 FORT IRWIN PALEONTOLOGICAL OVERVIEW

Fort Irwin hosts several known paleontological locales including important fossils and trackways predating human presence in what is now the Mojave Desert. Materials from these fossil locales are curated at accredited museums where they are available for study.

Fragmentary fossils of Late Pleistocene mammals including horses, camel, lama, and mammoth as well as tortoise, have been recovered at the "Fossil Bed Site" near Bitter Springs. This location has vertebrate fossil specimens from the Rancholabrean land mammal age dating from c. 700,000 years before present (ybp) to 10,000 ybp. The fossils appear to have accumulated by deflation of original matrix onto coarse sands. Collections are housed at the San Bernardino County Museum Earth Science Department in San Bernardino, California.

The Avawatz Locality has produced ancient mammal footprints and trackways. Collections from the Avawatz Locality are housed at the Raymond M. Alf Museum of Paleontology, the Webb Schools, Claremont, California.

The paleontological resources found on Army lands are recognized as constituting a fragile and nonrenewable scientific record of the history of life on earth, and so represent an important and critical component of America's natural heritage. Fort Irwin will exercise stewardship of these resources as a part of its land management/land use responsibilities. In meeting this responsibility, it shall be Fort Irwin's policy to:

1. Actively work with other Federal, State and Local Government Agencies, professional organizations, educational institutions and other interested parties to enhance and further the Army's needs and objectives for paleontological resources.
2. Consider paleontological resource management a distinct Army program, to be given full and equal consideration in all its land use planning and decision making actions.
3. Mitigate adverse impacts to paleontological resources as necessary.
4. Facilitate appropriate scientific use of and interest in paleontological resources.
5. Vigorously pursue the protection of paleontological resources from theft, destruction and other illegal or unauthorized uses.

In rare instances, paleontological resources may be found in association with cultural resources. Such occurrences fall under the provisions of the Archeological Resources Protection Act. In the event of such an occurrence, the Installation Archaeologist will evaluate the discovery and determine an appropriate course of action that will safeguard both the paleontological and archaeological materials. The Cultural Resource Program also provides the Paleontological Resource Management Program with its linkage to the Army's budget system. Therefore, the Installation Archaeologist is responsible for identifying and addressing funding needs for paleontology in the Army's annual budget process.

Except as otherwise provided in this document, possessing, destroying, injuring, defacing, removing, digging, or disturbing from its natural state non-fossilized and fossilized paleontological specimens, cultural or archeological resources, or the parts thereof, is prohibited. Taking plants, fish, wildlife, rocks or minerals except in accordance with this and other regulations or pursuant to the terms and conditions of a specimen collection permit, is prohibited.

Collection of paleontological specimens at Fort Irwin is allowed only with a permit processed through the Directorate of Public Works and issued by the Installation Commander. Upon the recommendation of the CRM, the GC may issue collection permits to qualified institutions for research, education and display of fossils. A qualified institution will be a recognized federal collections repository with a degreed professional paleontologist as curator, its displays open to the public and available for study by students, scholars and interested parties. All fossils collected under such permit shall remain the property of the federal government.

5.0 CULTURAL RESOURCES MANAGEMENT PLAN

5.1 Introduction

The purpose of this ICRMP is to outline the short and long term goals of the cultural resources management program and document the processes by which the CRPM can meet these goals. This plan provides the goals, processes for meeting these goals, and reporting requirements for monitoring the success of the program. The cultural resources program is not the primary mission of Fort Irwin, but the cultural resources program mission is critical to supporting the primary mission of the installation.

Efficient and effective cultural resources management comes from experience, understanding, and a consideration of the relevance of the cultural resources program. It derives from a contextual evaluation that leads to "integration" with other programs. The only way to practice efficient and effective management in a program such as cultural resources is to reach out and

maintain regular contact with the rest of the installation and outside entities. This ICRMP defines ways to establish and perpetuate that contact, and to make it simple and relevant.

This section is organized to include the management goals of the plan, a discussion of cultural resource issues, and yearly reporting requirements. This is followed by a list of standard operating procedures that detail how the CRPM and cultural resources staff will execute the cultural resources program and monitor it for success.

5.2 Cultural Resources Program Mission, Goals and Objectives

The Cultural Resources Program mission is to:

1. Comply with Army standards that are derived from Federal legislation pertaining to cultural resources management
2. Maintain a cultural resources management program that meets the installation mission
3. Assess the success of the cultural resources program and identify improvements

This mission is executed through implementation of the following goals, objectives and key activities.

Goal 1. Comply with Army standards and Federal legislation in the management of Fort Irwin cultural resources

a. Objective 1. Expand acreage inventoried for cultural resources
    1. Key activity - Conduct intensive surveys of up to 10,000 acres annually, in areas under represented in surveys to date, based on projected use, sample surveys, current knowledge, and data shortfalls.
    2. Key activity - Inventory, by intensive survey, areas identified for ground disturbing projects.

b. Objective 2. Evaluate all known cultural resources at Fort Irwin
    1. Key activity - Evaluate all previously recorded but unevaluated archaeological sites.
    2. Key activity - Evaluate all previously unevaluated buildings and structures that require consideration.

Goal 2. Manage cultural resources according to Best Management Practices.

a. Objective 1. Investigate the possible presence of traditional cultural properties and properties of traditional religious and cultural importance.
    1. Key activity - Engage all federally recognized tribes and other cultural groups with interests in installation lands in efforts to identify such properties.

b. Objective 2. Maintain curation of collections in compliance with 36 CFR 79.
    1. Key activity – Complete upgrading of all collections to 36 CFR 79 standards.
    2. Key activity – Complete upgrading of all records to 36 CFR 79 Standards.
    3. Key activity – Ensure all incoming collections and records meet 36 CFR 79 standards.

c. Objective 3. Fully integrate all Fort Irwin cultural resources into a GIS database.

1. Key activity – Complete input of all cultural resource records into an automated GIS system.
2. Key activity – Improve shared access to non-sensitive cultural resource information useful to installation planners and managers.

Goal 3. Identify improvements that can be made in the management process to continue success.

a. Objective 1. Conduct an annual review of ICRMP goals, objectives, key activities and SOPs for operation and effect with all installation stakeholders.
   1. Key activity – Identify shortcomings and solutions

b. Objective 2. Pursue cooperative agreements with universities to secure effective and efficient cultural resources investigation services that also contribute to scholarly and public knowledge.
   1. Key objective – Secure agreements to involve professors and students in field schools, class projects, and individual research that support the installation's mission through research activities.

c. Objective 3. Determine whether the AAP is more beneficial to Ft. Irwin than standard approaches to Section 106 SHPO consultation and pursue the action if appropriate.
   1. Key objective – Compare the AAP with a Programmatic Agreement to determine preferred course of action that benefits mission.

Goal 4. Coordinate with installation planners and trainers to eliminate delays to undertakings and training mission.

a. Objective 1. Actively participate in Real Property Planning Board meetings and the National Environmental Policy Act project review process.
   1. Key activity – Meet or exceed all suspense dates established for project review.

The CRPM meets existing standards and implements program improvements through program monitoring. Monitoring program success is accomplished as status reports are created and as processes are followed to accomplish program goals. Through this process, the CRPM can identify additional work that may be needed to more effectively meet existing standards. Responses to recurring emergencies, such as dealing with the inadvertent discovery of an archaeological site or human remains can be standardized to ensure compliance with federal legislation.

6.0 ANNUAL AND LONG RANGE FUNDING PLANNING

Future program management and associated funding requirements are derived from a cycle of ongoing, continual analyses of program processes related to program maintenance activities such as inventorying, evaluating, managing, and protecting cultural resources. Projects resulting from these analyses are phased to meet mission priorities, ever mindful of short-notice changes. Projects focus on inventory and evaluation of archeological sites, followed by avoidance, fencing, capping, or data recovery as mitigation for adverse effects to historic properties. The following sections identify project requirements by resource type.

6.1 Archaeology

Current and future efforts to inventory, evaluate, manage, and protect archaeological sites should address the following:

1. Continue annual programmatic surveys of the installation for cultural resources.

2. Continue inventory efforts for historic properties in the cantonment area on a project-driven basis as new undertakings require inventory surveys for cultural resources compliance.

3. Continue to manage and protect all historic properties, as well as those that have not yet been evaluated for listing in the NRHP. Where possible, protection should include marking with Sibert stakes (reflective horizontal bands atop fence posts), signs and fencing, periodic monitoring for evidence of unauthorized ground disturbance or other negative effects. Where protection is not possible, develop and implement a treatment plan for the site in consultation with the California SHPO and tribes.

5. Conduct NRHP eligibility assessments of previously recorded, but unevaluated sites and newly discovered sites to include test excavations and documentary research as needed.

6. Mitigate adverse effects to historic properties where adverse effects cannot be avoided.

7. Update the comprehensive Fort Irwin database of archaeological sites, and its associated Geographic Information System (GIS) data, to include NRHP status.

8. Verify the locations of all archaeological sites using appropriate Global Positioning System (GPS) equipment so that all site locations are recorded within current Universal Transverse Mercator (UTM) coordinates with sub-meter accuracy.

6.1.1 Properties of Traditional Religious and Cultural Importance and Traditional Cultural Properties

Efforts to inventory and manage these cultural resources should include the following:

1. Maintain open dialog with tribes and other cultural groups in the consultation process for all undertakings.

2. Conduct studies to evaluate the presence of traditional cultural properties and properties of traditional religious and cultural importance associated with federally recognized tribes or other cultural groups. Earle (2004) provides evidence that Native American tribes affiliated with the lands of Fort Irwin may have traditional associations with certain landforms, springs, trails, and/or native plants on the installation.

6.1.2 Historic Buildings and Structures

The list of NRHP listed and eligible buildings and structures is current as of 2015. Efforts to inventory and manage these cultural resources should include the following:

1. Reevaluate buildings or structures previously determined ineligible for NRHP listing, if the CRPM deems it appropriate or the SHPO, ACHP or interested member of the general public specifically requests it.

2. Have NASA conduct annual condition assessments on the NRHP-listed antenna (a National Historic Landmark) on the NASA-owned Pioneer Complex to monitor its condition.

3. Conduct evaluations, on an as-needed basis, for buildings and structures that become 50 years old between scheduled evaluations, if an undertaking will affect the identified buildings and structures.

6.2 Paleontology

Fort Irwin will take appropriate action to prevent damage to, and unauthorized collection of, fossils.

1. Monitor paleontological locales to ensure unauthorized collection does not occur.

2. Continue efforts to identify and manage paleontological resources.

6.3 Documents

Continue the archive program to collect, identify, organize, catalogue, label, and store all documentation for archaeological sites and historic buildings, and structures of Fort Irwin, including any records that pertain to sub-installations under the control of Fort Irwin.

6.4 Curation

Fort Irwin maintains a secure and compliant curation facility housing artifacts, records and photographs associated with installation cultural resources and their management. Curation goals are to:

1. Continue to curate artifacts and documents in facilities and containers that meet 36 CFR 79 standards.

2. Continue to require contractors meet 36 CFR 79 standards when submitting all materials for curation.

3. Update all archives.

6.5 Education and Outreach

Continue to provide education and public outreach for increased awareness to fulfill requirements of Army Regulation AR 200-1 and make soldiers and family members aware of their responsibilities to preserve and protect these limited resources for future generations.

6.6 Maintenance and Oversight

Provide support for monitoring of archaeological inventories, site protection measures, and compliance with applicable laws, rules and regulations.

7.0 MANAGEMENT PROCESSES

Monitoring of the Fort Irwin cultural resources program occurs at two levels: (1) monitoring the success of the program with respect to performance standards; and (2) assessing current conditions and documenting any changes since the last condition assessment was conducted. Monitoring the success of the cultural resources program entails evaluation of whether or not the management actions at Fort Irwin work to meet or exceed management goals. These goals are set by the Army in the form of the Installation Status Report (ISR) and the Army Environmental Database - Environmental Quality (AEDB – EQ).

7.1 Command and Installation Standards

The ISR is a three-part information system with the purpose of providing decision makers at all levels with an objective assessment of the status of Army installations with respect to infrastructure (ISR Part I), environment (ISR Part II), and services (ISR Part III). Part II of the ISR evaluates 24 different environmental programs. The evaluation for each is in four parts: (1) Program Performance, (2) Environmental Condition, (3) Mission Impact, and (4) Compliance with legal requirements. Each environmental program receives a GREEN, AMBER, or RED rating for the four areas.

The Fort Irwin CRM also sets standards to rate local success of the cultural resources management program at Fort Irwin. Under current IMCOM guidance all programs are funded at the amber level. If a rating is red, the CRM should revise management actions to address unacceptable resource conditions. The management strategies associated with green, amber, and red conditions are:

- Green Rating. Standard/maintenance-level resources management. All legal requirements are being met and all rating elements are acceptable.

- Amber Rating. Heightened resources management. All legal requirements are being met, and some rating elements are unacceptable. Management actions will be implemented in an attempt to specifically address resource conditions that are unacceptable. Resource conditions will be monitored and data reviewed for adaptive management.

- Red Rating. Priority resources management. Legal requirements are not being met, and/or several rating elements are unacceptable. Management actions will be implemented to meet all legal requirements and to specifically address all resource conditions that are unacceptable. The actions will be proactive to aggressively encourage improvement of resource conditions. Resource conditions will be monitored and data reviewed for evaluation of adaptive or alternative management strategies or actions.

The SOPs located in Appendix C are based on applicable federal, state, and local environmental laws and regulations, Army regulations and formal agreements. Fort Irwin performance standards apply to the entire range of cultural resources and cultural resource management processes. Paleontological sites and National Register eligible archaeological sites, buildings, and structures are cultural resources considered to have significant value to warrant protection, whereas National Register eligible properties of traditional religious and cultural importance are those sites of demonstrable continuing importance to Native American or other cultural groups. Significance of cultural resources is determined by application of the test for eligibility for inclusion on the NRHP. Only those properties that meet this test are significant and need to be protected.

7.2 Environmental Program Assessment System (EPAS)

EPAS is designed to provide status of installation environmental compliance and management systems to Garrison Commanders, provide Command emphasis to environmental programs and management systems, ensure management systems are complete and effective, and to provide input to Army environmental trends and identification of systemic problems. The CRPM provides data to the EPAS team via input through the AEDB-EQ system.

7.3 Reporting Requirements

7.3.1 ISR Part II (Environment)

The Chief of Staff, Army (CSA) directed the implementation of ISR Part II (Environment) on 2 October 1995. As part of the readiness review for the CSA, the Assistant Chief of Staff for Installation Management (ACSIM) reports ISR Part II results. The goal of Part II is to capture macro-level status of an installation's environmental program and improve the justification/prioritization of limited resources.

Project objectives are to assess installation environmental compliance, summarize environmental conditions, measure mission impacts, and assess the effectiveness of environmental program performance. Cultural resource program management is an integral part of overall environmental program performance. Analysis of ISR data should assist commanders at all levels to improve installation conditions and ultimately the readiness of forces that our installations support.

7.3.2 Army Environmental Database - Environmental Quality

The AEDB-EQ is a World Wide Web-based data system that serves as a primary source of information for conveying the Army's environmental status to the Senior Army Leadership, DoD, and Congress. Its primary focus is to track Army compliance with environmental laws for multi-media reporting and management areas through Inspections, Enforcement Actions (ENFs), and Fines and Penalties, and other program parameters.

7.4 Annual Program Management Review

Annually, the CRPM, with assistance from cultural resource staff, will conduct a formal after action review (AAR) analyzing all aspects of the cultural resources management program for operation and effect. Review will include analyses of Section 106 compliance, survey protocols, projects conducted during the past year, curation status, ARPA violations and permits and Native American consultation. The results of this after action review will be documented in a report identifying program strengths, weaknesses and appropriate corrective action with timelines for implementation of corrective measures. When possible, all stakeholders will be invited to participate in the AAR.

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APPENDIX A

ABBREVIATIONS

ABBREVIATIONS USED

AAR	After Action Review
ACHP	Advisory Council on Historic Preservation
ACSIM	Assistant Chief of Staff for Installation Management
ACR	Armored Cavalry Regiment
AEC	Army Environmental Center
AEDB-EQ	Army Environmental Database – Environmental Quality
AHPA	Archaeological and Historic Preservation Act
AIRFA	American Indian Religious Freedom Act
AMS	Accelerator Mass Spectrometry
APE	Area of Potential Effect
APM	Archaeological Predictive Model
AR	Army Regulation
ARPA	Archaeological Resources Protection Act
BLM	Bureau of Land Management
CA	Comprehensive Agreement
CF/AA	Complex Feature/Artifact Assemblage
CFR	Code of Federal Regulations
CID	Criminal Investigation Division
CR	Cultural Resources
CRM	Cultural Resources Manager

CSA	Chief of Staff
CX	Categorical Exclusion
DA	Department of the Army
DES	Directorate of Emergency Services
DF/A	Distinctive Feature/Artifact
DKMR	Desert King Mortar Range
DoD	Department of Defense
DoDI	Department of Defense Instruction
DPTM	Directorate of Plans, Training and Mobilization
DPW	Directorate of Public Works
EA	Environmental Assessment
ECAR	Environmental Compliance Assessment Report
ECAS	Environmental Compliance Assessment System
EIS	Environmental Impact Statement
EMS	Environmental Management System
ENF	Enforcement Action
ENRD	Environmental and Natural Resources Division
ENRO	Environmental and Natural Resources Office
EO	Executive Order
EOD	Explosive Ordnance Division
EQR	Environmental Quality Report
EPAS	Environmental Program Assessment System
EPR	Environmental Program Requirements
FICRD	Fort Irwin Cultural Resources Database
FICRMDB	Fort Irwin Cultural Resource Management Database

FONSI	Finding of No Significant Impact
FORSCOM	Forces Command
FPO	Federal Preservation Officer
GIS	Geographic Information System
GPS	Global Positioning Systems
HPP	Historic Preservation Plans
HQDA	Headquarters, Department of the Army
IAW	In Accordance With
ICAP	Installation Corrective Action Plan
ICRMP	Integrated Cultural Resources Management Plan
INRMP	Integrated Natural Resources Management Plan
IPB	Installation Planning Board
ISR	Installation Status Report
ITAM	Integrated Training Area Management
JOC	Job Order Contracts
LCTA	Land Condition Trend Analysis
LFX	Live Fire Exercise Area
LLGR	Leach Lake Gunnery Range
LRAM	Land Rehabilitation and Maintenance
MACOM	Major Army Command
MAU	Minimum Number of Animal Units
MCA	Major Construction Army
MNI	Minimum Number of Individuals
MOA	Memorandum of Agreement
NAF	Non Appropriated Funds

NAGPRA	Native American Graves Protection and Repartition Act
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NISP	Number of Identifiable Specimens
NPS	National Park Service
NRHP	National Register of Historic Places
NTC	National Training Center
OPFOR	Opposing Force
OPSGRP	Operations Group
OSJA	Office of Staff Judge Advocate
PA	Programmatic Agreement
PAO	Public Affairs Office
PCA	Principal Components Analysis
PL	Public Law
PM	Preventive Maintenance
PMO	Provost Marshal's Office
POL	Petroleum, Oil, and Lubricant
POM	Program Objective Memorandum
PTRCI	Places of Traditional Religious and Cultural Importance
RCS	Report to Congress
ROA	Records of Availability
ROE	Records of Excess
SF	Security Forces
SFSA	Simple Flake Stone Assemblage

SHPO	State Historic Preservation Officer
SME/PA	Simple Milling Equipment/Pottery Assemblage
SOP	Standard Operating Procedure
SRL	Single Reduction Locations
TCP	Traditional Cultural Property
TRI	Training Requirements Integration
USC	United States Code
UTM	Universal Transverse Mercator
WMC	Work Management Center

APPENDIX B

STATUTES, REGULATIONS AND GUIDANCE

This appendix lists the various legal requirements and Federal, DOD, and DA guidance under which the Fort Irwin cultural resources management program operates.

Statutes:
American Indian Religious Freedom Act of 1978, as amended42 USC 1996-1996a
Antiquities Act of 1906 16 USC 431-433; 34 Stat. 225
Archeological and Historic Data Preservation Act of 1974 16 USC 469-469c
Archeological Resources Protection Act of 1979--ARPA -- 16 USC 470aa-470ll
Historic Sites Act of 1935 16 USC 461-467
National Environmental Policy Act--NEPA -- 42 USC 4321-4370c
National Park Service and Related Programs Act – NPSRPA 54 U.S.C. 300101 et seq. formerly,
National Historic Preservation Act of 1966, as amended -- NHPA -- 16 USC 470-470w
Native American Graves Protection and Repatriation Act of 1990--NAGPRA -- 25 USC 3001-3013
Public Buildings Cooperative Use Act 40 USC 601-619
Sikes Act--16 USC 670a-670o, 74 Stat. 1052
Sikes Act Improvement Amendment-1998

Executive Orders:
EO 11593 - Protection and Enhancement of the Cultural Environment
EO 12512 - Federal Real Property Management
EO 13007 - Indian sacred sites
EO 13084 - Consultation and Coordination with Indian Tribal Governments
EO 13175 - Consultation and Coordination with Indian Tribal Governments
EO 13287- Preserve America

Presidential Memorandum:
Government-to-Government Relations with Native American Tribal Governments

Federal Regulations and Guidance:
Advisory Council on Historic Preservation (ACHP), Protection of Historic Properties, 36 CFR 800
Army Alternate Procedures (AAP), Substitute procedures for Section 106 subpart B per 36 CFR 800.14(a), 67 FR 10138 and amended 69 FR 20576
Council on Environmental Quality, Regulations Implementing the National Environmental Policy Act, 40 CFR 1500-1508
Department of the Interior, Curation of Federally-owned and Administered Archeological Collections, 36 CFR 79
Department of the Interior, Determinations of Eligibility for Inclusion in the National Register of Historic Places, 36 CFR 63
Department of the Interior, Native American Graves Protection and Repatriation Act Regulations 43 CFR 10
Department of the Interior, National Historic Landmark Program, 36 CFR 65
Department of the Interior, National Register of Historic Places, 36 CFR 60
Department of the Interior, Preservation of American Antiquities, 43 CFR 3

Department of the Interior, Supplemental Regulations [per ARPA], 43 CFR 7
Department of the Interior, Standards for the Treatment of Historic Properties 36 CFR 68
Department of the Interior, Waiver of Federal Agency Responsibility under Section 110 of the National Historic Preservation Act, 36 CFR 78
Department of the Interior, The Secretary of the Interior's Standard for the Treatment of Historic Properties, 36 CFR 68
Environmental Analysis of Army Actions 32 CFR 651
Environmental Protection and Enhancement 32 CFR 650
Protection of Archeological Resources, 32 CFR 229
Regulations Implementing the National Environmental Policy Act, 40 CFR 1500-1508

Department of Defense (DoD) Regulations and Guidance:
Department of Defense (DoD) Instruction 4715.3, Environmental Conservation Program
Department of Defense (DOD) Instruction 4715.16, Cultural Resource Management

Army Regulations and Guidance:
Army Regulation 200-1, Environmental Protection and Enhancement

NTC Regulations:
NTC Regulation 200-1 Environmental Quality, Environmental Protection and Enhancement
NTC Regulation 350-1 NTC Training
NTC Regulation 350-3 National Training Center and Fort Irwin Ranges and Training Areas

APPENDIX C

STANDARD OPERATING PROCEDURES

Standard Operating Procedures for Installation Undertakings

The following SOPs outline the steps in Fort Irwin's decision-making process and define processes to address proposed undertakings and other cultural resource management issues:

1. Identifying undertakings and defining areas of potential effect
2. Categorical exclusions and/or exemptions
3. Identifying and evaluating historic properties
4. Assessing effects of undertakings on identified historic properties
5. Historic properties treatment alternatives review
6. Treating adverse effects when avoidance of such effects is not possible
7. Obtaining technical assistance
8. Inadvertent discoveries and emergency actions
9. Government-to-government consultation with tribes
10. Procedures applicable to the inadvertent discovery of Native American human remains and related cultural items
11. Shared public data
12. Curation of materials and records
13. Granting ARPA permits and responses to violations
14. Artifact collection and curation
15. Paleontological Resources Management

For effective and efficient decision-making, each of the six initial steps must be completed in sequential order. The CRM and Installation Archaeologist (IA) shall proceed to the subsequent steps only when necessary and when the previous steps have been completed.

SOP 1

Identifying Undertakings and Defining Area of Potential Effect

1.0 Introduction

The Fort Irwin CRM shall determine whether a project or activity qualifies as an undertaking, and if so, whether the undertaking has the potential to affect historic properties. The CRM also will define the area(s) of potential effect (APE). The results of the undertaking determination and definition of the APE will be maintained in an electronic database. Supporting documentation and the rationale used in making determinations will be retained by the CRM.

1.1 Identify the Undertaking

An undertaking may be defined as a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of the Army, including those carried out by or on behalf of the Army, those carried out in whole or in part with Army funds, and those requiring Army approval.

If a project or activity involves the use of Army funds on behalf of, or with Army approval that project or activity will be considered an undertaking:

- If the project does not qualify as an undertaking, this determination shall be documented by the CRM and retained for future program review. No further action is required.

- If the project qualifies as an undertaking, this determination shall be documented by the CRM and retained for future program review.

1.2 Define the Area of Potential Effect (APE)

The APE is the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such historic properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.

The size of the APE is determined on a case-by-case basis and includes in its calculation the scale and nature of the undertaking. Generally, the size of the APE will be commensurate with the size of the project. Definition of the APE includes both direct (an effect caused by the action) and indirect (an effect that may occur later in time or be further removed in distance) effect areas. Cumulative effects may also influence the APE. Projects occurring within or adjacent to historic districts or sites, including their landscapes, should also take into account the visual effects of a proposed undertaking when determining the APE.

To determine the project APE, the CRM shall:

- Categorize the undertaking by considering the type of activity.
- Determine whether the effects typically associated with this category of undertaking are expected effects for the project.
- Based on anticipated effect(s) determine where those effects might occur in relation to the project. The areas where effects might occur constitute the APE.
- Examine the APE with respect to the anticipated possible effects to determine whether the undertaking activities are likely to affect historic properties.
- Complete this process for all potential project locations.
- Include all APE definitions on a project map, delineating the areas of direct and indirect effect.
- Determine whether the scope and/or nature of the project might result in additional or other effects.

Upon determination of the APE, the APE shall be documented by the CRM and retained for program review.

SOP 2

Categorical Exclusions and/or Exemptions

2.0 Introduction

After a project, activity, or program has been determined to be an undertaking under SOP 1, the CRM shall determine the type of undertaking. If an undertaking is exempted or identified as a categorical exclusion listed in this SOP, the NHPA files for the project will indicate this determination and no further CRM review is required.

2.1 Undertakings Exempted from Cultural Resources Actions under NHPA

The following management activities are exempt from further cultural resource review under Section 106 of the National Historic Preservation Act:

- Undertakings addressed through a fully executed nationwide Programmatic Agreement.

Fort Irwin has several classes of built resources that are the subjects of fully executed nationwide Programmatic Agreements executed in accordance with 36 CFR 800.14 which include the following:

- A nationwide Programmatic Agreement executed in 1986 allows the demolition of World War II temporary buildings and structures as an undertaking exempted from further review.
- Undertakings affected by Program Comment for Cold War era Unaccompanied Personnel Housing.
- Undertakings affected by Program Comment for World War II and Cold War Army Ammunition Storage Facilities.

If the project qualifies as an exempted undertaking, this determination must be documented and retained for future program review. The CRM will notify the SHPO of exempted undertakings. If the project does not qualify as an exempted undertaking, this determination must be documented and retained for future program review. Then the CRM shall proceed with Section 106 compliance as addressed in SOP 2.2.

2.2 Documenting the Decision

If the project qualifies as a categorical exclusion by categorized undertaking, this determination must be documented in the NHPA file and retained for future program review.

If the project does not qualify as a categorical exclusion by categorized undertaking, the CRM proceeds to SOP 3: Identifying and Evaluating Historic Properties.

SOP 3

Identifying and Evaluating Historic Properties

3.0 Introduction

Once an undertaking has been determined under SOP 1, and the CRM has also determined the undertaking is not exempt or identified as a categorical exclusion under SOP 2, the CRM must identify any historic properties within the APE and document findings derived from background research and inventory surveys. The CRM performs the procedures in this SOP in consultation with the SHPO and affiliated federally recognized tribes.

3.1 Identification of Historic Properties within the Area of Potential Effect

The CRM uses existing historic contexts, predictive models, and survey records and reports to identify potential historic properties within an APE. If the area has been inventoried, the CRM will determine if additional investigations are required. Additional investigations may include preliminary tribal consultations for determination of Properties of Traditional Religious and Cultural Importance (PTRCI), referred to as Traditional Cultural Properties (TCP) by the National Park Service (NPS), and periodic contact with NPS or US Army Environmental Center (USAEC) to determine whether any applicable nationwide historic context or program comments have been developed. If the area has not been previously inventoried, the area within the APE will be inventoried. These actions will be conducted in accordance with (IAW) SOP 9 and Appendices D, E, F and G.

Cultural resources will be recorded in accordance with long established practice and SHPO consultation subject to justifiable decisions of the field professional and the nature of the resource. Fort Irwin will record archaeological sites based on the presence of midden or significant features, or at least three classes of prehistoric artifacts, e.g., flakes, modified flakes, bifaces, projectile points, cores, ceramics, and/or historic artifact classes, e.g., domestic, military, and architecture, or the presence of at least 20 cultural items within a 10 meter radius.

Fort Irwin will record isolates (occurrences of less than 20 items within a 30 meter radius) by establishing the Global Positioning System (GPS) coordinates and completing a Primary Record form for noteworthy isolates, e.g., dateable, time-dianostic and rare items. One Primary Record form with a map and table will be completed for all other isolates within a discrete survey area, e.g., a project APE or a square kilometer of a large area. Isolates will be discussed in project reports.

If potential historic properties are identified in the APE, this determination shall be documented and retained for future program review of the undertaking.

3.2 Evaluation of Historic Properties within the Area of Potential Effect

Once potential historic properties have been identified in the APE the CRM will evaluate previously unevaluated properties for NRHP eligibility. Previously evaluated properties will be checked to determine whether there has been any change in relevant circumstances that could affect their eligibility evaluation. The CRM shall use the National Register criteria (36 CFR 60.4), historic contexts, other assessment documentation, models, and reports as the basis for determinations of eligibility. If information regarding the potential property is found to be non-existent, insufficient, or inaccurate the CRM shall evaluate the property using Appendices D, E, F, and G. The CRM will notify SHPO and affiliated federally recognized tribes, as appropriate, of the determination of eligibility. When the CRM finds a property or properties to be NRHP eligible, the property will be treated as such.

3.3 Determination of Eligibility Dispute Resolution

If the SHPO or a tribe does not agree with the CRM finding of eligibility within the 30-day NEPA and/or the NHPA review period, or the parties are unable to reach concurrence after consultation, the determination of eligibility will be forwarded on to the Keeper of the NRHP for a final determination. The Keeper will respond to a request for formal determination of eligibility within 45 days of receipt of the request. If there is no response within the allotted time, it will be assumed by all parties that the Keeper concurs with Fort Irwin's determination and the property will be managed accordingly.

3.4 Documenting the Decision

If no NRHP eligible historic properties are located within the APE, this determination shall be documented and retained for future program review.

If NRHP eligible historic properties are located within the APE, this determination shall be documented and the CRM shall proceed to Assessing Effects.

SOP 4

Assessing Effects of Undertakings on Historic Properties

4.0 Introduction

If the CRM determines that historic properties are present within an APE (SOP 3), it must be determined if the undertaking will have an effect upon those historic properties. Effect is defined as alterations to the characteristics of a historic property that qualify it for inclusion in, or make it eligible for, the National Register. Based on the evaluation of effect, the CRM will make one of the following determinations.

4.1 No Historic Properties Affected

If the CRM finds that either there are no historic properties present or there are historic properties present but the undertaking will have no effect upon them, the CRM will determine that there will be no historic properties affected.

If no historic properties are affected, this determination shall be documented and retained for future program review.

4.2 Historic Properties Affected

If the CRM finds that historic properties are present in an APE that may be affected by the undertaking, the CRM shall determine if these effects are adverse. Adverse effects are those effects of an undertaking that may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. The criteria of adverse effect also require consideration of all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the NRHP. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.

4.2.1 Finding of No Adverse Effect

The CRM shall make a finding of no adverse effect when the undertaking's effects do not alter or diminish, directly or indirectly, any of the characteristics of a historic property that qualify it for inclusion in the National Register. If there is a finding of no adverse effect, this determination shall be documented and retained for future program review.

4.2.2 Finding of Adverse Effect

The CRM shall find an adverse effect when the undertaking may alter or diminish, directly or indirectly, any of the characteristics of a historic property that qualify it for inclusion in the NRHP.

Adverse effects may include reasonably foreseeable effects caused by the undertaking that (1) may occur later, (2) be outside of the current APE, or (3) be cumulative.

The findings of adverse effect shall be documented and provided to the proponent. The proponent will then work with the CRM through the procedures set forth in SOP 5 and 6.

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SOP 5

Historic Properties Treatment Alternatives Review

5.1 Introduction

While Fort Irwin will always prefer and consider avoiding adverse effects, there are times when this option is not feasible or an undertaking cannot avoid adversely affecting a historic property. If it is determined that an undertaking will have an adverse effect on historic properties, IAW SOP 4, Fort Irwin will review project alternatives in consultation with the SHPO and affiliated federally recognized tribes and other stakeholders. Application of SOP 5 is required prior to applying SOP 6, Treatment of Adverse Effects.

5.2 Evaluation of Alternatives for Archaeological Sites and Properties of Traditional Religious and Cultural Importance

5.2.1 Archaeological Sites

- National Register eligible sites that can be avoided will be avoided and protected with inclusion on maps of off-limits areas, Sibert stakes (reflective horizontal bands at top of fence posts) and fencing.

- Sites that cannon be avoided but are significant and of value chiefly for the information on prehistory or history likely to be yielded through archaeological, historical, and scientific methods of information recovery, will be subjected to data recovery excavations and related investigations.

5.2.2 Properties of Traditional Religious and Cultural Importance and Traditional Cultural Properties

- PTRCI and TCP sites that can be avoided will be avoided. Decisions on protection will be made in consultation with affiliated federally recognized tribes and other stakeholders.

- Consultation with affiliated federally recognized tribes and other stakeholders will be undertaken to reach decisions on proper alternative treatment for PTRCI and TCP sites that cannot be avoided

5.3 Evaluation of Alternatives for Buildings and Structures

5.3.1 Adaptive Reuse (Conversion) of Affected Historic Properties

The proponent and the CRM will examine the alternative of adaptive reuse (conversion) when an undertaking adversely affects a historic property that is no longer needed or suitable for its original use. In this alternative, adaptive reuse (conversion) of a historic building or structure will be undertaken in accordance with the Secretary of the Interior's Standards for Rehabilitation.

5.3.2 Disposal of Affected Historic Properties

5.3.2.1 Deconstruction and Salvage

A decision to dispose by deconstruction of a historic building or structure shall be supported by an economic analysis using a cost analysis model selected and approved by the CRM. The economic analysis shall address and compare the economic costs associated with alternatives, including the life-cycle costs associated with: (1) rehabilitation and reuse; (2) demolition and new construction; and (3) mothballing for reuse. The conclusions of the economic analysis for the historic properties shall be documented and included in the NEPA file for that undertaking. Where deconstruction occurs, efforts should be made to identify the feasibility of salvaging any historic fabric for possible reuse in maintenance and repair of other similar properties.

5.3.2.2 Transfer to another Federal Agency, Negotiated Sale to State or Local Government Body or Tax-Supported Institution, Donation to a Public Body, Sale

If a historic property can no longer be used in support of Fort Irwin's mission, the transfer, sale, or lease of the historic property to another Federal agency, state or local government, or organization should be considered. If this alternative is pursued, covenants that provide for the historic property's long-term preservation may be attached to the real estate out grant, deed, sale, or donation documents. Alternatively, mitigation documentation may be prepared where no covenant is transferred.

5.3.3 Relocation of Historic Properties

Historic property relocation is not normally a preferred alternative because of the costs involved and the fact that the action destroys the integrity of the historic property for its inclusion in the National Register.

5.3.4 Mothballing (Layup/Layaway) of Affected Historic Properties

Consideration of this alternative will follow the National Park Service's Preservation Brief 31: Mothballing Historic Buildings.

5.4 Selection of Alternatives

After the proponent has reviewed alternatives for the undertaking with recommendations provided by the CRM, the proponent shall document all alternatives considered. That information shall then be provided to the CRM with supporting information for inclusion in the files for that undertaking.

5.5 Documenting the Decision

The alternative chosen and the determination whether it eliminates adverse effects to identified historic properties within the APE or not, is documented in writing (including supporting documentation) and shall be shared with the SHPO and affiliated federally recognized tribes and other stakeholders, if appropriate, and included in the files and retained for program review.

SOP 6

Treatment of Adverse Effects when Avoidance of Such Effects is not Possible

6.0 Introduction

Treatment of adverse effects will be decided in consultation with the California SHPO, and tribes and other stakeholders when appropriate, based on the alternative chosen from SOP 5 and will implement the most appropriate mitigation measures for historic properties, be it standardized or creative. Standardized mitigation measures generally satisfy Fort Irwin's needs for projects but alternatives or creative mitigation measures will also be considered. The following considerations are presented for the mitigation of historic properties.

6.1 Mitigation Measures for Archaeological Sites, PTRCI and TCP

When an undertaking will have an adverse effect on an archaeological site or PTRCI or TCP that is either listed in or eligible for listing in the National Register, and the recovery of significant information is proposed as a mitigation measure for the effect, the following will apply:

- If the site is a PTRCI or TCP and contains or is likely to contain human remains, associated or unassociated funerary objects, sacred objects, or items of cultural patrimony as those terms are defined by NAGPRA or tribes, Fort Irwin will comply with the requirements of NAGPRA and any activities related to such human remains and/or cultural items will be IAW NAGPRA.

- Fort Irwin will prepare a data recovery plan that is consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties, the Standards and Guidelines for Archaeology and Historic Preservation, and the ACHP's "Treatment of Archaeological Properties: A Handbook" (1980). The plan will specify:

    - the results of previous research relevant to the project

    - research problems or questions to be addressed with an explanation of their relevance and importance

    - the field and laboratory analysis methods to be used with a justification of their cost-effectiveness and how they apply to this particular historic property and these research needs

    - the methods to be used in artifact, data, and other records management

    - explicit provisions for disseminating the research findings to professional peers in a timely manner

- arrangements for presenting to the public what has been found and learned, focusing particularly on the community or communities that may have interests in the results

- the plan for curation of recovered materials and records resulting from the data recovery

- procedures for evaluating and treating unexpected discoveries of NAGPRA human remains and/or cultural items during the course of the project. In the case of sites found to have NAGPRA human remains and/or cultural items, Fort Irwin will follow the consultation procedures under NAGPRA.

- Fort Irwin will ensure that the data recovery plan is developed and will be implemented by or under the supervision of a person, or persons, meeting at a minimum the appropriate Secretary of the Interior's Professional Qualification Standards (1983).

- Fort Irwin will ensure that issues concerning the recovery of significant information are addressed with any tribe that may attach religious and cultural importance to the affected historic property.

- For PTRCI and TCP that are sacred but are not archaeological in nature, Fort Irwin will comply with the requirements of EO 13007 and AIRFA in consultation with affiliated federally recognized tribes

6.2 Treatment Measures for Historic Buildings, Structures, Districts and Objects

When an undertaking consists of deconstruction or alteration of historic buildings, structures, districts and/or objects, treatment will be decided in consultation with the California SHPO and generally take the form of Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) or similar equivalent documentation. The documentation will be provided to the SHPO by the CRM and will be managed at Fort Irwin by the Installation Archaeologist.

Other alternative mitigation measures may include, but are not limited to, transfer of the property to a suitable government entity or party with appropriate covenants to protect the resource, salvage, production of educational materials, interpretation of the resource, or relocation.

6.3 Disposal of Historic Properties

If, after a review of alternatives is completed under SOP 5 and the option of disposal is selected, Fort Irwin may include adequate restrictions, covenants, or conditions in the legally binding documents to ensure the continued preservation of the resource and its character-defining features as required in AR 405-90, Section 1-6 in lieu of documentation as a treatment measure. Restrictions and conditions included in the legal document will:

- Encumber title to the historic property with a clear and enforceable preservation easement or other covenant; and

- Apply to those aspects of the historic property that make it eligible for inclusion in the National Register; and

- Designate a person who has agreed to hold the covenant (covenantee); and

- Be in perpetuity, though not applicable for an out grant.

Where it is not possible to attach such restrictions and conditions to properties being disposed, Fort Irwin will implement the process in paragraph 6.2.

6.4 Documenting the Decision

After the proponent has reviewed mitigation measures for the undertaking along with recommendations by the CRM, the proponent shall record the decision. That information shall then be provided, with supporting information, to the CRM for consultation with the California SHPO. Regardless of the actions chosen, the determination along with all supporting documentation will be recorded, included in the NEPA file for the undertaking and retained for future cultural resources program review.

SOP 7

Obtaining Technical Assistance

7.0 Introduction

The purpose of this SOP is to establish the types of arrangements that Fort Irwin has made or may make to obtain technical assistance from qualified personnel or organizations.

7.1 Partnerships

Fort Irwin may establish partnerships with the consulting tribes and SHPO for support in the implementation of this ICRMP. Tribes are qualified to identify, evaluate, and treat historic properties to which they attach traditional religious and cultural importance. The SHPO possesses professional expertise for the identification and evaluation of historic properties as well as the assessment and the treatment of effects.

7.2 Cooperative Agreements

Cooperative Agreements provide Fort Irwin a means to obtain professional technical expertise from organizations such as universities, tribes, and non-profit and for-profit organizations. Fort Irwin currently has no Cooperative Agreement in effect, but is investigating the possibility with several regional universities.

7.3 Service Contracts for Technical Assistance

Fort Irwin has an on-going need for technical expertise related to the identification, evaluation, and treatment of historic properties. Fort Irwin obtains these services through contracts with qualified organizations and firms. With the exception of technical assistance that may be provided by members of a federally recognized tribe, any technical expertise procured to implement the ICRMP will be performed by or under the supervision of professionals qualified under the Secretary of the Interior's Standards. Fort Irwin will obtain necessary technical assistance using, to the extent practicable, reimbursable arrangements such as procurement contracts and Cooperative Agreements.

SOP 8

Inadvertent Discoveries and Emergency Actions

8.0 Introduction

This SOP sets forth a process for addressing both inadvertent discoveries and emergency actions that could affect historic properties. While emergency actions require an expedited process to address undertakings that respond to an emergency, inadvertent discoveries can be associated with both emergency and non-emergency actions.

8.1 Inadvertent Discoveries/Post Review Discoveries

Inadvertent discoveries typically involve archaeological remains rather than historic buildings because archaeological sites are usually not readily apparent. While archaeological investigation methods are designed to identify material evidence of past cultural activities, it is always possible that deeply buried archaeological deposits may remain undetected during the inventory process and may come to light during construction and/or other ground disturbing activities. This SOP will be coordinated with all other installation staff offices responsible for carrying out ground disturbing activities.

In the event that historical or archaeological sites, PTRCI, TCP, or deposits are encountered during an undertaking, work in the area of discovery will cease immediately and the following actions will be taken:

- Further direct effects to the site or deposits will be halted, minimized or avoided until requirements under Section 106 of the NHPA are completed.

- At the time of discovery, the project proponent will immediately notify the CRM and the IA.

- Result 3: The CRM through the IA and cultural resources staff takes measures to protect the discovery site, including entering the site into the Ft Irwin Cultural Resources Database and informing the SHPO and affiliated tribes or other appropriate stakeholders of the discovery. The CRM shall notify the NAGPRA Coordinator of each Indian tribe at least fifteen (15) days prior to moving any remains from the site. If remains are removed from the site, the CRM will ensure their curation per the requirements of 36 CFR 79.

- The CRM shall immediately notify the Garrison Commander or his/her official designee and NTC G3 of the discovery, in writing. The CRM shall also notify the Installation Directorate of Emergency Services (DES) that NAGPRA compliance procedures are in effect per this SOP and 43 CFR 10.

- Upon notification, or at the soonest possible time, the CRM and the IA will make a field evaluation of the context of the site, properties of traditional religious and

cultural importance, or deposit to ascertain its probable age and significance, record the findings in writing, and document with appropriate photographs and drawings. The result of this field evaluation will be a determination of National Register eligibility in consultation with the SHPO.

- Following the evaluation by the CRM, all consulting parties including affiliated federally recognized Indian tribes will be notified and provided an opportunity to comment on the inadvertent discovery. The standard comment period provided all stakeholders for inadvertent discoveries is ten days, however, this period may be shortened depending on the urgency of the undertaking.

- If bone is present within the deposit, the CRM will ensure that a qualified professional accompanies him/her to the work site to assist in the identification of the materials as human remains. If human remains or other cultural material that may fall under the provisions of NAGPRA are present, the CRM will complete the NAGPRA process (SOP 10).

- If disturbance of the site or deposit is minimal and the excavation or disturbance can be relocated to avoid the site, or if the site is determined by the CRM to not be eligible for the National Register, the CRM will conclude this procedure and complete consultation in a routine manner.

- If the site is eligible for the National Register and the activity cannot be relocated, the CRM will apply SOP 5 and 6 to review alternative treatments and treat adverse effects in the most expeditious manner that minimizes impacts to the timely completion of the undertaking.

- Fort Irwin will consult with appropriate consulting parties in all actions during the review process.

- Documentation of inadvertent discoveries will occur and be retained in the file for the subject project.

8.2 Emergency Actions for Historic Properties

There may be times when Fort Irwin must respond to disasters or emergencies that affect the operations and missions of the installation. These emergencies can be both natural or in response to situations that result from human events. This may also include those actions necessary to respond to a threat to national security, including short-term mission essential activities for deployable troops.

Activities and actions undertaken to respond to disasters and emergencies can have an adverse effect on historic properties located on the Installation. There may be instances where known historic properties will be affected or where undiscovered historic properties will be affected by activities undertaken in response to a disaster or emergency. These actions might take place in areas of the Installation that have not been previously inventoried.

As with inadvertent discoveries, emergency actions require an expedited process for handling historic properties including PTRCI that may be affected. The expedited processes to address emergency actions comply with Section 106 of the NHPA and include two alternatives. Before an anticipated emergency, the CRM will invite the ACHP, SHPO and affiliated federally recognized tribes to comment on the undertaking at least seven days before the undertaking, if possible. If not possible, comment will occur within the time available. After an unanticipated disaster or emergency has been declared, the CRM will consult with ACHP, SHPO and affiliated federally recognized tribes for undertakings that will be implemented within 30 days. Immediate rescue and salvage operations conducted to preserve life or property are exempt from the provisions of Section 106.

- Data recovery and/or recordation, if possible and necessary, will include, but is not limited to, any of the following:

    - if a known historic property is damaged, but the damage is minor, protective strategies designed to prevent further degradation will be implemented;

    - in the event the damage to a historic property is severe and the property is eligible for or listed in the National Register, a report will be prepared documenting the damage and the potential for salvage of data that cannot otherwise be conserved. If the potential for salvage is high, a research design will be prepared and salvage or rehabilitation may proceed when normal conditions are restored subject to availability of funds. If there is little or no potential for salvage or if not possible, the damage will be documented in photographs, artifacts at the site may be collected and documented;

    - if deconstruction of a National Register-listed or eligible historic property is necessary due to life safety issues as the result of a disaster or emergency, recordation will be limited to photographs of all exterior surfaces and features. Only those interior features that may be safely accessed may be documented with photographs;

    - Fort Irwin will consult with appropriate consulting parties during the review process; and

    - the occurrence of all emergencies will be documented and retained in the files.

SOP 9

Government-to-Government Consultation with Tribes

9.0 Introduction

The federally recognized Indian tribes with historic ties to the Fort Irwin region are recognized by the U.S. government as sovereign nations with status as unique political entities in a government-to-government relationship with the United States. Fort Irwin is involved in consultations and decision-making regarding interests of tribes. Formal government-to-government consultation with tribes occurs at the Garrison Commander level. Fort Irwin consults with the following tribes:

Big Pine Paiute Tribe of the Owens Valley
Bishop Paiute Tribe
Cabazon Band of Mission Indians
Cahuilla Band of Mission Indians
Chemehuevi Indian Tribes of the Chemehuevi Reservation, California
Colorado River Indian Tribes
Death Valley Timbisha Shoshone Tribe
Fort Independence Community of Paiute Indians of the Fort Independence Reservation, California
Fort Mojave Indian Tribe of Arizona, California and Nevada
Lone Pine Paiute-Shoshone Reservation
Morongo Band of Mission Indians
San Manuel Band of Mission Indians

9.1 Government to Government Communication

9.1.1 Written Communication

Each federally recognized tribe is a separate nation and is treated as such. All communications with the tribes shall occur between Fort Irwin and each individual tribe. Written communications shall be as follows:

- correspondence sent to the tribal government head, Chief, Governor, or Chair is signed by the Garrison Commander or his designated representative upon agreement with the tribe;

- correspondence sent to the tribal cultural resource coordinator/representative is signed by the Garrison Commander's appointed representative, the CRM;

- copies of any document intended for review during face-to-face consultation will be provided in advance of the consultation meetings.

9.1.2 Telephonic or Electronic Communication

The following guidance addresses telephonic and electronic communication. Fort Irwin will:

- document telephonic or other informal consultation communication in order to maintain a record of the consultation process;

- ensure a copy of all such documentation is provided to each tribe upon request;

9.2 Face-to-Face Meetings

Face-to-face meetings with the tribes can be individual in nature, or conducted in a collective setting.

9.2.1 Participation

Face-to-face meetings will be limited to government-to-government participation between Fort Irwin and federally recognized tribes.

9.2.2 Scheduling

Fort Irwin will work to achieve consensus on the dates of meetings to provide the greatest opportunity for full representation by all tribes wishing to participate.

9.2.3 Coordination

Fort Irwin will coordinate with tribal representatives on topics to address and solicit issues of tribal importance in order to facilitate meeting dialogs, limit the number of items discussed in face-to-face consultation meetings and program sufficient time to allow for adequate coverage of each item of concern. Fort Irwin will publish a proposed agenda and itinerary for the meeting/visit in advance so all parties arrive informed of the purpose and subject of the meetings.

9.2.4 Attendance

Whenever possible, Fort Irwin will open or close the meeting with appropriate comments from the Garrison Commander or his/her designee. The Garrison Commander or his/her designee may chair the meetings and may facilitate the discussions during the meeting.

9.2.5 Site Visits

Fort Irwin will determine whether attendees wish to participate in a site visit during the consultation meeting. Arrangements for a site visit will be scheduled in advance; it is important that participation is determined well in advance of the consultation meeting. If so, knowledgeable Fort Irwin staff representatives will accompany tribal representatives and make appropriate logistical arrangements including the preparation of appropriate transportation, maps, and background data.

9.2.6 Documentation

A written summary providing a detailed overview of the meeting will be prepared following each face-to-face consultation. If appropriate, due to the nature of the discussion, a verbatim transcript of the meeting may be prepared. Regardless of tribal participation in the face-to-face meetings, correspondence and accompanying enclosures related to these meetings will be sent to each tribe.

SOP 10

Procedures Applicable to the Inadvertent Discovery of Native American Human Remains and Related Cultural Items

10.0 Introduction

Fort Irwin shall treat all Native American human remains and associated funerary objects, sacred objects, and/or objects of cultural patrimony inadvertently discovered on lands under its ownership control in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA) and its implementing regulations (43 CFR 10). When such items are encountered, all use of the immediate area by Fort Irwin shall be suspended, the remains and associated cultural items will be protected in place to the greatest extent possible, and the immediate area will be secured until the federally recognized Indian tribes are contacted and consultation is undertaken to determine appropriate methods for the disposition of the human remains and associated cultural items. All such consultation and subsequent actions shall be conducted in full accordance with the provisions of 43 CFR 10 and this SOP.

10.1 Initial Discovery

Any person who knows, or has reason to know, that he or she has discovered, inadvertently, bone material and or human remains, funerary objects, sacred objects, or objects of cultural patrimony (potential NAGPRA items) on Fort Irwin lands must provide immediate telephone notification of the inadvertent discovery, with written confirmation, to the Fort Irwin CRM. The requirements of 43 CFR 10.4 regarding inadvertent discoveries applies whether or not an inadvertent discovery is duly reported. If written confirmation is provided by certified mail, the return receipt constitutes evidence of the receipt of the written notification by the Fort Irwin CRM.

If the inadvertent discovery occurred in connection with an on-going activity on Fort Irwin, the person, in addition to providing the notice described above, must stop the activity in the area of the inadvertent discovery and make a reasonable effort to protect the human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered inadvertently.

The CRM and IA will make every effort to visit the site as soon as possible after initial notification by the discoverer, but shall do so no later than three (3) working days after receipt of the written confirmation of notification. Further, the CRM shall:

- Certify receipt of the notification; and

- Take immediate steps, if necessary, to further secure and protect inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony, including, as appropriate, stabilization or covering;

The CRM with qualified professional assistance, e.g., the IA, will then determine the following:

- If bone material is present, the CRM determines if the remains are human*

- The CRM determines if the remains are recent (i.e., less than 50 years) and, in coordination with installation Security Forces (SF), if a crime scene is involved*

- The CRM determines if the remains are Native American*

[NOTE: Ft Irwin shall arrange for a qualified professional, such as the IA or the county coroner, to perform in situ identifications in assistance to the CRM.]*

The results of these identification procedures will determine whether NAGPRA provisions apply to the discovered remains. With regard to Native American human remains discovered on federal lands, NAGPRA and 43 CFR 10 make no distinction concerning their temporal context (i.e., recent or archaeological in nature) or whether a potential crime scene exists. This provision of the SOP combines the affirmative provisions of NAGPRA concerning tribal consultation with conventional installation law enforcement mandates. The following results are thus possible:

- Result 1: Remains are non-human and no funerary objects, sacred objects or objects of cultural patrimony are present

- Result 2: Recent human remains are present

- Result 3: Archaeological but non Native American human remains are present

- Result 4: Archaeological and Native American human remains and/or funerary objects, sacred objects, or objects of cultural patrimony are present.

10.2 Notification, Consultation, Treatment, and Disposition Procedures

- Result 1: Within three (3) working days of this determination, the CRM notifies the NAGPRA Coordinator of each affiliated federally recognized Indian tribe via telephone or email noting that a reported inadvertent discovery of bone was non-human and that no funerary objects, sacred objects or objects of cultural patrimony were present. After this notification, normal installation activities may resume in the area of the discovery.

- Result 2: If the discovery results in the identification of recent human remains then the CRM notifies the installation Directorate of Emergency Services (DES), which assumes jurisdiction and responsibility. DES ensures that all installation activities cease within a 30-meter radius of the site and declare the site off limits to everyone except authorized personnel. DES will investigate any potential criminal wrongdoing and carry the case to closure. Forensic examination of the remains will be conducted in accordance with local criminal investigative procedures. If evidence is present that the recent human remains are Native American, then the Indian tribes will be notified by DES following appropriate next-of-kin notification. Final disposition of the remains will be arranged by the next-of-kin. Otherwise, final disposition of the remains will be arranged in accordance with 43 CFR 10.5 and 10.6.

- The CRM shall immediately notify Range Control and the NTC G3.

- The CRM through the IA and cultural resources staff takes measures to protect the discovery site, including entering the site into the Ft Irwin Cultural Resources Database and informing the SHPO and federally recognized affiliated tribes of the discovery.

10.3 Required Procedures when Native American Human Remains and/or Funerary Objects, Sacred Objects or Objects of Cultural Patrimony are identified.

The CRM shall:

- Notify by telephone, with written confirmation, each of the Indian tribes regarding the discovery of human remains, funerary objects, sacred objects, or objects of cultural patrimony. This notification must include pertinent information as to kinds of human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered inadvertently, their condition, and the circumstances of their inadvertent discovery;

- Initiate consultation on the inadvertent discovery pursuant to 43 CFR 10.5 and this SOP;

- If the human remains, funerary objects, sacred objects, or objects of cultural patrimony must be excavated or removed, follow the requirements and procedures in 43 CFR 10.3 (b) and the provisions of this SOP; and

- Ensure that the disposition of all inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony is carried out following the provisions of 43 CFR 10.6.

10.4 Resumption of activity

The activity that resulted in the inadvertent discovery may resume thirty (30) days after verification by the Garrison Commander and CRM, through receipt of written confirmation or registered receipt, of notification of the Indian tribes of the inadvertent discovery, if the resumption of the activity is otherwise lawful. The activity may also resume, if otherwise lawful, at any time that a written, binding agreement is executed between Fort Irwin and the Indian tribes that authorizes a recovery plan for the excavation or removal of the human remains, funerary objects, sacred objects, or objects of cultural patrimony following 43 CFR 10.3 (b)(1). The disposition of all human remains, funerary objects, sacred objects, or objects of cultural patrimony must be carried out following 43 CFR 10.6.

Compliance with the provisions of this SOP does not relieve Fort Irwin of the requirement to comply with Section 106 of the National Historical Preservation Act (16 U.S.C. 470 (f) *et seq.*), 36 CFR 800.11, or section 3 (a) of the Archaeological and Historic Preservation Act (16 U.S.C. 469 (a-c)). The CRM shall ensure than any such compliance requirements are met.

For any Native American human remains and/or other cultural items that are removed from the site of their discovery, Fort Irwin will ensure their temporary storage in a repository meeting the

curation standards described in 36 CFR 79, until their final disposition is determined through consultation with lineal descendants or the Indian tribe. Within limits established by Federal laws and regulation, and in consultation with the Indian tribe, Fort Irwin shall accommodate Indian tribal customs and traditions when removing, analyzing, handling, and storing Native American human remains and other cultural items over which the Indian tribe may have claim of priority of custody.

10.5 General Consultation Procedures

Consultation as part of the intentional excavation or inadvertent discovery of human remains, funerary objects, sacred objects, or objects of cultural patrimony on Fort Irwin lands must be conducted in accordance with the following requirements of 43 CFR 10:

- **10.5 (b) (1) -** Upon receiving notice of, or otherwise becoming aware of, an inadvertent discovery or planned activity that has resulted or may result in the intentional excavation or inadvertent discovery of human remains, funerary objects, sacred objects, or objects of cultural patrimony on Fort Irwin lands, the CRM must, as part of the procedures described in 10.3 and 10.4, take appropriate steps to identify the lineal descendant and Indian entitled to custody of the human remains, funerary objects, sacred objects, or objects of cultural patrimony pursuant to 10.6 and 10.14. The CRM shall notify in writing the Indian tribes that have a demonstrated cultural relationship with the human remains, funerary objects, sacred objects, or objects of cultural patrimony that have been or are likely to be excavated intentionally or discovered inadvertently.

- **10.5 (b) (2) -** The notice must propose a time and place for meetings or consultation to further consider the intentional excavation or inadvertent discovery, Fort Irwin's proposed treatment of the human remains, funerary objects, sacred objects, or objects of cultural patrimony that may be excavated and the proposed disposition of any intentionally excavated or inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony.

As appropriate during the consultation process, the Indian tribes will provide the CRM with the names, telephone numbers, and addresses of the Executive Council Chairperson, the Tribal NAGPRA Representative, and the Tribal Historic Preservation Officer and thereafter will notify the installation when tribal Officers and/or contact information changes.

Following consultation, the CRM through the IA shall prepare a written plan of action that establishes provisions for the identification, treatment, and disposition of Native American human remains, funerary objects, sacred objects or objects of cultural patrimony recovered by intentional excavations or inadvertent discovery. All subsequent actions must be conducted according to the provisions of 43 CFR 10.5 and documented by this plan of action that must be approved and signed by the Garrison Commander or his/her designee. The Indian tribes have the option to be signatories to this document that can be developed pro forma to facilitate its use as needed. In accordance with 43 CFR 10.5 (e), the Action Plan must include:

- Any kinds of material to be considered as cultural items as defined in 43 CFR 10.2 (b)

- Specific information used to determine custody pursuant to 43 CFR 10.6
- Treatment, care, and handling of human remains and other cultural items
- Planned archaeological recording of human remains and other cultural items
- Kinds of analyses planned for identification of human remains and other cultural items
- Steps to be followed to contact tribal officials before any excavation
- Steps to incorporate compliance with Section 106 of the National Historic Preservation Act and 36 CFR 800, as appropriate, including contact with California Office of Historic Preservation and the California Native American Heritage Commission
- Kind of traditional treatment to be afforded human remains or other cultural items
- Nature of reports to be prepared
- Disposition of human remains and other cultural items in accordance with 43 CFR 10.6
- Possible involvement of a Indian representative during excavation
- Issuance of a permit pursuant to ARPA and 32 CFR 229, if applicable

10.6 Other Consultation Procedures

If more than one Indian tribe simultaneously claims affiliation with any Native American human remains and/or funerary objects, sacred objects or objects of cultural patrimony discovered on Fort Irwin lands, the installation shall follow dispute resolution procedures as stated in NAGPRA and 43 CFR 10.17, as required.

If no Indian tribe claims affiliation with any Native American human remains and/or funerary objects, sacred objects or objects of cultural patrimony discovered on Fort Irwin lands within 30 days of their notification of such discovery, the installation shall cause a public notice to be published for fifteen (15) days in a regional newspaper(s) of general circulation seeking such claim from the general public. If no claim is then received within fifteen (15) days of the completion of that notice period, Fort Irwin shall curate the materials in a manner that is in compliance with provisions of NAGPRA, 43 CFR 10, and 36 CFR 79.

SOP 11

Shared Public Data

11.0 Introduction

The Freedom of Information Act directs government agencies to disclose certain types of information to the public. Section 304 of the NHPA allows the head of a federal agency, after consultation with the Secretary of the Interior, the authority to withhold from public disclosure information regarding the location and character of historic properties where it is determined that disclosure may cause a significant invasion of privacy, risk harm to the historic property, or impede the use of a traditional religious site by practitioners. Section 9 of ARPA also provides authority for federal agencies to protect from disclosure the location of archaeological resources. This provision would be applicable in situations where archaeological resources have also been determined eligible for inclusion in the National Register of Historic Places. AR 200-1 requires the Garrison Commander not disclose to the public information concerning the nature and location of any archaeological resource for which the excavation or removal requires a permit or other permission under ARPA or under any other provision of Federal law. (LD: Section 9a, ARPA 1979)

This SOP identifies the types of data that are available for review by consulting and interested parties and provides for sharing data on historic properties, to the greatest extent practicable, between Fort Irwin and its consulting parties and the public. The list provided, however, is not inclusive, and additional document types, as they arise, should be properly categorized in the groups provided in this SOP.

11.1 Categories of Shared Data

The three categories of shared data include: NEPA documents, historic property management documents, and data documents and collections.

11.1.1 Group 1: NEPA Documents

NEPA documents include the following:

- Record of Environmental Consideration (REC)
- Draft Environmental Impact Statement (DEIS)
- Environmental Impact Statement (EIS)
- Programmatic Environmental Impact Statements (PEIS)
- Finding of No Significant Impact (FONSI)
- Environmental Assessment (EA)
- Supplemental Environmental Assessment
- Record of Decision (ROD)
- Notice of Intent (NOI)

- Notice of Availability (NOA)

11.1.2 Group 2: Historic Property Management Documents

The following historic property management documents are available for review:

- Archaeological Site Reports
- Historical Reports
- Inventory Survey and Evaluation Reports
- Management Plans
- Historic Structures Reports
- Installation Design Guide (IDG)
- Memoranda of Agreement, Programmatic Agreements, Program Comments, and Cooperative Agreements (including attachments)
- Consultation records (meeting minutes, correspondence, etc.)
- Integrated Cultural Resource Management Plan (ICRMP)

11.1.3 Group 3: Data Documents and Collections

The following data and collections documents are available for review:

- Archaeological, Historical, and Building Databases
- GIS Data
- GPS Data
- Map Data
- Archaeological Collections

11.2 Categories of Data Users

Individuals or organizations that may have an interest in obtaining data related to Fort Irwin historic property activities are classified in three groups:

11.2.1 Data User 1

- Consulting Parties
    - Tribes
    - Advisory Council on Historic Preservation
    - California SHPO

- Fort Irwin and Army personnel with a need to know

11.2.2 Data User 2

- Government and research organizations and individuals
    - Other military installations

- Federal agencies
- State government agencies
- County government agencies
- Universities
- Accredited professional archeologists, historians, and related professional research individuals

11.2.3 Data User 3

- Other ethnically affiliated groups
- Local/Regional historical societies
- Interested Public
  - Interested individuals
  - Local interest groups
  - Veterans groups

11.3 Protocol for Data Sharing

11.3.1 Data User 1

- Shall have access to all Group 1 and 2 data records
- Access shall be by method mutually established (e-mail, mail, library access, etc.)
- No restrictions on site geographical or location data
- Group 3 data records available for viewing at Fort Irwin upon advance request

11.3.2 Data User 2

- Shall have access to all Group 1 and 2 data records
- Access shall be by request in writing
- Sensitive geographical or location information will be restricted to those with a demonstrable need
- Data Group 3 records are available for viewing at Fort Irwin; request for viewing data must be made by appointment

11.3.3 Data User 3

- Shall have access to Group 1 data records
- Group 2 data records will be available at local libraries
- Group 3 data will be viewable at Fort Irwin by special request; request must be made by appointment through the Fort Irwin Public Affairs Office (PAO)
- Sensitive geographical or location information will be restricted

SOP 12

Curation of Materials and Records

12.0 Introduction

Artifacts and other records recovered from Fort Irwin lands are cultural resources, directly related to the history or prehistory of Fort Irwin. The Army must safeguard the archaeological collections and associated records generated as a result of its ongoing field efforts in the areas of archaeological inventory, NRHP eligibility assessments, and data recovery operations associated with mitigation of adverse effects to cultural resources. To ensure meeting its obligations, Fort Irwin constructed a curatorial facility in 1998 and developed a curation manual for operation of the facility. Both the facility and manual meet the standards of 36 CFR 79. The manual is titled Fort Irwin Cultural Resources Curation Procedures Manual: Guide to Submitting Collections for Permanent Curation at the Archaeological Curation Facility. It outlines the specific requirements for submitting materials to the facility. The facility follows the policies in the Archaeological Collections Care Management Plan for Fort Irwin in managing the collections in its custody. The curated collections have great scientific value but are difficult for researchers to access due to the remoteness of the location.

12.1 Policy

For Irwin will comply with requirements outlined in 36 CFR 79 to effectively and safely curate cultural resource artifacts, records and documents:

- Fort Irwin will maintain proof of ownership of all artifacts in its curation facility;
- The Fort Irwin Archaeological Curation Facility shall operate in compliance with all applicable federal regulations;
- All materials submitted to Fort Irwin at the completion of archaeological inventories, NRHP eligibility assessments, and data recovery operations shall meet the requirements of 36 CFR 79; and
- The overall supervision of the Fort Irwin archaeological collections is the responsibility of the CRM.

12.2 Procedures

Fort Irwin will:

- Comply with the following, as appropriate with regard to its archaeological collection:

    - Maintain complete and accurate records of the collection
    - Handle, store, clean, conserve, and if exhibited, exhibit the collection in a manner that is appropriate to the nature of the material remains and associated records

- Protect artifacts from breakage and possible deterioration from adverse temperature and relative humidity, visible light, ultraviolet radiation, dust, soot, gases, mold, fungus, insects, rodents, and general neglect.

- Preserve data for future laboratory analyses.

- Provide access to the collection in accordance with 36 CFR 79.10.

The CRM will, with assistance of the IA:

- Provide all contractors with copies of curation requirements at Fort Irwin.

- Include in contracts for archaeological survey, assessments for NRHP eligibility, and data recovery, a requirement that contractors submit all materials and records in accordance with the Fort Irwin curation manual.

- Review collections use and potential external threats to the collection on a yearly basis.

- Follow the Disaster Plan for Collections in the event of disaster, damage, loss, or physical injury.

- Ensure the facility's curator prepares and/or updates an annual report on any changes made to the facility or the collections, including receipt of new material and loans of collections, citations of any reports, exhibitions, educational or interpretive programs, manuscripts, theses, or dissertations resulting from use of the collections, and needs of the curation facility.

- Have a complete inventory of the collection completed every five years and a 20 percent sample inventory annually following the procedures in the facility’s Archaeological Collections Care Management Plan for Fort Irwin.

- Deaccession objects following the procedures in the Archaeological Collections Care Management Plan for Fort Irwin.

- Allow access to the collections to qualified professionals for study, loan, and use for such purposes as in-house exhibits, teaching, public interpretation, scientific analysis, and scholarly research.

- Allow members of affiliated tribes access to the collections.

SOP 13

Granting ARPA Permits and Responses to ARPA Violations

13.0 Introduction

The Archaeological Resources Protection Act of 1979 (ARPA) provides for civil and criminal penalties for persons who excavate, remove, damage, or otherwise deface any archaeological resource or paleontological remains located on federal lands. Archaeological investigations, other than those accomplished as part of Fort Irwin's archaeological resources management responsibilities, on installation lands require a federal permit issued by the U.S. Army Corps of Engineers (USACE). Activities conducted exclusively for purposes other than the excavation of archaeological or paleontological remains (e.g., excavation of a water line); even though they may disturb archaeological deposits, do not require an ARPA permit.

Procedures for granting archaeological investigation permits are covered in detail in ARPA and its implementing regulations at 32 CFR 229. ARPA established definitions, standards, and procedures to be used by all federal land managers in providing protection for archaeological resources. Regulations allow the ARPA review to be accomplished as part of the contracting process as long as the standards established in the ARPA regulations are followed.

13.1 Permits

13.1.1 Policy

The Army will protect archaeological resources from vandalism and other sources of known destruction. The Army will issue permits for non-governmental exceptions to ARPA.

The CRM through the IA established a proactive plan to preserve and protect all known archaeological sites. The plan includes fencing and the use of siber staking to mark known archaeological sites as off limits. Periodic monitoring of these sites is conducted to prevent/identify evidence of vandalism. ARPA violations will be reported to the Directorate of Emergency Services for investigation and prosecution.

13.1.2 Procedure for Applying for an ARPA Permit

- Step 1: Applications for ARPA permits must be submitted to the CRM for review by the IA.

- Step 2: Upon review and approval by the CRM, applications will be forwarded to the Fort Irwin Garrison Commander for review and approval.

- Step 3: Following Garrison Commander approval, applications will be forwarded to the USACE, Los Angeles District.

- The District Real Estate Office is responsible for coordination and issuance of ARPA permits.

- The District Commander will appoint a qualified archaeologist to provide technical review of the application.

- Federal land managers, in considering whether to grant a permit, must take into account whether the archaeological investigation will conflict with established policy or management plans and if it is in accordance with the other public uses of the land in question.

- If the project may result in harm to or destruction of any Native American tribal, religious, or cultural properties, the Federal land manager must notify any Native American tribe that may consider the site as having religious or cultural importance.

- Step 4: Once it is determined that the proposed archaeological investigation will not conflict with existing land management priorities, the qualifications of the individual or institution need to be considered.

  - Individual qualifications include a professional degree from an accredited school in anthropology or archaeology, or equivalent experience, the demonstrated ability to carry out the work in question as well as to carry the research to completion, at least 16 months of specialized training or professional experience, and at least one year of historical archaeology experience in order to conduct historic investigations.

  - The institution must show evidence of access to adequate curatorial facility and certify that all required materials will be delivered no later than 90 days after the final report is submitted to the Federal land manager.

- Step 5: The CRM, with assistance of the IA, shall monitor work conducted under ARPA permits to ensure compliance. The monitoring protocols for ARPA compliance on permits are based on program maintenance activities described in the SOPs. Once each year by December 1, the CRM shall prepare a report discussing all ARPA permit applications and their status. All professional archaeological research not for the government is accomplished under a valid permit. A permit may be revoked if it is determined:

  - The terms of the permit are not being met;

  - The work to be accomplished has been misrepresented;

  - Continuation of the work poses a hazard to public health or safety; and

  - Continuation of the work conflicts with military functions.
- Step 6: In the case of revocation of a permit, the individual or institution may appeal this decision. The permittee shall forward the appeal to the Garrison Commander for review

by the CRM with assistance of the IA. The Garrison Commander will sign the Determination of Appeal. Grounds for evaluating any possible penalties are set forth in ARPA.

13.2 Violations

ARPA provides legal penalties for the unauthorized excavation, removal, damage, alteration, defacement, or the attempt of such acts, of any archaeological resource more than 100 years of age on federal lands. ARPA defines an archaeological resource as any material remains of past human life or activities that are of archaeological interest. Such remains include but are not limited to pottery, basketry, bottles, weapons, projectiles, tools, structures or portions of structures, pithouses, rock paintings, rock carvings, intaglios, graves, human skeletal materials, or any portion or piece of the foregoing items. Paleontological specimens, deposits, and remains found in archaeological contexts are considered significant data under ARPA and are afforded legal protection under ARPA.

13.2.1 Policy

AR 200-1 requires that the Garrison Commander ensure that the security forces, installation legal staff, the public affairs office (PAO), the Cultural Resources Manager, and recreation management staff are familiar with the requirements and applicable civil and criminal penalties under ARPA.

13.2.2 Procedure

In the event that an ARPA violation is discovered at Fort Irwin, the following procedures shall be followed.

- Step 1: ARPA violation is reported to or is discovered by CRM.
    - The CRM reports violation to Directorate of Emergency Services (DES).
    - The CRM and the IA visit the site with DES and documents the violation through reports, drawings and photographs.
    - The Garrison Commander reports the violation to IMCOM within 48 hours of its discovery.
- Step 2: Site security and criminal investigation.
    - CRM, IA and DES secure the site.
    - DES conducts a criminal investigation.
    - If violation results in harm to or destruction of any Native American tribal, religious, or cultural properties, the federal land manager must notify any federally

recognized Native American tribe that may consider the site as having religious or cultural importance.

- Step 3: Stabilization of site:
    - CRM and IA or qualified archaeologist assess damage and stabilizes the site.
    - Archaeologists conduct emergency salvage/data recovery, as necessary.
    - This work will be carried out in consultation with the SHPO and affiliated federally recognized tribes.
- Step 4: Apprehension and prosecution.
    - When apprehended, perpetrator is legally charged with ARPA violation, prosecuted, and subjected to applicable fines and/or imprisonment.
    - CRM and IA provide support to charging officers and prosecutors.

13.3 ARPA Violations Monitoring

The monitoring protocols for ARPA violations are based on program maintenance activities described in the SOPs. ARPA violations are extremely rare at Fort Irwin due to its remoteness.

- Annually, Fort Irwin archaeologists will visit and develop an individual report on the present conditions and any changes to all National Register eligible and other important archaeological sites distributed throughout the installation.
- The IA shall analyze the site monitoring reports for patterns and trends in changing site condition.
- The IA shall prepare and submit an annual report to the Natural and Cultural Resources Program Manager, Fort Irwin assessing trends and patterns in changing archaeological site conditions; rate ARPA compliance as green, amber, or red according to the standards established by IMCOM and make recommendations for any necessary corrective action.
- The CRM shall review and initiate agreed upon corrective actions through the IA and monitor these actions by the process protocol identified above.

SOP 14

Artifact Collection and Curation

14.0 Introduction

There is a limited artifact collection policy at Fort Irwin.

14.1 Cultural Resources Inventory Surveys

- During cultural resources surveys only temporally diagnostic artifacts (e.g., projectile points, crescents, fluted point channel flakes), rare, or high-quality items (e.g., pendants, beads, incised tablets), those with direct potential for dating (e.g., obsidian) will be collected and curated in accordance with SOP 12. Selected examples of teaching items may also be collected from sites that lack research potential for education purposes, e.g., cores, biface reduction sequence preforms, production errors, and product examples.

- Manos, metates and other non-diagnostic tools, e.g., scrapers or modified flakes, bifaces, nondiagnostic point midsections and tips will be documented but not collected.

14.2 Archaeological Site Testing

- In general, artifacts encountered during site testing by surface scrapes or excavation will not be collected except artifacts that are temporally diagnostic, rare or high-quality, or have direct potential for dating which will be collected and curated in accordance with SOP 14. All other excavated archaeological material will be replaced in the unit from which it was excavated and the unit backfilled after appropriate field analysis and recording of the unit and artifacts.

14.3 Data Recovery Efforts

- All artifacts recovered during data recovery efforts, including surface collection and excavation will be collected and curated in accordance with SOP 12.

SOP 15

Paleontological Resources Management

15.0 Introduction

The paleontological resources found on Army lands are recognized as constituting a fragile and nonrenewable scientific record of the history of life on earth, and so represent an important and critical component of America's natural heritage. Fort Irwin will exercise stewardship of these resources as a part of its land management/land use responsibilities. In meeting this responsibility, it shall be Fort Irwin's policy to:

- Actively work with other Federal, State and Local Government Agencies, professional organizations, educational institutions and other interested parties to enhance and further the Army's needs and objectives for paleontological resources.
- Consider paleontological resource management a distinct Army program, to be given full and equal consideration in all its land use planning and decision making actions.
- Mitigate adverse impacts to paleontological resources as necessary.
- Facilitate appropriate scientific use of and interest in paleontological resources.
- Vigorously pursue the protection of paleontological resources from theft, destruction and other illegal or unauthorized uses.

15.1 Land Use Planning and Environmental Review.

The management of paleontological resources shall be guided by and be in accordance with approved Fort Irwin land use plans.

- Paleontological resources constitute a fragile and non-renewable scientific record of the history of life on earth. Once damaged, destroyed, or improperly collected, their scientific and educational value may be greatly reduced or lost forever. In addition to their scientific and educational values, paleontological resources can be used to inform land managers about interrelationships between the biological and geological components of ecosystems over long periods of time.

- It is the policy of Fort Irwin, therefore, to manage paleontological resources for these values, and to mitigate adverse impacts to them. To accomplish this goal, paleontological resources must be professionally identified and evaluated. Their values should be adequately addressed and integrated fully into Fort Irwin's planning system and environmental analysis documents. Generally, considerable time, money and effort may be saved by considering paleontological data as early as possible in the decision making process.

15.2 Paleontological Data Collection and Analysis for Planning.

- Locating, evaluating and classifying paleontological resources, and developing management strategies for them, must be based on the best scientific information available.

- Paleontological expertise is necessary to help managers and decision makers resolve issues involving paleontological resources.

15.3 Mitigation.

- Adverse impacts to paleontological resources shall be mitigated as necessary.

- Any field surveys and/or inventories intended to protect paleontological resources will be targeted to specific areas or be issue driven as needed.

- Unless other arrangements have been made, project proponents shall bear all costs associated with this activity. These mitigation requirements apply to vertebrate, invertebrate and plant fossils.

15.4 Paleontological Resource Use.

- The desired outcome of managing paleontological resources is to ensure their availability for scientific and educational uses. Such uses include collection, site interpretation, study and exhibition.

- Any collection requires a permit. The permitting process fulfills several important functions. Permits provide for the pro-active management of paleontological resources by alerting managers to the presence of noteworthy occurrences of paleontological resources, their condition and vulnerability. Permits facilitate research by qualified paleontologists and serve as a bridge for communication between land managers and researchers. The permitting process provides appropriate protection to other resources that may be impacted by permitted collecting activities, and provides a consistent administrative structure for Fort Irwin's management effort.

- A Paleontological Resource Use Permit is a land use authorization issued to a qualified applicant for the purpose of carrying out various paleontological activities, such as identification, survey, collection or excavation, on lands managed by Fort Irwin. Such permits are nonexclusive, noncompetitive, minimum impact permits.

15.5 Resource Protection/Mitigation.

- Paleontological resources, including both organic and mineralized remains in body or trace form, will be protected, preserved, and managed for education, interpretation, and scientific research.

- The Army will study and manage paleontological resources in their paleoecological context (that is, in terms of the geologic data associated with a particular fossil that provides information about the ancient environment).

- All Army programs that may have an adverse impact on paleontological resources through their actions or authorizations are responsible for funding any necessary resource inventories, evaluations or other work needed to avoid or mitigate adverse impacts on paleontological resources.

- Fort Irwin will take appropriate action to prevent damage to, and unauthorized collection of, fossils. To protect paleontological resources from harm, theft, or destruction, Fort Irwin will ensure, where necessary, that information about the nature and specific location of these resources remains confidential. In order to insure protection of these resources the CRM will:

    - Monitor paleontological locales to ensure unauthorized collection does not occur.
    - Continue efforts to identify and manage paleontological resources.

- Except as otherwise provided in this document, possessing, destroying, injuring, defacing, removing, digging, or disturbing from its natural state non-fossilized and fossilized paleontological specimens, cultural or archeological resources, or the parts thereof, is prohibited. Taking plants, fish, wildlife, rocks or minerals except in accordance with this and other regulations or pursuant to the terms and conditions of a specimen collection permit, is prohibited.

15.6 Specimen Collection

- A specimen collection permit may be issued only to an official representative of a reputable scientific or educational institution or State or Federal agency for the purpose of research, baseline inventories, monitoring, impact analysis, group study, or museum display when the Garrison Commander determines that the collection is necessary to the stated scientific or resource management goals of the institution or agency and that all applicable Federal and State permits have been acquired, and that the intended use of the specimens and their final disposal is in accordance with applicable law and Federal administrative policies.

- A permit shall not be issued if removal of the specimen would result in damage to other natural or cultural resources, affect adversely the environment, or if the specimen is readily available outside of Fort Irwin.

- Specimen collection permits shall contain the following conditions:

    - Specimens placed in displays or collections will bear labels identifying the Army and Fort Irwin as their source and bear appropriate catalog information.
    - Specimens and data derived from consumed specimens will be made available to the public and reports and publications resulting from a research specimen collection permit shall be provided to Fort Irwin.

- Violation of the terms and conditions of a permit issued in accordance with this section is prohibited and may result in the suspension or revocation of a permit.

- Collection of paleontological specimens at Fort Irwin is allowed only with a permit processed through the Directorate of Public Works and issued by the Installation Commander.

- Upon the recommendation of the CRM, the GC may issue collection permits to qualified institutions for research, education and display of fossils.

- A qualified institution will be a recognized federal collections repository with a degreed professional paleontologist as curator, its displays open to the public and available for study by students, scholars and interested parties.

- All fossils collected under such permit shall remain the property of the federal government.

U S ARMY GARRISON FORT IRWIN

APPLICATION FOR PALEONTOLOGICAL RESOURCES USE PERMIT

NOTE that Fort Irwin is an active training installation and training takes priority. Access may be denied or revoked. No one is allowed downrange until they have attended a Range Operations Safety Briefing.

1. Applicant: _____
2. Affiliation: _____
3. Address: _____
   _____
4. Telephone and FAX: _____
5. Email: _____
6. Purpose of Work: _____
   _____
   _____
   _____
   _____
7. Location (UTM coordinates): _____
   Attach map
8. Dates of Proposed Work: _____
9. Field Party: _____
   _____
   _____
   _____
   _____

10. Signature

_____ _____

Applicant Date

APPENDIX D

CULTURAL AND GEOMORPHOLOGICAL CONTEXTS FOR FORT IRWIN

PART I: THE CULTURAL CHRONOLOGY

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Prehistoric Chronology

This section, which strives to place the prehistory of Fort Irwin in a regional perspective, draws extensively on major reports and syntheses of the region. Those interested in more detailed discussions of Mojave Desert archaeology should examine these individual reports (particularly Everson and Schneider 1994; Sutton and Warren 1988; Warren 1980, 1984; Warren et al. 1986). The following summary of prehistoric occupation encompasses the Mojave Desert as a whole, with a focus on the north central portion where Fort Irwin is located.

Numerous survey, testing, and data recovery investigations have occurred on Fort Irwin during the last 25 years. All of the major basins have been investigated systematically, most notably Drinkwater Basin, Nelson Basin, No Name Basin, and Tiefort Basin (Basgall 1991, 1993a, 1993b; Basgall and Hall 1993, 1994a, 1994c; Basgall et al. 1988; Bouey and Mikkelsen 1989; Eckhardt and Hatley 1982; Hall 1993; Jenkins 1985, 1986, 1991; Jenkins and Warren 1986; McGuire et al. 1986; Skinner 1985, 1988; Underwood 1983; Warren 1991; Warren et al. 1986). More recently, inventories and data recovery efforts for the Avawatz and Goldstone Expansion Areas have broadened the view of archeological resources on and surrounding Fort Irwin (Byrd et al. 2005; Grant et al. 2005; TRC 2004).

Several chronologies have been proposed over the past 40 years for portions of the Mojave Desert and the Great Basin (e.g., Bettinger and Taylor 1974; Campbell 1936; Davis 1970; Rogers 1939; Shutler 1967; Sutton 1996; Wallace 1962; Warren 1984; Warren and Crabtree 1986). Local variations on these regional chronologies have been developed in the course of specific cultural resources investigations that provided opportunities for refinements (Ahlstrom and Roberts. 2001; Ezzo 1995; Hauck et al. 1979; Kelly et al. 1990; Rafferty 1984). No regional or local chronology has met with full acceptance, though overall agreement is apparent regarding most major chronological sequences. The key points of contention entail dating the transitions between temporal units, particularly with respect to the onset of the region's prehistory, and the precise duration of occupation phases prior to 3,200 years before present (B.P.) (Warren and Crabtree 1986).

Table 1 outlines some of the major regional and local chronologies developed between 1962 and 2001, arranged by date of publication. Illustrating the various temporal schemes in this fashion reveals central trends in the development of regional chronologies.

Prior to Warren's (1984) chronology, there was little consensus regarding period names or dates. This may have stemmed partly from the fact that data were incomplete, with perceived cultural hiatuses during portions of the Lake Mojave and Pinto periods. As more data became available , these gaps disappeared and cultural periods became more finely differentiated. Shutler's (1967) Pinto/Gypsum period, for example, which is preserved in the Hauck et al. (1979) chronology, is split into two discrete periods by 1984.

It is worth noting that as early as 1967, cultural periods specific to the Virgin River area of southern Nevada and on the margin of the Mojave Desert and the Colorado Plateau (Moapa, Muddy River, etc.) were well established and have not changed significantly since that time. This reflects the relative abundance of datable materials associated with these sedentary settlements, and contrasts sharply with the scarcity of such materials (and concomitant difficulty in finalizing a cultural chronology) for prehistoric hunter-gatherer sites of the Mojave Desert proper.

Table IV-1
Cultural Chronologies Developed for the Mojave Desert Region between 1962 and 2001
with Relevant Dated Geomorphic Units, Continental Climate Regimes, and Broad Adaptive Periods Indicated

Dated geomorphic unit, southern Avawatz and Silurian Valley piedmont (Byrd et al. 2005)
Dated geomorphic unit, Soda Mountains piedmont (Wells et al. 2003)
Continental climate regime (Grayson 1993)
Broad adaptive period (Ahlstrom and Roberts 2001)

Years BP	Wallace (1962)	Shutler (1967)	Bettinger and Taylor (1974)	Hauck et al. (1979)	Warren (1984)	Warren and Crabtree (1986)	Kelly et al. (1990)	Ezzo (1995)	Sutton (1996)	Ahlstrom and Roberts (2001)
200	Prehistoric Shoshonean and Yuman	Protohistoric	Marana	Protohistoric	Protohistoric	Shoshonean	Protohistoric	Protohistoric	Late Prehistoric	Late Ceramic
300								Late Prehistoric		
400										
500										
600										
700			Haiwee							Middle Ceramic
800		*Mesa House*		*Mesa House*	Saratoga Springs	Saratoga Springs: *Mesa House*	Saratoga Springs	Saratoga Springs		
900		*Lost City*		*Lost City*		*Lost City*				
1000		*Muddy River*		*Muddy River*		*Muddy R.*			Rose Spring	Early Ceramic
1500	Amargosa	*Moapa*	Newberry	*Moapa*		*Moapa*				
2000					Gypsum	Gypsum	Gypsum	Gypsum	Gypsum	Late Archaic
2500		Pinto/Gypsum		Little Lake; Pinto/Gypsum						
3000										
3500	Pinto									
4000										
4500		Corn Creek Dune	Little Lake							
5000					Pinto	Pinto	Pinto	Pinto	Pinto	Middle Archaic
5500	Lack of Evidence	Lack of Evidence		Lack of Evidence						
6000										
6500										
7000	Lake Mojave		Mojave (beginning date not specified)	San Dieguito	Lake Mojave	Lake Mojave	Lake Mojave	Lake Mojave	Lake Mojave	Early Archaic
7500										
8000										
8500										
9000										
9500	Unspecified									
10000		Las Vegas		Tule Springs					Unspecified	Paleo-Indian
10500										
11000		Tule Springs								
11500										
12000										

Qf5/6 | Qf5/6 | Qf4 | Qf4 | Qf3 | Qe2 | Qf2 | Qf3

Neoglacial/Post-pluvial | Upper Wisconson/Pluvial

Ceramic | Archaic | Paleo-Archaic

NOTE: Gray areas indicate absence of information.
Italicized periods apply only to Moapa Valley and extreme eastern Mojave Desert.
Cross-hatched bands indicate consensus across four or more researchers for a particular cultural period.

From 1984 onward, common date ranges can be established for all periods across most of the various chronologies. Beginning and ending dates of cultural components may vary, but fairly broad time spans for which all researchers are in agreement that a particular component existed can be identified. These "bands of consensus" are indicated by light blue cross-hatching on Table 1. Ahlstrom and Roberts (2001) are an exception to this pattern as their chronology focuses on conceptually broader adaptive strategies rather than specific artifact morphologies.

Pleistocene Occupation

The currently accepted model for human occupation of the western hemisphere asserts that humans entered the continent between 12,000 and 15,000 B.P. (Meltzer 1993). The antiquity of human occupation in the New World, however, has been the subject of considerable debate over the last two decades; a number of sites have been interpreted by some researchers to contain very early occupations in the Americas. Despite such intensive interest and a long history of research into the early occupation of North America, no firm, widely accepted evidence of occupation prior to approximately 15,000 B.P. has emerged.

While there is no firm evidence of Pleistocene human occupation in the Mojave Desert, the possibility has intrigued a number of investigators (e.g., Davis et al. 1980; Moratto 1984). Pre-terminal Pleistocene occupation of the general Mojave region has been suggested based on the presence of weathered surface material typically characterized by a crude flaking technology. One of the most vocal and controversial proponents was the late Louis Leakey, who proposed very early occupation based on excavations at the Calico site (Budinger 1983; Leakey et al. 1972). Other loci of proposed pre-terminal Pleistocene occupation include sites at China Lake (Davis 1978), Manix Lake, Coyote Gulch (Simpson 1958, 1961), and Manly Terrace in Death Valley (Clements and Clements 1953). Convincing evidence that the objects recovered from these sites were manufactured by humans, are older than 12,000 B.P., and are directly associated with Pleistocene deposits, is currently lacking (e.g., Haynes 1969; Jelinek 1992; Wallace 1962; Warren 1980).

Paleo-Indian occupation, a widespread phenomenon throughout North America, is poorly documented in the Mojave Desert (Sutton 1996). At present, there are no reliably dated sites in the Mojave that fall within this time period. Evidence of Paleo-Indian occupation is based on the presence of fluted (Clovis-like) projectile points. Such projectile points have been recovered throughout the Mojave Desert, but generally as surface finds (Basgall and Hall 1992, 1994b; Davis 1978; Warren and Phagan 1988).

Lake Mojave Period (ca. 10,000–7000 B.P.)

The earliest accepted period of human occupation in the Mojave Desert is tentatively dated from about 12,000/10,000 to 7,000 B.P. (Sutton 1996; Warren 1984, 1994), overlapping the Paleo-Indian and Early Archaic periods. The Lake Mojave cultural complex was originally identified at a series of sites along the shorelines of ancient Lake Mojave in the central Mojave Desert (Campbell et al. 1937). Lake Mojave encompassed modern Silver and Soda lakes directly to the southeast of Fort Irwin. Absolute dates from stratigraphically sealed Mojave Lake occupation horizons are rare (Apple and York 1993; Davis 1978; Warren and DeCosta 1964; Warren and Ore 1978). Consequently, the onset of this period is not fully clarified, though consensus regarding an approximate terminal date is more consistent.

Lake Mojave period sites, which are relatively infrequent and often ephemeral in the Mojave Desert, are characterized by a well-developed lithic industry and the production of stemmed to lanceolate projectile points that may be weakly to strongly shouldered. These are typically termed Silver Lake or Mojave types. Considerable variability in projectile point form is typical, and the Lake Mojave component temporally and morphologically includes Great Basin Stemmed forms (Justice 2002:86). Large bifaces, crescents, large flake and core scrapers, choppers, scraper-planes, and hammerstones also occur in

association with these projectile point types (e.g., Campbell et al. 1937; Warren and Crabtree 1986:184). Ground stone was not considered a principal component of Lake Mojave period assemblages until recent fieldwork on Fort Irwin, notably at the Awl site (Basgall and Hall 1993; Basgall et al. 1988; McGuire and Hall 1988).

The relationship between Lake Mojave sites and the Paleoindian Fluted projectile point tradition is unclear at present. The correlation of many Lake Mojave period sites with lakeshores, marshes, and stream channel contexts led Bedwell (1970) to propose the term Western Pluvial Lakes tradition to characterize a hunter-gatherer adaptation oriented around lacustrine resources (see also Warren 1994). Others have suggested a more generalized foraging economy focusing on large fauna and supplemented by plant collecting, with lakeshore occupation just one component of a broader system (e.g., Basgall and Hall 1992; Davis 1978; Wallace 1962; Warren and Crabtree 1986:184).

Recent research at a series of Lake Mojave period sites within Fort Irwin has provided new insights into this occupation period in the central Mojave. Buried sites, such as the Awl site, have yielded consistent but low quantities of ground stone and a diverse faunal assemblage with few large mammal resources. Such assemblages have been interpreted as reflecting a generalized foraging subsistence strategy (Basgall 1991, 1993; Basgall and Hall 1992, 1994b; Hall 1993). This may also indicate minimum change in subsistence strategies during the transition from the wet, pluvial environment of the terminal Pleistocene to the generally drier conditions of the Holocene.

Basgall and Hall (1992:5) suggest that the apparent lacustrine orientation of this period is a construct of site formation processes and local geomorphology. They argue the Lake Mojave settlement pattern represents easily identifiable surface site locations, and not necessarily an economic focus on well-watered lacustrine localities. Moreover, they assert that the early Holocene climate differed little from subsequent periods. This recent interpretation has not met with complete acceptance, particularly with respect to the settlement focus and degree of climatic change (Byrd 1998; Cleland and Spaulding 1992; Warren 1994, 1998). Nonetheless, the drying up of these lakes undoubtedly had an effect on the distribution of resources and the organization of settlement patterns (Warren 1994:113–119).

The average annual productivity of dry valley bottoms and lower bajada environments in the Mojave Desert, based on modern studies, ranges from 45–60 grams of plant matter per square meter of surface area. Marsh environments in modern Mojave Desert valley bottoms, which are analogous to pluvial lake margins, produce on average 3,000 grams of plant matter per square meter annually (Barbour et al. 1987; Hadley and Szarek 1981). Although the general trend toward a drier climate since the end of the Pleistocene has undoubtedly affected the distribution and density of biotic resources in the Mojave Desert, perennial lakes and marshes must have provided significantly greater economic opportunities than the surrounding valley floors and bajadas, regardless of prevailing climatic trends.

The Great Basin Stemmed tradition is noted along the Little Snake River drainage northward into the Columbia Plateau (Justice 2002:96). In the Rio Grande valley, the projectile points are known as the Jay type (Irwin-Williams 1973). The Lake Mojave type is identified southward as far as the extreme northern portions of the Mexican states of Baja and Sonora (Justice 2002:95).

Additional multidisciplinary research that examines the holistic relationship between cultural manifestations and dynamic environmental factors is needed to strengthen interpretations of early regional settlement and subsistence patterns and links to the broader Paleo-Indian tradition. Studies that focus on clarifying the dates of specific geomorphic events and associated landforms, evidence of flora and fauna present, and artifact distributions and discernible technologies should be particularly useful.

Pinto Period (ca. 7000–4000 B.P.)

This period is defined primarily by the presence of large stemmed projectile points with indented or bifurcated bases and weak to robust basal ears (Schroth 1994; Vaughan and Warren 1987; Warren 1984). Haft configurations are variable within this type and include straight, contracting, or expanding stems (Justice 2002:126). Although pressure notching was known from the previous period in the form of eccentric crescents with notches, Pinto projectile points probably mark the first appearance of pressure notching as a technique in the manufacture of dart points in the Mojave Desert. This technique persists with variations into the historic period. Leaf-shaped bifaces and various unifacial implements, including thick scrapers and core-cobble tools, are often associated with Pinto type projectile points. Milling stones and hand stones also are present.

The type site for this period is the Pinto Basin site (Campbell and Campbell 1935; see also Harrington 1957; Rogers 1939). Pinto period sites are typically small and consist of surface assemblages; buried sites with well-developed occupation deposits are rare. Despite a small number of radiocarbon dates for Pinto period sites, and considerable debate regarding this period's onset and termination (Basgall 1993b; Hall 1993; Jenkins 1987; Jenkins and Warren 1984; Meighan 1989; Warren 1984, 1994), the vast majority of radiocarbon dates indicate the projectile point type appears toward the end of the Lake Mojave period and disappears "around 5,000 B.P. or somewhat later" (Justice 2002:134).

Reconstruction of Pinto period settlement patterns has been subject to a number of interpretations. Warren (1984:413, 1994) suggests that few differences were apparent in hunter-gatherer lifeways in the Mojave Desert during the Lake Mojave and Pinto periods. Both periods were characterized by temporary seasonal camps. Subsistence strategies were generalized, though a well-developed ground stone technology for exploiting seed resources was not evident. With the exception of brief wet periods from 6,500–5,500 B.P., when sites were placed along watercourses and dry lakebeds, populations were centered around the margins of the desert or at perennial springs (Byrd 1998; Warren 1984, 1994). Although Pinto and Lake Mojave projectile points often occur on the same sites, single-component Pinto sites occur more frequently near active or fossil springs rather than along playa margins (Warren 1986:14–17).

Recent research at Fort Irwin has offered a slightly different and more refined reconstruction of Pinto period occupation (Basgall 1991; Basgall and Hall 1992; Hall 1993). Ground stone artifacts were recovered in quantities similar to those noted in subsequent periods. Subsistence patterns appear to have been more diversified, characterized by a greater reliance on plant resources and small animals. Thus, plant seed processing appears to have been an integral aspect of a broad-based subsistence pattern that included large and small faunal resources (Basgall and Hall 1992:5). Within the boundaries of Fort Irwin, this period was characterized by an extremely broad land use pattern and a diverse subsistence system involving a geographically dispersed foraging strategy.

Work at the Awl site produced a taxonomic key for defining metric attributes of Pinto projectile points in the Mojave Desert, which differ somewhat from those at the Stahl site and those from the Pinto Basin. Schroth (1994:214) demonstrates statistically that specimens from Fort Irwin and from Pinto Basin were members of a single population. Part of the difficulty in defining a temporal range for Pinto occupations arose from a tendency to misidentify morphologically similar but temporally unrelated types as Pinto. Both Kaberline (1995) and Holmer (1986), using cluster analysis and discriminant function analysis, respectively, demonstrate that Gatecliff split stem projectile points (circa 5,000–3,300 B.P. [Justice 2002:144]) and Pinto points form distinct and separate clusters based on metric attributes but were frequently confused as a single type in the absence of formal analysis.

Temporally, the onset of the Pinto period coincides with a broader adaptive transition in western North America from a big-game–oriented Paleo-Indian lifeway to a broader-based and highly mobile hunting

and foraging economy tied to seasonal cycles and exploitation of diverse resource niches (Fowler and Madsen 1986). However, Ezzo (1996) points out, independently of the Fort Irwin researchers cited above, that Paleo-Indian economic patterns may be skewed by site formation and preservation processes. Paleo-Indian groups may have pursued diverse plant and small animal resources in addition to large Pleistocene mammals but only those relatively permanent sites associated with large mammal procurement tend to survive in the archaeological record.

While the temporal range of this period is no longer contested as hotly as it once was, the adaptive implications of the transition from the Lake Mojave period to the Pinto period and the subsequent transition to the Gypsum period (discussed below) require considerable clarification. Studies that focus on refining the dates of specific geomorphic events and associated landforms, evidence of flora and fauna present, and artifact distributions and discernible technologies, should be particularly useful.

Gypsum Period (ca. 4000–1500 B.P.)

This period is generally thought to have been a time of intensified occupation of the Mojave Desert associated with broadened subsistence activities, and possibly the development of new socioeconomic ties with the California coast and the Southwest (Ezzo 1996). This intensive occupation is reflected in the more abundant Gypsum period material at a few sites such as Gypsum Cave, Newberry Cave, and Rose Spring (Davis and Smith 1981; Harrington 1933; Lanning 1963). Cultural assemblages are diverse and reflect generalized technology and mobile subsistence strategies.

Medium- to large-stemmed and notched projectile points (including those ascribed to the Elko, Gypsum, and possibly Humboldt series) indicate continued use of the dart and atlatl. Bifacially retouched cores, pressure flaking, and the use of microcrystallines are now widespread, the latter often being nonlocally available raw material (Basgall and Hall 1992; Hall and Basgall 1994). A range of other artifact types is present, including shaft smoothers, worked stone objects, ornaments and beads and, where preservation occasionally permits, perishable materials including atlatl components, sandals, and split-twig figurines (Warren 1984:416). The presence of Pacific Ocean marine shell beads and ornaments provides strong evidence of contact and exchange with coastal areas (Warren 1984:419). The presence of split-twig figurines at sites such as Newberry Cave (Smith 1963) and petroglyphs such as those in the Coso Mountains has been interpreted as aspects of a shared magico-religious system composed of a series of elements related to hunting ritual behavior (Warren 1984:417–418).

The hunting of large mammals (artiodactyls) appears to have been a significant aspect of Gypsum period subsistence, although smaller faunal remains also are well represented (McGuire and Hall 1988:319; Warren and Crabtree 1986:189). Ground stone artifacts are well represented during the Gypsum period, indicating utilization of hard seed resources. These artifacts are often small, portable, and formally diverse (Basgall and Hall 1992). The appearance of mortars and pestles during this period has been interpreted as indicating the onset of mesquite bean exploitation (Warren 1984:420). Hall and Basgall (1994) observe that Gypsum period settlement patterns are characterized by increased utilization of valley floors and interbasin transportation corridors on Fort Irwin. Most sites appear to have been formed by repeated short stays by mobile hunter-gatherers.

The onset of this period has been correlated with the beginning of the Little Pluvial, and continued well after the end of this moister period (Cleland and Spaulding 1992; Warren 1984:419–420; Warren and Crabtree 1986:189). Cultural developments of this period were made possible by the moister climatic conditions that yielded a greater abundance of plant and animal resources (Warren 1984:420). Others have maintained that the period's paleoclimatic regime was not significantly different from today, and pluvial episodes only improved groundwater conditions and expanded the riparian zones near springs (Basgall and Hall 1992:5). Even though there is considerable doubt about the cause and effect

relationship between climatic change and cultural developments in the Mojave Desert, it is clear that major technological and socioeconomic shifts occurred during the Gypsum period (Hall and Basgall 1994). These changes allowed for continued exploitation of the region, despite a possible return to arid conditions in the latter half of the period.

Test excavations at site CA-SBR-11588, approximately 20 km (12 miles) south of Fort Irwin on Manix Wash, recovered charcoal in association with a burned a cobble cluster, debitage, and flake tools, that provided a ^{14}C date of 1,940 ± 40 years B.P., which places the site's occupation in the late Gypsum period. The site area currently supports creosote and bur sage and a sparse understory of short grasses. Consistent with postulated climatic changes during the Little Pluvial episode, pollen samples from the dated stratum included significant counts of desert willow, indicating a desert riparian environment (Grant et al. 2004).

Contrary to the above, Byrd et al. (2005:168–171) note a significant decline in the frequency of grinding implements at Gypsum period sites on Fort Irwin, both in comparison to the preceding Pinto period and the subsequent Saratoga Springs/Rose Spring period, and a marked increase in the frequency of bifaces. They suggest this indicates decreased reliance on plant resources, increased reliance on hunting and game processing, and an overall decline in use of the area and in the diversity of activities that occurred on sites.

The Little Pluvial was a widespread phenomenon that has been thought to have resulted generally in prehistoric population expansions, indicated by increases in obtained radiocarbon dates and recorded sites with temporal markers throughout the western United States at least as far east as the eastern slope of the Rocky Mountains, where this period coincides approximately with the onset of the Triple Lakes Glaciation (Benedict 1975, 1979). The effects of the Little Pluvial, however, appear to have been quite variable across the western United States. Fort Irwin may be a localized area that experienced deteriorating environmental conditions during this time. More research is needed to conclusively address this problem. Well-designed studies that control for environmental and cultural covariates and that rely on large samples of reliably dated materials would be most beneficial.

Rose Spring Period/Saratoga Springs (ca. 1500–800 B.P.)

This period is characterized by increased regional variation within the Mojave Desert and potential external influence by Anasazi and Hakataya peoples to the east (Warren 1984:420–424). This potential influence is reflected in regional chronologies that introduce Puebloan cultural sequences, alone or in combination with Great Basin/Mojave Desert components such as Saratoga Springs, coincident with this period and continuing to Contact. These components coincide with Basket Maker II, III, and Pueblo I–III periods on the Colorado Plateau (Ezzo 1996:45–55). The incursion of Anasazi and Puebloan groups is limited geographically to the Virgin River, Saint George Basin, and, during the Lost City phase, the Las Vegas Valley. These groups' influence on local hunting-foraging people is evident in sparse occurrences of characteristic black-on-gray ceramics in combination with local ceramic wares on small sites in the Mojave desert and the southern Great Basin.

The material culture of this timeframe is characterized by small corner-notched triangular projectile points, first identified as a discrete type at the Rose Spring site in Owens Valley, California (Heizer and Braumhoff 1961), where they were associated with radiocarbon dates spanning 1,500–700 B.P. (Lanning 1963). Eastgate contracting stem projectile points often occur in association with Rose Spring types. Farther north in the Great Basin, these types replace Elko Corner-notched forms and precede the appearance of Cottonwood Triangular projectile points (Justice 2002:321). Both Rose Spring and Eastgate contracting stem types were presumably used with the bow and arrow rather than the atl-atl

(Yohe 1992). Haft elements on these projectile points range from slightly contracting to straight stems to expanding stems that give the appearance of side notching (Justice 2002:320).

Lithic tools became more specialized and were manufactured from a narrow range of locally available lithic sources, suggesting a more restricted foraging territory (Basgall and Hall 1992:6). Contrary to the above, milling stones, mortars, pestles, ceramics, and a variety of ornamental and ritual objects are well represented during this period. Reliance on the exploitation of plants and small animals increased (Wallace 1988; Warren 1988).

Large sites, such as Saratoga Springs north of Fort Irwin in Death Valley (Wallace and Taylor 1959) and Oro Grande on the Mojave River (Rector et al. 1983), are first documented during this period. Unfortunately, other potentially significant sites of this era, such as Afton Canyon, have extensive site disturbance that reduces their interpretive utility (Schneider 1989:19; Sutton and Yohe 1989:145). These sites are often interpreted as "village" settlements, reflecting a shift in settlement organization from a circulating to a radiating pattern in these areas, with temporary camps and processing stations situated around major habitation units (Warren 1984). Other portions of the Mojave Desert appear to have a continued mobile, low density, residential occupation often clustered around springs (e.g., Basgall and Hall 1992; Warren 1988:45).

Trade networks are well documented throughout the Mojave Desert during the Saratoga Springs period, and several interpretations have been offered regarding the implications of these trading processes (Lyneis 1982; Warren 1988). These trading networks appear to have been a factor in the increasing variation seen between regions within the Mojave Desert. One of the most interesting aspects of nonsubsistence decorative goods trade and acquisition entails the nature of Anasazi influence on turquoise mining, particularly in the Halloran Springs area of the central Mojave Desert (Rogers 1929; Warren 1984:421–422). Whether Anasazi groups actually mined turquoise or simply traded for this resource remains open to differing interpretations (e.g., Leonard and Drover 1980; Rogers 1929:12–13; Warren 1984, 1988:46–48).

Late Prehistoric Period (ca. 800 B.P.–Contact)

The onset of the Late Prehistoric period (designated the Protohistoric period in some chronologies) is indicated by the appearance of Desert series projectile points, including Cottonwood Triangular and Desert Side-notched projectile points, with or without basal notches. These types are widely distributed throughout western North America, extending northward into Alberta and Saskatchewan and eastward as far as the Colorado Front Range (Gilmore et al. 1999). Desert type projectile points persist well into the historic period (Justice 2002:380).

Major research themes in prehistoric settlement during this period include trade and exchange, the movement of populations (including the Numic spread), and the projection of ethnohistoric groups back into prehistory (Bettinger and Baumhoff 1982; Sutton 1988; Warren 1988). The Anasazi influence appears to decline in the region by 900 B.P. and is replaced by Hakataya interaction (Warren and Crabtree 1986:191). Warren (1984:391) suggests that Colorado River influence is discernible in the eastern portions of the valley based on the nature of the ceramics. These sites are widespread on Fort Irwin. Interestingly, Earle (2004), using ethnohistorical data, has documented the probability that a portion of Fort Irwin was once home to the "Desert Mojave" a group of Mojave who hunted big-horn sheep and used the bow and arrow. Recently, Jones et al. (1999:152–153) have argued that droughts between A.D. 800 (1150 B.P.) and A.D. 1350 (600 B.P.) had a significant impact on water availability in the region and seriously disrupted hunter-gatherer settlement patterns. This assertion, however, is contrasted by recent packrat midden analysis at Salt Springs in the Silurian Valley (Koehler and Anderson 1998) where more mesic conditions and an elevated water table are indicated between 1390 B.P. and 700 B.P.

Current Site Definitions on Fort Irwin

Archaeological sites on Fort Irwin are divided into five specific categories, listed below, based on the combination of artifacts and/or features present. These are discussed below and summarized in Table IV-2.

Table IV-2
General Summary of Artifact and Feature Categories that Define Site Types on Fort Irwin

	Debitage	Cores; Assayed Cobbles	Early Stage Bifaces, Preforms	Late Stage Bifaces	Points, Unifaces, Drills, etc.	Milling Equipment	Ceramics	Hearths, Stone Circles, Middens, etc.	Rock Art, Geoglyphs, Offerings, Pendants, etc.
Quarry	■	■	■						
SFSA	■	■	■	■					
SME/PA	■	■	■	■	■	■	■		
CF/AS	■	■	■	■	■	■	■	■	
DF/AA									■

Simple Flake Stone Assemblage (SFSA)
Quarry
Simple Milling Equipment/Pottery Assemblage (SME/PA)
Distinctive Feature/Artifact (DF/A)
Complex Feature/Artifact Assemblage (CF/AA)

Given that the archaeological distribution of domestic facilities and ground stone is especially sensitive to variations in human behavior and site function, the most significant condition of this classification with respect to artifactual material is whether a site contains intact features and milling equipment and/or pottery. Sites that lack milling artifacts or pottery are classified as Simple Flaked Stone Assemblage sites or Quarries.

Quarries are distinguished by the occurrence of locally available toolstone, with assemblages limited to a narrow range of artifacts, primarily discarded cobble cores, early stage bifaces, and debitage associated with early reduction stages. These sites represent either amalgams of Segregated Reduction Locations (SRLs) in areas where suitable cobbles occur in considerable numbers, or locations where bedrock outcrops have been exploited for toolstone. SRLs are very ephemeral, representing single flaked stone reduction events where locally available cobbles were briefly assayed and reduced to acquire blanks or cores for subsequent transport and tool manufacture at other sites. Individual SRLs are not classified as sites. Simple Flaked Stone Assemblage sites are typically small- to medium-sized accumulations that prior studies in the general area have revealed are primarily of reduction debris and cores (Byrd 1998; Mikkelsen and Hall 1990). These assemblages may also include other flaked stone artifacts that include projectile points, bifaces, and flake tools, indicating a relatively narrow range of hunting and other procurement activities.

Sites containing one or more pieces of milling equipment and/or pottery are divided into two categories: Simple Milling Equipment/Pottery Assemblage sites and Complex Feature/Artifact Assemblage sites. This division is based on the presence or absence of (1) maintenance and manufacturing implements and

(2) domestic facilities and socioeconomic artifacts. Each of these denotes differences in the range of activities performed and the intensity and permanence of occupation. Simple Milling Equipment/Pottery sites are distinguished by the occurrence of milling equipment and/or pottery and, at best, a limited range of flaked stone artifacts corresponding to the general utility implements found at Simple Flaked Stone Assemblage sites. This suggests that a comparatively narrow range of tasks was performed at these small- to medium-sized sites, including some amount of food procurement and processing. Markedly different assemblages occur at Complex Feature/Artifact Assemblage sites, with two variants distinguished: those containing a large and wide assortment of both flaked and ground stone artifacts, which reasonably reflect a moderate to high degree of occupational intensity (often referred to as "base camps," "villages," and "habitation sites"); and those containing a complement of features suggesting habitation (e.g., rock rings), or the intensive processing/ procuring of a patch resource (e.g., cleared areas on desert pavement). Faunal and/or macrobotanical remains, including charcoal, are further indications of complex sites.

Distinctive Feature/Artifact sites include sites limited primarily to features and artifacts representing ritual or symbolic activities. These locations reflect activities that stand out from subsistence-oriented sites by having trails, rock art, rock alignment features, or out-of-place objects that, according to contemporary Native American perspectives, indicate ceremonial activities. It may not be possible to determine the meanings of such sites, but their unique nature may still be of ethnohistoric significance to Native Americans. Given the vagaries that surround the function of rock art and past Native American behaviors associated with geoglyphs, petroglyphs, and pictographs, it is conceivable that when placed with rock art, seemingly mundane implements and items such as milling gear served a purpose other than that commonly ascribed to them. Throughout the West, rock art concentrations are commonly found to have milling gear in proximity. This has led to some speculation that in such contexts, the purpose of grinding was special, related to ceremonial feeding, or processing plants with special curative powers.

Alternative Site Definitions

The definition of site types by archaeologists is almost always subjective and potentially problematic. Any number of researchers will agree that site variables, such as mean elevation, landform, and so on, have only one value. The same researchers, however, will often disagree over what constitutes a particular site type, and how site types should be defined. The current site typology used by Fort Irwin avoids the use of subjective definitions, such as "base camp," "lithic workshop," etc., which are subject to broad interpretation in favor of more objective and purely descriptive definitions. Other researchers in the general region have taken similar approaches and arrived at site typologies that are inherently similar to the current one used by Fort Irwin. Kelly et al. (2003), for instance, divide prehistoric and ethnographic sites in the Kawich Range of southern Nevada into Complex, Intermediate, and Simple Assemblages based on material content. Kelly et al. (2003:4–5) use the following seven categories to define site types: (1) flaked stone, (2) ground stone, (3) ceramics, (4) historic material, (5) midden deposits, (6) other features, and (7) ornaments. In this typology, Complex Assemblages contain a combination of at least four items, Intermediate Assemblages contain at least three items in combination, and Simple Assemblages consist of only one artifact or feature category.

Site typologies are determined to a large extent by the range of cultural materials present (and the range of cultural materials recognized) in a particular region. Subsistence activities are represented by a fairly static assemblage of artifacts and features across large regions, and classification and interpretation of sites containing utilitarian artifacts are fairly straightforward regardless of the specific typological scheme employed. The current Fort Irwin typology recognizes a category of sites (Distinctive Feature/Artifact Assemblages) that can fall outside the purely economic domain. These sites can embody symbolic sociocultural activities that are rare, fragile, and often difficult to recognize. Such sites are also highly

significant in understanding the complete range of behaviors within a cultural region. The recording of such sites on Fort Irwin is recent, and it is unknown how many sites in this category may have been overlooked in the past. Learning to recognize and understand these types of sites is an ongoing process.

Recent investigations on the Nevada Test and Training Range (about 150 miles northeast of Fort Irwin), assisted by Native American monitors who are living descendants of those who used the area during the historic period and into the twentieth century, indicate sites in this domain can be extremely subtle. Indications of such sites that may be relevant to Fort Irwin and which have not been reported previously include the following (Grant et al. 2007):

- Short lengths of broken sticks, which are easily overlooked or assumed to be natural, wedged into natural cracks in the ceilings of rockshelters (purportedly associated with either thanksgiving or witchcraft).
- Obsidian needles (naturally occurring tapered, prismatic pieces of obsidian), approximately 3–5 cm in length and 0.5 cm in diameter were found on the Nevada Test and Training Range (n=28) and occur as isolated clusters in otherwise culturally sterile rockshelters or singly on open or sheltered habitation sites. Obsidian needles occur at only a few known sources and are reported by Native American monitors to be associated with healing ceremonies.
- Isolated artifacts, including flakes; or unusual nonlocal stones that are not culturally altered, placed inside a naturally eroded or purposefully pecked cavity in a prominent rock outcrop, reported to represent offerings ("offering holes").

Although not necessarily associated with the sociocultural site domain, another ephemeral site type recently recognized that may be applicable to Fort Irwin is the use of small rockshelters, often eroded solution cavities that are unsuitable for general habitation due to cramped vertical space, but were used as food storage areas. The model for this site type contained an intact basket of *Mentzellia albicaulis* seeds held in place by a ring of boulders and covered by *atrimisia* and *Eriogonum* branches (Grant 2007). Sites in this category are rarely so well preserved and are often apparent as a cluster of unburned and unaltered rocks on an otherwise culturally sterile rockshelter floor, or as a small arc, semicircle, or two short parallel rows of rocks near the rear wall of an apparently unoccupied rockshelter. Such items may occur with or without scattered brush and clumps of dried grass, with no evidence of the rockshelter's use by wood rats. These sites sometimes include associated offerings or sticks wedged into the ceilings.

A variety of typological approaches are available for defining site types. With the development of statistical techniques and numerical taxonomy in the 1960s, mathematical methods, including Cluster Analysis, Principal Components Analysis, and Correspondence Analysis, have been used to build typologies (Whallon and Brown 1982). During the 1990s, archaeologists began to use phylogenetic methods borrowed from Cladistics.

Strictly empirical approaches to site typologies may overlook subtle traits that require experience and intuition to recognize. Purely rationalistic approaches run the risk of becoming highly subjective. As in any discipline, fundamental concepts in cultural resources investigations can evolve intuitively and rationalistically, through strictly empirical approaches, or a combination of approaches. The critical factor is not the methods or tools used but the validity of the ideas driving them. The current Fort Irwin site typology, based on a large sample of recorded sites throughout the study area, appears to accurately distill the data into practical categories that reflect settlement trends. This typological framework will best serve management and research needs if viewed as an organic rather than static structure, subject to revision and expansion as new data are assimilated.

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Part II: SUMMARY OF PHYSICAL AND NATURAL ENVIRONMENT OF FORT IRWIN AND GEOMORPHOLOGICAL LAND SURFACE INTERPRETATION

Geoarcheology

This document reviews and assesses geoarchaeological data related to the Fort Irwin Planning Level Survey. Specific tasks are review of relevant literature, summary of major geomorphic events in the development of the current landscape, discussions of geomorphic mapping in relation to the Archaeological Predictive Model (APM), and recommendations for future study.

A composite model of late Quaternary evolution of the Fort Irwin landscape is presented. This model addresses (1) three late Pleistocene-Holocene periods of fan aggradations (early Holocene, late Holocene, latest Holocene), (2) one lacustrine event (early Holocene), (3) an eolian event (early to mid Holocene), and (4) a period of spring activity (latest mid Holocene). All of these postdate a late Pleistocene climatic event that fostered development of a strong argillic and calcareous paleosol.

Results of landscape modeling show that geomorphic mapping is progressing. Efforts are needed to correlate mapping units across the entire post, locate/test sediments capable of yielding buried cultural materials, and integrate results of recent geomorphic mapping into the APM.

METHODS

Literature related to the geoarchaeology of Fort Irwin was reviewed, followed by a field reconnaissance on August 29 and 30, 2007. The reconnaissance focused on the recognition of terrains within the newly acquired expansion areas and an examination of selected archaeological sites. Assembly of relevant literature included standard review of geologic and science libraries, on-line bibliographies, and geo-related search engines. Inquires were also directed to the San Bernardino County Museum and the Fort Irwin collections. Unique to this search and this project was the opportunity to discuss the Mojave Desert landscape with a number the referenced investigators on the 2007 "Friends of the Pleistocene" field trip (Machette et al. 2007).

DEVELOPMENT OF THE MOJAVE DESERT LANDSCAPE

The Mojave Desert is part of broader region of basin and range topography (Fenneman 1931), linear valleys, playa lakes, steep-sloping alluvial fans, bajadas, and volcanic mountain ranges that includes the Great Basin Desert to the north and the Sonoran Desert to the south. The Mojave region is an arid, seemingly inhospitable landscape with unique vegetation, usually dominated by creosote (*Larrea tridentata*), whose presence below about the 4,000-foot contour demarcates the Mojave Desert boundary with surrounding environments. Precipitation, which is scant and limited almost entirely to the winter months (Pacific weather pattern), can cause catastrophic sheet flooding funneled off ranges into narrow fan channels and debouched as debris flows on valley floors.

Geographer, geologist, hydrologist, and historian David Thompson (1929:539, 1921) was one of the first to recognize the region's fluvial geomorphology and basin hydrology as products of a vastly different

paleo-landscape with a flowing Mojave River and numerous extensive lakes in connected and isolated basins. A host of others have confirmed, expanded, and refined Thompson's original observations.

Two themes particularly important to Fort Irwin geoarchaeology emerge from their research. The Mojave climate fluctuated in the late Quaternary and those fluctuations left landscape signatures. For example, "Detailed analysis of . . . stratigraphic sections shows that a complex depositional mosaic composed of wet meadows, seeps, flowing springs, streams, and wetlands covered the valley bottom(s) during the last two glacial episodes" (Quade et al. 2003:165). Temperature on the valley bottoms during the older glacial "was at least 10.8°C (19°F) colder" and 5.6°C (10.08°F) colder during the last glacial (Quade et al. 2003).

Evidence of climatic change is also preserved in other geomorphological and pedological records. One of the most striking examples of Fort Irwin geo-climatic signatures is the alluvial fan deposits (Figure IV-1), especially those on the eastern flank of the Avawatz Mountains.

Figure IV-1. View northeast from Red Pass showing large alluvial fan grading to Salt Creek Lake in middle distance. Soil mapping units Qf2 and Qf5 (after Byrd et al. 2005:152) are indicated.

Other important, but less conspicuous remnants of the paleoenvironment are pluvial Lake Dumont's shoreline flanking the Salt Spring Hills (Anderson and Wells 2003), Holocene spring and alluvial sediments along Salt Creek (Anderson and Wells 2003), the VIP site and other spring localities (Thompson 1929:Plates 10 and 11), the paleo-shoreline sequence on the northern margin of Silver Lake Playa (Wells et al. 2003), and a dune on the Superior Lake paleo-shoreline.

Biotic resources respond to climate change (Knox 1984). Mammoth remains in a dune near Red Pass Lake are a striking reminder of changes in local floral and faunal communities. Discrete differences in soil development reflect the timing and intensity of such climate-related resource shifts. Climate-induced changes have influenced Fort Irwin human–land relationships. Recognizing this, researchers are attempting to refine the relationship between specific geomorphic events and the cultural chronology of

the Mojave Desert (Byrd et al. 2005) using geomorphic signatures as a means to identify, assess, and chronicle the geoarchaeological record. Such interpretations allow archaeologists to focus research on terrains and deposits likely to yield evidence of prehistoric habitation.

FORT IRWIN CHRONOLOGY

Several Quaternary signatures or geomorphic units are identified within the Mojave Desert. Harvey and Wells (2003) recognize as many as five fan (Qf), two lake (Ql or L), and three eolian (Qe) units (Figure IV-2) that are within the accepted age range for human occupation of North America (~ ≤ 12,500 B.P.).

		S Soda Mts (Zzyzx) This study	Estimated age (ka) a	Pluvial Lake Mojave b	Silver Lake and vicinity c	Providence Mountains d	Cima Piedmont e
HOLOCENE	Late	Modern sediments			Qf_5	Qf_9	Qf_9
		Qf_5	< 1.8		Qf_5 [Qe3]	Qf_8	Qf_8
	Middle	Qf_4	4.3–3.5		Qf_4 (3.4)	Qf_7 (4.4–2.2)	Qf_7
		Qf_3	9.3–5.2		Qf_3 [Qe2]	Qf_6 (5.4–2.8)	Qf_6
	Early	L_2	10–9.3	Youngest shoreline	Ql_2 (8.4)		
		Qf_2	11.5–9.3	Intermittent lake	Qf_2 (10.3–9.2) Qe_1	Qf_5 (18.1–10.4)	Qf_5
PLEISTOCENE	Late	L_1	14–11.5	Lake Mojave II (14–11.5)	Ql_1 (20.3–14.7)		
			18.4–16.6	Lake Mojave I (18.4–16.6)			
		Qf_1	*c* 34–18.4		Qf_1	Qf_4 (28.7–26.9)	Qf_4
							Qv_5 (72–65)
	Middle	Qf_0	> 68			Qf_3	
							Qv_4 (130)
							Qv_3 (170–150)
						Qf_2 (=Bishop Ash 780)	

Figure 5. Regional correlation between the late Quaternary sedimentary units recognized on the Zzyzx fans and those recognized on other fan groups within the eastern Mojave Desert. a—date ka, adopted in this study; b—from Brown et al. (1990), Wells et al. (1990a, 1997, this volume); c—from Reheis et al. (1989), Wells et al. (1997, 1998), Anderson and Wells (this volume, Chapter 6); d—from McDonald (1994), McDonald and McFadden (1994), McDonald et al. (1996), Wang et al. (1996); e—from McDonald and McFadden (1994), Wells et al. (1995).

Figure IV-2. Reproduction of Figure 5 from Harvey and Wells (2003:218), summarizing their correlation of Mojave Desert geomorphic units. Note the diversity of units and ages.

Recent investigators have identified, dated, and assessed the archaeological potential of geomorphic units in Fort Irwin (Table IV-3). These chronologies suggest deposits containing a stripped argillic and calcareous paleosol are too old to yield buried cultural materials. This temporal marker, informally termed it the "Sodwatz" paleosol, is older than ~15,800 B.P. (Byrd et al. 2005:63).

Table IV-3
Chronologies Related to the NTC with Proposed Correlations

	Investigator:						
Years B.P.	Byrd et al. 2005:5, 63	Grant et al. 2005	Grant et al 2004	Peter et al. 2004	McDonald et al. 2003	McMahon and McDonald 2000	Anderson and Wells 2003

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 >12000	Qf7 modern (5) Qf6 <2500 (5) Qf5 and Qf6 <~1800 (63) Qf5 Latest Pleistocene to ~<1800 (5) Qf4 `2000 to ~ 6300 (63) Bk and Bt (5) Qf3 ~10100 to 14,500 (63) Qf2 >~15800 (63)	Qa <1000 Qfa late (<5000) to latest Holocene tin A/Bw Qfi Mid to late Holocene (~7-5000) Bw maybe Btj Qfo latest Pleistocene Av/Bt or Bkt Qfvo Qfvo >100 ka K horizon	Qa/Qfy young active Qpx eolian on fan pediment Qf early Holocene Bt Ql Paleolakes ~10 to 12 ka Qfs multiple ages > latest Pleistocene	Qa, Qe recent alluvium and eolian no soil Qfy late to latest Holocene A/Bw horizons Qfi mid to late Holocene Bw maybe Btj Qfo latest Pleistocene Av/Bt/Btk Qfvo >100 ka K horizon	Qe3 eolian <500 Qf5 fan <2000 Qf4 Fan ~4100-2500 Qf3 fan ~6000-4000 Qe2 eolian ~9000-<6000 Qf2 fan ~14000-9000 Qe1 19000-16000	Fa, Apa,Pa maybe Wsa = weak to no soil Fys, Apys stable, Bw/jBk horizons Fms, Apms, Pi stable, mature Bt, Bk, structure Fr stripped Bt, Bk	Fan terrace 1.7 ka Springs 5.1 ka Aggradation > 9.3 to 2.5 ka Lakes/springs 19.4-18 ka Drier 23.4 and 19.4 ka Shallow lakes/springs ~23.4 ka Desiccation 25.3-23.4 ka Shallow lakes/springs 30-25.3 ka

Table IV-3 also shows Fort Irwin contains an array of Holocene geomorphic units that do not always appear to be in agreement. There are reasons for this divergence. Primary is the focus of individual investigations. For example, if the task is to identify Holocene alluvial sediments capable of containing in situ buried archaeology, it matters little what specific Holocene alluvial event the unit represents. Geomorphic units are often localized and difficult to correlate. Eolian deposits occurring near sediment sources are an example. Finally, there is the problem of correlating the results of many different investigations. Field methodologies differ and datable materials recovered during the investigation are often low and older, uncorrected radiometric assays are not fully reliable.

There are, however, similarities among the existing chronologies (Figure IV-3). All models, for instance, recognize a Pleistocene argillic and calcareous paleosol that provides a soil-stratigraphic marker indicating sediment too old to yield buried cultural materials. Byrd et al. (2005), Grant et al. (2004), and McDonald et al. (2003) note a latest Pleistocene-early Holocene fan deposit that postdates the Sowatz paleosol. The ~ 12,000–10,000 B.P. paleolake events of Grant et al. (2004) correspond with other Mojave lake events (Harvey and Wells 2003:218, Figure 50; Wells et al. 2003) as does the middle Holocene eolian event (Lancaster and Tchakerian 2003:246). Anderson and Wells (2003:135, Figure 5) present good evidence for spring activity that corresponds with ~ 5,100 B.P. playa filling (Wells et al. 2003:112). Five of these six reports note late to middle Holocene fan deposits defined by weak calcareous and juvenile (j) argillic soil B horizons. Finally, there is consensus regarding a latest Holocene fan and possibly an eolian event that predates modern fan, stream, and eolian activity on the lands of the NTC.

As with all models, this composite model needs testing and refining. An area for refinement is the relationship between the geomorphic units and geoarchaeology. As a hypothetical example: fan sediment sizes commonly decrease from a fan's apex at the mountain front to a fan's distal edge on the valley floor (Figure IV-4). This makes the likelihood of in situ artifact preservation greater near valley floors, suggesting distal fan sediments should be tested.

FORT IRWIN ARCHAEOLOGICAL PREDICTIVE MODEL

As outlined in Section 2-4, an archaeological predictive model was created for Fort Irwin by the University of Chicago. The model uses eight environmental variables to predict site locations. Attributes of known sites are used to generalize locations where others may occur. As initially designed, Fort Irwin archaeologists reported a < 60 percent accuracy rate for the APM's ability to identify lithic and habitation sites and that it performed poorly for rockshelters, rock art, and historic sites. Using geomorphic data, performance increased to ~80 percent.

This is not unexpected; the original APM predates a substantial amount of Fort Irwin and Mojave Desert geomorphic and pedologic research, including newly generated mapping related to archaeology in the expansion and construction areas (Byrd et al. 2005; Grant et al. 2004, 2005; Peter et al. 2004; Smith 2004). The increase in the APM's performance reflects improved understanding of the geoarchaeological characteristics of the individual geomorphic mapping units. New lines of thought have also been introduced that need to be considered in predicting archaeological potential:

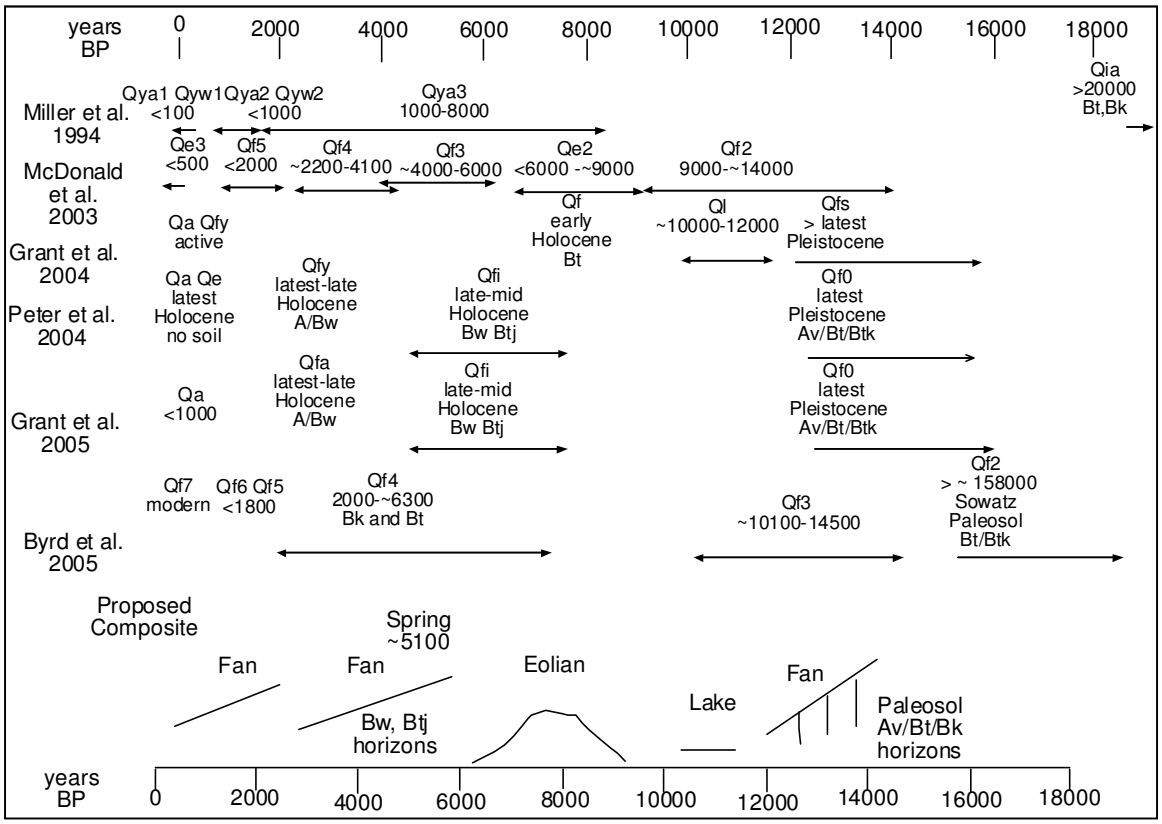

Figure IV-3. Geomorphic chronologies.

- The effect of high-energy fan environments on burial of archaeological components (Byrd et al. 2005; Grant et al. 2004, 2005; Peter et al. 2004)
- Codification of site-specific geomorphic data (Grant et al. 2005:49)
- Surface stability related to artifact integrities (Grant et al. 2004:85)
- Human response and land use resulting from climate change (Byrd et al. 2005:25)

RECOMMENDATIONS

Based on the preceding discussion, the following factors are recommended for potential incorporation into the APM:

- Bedrock geology related to cave, rockshelters, and rock art
- Geomorphic mapping
- Location of sediments capable of yielding in situ buried archaeological components
- Effects of high-energy fan environments on burial of archaeological components
- Surface stability
- Human land use as related to long-term and possibly seasonal climate change

Figure IV-4. Modern channel alluvium at head of the East Gate MSR fan. Note poor sorting, large clast sizes, and bar-swale topography, a depositional environment not conducive to in situ artifact burial.

This recommendation comes with the caveat that an effective APM relies on the smallest combination of predictor variables with the greatest predictive validity. Merely adding variables to the model because they appear theoretically beneficial is not recommended. Potential new variables need to be screened for possible redundancy with existing variables and tested for validity and reliability.

Geoarchaeological investigations at Fort Irwin and the NTC have certainly contributed to an understanding of prehistory and to the ability to predict locations on the installation where sediments have the potential to contain sites eligible for inclusion in the National Register. Nonetheless, additional studies are needed to gain a better understanding of the Fort Irwin physical environment and geoarchaeology. To attain that understanding, the following are recommended:

- Installation-wide correlation of mapping units
- More absolute dating of individual units
- Revise/standardize mapping unit terminology
- Standardize geomorphic data collection
- Refine characteristics and potential of sediments capable of yielding in situ buried cultural deposits

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APPENDIX E

HISTORIC CONTEXTS FOR EVALUATING PREHISTORIC SITES ON FORT IRWIN LANDS

Historic contexts are theoretical and thematic constructs for purposes of determining NRHP eligibility (see 48 Federal Register, pp. 44717–44720, the *Secretary of the Interior's Standards and Guidelines: Archaeology and Historic Preservation*). A historic context is an organizational format that groups information about related cultural resources based on a theme, geographic limit, and chronological period. The historic mining context for Fort Irwin is a full context that includes not only a summary, but the full background, examples of various site types, and registration requirements. Historic mining sites at Fort Irwin will be evaluated against the criteria in that context.

Numerous smaller historic contexts for the NRHP eligibility evaluation have been developed for prehistoric sites. Many of these are less detailed than the historic mining context and focus on one or more research issues relevant to the local region. Often, they lack some elements of historic contexts because some of that data remains unknown. Below are three such historic contexts relevant to the Mojave Desert and Fort Irwin. They are taken verbatim from Byrd et al. (2005:25–34). All cover a time span of 10,000 years, which is awkward because historic contexts typically refer to a smaller frame of time. However, the authors are correct in that these topics are relevant to sites on Fort Irwin lands, which cover nearly all timeframes. Importantly, the historic contexts below set forth data requirements to aid in the evaluation of sites for the NRHP. Such data requirements are essential to the evaluation process. If a site possesses the data requirements, then it is eligible for the NRHP; if it does not, then it is not eligible for the NRHP. Other historic contexts also merit study and will be developed as new information suggests other avenues that need research.

HISTORIC CONTEXT 1: LAND USE AND THE ORGANIZATION OF TECHNOLOGIES

Theme: Land Use and the Organization of Technologies
Time Frame: 10,000 B.C.—A.D. 1500
Geographic Area: Mojave Desert

As chronological controls and cultural-historical frameworks for the Mojave Desert have been refined, archaeological attention has shifted to more sophisticated methods of examining prehistoric lifeways. One of the most productive of these approaches is the technological analysis of artifact assemblages as they relate to hunter-gatherer settlement-subsistence strategies. Highly mobile adaptations tend, for instance, to be characterized by functionally specialized tool kits that are easily maintained and highly portable (Binford 1979; Bleed 1986). Thus, if milling equipment comprises a regular component of the technology, it will probably be of a fairly formalized nature and either portable or routinely cached at regularly re-occupied sites in anticipation of future use. By the same token, artifacts employed on a daily basis tend to be extremely durable and extensively curated items that were carried along and used for extended periods before they needed to be replaced. Just the opposite is true in more residentially tethered systems, where tools were of a more expedient and less efficient nature, given a more reliable and predictable source of replacement and fewer constraints on the time available to perform specific tasks. Although artifacts meeting either of these descriptions may be produced for a multitude of reasons under different adaptive circumstances, their consistent association within assemblages has shown to be a reliable indicator of broader settlement and subsistence strategies.

While most artifact classes will conform to these patterns, perhaps the most useful and certainly the most extensively studied are flaked stone implements and their residues, which are abundant, commonly analyzed, and described in similar ways by various Mojave Desert researchers. It is hardly surprising, therefore, that a number of evidently widespread technological trends have been identified in regional flaked stone technologies, and interpreted by some as evidence for changes in settlement-subsistence adaptation through time.

Reconstructions of early Holocene hunter-gatherer organization in the Mojave Desert and Great Basin typically emphasize high mobility across a large region during an annual cycle, high assemblage redundancy, and widespread use of curated tools (e.g., Delacorte 1999). At Fort Irwin, Basgall and Hall (1992, 1994a) have argued that Lake Mojave period hunter-gatherer flaked stone procurement and technology were effectively imbedded in a highly mobile foraging adaptation that moved consumers to the resources, with foragers frequently shifting camp after they had exhausted resources within a daily foraging range. This settlement system, which appears to have continued at least in part into the subsequent Pinto period, entailed mobile tools kits with multi-purpose tools (such as large, heavy-duty flake-core tools), the use of durable raw material for points (such as fine-grained igneous toolstone), and reliance on portable cores to provide flakes and expedient tools (in the form of large pressure-flaked bifaces). At Fort Irwin, the structure of this system was well-developed, entailed repeated annual returns to favored localities (creating large archaeological sites), and required time to plan so that re-provisioning of flaked stone material at key quarries was well-embedded within a wide-ranging annual round (Basgall and Hall 1992, 1994c). It is also interesting to note that use of Coso obsidian appears to have peaked during the early Holocene, in contrast to the peak of production at the quarry itself, and to usage peaks in neighboring regions, which occurred later in time (Gilreath and Hildebrandt 1997:164-166).

In much of California, particularly the more westerly portions, the Gypsum period was characterized by a collector-based settlement system, where residential sites were occupied for longer periods each year (thereby reducing overall mobility). At the same time, this settlement structure created more numerous, varied, and often specialized site types, as resources were more often brought to the consumer. This type of settlement system also facilitated more specialized tool kits, different flaked stone procurement and reduction strategies, and the greater use of ground stone to process plant foods. This increase in settlement permanence also appears to be tied to important social changes related to gender, prestige, and intra-group dynamics (Hildebrandt and McGuire 2002).

For the period between 3500 and 1000 B.P. (primarily within the Gypsum period), a reliance on often large, standardized bifaces has been well-documented in portions of the Mojave Desert and Great Basin (Gilreath and Hildebrandt 1997; Hall 1983; Singer and Ericson 1977). Use of quarries before and after this interval appears to have been negligible by comparison and directed, as often as not, toward the manufacture of other kinds of tools with associated telltale debris (Gilreath and Hildebrandt 1997). In the northern Mojave and adjacent regions, where the use of geochemically identifiable obsidian allows us to track the movement of raw materials leaving the quarries, it has been shown that these bifaces were often transported hundreds of kilometers from their point of manufacture. There is some question as to whether this was the result of long-range logistical mobility related to the hunting of large mammals (Hildebrandt and McGuire 2002; McGuire 2002), or a series of sequential residential moves covering great distances (Basgall 1989; Delacorte 1997; Delacorte and McGuire 1993). During this same period at Fort Irwin, the reliance on fine grained igneous materials declined significantly from earlier periods, and the use of cryptocrystalline raw material increased (Basgall and Hall 1992, McGuire and Hall 1988).
A different technological pattern characterizes post-1500/1000 B.P. adaptations across much of this region, as populations in some areas appear to have operated on a much smaller land-use scale, and in some locales, such as along the Colorado River, multi-season residential sites were established. Family-band foraging strategies with periodic or annual aggregations appear to dominate many regional sequences.

Associated site types include small and large residential bases, milling stations, and isolated features such as hearths and pinyon-cache rock rings. Though still important, bifaces play a less significant role and prepared cores disappear, being replaced instead by numerous expedient flake tools (e.g., Basgall and Hall 1992; Flenniken and Spencer 2001). These are typically made on non-patterned flakes of local raw materials, with less selectivity with respect to type/quality of material or the size and shape of the flakes used. As might be expected, most of the flaking used to shape and resharpen tools during this time was restricted to pressure retouch, with percussion work of the type used to shape and thin bifaces now limited

to the removal of flakes from non-patterned cores. Dart points were replaced by arrow points, facilitating the shift to the use of flake blanks for point production (Yohe 1998, 2003). The ability to use smaller blanks, typically flakes, also allowed for a wider range of local raw materials to be exploited for projectile point manufacture, changing the dynamics of resource acquisition.

Data Requirements

Overall, a series of important shifts in the dynamics between settlement organization, annual territory size, site types, and technology characterize the trans-Holocene record of the Mojave Desert. The ability to track the interplay between technology, the organization of production, and land-use patterns in the past provides a potentially powerful line of investigation with wider application for prehistorians. For example, the acquisition of flaked stone raw material, the dominant artifact of the region, has the potential to provide important insight into these issues. This requires differences in flaked stone reduction trajectories to be distinguished operationally and then linked in meaningful ways to broader questions of mobility, embededdness, and function within regional systems.

In order for individual sites to contribute substantively to this topic, they need to meet certain criteria. First, they must be dated by one of the methods outline in the chronology section. Second, they must provide data on diachronic trends in technology, including the quarrying or reduction of distinctive raw material, and the use of a reduction technology characteristic of a particular time period or function. Sites that cannot be dated, that represent extraction of a ubiquitous raw material source, or that result from nondiagnostic reduction technology will not be able to contribute substantively to these research issues.

HISTORIC CONTEXT 2: SUBSISTENCE INTENSIFICATION

Theme: Subsistence Intensification
Time Frame: 10,000 B.C.—A. D. 1500
Geographic Region: Mojave Desert

A great deal of effort has focused on the study of subsistence intensification throughout California and the Great Basin. Analysis of floral remains from central California reveals an expansion of diet breadth throughout the Holocene, showing a progressive shift from an emphasis on bulbs and acorns early on, to the addition of small seeds later in time (Wohlgemuth 2004). Plant studies from the Great Basin are less comprehensive, but it appears that small seeds and pinyon nuts gained importance over time, and this shift is thought by many to have facilitated the expansion of Numic populations throughout the region (e.g., Bettinger and Baumhoff 1982).

Changes in archaeological faunal remains are much more difficult to interpret, as they do not follow unilinear trends. It has been traditionally assumed that there has been a progressive shift from an emphasis on large to small game through the Holocene, beginning with Clovis and Lake Mojave big-game hunters and ending with a Numic focus on the use of rabbits, rodents, and reptiles. Archaeological data from throughout the West has shown that this is not the case, as early and middle Holocene archaeofaunal assemblages are dominated by small game, later (ca. 4000-1000 B.P.) assemblages by large game, and still later (after 1000 B.P.) ones by a return to small game (Hildebrandt and McGuire 2002:Table 1). Alternative explanations have been offered to account for these trends—some environmentally derived (Broughton and Bayham 2003) and others based on gender-differentiated fitness and work organization (Hildebrandt and McGuire 2003)—and the subject remains a focus of research in the Desert West.

Subsistence data specific to the Mojave Desert are less robust, particularly with regard to plant macrofossils. Even so, the late-period intensification of small seed use can be seen in settlement-pattern data, as sites with milling gear tend to post-date 1000 B.P., and people seem to have colonized areas containing seed resources that were rarely used for this purpose before (Gilreath and Hildebrandt 1997; Hall 1993; McGuire and Hall 1988). Faunal remains are better represented and largely follow the interregional trends outlined above. When artiodactyls and undifferentiated large mammals are compared with small mammals, tortoises, and reptiles, the former represent 13.5% of the early/middle Holocene (pre-Gypsum period) sample, increase to 19.0% during the Gypsum period, continue to increase in the Saratoga Springs period (36.5%), but drop significantly thereafter (1.4%). The late-period focus on small game is reflected by high frequencies of desert tortoise (69.6%), followed by rabbits and rodents. The archaeological, ethnographic, and biogeographical significance of desert tortoise (*Gopherus agassizii*) has been summarized by Schneider and Everson (1989); they appear to be a hallmark of late prehistoric animal exploitation throughout their range in the Mojave Desert.

Data Requirements

For a site to contribute substantively to this topic, it must first be dateable, and second must retain direct or indirect evidence of subsistence activities. Direct evidence, in the form of floral and faunal refuse, is typically preserved only at sites with intact subsurface midden deposits. Some sites without midden deposits may contain indirect evidence of subsistence activities, most often in the form of milling gear (e.g., millingstones, handstones, and bedrock milling features). Simple flaked stone scatters, the most ubiquitous site type previously encountered in this area (Byrd 1998; Mikkelsen and Hall 1990; Smith 2004), typically are unable to contribute significant insight into this topic, since these sites were created primarily by lithic reduction and maintenance activities.

HISTORIC CONTEXT 3: DEFINING REGIONAL INTERACTION SPHERES

Theme: Defining Regional Interaction Spheres
Time Frame: 10,000 B.C.—A.D. 1700
Geographic Region: Mojave Desert

Hunter-gatherers, particularly those in arid regions such as the Mojave Desert, participated in regional spheres of social interaction larger than the territory of a single group's annual cycle. These interaction spheres provided hunter-gatherers with a larger biological group in which to operate, facilitated alliance building and the creation of reciprocal obligations, and increased the likelihood that social groups could carry on during difficult social or economic times. The nature, scale, and spatial orientation of these supra-territorial interactions were not static, were typically unstable, and may have varied greatly over time. Important manifestations of these phenomena include travel corridors, trade and exchange networks, and ritual/spiritual activities.

Ethnographic and ethnohistoric accounts reveal that a wide range of goods were traded throughout southern California, with Native Americans as distant as the California coast and the Hohokam heartland of the Salt and Verde river basins in south-central Arizona participating in such commerce (e.g., Davis 1961; Forde 1931; Rogers 1966). Trade ran both east-west and north-south along a series of established routes (e.g., Coues 1900; Davis 1961; Doyel 1991:Figure 10.2; Forbes 1965). For example, the Mojave Trail was a prominent east-west travel route, and its western segment extended from the Needles/Fort Mojave area westward across the Providence Mountains, up the Mojave River and ultimately via El Cajon Pass into the present-day Los Angeles basin. The types of goods that were traded included non-perishable items such as Pacific coast shell and Gulf of California coral, and perishable items such as furs,

acorns, and tobacco. It should also be noted that the containers (both ceramic vessels and baskets) that held these goods may also have been exchanged.

Tangible archaeological evidence that similar activities took place in the past includes the presence of extra-local, non-perishable goods as well as alterations of the landscape resulting from repeated travel along the same route. Recently, Fitzgerald et al. (2005) have demonstrated that Pacific coast shell beads were traded great distances during the early Holocene, including into the Mojave Desert. Evidence for the full range of goods that were traded, however, may be preserved only at the termination point, due to the nature of down the-line trading, or if direct acquisition took place. For example, turquoise from the Halloran Springs area east of the study area and beyond the Silurian Valley is considered by some scholars to have been acquired directly by Anasazi groups who must have crossed extensive arid lands to do so (Leonard and Drover 1980).

Similarly, middle-men in down-the-line trading of obsidian may not have retained large quantities of the material. Archaeological evidence, however, has revealed that wide-ranging obsidian trade networks characterized the region (e.g., Jackson and Ericson 1994), often structured by the nature of social boundaries (Ericson 1982).

Based on prior work, the current study area may well be situated near the intersection of a series of regional interaction networks. For example, a significant percentage of obsidian acquired by prehistoric groups exploiting the Salt Spring area at the north end of the Silurian Valley is from southern Nevada sources, revealing the influence of a strong regional interaction sphere oriented to the northeast (Byrd 1998:782-783). In contrast, prehistoric populations in the Fort Irwin area almost exclusively acquired Coso obsidian, revealing a prominent trade and exchange network oriented to the northwest (Basgall and Hall 1994c; Gilreath and Hildebrandt 1997). Finally, obsidian from the Bagdad and Obsidian Butte sources dominates prehistoric sites farther upstream along the Mojave River (southwest of the study area), suggesting the presence of a third interaction sphere oriented to the southeast (York 1989).

Travel corridors represent the conduits by which Native Americans interacted within the Mojave Desert and beyond. Ethnographic and ethnohistoric accounts, particularly from areas along the Colorado River Basin on the eastern edge of the California deserts, clearly demonstrate the fundamental role travel corridors played in facilitating regional interaction, trade, ritual activity, and warfare (e.g., Cleland and Apple 2003; Forbes 1965; Kroeber 1925). Thus, the reconstruction of travel corridors provides an important opportunity to gain insight into a series of overlapping aspects of Native American social interaction. Trail systems were the focal point of regional prehistoric travel, and key trails ran up and down the major valleys and through major mountain passes. Within and near the study area, the Silurian Valley is a logical major north-south travel corridor, while Red Pass and the pass near Iron Mountain may have been noteworthy eastwest travel corridors, particularly since passage through the main portion of the Avawatz Mountains to the north is much more difficult.

In the Colorado River Basin, some trails led to sacred localities where ceremonial activities were performed. Structural features associated with these ceremonial events included trails, geoglyphs (intaglios), shrines, spirit breaks and deflectors, offerings, rock art, and cleared circles (Altschul and Ezzo 1994; Cleland and Apple 2003; Ezzo 1994; Johnson 1985, 2003). Much of this Yuman ritual behavior revolved around *Avikwaame* (Spirit Mountain), the place of creation (Baksh 1995; Forbes 1965; Kroeber 1925). Yuman groups traditionally participated in ritual treks back to the place of creation both physically and metaphorically, the latter in a dream state. Notably, the *Xam Kwatcan* trail led along the west side of Colorado River from Pilot Knob (also called *Avikwalal*) near Yuma to Spirit Mountain (Johnson 2003:161- 164). During these travels, ceremonial activities were conducted and a wide range of structural features were created on the landscape. The most notable and widely discussed activity was the *Keruk* mourning ceremony that often took place at well-known ritual centers along the *Xam Kwatcan* trail

(Forde 1931; Halpern 1997; Johnson 2003). *Keruk* mourning ceremonies also served as important integrative events in Yuman society, and many other key social activities were carried out at these gatherings.

Although this complex set of ceremonial features appears to be distinctive to Patayan/Yuman groups along the Colorado River Basin, the possibility exists that ceremonial and ritual activities associated with prehistoric Mojave Desert groups left tangible traces on the landscape. Indeed, trails in the southern California desert are often associated with a variety of features including cleared circles, rock features (such as enclosed areas, alignments and stacked features), rock art, and pot drops (e.g., Rogers 1966). Many of these features have been documented in the general Avawatz region during prior archaeological survey (e.g., Byrd 1998). Spatial patterning in the distributions of these features provides an opportunity to gain insight into regional variation in the range of activities associated with particular travel corridors.

For the Mojave Desert, petroglyphs and pictographs, referred to here under the general rubric of rock art, is an important category of ritual expression that preserves archaeologically. From a cross-cultural perspective, rock art is known to have functioned in several ways: 1) as illustrative art, intended to inform or remind, perhaps teach a lesson or commemorate a noteworthy event; 2) as a product of magico-religious practices seeking supernatural influence or control over events; 3) as territory or boundary markers; and 4) as a chronology system, marking celestial events such as equinoxes, solstices, and eclipses. In the Great Basin and Mojave Desert, the two prominent interpretive frameworks put forward to understand the role that rock art played within prehistoric social systems are the neuropsychological model (Lewis-Williams 1986; Lewis-Williams and Dowson 1988; Whitley 1992, 1996) and the hunting practices model (Heizer and Baumhoff 1962; Grant et al. 1968). Rock art has been previously documented near the project area, most notably at site SBR-8693 southeast of Red Pass Lake (Byrd 1998:615), and the potential exists for additional sites to be found within the study area.

Data Requirements

The investigation of regional interaction networks within the study area entails several facets. Sites with extra-local goods (such as obsidian, turquoise, shell beads, trade-ware pottery) can significantly contribute to this topic, as they provide direct insight into the types of goods that were traded and exchanged by local groups. Sites with trails and associated features can also contribute substantively to this topic, since they provide insight into whether the two mountain passes within the study area were important travel corridors in the past. In addition, sites with ceremonial/ritual features (such as rock art or intaglios) can provide the opportunity to gain additional insight into ideology and interaction patterns within the central Mojave. Sites that lack extra-local goods, trails, and ceremonial/ritual features will not be able to contribute substantially to this research topic. At the regional scale, patterns in the spatial distribution of major rock art sites, and their correlation with trails and travel corridors, provide an important “macro-level” venue for investigating regional interaction spheres.

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APPENDIX F

HISTORIC CONTEXT FOR EVALUATING HISTORIC MINING SITES

HISTORIC CONTEXT:
HISTORICAL MINING,
FORT IRWIN AND THE NATIONAL TRAINING CENTER,
SAN BERNARDINO COUNTY, CALIFORNIA,
1870s–1930s

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CHAPTER 1
INTRODUCTION

INTRODUCTION

Fort Irwin experienced a lengthy and colorful mining history that spanned from 1870 through the 1930s. In the first years, the Avawatz Mountains attracted prospectors who made some of the earliest mineral discoveries in the region. During the following decade, wealth-seekers found gold near springs to the north, south, and west. By the 1890s, prospectors identified four general areas known for ore, but the remote locations and lack of water confounded efforts for organized development. In the first decade of the twentieth century, one of these areas, Cave Spring in the Avawatz Mountains, hosted an intense rush that created a sensation in the press. Ten years later, Goldstone, another of the areas, also became the scene of notable excitement. Despite decades of prospecting and minor development, few rich and extensive mineral deposits were found on Fort Irwin, and thus the mining industry remained the domain mostly of individual miners and small partnerships that were able to profit from the limited ore formations.

Currently, a legacy of historic sites represents Fort Irwin's mining industry. After abandonment, many of the prospects, mines, and mills fell to the pressures of materials-scavenging, closure projects, and especially natural decay. This left a number of sites in various states of preservation, mostly archaeological in nature.

RESEARCH METHODOLOGY

The research methodology followed two tracks. One was to chart the history of Fort Irwin's mining industry, which was important for identifying time, place, trends, and events. The other was to identify the types of mining-related sites common to the region.

Most of the information for Fort Irwin's mining history was condensed from secondary sources. Between 1981 and present, researchers completed a number of cultural resources projects on and around Fort Irwin and covered aspects of the mining industry in their reports. Two authors in particular, Larry M. Vredenburgh and Ronald Quinn, provided detailed accounts in several publications. In total, Vredenburgh's and Quinn's work combined with the other cultural resources reports provided enough information to meet the needs of the context. Regardless, additional references were consulted, including a few primary sources on San Bernardino's mineral production (Clark 1970; Wright et al. 1953).

The context structure, discussions of significance evaluations, and descriptions of property types and site types came from the author's experience in three arenas. First, the author has produced or contributed to six mining-specific contexts and written two books on mining technology. Second, over the course of eight years, the author has identified, recorded, and evaluated hundreds of mining-related resources. Last, between 1983 and 1997, the author informally examined sites in all the principal mining districts around Death Valley. Collectively, the above experience provided enough information to define Fort Irwin's common types of mining-related sites and guidelines for their significance evaluation.

CONTEXT FOR EVALUATING MINING RESOURCES ON FORT IRWIN

Geo-Marine, Inc., subcontractor, Mountain States Historical, developed this context to guide researchers in recording, interpreting, and evaluating the significance of Fort Irwin's mining-related sites. The types of sites discussed in the context are those directly attributable to mining. Fort Irwin was host to a number of industries and land use patterns that were certainly byproducts of mining but not directly related to mineral exploration and ore extraction. Sites in this category associated with transportation (as well as Fort Irwin historic-era windmill remains, road features, and homestead sites), for example, are not discussed in the context because their association with mining is too indirect.

The context is intended to fulfill current and future needs of projects that involve mining-related sites. The following are the goals of the context:

- To help researchers identify and understand the types of mining-related resources common to Fort Irwin
- To provide background information for evaluating sites in terms of the National Register of Historic Places (NRHP)
- To define specific criteria under which sites can be evaluated for significance
- To establish baselines of integrity that sites must meet for eligibility
- To help researchers interpret mining-related sites for development as heritage resources
- To consolidate previous cultural resources documents into a fluent history of mining
- To provide guidance in recording sites

The context has been divided into seven chapters in an attempt to fulfill the above goals. Chapter 2 covers the geography of Fort Irwin's mining areas and relevant details of the natural environment.

Chapter 3 chronicles the mining industry, which has been divided among four principal areas. The industry was so divided for several reasons. First, while mining certainly occurred across much of Fort Irwin's eastern half, the industry was far from uniform in time, place, and localized events. Each area had its own timeframes, trends, organizations, and places of importance. The key timeframes, known as Periods of Significance, were often isolated to specific areas. In many cases, the Periods of Significance for one area had little to do with those in another area.
Chapter 4 outlines information important for evaluating sites in terms of the National Register of Historic Places. The chapter summarizes the criteria defined by the NRHP then explains how the concept of integrity applies to mining-related sites. Last, the chapter itemizes each NRHP criterion and relates how to apply each to mining-related sites.

Chapter 5 delineates in detail the specific types of mining-related sites that can be expected on Fort Irwin. To enhance an understanding of the site types, the chapter explains the processes, methods, and technologies employed for prospecting, mining, and milling. The chapter also defines common architectural, engineering, and archaeological features. Last, the chapter relates the NRHP criteria to each site type.

Chapters 6 and 7 provide suggestions for recording sites and artifacts. Chapter 6 discusses a methodology for defining sites and documenting features. Chapter 7 offers a similar treatment for artifacts.

CHAPTER 2
NATURAL SETTING

Fort Irwin is in the central Mojave Desert, one of North America's largest deserts. The Mojave encompasses southern Nevada as well as portions of southern California and northwestern Arizona. It has been argued that the Mojave is not a discrete biotic or geographic province but a transitional vegetation zone between the Great Basin Desert to the north and the Sonoran Desert to the south (MacMahon 1997:47). Others have argued that the Mojave Desert constitutes a separate vegetational and geologic region despite the fact that it acts as a transitional zone between adjacent deserts.

Characteristics that are common to both the Mojave and the Great Basin deserts include basin and range topography and certain plant types. Topographically, the two are different only in relative elevations. Valley floors at least 4,000 feet above sea level are typical of the Great Basin, but the Mojave's valley floors average about 2,000 feet above sea level. The topography of the Mojave, like that of the Great Basin, is typified by internally drained basins and playas separated by north/south-trending mountain ranges. Although the vegetation of the southern Mojave can be similar that of the northern Sonora, this portion of the desert continues to share some characteristics of the Great Basin, among them the presence of internally draining rivers (MacMahon 1997:47). The Mojave shares similarities with the Sonoran and Chihuahuan deserts to the south as well, mainly in the presence of creosote bush (*Larrea tridentate*) as a dominant vegetation community. Creosote generally does not grow above the 4,000-foot elevation contour that divides the botanical Great Basin from the Mojave (Grayson 1993:22).

CLIMATE

The climate of the Mojave is that of a semi-arid or arid desert. Temperatures tend to be warmer year-round than those of the Great Basin. Summer temperatures can reach 120° Fahrenheit during the height of the season, but winter temperatures rarely fall below freezing. Death Valley, in the northern Mojave, holds the record for the highest temperature in the United States at 134° Fahrenheit (MacMahon 1997:48). Because freezing temperatures are rare, the Mojave is thought to be an ideal location for agriculture. However, the lack of water has deterred most farmers and ranchers.

Annual precipitation is slight, averaging about 4.2 inches. Most rainfall occurs in the winter, but strong thunderstorms provide some additional precipitation during the summer. Major water sources include the Amargosa, Owens, and Mojave rivers. The Mojave and Amargosa rivers are considered upside-down rivers, flowing underground until forced above by bedrock. Lakebeds, dry since the end of the Pleistocene, are present on the valley floors. Rainfall may temporally create mud flats in these beds, though they tend to be saline and quickly lose all moisture.

FLORA

The vegetation of the Mojave Desert is composed mainly of low shrubs (MacMahon 1997:48). The Mojave Desert shrub associations do not separate into distinctive, rigidly bound communities

but intermix according to a variety of habitat preferences (Rhode 2002:4). Several species of yucca and some low cacti are also present, as well as short grasses. The Mojave is dominated by shrubs such as creosote and white bursage, which are most common below about 4,000 feet elevation. Other common shrubs include ephedra, brittlebush, and white burrobrush. On bajadas, fans, and pediments, creosote dominates, while desert thorn, spiny hopsage, and shadscale are subdominant species. Big sagebrush, which is found in abundance in the Great Basin, occurs in areas of the Mojave that receive over 7 inches of rainfall annually (MacMahon 1997:49). Common cacti include beavertail, diamond cholla, and barrel cactus. Yucca species include blue yucca, Mojave yucca, and Joshua tree. Tree species are rare within the Mojave and tend to grow along springs, rivers, and other permanent water sources. Among these species are Fremont cottonwood, two varieties of mesquite, and two kinds of willow. A list of plant species is summarized in Table 1.

FAUNA

The Mojave Desert is home to a wide variety of faunal species. Because of the region's heat and aridity, most vertebrates are small and nocturnal. The majority of mammal species are rodents—hares, rabbits, rats, mice, and ground squirrels are most common. Larger mammal species such as bighorn sheep, mountain lion, and mule deer are found near water sources and at higher elevations. Reptiles are abundant and are found in a variety of Mojave habitats. Rocky areas tend to attract gila monsters, longnose leopard lizards, collared lizards, and chuckwallas, while sandy areas are home to zebratail lizards and western whiptails (MacMahon 1997:55). The desert tortoise, an endangered species, is also found in the Mojave. Small birds are numerous, particularly in the lower elevations where cacti provide nesting environments. Raptors commonly found in the Mojave include the golden eagle, turkey vulture, red-tailed hawk, Cooper's hawk, and American kestrel (MacMahon 1997:61). Table 2 provides a summary of common fauna in the Mojave.

PALEOENVIRONMENT

Although past environmental factors have been traced as far back as 40,000 years, archaeological investigators are particularly interested in the periods starting with the late Pleistocene. By 14,000 years before present (B.P.), temperatures in the Mojave were gradually warming and Ice Age glaciers began to melt. During this period of glacial retreat, the primary plant species along

Table 1
Common Flora of the Mojave Desert

Common Name	Scientific Name
Shrubs and Trees	
Creosote bush	*Larrea tridentate*
Desert holly	*Atriplex hymenelytra*
Hopsage	*Atriplex spinosa*
Parry saltbush	*Atriplex parryi*
Shadscale	*Atriplex confertifolia*

Mojave sage	*Salvia mohavensis*
Blackbrush	*Coleogyne ramoisissima*
Big sagebrush	*Artemisia tridentate*
White bursage	*Ambrosia dumosa*
Brittlebush	*Encelia farinose*
Spiny menodora	*Menedora spinescens*
Ratany	*Krameria parvifolia*
Goldenhead	*Acamptopappus schockleyi*
Turpentine broom	*Thamnosma montana*
Freckled milkvetch	*Atragalus lentigenosus*
Burrobush	*Hymenoclea salsola*
Catclaw	*Acacia greggii*
Honey mesquite	*Prosopis glandulosa*
Screwbean mesquite	*Prosopis pubescens*
Fremont cottonwood	*Populus fremontii*
Desert willow	*Chilopsis linearis*
Seep willow	*Baccharis glutinosa*

the valley floors were juniper and sagebrush. Along higher elevations and alluvial fans, limber pine, juniper, and steppe shrubs predominated. Fossil pack rat midden and pollen evidence indicate that shallow ponds surrounded by cattails and other marsh vegetation existed on valley floors. Marshy grasslands supporting ash and willow trees were also present (Grayson 1993:123). By the early Holocene (ca. 10,000 B.P.), these ponds and marshlands had diminished substantially.

Large animal species were abundant in the region during the Late Pleistocene. Megafauna during this time included mammoth (*Mammathus* sp.), camel (*Camelops* sp.), bison (*Bison* sp.), and ground sloth (*Nothreotherium shastense*). These animals were primarily found in the grassy marsh areas and along ponds and lakeshores. Many modern animals seen in the region, such as mule deer, pronghorn antelope, black-tailed jackrabbit, and desert cottontail, were also present. Waterfowl were in the region, particularly in lower elevation wetland areas (Mawby 1967).

Table 2
Common Vertebrate Fauna of the Mojave Desert

Common Name	Scientific Name
Small Mammals	
Black-tailed jackrabbit	*Lepus californicus*
Desert cottontail	*Sylvilagus audubonii*
Mice	*Perognatuhus* sp., *Peromyscus* spp., *Onychomys* sp.
Kangaroo rats	*Dipodomys* spp
Woodrats	*Neotoma* sp.

Round-tailed ground squirrel	*Spermophilus tereticaudus*
White-tailed antelope squirrel	*Ammospermophilus leucurus*
Gray fox	*Urocyon cinereoargenteus*
Kit fox	*Vulpes microtis*
Badger	*Taxidea taxus*
Chipmunks	*Eutamias* spp.
Desert shrew	*Notiosorex crawfordi*
Gophers	*Thomomys* sp.
Porcupine	*Erethizon dorsatum*
Large Mammals	
Bobcat	*Lynx rufus*
Coyote	*Canis latrans*
Mountain lion	*Felis concolor*
Desert bighorn sheep	*Ovis canadensis*
Mule deer	*Odocoileus hemionus*
Pronghorn antelope	*Antilocapra Americana*
Birds	
Black-throated sparrow	*Amphispiza bilineata*
Le Conte's thrasher	*Toxostoma lecontei*
Northern mockingbird	*Mimus polyglottos*
Cactus wren	*Campylorhynchus bruneicapillus*
California quail	*Callipepla californica*
Gambel's quail	*Callipepla gamebelii*
Doves	*Zenaida* sp.
Mourning dove	*Zenaida macroura*
Greater roadrunner	*Geococcyx californianus*
Common raven	*Corvus corax*
Phainopepla	*Phainopepla nitens*
Loggerhead shrike	*Lanius ludovicianus*
Scott's oriole	*Icterus parisorum*
Turkey vulture	*Cathartes aura*
Lesser nighthawk	*Chordeiles acutipennis*
Cooper's hawk	*Accipiter cooperii*
Red-tailed hawk	*Buteo jamaicensis*
Golden eagle	*Aquila chrysaetos*
American kestrel	*Falco sparverius*
Greater horned owl	*Bubu virginianus*
Burrowing owl	*Athene cunicularia*
Common barn owl	*Tyto alba*
Reptiles	
Desert tortoise	*Gopherus agassizi*

Brush lizard	*Urosaurus graciosus*
Chuckwalla	*Sauromalus obesus*
Collared lizard	*Crotaphytus collaris*
Desert horned lizard	*Phrynosoma platryrhinos*
Desert spiny lizard	*Sceloporus magister*
Longnose leopard lizard	*Gambelia wiszlizenii*
Side-blotched lizard	*Uta stansburiana*
Tree lizard	*Urosaurus ornatus*
Western whiptail	*Cnemidophorus tigris*
Zebratail lizard	*Callisaurus draconoides*
Desert iguana	*Dipsosaurus dorsalis*
Gila monster	*Heloderma suspectum*
Western banded gecko	*Coleonyx variegatus*
California king snake	*Lampropeltis getulus californiae*
Great Basin gopher snake	*Pituophis melanoleucus deserticola*
Rattlesnakes	*Crotalus* sp.
Red coachwhip	*Masticophis flagellum*
Western patchnose snake	*Salvadora hexalepis*

By the early Holocene, precipitation had decreased and the region entered a general warming and drying trend. Pleistocene megafauna became extinct, and the modern-day desert environment began to take form (Mehringer 1986). Grasses and cacti in some locations and desert-scrub plant communities in other areas eventually replaced woodlands. By 8,000 B.P., desert vegetation was firmly established in the region, although creosote bush and other characteristic plant taxa did not arrive until 5,500 B.P. or later. As desert vegetation became established in the Mojave, woodland species and other cold-adapted plants shifted upward in both elevation and latitude into the Great Basin desert. The lower limit of the coniferous forest zone shifted upward approximately 200 m during this period (USGS 2004), and piñon pine first colonized the area (Grayson 1993:216–217).

A shift from summer-dominant to winter-dominant precipitation occurred, as evidenced by a shift in the position and composition of vegetation zones in the Mojave and Great Basin deserts (Mehringer 1986). Although overall precipitation decreased during this period, the water table was higher than today, allowing for more seeps and springs. Numerous springs emerged in the region along fault lines where channels had cut through older sediments. Some of these springs may have formed shallow lakes or marshes. Runoff water collected in the valley floors in some areas, resulting in small seasonal streams and ponds.

By the middle of the Holocene, or roughly 7,000 years ago, levels of precipitation were similar to those of the modern Mojave Desert. Creosote bush replaced the sagebrush along valley floors, and mesquite bosques grew in portions of the range where the water table was relatively high. Streams and marshlands in the lower elevations no longer existed, and small springs in the foothills were the only available water. Recent research indicates that the climatic record of the late Holocene was highly varied in many areas of the Great Basin and Mojave deserts (Spaulding 1990) with intermittent periods of extended droughts and increased moisture. Modern

longitudinal studies indicate that Mojave and Great Basin ecosystems may be subject to fairly rapid transitions (Beatley 1974:856–863).

CHAPTER 3
A BRIEF HISTORY OF MINING ON FORT IRWIN

INTRODUCTION

Chapter 3 provides a cursory history of Fort Irwin's mining industry, beginning with the first hardrock (underground) discoveries in 1870 and ending with a final decline in 1942. The purpose is to provide researchers with information necessary to understand and evaluate today's mining-related sites. The discussion of history will help researchers place the sites in time and place, and relate them to important trends and events. These factors will be important when evaluating sites in terms of NRHP Criteria A and C.

While mining occurred throughout much of Fort Irwin's eastern and southern portions, activity was far from uniform in time and location. Rather, prospecting and mining were limited to four general areas separated by substantial distances. The areas include the northern portion of the Avawatz Mountains, Red Pass and Bonanza Mountain, Goldstone, and Soda Lake. Because these areas were autonomous entities with their own events and trends, they are discussed separately.

The historical accounts define Periods of Significance for each area. A Period of Significance is a timeframe during which key events, trends, and contributions occurred. The concept is important when assessing the eligibility of a site. If a site dates to a Period of Significance, then the site may be eligible through an association with the period's important events and trends. If a site falls outside of a Period of Significance, then it was probably not associated with important events and trends because the host mining area no longer had a major impact.

AVAWATZ MOUNTAINS

In 1871, the first recorded mineral discovery on Fort Irwin occurred when an experienced pair of prospectors, Johnny Moss and Samuel Strong, found silver ore in the Avawatz Mountains. At that time, the Mojave Desert was a remote wilderness that most people avoided, but the potential for riches drew handfuls of individuals such as Moss and Strong (Lingenfelter 1986:136).

During the previous several years, other individuals proved that the Mojave offered ore for prospectors daring enough to brave the arid conditions and, at times, hostile natives. Moss understood this first-hand because in 1869 he found a rich copper deposit at Ivanpah, located on the California-Nevada border (Vredenburgh 1994:84). Around the same time, European-American and Mexican prospectors discovered rich silver veins west of Death Valley at Cerro Gordo and Palmetto. These mineral strikes incited small rushes, fostered boomtowns, and drew attention to the Mojave's potential for ore. Some of the prospectors initially drawn by Cerro Gordo and Ivanpah fanned out and explored other areas in hopes of making their own finds. Moss and Strong were apparently among these individuals and chose the Avawatz Mountains, where they experienced a limited degree of success.

Relative to the area's history, Moss and Strong were late-comers in some senses. An overland route informally known as the Old Spanish Trail passed along the east base of the Avawatz Mountains and relied on Resting and Salt springs as important watering stops. Traders and

Mormons traveling between Las Vegas and coastal missions used the trail during the 1840s, and several parties of hasty Forty-niners tried the route at the end of the decade. In 1849, one of these parties even found a rich but shallow gold deposit at Salt Spring, which several companies then tried to mine with limited results. Curiously, none of the travelers on the trail prospected the adjacent Avawatz Mountains, leaving its mineral formations for later wealth-seekers.

When Moss and Strong made their discovery, they claimed it as the San Francisco then organized the Ava Watts Mining District to formalize future claim activities. In later years, the district name was corrupted into Avawatz. Almost at once, Moss developed the ore vein and renamed it the Summit Mine, which was renamed yet again as the Avawatz Crown around 1906. Although the Summit certainly offered rich ore, it was not destined to become a bonanza operation because of its geographic location. The mine was high in the mountains far from water, and the rugged topography made the property extremely difficult to access. Further, the mountains were far from the nearest commercial center where the ore could be shipped and supplies obtained. As a result of these conditions, Moss was limited to extracting only the richest ore (Lingenfelter 1986:136; Shumway et al. 1980:42; Vredenburgh 1994:84).

Moss and Strong were the first to explore the Avawatz Mountains, but they were not alone for long. Probably during the same year, several other parties of prospectors arrived and examined the area surrounding the Summit Mine. They discovered a few additional ore veins and brought the formations into production. Faced with the same problems as Moss, the additional prospectors produced small volumes of ore but gave up within several years when they exhausted the richest ore. Moss worked his Summit through 1873 then quit for the same reasons. Stigmatized by the hostile conditions, the Avawatz Mountains saw little more activity for several decades (Earle 2004:126; Shumway et al. 1980:42).

The end of activity brought the first Period of Significance to a close. The first period began in 1871 when Moss and Strong made their silver discovery, and it ended when Moss and other prospectors left by 1874. Several important events and trends define the first period. During this time, the first mineral discoveries and an initial wave of prospecting took place in the Avawatz Mountains. The original prospectors laid the groundwork for later mining by proving the existence of ore, exploring the mountain range, noting important geographical features such as springs, and making their findings known.

The Avawatz Mountains were relatively quiet for approximately 30 years, although they were not completely abandoned. In 1881, William Coleman established the Harmony Borax Works in Death Valley and employed the famed 20 mule team wagons to haul his products to the Southern Pacific Railroad at Dagget. Initially, Coleman's route ascended south from Death Valley, passed Denning Spring, crossed over Avawatz Pass, and descended through Cave Spring. The first wagons crossed over the pass in 1883, and traffic continued as late as 1887, when another route was selected (Lingenfelter 1986:180–182; Quinn 1981:17; Rapp et al. 1982:6; Vredenburgh 1994:85).

Denning Spring was named after Frank Denning, who was an experienced local prospector. During the first years when the borax wagons passed the spring, he and Joe Cook poked around the area in search of ore. In 1884, they found a gold vein that was tantalizing but not particularly rich, and they explored it at depth. The vein seemed to hold value, so the partners built an arrastra (a mill for pulverizing ores; for a description of an arrastra, see Chapter 5) and tried

processing the ore. The material was apparently too resilient for the arrastra's simple amalgamation, and Denning and Cook realized only $50 for their efforts (Vredenburgh 1994:85).

Tom and William McFarlane, and Gus Yager had a similar experience near Quail Spring, northwest of Denning Spring. In 1895, the trio found a gold vein that held the potential for profitability and developed the formation. When they searched the surrounding area, the party realized that more veins might be found, and their reports drew a few interested prospectors. To lend legitimacy to the area, the original trio organized the Lone Star Mining District, which encompassed the spring. The district was soon forgotten, however, because close examination found no more ore veins and the area was abandoned (Vredenburgh 1994:85).

The year 1904 brought the next mineral discoveries of significance in the Avawatz Mountains. At that time, the entire area around Death Valley was swept up in a mining excitement, which fostered an optimistic climate for prospecting. With burros and, in some cases, automobiles, prospectors penetrated likely mountain ranges in search of ore, including the Avawatz Mountains.

One group exploring an area several miles southwest of Cave Spring found a rich gold vein and staked the Crackerjack, Crackerjack No. 2, and other claims over the formation. They did little with the find at the time but returned the following year and repeated the process with several other veins. Although the discoveries were not spectacular, they were enough to rouse the interest of other prospectors (Vredenburgh 1994:85).

By 1906, several important factors came together to make the gold discoveries a seed for a significant rush. First, a number of important mining excitements around Death Valley charged the atmosphere more than ever. To the north, Tonopah and Goldfield showed signs of becoming metropolises. East of Death Valley, Bullfrog, Rhyolite, Beatty, and surrounding camps boomed. To the west, Ballarat was center to a sound mining industry, and at the valley's south end, Greenwater was in a frenzy. This latter camp was important because it lay a short distance north of the Avawatz Mountains and drew attention to the general region.

The second important factor was that the Avawatz Mountains received rail service. In 1888, William Coleman sold his small Death Valley borax empire to Francis M. Smith, who operated several evaporite plants in Nevada. Smith realized that shipping the borax by wagon was slow and costly, and he considered the possibility of a railroad. The economics of his Death Valley borax operation alone, however, would not justify the expense. When mining blossomed around the valley during the early 1900s, Smith realized that enough demand finally existed and planned a north-south route from Ludlow to Goldfield. In 1904, he formalized the project as the Tonopah & Tidewater Railroad and began construction. Within two years, workers completed a track from Ludlow through Baker to the town of Silver Lake, at the east base of the Avawatz Mountains (Myrick 1963:546).

The Tonopah & Tidewater had significant implications for the Avawatz Mountains, as it did for many mineralized areas along the route. Because of a direct link with the Southern Pacific Railroad at Ludlow, the Tonopah & Tidewater could deliver any manner of supplies, machinery, and people to the base of the Avawatz range. This lowered the cost of goods, improved accessibility, and increased the likelihood that investors would visit promising mines.

In the buoyant climate of 1906, prospectors finally responded to the gold discoveries south of Cave Spring. They came in small numbers at first and organized the Crackerjack Mining District, which drew in 36 square miles on the west slope of the Avawatz Mountains. The purpose of the district was to define rules and laws governing claim sizes, development, and records-keeping. The discovery of a few more gold veins and the reports that followed stimulated a rush that brought speculators and promoters from the surrounding region (Lingenfelter 1986:331; Vredenburgh 1981a:27, 1994:85).

Within a short time, the prospectors' camp near the original discoveries evolved into the tent town of Crackerjack. Like many rushes around Death Valley, the Crackerjack event drew many more prospectors than there were ore veins, but individuals kept coming. Quick to profit from the excitement, promoters formally platted the townsite of Crackerjack on the Crackerjack No. 2 claim and solicited entrepreneurs to establish businesses. Almost immediately, a settlement core took form and featured several saloons, a hotel, and a primitive mercantile. Herbert Stanton began printing the Crackerjack *News*, which was mostly a promotional newspaper, and Silver Lake businessman O. J. Fisk provided stage service with his automobile (Lingenfelter 1986:331; Quinn 1981:19; Shumway et al. 1980:45; Vredenburgh 1994:85).

By 1907, the Crackerjack rush spread throughout much of the Avawatz Mountains. Promoters attempted to mimic the success of the Crackerjack townsite and organized their own small camps. C. H. Southworth established Copper City near a discovery of copper ore in hopes of fomenting an excitement comparable to Greenwater, which possessed similar mineralization. Copper City, near Crackerjack, had a boardinghouse, a saloon, a store, and a population of around 100 (Rapp et al. 1982:10; Vredenburgh 1994:87).

Because water was a fundamental necessity for population centers, promoters naturally focused on the springs nearest to Crackerjack. Opportunists platted the competing townsites of Arrastra, Avawatz, Cave Springs, and Denning Spring at water sources of like names. Even though these settlements probably attracted a few individuals, they never progressed beyond the paper stage (Lingenfelter 1986:331).

Arrastra in particular was unusual because the spring featured several arrastras and adobe buildings abandoned long ago. Initially, people speculated that early Spanish miners left the arrastras on the grounds and that the Spanish introduced this simple ore crushing apparatus to North America. Historians, however, currently offer two explanations. Vredenburgh (1994:86) suggests that high-graders (buyers of illicit, stolen gold ore) used Arrastra Spring as a base of operations because of its remote and hidden location. At the spring, they built the arrastras to process the stolen ore and lived in the adobe buildings. Death Valley historian Lingenfelter (1986:331) offers the most plausible explanation. He suggests that some of the prospectors who mined during the early 1870s interest built the arrastras to process their ore.

During the Crackerjack rush, most of the camps grew on the west side of the mountains where prospecting was heaviest. However, a few camps developed on the east side of the range. In particular, William D. Allen and Tracy C. Becker purchased a group of claims near Sheep Spring in 1908 and established Harper's South Camp. Allen and Becker invested in extensive claim development and erected a boardinghouse, assay shop, and stable for the operation. Although the camp was primarily a company operation, it became the nucleus for a small settlement of unassociated prospectors who wanted the convenience of the spring (Vredenburgh 1994:84).

Several more nascent camps were established north of Crackerjack in 1907. As can be inferred from above, one of the camps grew at Denning Spring, and it was no more than a collection of prospectors' tents. The gold vein initially worked by Denning and Cook was probably the seed of interest, and when prospectors scoured the surrounding area, they found several additional ore formations. Quail Spring hosted another of the northern camps. Milton Armstrong discovered gold ore, which caused a rush that lasted several months. While Armstrong commanded the principal gold vein, prospectors found a few copper and silver ore bodies that justified formal development (Shumway et al. 1980:45; Vredenburgh 1994:85).

In 1907, what became the second-most important town in the mining district arose on the west side of the Avawatz Mountains. In compliance with district laws, which stated that no Chinese shall be tolerated, a vigilance committee forced the only Chinese individual, a cook, out of Crackerjack. The committee faced stiff protests but succeeded. In response, mine owner Louis F. Flormann and several sympathizers decided to leave as well and establish their own settlement that accepted Chinese. Under the Avawatz Mining & Development Company, Flormann platted the townsite of Avawatz City approximately 1 mile to the east of Crackerjack and drew off a significant proportion of Crackerjack's population. Further, Turner Mercantile and the post office moved, and the disenfranchised cook was hired by a local business. Crackerjack withered as a result and contracted around its several mines (Quinn 1981:20; Rapp et al. 1982:9; Shumway et al. 1980:45; Vredenburgh 1994:87).

Predictably, the Crackerjack boom was unable to live up to the unrealistic, heightened expectations fomented by the speculators and promoters. During 1906 and 1907, prospectors found a limited number of gold and copper veins mostly around Crackerjack and Cave Spring. The ridges between Crackerjack and Avawatz City had the greatest density of productive operations, which included the Tungate, Blue Bucket, Crackerjack Tomboy, Crackerjack, and Copper Prince mines. All were small, shallow, and limited in scale. Prospectors, promoters, and legitimate companies attempted to develop mineral formations elsewhere, but most of these never progressed beyond speculative and exploratory stages (Vredenburgh 1994:88).

When it became obvious by 1908 that relatively few paying mines would come of the rush, groups of mining boom participants began leaving in succession. The first to leave were the individuals who profited from the boom atmosphere while contributing little in the way of meaningful goods or services. Among this group were the speculators, promoters, and gamblers. Next, the prospectors followed because more than a year of examination proved that the region had little to offer them. As the demand for goods and services decreased, most of the businesses closed and moved on. This left several handfuls of miners employed at the few productive mines, most of which operated near Avawatz City and Crackerjack. The region still had enough of a population to support several businesses and a post office at Avawatz City, while Crackerjack was reduced to only a few hangers-on. The decline continued through 1909 and was exacerbated by an almost simultaneous failure of the productive mines when they ran out of ore. Officially heralding an end to the Crackerjack boom, the postal service revoked the Avawatz City post office in 1910.

Closure of the post office defines an end to the second Period of Significance in the Avawatz Mountains. The second period began in 1906 when a substantial rush developed in response to

the discovery of several gold veins south of Cave Spring. During the second period, the region experienced a boom-and-bust life cycle compressed into the span of only four years.

In the life cycle's first phase, prospectors extensively explored the region, identified areas with promising mineral formations, and found most of the principal ore veins. In so doing, the prospectors contributed to an understanding of the region's geography and economic geology, and their camps became the foundations for later settlements.

In the life cycle's second phase, promoters and speculators arrived with several motives. One was to buy any potentially profitable ore veins, another was to purchase unproven claims for resale, and last was to organize settlements. Several productive mines came of the efforts, Crackerjack and Avawatz City materialized into formal towns, and several other settlements such as Copper City drew interest.

The second phase also brought the bulk of the rush. Mining boom participants of all levels arrived within a year and included prospectors, miners, businessmen, families, and both honest and predatory opportunists. These individuals constituted a population that was disbursed throughout the Avawatz range. Their demand for goods and services supported businesses, commerce, communication, transportation, and government and regulation.

During the third phase, speculation and promotion gave way to actual mining and claim development. The third phase was not particularly kind to the region because the people who were there for the ore found that the material was in short supply. Prospecting outfits quickly demonstrated that most mineral formations were bereft of ore, rendering their claims worthless. At the same time, a few companies proved ore on their properties and began production, which became the foundation for the region's mining industry.

The fourth phase saw the boom collapse. As prospect after prospect failed, it became obvious that the productive mines would have to serve as the region's economic foundation. However, they were ill-equipped to do so because the productive mines were few in number, small, shallow, and marginal. When it became obvious that the boom was out of proportion with the number of mines, people began leaving the region. Then, when these productive mines failed, the region lost its economic base and most of the population dissipated.

After the Crackerjack rush ended in 1910, the Avawatz Mountains descended into another period of relative quiet. The region was not completely silent, however, because various interests worked a few disbursed mines on an intermittent basis. At Quail Spring, Milton Armstrong and several other parties worked their small mines through 1912. The Atlasta Mining Company reopened the Desert King Mine in 1911, enjoyed limited production for a year, then leased the property to Louis Flormann, Avawatz City organizer. The Desert King, 15 miles west of Crackerjack, was initially developed in 1903 and worked by Ella F. Rose and Amelia Clemens two years later (Rapp et al. 1982:8; Vredenburgh 1994:85).

World War I had a significant impact on the general demand for industrial metals, which was a type of ore that prospectors overlooked during the Crackerjack rush. In particular, arms manufacturers sought manganese, tungsten, and molybdenum because these metals were crucial for making weapons-grade steel alloys. When the value of industrial metals began to soar, a few individuals returned to the Avawatz Mountains in search of the overlooked ore veins.

At Owl's Head Spring, prospectors discovered a sound deposit of manganese, which a company brought into production in 1914. Activity lasted through 1918, when metals prices slumped in response to the declaration of armistice (Shumway et al. 1980:46). Around 1916, Marsene Rose claimed a vein near Denning Spring that featured a suspicious plethora of valuable metals including gold, silver, lead, vanadium, tungsten, and molybdenum. He found investors to finance development and built a residence, a boardinghouse, several cabins, and a small mill. Undoubtedly a fraud, the mine never turned out much metal and ceased after several years (Vredenburgh 1994:89).

The 1930s was the last timeframe of note in the Avawatz Mountains. In 1929, the United States descended into one of its worst depressions ever, which lasted until World War II. The nation's economy collapsed, thousands were thrown out of work, capital necessary for industry evaporated, and many goods and services were curtailed at best or became no longer available at worst.

In 1932, Franklin Delano Roosevelt was elected president and immediately began developing a variety of programs to revive the nation's dismal economy. A year later, Roosevelt devised a program intended to simultaneously devalue the dollar while stimulating metals mining on a broad scale. As part of the plan, the dollar was taken off the gold standard and the Federal Reserve bought gold at inflated prices. The plan worked well and stimulated gold mining as expected, proven by an increase in the volume of gold that flowed into the treasury. In 1934, satisfied with the test, Roosevelt signed into law the Gold Reserve and Silver Purchase acts in hopes that they would resuscitate mining. The Gold Reserve Act raised the minimum price of gold from around $20.67 to $35 per ounce and the Silver Purchase Act raised the value of silver from around $.40 to $.70 per ounce (McElvaine 1993:164; Saxon 1959:7, 8, 12, 14, 16).

Roosevelt's plan combined with widespread destitution and lack of employment spelled a Great Depression-era revival of mining across the West. The Avawatz Mountains, known for gold and silver, certainly attracted attention during this movement. Individuals, some of whom may have even participated in the Crackerjack rush, examined most if not all the formerly productive mines, as well as some of the prospects, for gold. Few of the Depression-era prospectors entertained the expectations of finding rich ore, which they knew had been exhausted during the Crackerjack rush. Instead, the prospectors hoped to identify small ore chutes and bodies of low-grade ore that had been overlooked in decades past.

Another potential source of ore that the Depression-era prospectors closely examined was the waste rock dumps associated with the formerly productive mines. Prior to the Great Depression, it was common practice for miners to throw out low-grade ore because it was uneconomical to ship and treat in a mill. In the climate of the Depression, however, individuals perceived such material as a viable source of income for two principal reasons. First, it had already been brought out of the mine and was easily gathered, and second, improvements in milling technology rendered low-grade ores economical to treat.

When combined, the discovery of small ore chutes and sorting some of the waste rock dumps for low-grade ore constituted a very limited but present mining industry in the Avawatz Mountains. The small volume and poor quality of the ore governed the types of operations that were viable. The inconsistent availability of the ore discouraged traditional, capitalized companies and was only able to support individuals and partnerships. These small outfits were simple, labor-

intensive, and lacked capital and machinery for the most part. Instead of working for large profits, the prospectors and miners had as a goal subsistence-level incomes.

The nation's entry into World War II in 1941 set in motion a series of events that brought an end to most mining in the Avawatz Mountains. The federal government initiated a series of programs to administer economic, material, and labor resources as part of the war mobilization effort. With domestic mineral resources suddenly of supreme importance, the government passed several pieces of legislation that emphasized mining. War Production Board Ruling L-208 was among the legislation, and it mandated the immediate suspension of gold mining by the end of 1942 on the grounds that gold was not of strategic importance.

The impact on the Depression-era mining industry in the Avawatz Mountains was significant because most of the operations produced gold. Now outlawed, they were forced to suspend and never resumed. The only operation of substance that survived was the Owl's Head Mine, which produced manganese near Owl's Head Spring. Manganese was in demand during the war as an industrial metal, and the mine produced through 1950, and then closed. It was apparently the last mine of substance to operate in the Avawatz Mountains.

The Great Depression was the third and last Period of Significance in the Avawatz Mountains. During the third period, which began in 1930, the Avawatz Mountains was the locale for the only significant revival of mining that followed the Crackerjack rush. The Depression-era revival brought few organized companies and was dominated by individuals and partnerships who gleaned ore in hopes of subsistence.

Several important factors can be attributed to the third Period of Significance. First, the revival provided individuals with enough income to survive in an area that had few alternatives to mining. Second, the mining industry, as limited as it was, maintained a small population in the area. Were it not for the gold, the region may have been completely abandoned. Third, the mining industry helped to support the economies of local towns such as Baker, Barstow, Dagget, and Ludlow. During the Great Depression, all the towns around the south end of Death Valley were in duress and welcomed income from any source, no matter how small.

RED PASS/BONANZA MOUNTAIN

The history of the Red Pass and Bonanza Mountain area is integrally tied to the Crackerjack rush of 1906. As noted in the account of the Avawatz Mountains above, the Crackerjack rush drew a significant number of prospectors to the region, and they overwhelmed the area around Crackerjack. The overflow population was forced to wander afield because the mineral formations and promising ground had already been claimed.

In 1906, two prospectors, S. S. Worley and W. L. Snodderly, decided to venture to the south tip of the Avawatz Mountains in search of ore. On the north side of what became known as Bonanza Mountain, the partners found a gold vein and apparently claimed it as the Bonanza. Their reports drew the attention of other prospectors who climbed Bonanza Mountain and located several additional mineralized veins in the immediate area. These were claimed as the Cameo, Morning Star, and Little Bonanza (Rapp et al. 1982:8; Vredenburgh 1994:88).

Almost at once, the various parties began prospecting the claims with shallow adits and shafts, most of which quickly proved barren of ore. The veins of the Bonanza and Cameo, however, seemed to hold their values at depth, which attracted speculators. In 1907, a group of investors purchased the Bonanza and organized the Crackerjack-Bonanza Gold Mining Company to bring the vein into meaningful production. In a drainage below the mine, the company established Bonanza Camp, which consisted of a boardinghouse for mineworkers, several other buildings, and a well. It seems likely that some of the prospectors who worked nearby claims pitched their tents at the camp, as well. Within a short time, the company sank a shaft to a depth of 250 feet, developed the vein, and enjoyed production (Rapp et al. 1982:8; Vredenburgh 1994:88).

The Crackerjack-Bonanza Mine featured one of the best gold veins in the Avawatz Mountains, which helped the operation weather the collapse of the Crackerjack rush. The mine yielded ore through 1909, when Avawatz City founder Louis Flormann joined the company and managed operations. At the same time, Flormann also acquired the Cameo and produced small volumes of ore from its shallow workings (Rapp et al. 1982:8; Vredenburgh 1994:88).

Flormann stayed with the company until 1914, when both the Crackerjack-Bonanza and Cameo mines were exhausted. At that time, both operations ceased and the properties abandoned. It seems likely that Bonanza Mountain was examined during the same Depression-era revival that swept the Avawatz Mountains. All the claims, and especially the Crackerjack-Bonanza, were almost certainly inspected during the 1930s, but the Depression-era prospectors found little of worth.

The Red Pass and Bonanza Mountain area experienced only one Period of Significance, which spanned 1906 to 1914. The first several years brought a wave of prospecting during which most of the promising mineral veins were claimed. Underground exploration proved that only the Crackerjack-Bonanza, Cameo, and possibly several other claims offered ore in economic volumes. Afterward, limited production came from the above mines, and except for the Crackerjack-Bonanza, the operations were short-lived. The Crackerjack-Bonanza was the only mine to last more than several years, and it served as the area's economic engine until the mine closed and Bonanza Camp was abandoned.

GOLDSTONE

Both the town and mining district of Goldstone were the principal centers of mineral interest in Fort Irwin's southern portion. Although Goldstone had yet to be named, the first activity in the area was a byproduct of a rush to Calico, approximately 30 miles to the south. During the early 1880s, prospectors discovered silver ore at Calico, which stimulated a boom. Like most mining rushes, late-comers found the promising ground already claimed and fanned out into the surrounding mining districts in hopes of finding more ore. At least one group went north and examined a group of low hills between several dry lakebeds. The prospectors were probably initially seeking silver, but they discovered several gold veins that were equally as acceptable. The finds were meager, however, and the prospectors did little with the veins and left (Reynolds 1981:10; Shumway et al. 1980:98).

Curiously, prospectors assumed that the impoverished veins were all that Goldstone had to offer and ignored the area for slightly more than 10 years. In 1894, another group finally examined the

area again and was rewarded with just enough gold to keep them busy for a year. It remains unknown whether the group mined a hardrock vein or placer gold disseminated in the surface gravel of local drainages. The party's success, however limited, almost certainly attracted other prospectors, but the interest was nothing that even approached a typical mining excitement (JPR Historical Consulting Services [JPR] 1997:33).

Goldstone finally received the attention it deserved in 1910, when George Drumm found a rich gold vein and developed it as the Big Drumm Mine. Even though the vein proved to be shallow, its ore was rich enough to justify a stamp mill to recover the gold. Reports of both the rich ore and construction of the mill fostered a renewed sense of confidence in the Goldstone area, which became the foundation for a small rush. During the event, prospectors not only found several ore veins, but also they brought the dry placer deposits into production (see Chapter 5 for a description of dry placer mining). Even though prospectors used dry-washing methods to separate out the placer gold, they still needed water to finish the recovery process, as well as for general living purposes. In an attempt to satisfy the need, George W. Toennies sank a well in the Goldstone area's principal drainage but met with failure. As a result, water had to be hauled in from Seeber Well, which discouraged large-scale placer operations because they consumed too much of the liquid resource to be profitable. Afterward, placer mining, prospecting, and the development of several hardrock ore veins continued for several years then slowed but never completely stopped (Hall 1987:19; JPR 1997:33; Quinn 1981:20; Reynolds 1981:10; Shumway et al. 1980:98).

The spike of activity between 1910 and around 1913 at what became Goldstone defines the area's first Period of Significance. During the period, George Drumm's mine became the cornerstone of a slowly growing hardrock mining industry. Drumm's discovery drew prospectors who found enough ore veins to interest investors and begin claim development. Prospectors also brought some of the placer deposits into production, and their efforts contributed to the nascent mining industry. It seems likely that at least some of the prospectors already knew of the deposits by 1910 and collectively explored their extent during the excitement.

During the first Period of Significance, the rush's participants established several more fundamental trends. The participants constituted the first population of substance in Goldstone, and their camp became the site of a more permanent settlement. The participants also mapped out, figuratively if not literally, where hardrock ore was most likely to be found, and where the placer deposits lay.

The trends set in motion by the 1910 excitement came to fruition five years later. In 1915, W. B. Redfield encountered extremely rich gold ore in his Redfield Mine, most likely during development and exploration efforts. Unlike the 1910 event, the new discovery incited a substantial rush that had the greatest impact on the Goldstone area, although the event was much more modest than the Crackerjack boom of 1906 (Shumway et al. 1980:98).

The rush followed the pattern typical of most mining booms. Shortly after Redfield's discovery, prospectors arrived, thoroughly explored the hills for hardrock ore veins, and blanketed the area with claims. Once the extent of mineralized ground became apparent, the prospectors apparently organized the Goldstone Mining District to govern claim activity. As the rush gained momentum, townsite promoters and businesses moved in and solidified the camp now known as Goldstone. By 1916, Goldstone featured a population of 150 residents, a hotel, a boardinghouse, a restaurant,

stage service, and mail service (Hall 1987:20; JPR 1997:33; Quinn 1981:21; Reynolds 1981:11; Shumway et al. 1980:98).

In terms of mining, hardrock operations quickly superseded placer mining. Even though available archival sources fail to mention placer mining during the rush, it seems likely that this continued but waned in importance. The reasons are that the placer deposits were limited in extent, mostly claimed by 1915, and had already been worked since 1910 and probably before.

During 1916, a small but sound hardrock mining industry emerged at Goldstone with three operations leading production. W. B. Redfield obtained financial backing for the Red Bridge Gold Mines Company and began producing ore. Investors organized the Goldstone Mining Company to work several groups of claims and when miners found ore, the company built a mill. In addition to the above two companies, the Big Drumm Mine continued to yield payrock. It seems likely that a few other, small mines generated ore, as well. In preparation for the ore production that was sure to come from additional discoveries, a Los Angeles investor built a stamp mill at Seeber Well, three miles to the south (Hall 1987:20; JPR 1997:33; Quinn 1981:21; Reynolds 1981:11; Shumway et al. 1980:98).

In 1917, the boom matured as prospecting decreased, underground exploration increased, and the principal mines continued production. The postal service officially acknowledged the area with a post office under the name of Goldbridge, which was a contraction of Goldstone Mining Company and Redbridge (JPR 1997:34; Quinn 1981:21; Reynolds 1981:11; Shumway et al. 1980:98).

The post office may have been premature in its offering because the boom collapsed by the end of 1917. As was typical of mining booms, most of the promising claims went bust, the number of profitable ore veins proved to be limited, and the productive mines failed because their ore veins were shallow. Miners were laid off, the mills shut down, and investors became unwilling to risk their money in the area. By that point, it was obvious that the mines were unable to sustain Goldstone, and most of the people and businesses left. Goldstone's population became so small by 1918 that the few remaining businesses were unable to survive and the postal service revoked the post office. Within the year, the area was almost completely abandoned (JPR 1997:34; Quinn 1981:21; Shumway et al. 1980:98).

The abandonment of Goldstone in 1918 brought the area's second Period of Significance to an end. The period, which began in 1915, was a typical brief mining boom similar in pattern to the Crackerjack event of 1906. Unlike Crackerjack, however, Goldstone already had a few mines in the form of the Big Drumm and several placer operations, which fostered confidence in the area. In the beginning of the rush, prospectors defined the areas where ore was likely to be found then engaged in claim development and exploration. Their main camp evolved into the town of Goldstone, which the postal service recognized as Goldbridge. Like many rushes in the Mojave Desert, the level of promotion and speculation was far in advance of the paying ore veins, and the boom collapsed when this became apparent.

Several important trends developed during the second Period of Significance. First, prospectors honed the existing body of knowledge regarding Goldstone's mineral resources. Through success and failure, they demonstrated which ore veins were viable and which areas held little potential. Second, the productive mines contributed to the local economy, provided miners and owners with

income, and drew investors to the area. Third, the boom resulted in the town of Goldstone, which became the region's center of population, commerce, communication, and transportation. Last, the boom maintained a population in the region in part because it occurred at a time when other rushes were ending. Instead of leaving the region, some of the participants of the failing rushes moved on to Goldstone.

After the boom ended, the Goldstone area remained quiet for slightly more than 10 years. As with the Avawatz Mountains, the Great Depression brought together the conditions for a renewed interest in gold mines. Unemployed and impoverished individuals saw small-scale mining as a means of subsistence, and an increase in the value of gold made previously uneconomical sources of the metal viable. Further, the increase in gold prices combined with improved milling technologies provided enough incentive to interest companies in organized operations.

Goldstone offered opportunities for both individual miners and capitalized companies during the Great Depression. As early as 1930, individual miners and small partnerships returned to the placer deposits and began recovering gold that earlier operators missed. A year later, several groups of investors reopened the Redbridge, Goldstone, and Belmont mines, which still possessed low-grade ore. The success of these operations drew interest in Goldstone and instilled a sense of tempered confidence among other investors. By the middle of the decade, several more companies engaged in production in Goldstone and reopened the Rio Hondo, Reward, Uncle Sam, Merrick, and Gold Divide properties. Further, one company even built a new mill to treat ore from the Belmont Mine (Hall 1987:24; Quinn 1981:24; Reynolds 1981:12; Shumway et al. 1980:98).

Cumulatively, the crews for the various mining operations constituted a substantial population. While some of the workers lived at their places of employment, many more undoubtedly congregated in a principal settlement, although archival sources make no mention of this. If the population was large enough, the Depression-era camp of Goldstone could have featured several businesses.

Like the Depression-era revival in the Avawatz Mountains, federal regulations in 1942 ushered in the end of mining at Goldstone. In 1942, the federal government outlawed gold mining, which mandated the suspension of gold production. This event marks the end of Goldstone's last Period of Significance. The period began in 1930 when the poor economic climate of the Great Depression fostered a return to Goldstone's placer and hardrock mines. As small an area as Goldstone was, it offered sources of gold capable of sustaining both individual miners and company operations, and those sources cumulatively lasted through much of the decade.

Several important factors can be attributed to the third Period of Significance. First, the revival provided individuals and company employees with enough income to survive in an area that had few alternatives to mining. Second, the mining industry, as limited as it was, maintained a small population at Goldstone. Were it not for the gold, the area may have been completely abandoned. Third, the mining industry helped to support the economies of local towns such as Baker, Barstow, Dagget, and Ludlow. During the Great Depression, all the towns around the south end of Death Valley were under duress and welcomed income from any source, no matter how small.

SODA LAKE

Soda Lake was center to a rare but important type of mining limited largely to the Great Basin. Like many dry lakebeds in the Great Basin, Soda Lake began as a large body of water left over from an inland sea, which was shed off the region as the Great Basin landmass rose. As the climate warmed and dried, Soda Lake became center to a small drainage basin that received mineralized water from several small streams. Over time, evaporation exceeded stream-flow until only a dry lakebed encrusted with mineralized evaporite deposits remained.

As early as the 1860s, entrepreneurs in Nevada found that some of the evaporite deposits on dry lakebeds possessed both salt and other minerals, such as borax and soda, that were in demand for industrial purposes. The demand for evaporite minerals increased through the latter half of the nineteenth century and, in response, dry lakebeds across the Great Basin began to attract attention. In 1878, a company established a mining operation on Searles Lake in eastern California, and two years later, William T. Coleman developed the Harmony Borax Works in Death Valley. As the century progressed, other lakebeds were brought into production for minerals in addition to borax, sodium, and salt.

Technically, evaporite operations were mines, but the methods used to produce and concentrate the minerals were specific to the unique conditions of dry lakebeds. The general process began with testing evaporite deposits for their mineral content. If minerals of economic worth were present, then workers scraped off crude material and hauled it to a concentration facility. The crude material was dissolved through boiling in large tanks and decanted into other vessels for cooling. The liquid was then seeded for crystallization, the minerals precipitated out, and then dried. The resultant concentrates were shipped to another facility for refining if it was not done on-site. While simple in overview, the process was actually complicated by economic factors, the climate, and the chemistry of refining methods. For an operation to be profitable, a preponderance of material had to be harvested and hauled, and the refining process had to separate out the specific minerals of worth. For this reason, evaporite mining was an endeavor that required capital, formal engineering, and knowledge of chemistry, which was the domain of organized companies.

During the early 1900s, investors involved in one such company based in Santa Anna found that the floor of Soda Lake was an excellent source of sodium carbonate, sodium bicarbonate, and caustic soda. Unsure if the deposits could be economically mined, they organized the Pacific Coast Soda Company in 1907 with the purpose of testing potential processes. At first, the company built an experimental facility at Soda Lake, and it was small in scale. When the plant proved successful, the company invested in a considerable infrastructure for large-scale production. By 1908, workers finished a new plant that crushed crude evaporates into powder, liquefied the material, separated the mineral constituents, precipitated them out, and kiln-dried the concentrates. The company also built a narrow-gauge railroad 2 miles across the lakebed to haul high volumes of the crude material to the mill. The final products were sent to the company's refinery at Santa Anna for purification. In 1910, the company came to an end of the richest deposits, suspended operations, and apparently dismantled the railroad and mill (Vredenburgh 1994:88).

Because Soda Lake was only one concise but successful mining operation, only one Period of Significance applies to the area. The period, synonymous with the Pacific Coast Soda Company,

began in 1907 and ended in 1910. During the period, the company adapted known evaporite mining processes and technologies to the unique deposits of Soda Lake. In so doing, the company furthered the science of evaporite mining and refining. In addition, the company brought industry to an area that would have otherwise remained vacant, employed a substantial workforce, and contributed to the regional economy.

CHAPTER 4
GUIDELINES FOR RECOMMENDING ELIGIBILITY

Chapter 4 provides general guidelines for evaluating the significance of mining-related sites on Fort Irwin. Sites may be eligible for the National Register of Historic Places on local, state, and national levels. Sites that are eligible for or listed in the NRHP are *historic properties*. Criteria for assessing the eligibility of historic sites are provided under 36 CFR 60.4, as follows:

Criterion A: An association with events that have made significant contributions to the broad patterns of our history;
Criterion B: An association with the lives of significant persons in our past.
Criterion C: The embodiment of distinctive characteristics of a type, period, or method of construction, or representing the work of a master, or representing a significant and distinguishable entity whose components may lack individual distinction;
Criterion D: A likelihood to yield information important to the understanding of history.

A site must possess *historical integrity* relative to one or all of the applicable criteria. The NRHP recognizes seven specific aspects of integrity, as follows (National Park Service 1990):

Location: The place where the historic property was constructed or the place where the historic event occurred. In the context of industrial sites, this refers to buildings, structures, and objects such as machinery; mine or mill sites usually constitute a location.

Design: The combination of elements that create the form, plan, space, structure, and style of a property. To fulfill this aspect of integrity, a mine or mill site must possess at least an intact assemblage of archaeological remnants, such as foundations and artifact loci. The material remains must clearly represent the original organization, plan, evolution, and function of the operation.

Setting: The physical environment of a historic property. Setting includes elements such as topographic features, open space, viewshed, landscape, vegetation, and artificial features. To fulfill this aspect of integrity, the landscape surrounding a site must appear as it did when the site was active.

Materials: The physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property. This primarily refers to buildings, structures, and objects on mining and industrial sites. To fulfill this aspect of integrity a structure or object must consist of primarily original materials. Any alterations or repairs conducted within the last 50 years must have used materials identical or very similar to the original.

Workmanship: The physical evidence of the labor and skill of a particular culture or people during any given period in history. Similar to integrity of materials, a structure or object should retain primarily original workmanship. Any repairs or alterations should be accomplished with methods similar to the original.

Feeling: A property's expression of the aesthetic or historic sense of a particular period of time. Feeling is broadly applicable to mine and mill sites and in some cases is a function of setting. In terms of mine sites, the property

should convey the feeling or perception of mining, both from a historical perspective and from today's standpoint. A site need not be completely intact structurally or architecturally to convey feeling.

Association: The direct link between an important historic event or person and a historic property. The aspect of association is broadly applicable to mine sites. Was the site directly associated with the event or pattern of history it is supposed to represent? Usually, this requires that the setting and the site itself be physically intact. For example, if a concentration mill is recommended eligible under Criterion A because it hosted the first application of a revolutionary process, then the site today must retain at least archaeological integrity relative to the process.

Noble and Spude (1992) surmised that evaluating the integrity of mines can be difficult, in part because the seven aspects weigh heavily toward intact architecture. Consequently, it is useful to view mining-related sites in terms of *physical integrity*, which encompasses the aspects of design, association, materials, and workmanship.

Physical integrity can be divided into three general categories, which are best understood through a brief explanation of the composition of typical mines. Nearly every mining and prospecting operation erected a *surface plant*, which was the collection of facilities that supported activity on the property, around the mine opening. Surface plants included buildings, other structures, machinery, small equipment, activity areas, and topographical alterations (Twitty 2002:24–25). Some mines also included residential buildings and related activity areas. These factors also apply to concentration mills.

Architectural integrity refers to standing buildings on a site. Sites on which all original buildings are standing retain complete architectural integrity, but those with only a portion of the original buildings standing retain partial architectural integrity.

Engineering integrity refers to nonarchitectural structures and machinery. Nonarchitectural structures at mines usually include ore bins, trestles, rail lines, drainage boxes, headframes, boilers, foundations, and timbering around mine openings.

Most mining-related sites as they exist today cannot be expected to possess architectural or even engineering integrity. This is because mine operators or subsequent parties usually removed most structures, materials, and equipment of value after a mine ceased operations. The traces that remain are classified as *archaeological features* and *artifacts*. When machinery or buildings were removed, archaeological features such as foundations and earthen platforms remained. Concentrations of artifacts, such as building materials and materials from industrial activities, are often present as well. When the archaeological evidence facilitates an accurate reconstruction of the former mining or milling operation, a site retains *archaeological integrity*. It should be noted that for archaeological features to contribute to a site's integrity, they must be from the site's Period of Significance, which is the site's important timeframe of operation.

Generally, mining-related sites with architectural or engineering integrity usually possess archaeological integrity as well. If the archaeological integrity has been compromised by, for example, bulldozing, the site probably has been disturbed to the point of losing its feel and ambiance. Further, the loss of archaeological features and artifacts would prevent the ready

reconstruction of the mining operation. In general, buildings and intact engineering features are very uncommon and for this reason may warrant recommending a site eligible under Criterion C. In sum, the site must possess at least archaeological integrity or better, be located in a little-disturbed setting, and convey a sense of prospecting, mining, milling, or associated settlement.

To recommend a site eligible for the NRHP, the above concepts of integrity must be considered in conjunction with the NRHP criteria defined at the beginning of the chapter. If a site is recommended eligible under Criterion A because it is associated with an event or trend in history, then the site's material remains must date to the same timeframe as the event or trend. In other words, the site cannot have changed substantially from when the event or trend occurred. One important exception allows for the removal of buildings, structures, and machinery, and for the site to have been reduced to archaeological features. In most cases, a high degree of archaeological integrity is sufficient for Criterion A.

If a site is recommended eligible under Criterion B because it was associated with an important person, then the site must be recognizable to that person were they alive today. If the site has been reduced to archaeological features and would still be recognizable to the important person, such a level of integrity may be sufficient for Criterion B. In terms of Criterion C, if a site is argued to represent a specific type of site, then it must retain those identifying characteristics. For example, to claim that a site is an example of an early 1890s shaft mine, the site should possess features commonly associated with shaft mines and an artifact assemblage that dates to the early 1890s.

NRHP CRITERION A

The principal mining areas within Fort Irwin can be considered entities that were sums of the people, companies, and other organizations involved with the areas' development and evolution. Through such participation, the mining areas can be credited with contributions and ties to historical themes on local, regional, statewide, and national levels.

If a site played an important role in a specific mining area, the site may be eligible under Criterion A because of its contributions to the area. In such a case, the site would be associated with some of the same important trends and themes as the mining area and therefore be eligible under Criterion A. Some sites also may be associated with single, pinpoint events in history and therefore be eligible under Criterion A, which can only be determined through archival research. A few general historic themes and contributions of Fort Irwin's mining areas developed specifically for this context are discussed below, and the term *theme* used here refers to general categories or subjects of historic trends, systems, and arenas of study. Researchers should review the following trends and determine which of them apply to their sites.

Frontier and Settlement Themes

The early prospectors and miners who found, and then developed, mineral formations during the 1870s and 1880s participated in the European-American frontier, settlement, and industrialization of eastern California and the greater West. In 1870, when prospectors penetrated the mountain ranges of present-day Fort Irwin, the region was largely unknown and considered wild by the

broader American society. In this way, their efforts contributed to a general understanding of the geography and resources necessary for settlement. Such a body of knowledge was important because it ultimately helped foster later resources extraction, ranching, settlement, road and railroad transportation, and tourism.

On a broad scale, prospecting and mining within Fort Irwin were constituents and manifestations of a broad movement that explored and then industrialized eastern California. During the early 1870s, when prospectors first perused the region, the West, including eastern California, was still a frontier. As mineral formations within Fort Irwin were brought into production during the 1880s and 1890s, the region participated in a wave of industrialization and permanent settlement that swept eastern California and the Great Basin.

In light of the above, it can be argued that some of the mining-related sites active between the 1870s and 1890s were associated with the above trends. It should be noted, however, that such sites must retain archaeological integrity for that timeframe.

Economic Themes

Fort Irwin's mining areas participated in and were tied to economic themes ranging in significance from local to national scales. For example, most of the capitalists who funded prospecting and mining were of regional importance, some were important on a statewide scale, and a few were based outside of California. Implementation of investments, associated communication, banking, and the acquisition and shipment of supplies and food occurred on inter- and intrastate levels. The prospects and mines within Fort Irwin were part of, and contributed to, the regional, statewide, and national economic and financial systems. The degree of involvement was relative to the scale of the operation. Simple sites such as prospects had minimal involvement, while complex and productive mines had greater ties to those broader systems.

Prospecting and mining on Fort Irwin contributed to regional, statewide, and national markets. Mining companies diverted money into the local economy by paying wages to their workers, hiring consultants for various services, and purchasing small items from local sources, mostly in the major towns such as Calico and Silver Lake. Productive companies acquired large machinery and other industrial goods from manufacturers mostly in the San Francisco Bay Area and to a lesser degree from outside of California. The manufacturers in the Bay Area in turn purchased their materials from sources within and outside of California. Thus, the mining companies and prospectors on Fort Irwin supported California's economy primarily and other economies secondarily. Further, between the 1880s and 1930s, the Bay Area hosted one of the nation's most prolific mine supply industries, and by acquiring goods and machinery from the Bay Area, prospectors and miners ensured the continued success of the mine supply industry there.

Miners, workers, and prospectors on Fort Irwin consumed food and other domestic goods purchased from a variety of sources. Preserved food was shipped from packing companies in the Midwest and California, and fresh foods came from California farms and ranches. By consuming both preserved and fresh foods, the people of Fort Irwin's mining industry not only supported a complex national food transportation network, but also helped the development of farming and ranching in California.

From a historical perspective, the substantial mines, mills, and settlements that developed as a result of pronounced investment and that consumed volumes of goods, services, and machinery are more closely allied with the above trends than with small operations. Nonetheless, cumulatively, the small mines and prospects, which outnumbered substantial operations, had a significant impact.

When the mines within Fort Irwin actually yielded ore, their production provided direct economic contributions primarily on regional and statewide scales. Depending on the type of ore, mining companies sent their products out for processing, and the fees that these companies paid to the mills and smelters became a regional economic contribution. The profits realized from the productive mines then went to capitalists and to pay for goods and services, most of which were located in the region and elsewhere in the state. In terms of Fort Irwin's mining-related sites, only the mines and mills that had substantial outputs can be associated with this trend.

Prospecting, mining, and settlement during the mining era within Fort Irwin were direct functions of national and international market systems and forces. While the exact recipients of the silver, lead, gold, iron, and evaporites sold by the productive mines is difficult to trace, these materials became a direct contribution to American manufacturing firms, the United States Mint, and European governments. Specifically, through various programs, the federal government acquired silver until the repeal of the Sherman Silver Purchase Act in 1893. Also until 1893, the British government consumed high quantities of silver to maintain its silver standard and to mint coins for other foreign entities. During World War I, European governments also sought the metal to stabilize their failing economies. In addition, American manufacturing firms purchased silver, lead, and evaporites to produce goods. In terms of Fort Irwin's mining-related sites, only the productive mines can be allied with these trends; the prospects were created primarily in response to peaks of high metals prices.

Political Themes

Mining within Fort Irwin was integrally tied to and a direct function of political systems on state, national, and international scales. In terms of a national scale, federal programs proved crucial to the demand for silver and inflated silver's values to levels that rendered mining economical. The Bland-Allison Act of 1878 and the Sherman Silver Purchase Act of 1890 instituted price supports and acquisition quotas for silver. In response, mining companies within Fort Irwin, mostly in the Avawatz Mountains, prospected for and some actually produced the metal. Repeal of the Sherman Silver Purchase Act and the subsequent collapse of silver's value brought silver mining and prospecting to an abrupt halt. Passage of the Silver Purchase Act of 1934 increased the metal's value again, resuscitating mining.

In terms of an international scale, until 1893 the British pursued a pro-silver policy, and many European countries followed the same trend during World War I, which stimulated mining. With the return to normalcy in 1920, the demand for silver returned to low levels, which caused silver mining to collapse into a torpid state.

In terms of a regional scale, workers employed in the mining industry, and especially mining capitalists, provided political and economic support for senators, representatives, and lobbyists

who fought for the federal programs that kept silver's value high. In this light, the people who made up Fort Irwin's mining industry contributed to the California and the national political landscapes.

In terms of the region's mining-related sites, prospects tend to be indirectly associated with political themes. Although political acts created the economic environment that stimulated prospecting, the exploratory operations yielded no ore and had brief lives. Mine and mill sites, however, are more closely associated because their capitalists, company officials, and workers may have been politically active and directly or indirectly influenced public policy.

Social Themes

The people and institutions of Fort Irwin's mining industry participated in the development and evolution of regional, California, and national social structures. From 1870 through the 1890s, prospectors and independent miners constituted a significant portion of Fort Irwin's mining industry because the region's remote nature and inconsistent mineral resources discouraged major investment by large companies. As a demographic group, the prospectors and independent miners tended to be autonomous, self-sufficient, educated, physically fit, and comfortable operating in remote, unexplored areas. This demographic group was not confined to Fort Irwin but instead belonged to a greater movement throughout the West. Between the 1870s and 1890s, these prospectors and independent miners had a significant influence on and helped to shape Western society by imparting their attitudes, culture, behaviors, and beliefs.

Today, sites dominated by prospect workings, excavations, and camps can be associated with the social theme discussed above. Because such sites were created by prospectors, they are directly associated with this important demographic group and its impacts to Western society and culture.

The concept of class is another important social theme. When mining companies on present-day Fort Irwin actually produced ore, their profits reinforced the development of social classes in the region and eastern California. The mine owners began their ascent to upper classes while the laborers, of whom there were many, formed a working class dependent on wages. Two general categories of capitalists acquired the productive properties and financed exploration. The first and by far largest category consisted of local investors of limited means primarily in nearby commercial centers, and the second category consisted of the already wealthy elite who were based in cities. The profits realized from the mines reinforced the fortunes of the few elite while contributing heavily to the formation of a middle-class, a class that ultimately became one of the country's economic and political backbones. Because the mining companies depended on wage laborers, company operations ensured the continuation of a working class.

The very nature of the workforce that made mining within Fort Irwin possible constituted another form of social structure. Activity among the various prospects, mines, and mills created a pronounced employment market that drew workers from points throughout the Great Basin and California. Some of those workers were immigrants, mostly from China, Mexico, and European countries. The cycles of boom and bust inherent to gold, silver, and industrial minerals mining required that these workers be mobile, which contrasted sharply with sedentary farming and ranching societies. Each boom drew laborers from a variety of backgrounds while busts

propelled them to other areas and economic sectors in California and elsewhere in the West. The result was a mobile, adaptable, and diverse society.

Fort Irwin's mine, mill, and settlement sites can be allied with the themes of class, workforce, and demography because they supported wage labor workforces. Prospect sites, on the other hand, tend to be associated primarily with mobility, lower classes, and a demographic of independent individuals as noted above.

Industry and Engineering Themes

Most of the prospect and mining operations within Fort Irwin were very limited in scale and therefore tend not to be associated with developments in industry and engineering. The immediate vicinity of Fort Irwin did, however, feature several types of mineral deposits that provided opportunities for a participation in technological innovation.

Prospectors discovered the first type of gold deposit during the 1870s or 1880s near Goldstone and Denning Spring. Specifically, these areas featured placer gold eroded off surrounding hardrock veins and disseminated in valley gravel. Ordinarily, miners worked placer deposits with cradles and sluices, which required flows of water to separate the gold particles from the gravel. Water, however, was conspicuously absent from the drainages around Goldstone and Denning Spring, leaving miners with the problem of determining the most efficient means of separating the placer gold from the gravel.

During the 1890s or 1900s, miners successfully adapted what were known as dry-washing techniques. Dry-washing involved the use of screens to reduce coarse gravel to its fine constituents, air blasts to lift off the light particles, and tubs of water to pan out the remaining heavy material. Manufacturers introduced several versions of dry-washing machines during the 1880s and 1890s, and the apparatuses carried out some of the screening and air blasts. These machines then made it possible for miners to process placer deposits throughout the Great Basin using only a paucity of water. But because dry placers were relatively rare, knowledge of how best to apply the machines developed during a prolonged trial-and-error period. Thus, by successfully employing dry-washers, Fort Irwin's miners contributed to the general understanding of how to use these devices and carried this knowledge with them to other regions.

The second type of mineral formation was another manifestation mostly limited to the Great Basin. As early as the 1860s, entrepreneurs in Nevada exploited evaporite deposits on dry lakebeds as industrial minerals. The general process involved scraping off crude material, hauling it to a concentration facility, separating out the waste, and refining the recovered minerals. While simple in overview, the process was actually complicated by economic factors and the chemistry of refining methods. For an operation to be profitable, a preponderance of material had to be harvested and hauled, and the refining process had to separate out specific minerals of worth. In the 1880s, William T. Coleman provided a crude model with his large borax operation in Death Valley, but the model was of limited use. The reason was that deposits of every lake bed differed, and by the 1900s, minerals in addition to borax came into demand. As a result, companies had to apply experimentation, calculation, and technology to make their specific evaporite deposits pay. on Fort Irwin, the Pacific Coast Soda Company successfully carried out these steps in 1907 to bring a deposit on Soda Lake into production. In so doing, the

company contributed to the business model and the general body of knowledge on how to develop and exploit evaporite formations.

NRHP CRITERION B

To recommend a mining-related site within Fort Irwin that is eligible under Criterion B, a person of importance and influence must have played a direct role in the site's development or spent an appreciable amount of time there. Further, the site must retain at least archaeological integrity, if not better, from when the person was involved. If the site changed a great deal after that person's presence, then integrity relative to the individual is lost. An example of direct involvement would be a mill that a notable engineer personally designed or a building platform on which an important individual lived. People of prominence, especially influential capitalists, certainly backed mining companies or owned property within the fort. Financial involvement or property ownership, however, are too indirect an association for eligibility under Criterion B.

The direct involvement of or occupation by people of importance and influence with sites on Fort Irwin is certain. However, few sites are expected to be eligible under Criterion B because most sites either changed through subsequent activity or lost physical integrity due to natural decay. To ensure an objective assessment under Criterion B, thorough research of a site's history and biographies is absolutely necessary.

NRHP CRITERION C

In a general sense, to be recommended eligible under Criterion C, sites within Fort Irwin must embody distinctive characteristics of a type, period, method of construction, or represent the work of a master. Sites may also be significant as components of a greater whole. Equally important, a site must retain archaeological integrity.

Site type and importance will probably be the most common applications of Criterion C within Fort Irwin. For a site to be recommended eligible under Criterion C, it must be a physical representation of a specific *type*, or category, of an entity. These are clearly defined under the discussion of Property and Site Types in Chapter 5. A site's general function or the nature of activity that occurred on the site usually defines the type, and identification of the type should be as specific as possible. In the case of industrial and commercial sites, the site's role often defines its type. For example, several types of mines are left from the mining industry. Mines came in a variety of forms from small tunnel operations to large shaft complexes, and each form can be classified as an individual site type. On Fort Irwin, most sites will fall into the category of prospects, mines, mills, and settlements, which are delineated in detail in Chapter 5.

Once the specific type of site is defined, the site should be examined to determine how well it represents the type. Here, physical integrity as discussed above is important. Traditionally, mine sites have been perceived to be sound representations only when they possess buildings, machinery, and other engineering features. However, mines that retain only archaeological integrity also can be good representations of specific site types. When the structures, machinery, and other materials of value were removed from a mine or prospect, they often left direct archaeological evidence. If this evidence permits the clear and ready reconstruction of the mining

operation and its physical makeup, then the site still represents a specific type. When these conditions are met, and if the researcher demonstrates the type's importance, the site may be eligible under Criterion C.

The mere presence of a site type is insufficient for eligibility under Criterion C, and in such cases the concept of its significance within that type must be considered. Several questions should be addressed. How and why is the site type important? Do the physical remains exemplify important aspects of the development or application of engineering, architecture, processes, methods, or materials used? Defining the property's significance within a type can be subjective and includes other issues in addition to those mentioned; .

In addition to determining the site type, the Period of Significance must also be specified. A Period of Significance is defined as the timeframe when a site was prominent or experienced a height of activity. In many cases, small mines and prospects were abandoned after a brief period and so identifying the Period of Significance is straightforward. Large, productive mines, however, were often reworked from time to time, leaving evidence of sequential operations. In such cases, the operation that left the greatest impact to the site defines the dominant Period of Significance. For example, for a mine initially developed during the 1890s and heavily altered during the 1930s, the Period of Significance dates to the 1930s. The reason is that the 1930s operation was the most prominent and left the greatest impact. Chapter 3 delineates the Periods of Significance for Fort Irwin's principal mining areas.

In some cases, rarity can lend weight to the significance of a mining-related site or an individual feature. If few physical examples of a site type, a technology, or practice important at one time currently survive, then intact resources may be eligible. However, rarity alone does not determine significance as many rare sites and features are unimportant. Determination of a site's rarity is somewhat subjective; however, there are universally uncommon and important site types. In general, sites retaining aspects of architectural or engineering integrity are rare because mining outfits or other parties usually removed most structures, materials, and equipment of value when they abandoned a site. Sites with integrity predating the 1890s tend to be uncommon and important. Constant improvements in mining and milling technologies, the fluctuations of economic cycles, and intermittent speculation fostered the periodic reopening and rehabilitation of mines and prospects. This trend became pronounced during the 1930s when metals prices increased, and new operations usually erased evidence left by previous activities.

It should be noted that to date, thousands of mining-related sites have been recorded in California, and certain types have been well-documented. Given this, some are considered common and are therefore no longer important enough to be eligible under Criterion C unless they possess important attributes. In general, common site types include small prospect adits and shafts, mines lacking archaeological integrity, and mines equipped at one time with very simple surface plants.

Sites may be eligible under Criterion C if they were the work of a master, if they possess important and unusual attributes, and if they represent important and uncommon methods of construction. In terms of unusual attributes, while no two mines are identical, they often followed general patterns of organization and function relative to timeframe. Features on a site that represent deviations from convention could be considered unusual attributes. For example, mining companies and prospect outfits usually followed the convention of employing blowers or windsocks to direct fresh air underground. Deviating from this, a few outfits used furnaces and

stoves to create convection currents to draw foul air out of the workings. The remnants of a ventilation furnace on a prospect site today could constitute an unusual engineering attribute that may warrant recommending the site eligible under Criterion C. A similar case can be made for sites representing uncommon methods of construction and organization. The researcher should review some of the popular historical references listed at the beginning of Chapter 5 for an understanding of conventional engineering.

NRHP CRITERION D

General full recording is intended not only to document the remains of a site, but also to evaluate whether the site possesses attributes that may address important research questions upon in-depth study. Sites that hold such potential may be eligible for the NRHP under Criterion D. The information may enhance the current understanding of an individual site or may contribute to broader areas of study. To recommend a site eligible, the source of potential information must be discussed in terms of specific arenas of study and how the information can contribute.

Archival Research

Site recording and inventory projects usually carry out archival research for specific sites in a cursory and incomplete manner. In-depth archival research can greatly enhance the understanding of a site and attach events, trends, and people to a site's material remains. Archival research holds the capacity to facilitate an interpretation of the material remains not clearly understandable today and to explain the chronology of a site's history. Research may also help contribute to dating specific types of machines and structures, construction methods, and mining and milling practices.

Buried Deposits

Buried deposits hold a high potential to provide information for a variety of studies. Traditionally, arenas of inquiry focused on deposits such as privy pits, refuse dumps, cellar pits, and the areas around building platforms associated with residences at mines. Artifacts recovered from any of these deposits can answer questions regarding culture, social structure, gender, family, ethnicity, consumerism, diet, health, substance abuse, and other aspects of life in the mining industry (an in-depth discussion of social issues is beyond the scope of this mining context). Privy pits are particularly valuable because they offer the potential to contain an artifact assemblage not found elsewhere. They provided a secluded environment for residents to dispose of items under secrecy and were a repository of organic wastes. Cellar pits have the potential to contain articles kept in storage and not intended to be refuse.

Buried deposits associated with the mine as a workplace have escaped intensive examination. Buried deposits that can feature cohesive artifact assemblages accumulated in crooks in waste rock dumps, boiler clinker dumps where workers threw industrial refuse, and privy pits. Workplace privy pits are especially valuable because they hold the potential to possess personal items representing workers in their environment. As with domestic privy pits, laborers may have disposed of articles under secrecy or accidentally dropped items of value. Buried industrial

deposits may also enhance the understanding of sites lacking a definitive assemblage of surface artifacts.

Buried Features

Like buried deposits of artifacts and other cultural materials, buried features also hold the potential to address arenas of inquiry. Exhuming foundations, structures, machinery, and other components of feature systems may provide information regarding engineering, function, construction methods, and timeframe.

Analysis of Buildings and Engineering Features

Site recording and lesser forms of conventional cultural resource inventory practices are poorly equipped to study in detail complex buildings, structures, and systems of features. The operation of mines and the application of engineering can be better understood by closely documenting such attributes, and using the information for interpretation, comparison, and explanation. For example, a detailed plan view of a mill foundation and an explanation of the flow of ore across the structure can enlighten the current understanding of ore treatment practices and the adaptation of engineering to the industrial needs of mines. A similar case can be made for the application of machinery, which is poorly understood since intact machinery is rare today.

Underground mine workings are as important a component of a mine or prospect site as are the features and artifacts on ground-surface. Underground workings are perhaps one of the least understood aspects of mine sites and, to date, few if any formal studies have been carried out. Hazards, lack of time and funds, and unconventionality conspire to prevent the documentation and interpretation of these important industrial resources. The current familiarity with mine workings came about through historic photographs and texts, and anecdotal information.

In general, miners and engineers across the West followed a few general patterns for driving exploratory passages, developing and extracting ore bodies, and constructing necessary infrastructures. In some cases, mine sites can hold a great potential to provide information for a variety of studies. A mine's underground workings can contain internal structures, features, machinery, and artifacts found nowhere else. As a whole, these resources can contribute greatly to a currently dim understanding of mining engineering, the operations of mines, and the mine as a workplace.
Fort Irwin and other military installations within the Great Basin have great potential to make very meaningful contributions to this important arena of inquiry. Because of an arid climate and low watertable, most of the mines and prospects are absolutely dry and provide excellent preservation environments. Further, the lack of public access has discouraged artifact collectors from venturing underground and removing materials. As a result, the mines and prospects on Fort Irwin and other military bases are extremely likely to contain perishable features and artifact assemblages not found on the surface and that were destroyed in wet workings. This trend is noteworthy because most of North America's mining regions lack such potential due to damp or flooded underground environments.

Mining played a huge role in the West and therefore a clear understanding of mine sites, which necessarily include underground workings, is of the utmost importance. Because few studies

have been carried out, fields of inquiry are numerous and should be at least discussed during a site's evaluation, if not actively pursued.

CHAPTER 5
PROPERTY AND SITE TYPES

Chapter 5 provides a roster and descriptions of the Property, Site, and Feature types common to Fort Irwin's mining industry. The objective is to bring order and standardization to site recording, evaluation, and historic preservation.

The discussion of Property and Site types follows a three-tiered structure. The *Property Types* listed below encompass broad categories of sites and are based on general patterns of function. *Site Types* represent discrete entities within a given Property Type. *Feature Types* define the common types of archaeological, engineering, and architectural manifestations that makeup specific types of sites.

The descriptions of the Property and Site types will certainly help researchers identify, define, and interpret specific sites. However, the descriptions are necessarily brief. Researchers unfamiliar with the nuances of mines, mills, and the mining industry are strongly urged to review some of the literature listed below for a greater understanding of mining-related sites. The following publications are in order of relevance:

Twitty, Eric
2002 *Riches to Rust: A Guide to Mining in the Old West* Western Reflections, Montrose, CO.
Discusses in detail the constitution, layout, development, and equipment of mining. Focuses on mine surface plants and how to interpret today's remains.

Meyerriecks, Will
2001 *Drills and Mills: Precious Metal Mining and Milling Methods of the Frontier West* Self Published, Tampa, FL.
Provides accurate and comprehensive coverage of common mining and milling practices.

Twitty, Eric
2001 *Blown to Bits in the Mine: A History of Mining and Explosives in the United States* Western Reflections, Montrose, CO.
Discusses conventional mining practices with an emphasis on underground work and artifacts.

Hardesty, Donald
1988 *The Archaeology of Mining and Miners: A View from the Silver State.* Society for Historical Archaeology.
Discusses mining-related sites as archaeological resources.

Francaviglia, Richard
1991 *Hard Places: Reading the Landscape of America's Historic Mining Districts.* University of Iowa Press, Iowa City, IA.
Focuses on reading and interpreting mining landscapes.

Young, Otis E.
1989 [1970] *Western Mining*. University of Oklahoma Press, Norman, OK.

Discusses hardrock prospecting, mining, and milling methods employed prior to 1893.

Bailey, Lynn
1996 *Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850–1900.* Westernlore Press, Tucson, AZ.
Discusses various types of mill and mine machines.

Sagstetter, Bill, and Sagstetter, Beth
1998 *The Mining Camps Speak: A New Way to Explore the Ghost Town of the American West.* Benchmark Publishing, Denver, CO.
Discusses the examination of mine sites through remaining material culture. The authors make a few inaccurate generalizations and dates of artifacts.

THEME: MINING INDUSTRY

Property Type 1: Hardrock Prospects

The Nature of Hardrock Ore Deposits

In general, economic minerals and metals found in the metamorphic and igneous rock formations of Fort Irwin constituted hardrock ores. The principal precious and semi-precious metals were silver and gold, and the principal industrial metals were manganese, lead, and copper. Gold and silver commanded the most attention by far on Fort Irwin during the life of the mining industry.

The common traits shared by most of the hardrock ores, which influenced how companies mined them, were the nature of the formations and their geographic locations. The ore formations were primarily functions of the the region's volcanism. During the activity, superheated, plastic magmatic bodies slowly intruded the basement rocks deep under the surface and exerted great pressure. As these bodies made their way upward, pockets of liquid rock and superheated fluids and gases attempted to escape through paths of least resistance. Faults and fissures provided these paths, and they ranged from microscopic to several feet in width and tended to be oriented vertically. As the gases and fluids lost pressure and heat during ascent, insoluble minerals first precipitated out on the fault walls, followed by soluble minerals and metals with low melting points. The result was irregular and mineralized bands or seams of quartz and other silica-based rocks that the mining industry recognized as *veins*. Most veins were barren of metals, some offered disbursed ore, and a few featured rich pockets or stringers. Nearly all terminated less than 300 feet deep. Although this is a great oversimplification of the economic geology on Fort Irwin, some background is necessary to understand the conditions in which mining companies worked.

In terms of geographic location, most of economic mineral veins formed in four principal areas. The first was around Denning and Quail springs, the second manifested in the Avawatz Mountains, the third developed at Red Pass, and the fourth was around Goldstone. These areas were among the most rugged and inaccessible within Fort Irwin, and they presented a raft of problems for profitable mining.

Prospecting for Hardrock Ore

Finding the ore formations was the first step in hardrock mining, and this was the task of prospectors. Popular history suggests that individual or pairs of prospectors found rich gold and silver veins by simply excavating pits with pick and shovel, or by wandering the countryside until they encountered rich outcrops. In actuality, successful prospecting usually involved a basic knowledge of mineralogy and geology, hard work, patience, and planning. Prospectors also rarely worked alone because parties ensured safety and security, increased the likelihood of finding ore, and hastened the examination and sampling of mineral bodies.

The process of prospecting often began with a cursory survey of an area. Wealth-seekers often examined visible portions of bedrock for seams, outcrops of quartz veins, dykes, unusual mineral formations, and iron staining. In regions where vegetation and soil concealed bedrock, prospectors also scanned the landscape for anomalous features such as water seeps, abrupt changes in topography, and changes in soil character (Bramble 1980:11–13; Peele 1918:381–385; Young 1946:19–26).

If an area offered some of these characteristics, the party of prospectors may have shifted to more intensive examination methods. In arid environments, a search for what they termed *float* was the most common means. Float consisted of isolated samples of ore-bearing rock that natural weathering fractured off an ore body and transported downslope. Over time, erosion freed enough float to create a notable deposit, usually in the shape of a fan that radiated outward from the parent vein.

During their search, prospectors scanned drainage floors and areas of exposed soil where float was likely to accumulate, and if the prospectors encountered ore specimens, they walked transects to define the boundaries of the scatter. Once the prospectors determined the approximate apex of the fan, they excavated groups or rows of pits in hopes of tracking the samples to the vein. With high hopes, the prospectors sank several prospect pits down to bedrock and chipped away at the material to expose fresh minerals (Bramble 1980:11–13; Peele 1918:381–385; Young 1946:19–26).

If the exposed bedrock suggested the presence of an ore body, the party of prospectors may have elected to drive either a small shaft or adit with the intent of sampling the mineral deposit at depth and confirm its continuation. After clearing away as much fractured, loose bedrock as possible with pick and shovel, a pair of prospectors began boring blast-holes with a hammer and drill-steels. They often bored between 12 and 18 holes in a special pattern designed to maximize the force of the explosive charges they loaded. Prior to the 1880s, prospecting parties usually used blasting powder, and by the 1890s, most converted to stronger but more expensive dynamite. Until economic ore had been proven, the operation was classified as a *prospect adit* or *prospect shaft*.

The Nature of Deep Prospect Operations

As a site type, a prospect is the manifestation of an effort to locate economic ore deposits. Prospects ranged in scale from shallow pits to extensive underground operations. In general, a lack of significant production serves as a unifying definition for prospects, although some may

have yielded small volumes of ore. The absence of ore storage facilities, minimal property development, and the investment of little capital often are hallmarks of prospect operations.

Most prospects tended to be simple, shallow, and lacked machinery; some were fairly advanced and possessed surface plants that required formal engineering and equipment. Of note, because many of Fort Irwin's small mining operations were poorly capitalized and possessed simple surface plants, productive mines hold the potential to appear similar to prospect sites. The substantial prospect operations were usually centered around an adit or a shaft with an associated waste rock dump of some volume, which represents deep workings. When arranging a surface plant for a deep adit or shaft, prospect outfits tended to follow patterns in terms of facilities, equipment, and the surface plant layout.

When prospect outfits explored subsurface geology for ore, they elected either to drive an *adit* or *tunnel*, which were horizontal passages, or to sink a vertical or inclined *shaft*. To do so, prospectors used drill-steels to bore blast-holes, they inserted explosive charges into the holes, and set the round off. When driving an adit, they shoveled the resultant fractured rock into either a wheelbarrow or an ore car, which ran on a mine rail line, pushed it out of the workings, and dumped it at the adit's mouth. Over time, the buildup of the unwanted material formed a *waste rock dump*. When sinking a shaft, the prospectors shoveled waste rock into an ore bucket, which they raised out of the workings and dumped around the shaft collar. The extent of the underground passages expanded as prospectors pursued various leads and mineral formations, and the workings' expansion required the coordination of a simple underground infrastructure. Additional horizontal passages were known as *drifts*, and such passages in shafts presented the problem of transferring waste rock from ore cars underground into the ore bucket raised out of the workings.

As can be surmised, the activity underground created the need for support facilities on the surface, and they constituted the *surface plant*. When prospect outfits constructed surface plants, they followed a general pattern in terms of layout and content. At a minimum, surface plants for deep prospects included a shop, transportation system, and a means of accessing the operation.

In the shop, a blacksmith sharpened drill-steels and picks, and manufactured hardware. Shops were usually equipped with a forge, a workbench, hand-tools, and possibly a hand-powered appliance such as a drill press. Shops were usually enclosed in either frame buildings or wall tents less than 15-by-20 feet in area, and prospectors occasionally erected forges in the open. To minimize the handling of heavy materials, the shop was located near the mine opening, often on a cut-and-fill platform.
Transportation systems permitted prospectors to move waste rock out of and supplies into the underground workings. Wheelbarrows were adequate for shallow adits, ore cars were necessary for deeper adits, and shafts required some form of a hoisting system. The mine rail lines for ore cars were relatively simple and consisted of a track that exited the tunnel or adit and terminated on the waste rock dump. Usually, deep shafts also featured a mine rail line so prospectors could send waste to the dump.

Hoisting systems, used for vertical transportation in shafts, required engineering and planning (Figures 1–3). The *hand windlass* was the most primitive form of hoisting system and offered a depth capacity of around 100 feet. A windlass consisted of a frame around the shaft collar and two vertical posts usually 4 feet high that braced a spool. To operate a windlass, a prospector

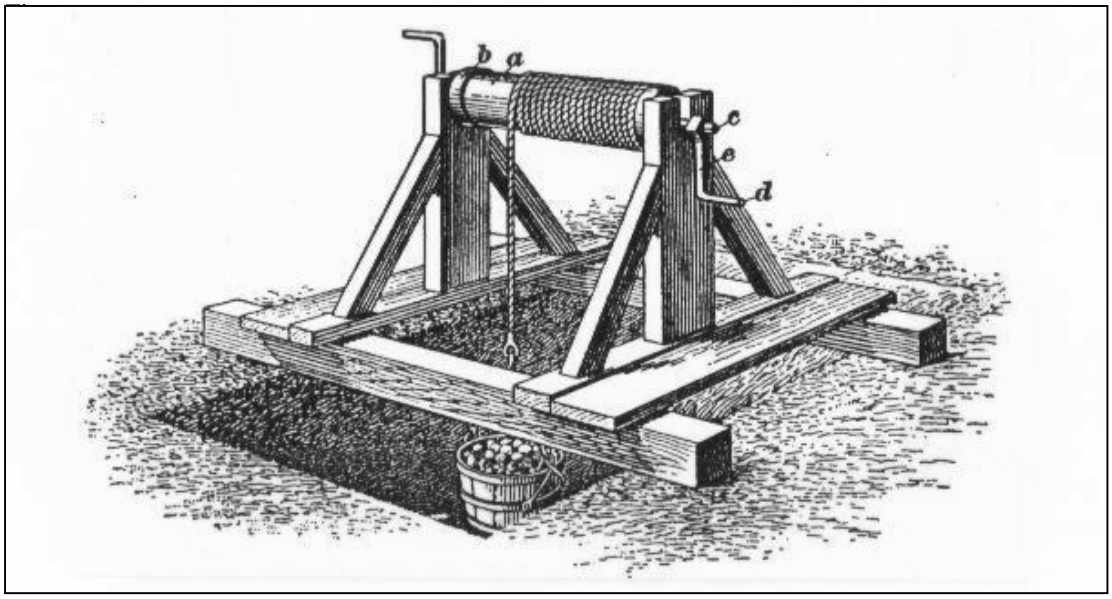

Figure 1. The windlass was a mining frontier institution, and nearly all prospect shafts less than 100 feet deep were equipped with this simple, inexpensive, and portable type of hoist. Usually, windlasses were removed when a shaft was abandoned, and so structural elements remaining today are rare and important. Source: Twitty 2002:145.

turned a crank handle that wound the spool, wrestled the full ore bucket to the shaft's collar, and dumped it. Because windlasses were small and portable, prospectors usually removed them when they abandoned a shaft, often leaving little evidence (Twitty 2002:145).

When the depth of the shaft exceeded the 100-foot-depth capacity of a windlass, prospectors had to turn toward a mechanical hoist. Outfits in remote locations or lacking capital often selected a *horse whim*, which was powered by a draft animal. Two types of whims proved popular. The first, generally used into the 1880s, consisted of a horizontally oriented cable reel turned by a draft animal that walked a circular track around the apparatus. A cable passed from the reel through a shallow trench to a headframe standing over the shaft. At the headframe, the cable passed through a pulley at the headframe's base and over a second pulley at the top, then down

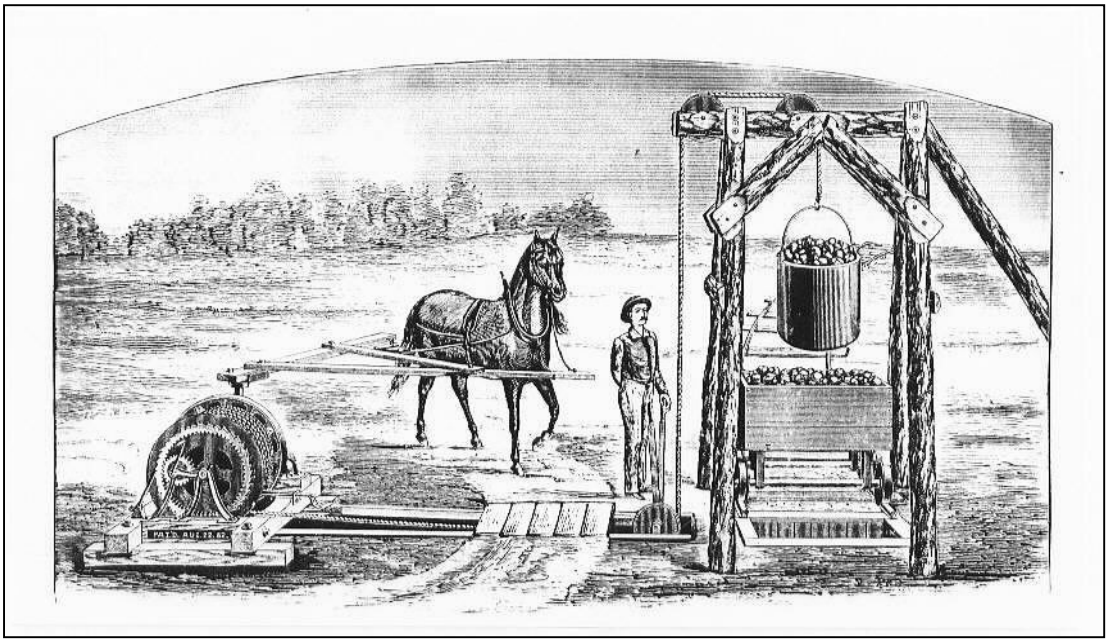

Figure 2. Horse whims were the most primitive form of mechanical hoist, and because of their simplicity and portability, they were a favorite among prospectors. Impoverished mining outfits used whims, as well. The unit shown is a geared whim, which was popular from the 1880s through the 1910s. Source: Ingersoll Rock Drill Company 1887:60.

the shaft. Control linkages extended from levers at the headframe through the trench to the whim. The headframe stood on timber footers and facilitated pouring waste rock from the ore bucket hoisting vehicle into an ore car for removal. By the 1880s, prospectors adopted the factory-made *geared whim*, which consisted of a vertical cable drum geared to a capstan. A draft animal, tethered to a harness beam bolted to the capstan, walked a track around the whim to wind the cable (Twitty 2002:159–162).

Installation of a whim required some degree of engineering. Usually, prospectors sank shafts that were rectangular in footprint, with 4-by-8 feet in-the-clear (interior dimensions) being the most common size. To install a whim, they established a datum line with an orientation parallel to the shaft and located the whim's components according to the datum. As a result, the whim's components shared the same orientation as the shaft and may have been placed slightly off-center. Further, to provide enough space for the animal track, usually 20 feet in diameter, the whim was located at least 15 feet away. Most of the prospect shafts within Fort Irwin relied on windlasses and horse whims for hoisting.

Mining engineers recognized that horse whims were slow, cumbersome, and had depth limitations of around 300 feet. To overcome such problems, those prospect outfits wishing to work at depth installed power hoisting systems. Such systems usually consisted of a hoist, a power source, a headframe, a hoisting vehicle, and a mine rail line to shuttle rock away from the shaft. To ensure an orderly and functioning hoisting system, prospect outfits arranged the components according to a datum line taken from the shaft. The hoist and headframe were directly aligned with the shaft (Twitty 2002:160).

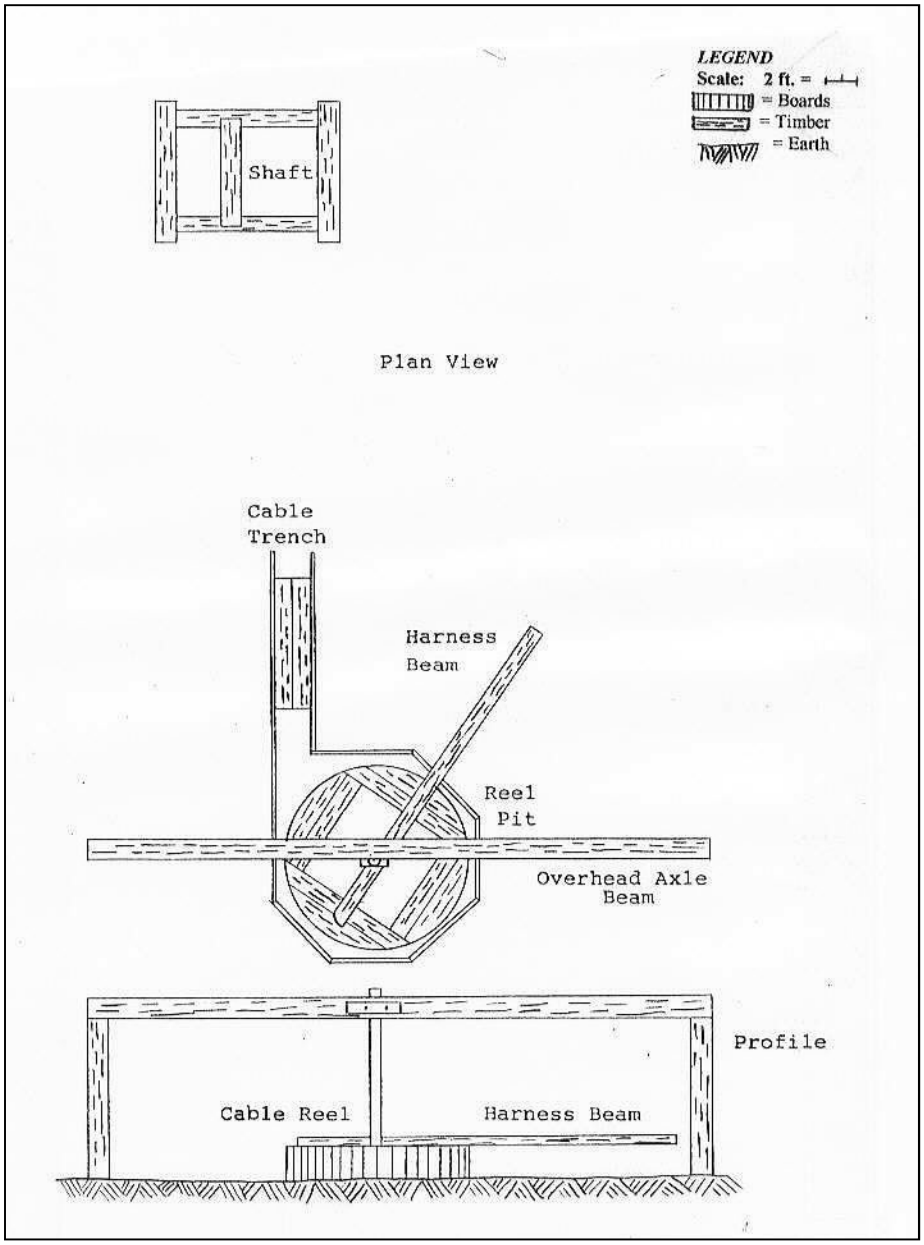

Figure 3. The plan view (top) and elevation (bottom) depict a horizontal reel horse whim, which was a universal hoist prior to the 1880s. Usually, only the reel pit and cable trench remain at prospect and mine sites today. Existing structural remnants are rare and important. Source: Twitty 2002:158.

Deep prospects equipped with power hoists often featured a shaft divided into two *compartments*. The *hoisting compartment* was the larger and accommodated the hoisting vehicle, and the *utility compartment* or *manway* was the smaller and featured ladders. The headframe stood over the shaft, usually on timber footers equal in length to the structure's height, and the hoist was usually located twice as far away. Further, the hoist had to be located slightly off-center to ensure that the cable passed down the hoisting compartment.

Prior to the 1900s, steam powered most hoists, and afterward, gasoline hoists became popular. In general, mining engineers considered hoists less than 5-by-6 feet in area, and most gasoline hoists, to be for deep prospecting. However, poorly financed and remote operations frequently used substandard hoists for minor ore production. All steam hoists required a boiler, and like the rest of a hoisting system's components, prospect outfits usually oriented the boiler according to the shaft's datum and located the apparatuses near the hoist. In general, prospect outfits favored portable boilers for their low cost, ease of transport, and low maintenance. For a detailed description of the various types of hoists, headframes, and boilers, see the list of Feature Types below (Twitty 2002:175, 320).

While small, poorly capitalized prospect outfits minimized the structures they erected, substantial operations constructed buildings intended to shelter vital surface plant components. Outfits driving adits erected shop buildings that enclosed the blacksmith facilities and a work area where prospectors dressed mine timbers. Shop buildings were usually less than 20-by-20 feet in area, made of rock masonry or lumber, and permitted the prospect outfit to function in all weather. Today, shop buildings may be identified by platforms, foundations, footprints, and structural debris. Most prospect outfits that sank shafts erected *hoist houses* to enclose the hoisting system and a blacksmith shop. In some cases, substantial, well-capitalized outfits erected *shaft houses* that also enclosed the shaft collar and a work area. Evidence for these two types of structures is similar to that for tunnel houses.

In sum, prospect outfits constructed simple and compact surface plants that were equipped with portable and inexpensive components. Most prospects lacked machinery and were labor-intensive, but deep operations employed some power appliances. Buildings, machinery, and other facilities usually shared the same orientation as the shaft or adit and were clustered together around the opening. Because equipment for deep prospecting was intended to be portable, items were usually removed, leaving primarily archaeological evidence. Whims left depressions and trenches, power hoists left foundations, and headframes can be represented by timber footers or impressions left by the footers.

Hardrock Prospect Site Types

Prospect Complex

Prospect complexes can manifest as a closely spaced group of pits, trenches, adits, or shafts arranged according to a pattern. The workings are very shallow and represent organized mineral sampling. If the organization pattern is clearly evident, then the site may be eligible for the NRHP under Criterion C. While prospect workings are relatively common, complexes reflecting a discernable, organized, planned effort are uncommon and may be important.

Prospect Shaft

A single, unproductive, simple shaft operation with a waste rock dump of limited volume, prospect shafts, vertical or inclined entries underground, often featured surface plants equipped with a hoisting system and a blacksmith shop. Hoisting systems were simple and ranged from

manually operated windlasses to small mechanical units, as discussed above. The surface plant components were usually clustered around the shaft, and by definition, prospect shafts lacked evidence of ore storage or processing facilities. Today, most shaft collars have collapsed, leaving areas of subsidence that can appear similar to large prospect pits. For a site to be defined as a shaft, the volume of waste rock should exceed the volume of the shaft's area of subsidence.

As a site type, prospect shafts tend to be common, while examples retaining high degrees of archaeological, engineering or standing buildings are uncommon and often important. Intact shaft collars are important, as are machinery and structures.

Prospect Adit

A single, unproductive, simple adit operation with a waste rock dump of limited volume, an adit was a horizontal entry underground usually 3-by-6 feet or less in-the-clear. Prospect adit operations often featured surface plants equipped with little more than a blacksmith shop and a mine rail line exiting the adit. Hand-powered mechanical blowers may have been used to force fresh air underground. As a site type, prospect adits tend to be common, while examples retaining high degrees of archaeological, engineering, or architectural integrity are uncommon and important.

Feature Types Common to Prospect Sites

Boiler System Feature Types

A boiler was a vessel that generated the steam that powered machinery. It seems little exaggeration to state that the mining industry ran on steam power until the 1910s, when electricity and petroleum engines became nearly universal. Prospect outfits chose the type and size of boiler according to the operation's degree of remoteness, budget, and power needs. When encountered at a prospect site, a boiler falls under the general Feature Type of Boiler, and the researcher should discuss the type and size in the feature description. The types are noted below in order of size, and as a general rule, existing boilers are rare and important engineering features.

Upright boilers (Figure 4) were the least costly, the easiest to transport, and the most inefficient of the portable types. Upright boilers featured a vertical, cylindrical shell over a firebox. Flue gases left the firebox, rose through a cluster of tubes that perforated the shell, and exited a smokestack. Upright boilers were self-contained, stood on a cast-iron base, and ranged from 2 feet in diameter and 7 feet high up to 5 feet in diameter and 12 feet high. Because they were self-contained, upright boilers required no formal foundations, although workers often placed them on rock pads.

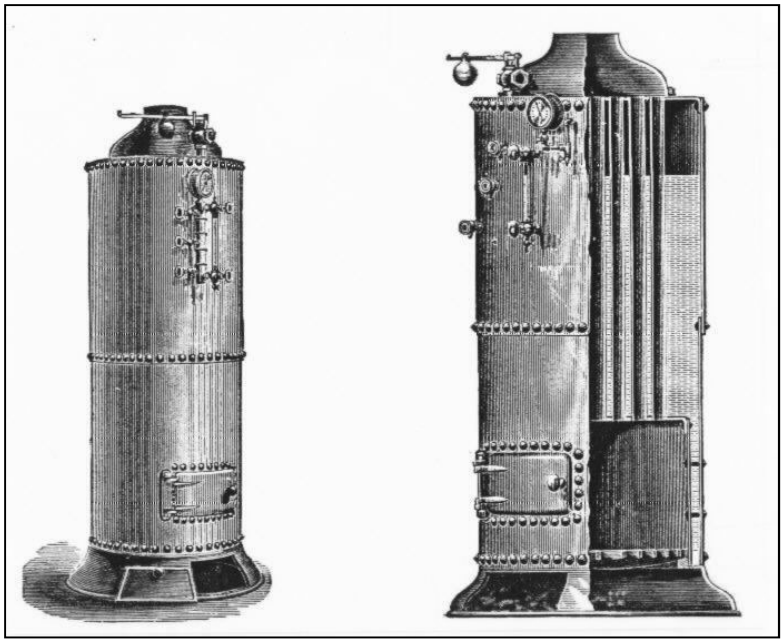

Figure 4. Upright boilers were the least expensive and most portable type of boiler, but they were also inefficient. Flue gases rose from the firebox at bottom, through the flue tubes, and out a smokestack at top. Note the water level sight tube, pressure gauge, and pressure valve. Source: Rand Drill Company 1886:47.

The *locomotive boiler* (Figure 5) was one of the most popular types of portable boiler and derived its name from its common use in railroad locomotives. The locomotive boiler consisted of a horizontal shell perforated with flue tubes, a firebox underneath one end, and an attachment for a smokestack at the other. The firebox and shell were manufactured as a single, riveted iron unit that stood on skids. Hot flue gases left the firebox, traveled through the tubes, and exited the smokestack. Small boilers featured a shell 2 feet in diameter, stood 4 feet high including the fire box, and were up to 10 feet in length. Large units featured a 5-foot diameter shell, stood 9 feet high, and were up to 23 feet long. Boilers commonly employed at mines were usually in between in size.

To overcome inefficiencies of the locomotive boiler, manufacturers offered the *Pennsylvania boiler* (Figure 6), which was self-contained and portable. While Pennsylvania boilers were similar in appearance to locomotive units, the path that the flue gases traveled differed. They left the firebox, traveled through a set of lower tubes, gathered in a chamber at the boiler's rear, returned through a set of upper tubes, and exited the smokestack located over, but sealed from, the firebox. As a general description, Pennsylvania boilers featured a horizontal shell with a firebox under one end, a sealed rear, and a manifold for a smokestack over the firebox.

Boiler Foundation: Because portable boilers were self-contained and free-standing, prospect outfits usually stood them on platforms located near the hoist. Occasionally, however, workers erected rock or brick foundations or pads on the platform to support the boiler. The artifact assemblage around a foundation or platform can help the researcher identify it as that for a boiler. The assemblage should include clinker, unburned bituminous coal, ash, water-level sight-glass fragments, and pipe fittings.

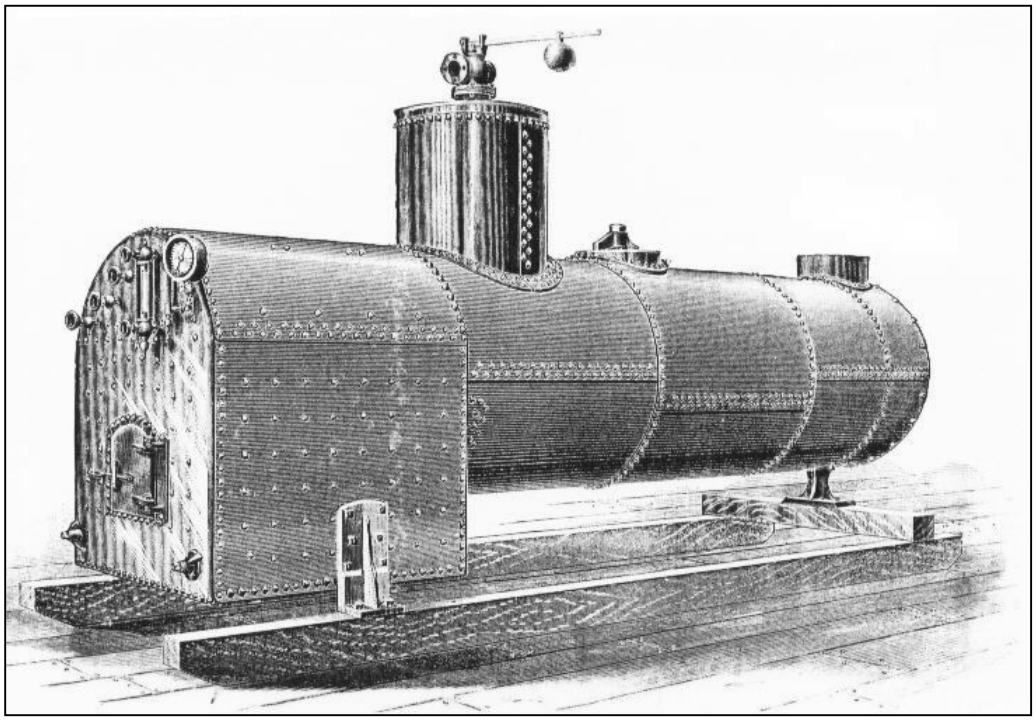

Figure 5. The locomotive boiler was one of the most popular steam generators. Flue gases traveled from the firebox at left through flue tubes in the tank and out a smokestack at right. Source: Rand Drill Company 1886:45.

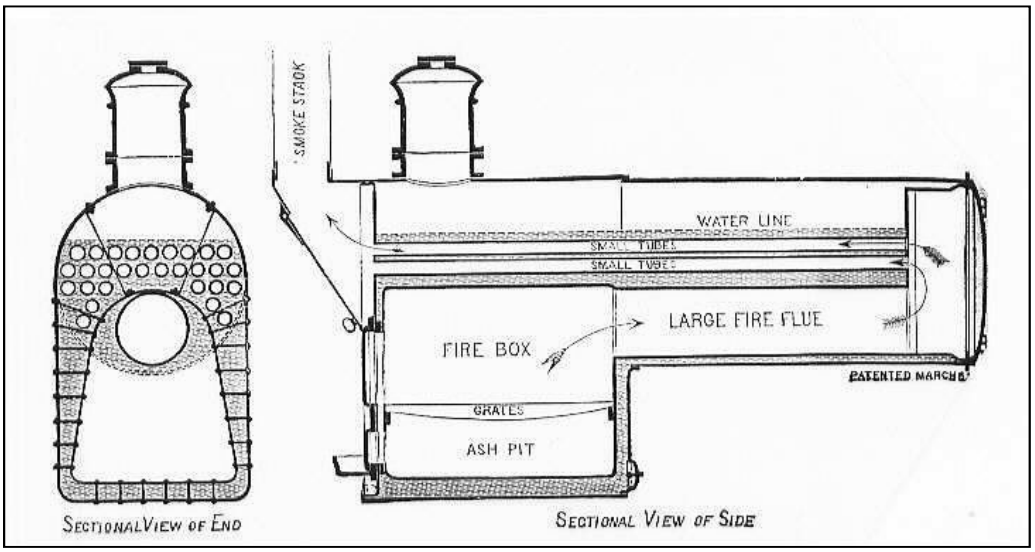

Figure 6. The Pennsylvania boiler was portable, stood on skids, and provided greater fuel economy than the locomotive type. Note the path traveled by the flue gases, which prolonged contact with the boiler surfaces. Source: Rand Drill Company 1886:46.

Some prospect outfits installed upright boilers on square or circular dry-laid rock pads, or excavated a shallow pit underneath the boiler to allow ashes from the firebox to drop through. The pad's size should approximate the boiler's diameter.

Pennsylvania boilers and locomotive boilers stood on skids, which usually required no support. However, where the ground was soft or uneven, workers often laid parallel rock alignments to prevent the boiler from settling. In the absence of rock supports, the skids occasionally became embedded in the ground, which left two parallel depressions the length and width of the boiler. For locomotive boilers without skids, which were rare, workers erected a rock or brick pylon to support the high rear, and laid a rock or brick pad that supported the firebox end.

Claim Marker and Stake Feature Types

Claim Marker: Prospectors erected claim markers at the corners of their claims, which were usually 600-by-1,500 feet in area. Markers ranged from cairns to up-ended boulders. When a surveyor mapped and registered a claim, he usually etched the survey number into a corner rock.

Claim Stake: A claim stake was the universally recognized form of claim marker. Claim stakes were usually 4-foot high, 4-x-4 posts.

Hoisting System Feature Types

Headframe: A frame made of timber or logs that stood over a shaft. Headframes associated with horse whims were often large tripods or tetrapods. Power hoisting systems usually employed *two-post gallows* headframes (Figure 7) that consisted of two posts on timber footers, backbraces that supported the posts, and cross-members at top. The cross-members featured a large pulley known as a *sheave* that guided the hoist cable into the shaft. Headframes associated with prospect shafts were less than 25 feet high (Twitty 2002:177).

Headframe Ruin: The collapsed remnants of a headframe.

Headframe Foundation: Headframe foundations usually manifest as parallel timbers flanking a shaft and extending toward the area where a hoist was located. The foundation should feature joints adjacent to the shaft for the headframe posts and another set of joints near the hoist for the backbraces.

Hoist: Almost all shaft operations required a hoist to raise rock out of the underground workings. While windlasses and horse whims are versions of hoists, the term as used here refers to mechanical, power-driven types (Figure 8). The hoist's basic form remained fairly constant between the 1870s and 1950s, and most changes involved the evolution of different sources of power. Between the 1870s and 1900s, steam reigned supreme and, afterward, petroleum power came to dominate.

Figure 7. The headframe at the Village Belle Mine in the Rocky Mountains exemplifies a typical two-post gallows headframe. Sinking-class headframes tend to be less than 25 feet high and stand on timber footers. Source: Carol Beam

The *single-drum steam hoist* (Figure 9) was the most common power-driven type employed between the 1870s and 1900s. Single-drum steam hoists consisted of a cable drum flanked by two steam cylinders, and a braking apparatus, all assembled on a common cast-iron bedplate. The steam cylinders powered the cable drum through a set of reduction gears, and the hoist operator controlled the machine via levers and foot pedals at the rear. Hoists less than 6-by-6 feet in area were intended for deep exploration and larger units were intended for light to moderate production.

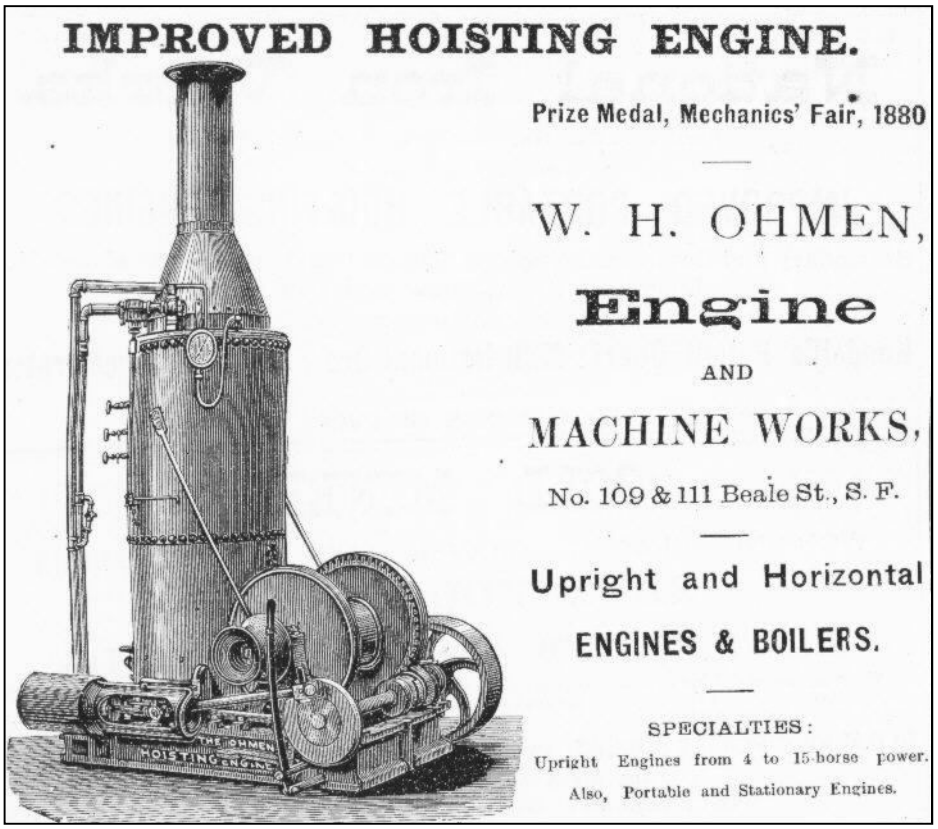

Figure 8. Donkey hoists were popular for deep prospecting after the 1880s because they were self-contained and required little site preparation other than a flat area. Source: *Mining & Scientific Press* 1881.

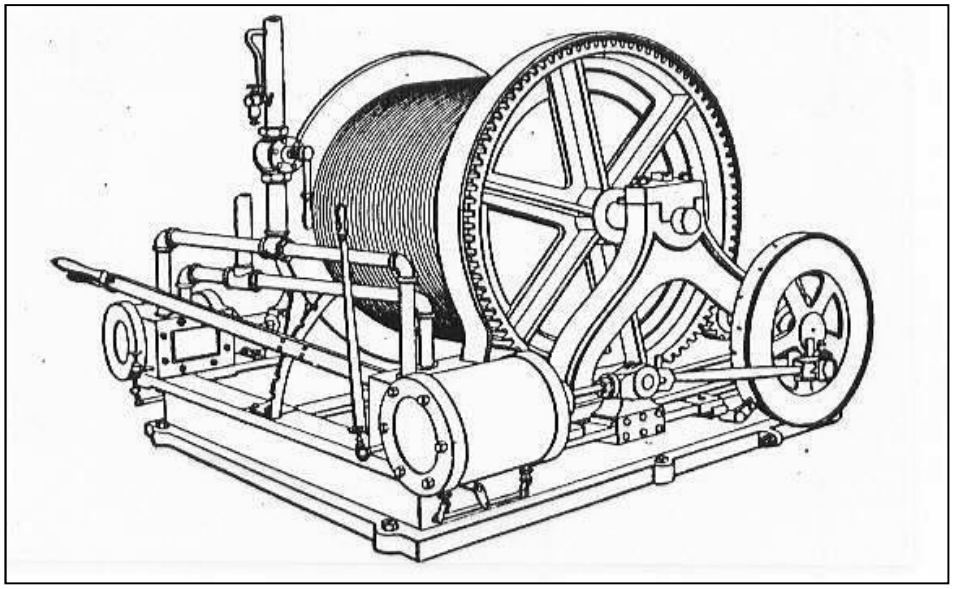

Figure 9. Single-drum geared steam hoists were the most common types of power hoists employed between the 1870s and 1900s, when gasoline and electric models became popular. Source: International Text Book Company 1906:A50:8.

Single-drum electric hoists (Figure 10) were one of the most common types of hoist used between the 1910s and 1950s. Factory-made models consisted of a cable drum, a shaft featuring a bull gear, and an electric motor, all bolted to a common cast-iron bedplate. The duty and size rating for electric hoists were similar to those for their steam-driven predecessors. Large units often featured an electric motor bolted to a separate mount adjacent to the bull gear. Between the 1910s and 1930s, prospect outfits attempting to save capital stripped the drive trains off obsolete steam hoists and retrofitted a motor to the bull gear.

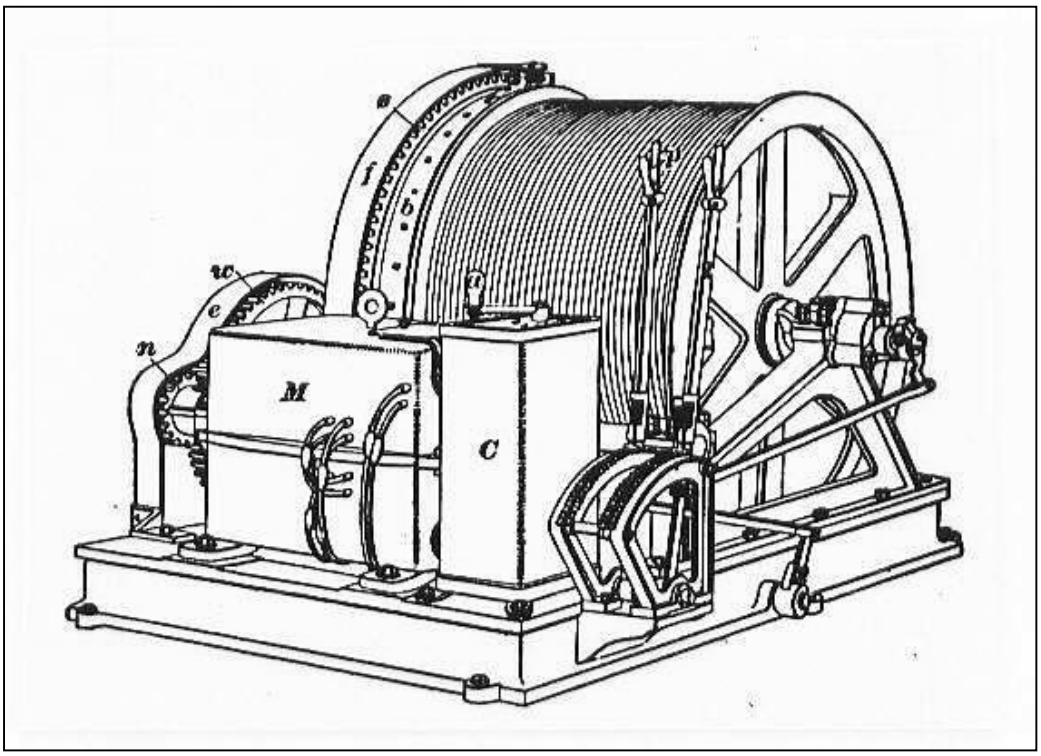

Figure 10. The illustration depicts a common single-drum electric hoist, which grew in popularity during the 1910s where power was available. The motor is in the case, the upright box is a speed controller, and the motor turned the drum via gearing. Source: Twitty 2002:224.

By around 1900, mining outfits began employing *petroleum hoists*, also known as *gasoline hoists* (Figure 11) because the machines required easily transported liquid fuel and water only for cooling. By contrast, steam hoists needed a reliable source of water and consumed high volumes of bulky fuel that was costly to ship. Factory-made gasoline hoists featured a large cable drum and reduction gears assembled on the front of a tall cast-iron bedplate. A single-cylinder gasoline engine was usually anchored to the bedplate's rear, and the controls were either on the side or at the rear. The engine is often distinct and consists of large, horizontal cylinder, dual flywheels, an exhaust pipe, and fine machine linkages.

Hoist Foundation: Nearly all mechanical hoists were anchored to foundations to keep them in place, and a foundation's footprint usually reflects the type of hoist (Figure 12). Foundations are common at prospect shaft sites and can usually be found aligned with and at least 20 feet

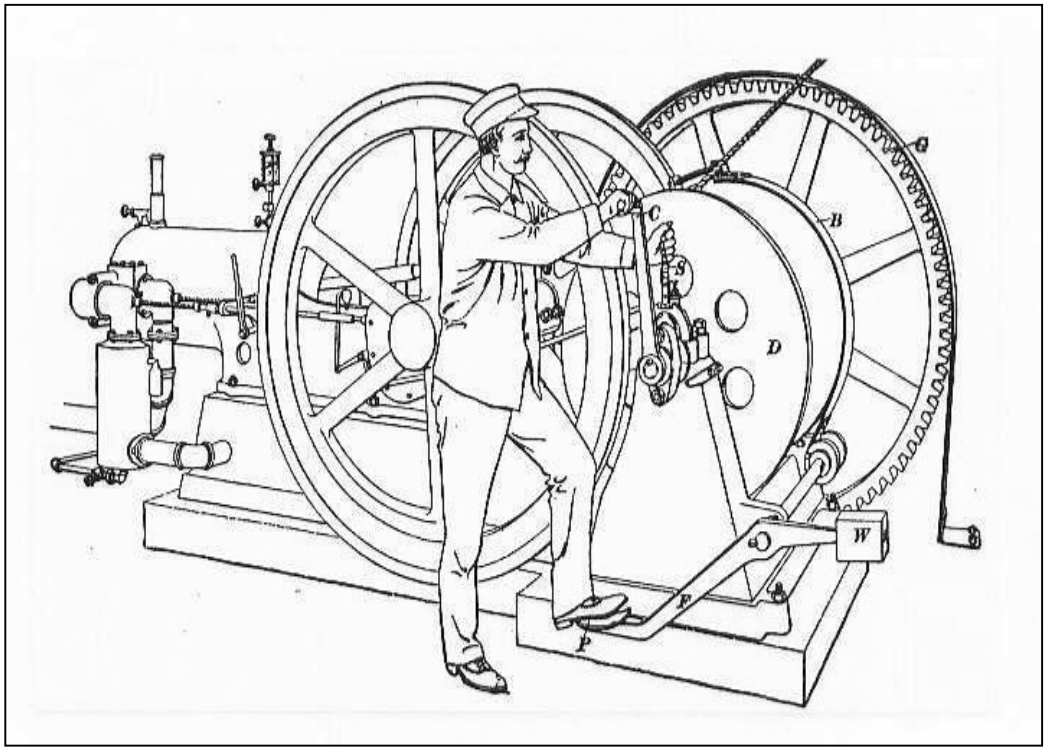

Figure 11. This type of gasoline hoist was employed for deep prospecting and minor ore production between around 1900 and 1930. A single-cylinder engine is at left, dual flywheels are at center, and the cable drum is at right. Source: International Textbook Company 1906:A50:31.

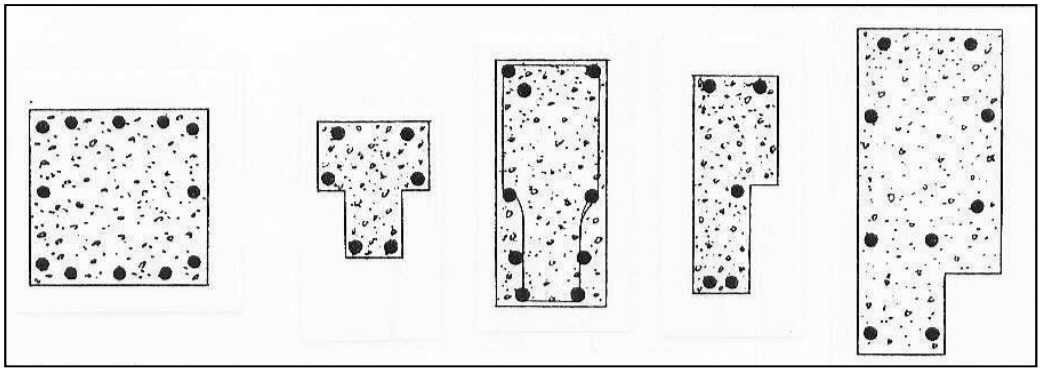

Figure 12. Hoist foundation plan views. Single-drum steam hoists were bolted to foundations like the one at left, and the other foundations were for various types of gasoline hoists. Source: Twitty 2002:187, 241.

from the shaft. Because of their ease of construction and low cost, prospectors usually assembled hoist foundations with timbers, and occasionally with stone or concrete. Timber foundations decay and become buried over time, and often manifest today as rectangular groups of four to six anchor bolts projecting out of a hoist house platform.

Horse whims were usually bolted to timber foundations 2-by-2 feet in area at the bottom of a shallow pit. The trench for the cable and linkages often extends from the pit to the shaft. Foundations for *horizontal reel whims* feature four anchor bolts and may retain the hub that the reel rotated on. Foundations for *geared whims* often consist of four anchor bolts projecting out of parallel timbers.

Foundations for *single drum steam hoists* are usually rectangular, flat, and feature at least four anchor bolts. They can range in size from 6-by-6 feet to as little as 2-by-3 feet in area. The artifact assemblage associated with a foundation may help confirm the use of steam power. Steam hoists often left behind plumbing and gaskets, and the site should possess evidence of an associated boiler.

Foundations for *gasoline hoists* are fairly distinct. Their footprint is that of an elongated rectangle at least 2-by-5 feet in area oriented toward and aligned with the shaft. Due to the engine's severe vibrations, prospectors often bolted hoists to concrete foundations at least 1 foot thick. Gasoline hoist foundations usually feature at least two rows of three anchor bolts, with the rear two closer together than the rest. Gasoline hoists can leave distinct artifact assemblages that include thin wires, spark plugs, small pipes, and fine machine parts.

Hoist House: A structure that enclosed a hoist, the hoist's power source, and often a blacksmith shop (Figure 13). Hoist houses were usually located at least 30 feet away from the shaft.

Figure 13. At shaft operations, mining companies erected hoist houses to enclose critical facilities. The Blue Jay Mine's hoist house in the Rocky Mountains is a typical example. The left roofline features an angled cupola for the hoist cable, which ascended to a headframe left and out of view. Source: Author.

Hoist House Platform: An earthen platform, usually graded with cut-and-fill methods, that supported a hoist house. The platform often features evidence of a hoist and a shop.

Hoist House Ruin: The collapsed remnants of a hoist house.

Horse Whim: A mechanical hoist powered by a draft animal. Two types of whims were popular at different times (discussed above). The *horizontal reel whim* consisted of a cable reel at least 3 feet in diameter fitted with a harness beam on top. The reel was oriented horizontally, much like a turntable. The *geared whim* was compact and featured a vertical cable drum assembled in a frame. A capstan, geared to the drum, featured a hardness beam on top.

Horse Whim Pit: Prospectors often placed horse whims in shallow pits so the cable could pass through a trench to the headframe and thus pose no obstacle to the encircling draft animal. They often lined pits with planks to retain soil that, over time, collapsed, leaving linear depressions. The pit should be at the center of a draft animal track, aligned with and at least 20 feet from the shaft, and feature the remnants of the cable trench.

Rail Line, Draft Animal Track, and Pack Trail Feature Types

Mine Rail Line: A track for ore cars that extended away from either an adit portal or shaft.

Mine Rail Line Remnant: When prospectors dismantled a track, they often left in situ ties, impressions of ties, and sections of in-site rails.

Draft Animal Track: A track walked by a draft animal around a horse whim, as discussed above. Draft animal tracks tend to be around 20 feet in diameter and were cleared of major obstacles. Prospectors often graded semi-circular platforms adjacent to shafts for tracks.

Pack Trail: A path less than 8 feet wide that provided access to prospect workings.

Prospect Adit, Pit, Shaft, and Trench Feature Types

Prospect Adit: A horizontal entry underground denoted by a waste rock dump. Prospectors often erected cap-and-post timbering to support the initial point of entry known as a *portal*. After abandonment, adits often collapsed and eroded into what appear to be trenches.

Prospect Pit: A circular excavation surrounded by a small volume of waste rock.

Prospect Shaft: A vertical or inclined opening underground. When intact, shafts tend to be rectangular and when collapsed, they manifest as circular areas of subsidence. Prospectors often installed timber or log cribbing to support a shaft's walls. The area around the shaft is known as the *collar*.

Prospect Trench: A linear excavation flanked by a small volume of waste rock.

Shop Feature Types

Forge Remnant: Can manifest as a mound of gravel and rocks or the remnants of a gravel-filled wood box (Figure 14), usually impregnated with coal and clinker. When coal burned at high temperatures, it left a **scoriaceous**, dark residue known as *clinker*. Forge remnants are usually located on a shop platform, and some may have been open-air affairs.

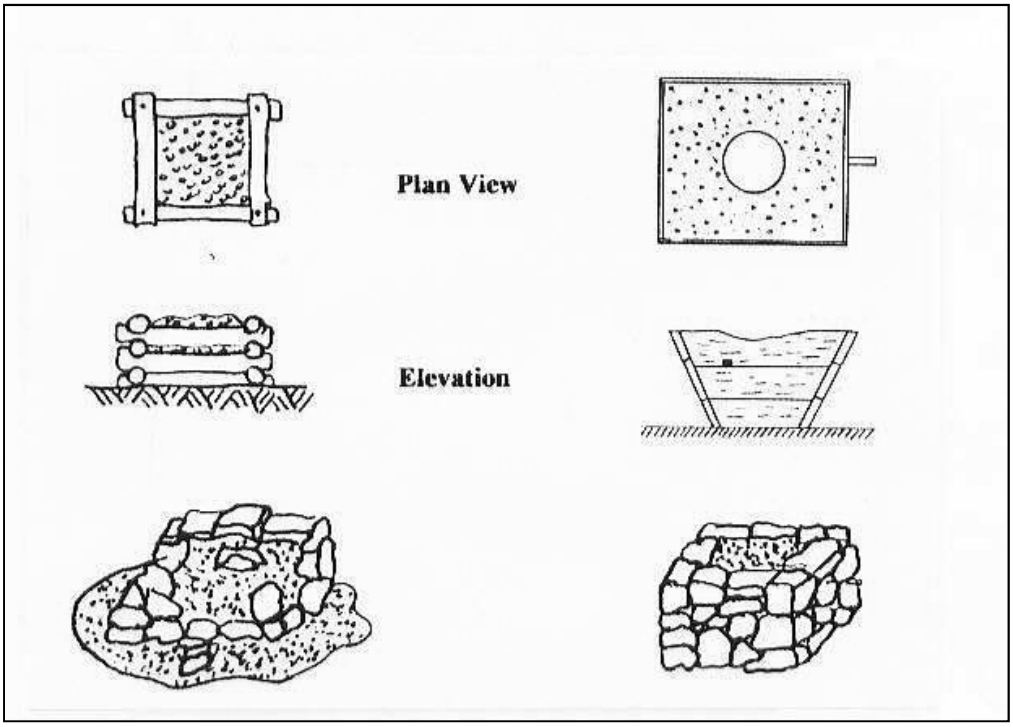

Figure 14. Examples of the common forges used in mine shops. At upper left is a gravel-filled log forge, at right is a wood box forge, and at lower right is a dry-laid rock forge. Over time, rock forges decay and collapse, and manifest as the remnant at lower left. Source: Author.

Shop: A building that enclosed facilities where a worker fabricated and maintained tools and hardware (Figure 15). Simple shops, such as those at prospect operations, usually featured a forge, a workbench, and possibly a hand-powered appliance such as a drill-press.

Shop Platform: An earthen platform that supported a blacksmith shop. Shop platforms may feature forge remnants and often possess artifacts such as forge-cut iron scraps, anthracite coal, and clinker, which is a **scoriaceous**, ashy residue created by burning coal.

Shop Ruin: The collapsed remnants of a shop.

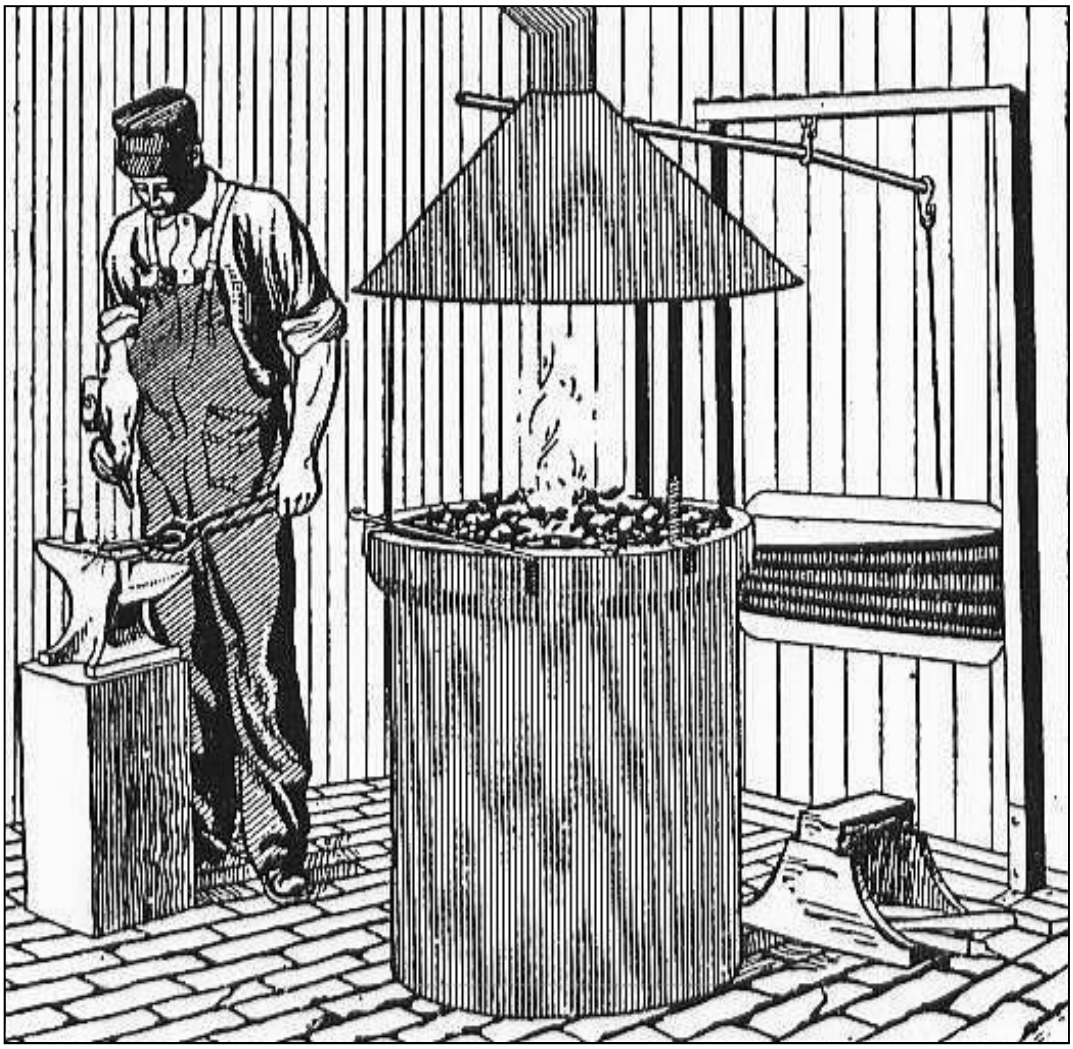

Figure 15. The illustrated shop is representative of those at prospects and small mines. Such shops usually consisted of little more than a forge, an anvil, and hand-tools, which restricted the type of work that the blacksmith could accomplish. Source: Drew 1910:1.

Waste Rock Dump Feature Type

Waste Rock Dump: The waste material removed from underground workings.

Hardrock Prospect Eligibility Guidelines

The three types of sites associated with hardrock prospecting tend to be common and usually do not retain important characteristics or features. Given this, most will be ineligible for the NRHP, although several exceptions exist. Eligible resources must possess physical integrity relative to the exploration and discovery Period of Significance for a given mining area (defined in Chapter 3). Because hardware, equipment, and structures were usually removed from a site when it was

abandoned, prospects will probably consist of archaeological features. For the archaeological remains to possess integrity, the material evidence should permit the virtual reconstruction of the prospect operation.

Only several of the seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospect complexes. The most applicable aspects will probably be Setting, Feeling, and Association. The Setting around the site, and the site itself, must not have changed to a great degree from its Period of Significance, excepting the removal of structures and equipment. Usually, this requires a preserved natural landscape and environment. In terms of Feeling, the site should convey the sense or perception of prospecting from a historical perspective and from today's standpoint. For Association, the site's sum of features and artifacts should permit the researcher to reconstruct the prospect operation.

NRHP Criterion A

Sites eligible under Criterion A must be associated with the events and themes important to a specific mining area, as well as one of the following trends. First, Fort Irwin's hardrock mining industry was founded on and a function of prospecting, and because economic ore could only be found through prospecting, this activity was a cornerstone of the region's mining history.

Second, early hardrock prospecting brought the first large numbers of European-Americans to Fort Irwin. They established the first settlements, economies, government entities, and detailed understanding of the regional geography.

Third, prospecting was important to the social development of eastern California and southern Nevada. In one sense, prospecting provided an opportunity for individuals to realize income and even ascend to elevated social and economic statuses. In another sense, prospecting contributed to a culture that pervaded the desert. Prospectors were an unusual cast of society. To search and labor in the wilderness, they had to be adventuresome, independent, curious, physically robust, and skilled at survival. Most prospectors also possessed at least some formal education and many learned about geology and mineralogy through a combination of experience and training. The very nature of wandering the desert in search of wealth required individuals who did not conform to traditional Victorian cultural values. Prospecting distributed these individuals throughout eastern California and southern Nevada, and they imparted some of their values and behaviors that persist to the present.

NRHP Criterion B

Prospect sites may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Because it is extremely difficult to directly attribute a given prospect to an important person, few sites will be eligible under Criterion B.

NRHP Criterion C

Most prospect sites will not be eligible under Criterion C because they are common types of resources, offer few important characteristics and attributes, and usually possess integrity impaired by natural decay and modern disturbance. Several exceptions, however, exist. One exception that applies to all three site types is the presence of intact architectural or engineering features. These were important aspects of prospecting and few survive today.

Prospect Complex sites may be eligible if an organization pattern is clearly evident among the various excavations. If this is so, the site may be a representation of an organized and planned effort on the part of educated and experienced individuals.

Prospect Shaft and Prospect Adit sites may be eligible if they retain a high degree of integrity, possess intact machinery, or are early in timeframe. In general, sites with integrity or machinery, and that are early, are rare.

NRHP Criterion D

Few prospect sites will be eligible under Criterion D because most information can be collected by detailed recording of surface features. Several exceptions, however, may exist. If a single group of workings appears to follow a pattern, then recording the surrounding feature groups may enhance the current understanding of the sampling methods that prospectors used. If the site possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding prospectors' lifestyles and social structures, which is important because these topics were not heavily documented in the past. If a prospect adit or shaft appears to be deep, it may contain meaningful features and artifacts underground.

Property Type 2: Hardrock Mines

General Description of Hardrock Mines

Hardrock mines were underground operations that produced measurable volumes of ore. Usually company endeavors, mines ranged in scale from small and labor-intensive to substantial, mechanized operations. Not all mines were profitable, but most shared a few basic characteristics such as substantial waste rock dumps often at least 125-by-125 feet in area, ore storage facilities, more than one structure, and roads to transport materials and ore.

Although small, marginal mines were similar in scale and content to advanced prospects, many operations featured substantial surface plants to support intensive work underground. It should be noted that most mines within Fort Irwin were small, and so they are expected to resemble deep prospects.

Regardless, mining companies often employed machinery and erected buildings larger than those at prospects to facilitate ore production. Some companies attempted to produce ore in economies of scale while minimizing energy consumption and costly labor. Such operations employed machinery and efficient ore handling systems arranged in spacious surface plants. In general,

when a mine closed, the structures, machinery, and other items of value were removed, often leaving distinct types of archaeological evidence today. Given this, intact machinery and structures are rare, which can lend to a site's importance.

Mines shared the same needs as deep prospects, and so their surface plants possessed the same sets of facilities. However, mines often possessed additional facilities and other characteristics not found at prospects. First, small mines usually had ore storage or processing facilities. Ore bins (discussed under Feature Types below) permitted a mining company to store ore between shipments. Miners usually transported payrock in ore cars through the surface plant and dumped it in the bin, and to permit this, miners usually built the structure on the flank of the waste rock dump. The least productive, most capital-poor operations tended to construct roofless, *flat-bottom ore bins*. Operations with capital and a sense of longevity erected *sloped-floor bins*, which were structurally superior, contained more rock, and permitted the ore to be poured into a wagon or truck. Like prospects, nearly all mines featured a shop usually located near the mine opening. To meet a greater need for materials-handling and fabrication, shops at mines tended to be larger and better equipped. In addition to the shop facilities found at prospects, mine shops often included a drill-press and lathe, and greater working space.

Substantial, productive mines begin to differ from prospects and small mines in the scale and content of their surface plants. Shaft operations in particular featured hoisting systems that permitted high tonnages of payrock to be raised from deep workings. The general layout and types of components were similar, only larger in scale and structurally superior. Prior to the 1900s, substantial mines employed steam hoists and afterward used gasoline hoists. Mining engineers defined steam hoists suited for production as being at least 6-by-6 feet in area.

Because the simple ore bucket employed by small operations was an insufficient hoisting vehicle for heavy production, some mining companies used *cages* instead, which were similar to an open elevator car. Cages ran on guide rails, which had to be bolted to timbering the length of the shaft and up into the headframe. To send a load to the surface, a miner underground merely had to push an ore car onto the cage, which another worker wheeled off at the shaft collar. Today, shafts and headframes featuring guide rails reflect the use of cages for hoisting.

To match the duty of the hoist and hoisting vehicle, mining companies usually erected a well-built headframe. Most companies favored the two-post gallows, four-post derrick, the six-post derrick, and A-frame. By the 1910s, some mining replaced the cage with a *skip*, which was an iron box that ran on guide rails. Guides in the headframe upset the skip, which dumped its contents into a bin attached to the headframe's side. Headframes with attached bins combined with guide rails in the shaft are hallmarks of the use of skips. In general, mining engineers considered headframes higher than 30 feet to be production-class structures.

Prior to around 1900, most mining companies within Fort Irwin used portable boilers to power their steam hoists. Professionally trained engineers, however, deemed portable boilers inefficient and inadequate for significant mining operations. Instead, engineers recommended stationary units, and the *return-tube boiler* was by far the most common type. Return-tube boilers were very distinct and consisted of a cylindrical plate-iron shell encased in a masonry setting. The shell featured numerous flue tubes and lay horizontally across the setting. A cast-iron façade was bolted across the setting's front and shrouded a firebox and ash pit below. Because return-tube boilers were costly and usually employed at significant mines, few if any are expected within Fort Irwin.

Highly productive, well-capitalized mines included additional facilities amid their surface plants. The compressed air system was one of the most common, and it permitted miners to use mechanical rockdrills to bore blast-holes underground.

As with prospecting, drilling and blasting was the primary means of advancing underground workings in mines. Prior to the 1870s, miners almost exclusively drilled by hand with hammers and drill-steels, inserted explosive charges in the holes, and set off the round. In an effort to increase the length and diameter of blast-holes and decrease drilling time, machinery manufacturers introduced mechanical rockdrills during the 1870s. The costs of purchasing and maintaining the drills and the necessary compressed air systems proved to be quite high, and as a result only the most progressive and heavily financed companies employed the machines. Rockdrill use increased through the 1880s as manufacturers effected improvements and costs decreased, and by the 1890s the machines became common among well-capitalized operations. Through the 1890s and into the 1900s, costs continued to decrease while manufacturers improved compressed air systems, and as a result a wide spectrum of companies was able to employ the machines. By the Great Depression, most mining companies perceived rockdrills as a requirement for profitable work. Due to the high costs of compressed air systems, few mining companies within Fort Irwin employed rockdrills until the 1930s.

Compressed air systems featured an assemblage of components that compressed the air, moderated the air's flow, and delivered it underground to the points of work. The *compressor* can be viewed as the system's heart. Between the 1870s and 1950s, compressors evolved in terms of size, form, and power source (discussed under Feature Types below). Once the air was compressed, it left the machine through a *main* to a *receiving tank*, which moderated the flow of air and dampened pulses created by compressor. Receiving tanks, similar in appearance to small boilers, were riveted iron cylinders that featured input and output pipes, a drain valve, and an ovoid cleaning port. The compressed air left the receiving tank through another main that extended into the mine opening.

Mining companies installed compressed air systems with the same methods that they used to engineer hoisting systems. They arranged the components according to a master datum taken off the shaft or tunnel. Depending on the compressor's power source, the mining company had to install additional components for the system. Prior to the 1900s, most compressors were powered by an integral steam engine, and afterward, they were either belted to or directly driven by gasoline engines.

To facilitate production in economies of scale, many substantial mining companies constructed ore storage and processing facilities capable of receiving high volumes of ore. Some mines were fortunate enough to feature fairly straightforward, consistent payrock, which miners sent directly to ore bins at the surface plant. To handle significant tonnages, moderate to highly productive companies usually erected large sloped-floor bins. Multiple cells added structural rigidity, as well as permitting some separation for different grades and lots produced by independent parties leasing sections of the workings.

The shop was another facility that differed in size, scale, and complexity for small, moderate, and large operations. In general, the employment of mechanization created a heavy demand for advanced metalwork and carpentry. To meet such needs, and to increase the volume and scale of work, substantial mining companies erected spacious shops equipped with power-driven

appliances. Further, particularly large companies constructed separate buildings for blacksmithing and sharpening of drill-steels, machine work, and carpentry. Where possible, companies located the shop adjacent to the mine opening to minimize the undue handling of heavy materials. Many shops featured a basic array of power appliances, including a drill-press, lathe, trip hammer, and pipe cutter. In the late 1890s, a number of mining companies employed gasoline engines to power their shop appliances, but had used upright steam engines in prior years. Most power appliances had to be anchored to foundations, which ranged from timbers to concrete pads.

In many cases, the surface plants erected by advanced companies required more than the single structures typical of small outfits. Facilities such as shops, explosives magazines, offices, and quarters for draft animals were enclosed in individual buildings clustered around the mine opening. At shaft mines, *hoist houses* were dominant buildings and enclosed the hoist and a shop, and at tunnel mines, *compressor houses* sheltered a compressor and shop.

Except for a few deviations, most mining companies designed their buildings according to function and economy with little thought of adornment or architectural style. Foundations for mine buildings were often temporary and consisted of timbers, logs, posts, or rock alignments. Floors were often of earth or planks where necessary. To support small structures, companies usually built vernacular or post-and-girt frames. To support large structures and those that bore great weight, they designed vernacular frames with heavy timbers or variations of square-set frames. Before corrugated sheet iron became common by the late 1890s, mining companies sided their structures with planks, and by the 1900s, many companies used tarpaper for small buildings. Due to the high cost of hauling in lumber, mining companies within Fort Irwin also constructed buildings with dry-laid rock masonry.

From an industry-wide perspective, mine buildings existing today possess similar attributes in terms of appearance, materials, design, and workmanship. Further, two trends based on timeframe are apparent. Buildings erected prior to the sweeping decline of mining during the 1910s tended to follow a formal design and were well-constructed with virgin or original materials. The overall style can be referred to as *Western mining vernacular*. During the Great Depression, a change occurred that was largely a function of a lack of capital, resources, and experienced mine labor. Workmanship tended to be poor, buildings small, a high degree of salvaged materials used, and design and structural features based around available materials. Many buildings erected between the Depression and the 1940s often appear ramshackle, crude, battered, and assembled by inexperienced individuals. Mine buildings with such style can be described as *Depression-era mining vernacular*.

Hardrock Mine Site Types

Shaft Mine

Small shaft mines were similar to but more extensive than prospect shafts. Surface plants typically included a power hoisting system consisting of a steam or gasoline hoist, a headframe, and a portable boiler (associated with steam hoists). A hoist house enclosed the hoisting system and almost always a shop. Surface plants also featured an ore bin and possibly other structures. Large shaft mines possessed complex, mechanized surface plants with multiple structures.

Well-capitalized operations often featured compressed air systems enclosed in either the hoist house or a separate compressor house.

Small to moderate-sized shaft mines retaining limited integrity are common, but sites retaining high degrees of any form of integrity are uncommon and possibly important. Large, complex shaft mines are uncommon, and those retaining any form of integrity are rare and important.

Tunnel Mine

Small tunnel mines were similar to and slightly more extensive than prospect adits. Surface plants usually consisted of a shop, an ore bin, and possibly another structure. Moderate to large tunnel mines often possessed complex surface plants that included machinery and several structures. Well-capitalized tunnel operations often featured compressed air systems located in compressor houses.

Small to moderate tunnel mines retaining limited integrity are common while sites retaining high degrees of any form of integrity are uncommon and possibly important. Large, complex tunnel mines are uncommon and those retaining any form of integrity are rare and important.

Feature Types Common to Mine Sites

Mine sites often possess an array of archaeological, engineering, and architectural features that were originally components of the principal transportation, ore storage and processing, and support systems discussed above.

General Feature Types

Adit: A horizontal opening usually less than 3-by-6 feet in-the-clear. Collapsed adits manifest as linear areas of subsidence. For comparison, tunnels were horizontal openings and greater than 3-by-6 feet in-the-clear.

Building Platform: A flat area upon which an unidentifiable type of building stood.

Explosives Magazine: Organized mining outfits erected magazines to store explosives away from a mine's surface plant. Some magazines were dugouts, some were stout stone structures, while others were no more than small sheds much like dog houses.

Machine Foundation: A timber, masonry, or concrete foundation for an unknown type of machine.

Mine Rail Line: A track that facilitated the movement of ore cars around a mine site. Tracks usually consisted of rails spiked to a series of crossties.

Mine Rail Line Remnant: When a mine rail line was dismantled, workers often left ties, impressions from ties, portions of rails, and the rail bed that represent the track today.

Pipeline: An assembly of pipes usually intended to carry water. Pipelines should not be confused with compressed air mains, which extended from a compressor into underground workings.

Pipeline Remnant: Evidence of a disassembled pipeline.

Privy: Most mines of substance featured a privy for the crew's personal use. Privies usually are small frame structures with a door and a bench featuring between one and several cutouts for toilet seats.

Privy Pit: A pit that underlay a privy. Pits tend to manifest as depressions less than 5 feet in diameter, often with artifacts and other materials in their walls and bottoms. Some pits may be larger.

Refuse Dump: A collection of hardware, structural materials, and other cast-off items.

Road: Roads were graded for wagons and were usually at least 8 feet wide.

Shaft: A vertical or inclined opening underground usually at least 4-by-8 feet in area. Some shafts were divided into compartments. The larger compartment was the *hoisting compartment,* and the smaller, usually less than 3 feet wide, was the *utility compartment*.

Shaft House: A shaft house was a large building that enclosed the shaft collar, the hoisting system, and usually a shop. Fort Irwin's mines possessed few if any shaft houses.

Shaft House Platform: The platform that supported a shaft house. Large shaft houses often stood on rock foundations, which can define the structure's perimeter. Differences in soil types and consistencies can reflect a shaft house's footprint.

Shaft House Ruin: The collapsed remains of a shaft house.

Stable: A building that housed draft animals used for both underground and surface transportation. Stables were often crude and featured wide doorways, feed mangers, and oat boxes.

Stable Ruin: The collapsed remnants of a stable.

Timber Dressing Station: Timber dressing stations tend to be represented by collections of raw logs and numerous cut wood scraps, usually on flat or gently sloped ground near the mine opening.

Timber Stockpile: A stockpile of stout mine timbers, often located near the mine opening.

Trestle: A structure that supported a mine rail line, walkway, or pipeline. Trestles usually consist of a series of piers linked by horizontal stringers. A pier was a pair of timber or log posts joined by a cap timber. Workers often built small trestles on the flanks of waste rock dumps to support dead-end rail lines.

Trestle Remnant: Posts, single piers, or partial stringers left from a trestle.

Tunnel: A horizontal opening underground usually more than 3-by-6 feet in-the-clear. Collapsed tunnels often manifest as linear areas of subsidence, possibly with pipes or rails projecting outward.

Utility Pole: A pole that supported an electrical or communication line.

Ventilation Blower: Many mining operations employed ventilation blowers to force fresh air underground (Figure 16). Blowers were usually located adjacent to the mine opening and attached to an assemblage of ventilation tubes that extended underground. Two types of blowers proved popular. The *propeller fan* was similar to an enlarged version of today's household fan and was encased in a sheet iron shroud with a port for ventilation tubes. The *centrifugal blower*, by far the most popular, can be divided into two categories. The first was boxy and featured a ring of vanes in a sheet-iron shroud, and the second was curvaceous, thin, and encased in a cast-iron shroud. Large blowers had to be anchored to foundations, and as most were belt-driven, they featured an adjacent gasoline or steam engine.

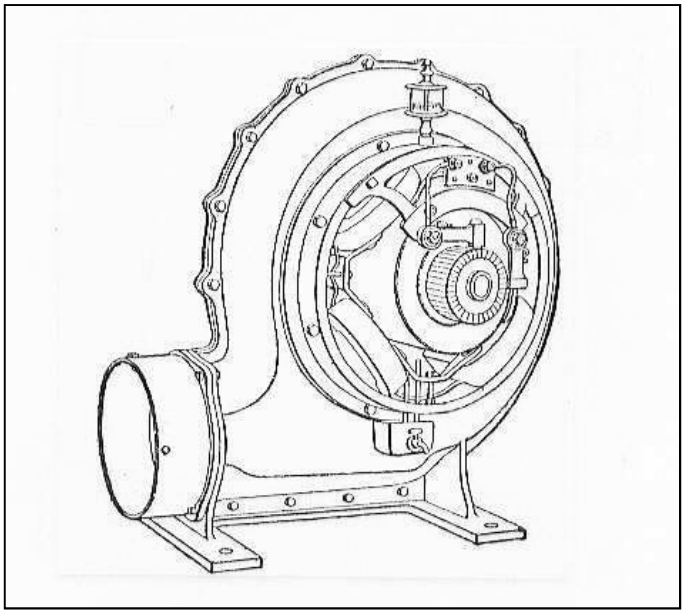

Figure 16. A common ventilation blower used to force fresh air underground. Ducting was fastened to the nozzle, and a belt turned the machine. Source: International Text Book Company 1899:A41:146.

Compressed Air System Feature Types

Ventilation Blower Foundation: Large blowers were anchored to simple foundations (Figure 17) usually consisting of timbers embedded in the ground adjacent to the mine opening . The foundations tend to be 3-by-4 feet in area or less and feature four anchor bolts. A gasoline or steam engine that powered the blower was usually bolted to an adjacent foundation.

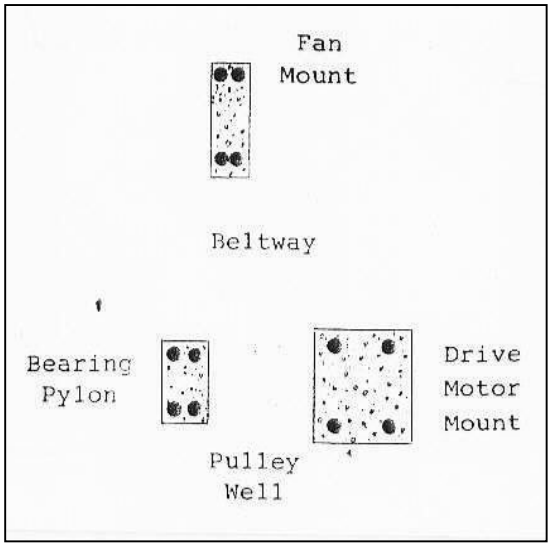

Figure 17. The plan view depicts a typical concrete foundation for a ventilation blower and its drive motor. Source: Author.

Air Compressor: An air compressor was a machine that compressed air to power rockdrills underground. Mining companies employed a variety of types, which rose and fell in popularity between the 1870s and 1940s. As a general rule, intact compressors are rare and important engineering features.

Straight-line steam compressors (Figure 18) were the earliest and simplest type, and they were introduced during the 1870s and fell out of favor by the 1910s. Most straight-line steam compressors featured a compression cylinder at one end, and both a steam cylinder and flywheel at the opposite end. The components were integral with a large cast-iron body bolted to a foundation. Small units were 2 feet wide and 7 feet long, and large units were up to 5 feet wide and 14 feet long, often with an outboard flywheel bearing.

During the 1890s, as gasoline utility engines grew in popularity, machinery manufactures offered *straight-line belt-driven compressors* (Figure 19). Early models were similar to their steam-driven brethren, except the apparatus lacked steam equipment and instead featured a broad flywheel belted to an engine. By the 1910s, a small model became popular and was in heavy use into the 1940s at mines where air needs were limited. These small units ranged in size from 2-by-5 feet to 4-by-9 feet in area.

Machinery manufacturers introduced a *duplex belt-driven compressor* (Figure 20) during the late 1890s that was popular into the 1950s. Most ranged in size from 5-by-6 feet to 10-by-14 feet in area, and consisted of a U-shaped cast-iron body with a flywheel near center and compression cylinders at the open end.

During the 1910s, machinery manufacturers introduced the *petroleum compressor*, which consisted of a small straight-line unit shafted to a petroleum engine. Their sizes were similar to the small belt-driven compressors and the machines were popular at remote mines through the 1940s.

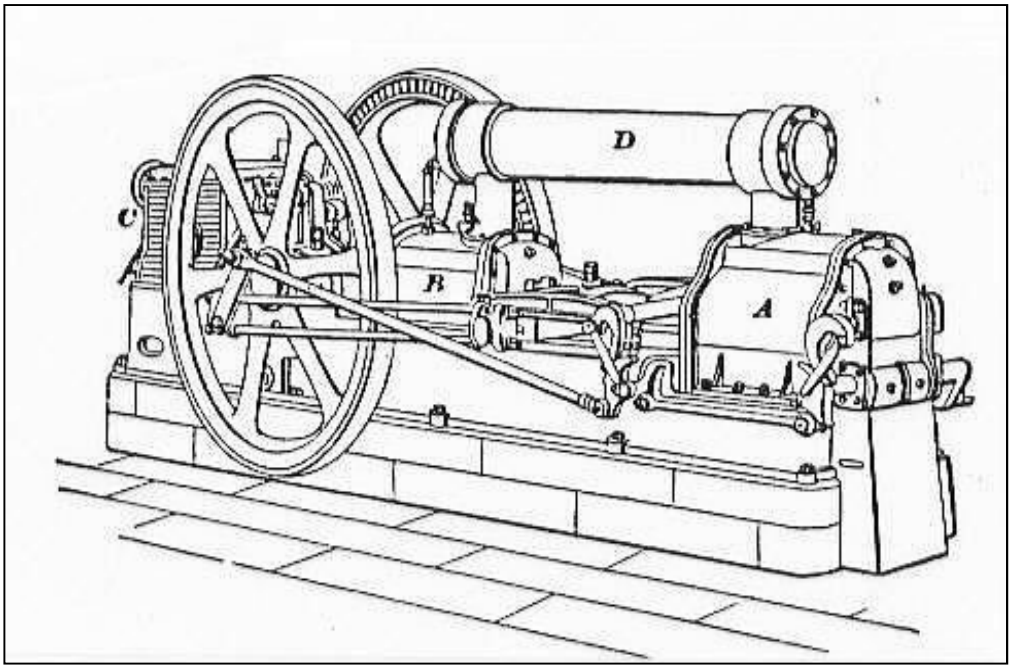

Figure 18. The line drawing depicts a straight-line steam compressor that provided two stages of compression. One compression cylinder is at right, another is at center, and the steam drive cylinder is at left. The flywheels imparted momentum to the machine. Source: International Textbook Company 1899:A20:32.

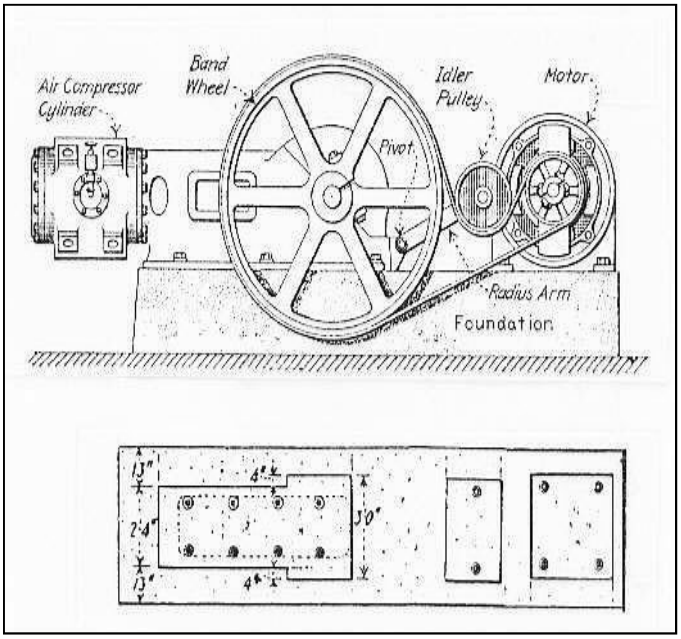

Figure 19. The profile illustrates the type of small, belted compressor popular between the 1900s and 1940s. The plan view depicts the foundation, which features mounts for the compressor and motor. Source: Author.

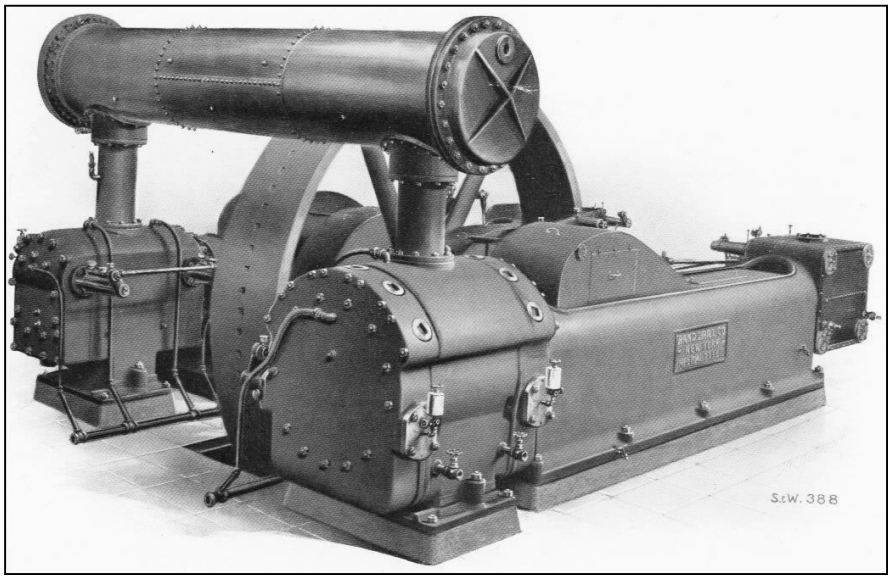

Figure 20. During the 1890s, this form of duplex compressor became popular due to its efficiency and compact size. Originally, these machines were powered by steam, and by the 1900s, some were also belted to gasoline engines. Source: Rand Drill Company 1904:12.

Some mining operations with limited air needs employed *upright compressors*, which featured two vertical compression cylinders bolted to a subframe. These machines were usually powered by a gasoline engine and were rarely larger than several feet in area. Like the petroleum compressors, upright models were popular at small, remote mines between the 1910s and 1940s.

During the 1930s, compressor designs changed substantially and manufacturers introduced the *V-cylinder compressor* (Figure 21), which was based on the mechanics of the automobile engine. V-cylinder compressors featured a crankcase, several cylinders on top, and a radiator to dissipate heat.

Air Compressor Foundation: Because of their great weight and powerful motion, air compressors had to be anchored to solid foundations. Workers often constructed timber foundations for small compressors and used either masonry or concrete for large models. In most cases, when a mine was abandoned the compressor was removed, leaving the foundation as the machine's only representation. Based on a foundation's footprint, the researcher can often determine the exact type of compressor. The foundations for the above types of compressors are described below.

Straight-line steam compressors usually stood on foundations that featured a rectangular footprint and a flat top-surface *studded* with two rows of anchor bolts (Figure 22). In general, workers used masonry or concrete, although they bolted some machines less than 12 feet long to timber foundations.

Figure 21. The V-cylinder compressor, similar to a large engine, became one of the most popular compressor types after the 1930s. Note the foundation. Source: Twitty 2002:274.

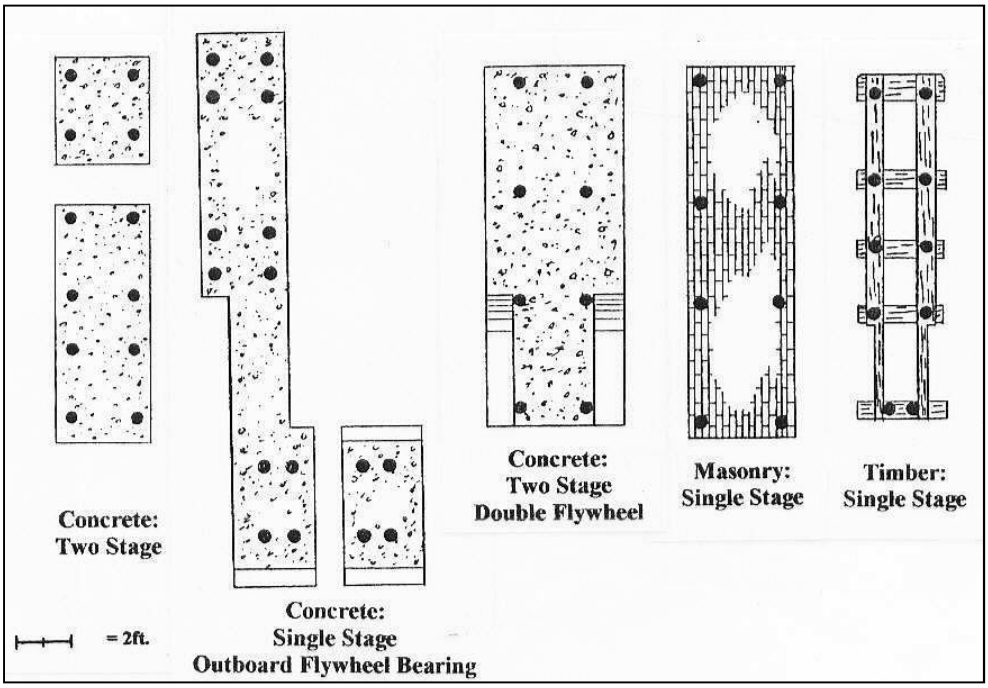

Figure 22. The plan view depicts foundations for straight-line compressors. Source: Twitty 2002:145.

Duplex compressors were bolted to foundations easily identified today (Figure 23). Foundations for these *machines* are concrete, U-shaped, at least 4-by-5 feet in area, and tend to be several feet high.

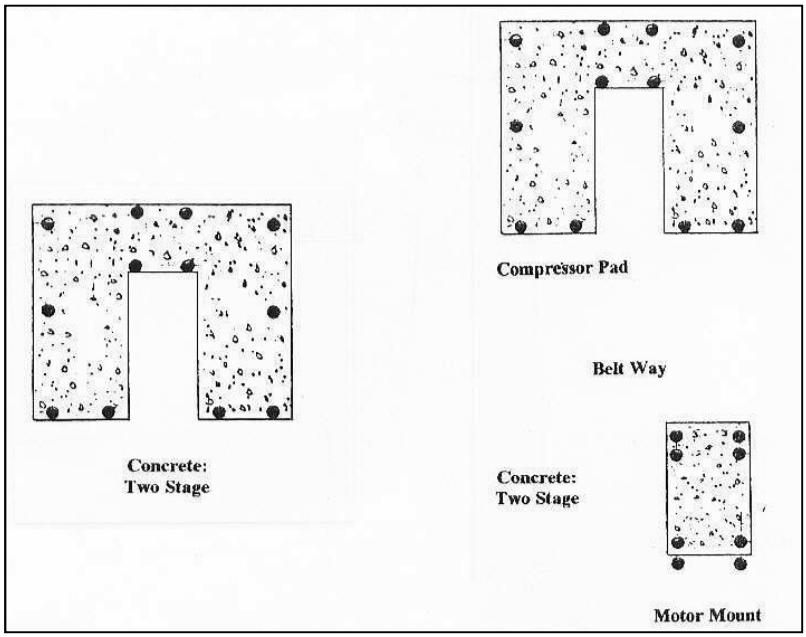

Figure 23. The plan view depicts the common foundations for duplex compressors. The foundation at left anchored a steam-powered unit, and the one at right was for a belted version, which became popular by the 1910s. Source: Twitty 2002:109.

Straight-line belt-driven compressors (see Figure 19) were bolted to foundations similar in appearance and size to *those* for their steam-driven counterparts. A second foundation for the drive engine should be located nearby and must be aligned with the area where the compressor's flywheel spun.

Due to severe vibrations, *petroleum compressors* were usually bolted to stout concrete foundations often several feet high. The foundation is almost always rectangular, several feet wide, less than 9 feet long, and features two rows of anchor bolts.

Upright compressors, small in size, could have been bolted to either timber or concrete foundations *rectangular* in footprint. A pad for the engine should be adjacent and aligned.

Foundations for *V-cylinder compressors* (Figure 24) tend to be fairly distinct and often feature an adjacent mount for an engine. The foundations are rectangular, between 4-by-5 feet and 3-by-3 feet in area, and constructed with a series of closely spaced timbers bolted to either an underlying concrete pad or buried timber footer.

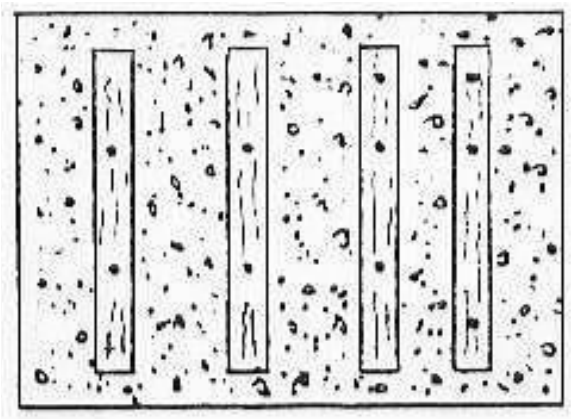

Figure 24. The illustration depicts a common V-cylinder compressor foundation. Timber footers are embedded in a concrete rectangle around 3-by-4 feet in area. Source: Author.

Compressed Air Main: A pipeline that carried compressed air from a compressor into the underground workings.

Compressor House: Usually found at tunnel mines, a compressor house enclosed an air compressor and receiving tank. The building should possess evidence of a compressed air system. If the compressor was steam-driven, then the building also usually enclosed a boiler, unless the mine featured one elsewhere.

Compressor House Platform: The platform that supported a compressor house. Workers usually graded a cut-and-fill platform for the building, and the platform should feature a compressor foundation, a motor mount or boiler setting remnant, and an artifact assemblage consisting of machine parts and pipe fittings.

Compressor House Ruin: The collapsed remains of a compressor house.

Hoisting System Feature Types

Headframe: Mining operations erected three general types of headframes to meet the needs of ore production. The first was an enlarged version of the two-post gallows (see Figure 7) discussed above with Prospect Shafts. The second was the *four post derrick* (Figure 25), which consisted of four posts joined with cross-members and diagonal beams, all supported by two backbraces. The third was a large *A-frame* (Twitty 2002:231). Production-class headframes were more than 30 feet high and stood on well-built timber foundations.

Headframe Foundation: Foundations for production-class headframes consisted of a timber frame usually straddling a shaft. The timbers flanked the shaft and extended toward the area where the hoist was located. Headframe foundations often featured notches or other joints for the posts and backbraces.

Figure 25. The headframe at the Blue Jay Mine in the Rocky Mountains exemplifies a typical four-post derrick headframe. Production-class headframes such as the one illustrated tend to be higher than 25 feet. Source: Carol Beam.

Headframe Remnant: The collapsed remnants of a headframe.

Hoist: To meet the needs of ore production, companies usually employed power hoists at shaft mines (Figure 26). Small companies installed the same types and sizes of steam and gasoline hoists as the prospect outfits discussed above. However, moderate and large-scale operations sought machines that could raise more tonnages from greater depths.

Single-drum steam models were the most common until the 1900s, when gasoline units became popular. *Production-class* steam models ranged in size from 6-by-6 feet to around 11-by-12 feet in area. The large units offered the greatest power and depth capacity.

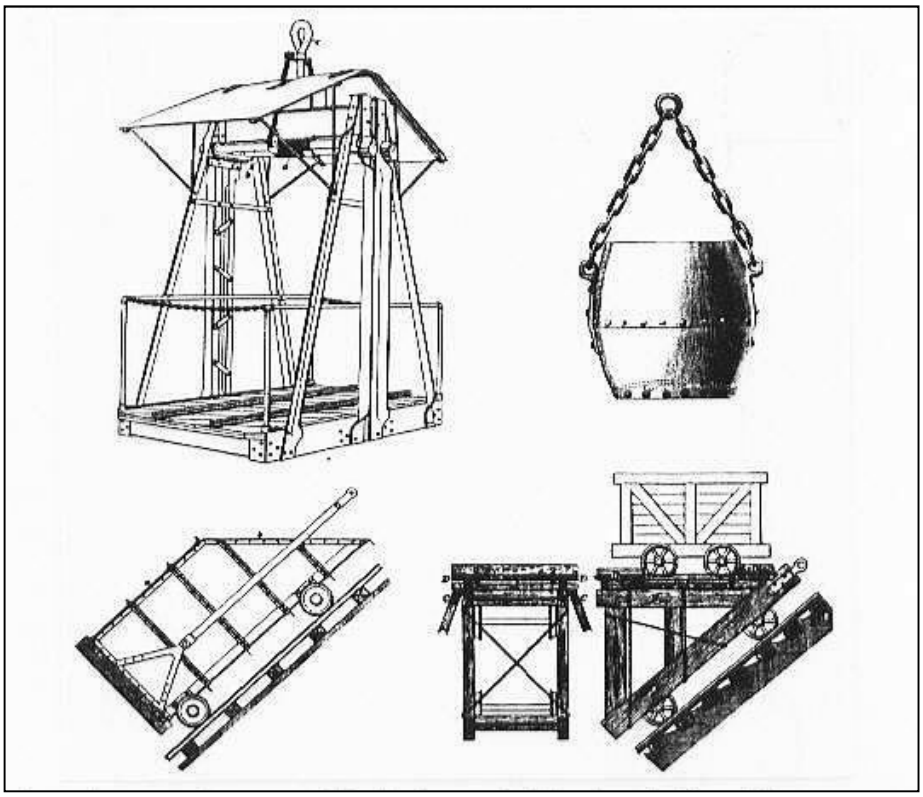

Figure 26. Mining companies employed several types of hoisting vehicles in shafts. The cage at upper left, popular from the 1870s through the 1930s, ran on guide rails and carried miners or an ore car. The sinking bucket at upper right required no rails and was common among small operations. The skip at lower left was popular in both vertical and inclined shafts during and after the 1900s. It ran on rails and required guides in the headframe to empty. At lower right is a vehicle for inclined shafts that became obsolete by the 1900s. Source: Twitty 2002:151.

Hoist Foundation: Few shaft mines retain their hoists and instead feature foundations, which are distinct today. The foundations for single-drum steam and gasoline hoists are discussed with Prospect Shafts, above.

Hoist House: Described under Prospect Site Feature Types.

Hoist House Platform: Described under Prospect Site Feature Types.

Hoist House Ruin: Described under Prospect Site Feature Types.

Power System Feature Types

Boiler: Most small, marginal mining operations within Fort Irwin employed portable boilers to power hoists and minor pieces of equipment. However, a few mining companies wishing for a permanent, efficient source of steam may have installed *return-tube boilers* (Figure 27). Return-tube boilers consisted of a riveted plate-iron shell encased in a masonry setting. The

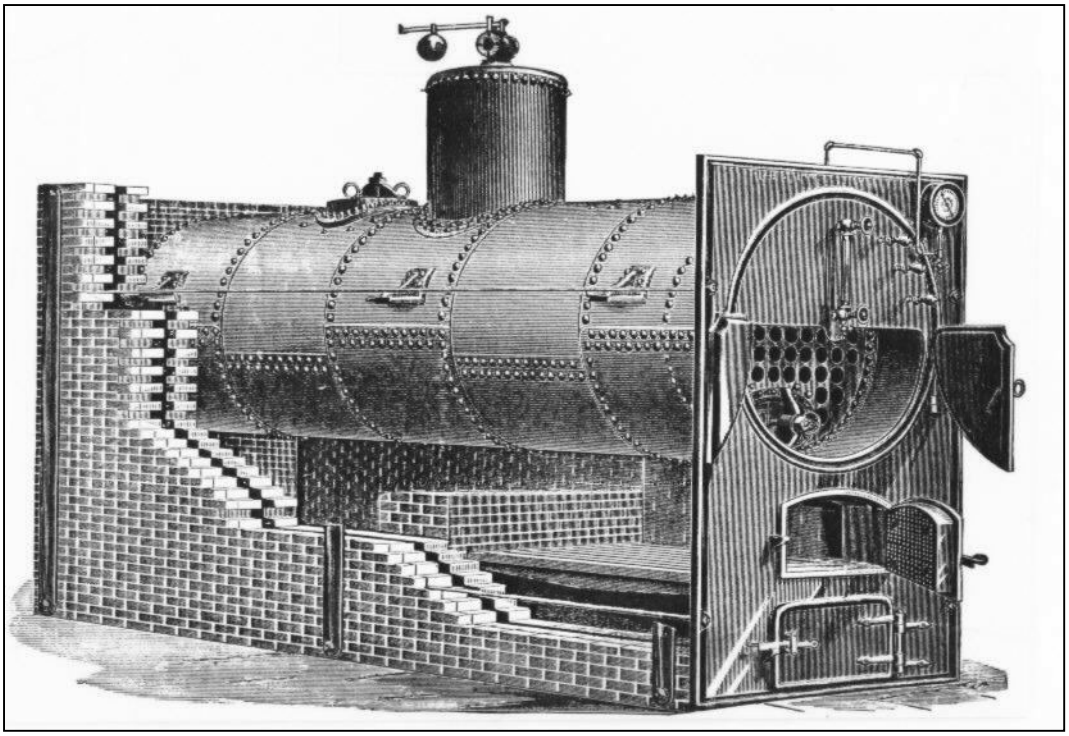

Figure 27. The return-tube boiler was the most popular industrial steam generator prior to the widespread embrace of electricity and gasoline. The unit consisted of an iron shell, a masonry setting, and a cast-iron façade. Flue gases traveled from the firebox behind the façade and under the shell. The gases rose into a smoke chamber at rear, reversed direction and returned through the flue tubes perforating the shell, and escaped out a smokestack over the façade. The top doors permitted workers to swab out the flue tubes. Source: Rand Drill Company 1886:44.

shell was horizontal and featured numerous flue tubes, and either rested on the masonry setting or stood on posts. Small shells, rarely used, were as little as 2 feet in diameter and 6 feet long, and large shells were 7 feet in diameter and 20 feet long. The most common sizes were between 4 feet in diameter and 13 feet long, and 5 feet in diameter and 16 feet long. As a general rule, the masonry setting was 3 feet wider and 3 feet longer than the shell. Given this, even if the shell is gone, its size can be estimated from the masonry setting's footprint. The boiler's front almost always featured a cast-iron façade enshrouding the firebox. The façade featured a large upper door so workers could swab out the flue tubes, and lower doors to feed the fire and remove ash. The flue gases traveled a path similar to the Pennsylvania boiler, discussed under Prospect Site Types above. The gases left the firebox, traveled through the setting underneath the shell's bottom, rose into a smoke chamber in the setting's rear, returned through the tubes perforating the shell, and exited through a smokestack over the firebox.

Often, when a mine closed, the key components comprising the boiler assemblage were salvaged and, as a result, researchers are likely to encounter only masonry settings today. Given this, for the researcher to record a feature as a return-tube boiler, it must possess the principal iron components. If only the masonry is left, then it should be recorded as a *boiler setting remnant*.

Boiler Foundation: When small mining operations removed portable boilers, they occasionally left simple rock or brick supports for the unit that are a form of foundation. Dismantling a return-tube boiler, however, resulted in more substantial, distinct structural remnants. If portions of the collapsed setting are present, the researcher should record them as a boiler setting remnant, discussed below. In some cases, when the boiler was dismantled, the bricks and rocks comprising the masonry setting were completely removed. This left only the foundation, which was flat and rectangular. Workers usually used rocks for the foundation, although some companies substituted bricks. In many cases, a setting remnant may still retain the *bridge wall*, which was a low row of bricks between the walls that forced flue gases against the boiler's belly. When visible, the bridge wall crosses the foundation near its center. Charred rocks and ash may denote the location of the firebox.

Boiler Setting Remnant: When boilers were dismantled, the masonry settings were usually left but were damaged to some degree during salvage operations (Figure 28). Collapsed settings range in appearance from mostly intact masonry walls to mere piles of rubble. With some examination, the researcher may be able to discern enough of the walls to reconstruct the boiler size and location of the firebox. If the walls are intact, setting remnants may feature the masonry bolts that anchored the façade, and they many also feature the posts that supported the boiler shell. Most setting remnants also feature a bridge wall, which was a low brick divider in the setting's interior. The wall usually stood between the firebox and smoke chamber, and forced flue gases up against the boiler's belly. Most return-tube boiler settings consisted of red bricks or rocks and featured a cleaning port near ground-level at the rear. Well-capitalized companies often lined fireboxes with firebricks.

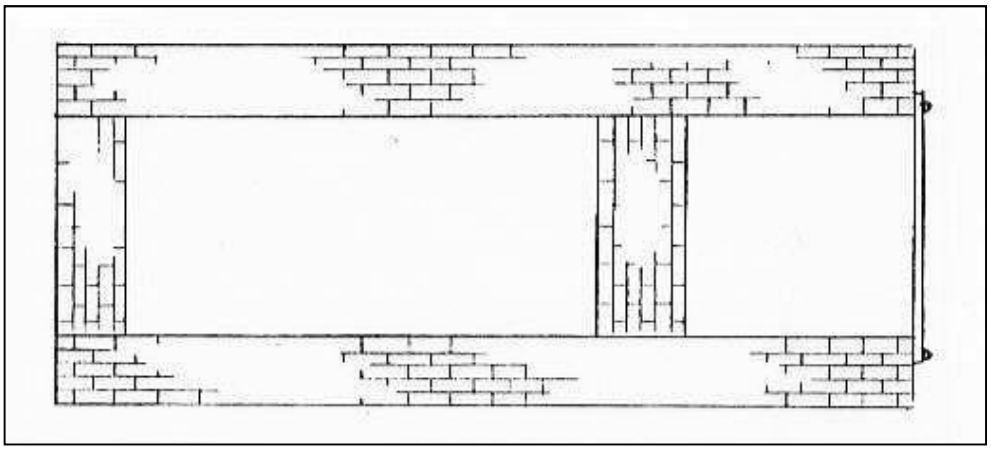

Figure 28. Few return-tube boilers currently remain intact. Most have been reduced to setting remnants and foundations. The plan view depicts the footprint of a setting remnant. Source: Twitty 2002:145.

Boiler Clinker Dump: When workers shoveled residue out of a boiler's firebox, they usually dumped the material on the waste rock dump near the boiler. Boiler clinker dumps tend to be distinct and consist primarily of boiler clinkers, which are dark, **scoriaceous**, ashy clasts created by burning coal. Boiler clinker dumps also usually include slate fragments, unburned bituminous coal, and structural and industrial hardware.

Ore Storage and Processing Feature Types

Ore Bin: Mining outfits erected ore bins to contain payrock for shipment. Ore bins could be of the sloped-floor variety or open, flat-bottom structures. Flat-bottom bins usually consisted of plank walls and a plank floor nailed to joists, all assembled on a flat platform. Sloped-floor bins possessed a floor often with a pitch of 45 degrees, and at least front and side walls. These structures often stood on a combination of rock walls and posts, and may have featured multiple cells. Ore chutes projecting out of the front permitted workers to discharge the contents into a wagon or truck.

Ore Bin Platform or Foundation: A platform or foundation that supported an ore bin. Open, flat-bottom bins usually stood on a platform located on the flank of a waste rock dump so workers could dump payrock from an ore car. Sloped-floor bins usually stood on a combination of a platform, which supported the bin's head, and rock walls that supported the remainder.

Ore Bin Ruin: The collapsed or partial remnants of an ore bin.

Ore Chute: A chute that directed payrock into an ore bin or into a vehicle.

Ore Chute Remnant: The collapsed remnants of an ore chute.

Shop Feature Systems

Backing Block: Some mining companies that employed mechanical rockdrills installed backing blocks (Figure 29) in their shops to aid workers who sharpened drill-steels. A backing block consisted of an iron rod 4-by-4 inches or less in size and up to 8 feet long, embedded in the shop floor near the forge. The block's surface featured a series of deep divots where the worker rested the drill-steel's butt, and leaned the drill-steel's neck against an anvil to brace the item for sharpening. Many mining outfits substituted a railroad rail for the iron rod.

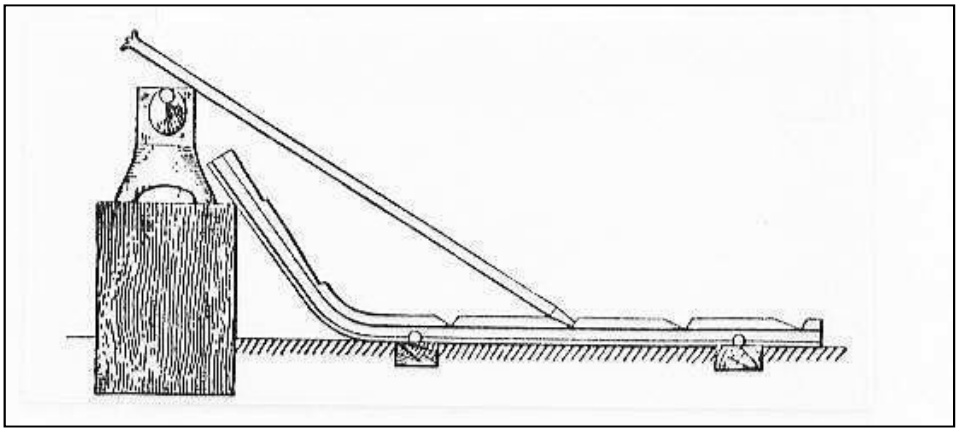

Figure 29. The profile illustrates a backing block, which shop workers used to brace hot drill-steels during sharpening. The drill-steel rests in a divot in a steel bar, and its neck rests against an anvil on a timber stand, ready for the blacksmith's hammer. Backing blocks were embedded in the shop floor adjacent to the forge. Source: *Engineering & Mining Journal* 1916:14

Drill-Steel Sharpening Machine: Advanced, well-capitalized mining companies installed drill-steel sharpening machines (Figure 30) in their shops to increase the volume of drill-steels that workers sharpened. Most sharpeners were upright units 2-by-3 feet in area, 3-to-5 feet high, and featured an assemblage of clamps and power hammers mounted on a cast-iron pedestal. Sharpeners are always located in a shop or on a shop platform.

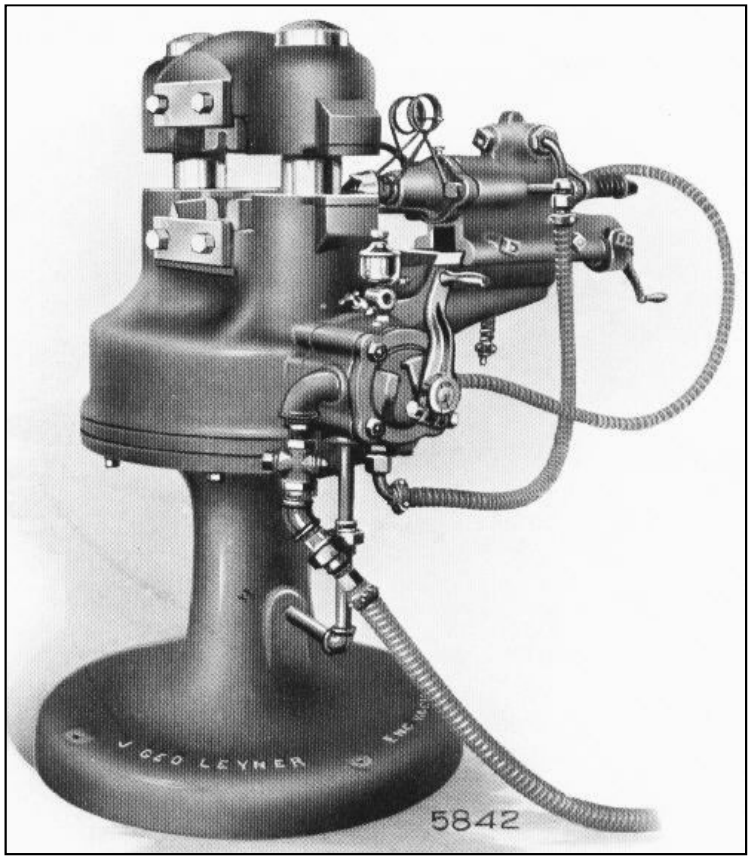

Figure 30. Shortly after 1910, leading rockdrill makers introduced a compact drill-steel sharpening machine approximately 5 feet high. The device, purchased by well-capitalized mining companies, expedited the drill-steel sharpening process. Source: Ingersoll-Rand Company 1913:2

Drill-Steel Sharpening Machine Foundation: Because drill-steel sharpening machines destroyed unpadded concrete foundations over time, they were usually bolted to foundations consisting of timbers or timber footers over concrete. Sharpener foundations are always located in a shop or on a shop platform, are usually 2-by-3 feet in area, and possess four to five anchor bolts. The most popular form of sharpener, made by Ingersoll-Rand, had a circular base that often left a like footprint.

Forge: Almost every mine shop featured a forge where blacksmiths heated iron. Several types of forges proved popular (see Figure 14, Prospect Sites Feature Types), and most were 3-by-3 feet in area and 2 feet high. The *gravel-filled rock forge* consisted of dry-laid rock walls filled with gravel. The *wood box forge* consisted of plank walls retaining gravel fill. The

freestanding *iron pan forge* featured an iron pan supported by iron legs. Companies that required high volumes of work also installed cylindrical iron and square iron box forges, usually 4-by-4 feet in area.

Forge Remnant: Over time, rock forges and wood box forges decayed (see Figure 14, Prospect Sites Feature Types), leaving mounds of gravel that often feature anthracite coal, clinker, and forge-cut iron scraps. Evidence of the walls also may be visible.

Lathe Foundation: Some mechanized shops featured a lathe to facilitate metal- and woodwork. Lathes were usually bolted to foundations that consisted of parallel timbers totaling around 2-by-8 feet in area or less. Lathe foundations are always located in a shop or on a shop platform.

Shop: Shops at mines featured facilities for the manufacture and repair of tools, hardware, and machinery. Some shops also facilitated carpentry. Nearly all shops included blacksmith facilities at the least, and some were equipped with power-driven appliances. The use of a forge often left a coating of soot on a building's interior.

Shop Platform: The platform that supported a shop. An artifact assemblage including forge clinker, pieces of hardware, forge-cut iron scraps, cut pipe scraps, and cut wood scraps can help identify a shop platform. Shops that featured power appliances may feature small machine foundations, short timber posts for power hammers and drill-presses, and artifacts such as lathed metal turnings.

Shop Ruin: The collapsed remains of a shop.

Shop Refuse Dump: A deposit or scatter of forge clinker, forge-cut iron scraps, cut pipe scraps, and pieces of hardware. Forge clinker consists of small pieces of **scoriaceous**, ashy residue and unburned anthracite coal. Carpentry shops left an abundance of cut wood scraps, sawdust, and hardware.

Hardrock Mine Eligibility Guidelines

As site types, both shaft and tunnel mines form a spectrum ranging from small, simple, and unimportant to large, complex, and significant. Small and simple mines were common and tended not to be involved with major contributions on an individual basis, although they could have been important to a specific mining area. In such cases, their significance will be local. Large and complex mines were uncommon and tend to be associated with multiple themes of importance. Most small mines will be ineligible for the NRHP, although exceptions certainly exist.

Eligible sites must possess physical integrity relative to the Period of Significance of the host mining area, which will vary. Because structures, machinery, and materials of value were usually salvaged when a mine was abandoned, most sites will consist of archaeological features. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the mining operation.

Most of the seven aspects of historical integrity defined by the NRHP can apply to mine sites. Some mine sites may possess standing structures and intact machinery that must retain the aspect of Location to contribute to a site's integrity. To retain Location, the structure or machine must be in its original place of installation. For a site to retain the aspect of Design, the resource's material remains, including the archaeological features, must convey the mine's organization, planning, and engineering. In many cases, mines were worked periodically and the surface facilities changed and adapted to new operations, leaving evidence of sequential occupation. In such cases, a site can retain the aspect of Design if the material remains reflect the evolution of the surface facilities over time. By studying archival information and material evidence, the researcher can determine when specific surface facilities were built and abandoned, thereby establishing a chronology for the site's evolution. To retain the aspect of Setting, the area around the site, and the site itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures and machinery. If the site is isolated, then the natural landscape should be preserved. If the site lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. In terms of Feeling, the site should convey the sense or perception of mining from a historical perspective and from today's standpoint. For Association, the site's sum of features and artifacts should permit the researcher to reconstruct the mining operation.

NRHP Criterion A

Shaft and tunnel mine sites eligible under Criterion A must be associated with the events and trends important to a specific mining area, as well as one of the following aspects. First, in parallel with the prospects discussed above, early hardrock mining brought the first large numbers of European-Americans to Fort Irwin. The industry established the initial settlements, economies, government entities, and detailed understanding of the regional geography.

The second aspect is that of the mining frontier. Prior to around 1890, those mining companies that were on the heels of prospectors were on the forefront of eastern California's frontier and helped to foster social, economic, government, and transportation systems. If a region featured ore deposits that lasted more than a few years, a mining industry developed and it usually resulted in permanent settlement that outlived the industry.

The third aspect of significance involves economic themes. On a broad scale, mining companies were part of and contributed to complex regional, statewide, and national economic and financial systems. For example, most of the capitalists who invested in Fort Irwin's mines were of regional and statewide importance, while a few were based outside of California. Implementation of investments, associated communication, banking, and the acquisition and shipment of supplies and food occurred on interstate and intrastate levels.

As another example, mining companies diverted money into local economies by paying wages to their workers, hiring consultants for various services, and purchasing small items from sources mostly in the surrounding towns. Productive companies also contributed to a statewide economy when they acquired large machinery and other industrial goods from manufacturers, most of whom were located in the San Francisco Bay Area. The workers employed by the mining companies also had an economic impact because they consumed food and other domestic goods purchased from a variety of sources and shipped by rail. Preserved food came from packing companies in the Midwest and on the West Coast, and fresh foods came from California farms and ranches.

The fourth aspect of significance involves social themes. The participants in the hardrock mining industry participated in the development and evolution of regional, state, and national social structures. One social structure was the development of classes in the region and greater California. Two general categories of capitalists acquired the productive properties, and the first and by far largest consisted of local investors of limited means. The second category consisted of already wealthy elite who most likely owned more than one mine. The profits realized from mining propelled local investors into the middle class and cemented the standing of the already wealthy in upper classes. Because the mining companies depended on wage laborers, company operations ensured the continuation of a working class.

The very nature of the workforce that made mining within Fort Irwin possible constituted another form of social structure. Activity in the various mining areas created an employment market that provided jobs to a variety of workers from points throughout the region, eastern California, and southern Nevada. Each boom drew laborers and the busts propelled them to other areas and economic sectors. The result was a mobile, adaptable, and diverse society.

NRHP Criterion B

Most mine sites will not be eligible under Criterion B because it is difficult to establish a lasting imprint of important people. Some mines, especially large complexes, can be traced to important individuals such as engineers, and in these cases, they can be eligible under Criterion B. For eligibility, the site must retain integrity relative to the important person's period of occupation or participation. As noted in Chapter 4, an important person's investment in a property or involvement with a company is too indirect an association for Criterion B. The individual of note must have either been present on-site or played a fundamental and direct role in its physical development.

NRHP Criterion C

Most small mines will probably not be eligible under Criterion C because they are a common site type, usually lack integrity, and offer few important characteristics and attributes. However, if the organization pattern of the surface facilities is clearly evident or structures and machinery are present, then the resource may be eligible under Criterion C. In general, intact structures and machinery are uncommon and important representations of engineering and technology.

Large mines can be eligible under Criterion C if the resources possess intact archaeological, architectural or engineering features that clearly convey the nature of the mining operation. The features must represent the application of engineering, technology, and methods during the area's Period of Significance (defined in Chapter 3).

NRHP Criterion D

Few small mines will be eligible under Criterion D because most information can be collected by detailed recording of surface features. Several exceptions, however, may exist, especially at large mines. If the resource possesses building platforms, privy pits, and boiler clinker dumps, testing

and excavation of these buried archaeological deposits may reveal information regarding miners' lifestyles, social structures, and the workplace, which is important because these topics were not heavily documented in the past.

If either shaft or tunnel mines possess accessible and intact underground workings, they should be recommended eligible under Criterion D. No formal studies of underground workings have been conducted, leaving this arena of inquiry unexplored and rich with the potential for meaningful conclusions. Researchers have derived the current understanding of the mine as a workplace from historical documentation and a few informal observations. For this reason, material information regarding the underground work environment, engineering, equipment, and practices of drilling, blasting, and removing rock is absent. Many of Fort Irwin's mines hold a high potential to contribute to studies because their workings are dry and the features and artifacts within are almost certainly well-preserved.

Property Type 3: Ore Processing Facilities

General Description of Ore Processing Facilities

One of the main objectives of mining was to reduce ore to its constituent metals. In general, the process began with crushing and grinding the ore, followed by separating metalliferous material from waste in a stage known as *concentration*. The resultant *concentrates* were shipped to a smelter for final treatment. In general, ores of purity or simplicity required fewer steps, while complex, refractory ores required time-intensive treatment and numerous steps.

A variety of facilities carried out one or all of the necessary processing steps, and most within Fort Irwin operated either as independent mills or in conjunction with a specific mine. For complex ore, mining companies erected *concentration mills* to complete the crushing and concentration steps ordinarily carried out by smelters, which saved the companies costs in two areas. First, the mining companies did not incur the high transportation costs of shipping waste-laden ore, and second, they avoided paying the fees charged by smelters for complete treatment. Concentration mills, also known as *reduction mills*, produced only concentrates and no refined metals, and they processed gold, silver, copper, and industrial mineral ores.

Concentration mills ranged in scale from small facilities to sprawling industrial complexes, and metallurgists based the treatment processes on specific types of ore. Mining on Fort Irwin employed three general categories of concentration mills, which are described in detail below. The historic mining industry termed the first and most popular the concentration mill, the second was the amalgamation stamp mill, and the third, used by independent miners, was the arrastra.

In general, concentration mills often employed batteries of stamps to crush ore prior to other processing steps. However, for simple gold ore, companies were able to employ what were categorically known as *amalgamation stamp mills* as a simple means of recovering the gold on-site. In this instance, a battery of stamps crushed the crude ore and amalgamating tables at the battery's toe recovered the gold. Because of its simplicity and relatively low cost, the amalgamation stamp mill was within economic reach of many mining companies. However, this type of mill proved ineffective for other types of ore.

Ore Processing Site Types

Concentration Mill

A concentration mill (Figure 31) was a facility that employed primarily mechanical and occasionally chemical means to separate metalliferous materials from waste. Mills were usually built over a series of terraces incised into a hillslope so that gravity could draw the ore through the various processing stages. Although mills came in a variety of scales, those within Fort Irwin tended to be small and simple. The small mills usually provided several stages of crushing and concentration in a single, linear path.

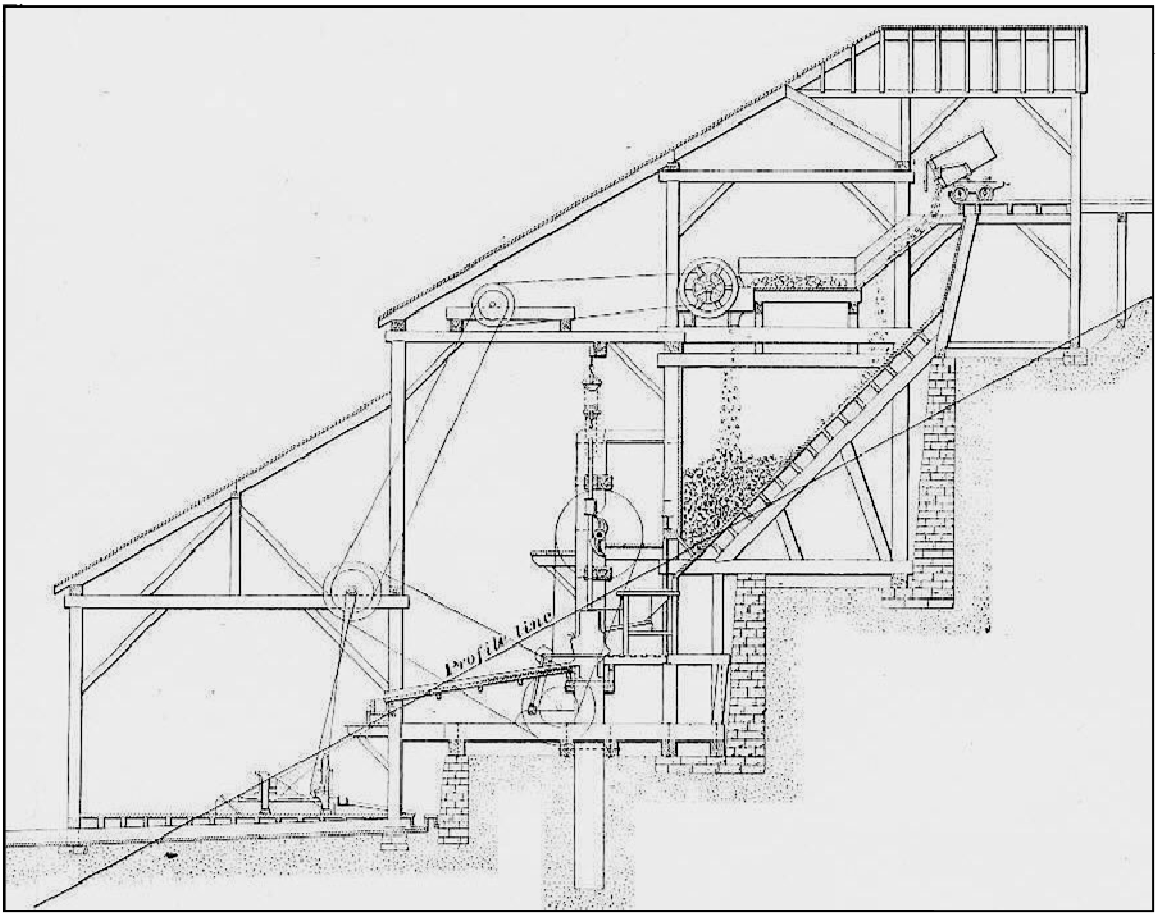

Figure 31. The profile illustrates both the stair-step configuration of a typical concentration mill and the process flow path. Workers dumped ore onto a screen at top, and fine material passed through while course cobbles were diverted into a crusher. A stamp battery at center pulverized the ore into a slurry, which passed over amalgamating tables that extracted gold and silver. The slurry then descended to concentration machinery on the lower platform. Source: International Textbook Company 1899:A43:214.

Engineers tended to follow a general pattern when designing concentration mills. An ore bin stood at the mill's head and it fed crude ore into a primary crusher, usually located on the mill's top platform. The resultant gravel descended to a secondary crusher located on a platform below, then through a screening system. Oversized material returned for secondary crushing and material that passed the screen went on for concentration.

Machinery manufacturers offered a wide array of crushers and grinders, which metallurgists selected according to the ore's characteristics. Because no two mines featured the same ore and no two metallurgists were alike, each mill was a custom affair. However, engineers followed some patterns regarding the application of crushing machinery. Jaw crushers, also known as Blake crushers, provided primary crushing. Batteries of stamps were commonly employed for secondary crushing. A stamp battery consisted of a timber gallows frame with guides for heavy iron rods featuring cylindrical iron shoes. A cam lifted the rods in sequence and let them drop on the gravel being crushed. A device known as a crushing rolls often carried out secondary and tertiary crushing, and it consisted of a pair of heavy iron rollers in a stout timber frame. A narrow gap between the rollers drew in clasts of sand and gravel and fragmented them. Grinding pans (Figure 32) and Huntington mills were used for tertiary crushing, and both featured a heavy cast-iron pan and iron shoes or rollers that dragged across the floor, grinding the ore. When the ore was free-milling gold or silver, the metallurgist introduced mercury into the pan to amalgamate with the metals. The end products of crushing and grinding were *fines* and *slurry* (Figure 33).

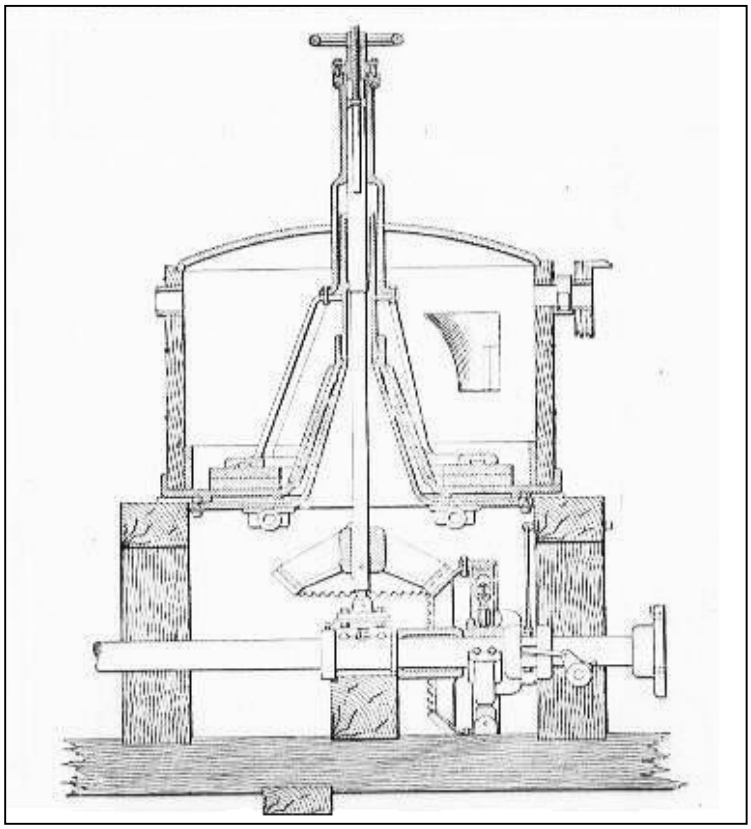

Figure 32. The profile depicts a grinding pan, which provided tertiary crushing usually for silver ores. Some mills also used the pans for amalgamation. A belt drove the pan, which featured heavy shoes that rotated around the cast iron floor. Source: International Textbook Company 1899:A43:172

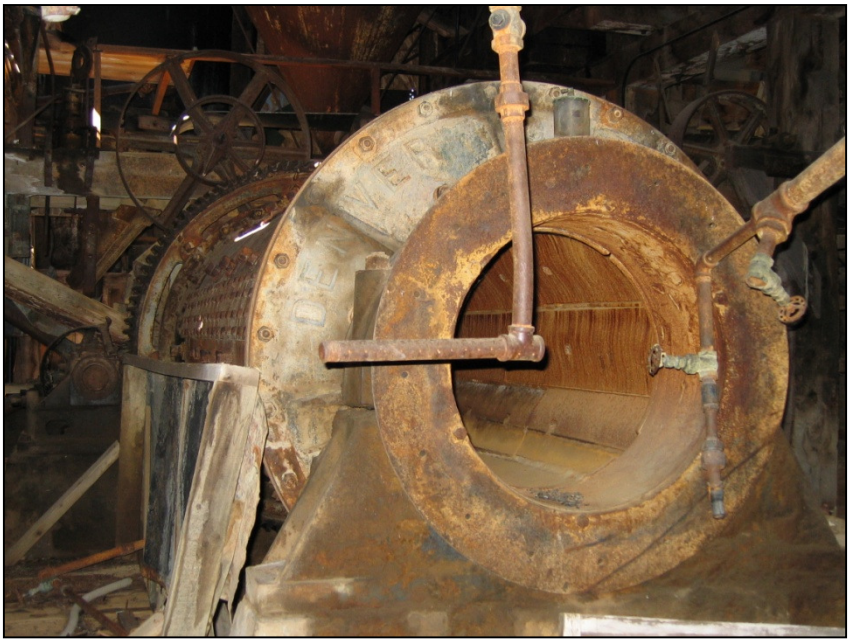

Figure 33. Rod mills became popular for fine grinding by the 1910s. As the entire cylinder slowly rotated, tumbling steel rods in the chamber ground screened ore into a slurry. A hatch covered the opening. Source: Carol Beam.

Following another screening, the ore descended to subsequent mill platforms for concentration. Several devices proved relatively popular for separating metals, and many metallurgists assembled a concentration sequence involving more than one appliance. The *jig* relied on water currents and agitation to both separate heavy metalliferous material from lighter waste and classify particles by size. The jig consisted of a wooden trough, often 4-by-9 feet long and 4 feet high, divided into cells that opened onto a V-shaped floor featuring valves and drains. Plungers agitated the slurry of ground ore in the cells, causing the heavy or large fines to settle while a gentle current of water washed the waste away.

Mullers were one of the earliest mechanized forms of grinding already-pulverized ore and separating out some of the metals, most commonly silver. A muller featured a cast-iron pan between 3 feet and 6 feet in diameter and up to 4 feet deep. A capstan extended out of the pan's floor, and a heavy hub fitted with iron shoes rotated around the capstan. As the shoes dragged around the pan's floor, they ground the ore and mixed it with mercury, which, the metallurgist hoped, would amalgamate with the silver content as it became exposed during grinding.

Vibrating tables became one of the most popular concentration appliances, primarily because they were originally designed to treat silver ores. A vibrating table featured a tabletop, often 5-by-15 feet in area, clad with rubber or linoleum held down with fine riffles. The tabletop was mounted at a slant on a mobile iron frame that rapidly oscillated, and the vigorous action caused heavy metalliferous material to settle against the higher riffles while the waste worked its way downward. Water playing across the tabletop washed the waste away.

Vanners were another popular concentration appliance and were similar in size to vibrating tables. A vanner featured a broad rubber belt on rollers that vibrated. The belt was kept wet and as the machine vibrated, the heavy metalliferous material settled against and stuck to the rubber while a jet of water washed off the waste. As the belt wrapped down around one of the rollers, the metalliferous material dropped into a flume and proceeded for further concentration.

By the 1920s, *flotation cells* were proving their worth and operated according to principals that seemed to defy traditional concentration technology. By the 1930s flotation replaced some of the above concentration appliances and became common by the 1940s. A flotation machine consisted of a large rectangular tank divided into cells filled with water and slurry. Oils or detergent, which compressed air or agitators worked into a froth, were introduced. In contrast to the above mechanical devices, the froth carried the metalliferous materials upward while wastes settled to the bottom of the cells. Revolving paddles then swept the metalliferous material into flumes.

The above appliances proved highly effective for silver and industrial metal ores, but they provided limited success for complex gold ores. During the 1900s, mining companies began experimenting with *cyanidation* technology, which was pioneered in New Zealand. For cyanidation, the ore was crushed and ground as above, then concentrated. The metalliferous material was then admitted into *cyanide tanks*, which were large wooden vats, and agitated in a dilute cyanide solution. The cyanide bonded with the gold, the waste was ejected, and the solution tapped into *precipitating boxes*. A worker added zinc, which cyanide preferred over gold, causing the precious metal to precipitate out. Cyanide mills could have featured one or a series of cyanide tanks, depending on the purity and volume of ore.

As can be surmised, concentration mills were complex facilities equipped with a variety of crushing and concentration appliances, and the specific flow path was a function of the type and volume of ore treated. When intact, concentration mills were substantial industrial structures that descended a hillslope and enclosed the various terraces. When a mill was abandoned, the structures and machinery were usually removed, leaving stair-step platforms, machine foundations, and hardware. Tailings left from ore processing were usually flumed to an area downslope from the mill and today manifest as substantial deposits of finely ground sand and rock flour. Mill sites lacking tailings may not have processed much ore.

Concentration mills relied on the same sources of power as mine surface plants. Through the 1890s, most mills relied on a single steam engine, which drove the various appliances through a system of overhead drive shafts and belts. As the mining industry embraced gasoline engines during the 1900s, engineers found that they were well-suited to drive constantly operating mill machinery.

Amalgamation Stamp Mill

Two definitions apply to the term *stamp mill*. Often, concentration mills employed batteries of stamps to crush ore prior to other processing steps. In this case the term stamp mill refers to the stamp battery, which was a component of a concentration mill.

However, if the ore possessed easily separated gold, companies based an entire mill facility around a stamp battery to recover the metal on-site. A jaw crusher usually provided primary crushing, the stamps affected the rest of the physical reduction, and amalgamating tables at the battery's toe, coated with mercury, recovered the gold. Workers periodically scraped off the amalgam and heated the mass in a retort, which volatized the mercury and left the gold. These treatment facilities are generally termed amalgamation stamp mills and as such are an individual site type.

Because stamp mills featured a fraction of the equipment installed at concentration mills, they tended to be smaller and simpler. Regardless, stamp mills shared with concentration mills a few fundamental components. First, the various stages of crushing and metals recovery were arranged on a series of platforms to use gravity to advantage. Second, they usually featured a receiving bin above the primary crusher to hold crude ore destined for processing. Third, the mid- or lower platform featured the power source, which was often a steam engine or gasoline engine. Last, the mill required a source of water.

Arrastra

An arrastra was a simple, inexpensive, labor-intensive, and inefficient means of recovering gold from ore (Figure 34). Arrastras were originally employed early in California's history, and their simplicity made them ideal for capital-starved outfits and the remote locations found on Fort Irwin. As a result, even though custom mills provided ore treatment for independent miners by the 1900s, some individuals used arrastras as late as the 1930s.

A typical arrastra featured a circular floor of carefully fitted stones, low sidewalls, and a capstan at center. Arrastras ranged in size from around 6 to 20 feet in diameter, and all featured common characteristics. A beam was attached to the capstan's top, and as it rotated, the beam dragged at least several muller stones around the floor. Usually, the stones, chained to the beam, were staggered so they covered the floor's entire surface area. The floor stones had to possess flat faces and tight joints, and the mullers had to feature convex bottoms and iron hooks hammered tight into drill-holes. The Spanish, credited with popularizing the arrastra, relied on slave labor for power, which draft animals replaced. With the improvement of technology, scarcity of labor, and the desire for greater production, in a few cases engineers harnessed engines. The simplest form of arrastra cost around $150 to build, much of which went to the labor for dressing and assembling the rockwork (Meyerreicks 2001:194).

To build an arrastra, a worker leveled a platform, excavated a pit at center, and installed the capstan, which had to be stout enough to resist great horizontal force. The worker paved the platform with a layer of fine clay and carefully fitted the floor stones together using more clay as mortar. With the floor complete, he erected the sidewall, which consisted either of more stonework or planks on end. During the twentieth century, concrete became a popular substitute for rocks. Once the beam and mullers were in place, the arrastra was ready for operation (Young 1987:69–71).

Figure 34. When capital and resources permitted, mining outfits constructed arrastras that were powered by water. This unit at the Death Valley Museum illustrates the drivetrain, capstan, and sidewalls typical of power-driven arrastras. Source: Author.

Running an arrastra required more skill and experience with local ores than engineering and formal training in metallurgy. First, a worker scattered a *charge* of ore across the arrastra's floor then introduced a little water. A draft animal rotated the beam that dragged the mullers over the ore and ground it into sand. The worker periodically added more water to convert the material into a slurry and sprinkled mercury into the material. The mullers continued to reduce the ore into a combination of sand and fine particles known as *slimes*, and the arrastra's sidewalls contained all on the floor stones. The purpose of adding mercury was to create an amalgam with the metals as they became exposed. Fine particles offered a greater surface area, facilitating amalgamation. Here, experience and familiarity with local ores came into play, and the arrastra operator added enough mercury to form an amalgam paste, but not in excess, which created a liquid difficult to recover. In some cases, the operator added lye to bind with oils and grease, which interfered with amalgamation (Meyerreicks 2001:143, 195; Young 1987:71).

The next stage was known as *cleanup*, where worthless *gangue* was removed and the amalgam recovered from the arrastra's interior. First, the operator had to drain the interior either by bailing, breaching the sidewall, or opening a port near the wall's base. With the water gone, the operator shoveled the exhausted sand and slime out, leaving a mud and sand layer on the flooring stones. The operator may have carefully washed additional material out of the arrastra's interior,

exposing as much of the amalgam, smeared on the floor stones and deposited between the joints, as possible. Here heavy labor came into play. The operator disassembled the floor stones, if small, and washed and scraped off the amalgam, or merely scraped the amalgam off the stones if large. Last, he filled a retort with the precious material and heated the vessel to volatize the mercury, leaving a sponge-like mass of metal. The retort vapors were usually routed through cool pipes to condense the mercury for reuse. Afterward, the operator rebuilt the arrastra and repeated the process with another load of ore (Meyerreicks 2001:143, 195; Young 1987:71).

Feature Types Common to Ore Processing Facilities

Mill sites often possess an array of archaeological, engineering, and architectural features that were components of the crushing, concentration, power, and support facility systems discussed above.

General Feature Types

Arrastra: An arrastra was a simple, open-air facility for crushing and amalgamating gold and silver ores (see Figure 34). An arrastra consisted of a circular stone floor ringed with low sidewalls, and a capstan at center. A draft animal tethered to a harness beam bolted to the capstan walked around the floor, dragging stones chained to the beam.

Arrastra Remnant: Arrastra remnants may retain aspects of the floor, sidewalls, and capstan.

Assay Shop Platform: Mills usually featured an assay shop to track the efficiency of metals recovery and concentration. Such a platform may feature a foundation or other remnant of an assay furnace, as well as clinker, bricks, assay crucibles, and laboratory artifacts.

Cistern: A concrete, masonry, or timber chamber that contained water for mill use. Because mills usually relied on gravity to pressurize plumbing, cisterns tend to be located upslope from a mill.

Conveyor: Conveyors lifted ore from one mill appliance or process to another. Early conveyors consisted of a bucket-line or spiral feed, and later conveyors consisted of belts on rollers. The type of conveyor should be specified.

Conveyor Remnant: A partially disassembled conveyor.

Ditch: An excavation that carried water to a mill.

Flume: A wooden structure usually constructed with plank walls and a plank floor. Workers built flumes to convey water to or tailings away from the mill, and to transfer slurry from one process to another.

Flume Remnant: The collapsed or buried remnants of a flume.

Machine Foundation: A foundation that anchored an unknown type of mill machine.

Mill Building: The structure that enclosed a mill. Mill buildings tend to be large, based on stout frames, and conformed to stair-step terraces or foundations.

Mill Building Ruin: A collapsed mill building.

Mill Platform: One of the main platforms or flat areas that supported a stage of crushing or concentration. Platforms should be numbered from the top down and described according to function.

Mill Tailings Dump: A deposit of finely ground rock flour and sand usually downslope or downstream from a mill.

Pipeline: An assembly of pipes that carried water.

Pipeline Remnant: The evidence left by a disassembled pipeline.

Privy: Most mill complexes included a privy for the crew's personal use. Privies usually are small frame structures with a door and a bench featuring between one and several cut-outs for toilet seats.

Privy Pit: The pit that underlay a privy. Privy pits are often less than 5 feet in diameter and may feature artifacts visible in the walls and floor.

Receiving Bin: An ore bin located at the mill's head that received crude ore for processing. Bins at mills were similar to those at mines.

Receiving Bin Platform or Foundation: Foundations and platforms for receiving bins are similar to those at Mine Sites (discussed above).

Receiving Bin Remnant: Remnants of receiving bins can be similar to those for ore bins at Mine Sites (discussed above).

Refuse Dump: A collection of hardware, structural materials, and other cast-off items.

Utility Pole: See Mine Site Feature Types.

Water Tank: A large vessel, usually cylindrical, made of planks or sheet iron. To pressurize plumbing, water tanks were usually located near the head of a mill.

Water Tank Platform: Often a circular or semicircular platform for a tank. The platform's floor may feature a pipe. To use gravity to pressurize plumbing, water tanks were often located upslope from a mill.

Crushing System Feature Types

Jaw Crusher: A mill apparatus located on the mill's upper terrace that pulverized crude ore into gravel (Figure 35). Crushers usually featured jaws and dual flywheels, and were powered by a belt. Small units were around 2-by-4 feet in area and large units were up to 4-by-8 feet in area.

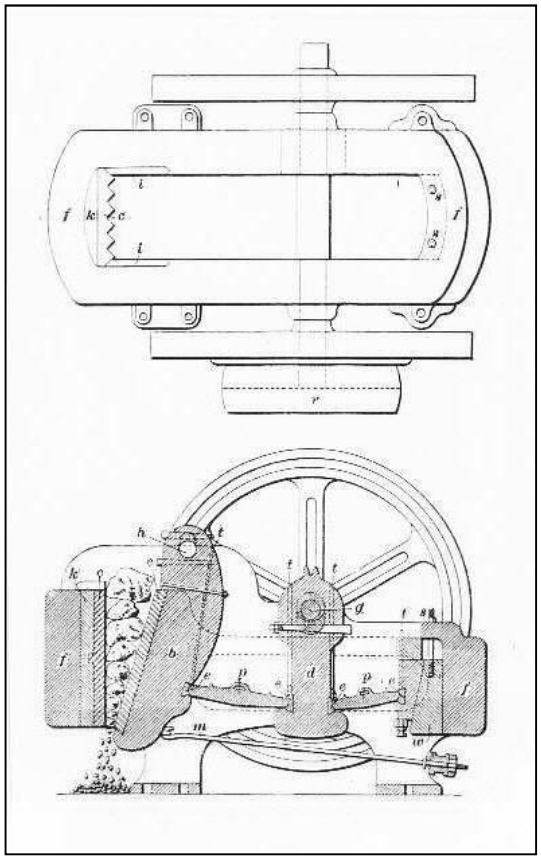

Figure 35. The plan view (top) and profile (bottom) illustrate a jaw crusher, which provided initial crushing at most mills. Source: International Textbook Company 1899:A43:2.

Crusher Foundation: Due to severe vibrations, crushers were often anchored to stout timber foundations or masonry with timber footings. Small piles of crushed gravel often underlay crusher foundations.

Stamp Battery: A stamp battery consisted of a heavy timber gallows frame, stamps that dropped into a battery box, and a cam shaft that raised and let drop the stamps (Figure 36). Batteries usually featured stamps in groups of five, and so a 15-stamp battery had three groups. The timber frame for a single group tended to be 7 feet wide and up to 15 feet high, and stood over a cast-iron battery box bolted to a timber pedestal. The frame featured guides for the stamps and a cam shaft fitted with a large bull wheel. True stamp mills featured an amalgamating table extending outward from the battery's toe.

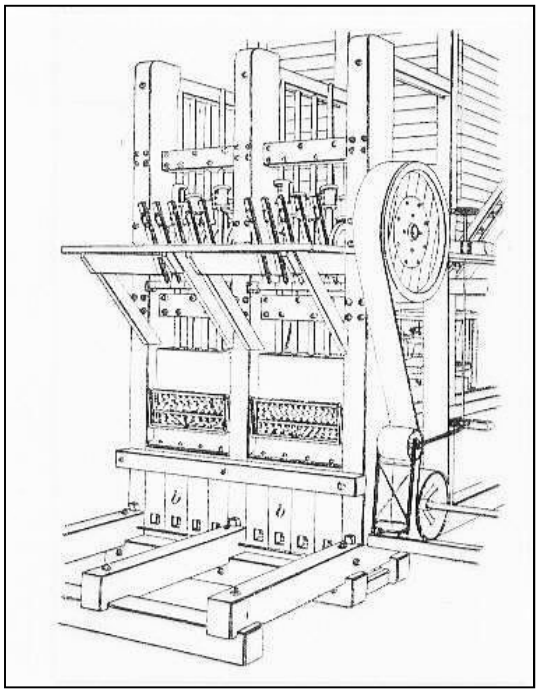

Figure 36. The quarterview illustrates the front of a stamp battery, which provided secondary crushing at some mills. Stamp rods are visible between the timber posts, and heavy iron shoes pounded ore in the battery boxes below. The battery boxes are bolted to pedestals of upright timbers, which are often the only remnants of stamp batteries today. Source: International Textbook Company 1899:A43:27.

Stamp Battery Frame: In many cases salvage efforts dismantled the iron hardware from a stamp battery, leaving the frame. Stamp battery frames, discussed above, usually stood over a pedestal for the battery box.

Stamp Battery Pedestal: Often, stamp mills were dismantled for use elsewhere, and the entire stamp battery was removed, leaving the stamp battery pedestal as the principal representation today. Stamp battery pedestals were rectangular, often 2-by-5 feet in area and 2 feet high, and consisted of timbers set on-end on a mill's crushing platform. The pedestal anchored a cast-iron battery box in which the stamps crushed the ore.

Screening Station: After ore was initially crushed, it passed through a screening system that classified the material by particle size. Material too large to pass the screens returned for crushing, while gravel and sand went on for secondary or tertiary crushing. Screens, often cylindrical trommels (Figure 37), were usually located below each crushing stage.

Crushing Rolls: A crushing rolls was an apparatus that provided secondary or tertiary crushing for ore already reduced to gravel (Figure 38). A set of crushing rolls featured two large iron rollers in a cast iron or heavy timber frame that crushed gravel passing between. Small units were around 4-by-4 feet in area and common units were 6-by-6 feet in area. Crushing rolls were usually located on an upper mill terrace below the primary crusher.

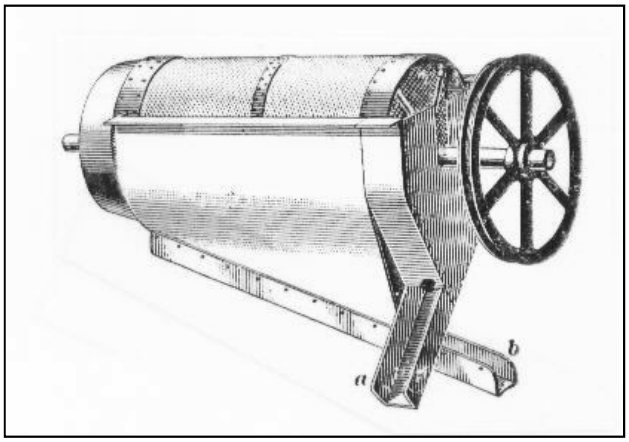

Figure 37. Most mills relied on trommel screens to sort crushed rock between processing stages. Source: International Textbook Company 1899:A43:12.

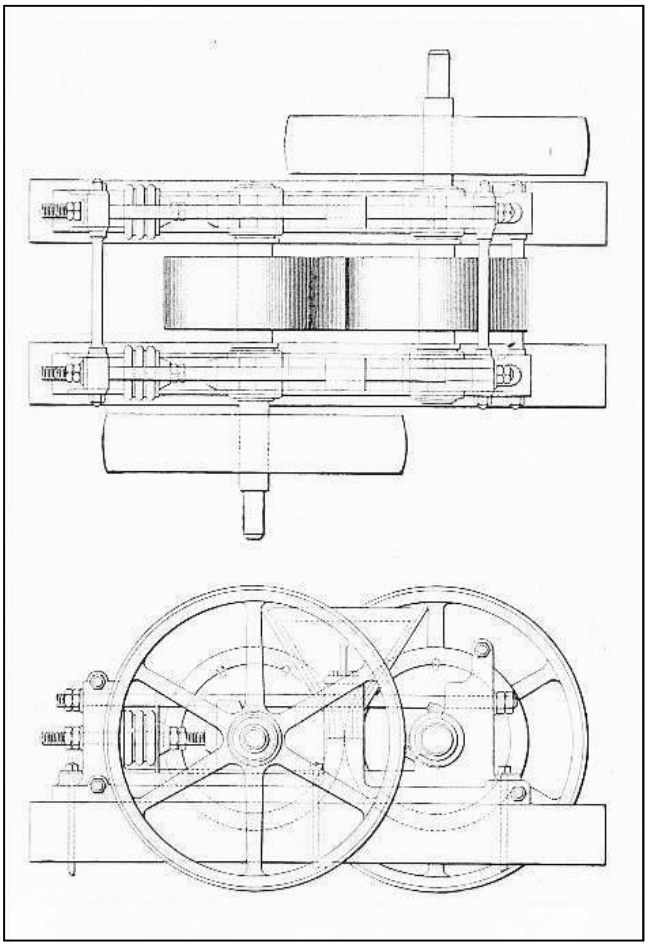

Figure 38. The plan view (top) and profile (bottom) illustrate a device known as a crushing rolls, which was popular in many mills for secondary and tertiary crushing. Source: International Textbook Company 1899:A43:12.

Crushing Rolls Foundation: Crushing rolls were often anchored to a rectangular timber foundation consisting of heavy horizontal beams bolted to posts that leaned slightly inward.

Huntington Mill: A Huntington mill was an apparatus that finely ground previously crushed ore, and some were used for amalgamation (Figure 39). The machine was based on a cast-iron pan approximately 6 feet in diameter and 3–4 feet deep ringed with a channel. A set of heavy iron rollers rotated across the pan floor, powered by an axle extending down through the unit. As the rollers ground the ore to a slurry, fine particles passed through screens breaching the walls and left via the channel. Huntington mills were bolted to a factory-made foundation.

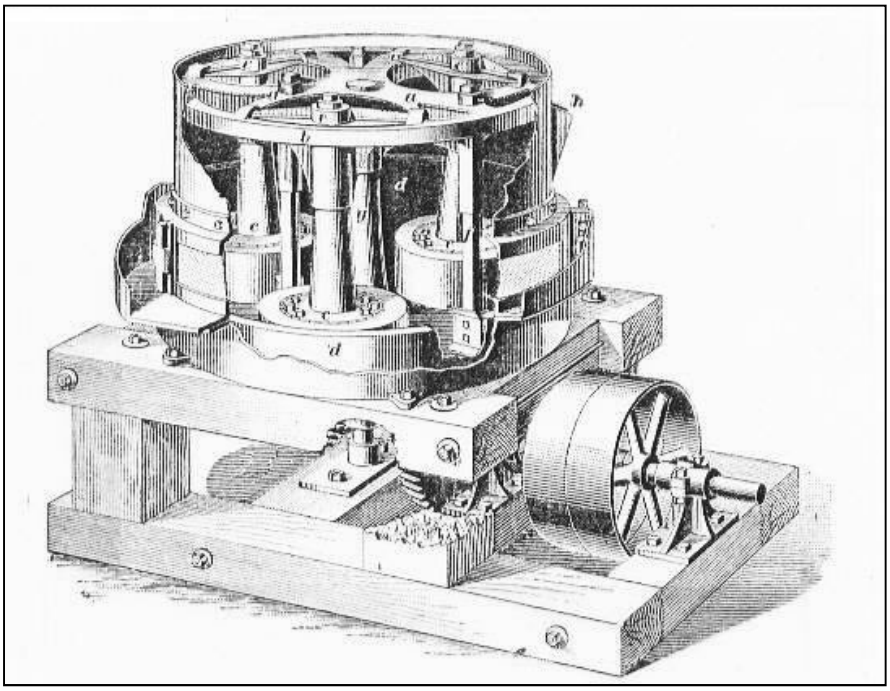

Figure 39. The device known as the Huntington mill had two applications. At concentration facilities, it provided secondary and tertiary crushing, and at amalgamation mills, the device simultaneously ground and amalgamated gold and silver ores. The driveshaft at right turned a capstan in the mill's pan, which caused the rollers to grind screened ore against the pan's cast-iron walls. Note the foundation. Source: International Textbook Company 1899:Z43:47.

Huntington Mill Foundation: Huntington mill foundations were factory-made, they appear finished, and the timbers often feature beveled edges. The foundation usually consists of a rectangular timber footer 6-by-9 feet in area. The machine stood on heavy posts forming a 6-by-6-foot square at one end. The posts lean slightly inward and are capped with horizontal beams. The foundation's other end features a raised block with an arced cut-out that braced the drive shaft.

Concentration System Feature Types

Cyanide Tank: Similar to a water tank, cyanide tanks were usually located on a mill's lowest terrace and surrounded by mill tailings. In the tank, a cyanide solution leached gold out of finely crushed ore.

Flotation Cells: Flotation cells, as discussed above, became one of the most popular concentration apparatuses during the 1920s. Flotation cells were based on a large rectangular wooden tank divided into compartments. Paddles that rotated in a framework over the tank agitated a slurry solution in each cell and swept a froth that carried metalliferous material over the cell's sides. The froth either flowed into a flume or into a second set of cells for additional concentration. A plank walkway often extended along one side of the tank, and the assemblage stood on timbers on one of the mill's lower terraces.

Muller: A muller featured a cast-iron pan between 3 feet and 6 feet in diameter and up to 4 feet deep. A capstan extended out of the pan's floor, and a heavy hub fitted with iron shoes rotated around the capstan. As the shoes dragged around the pan's floor, they ground the ore and mixed it with mercury, which, the metallurgist hoped, would amalgamate with the silver content as it became exposed during grinding.

Jig: A jig was an appliance that enhanced the separation of metalliferous particles from waste (Figure 40). Common jigs consisted of a wood body with a V-shaped bottom that featured drain ports, and wood walls dividing the interior into cells. Most tended to be around 4-by-9 feet in area and 4 feet high.

Settling Tank: Some concentration mills featured settling tanks on the lowest platform where heavy metalliferous fines gravitated out of spent slurry. Settling tanks were similar to wooden water tanks and often featured a revolving arm at center to exacerbate the settling process.

Vanner: A vanner was a concentration apparatus between 4-by-8 feet and 6-by-13 feet in area (Figure 41). The machine featured a broad rubber belt that passed around rollers at both ends of a mobile iron frame. An eccentric cam bolted to a chassis imparted a vibrating motion.

Vanner Foundation: The chassis of a vanner was usually bolted to a timber foundation that featured cross-members at both ends, stringers linking the cross-members, and additional braces. A flume that shunted slurry off usually passed by the vanner's head.

Vibrating Table: A vibrating table was an apparatus that concentrated crushed ore (Figures 42 and 43). Vibrating tables featured a slanted tabletop, often 5-by-15 feet in area, clad with rubber and narrow wooden riffles. Tabletops were often mounted at a slant on a mobile iron frame set in motion by an eccentric cam. Vibrating tables were usually located on mid- or lower terraces.

Vibrating Table Foundation: Vibrating table foundations featured six pairs of anchor bolts projecting out of three timber footers totaling around 12–15 feet in length.

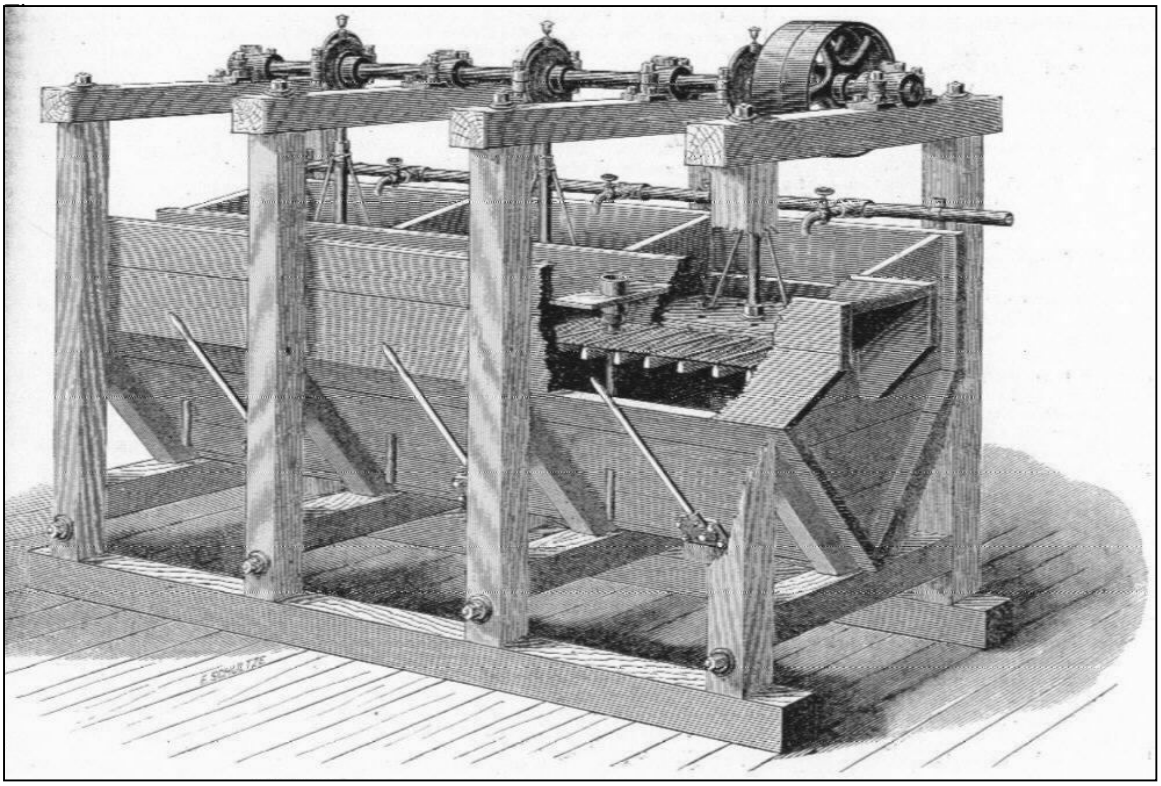

Figure 40. The jig was an effective concentration device popular from the 1860s through the 1930s. The crank at top moved three screen plungers up and down in the water-filled cells, which the cut-away view illustrates. The agitating action classified crushed ore particles by size or weight, depending on the application. Source: *Mining & Scientific Press* 8/9/90:83

Power System Feature Types

Boiler: See Mine Site Feature Types.

Boiler Foundation: See Mine Site Feature Types.

Boiler Setting Remnant: See Mine Site Feature Types.

Boiler Clinker Dump: See Mine Site Feature Types.

Overhead Driveshaft: Overhead driveshafts transferred motion from an engine to the mill appliances. Overhead driveshafts featured belt pulleys over each mill appliance and rotated in bearings usually bolted to the mill building's frame.

Steam Engine: Prior to the 1900s, steam engines were a common source of power for mills (Figures 44, 45, and 46). Usually located on the mill's lowest terrace, the engine transferred motion to a system of overhead driveshafts via a canvas belt. Most engines were horizontal units between 2 feet and 3 feet in width and 8–12 feet long.

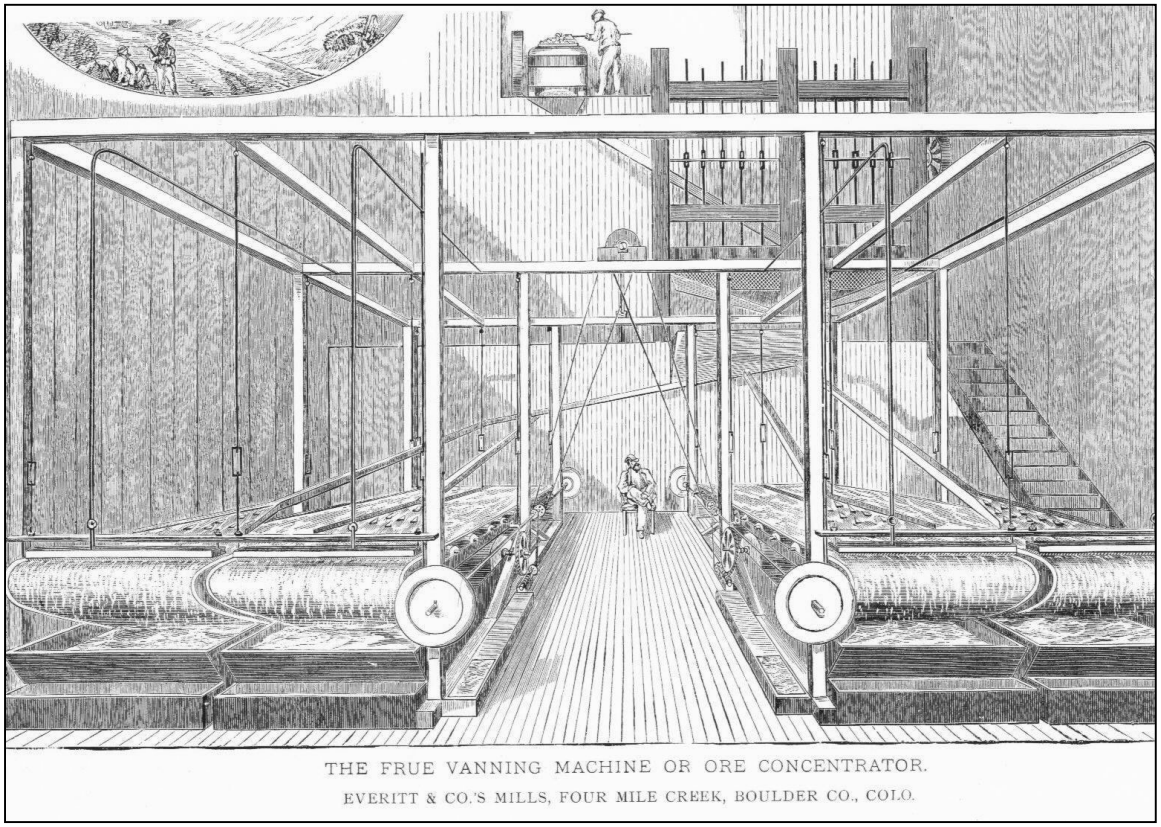

Figure 41. The Everett Mill, which operated in the Rocky Mountains during the late 1870s, employed several Frue vanners to concentrate local telluride ore. As the vanner vibrated, finely ground ore settled against the broad rubber belt while water jets and a scraper removed light waste material. Note the stamp battery at upper right. Source: *Engineering & Mining Journal* 24 November 1977, p387.

Steam Engine Foundation: Steam engine foundations are often rectangular, studded with anchor bolts, and between 2 feet and 3 feet in width and 8–12 feet long. Workers built engine foundations with heavy timbers, brick or rock masonry, or concrete, and the foundations often featured a pylon for the outboard flywheel bearing.

Ore Processing Facility Eligibility Guidelines

As a site type, ore processing facilities form a spectrum ranging from small and simple to large and complex. Most mills and arrastras within Fort Irwin were important to a specific mining area, and in such cases, their significance will be local. Those mills that were failures and did not process much ore were unimportant because their impact was limited.

Eligible sites must possess physical integrity relative to the Period of Significance of the host mining area, which will vary. Because structures, machinery, and materials of value were usually salvaged when a mill was abandoned, most sites will consist of archaeological features. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the milling operation.

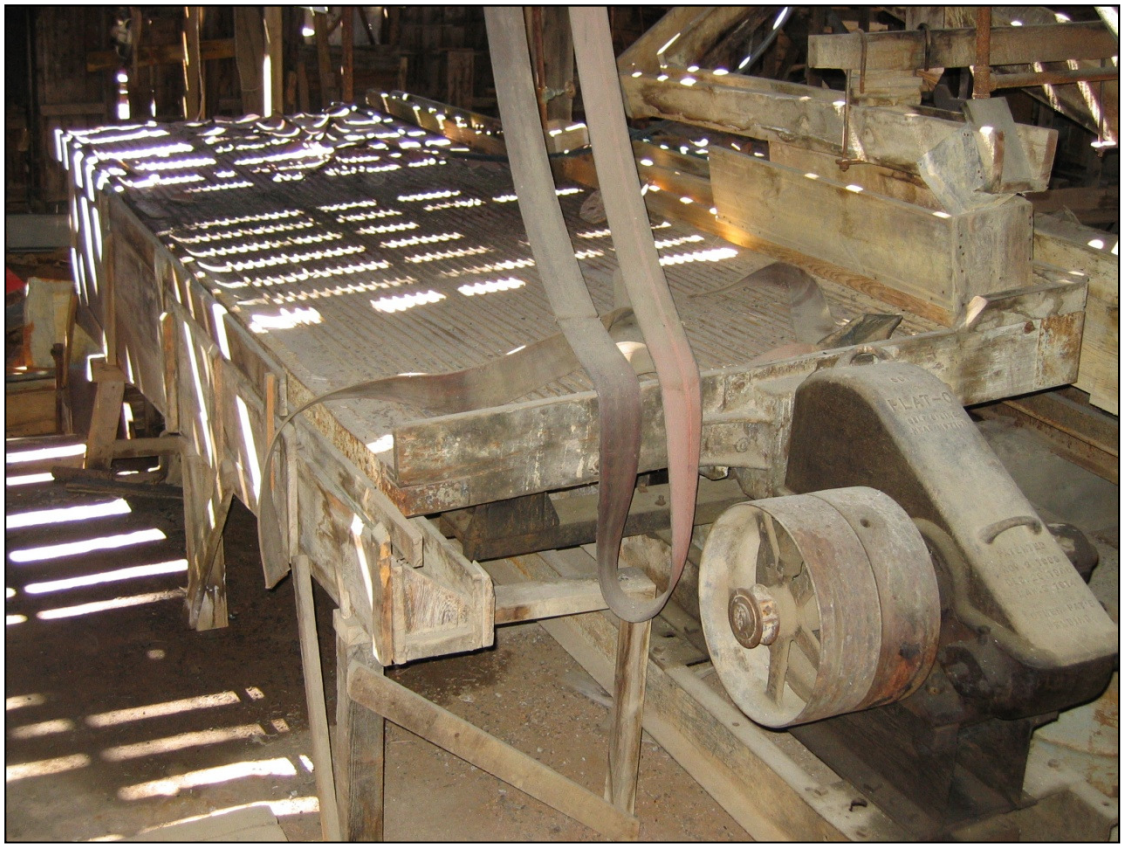

Figure 42. Following its introduction around 1898, the vibrating table was one of the most popular and effective concentration appliances throughout the West. An eccentric cam under the guard at right imparted a vibrating motion to the tabletop, and the vigorous action caused heavy metalliferous material to settle against the riffles. Water currents washed the light waste off. Source: Carol Beam.

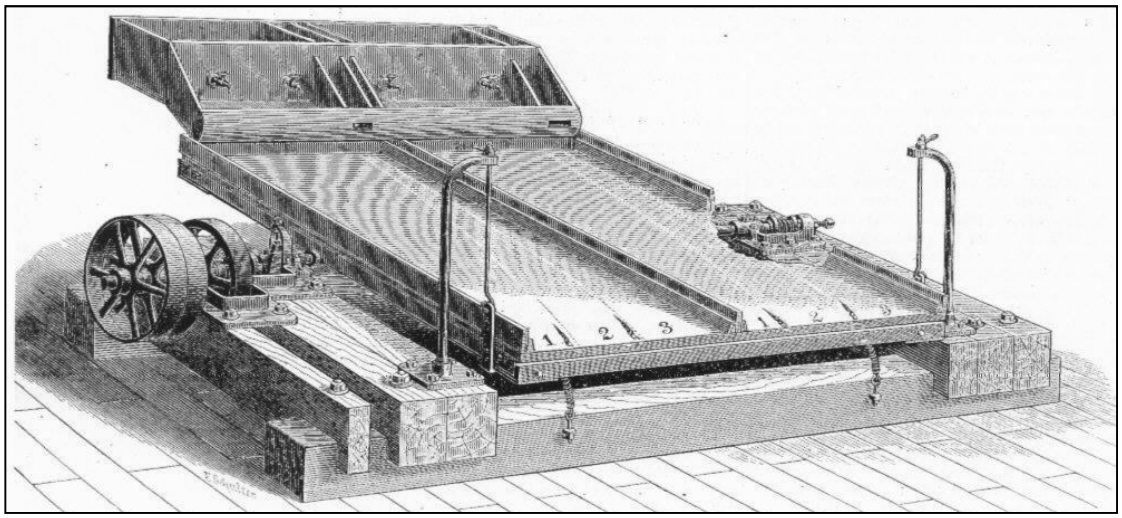

Figure 43. Known as both a percussion table and a bumping table, this apparatus used vibratory action to concentrate finely ground gold and silver ores. The table was popular from the 1860s into the 1880s. Source: *Mining & Scientific Press* 8/9/90:83.

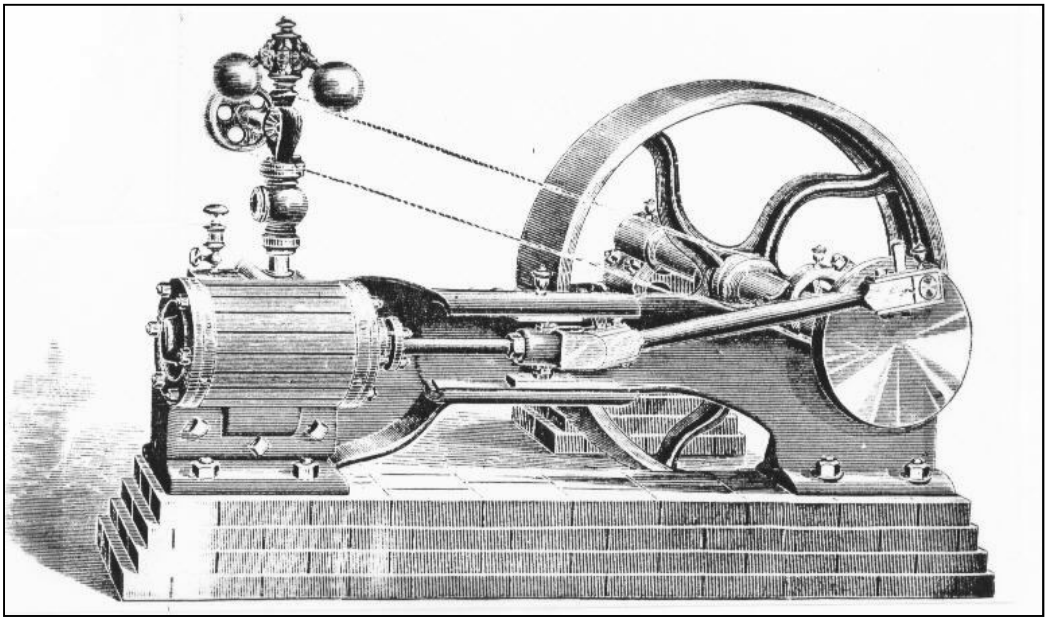

Figure 44. Until gasoline engines became popular during the 1900s, horizontal steam engines powered most concentration mills. Note the masonry foundation. Source: Ingersoll Rock Drill Company 1887:53.

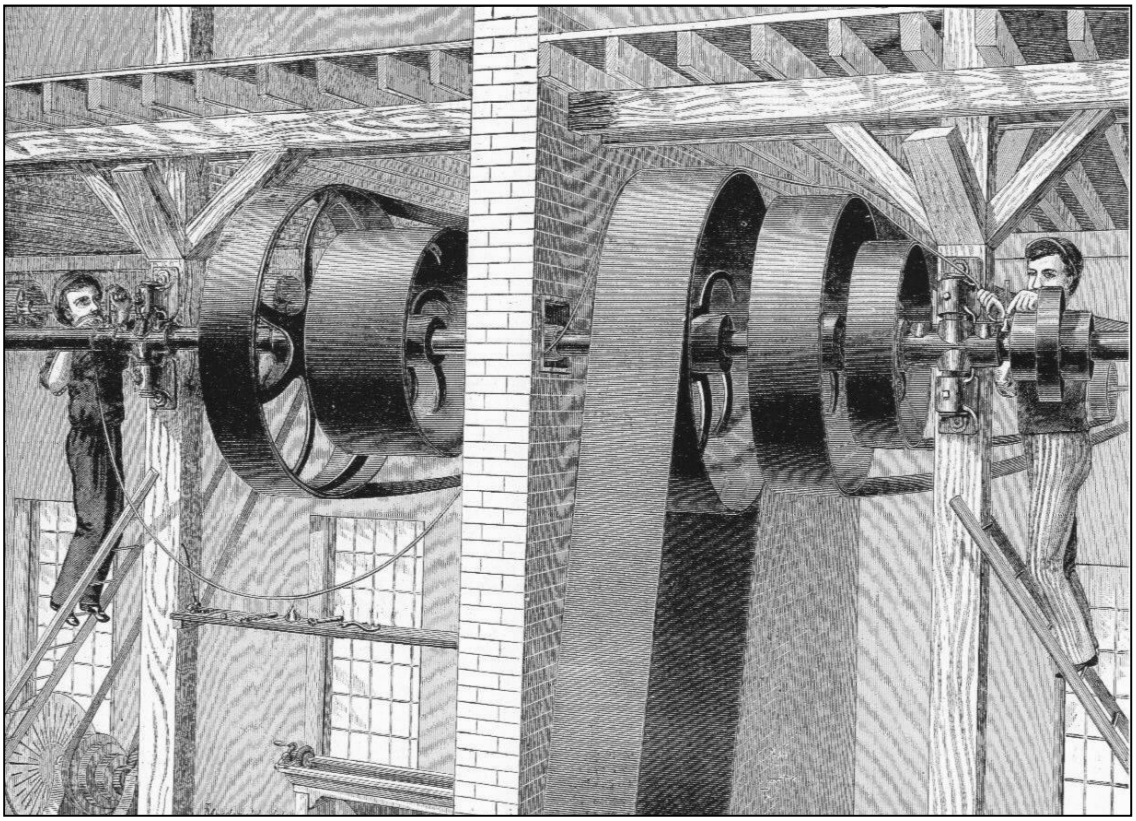

Figure 45. A system of overhead driveshafts and belts was the most common means of transferring motion from a mill's engine to its various appliances. Source: *Mining & Scientific Press* 9/1/83:129.

Figure 46. By the 1900s, mining companies used gasoline engines to power mill equipment, and the engines were anchored to foundations such this one at the Rio Hondo Mine. Source: Author.

Most of the seven aspects of historical integrity defined by the NRHP apply to mill sites. Some mill sites may possess standing structures and intact machinery, which must retain the aspect of Location to contribute to a site's integrity. To retain Location, the structure or machine must be in its original place of installation. For a site to retain the aspect of Design, the site's material remains, including the archaeological features, must reflect how the ore was treated, as well as the mill's organization, planning, and engineering. To retain the aspect of Setting, the area around the site, and the site itself, must not have changed to a great degree from its Period of Significance, excepting the removal of structures and machinery. If the site is isolated, then the natural landscape should be preserved. If the site lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. For Association, the site's sum of features and artifacts should permit the researcher to reconstruct the milling operation.

NRHP Criterion A

Ore processing facilities played key roles in the long-term success of hardrock mining at Fort Irwin. Without a local means for treating ore, mining companies would have been limited to only those grades of ores that were profitable enough to ship to distant mills, and such ores were in

limited supply. Concentration and amalgamation mills allowed mining companies to produce a variety of low-grade ores in high volumes, which allowed the industry to remain profitable intermittently through the 1930s. Arrastras were the first type of processing facility used at Fort Irwin, and they permitted individual miners to develop ore deposits that were too small and limited to interest organized companies. In sum, the ore treatment industry directly supported Fort Irwin's mining industry.

Arrastras may be associated with the theme of the mining frontier as discussed above with prospect and mine sites. For such an association, an arrastra must predate 1890, when eastern California was no longer in a frontier state.

Mills of a substantial size or that operated for sustained periods of time are associated with many of the trends and themes discussed above with hardrock mine sites. Because mills contributed to a mining company's production and required supplies and machinery, they were also associated with economic themes. Mills can be associated with social themes through their ownership by investors and as employment centers.

NRHP Criterion B

Most mill sites will not be eligible under Criterion B because of difficulty directly associating them with important people. Some mills, especially large complexes, can be traced to important individuals such as engineers, and in these cases, they may be eligible under Criterion B. For eligibility, the site must retain integrity relative to the important person's period of occupation or participation. As noted in Chapter 4, an important person's investment in a property or involvement with a company is too indirect an association for Criterion B. The individual of note must have either been present on-site or played a fundamental and direct role in its physical development.

NRHP Criterion C

Mill sites and arrastras may be eligible under Criterion C provided that they meet several conditions. First, the site must retain at least archaeological integrity, and the features should represent the footprint of the mill building, the locations of machines, and aspects of the associated infrastructure. Second, the general treatment processes and the general flow-path that the ore followed must be interpretable.

Mill sites with integrity are uncommon around Fort Irwin and can be considered to be important given their historic roles (Figure 47). Such sites are likely to represent aspects of ore treatment technology that are poorly understood. For example, conventional ore treatment methods required considerable volumes of water for processing. In response to the extremely arid conditions of eastern California, companies often experimented with dry methods for crushing and concentration. As another example, the ores in each region in eastern California, as well as the greater West, had unique properties and characteristics that metallurgists had to puzzle out. Mill sites on Fort Irwin may exemplify how conventional treatment methods and equipment were adapted to the local ores.

Figure 47. Few if any mills survive intact and nearly all have been reduced to platforms and foundations, such as at the Rio Hondo Mine in southern Fort Irwin. If the ore treatment processes and infrastructure are clearly represented, then the site may be eligible under Criterion C. Source: Author.

Arrastras are worth special consideration under Criterion C. Because of its simplicity and low cost, the arrastra was the first type of ore treatment facility used on Fort Irwin, as it was in mining districts elsewhere in the West. Mining outfits quickly abandoned their arrastras in favor of mechanized mills, and so relatively few arrastras were constructed. Many of those arrastras that survived after abandonment were dismantled by individuals interested in gleaning any remaining amalgam and loose gold from around the floors. As a result, intact arrastras are very rare and important not only because they represent the first stage of milling at Fort Irwin, but also because they exemplify a type of ore treatment facility that was vital to the mining frontier of the greater West.

NRHP Criterion D

Few small mills will be eligible under Criterion D because most information can be collected by detailed recording of surface features. Several exceptions, however, may exist, especially at large mills. If the site possesses building platforms, privy pits, and boiler clinker dumps, testing and excavation of buried archaeological deposits may reveal information regarding workers'

lifestyles, social structures, and the workplace, which is important because these were not heavily documented in the past. Detailed studies of structures and machinery can also contribute information regarding metallurgical engineering, architectural practices, and the application of technology that are poorly understood at present.

Some arrastras will be eligible under Criterion D for several reasons. First, arrastra engineering was poorly documented in the past, leaving ample room for detailed studies of surface evidence to contribute meaningful information. Second, radar surveys, testing, and excavation of buried deposits, features, and soil strata hold a high potential to render meaningful information for similar purposes.

Property Type 4: Placer Mines

While Fort Irwin's mining industry emphasized hardrock ore deposits, several areas also offered gold mixed in with surface gravel, known as *placer deposits*. As early as the 1880s, miners exploited these deposits around Denning Spring and Goldstone, and a number of sites are left today. For this reason, a general discussion of basic placer mining and such sites is warranted.

Over the course of eons, erosion attacked gold veins that cropped out on ground surface and deposited the fragmented material in nearby drainages. Early in the history of the West and California, prospectors learned to sample the gravel in areas known for gold ore to find placer deposits. If a stream bed or gulch floor offered placer gold, miners then removed the top layers of gravel and processed the lower levels, often piling the tailings to one side then the other as the excavation increased in area. In so doing, prospectors left pits, trenches, and cuts of various sizes.

One of placer mining's main attractions was that it was within the practical and economic reach of individual miners as well as organized companies. Where water was available, miners traditionally employed pans, cradles, and sluices to separate out the gold. But in arid Fort Irwin, they had no such luxury and instead relied on a method known as dry-washing.

The process began when miners cleared barren gravel off the top of the gold-bearing layer of sediment, creating the types of excavations noted above. The miners then used screens to reduce the gold-bearing gravel to its finest constituents and shoveled the large clasts into unwanted piles of tailings.

The next step was to separate the heavy, gold-bearing fines from light waste using blasts of air. Apparatuses known as *dry-washing machines* carried out the separation, and they featured a bellows underneath a slanted screen. The miner shoveled the fine gravel onto the screen and worked the bellows, which blew the light waste up and away, leaving the heavy gold-bearing material.

Developed during the 1880s and refined 10 years later, dry-washing machines came in a variety of sizes, and all featured a stout frame and a hopper at the top (Figures 48 and 49). Large units were designed to process a continuous flow of gravel and relied on either a hand crank or small engine to pump the bellows. Small versions were intended to be portable and inexpensive, and the miner activated the bellows with a simple lever.

Figure 48. Independent placer miners often used portable dry-washing machines to process gold-bearing gravel. The miner shoveled gravel into the hopper at top, fed small batches of material onto the screen, and pumped a bellows at bottom. The air blasts lifted light waste away and concentrated the heavy particles for reduction by panning in water. Source: Author.

Dry-washing machines did not separate all the gravel from the gold, but instead produced *placer concentrates* that was a blend of heavy particles. In the final step, the miner used a gold pan in a tub of water to carefully complete the final separation of precious metal from waste. These methods were slow and limited the amount of gravel that could be processed, which tended to discourage the involvement of large companies.

Placer Mine Site Types

Dry Placer: Individual miners and the occasional company created dry placers when they worked gravel deposits for gold. The gravel deposits tended to form the gently sloped floors of broad drainages. Miners often hand-dug pits, trenches, and broad excavations in their efforts to expose gold-bearing sediment layers, and shoveled the overburden into piles. During the 1930s when power equipment was available, companies may have created substantial excavations. The areas where the miners processed the gravel tend to be denoted by piles of sand, gravel, and cobbles segregated by size. Residential buildings and work stations often stood nearby, leaving platforms.

Figure 49. Mining companies and partnerships used large dry-washing machines such as this unit at the Rio Hondo Mine in southern Fort Irwin to process high volumes of gold-bearing gravel. Source: Author.

In general, dry placers are uncommon site types, limited to areas where hardrock gold ore was abundant and subjected to erosion when the local climate was wet. By nature, dry placer sites are located in an unstable physical environment prone to erosion, floods, and constantly shifting streambeds. In addition, placers were usually reworked and evidence of early activity erased. Given the above confounding factors, dry placer sites that retain integrity are very rare.

Features Common to Placer Mines

Building Platform: A flat area that supported a building.

Building Ruin: The collapsed remains of a building.

Cut-Bank: The headwall of an excavation.

Placer Pit: An excavation circular or ovoid in footprint where miners sought deep gravel.

Placer Trench: A linear excavation where miners sought deep gravel.

Placer Tailings: The hallmark of placer mining, tailings usually consist of ovoid or linear piles of gravel and cobbles.

Refuse Dump: A collection of industrial and structural debris cast-off during operations.

Work Station: A platform amid placer workings where workers processed gravel and maintained equipment.

Placer Mine Eligibility Guidelines

Most placer mines within Fort Irwin were small operations, limited in extent, and produced only minor amounts of gold, and for these reasons, their significance will be local. Placer mines usually had impermanent structures and portable equipment that was removed, and so their integrity is likely to be archaeological. Few sites can be expected to retain integrity because the workings usually collapsed and became eroded, other features tend to be ephemeral, and modern exploration caused major disruptions. Eligible sites must possess physical integrity and well-defined groups of features.

NRHP Criterion A

The type of dry placer mine found on Fort Irwin may be eligible for the NRHP under Criterion A for several reasons. First, dry placers provided independent miners and partnerships with an opportunity to earn income. In so doing, the miners constituted a local population independent of the traditional wage labor system based on company employment. This was particularly important during the depressions of the mid-1890s and 1930s, when the region offered few other sources of income.

Second, the miners contributed to the local economy by generating gold from a source that discouraged large-scale operations. The gold then served as income that the miners used to purchase their goods in regional towns.

Last, during the 1880s and 1890s, dry-washing methods were in a developmental state. By successfully producing gold with dry-washing methods, the miners contributed to the general body of knowledge regarding how best to use dry-washing machines and separate out the gold in a region with little water.

NRHP Criterion B

Most dry placer mine sites will not be eligible under Criterion B because of difficulty directly associating them with important people. A few mining claims, however, could be traced to individuals who were important in the region, and in these cases, the sites can be eligible under Criterion B. For eligibility, the site must retain integrity relative to the important person's time period of occupation or participation. As noted in Chapter 4, the individual of note must have either been present on-site or played a fundamental and direct role in its physical development.

NRHP Criterion C

For a dry placer mine to be eligible under Criterion C, the site must clearly represent a dry placer and retain at least archaeological integrity. To represent a dry placer, the site must possess relatively intact excavations and tailings piles, a clearly discernable work station, and few modern intrusions. By nature, placer mines tend to be located in unstable physical environments prone to erosion, floods, and constantly shifting gravel beds, leaving relatively few sites with integrity. Intact examples may be important because they represent a type of placer mine that is rare and important to the West.

NRHP Criterion D

Few placer mines will be eligible under Criterion D because most information can be collected by detailed recording of surface features. Several exceptions, however, may exist. Large mines may feature aspects of infrastructure, extensive workings and prospects that adhere to patterns, and artifacts specific to dry-washing. Studying such sites may enhance the current understanding of dry placer mining, which is poorly understood. If the site possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding workers' lifestyles and social structures of the workforce.

THEME: SETTLEMENT AND RESIDENCE

Because the mines and prospects within Fort Irwin were a fair distance from regional towns, industry laborers had to live near their points of work. Prospectors tended to establish temporary camps, mining companies erected company housing, and other workers provided their own residences. In a few areas such as Goldstone, mines and prospects were numerous and closely spaced enough to give rise to concentrations of residences referred to as settlements. During intense booms, promoters platted townsites and developed them into formal but short-lived towns such as Crackerjack. All these types of resources exist within Fort Irwin, and most have been reduced to archaeological features. The types of sites related to settlement and residence within the fort are defined below.

Property Type 5: Workers' Housing

Property Type 5 refers to housing and accommodations for workers employed at known industrial or commercial operations. Workers' housing is almost always associated with and a residential component of mines and ore treatment facilities. In such instances, workers' housing rarely would be a site in and of itself. Instead, the workers' housing would be included with the mine or mill complex.

Workers' housing may be classified as an independent site under several conditions: (1) the associated industrial or commercial complex has been destroyed, leaving only the residential features; and (2) the workers' housing features cannot be tied to a single industrial or commercial complex: for example, residential features may lie near a cluster of mines, yet far enough away so that the residential features cannot be attributed to one of the specific operations.

Workers' Housing Site Types

Workers' Housing: As a site type, workers' housing includes all features associated with workers' residence and other domestic activities. Such sites typically consist of at least one residential building or ruin, a refuse scatter or dump, a privy or privy pit, and activity areas. Workers employed by an organized company often lived communally in a boardinghouse and may not have possessed private accommodations, and they usually dined en masse.

Feature Types Common to Workers' Housing

Boardinghouse: A large residential structure intended to house more than several workers. Workers may have shared sleeping quarters and usually consumed meals together, which were prepared in the building. As a result, domestic refuse dumps or scatters, and privies are usually associated with boardinghouses.

Boardinghouse Platform: A platform where a boardinghouse stood (Figures 50 and 51). The platform may feature a root cellar and often represents the structure's size and footprint.

Figure 50. Usually, buildings were either moved or dismantled, leaving only the underlying platform and associated artifacts. Substantial platforms such as the one at the Rio Hondo Mine in southern Fort Irwin often supported boardinghouses. Source: Author.

Figure 51. This boardinghouse platform at Bonanza Camp on Fort Irwin manifests as an elevated gravel pad and features impressions left by floor joists. Source: Author.

Boardinghouse Ruin: The structural remnants of a boardinghouse.

Bunkhouse: A residential structure where workers slept and spent leisure time, but did not regularly prepare food. Given this, bunkhouses often feature few food-related artifacts relative to the number of inhabitants.

Bunkhouse Platform: A platform where a bunkhouse stood. The platform should feature few food-related artifacts, and the platform usually represents the structure's size and footprint.

Bunkhouse Ruin: The structural remnants of a bunkhouse.

Cabin: A small residential structure, often less than 20-by-25 feet in area. Workers built some cabins of rock masonry and others of lumber. Because cabins were often self-contained households, they usually offer a wide array of domestic artifacts. Privies are also often associated with cabins.

Cabin Ruin: The collapsed remains of a cabin.

Cellar Pit: A pit excavated for storage, often surrounded by backdirt or a foundation that supported a building. Cellar pits usually underlay buildings and would therefore be a component of a building platform or foundation.

Chimney Remnant: A collapsed chimney, usually consisting of rocks or bricks. Chimneys are usually components of building platforms.

Cistern: Organized, well-capitalized residential complexes occasionally included cisterns that stored fresh water. Cisterns at residential complexes were like those at mill sites.

Corral: Due to a need for transportation, large residential complexes often included a corral. Corrals may feature formal and informal fences constructed from a variety of materials, and often utilize natural features.

Corral Remnant: Fences, fence remnants, linear rock piles, linear arrangements of stumps, and changes in vegetation often represent corrals.

Domestic Refuse Dump: A substantial volume of domestic refuse, usually located downslope from a residential feature. Domestic refuse dumps consist primarily of food-related and other domestic artifacts, including food cans, fragmented bottles and tableware, and personal articles.

Domestic Refuse Scatter: A disbursed scatter of domestic refuse, usually located downslope from a residential feature.

Privy: The structure that served as a toilet facility. Privy buildings were like those at mine sites.

Privy Pit: The pit that underlies a privy. Privy pits often feature a small pile of backdirt and some domestic refuse in the pit, and may be surrounded by more refuse. Privy pits are often less than 5 feet in diameter and may retain footers for the privy structure.

Residential Building: A building, confirmed by artifacts, that served as a residence. Buildings may be classified as residential if they do not possess the characteristics of boardinghouses, bunkhouses, or small cabins.

Residential Building Platform: A platform, confirmed by artifacts, to have supported an unspecified residential building.

Residential Building Ruin: The structural remnants of a residential building.

Road: Residential complexes usually required roads to accommodate traffic. Roads are at least 8 feet wide.

Root Cellar: Root cellars often manifest as collapsed dugouts located near residential buildings. They were independent structures used for food storage and were usually made of rocks or lumber.

Stable: See Mine Site Feature Types.

Stable Remnant: See Mine Site Feature Types.

Tent Platform: Because Fort Irwin possesses a dry and warm climate and lumber was expensive, some companies provided their workers with wall tents as residences. The workers usually graded cut-and-fill platforms for the tents, which were usually less than 20-by-20 feet in area. Because tents were simple, they left few structural materials except for nails when removed.

Workers' Housing Eligibility Guidelines

As noted above, workers' housing can be a site if the associated industrial complex has been destroyed and only aspects of the housing remain, or if the housing features cannot be tied to a specific mine or mill. In cases where the industrial complex has been lost, the remaining housing features most likely will not be eligible. The reason is that key elements of the site are missing and the existing housing aspects are an incomplete representation of what was a greater entity.

Workers' housing that cannot be tied to a specific mine or mill may be eligible as an autonomous site. The level of its significance should match that of the nearby mines and mills, or the surrounding area. For example, if a group of mines was of statewide importance, then nearby workers' housing would probably share the same level. The integrity of workers' housing is likely to be archaeological because buildings were usually dismantled for their structural materials.

NRHP Criterion A

Workers' housing may be eligible for the NRHP under Criterion A for several reasons. First, by definition, workers' housing was the place where laborers lived, and they were the backbone of mining and milling operations, as well as other forms of industry.

Second, residences, especially boardinghouses and bunkhouses, were microcosms of important economic activities. They were the sites of personal financial transactions such as the exchange of time and labor for pay, and the exchange of pay for room, board, and goods.

Workers' housing was also an important element of regional, state, and national economic systems. The workers consumed food and other domestic goods purchased from a variety of sources. Preserved food was shipped from packing companies in the Midwest and on the West Coast, while fresh foods came from California farms and ranches. By consuming preserved and fresh foods, company employees not only supported a complex national food transportation network, but also helped the development of farming and ranching. Merchants in the major towns handled most of the food and goods, and the acquisition of such therefore contributed to local economies.

Last, workers' housing was an important social institution. Communal residences were centers of communication between individuals, company officials, and the outside world. They were also the place of cultural practices, traditions, and diffusion between workers of various national and ethnic origins. In addition, residences were places where workers could attend to the necessities of life outside of the workplace. On a broad scale, the sum of workers' housing sheltered and fed much of the mining industry's workforce. Workers' housing also was a direct manifestation of and instrument for permanent settlement of eastern California.

NRHP Criterion B

Most workers' housing sites will not be eligible under Criterion B because of difficulty demonstrating an association with important people. In a few cases, individuals of note may be identified through archival research, and if so, the sites can be eligible under Criterion B. For eligibility, the site must retain integrity relative to the important person's period of occupation or participation. As noted in Chapter 4, the individual of note must have either been present on-site or played a fundamental and direct role in its physical development.

NRHP Criterion C

Workers' housing sites can be eligible under Criterion C if they clearly represent the nature of residential accommodations or offer evidence that reflects the demography of laborers. If a site possesses a standing building, it can be argued that the structure reflects the architecture of workers' housing. The time period, type of architecture, and method of construction should be specified.

If the site consists only of archaeological features, then it can be argued that such features provide an approximate representation. Further, building type, size, footprint, and numbers of residents may be interpreted from the archaeological evidence.

The artifact assemblage associated with a workers' housing site can bolster eligibility under Criterion C because it can reflect aspects of demography. If an artifact assemblage is complete, conclusions can be drawn regarding gender, ethnicity, socioeconomic status, diet, health, and substance abuse. These are important research topics that are currently poorly understood due to little archival information.

NRHP Criterion D

Workers' housing sites hold a high potential to be eligible under Criterion D because they may possess a likelihood of offering important information regarding the current understanding of mining industry laborers. Workers' housing complexes often possess building platforms, privy pits, and refuse dumps that feature buried archaeological deposits. Testing and excavation may reveal information regarding the demography and behaviors of workers, such as gender, social structure, ethnicity, socioeconomic status, diet, health, and substance abuse. Such studies are important because these subjects were not extensively documented in the past.

Property Type 6: Prospectors' Camps

When examining an area or developing a claim, prospectors usually established camps intended to be impermanent. Prospectors' camps differ from workers' housing in that they were simple, may have lacked formal buildings, and were abandoned after brief occupation. Because prospectors' camps tend to be ephemeral and offer few industry-specific artifacts, they can be determined as such through association with prospect workings. Some camps may be directly associated with prospect workings or located in an area subjected to prospecting. When directly associated with a prospect complex, the camp would be a component of that site.

Prospectors' Camps Site Types

Prospector's Camp: Because prospect camps were intended to be impermanent and were occupied briefly, often only the barest material evidence of camps is left remaining today. For example, some camps are represented by a tent platform, a sparse scatter of food cans, and little else. In some cases, groups of prospectors established camps that are represented today by several tent platforms. Occasionally, one or several prospectors intending to spend time intensely examining an area erected a log cabin as a base of operations. For a cabin to be determined a prospector's camp, it would have to be a simple, crude, and small structure located amid prospect workings and not near any substantial underground operations. Otherwise, the cabin would fall under Workers' Housing. A confirmed prospector's camp clearly represented by features and artifacts can be considered to be an uncommon site type. In some cases, remote mines may feature remnants of a prospector's camp that was abandoned when the mine was brought into production.

Feature Types Common to Prospectors' Camps

Cabin: A small residential structure, often less than 20-by-20 feet in area. Prospectors built cabins of stone masonry or lumber.

Cabin Ruin: The collapsed remains of a cabin.

Domestic Refuse Scatter: A disbursed scatter of domestic refuse, usually located downslope from a residential feature.

Fire Hearth: An outdoor ring or rock structure where prospectors kept fires for cooking and heating.

Pack Trail: The traffic from a prospector's camp to areas under examination resulted in the development of pack trails, which are no wider than 8 feet.

Root Cellar: See Workers' Housing Feature Types.

Tent Platform: Prospectors often graded small platforms for wall tents. In some cases, prospectors placed rocks on the platform's edges or corners to support a tent's wood pallet floor and drove stakes along the edges to guy the walls. A paucity of structural artifacts, the presence of tarpaper washers, and disbursed domestic artifacts characterize tent platforms. When possible, prospectors often used natural flat areas to advantage.

Prospectors' Camps Eligibility Guidelines

Prospectors' camps are a common site type and usually do not retain important characteristics or features. Given this, most will be ineligible for the NRHP, although outstanding examples may be an exception. For a site to be considered outstanding, it should have a well-preserved assemblage of features and artifacts. Eligible sites must possess physical integrity relative to the exploration and discovery Period of Significance for a given mining area (defined in Chapter 3).

Because prospectors' residences such as wall tents were intended to be impermanent and sites occupied only briefly, camps usually consist of archaeological features. For the archaeological remains to possess integrity, the material evidence should permit the virtual reconstruction of the camp and represent the demography of the prospectors. Intact architecture is rare and should be considered to be an important representation of the types of residences erected by prospectors.

Only a few aspects of historical integrity defined by the NRHP are likely to be relevant for prospectors' camps. The most applicable aspects will probably be Setting, Feeling, and Association. The Setting around the camp, and the camp itself, must not have changed to a great degree from its Period of Significance, excepting the removal of structures and equipment. Usually, this requires a preserved natural landscape and environment. In terms of Feeling, the camp should convey the sense or perception of prospecting from a historical perspective and from today's standpoint. For Association, the site's sum of features and artifacts should permit the researcher to reconstruct the camp.

NRHP Criterion A

Prospectors' camps eligible under Criterion A must be associated with the events and themes important to a specific mining area, as well as one of the following trends. First, the temporary encampments served as bases of operations for prospectors engaged in the activities that were necessary for the discovery of economic mineral deposits. Camps allowed prospectors to search for ore, characterize a region's geology, and conduct general exploration. When inhabited by groups of prospectors, camps served as frontier meeting and communication centers where individuals exchanged information and news. Camps also served as primitive social centers for a segment of the mining industry that often went without human contact for long periods of time.

Second, in light of their important role in the process of mineral discoveries, prospectors' camps were associated with local and regional history. Fort Irwin's hardrock mining industry was founded on and a function of prospecting, which the temporary camps supported. In addition, early hardrock prospecting brought the first large numbers of European-Americans to Fort Irwin. They established the first settlements, economy, government entities, and detailed understanding of the regional geography.

NRHP Criterion B

Prospects' camps are unlikely to be eligible under Criterion B because of extreme difficulty directly attributing a given site to an important person. Should archival research identify an association between a camp and an important individual, the site must meet several conditions for eligibility under Criterion B. First, the site's features and artifacts should date to that person's timeframe. Second, the site must retain integrity relative to the person's stay and not have been heavily altered afterward.

NRHP Criterion C

Most prospect camps will not be eligible under Criterion C because they are common types of sites, offer few important characteristics and attributes, and usually possess integrity impaired by natural decay. Several exceptions, however, exist. One exception is the presence of intact architectural or engineering features. These were fundamental aspects of prospectors' camps and few architectural elements survive today.

Prospectors' camps may be eligible if they possess well-preserved assemblages of features and artifacts. The features should clearly represent the nature of the residence and activity areas. The artifact assemblage should reflect aspects of prospector demography including socioeconomic status, ethnicity, diet, and product consumption.

NRHP Criterion D

Few prospect camps will be eligible under Criterion D because most information can be collected by detailed recording of surface features. In general, the brief occupation of prospectors' camps usually precluded the accumulation of meaningful buried archaeological deposits.

Property Type 7: Isolated Residences

Isolated residences are places of developed inhabitation not directly tied to, or associated with, an industry or other pattern of subsistence. Within Fort Irwin, such sites would lack characteristics that represent prospecting, mining, transportation, agriculture, or ranching. Determining whether a site in a mining area is an isolated residence can be somewhat subjective, as it may have served as a base of operations for prospectors or freighters. Isolated residences can be considered to be common, and since they can not be tied to a specific industry or means of subsistence, they lack significance. However, buried archaeological deposits may clarify with which industry the residents were associated. If this seems likely, the site may be recommended eligible under NRHP Criterion D.

Isolated Residence: Isolated residences are very simple and usually consist of a few residential features with no industrial or commercial attributes. By definition, isolated residences cannot be directly tied to a form of subsistence, their occupation was usually brief, and the volume of artifacts low. The types of features comprising an Isolated Residence are identical to those at Workers' Housing.

Property Type 8: Townsites and Unincorporated Settlements

Townsites and Unincorporated Settlements are organized centers of residence, commerce, and industry. Townsites tended to be formally surveyed and featured established businesses, but unincorporated settlements were often no more than collections of residences with few or no businesses. Further, unincorporated settlements usually grew around and depended on an industry entity that required a large workforce, such as a cluster of mines or mills.

Fort Irwin and the surrounding area feature several townsites and unincorporated settlements that are currently abandoned and represented primarily by archaeological remains. Sites such as Crackerjack and Avawatz City represent townsites, and Goldstone, Cave Spring, and Arrastra Spring are examples of unincorporated settlements. Because water was a precious resource on and around Fort Irwin, towns and unincorporated settlements often grew near springs.

Townsite and Unincorporated Settlement Site Types

Townsite

Townsites were organized settlements often platted with lots and blocks laid out according to a grid. Because towns often served as centers of transportation, commerce, and industry, townsites existing today may possess an array of features. Large townsites tend to be more complex and diverse than small boomtowns occupied for a short time. A business district, however small, usually served as the center of a townsite, and outlying residences may have been scattered and haphazard in organization. Business proprietors often lived in their commercial buildings, but workers employed by other industries may have lived anywhere in town. Commercial buildings ranged in scale from wall tents to lofty frame structures, which often stood on well-graded platforms and informal foundations. Towns also often possessed developed infrastructures such as transportation and communication networks.

Because of their commercial, industrial, governmental, and social roles in mining districts, townsites may be considered important. Townsites also often hold the potential to contain meaningful information in the forms of archival materials and buried archaeological deposits.

Unincorporated Settlement

Unincorporated settlements were often informal collections of residences that arose to serve a combination of purposes. First, such settlements usually grew around a primary industry that required a substantial workforce, such as a group of mines or a mill. Second, some unincorporated settlements provided a few of the same services found in a town. Such services may have been transportation, communication such as a post office, accommodations such as a hotel, or sales of goods. Unincorporated settlements often possessed no formal organization and tended to be disbursed.

Because of their social roles in mining districts, unincorporated settlements may be considered important. They also often hold the potential to contain meaningful information in the forms of archival materials and buried archaeological deposits.

Feature Types Common to Townsites and Unincorporated Settlements

Assay Shop Platform: A platform where an assay shop stood. Assay shops may be identified by artifact assemblages consisting of crucibles, cupels, fired clay fragments, laboratory ware, ore specimens, and bricks.

Boardinghouse: See Workers' Housing Feature Types.

Boardinghouse Platform: See Workers' Housing Feature Types.

Boardinghouse Ruin: See Workers' Housing Feature Types.

Bunkhouse: See Workers' Housing Feature Types.
Bunkhouse Platform: See Workers' Housing Feature Types.

Bunkhouse Ruin: See Workers' Housing Feature Types.

Cabin: See Workers' Housing Feature Types.

Cabin Ruin: See Workers' Housing Feature Types.

Cellar Pit: See Workers' Housing Feature Types.

Chimney Remnant: See Workers' Housing Feature Types.

Cistern: See Workers' Housing Feature Types.

Commercial Building Platform or Foundation: A platform or foundation where a commercial building stood. Because commercial buildings usually housed businesses and few residents, the artifact assemblages tend to be sparse and offer limited volumes and varieties of domestic items.

Corral: See Workers' Housing Feature Types.

Corral Remnant: See Workers' Housing Feature Types.

Ditch: See Ore Processing Feature Types.

Domestic Refuse Dump: See Workers' Housing Feature Types.

Domestic Refuse Scatter: See Workers' Housing Feature Types.

Hotel Platform or Foundation: A platform where a hotel stood. Hotel platforms tend to be large and may feature a cellar pit. Artifact assemblages usually include small personal items, food-related artifacts, furniture parts, and lamp parts and fragments. Hotel platforms may be difficult to distinguish from other residential structure platforms and may be identified through archival research. Large and numerous privy pits are often associated, and the quantity of ornate artifacts may be high.

Livery: A livery was an establishment where draft animals were temporarily boarded. Liveries may be defined by stable platforms and broad corrals. Earth packed by animal traffic, manure deposits, collapsed fences, and artifacts such as tack straps and hardware can define a livery complex.

Mercantile Platform or Foundation: A platform on which a mercantile establishment stood. Mercantiles were primarily retail establishments often located in moderate-sized to large buildings. Based on this, mercantiles may be identified by a substantial platform or foundation and an associated privy pit with little evidence of actual residence, such as food-related items.

Privy: See Workers' Housing Feature Types.

Privy Pit: See Workers' Housing Feature Types.

Residential Building: See Workers' Housing Feature Types.

Residential Building Platform: See Workers' Housing Feature Types.

Residential Building Ruin: See Workers' Housing Feature Types.

Restaurant Platform or Foundation: A platform or foundation where a restaurant stood. Restaurant platforms are almost always denoted by large quantities of food cans, fragmented tableware, fragmented bottles, butchered bones, and kitchen implements.

Road: See Workers' Housing Feature Types.

Root Cellar: See Workers' Housing Feature Types.

Saloon Platform or Foundation: The platform where a saloon stood. High proportions of fragmented bottles relative to other types of artifacts often denote a saloon platform.

Shop Platform: See Mine Site Feature Types.

Stable: See Mine Site Feature Types.

Stable Ruin: See Mine Site Feature Types.

Townsite and Unincorporated Settlement Eligibility Guidelines

Although townsites and unincorporated settlements can be considered common site types relative to the West, they were uncommon on Fort Irwin and were of great local importance. For this reason, most can be eligible for the NRHP provided several conditions are met. Eligible sites must possess physical integrity relative to the principal Periods of Significance for a given mining area (defined in Chapter 3). The level of integrity is expected to be archaeological because buildings and structures were usually moved or dismantled. For the archaeological remains to possess integrity, the features and artifacts should permit the virtual reconstruction of the settlement and represent the locations of buildings, patterns of community organization, types of businesses and residences, and the demography of the inhabitants. Intact architecture is rare and should be considered to be an important representation of the types of buildings erected at settlements.

Most of the seven aspects of historical integrity defined by the NRHP apply to settlements. Some sites may possess standing structures, which must retain the aspect of Location to contribute to the site's integrity. To retain Location, the structure must be in its original place of use. For a site to retain the aspect of Design, the material remains, including archaeological features, must convey organization and planning applied to a settlement. Sites may feature standing buildings that were reoccupied on a serial basis. Residents may have altered a given building and constructed additions, and in such cases, the building can retain the aspect of Design if the material remains reflect the changes over time. To retain the aspect of Setting, the area around the site, and the site itself, must not have changed to a great degree from its Period of Significance, excepting the removal of structures. If the site is isolated, then the natural landscape should be preserved. If the site lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. In terms of Feeling, the site should convey the sense or perception of settlement from the Period of Significance. For Association, the site's sum of features and artifacts should permit the researcher to reconstruct the settlement.

NRHP Criterion A

Because townsites and unincorporated settlements were usually complex and tied to numerous themes and systems, they are associated with several important arenas of significance. The first is architecture. Building construction in townsites and unincorporated settlements contributed to the adaptation of both utilitarian vernacular and formal architecture to the materials and construction practices of the Mojave Desert. Townsites also were the prime vehicle for the application of defined architectural styles to the types of commercial and residential buildings erected in the mining towns. On a broad scale, towns and, to a lesser degree, unincorporated settlements were nodes and centers of infrastructure important to the region's mining industry. In this role, they were vehicles that brought infrastructure and primitive urban planning to Fort Irwin and the surrounding area.

The theme of economics serves as another arena of significance. Townsites were centers of commerce, banking, business, and trade. They also were transportation nodes and transfer points for the movement of goods and people. Supplies, equipment, and services often flowed in prior to distribution to consumers, and ore and mill products flowed out. The transportation occurred on several levels relative to an area's remoteness and development, and ranged from rail service to pack trains. Further, established townsites and unincorporated settlements served as anchors and conduits for capital and investment. The presence of established settlements, especially towns, lent legitimacy to a local mining industry, which fostered confidence among potential investors. Further, these investors were more likely to personally examine a mining district if it featured an established settlement. In general, settlements were the points through which capital flowed from investors to associated mines and mills. On a broad scale, settlements were part of and contributed to complex regional, state, and national economic and financial systems. For example, inhabitants consumed food and other domestic and commercial goods purchased from a variety of sources. Preserved food was shipped from packing companies in the Midwest and on the West Coast while fresh foods came from the California farms and ranches. Domestic and commercial produces were acquired from manufacturers in the East, Midwest, and the West Coast. By consuming preserved and fresh foods, settlement residents not only supported a complex national food transportation network, but also supported farming and ranching. The consumption of domestic and commercial goods had a similar impact.

Townsites and unincorporated settlements were associated with social themes of significance. Settlements were important communication centers for the residents and businesses within a region, as well as with the outside world. They also were centers for both passive and active cultural practices and traditions. For passive practices, inhabitants followed their cultural patterns, traditions, and ways almost unconsciously in daily life. For active practices, inhabitants purposefully sought out cultural traditions such as performances, lectures, salons, organizations, and community events. Through these practices, settlement residents imprinted their culture on a surrounding region. In addition, the interaction of the mining industry with the surrounding wilderness landscapes fostered a culture of its own. This movement, which we can refer to as desert mining culture, became pronounced in eastern California and southern Nevada. The region's mobile workforce carried this mining culture into other portions of the two states as it moved from place to place, helping spread the phenomenon. Moreover, the townsites and unincorporated settlements attracted a variety of individuals who did not work directly in mines or mills but were important to the development of the social fabric. This included women, families, day laborers, and businessmen, and all played various roles. Their arrival fostered a demand for cultural and social institutions that were both embraced and distained. Institutions that communities openly accepted included, for example, schools, churches, civic associations, unions, and meeting halls. Institutions that communities openly condemned but tacitly supported anyway included prostitution, dens of substance abuse, a drug trade, and saloons.

The theme of politics is another arena of significance that settlements share. On one level, settlements were active centers of the law enforcement and judicial systems that maintained order. On another level, settlements and especially the organized towns gave rise to administrative and regulatory bodies that oversaw local government activities, ordinances, claim registration and regulation, and records keeping. Settlements also served as polling stations and, occasionally, as sources of candidates for local and countywide political offices.

NRHP Criterion B

Townsites and unincorporated settlements may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Some building features and complexes can be traced to important individuals and in these cases they may be eligible under Criterion B. It should be noted, however, that the general inhabitation of a settlement by an important person is too indirect an association for Criterion B. The specific place of occupation by the individual of note must be identified, or the individual must have played a fundamental role in the settlement's physical development.

NRHP Criterion C

Settlements can be eligible under Criterion C if the site possesses intact archaeological, architectural, or engineering features and artifacts that clearly convey key aspects. Examples of key aspects include the settlement's organization and infrastructure; the makeup and arrangement of residences and businesses; the distribution of socioeconomic status, gender, ethnicity, and modes of employment; and characterizations of lifestyle such as diet, health, substance abuse, and consumerism. Many of these aspects can be charted through a careful study of artifacts and distribution of features.

The presence of standing structures can complicate a resource's eligibility under Criterion C. Structures that retain integrity relative to a Period of Significance may be contributing elements of a town or unincorporated settlement. They represent engineering, architecture, business, or residence associated with the mining industry. Nevertheless, because some settlements, especially those at springs, were occupied intermittently for decades, they can possess buildings and other features that were constructed outside of relevant Periods of Significance. In such cases, late buildings and structures would be noncontributing elements of the site because they were not part of the settlement's important timeframes.

NRHP Criterion D

Settlements offer a high potential for eligibility under Criterion D because many are likely to contribute meaningful information. An analysis of architectural features may enlighten the existing understanding of commercial architecture, housing, and the residential environment associated with the mining industry. Broad-scale studies of settlements often reveal aspects of community development, distribution of gender, modes of employment, socioeconomic status, and businesses. Settlements often possess building platforms, privy pits, and refuse dumps that feature buried archaeological deposits. Testing and excavation may reveal information regarding types of businesses, the lifestyles, social structures, and demography of residents, as well as the presence of families and women. Such studies are important because these subjects were not extensively documented in the past.

CHAPTER 6
STRATEGY FOR RECORDING MINING-RELATED SITES

Several fundamental goals govern how and why mining-related sites are recorded on Fort Irwin. The goals are to (1) understand and explain the history of a specific site; (2) complement the results of archival research; (3) know more about mining industry participants; and (4) contribute to the general body of data regarding regional and statewide mining history. All the above objectives are important steps in the two principal reasons for site recording, which are significance evaluation and historic preservation. Mining-related resources, however, can be complex and cumbersome to record, and so a general method is outlined below to achieve the above goals.

DEFINE THE SITE

Simple and well-defined sites are easier to record, discuss, and evaluate than large, multi-component sites. Yet, areas subjected to mining often possess complex assemblages of features left from a variety of activities. To facilitate efficient recording and data management, such large assemblages can be divided into individual sites. Entities defined by specialized functions, autonomy, concise geographic locations, or timeframes can qualify as individual sites. For example, sites can be drawn around individual mines, clusters of prospects, and residential features.

Once the general nature of a site has been defined, its physical boundaries must be firmly established. The researcher should identify all directly associated features and artifacts through careful examination. The outer limits then become the site boundary. When multiple sites adjoin, attributing artifacts to one or another of the sites can be difficult. Several points should be considered in such cases. Sites of different functions and timeframes usually have distinct artifact assemblages. Also, artifacts tend to migrate downslope from their sources instead of upslope.

DEFINE FEATURES

Sites should be dissected into their individual features with as much detail as possible. Because most sites have been reduced to archaeological remnants, the researcher must engage in some interpretation and speculation. Here, understanding the processes of prospecting, mining, and milling is an important guide for identification. Features should be labeled with a term common to the mining industry, the timeframe, or function.

Number/Order of Features

Features were usually constituents of systems, and the numbering sequence applied to the features should follow the order of the system. Some sites had multiple systems, and the hierarchy of the systems must first be determined, then the features numbered accordingly. At industrial sites, systems tended to be based on the flow of materials, processes, and the use of resources. With

habitation sites, systems tended to be based on residence, support activities and facilities, and waste disposal.

A typical mine exemplifies an industrial site with multiple feature systems. The flow of waste rock and ore out of the underground workings was the basis for the site's primary feature system. Because the underground opening was the most fundamental part of the system, it would be recorded as Feature 1. The waste rock dump, which was derived from the opening, should then be Feature 2. The rail line used to haul out the waste rock can be Feature 3. The facilities that supported the elementary work underground were parts of a secondary system. If the mine had a hoist, then its associated features would comprise the next system in the hierarchy. The hoist (or foundation) would be Feature 4, its water source can be Feature 5, and the hoist house Feature 6. In essence, a site's features are prioritized according to their relevancy to the extraction of rock from the mine.

Description of Features

Features should be described with the intent of documenting pertinent details while maintaining brevity. Descriptions can account for form, function, and relationships to feature systems. Note shape, construction, materials, and unusual attributes. Measurements are vital, and they should be recorded in English units since this is what the mining industry historically used. The level of integrity, or degree of intactness, is important. In addition, the distribution of artifacts and the potential for buried deposits should be noted.

MAP THE SITE

Several methods for mapping sites are commonly employed. Mapping a site by hand with a pocket transit is excellent because this method captures detail, provides an accurate plan view, and captures a site's organic nature. Mapping with a global positioning system (GPS) tends to be less accurate and provides an abstract representation of a site through symbols rather than actual feature shapes. The maps generated by GPS, however, can be directly integrated into geographic information system (GIS) programs and files. GPS mapping is ideally suited for linear sites and extensive sites with repetitive feature types, such as prospect complexes.
Site maps must be easy to read and interpret, which is important when justifying a significance evaluation. The scale should be relatively large, such as 1 centimeter equal to 15 feet. The map may depict key landscape elements such as drainages, roads, slope, and topography. It is important to avoid extraneous detail because this reduces simplicity. The symbols used to represent natural and manmade features should be either conventional or intuitively understood.

PHOTOGRAPHY

Photography is an important facet of site documentation because it provides a visual record. Many sites and their constituent features, however, do not photograph well, and so photography is not a substitute for mapping and textual descriptions.

Researchers should use photography to portray the site in its setting, important feature systems, and individual features of significance. Unusual artifacts can be photographed, as well.

Overview pictures from distant vantage points are usually sufficient to depict the setting. Similarly, overviews of feature systems can be taken at localized high points, and the pictures should exclude as much unrelated material as possible. Individual features may photographed from any angle and should fill the camera frame to ensure detail.

Traditionally, researchers used 35 millimeter black-and-white film for photography, and digital cameras have become popular in recent years. Digital cameras are economical and allow picture files to be downloaded directly into documents such as reports. The long-term preservation of digital files and prints, however, is questionable. The archival quality of digital prints, even when on photograph paper, has not been established. Changes in computer technology may render today's digital files obsolete and unreadable in the future. By contrast, the archival stability of black-and-white negatives and prints has been established, which is why this type of medium is currently required for intensive level site documentation.

CHAPTER 7
ARTIFACT TYPES AND CATEGORIES

Mining-related sites usually feature a variety of items and other materials left by industrial and residential activities. Some items were intentionally cast off as waste, some were left when a site was abandoned, and some were generated when a resource's structures and equipment were dismantled. Any manufactured item or altered natural object can be classified as an *artifact*. For example, building materials, domestic refuse, and industrial hardware are manufactured items, and quarried or chiseled rocks and cut logs are altered natural objects. Nearly all mining-related sites possess artifacts, usually divided among the various features and structures, and the sum is known as an *artifact assemblage*.

FUNCTION AND ROLE OF ARTIFACTS

Because few mining-related sites were thoroughly documented by records-keepers of the past, artifact assemblages play a key role in understanding the history of a site and its occupants. Artifacts hold great potential to provide firm information regarding poorly documented resources, as well as suggesting trends for subjective arenas of study. Many artifacts were made for defined periods of time, and their presence on a site can help assign dates of activity and sequences of occupation. Maker's marks, manufacturing techniques, and artifact types and forms often were used for definite periods of time, which are referenced in some publications.

Artifacts can also help clarify the functions of some features. For example, forge-cut iron scraps, anthracite coal, and forge clinker can define an otherwise generic building platform as that for a blacksmith shop. Further, artifacts may be the only representation of a facility or a surface plant component that left no other evidence. For example, ventilation tubes at a mine indicate that the operation employed a free-standing, portable blower to force fresh air underground. Such blowers usually left no evidence in the form of foundations or other features. Artifacts usually constitute the only evidence that suggests trends regarding a resource's occupants. Specific types of items and the overall assemblage can reflect aspects of gender, ethnicity, socioeconomic status, health, diet, and consumerism.

RECORDING ARTIFACTS

To maximize the potential offered by a resource's artifacts, they should be recorded in a systematic fashion. First, because many artifacts tended to be associated with a specific activity, facility, or structure, they are best inventoried by feature. Second, the artifacts should be categorized to make sense of their form, function, reason for deposition, and any other information that may be extracted upon further study. Third, the artifacts should be quantified.

CATEGORIZING ARTIFACTS

Resources occupied for lengthy periods of time and resources that represent complex operations tend to possess high volumes and wide arrays of artifacts. By contrast, simple resources occupied for brief periods often possess a limited variety of few artifacts. In either case, categorization will help organize information, which can facilitate a better understanding of the site.

Mines and mills were industrial sites that often included structures, buildings, facilities, and machinery. Continued operations, construction, repair, and dismantling of facilities and structures generated industrial and structural materials. Workers may have lived on-site, and certainly spent a considerable portion of their days there, and generated domestic refuse through their extended presence. Given the above, a mine site's artifacts can be divided into six general categories.

Structural Artifacts: Structural artifacts include any materials used for buildings and structures, including machine foundations. Some of the basic forms of structural artifacts include, but are not limited to, dimension lumber, nails, sheet iron, stovepipes, bricks, stones, and logs. Items lying scattered on the ground should be quantified, while standing structures should be dissected and their individual artifacts also quantified.

Industrial Artifacts: Industrial artifacts include a broad variety of items representing machinery, mechanical systems, workplace practices, manufacturing, goods, hardware, materials-handling, and other industrial activities. Industrial artifacts should be described by their historic or technical names. If this is unknown, then they should be identified by function and modified with a descriptor. Machines can be recorded as single, large artifacts. When they are attached to a structure such as a foundation, the structure should be dissected and its components inventoried as artifacts.

The other four categories of artifacts fall under the broad umbrella of *Domestic Artifacts* and include the following:

Bottle Glass: Bottle fragments and identifiable bottle parts. Bottle fragments and parts should be described by:

- Part name, manufacturing technique, color, vessel contents, maker's marks.

Cans: All types of cans. Cans should be described by:

- Type, manufacturing technique, size, shape, and opening if unusual, and vessel contents.

Ceramics: All types of domestic ceramics. Ceramics should be described by:

- Ceramic type, function if known, glaze, decorative pattern.

Miscellaneous Items: The category of miscellaneous items encompasses general domestic refuse outside of bottle glass, cans, and ceramics. Butchered bones, food-preparation utensils, personal items, other forms of waste, and domestic goods fall into the miscellaneous category.

QUANTIFYING ARTIFACTS

Several methods for quantifying artifacts can be employed. An absolute count is not only preferred, but also can be easily accomplished for light to moderate volumes of artifacts. High volumes of artifacts and jumbled items such as lumber, however, can render such an approach difficult if not impossible. For example, a domestic refuse dump may contain thousands of food cans scattered over a broad area; or, a collapsed building may feature piles of boards and other debris that are very difficult to quantify. Two approaches can organize the quantification of artifacts under these conditions.

The first method generally applies to refuse dumps and scatters of artifacts. In the event a feature possesses a high number of repetitive artifacts, a sample can be taken and extrapolated to determine the total volume. For example, if a domestic refuse dump occupies 1,000 square feet, the artifacts within a 100-square-foot area can be quantified and multiplied by a factor of 10. If this approach is used, the entire dump must be thoroughly examined for unusual items potentially missed by the sample.

The second method generally applies to structural remnants such as collapsed buildings, and requires some preplanning. Specifically, the cultural resources specialist should quantify the total materials comprising standing buildings of known sizes. The total can then be extrapolated to collapsed structures of like size and construction. If the collapsed building is larger or smaller, then the quantity of structural materials can be adjusted proportionately. For example, based on examples of intact structures, a standing privy often consists of between 40 and 60 pieces of lumber and approximately 200 nails. Collapsed privies would then possess approximately the same quantity of structural materials. Standing cabins of frame construction around 15-by-15 feet in area often consist of roughly 320 pieces of lumber and 1,200 nails. A collapsed cabin of like area would consist of approximately the same volume of materials. When the cultural resources specialist estimates a collapsed structure's materials, they must closely examine the structure remnant to identify additional items.

In sum, artifacts should be inventoried by feature and categorized as either structural, industrial, or domestic in nature, and clearly described and quantified. Artifact assemblages may be the only evidence representing a site's history, constitution, and occupants. In this light, accurate, thorough, and systematic inventories are crucial and can strongly influence the objective evaluation of the resource's significance.

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Appendix G

Supplemental Information for Identification and Evaluation of Previously Unevaluated Properties

Identification and Evaluation of Previously Unevaluated Properties

1.0 Introduction

This Appendix provides supplemental information for identifying and evaluating previously unevaluated properties on Fort Irwin. This Appendix may be useful to the CRPM when reviewing undertakings or in cases of inadvertent discoveries and by contractors conducting resources surveys on behalf of Fort Irwin. This Appendix does not create any new or independent requirements beyond those compliance requirements directly associated with undertakings.

2.0 Identification of Historic Properties

The following information on the identification of historic properties complies with the Secretary of the Interior's Standards for Identification. The purpose of identification is to collect sufficient information to evaluate if historic properties are present within an APE. All identification activities should be designed to refine and/or add to the background information, satisfy compliance requirements and achieve goals of resource management, and military Identification activities are grouped into three sets of procedures: pre-inventory preparation, field procedures, and data collection. Pre-inventory preparation and results integration are the same for the identification of all expected historic property types and are discussed below. Field procedures for the identification of cultural and archaeological sites, PTRCI and TCP, buildings, structures, and objects, and districts differ and are discussed individually.

2.1 Pre-Inventory Preparation

2.1.1 Review of Planning Level Survey (PLS) Data

The review should be commensurate with the size and scale of the project. The review should establish whether the project-specific APE(s) contains areas that were the subject of previous cultural resources studies or areas where historic properties have been previously identified. This data could encompass GIS data, previous CRM reports, Installation site and map files, historic contexts on the Installation and region, archaeological predictive models or sensitivity studies, and other relevant information related to previous identification surveys. The review of PLS data should determine what historic property types are likely to be found in the APE. The quality of previous information should be reviewed as follows:

- If the area previously has been investigated, assess the quality of any data collected.
- Determine whether the APE is "large" or "small." The size will help determine the appropriate field identification method.
- Determine the need for additional identification based on the size of the APE, PLS data, and knowledge and experience.

2.2 Archival Research

Archival research may be warranted when there is insufficient data about resources within an APE. The purpose of additional archival research will be to document resources and their historic context

sufficient to evaluate the resource through applying the National Register Criteria for Evaluation. The extent of additional archival research will depend on the existing resource-specific data and the extent of previously prepared historic contexts. Research should include comprehensive archival research at local libraries; interviews with individuals knowledgeable about the prehistory (pre-contact) and history (post-contact) of the area; field checks of site locations; an examination of photographs and maps of historic and/or prehistoric sites within the study area; an examination or review of photographs, maps and descriptions of private collections; obtaining copies of site forms and other primary data from national, state, and local repositories, state or local museums and historical societies, and other pertinent institutions; preparation of overviews; and the preparation and production of reports summarizing the results of the archival research. For built resources on the Installation, sources of data could include historic building files and photographs, and real property records. For properties of traditional religious and cultural importance, consultation with the Tribes is indicated. Background research on archaeological resources allows the identification of potential archaeological sites, generation of research questions used in preparing a research design, and estimation of the scope of fieldwork, analysis, and artifact curation.

2.3 Inventory Strategy

No single inventory technique will fit every project. The scope and nature of the survey, anticipated effects, and the historic property types predicted to be located within the survey area based on the review of background data will help to determine the methodology to be used for specific survey areas. Generally, field inventory may be characterized by two techniques: reconnaissance and intensive. Sampling is a form of predictive modeling generally reserved for "large" survey areas.

2.3.1 Reconnaissance survey

Reconnaissance surveys are most often used to determine whether or not historic properties are present within an area. Methods may include visual identification of standing historic properties, interviews with knowledgeable individuals, and archaeological inspection of sample tracts, coupled with appropriate background research. If the results of the reconnaissance survey indicate that historic properties might be present, then an intensive survey might be necessary. Documentation for reconnaissance surveys shall include:

- the types of historic properties the inventory is designed to identify;
- the boundaries of the area surveyed;
- the method of survey, including the extent of survey coverage;
- specific historic properties that were identified, and the categories of information collected; and,
- surveyed areas that did not contain historic properties.

2.3.2 Intensive survey

The size and complexity of the land area, the types of properties expected, the ease or difficulty with which such historic property types can be identified, the prior ownership and use of the lands

involved, the ease or difficulty with which access can be obtained, and the nature of the projected effects contribute to the decision to conduct an intensive inventory. Intensive inventory methods are used to determine what specific historic properties are located within a defined area or to collect enough data on a specific historic property to allow for later evaluation. Intensive inventories reveal the actual types and distribution of historic properties within a survey area, their location and condition, and their physical extent. Documentation for intensive inventories shall include:

- the types of historic properties the inventory is designed to identify;
- the boundaries of the area inventoried;
- the method of inventory and the extent of inventory coverage;
- the precise location of identified historic properties; and
- information regarding the appearance, significance, integrity, and boundaries of each historic property sufficient to permit an evaluation of its significance.

3.0 Field Procedures: Sites

The purpose of archaeological field inventory is to identify the location, nature, and condition of archaeological sites either previously identified, or heretofore unknown, within a proposed project's area of potential effect. Archaeological sites may include prehistoric, proto-historic, and historic artifacts, burials, landscape features, and the remains of buildings, structures, or objects.

3.1 Field Methodology

Procedures for archaeological field inventories include: pre-field briefing, identification of appropriate methodology for specific survey area(s), field investigation, recordation, laboratory processing, and data compilation. The appropriate field methodology will be determined by the project parameters. No set of guidance covers all possibilities and the person in charge of the field work is expected to exercise professional judgment in this guidance and justifying deviations.

a. Sampling may be used to estimate the historic properties that might be located within a survey area. Sampling may be random, stratified, or systematic, and may be approached in stages so that the results of the initial large area survey are used to structure successively smaller, more intensive inventories. The research goals towards which the inventory is expected to contribute should provide the basis for the sample strategy. The research strategy should identify the type of expected historic properties and the nature of the area to be inventoried. Sampling provides information about the frequencies and types of historic properties identified within specific areas at various confidence levels. Predictive modeling applies basic sampling techniques to the number, classes, and frequencies of historic properties within inventoried areas. The data can be extrapolated to areas that have not been inventoried. Predictive models are effective tools for the early stages of planning an undertaking; however the accuracy of any model must be verified with field-testing.

b. Mapping should include topographic and environmental features as well as the location of surface finds (including isolated finds), shovel tests, cultural features, excavation units and site boundaries.

c. Mapping must maintain horizontal spatial control. If GPS is available, the locations of features, debris, tools, or clusters may be logged as well as the perimeter of the site area. If GPS is not available, locations will be recorded by compass azimuth from a datum or by triangulation. Archaeological materials at Fort Irwin will be recorded by one of two types, sites and isolates. The following definitions of sites and isolates have been in use at Fort Irwin for more than 25 years and remain technically adequate. Any change would cause great difficulties in comparing data with nearly 1,200 sites already recorded. The definitions are more fully reported in the Fort Irwin Historic Properties Preservation Plan (Warren et al 1986: 5-6 – 5-10). Sites are locations with midden, or multiple–class artifacts, or significant features, or a density of at least 20 cultural items (e.g., flakes, cores, bifaces, etc.) within a 10 meter radius. Isolates are those occurrences of artifacts totaling less than 30 items in a 20 meter radius. All sites will be recorded on California Department of Parks and Recreation forms. Small sites or isolates within close proximity (30 meters) of a site may be loci within a larger site and so recorded under the judgment of the person in charge in the field. Site record forms will include information on vicinity isolates. Isolates are individual cultural items such as unmodified or modified flakes, bifaces, potsherds.

d. Only significant Isolates, those that are dateable or time-diagnostic, or rare will be individually recorded on California Department of Parks and Recreation forms. Complete one Primary Record form, with map, for all isolates of any nature that are recorded within a discrete survey area, e.g., a square kilometer. The Primary Record will show the locations of all the isolates recorded and give some information (such as would be listed and described in the artifact form). Include the location of such isolates on report maps, list and describe them in tables and discuss them in the text of the report.

e. Shovel testing is appropriate for areas that are obscured by vegetation, drifted sand or accumulated sediment. It may be used as part of a sampling strategy or to assist in boundary definition, or test for subsurface deposits.

f. Test excavation units sample the site area for subsurface deposits and features and provide assessments of site integrity and information potential. Units are excavated in either natural or arbitrary levels as appropriate. This technique may result in information related to site age, cultural affiliation, site function, degree of preservation of organic remains, the presence of cultural features and/or activity areas, and disturbances.

g. Remote sensing methods include aerial photo interpretation, which defines site setting, site limits, and internal site structure, ground-penetrating radar, resistivity, conductivity, magnetometry or any other non-destructive, instrumental method used to determine the location and/or structure of above ground or buried historic properties.

h. Field inventory forms for standardized site and inventory recordation shall be used.

i. Fort Irwin has a limited collection policy. Artifact collection at the identification level of inventory should be limited to diagnostic materials, even from shovel probes or test units. Any excavated non-diagnostic material from shovel tests and test units will be recorded and replaced in the unit and covered with sediment form the unit. Surface scatters will be

noted, photographed, and used to identify possible follow-up site evaluations. Metates and fire-cracked rock will not be collected unless specific site circumstances dictate otherwise.

j. As a matter of safety, explosive ordnance impact areas, as well as temporary SDZs, will not be inventoried.

3.2 Field Personnel

Field supervisors must meet the Secretary of the Interior's Professional Qualification Standards (1983), or be a Tribal member for PTRCI.

All field technicians should have completed a formal archaeological field school at a recognized university, and must have experience with both archaeological identification and evaluation techniques.

Each team member will attend a field safety and unexploded ordnance briefing prior to beginning fieldwork.

In the field, technicians will wear proper field attire and equipment, and an identification badge that designates the wearer as a government employee or employee of a contractor.

Field supervisors consult the Range Control schedule before entering the field each day to determine site availability. Military training always takes precedence, and it is the responsibility of the field supervisor to maintain contact with Range Control to coordinate schedule changes or report emergencies. Protocol between Range Control and field crews shall be established at the outset of each field season.

3.3 Analysis and Interpretation

All artifacts observed in the field should be analyzed. All collected materials should be cleaned, labeled, and analyzed. Analysis and interpretation include the following:

- description of all artifacts by type, including provenience, measurements, and quantity;
- description of how dates for the site were obtained;
- description of diagnostic materials that includes type, date, and photographs;
- description of features including content, plan views, and profiles when appropriate;
- description of the soil matrix, horizons, disturbances, and site formation processes;
- description and interpretation of the spatial relationships of features and artifact concentrations within the site and nearby isolates; and
- description of methodology for analysis of any paleoecological data collected from the site.

4.0 Field Procedures: Properties of Traditional Religious and Cultural Importance (PTRCI)

To identify PTRCI, it will be necessary to consult directly with knowledgeable tribal members. For some Tribes, individuals who retain knowledge regarding these properties may not be the

current community leaders. The community leaders, however, may be able to identify members of the Tribe who are knowledgeable about traditional matters and who are willing to consult and assist. Consultation with any tribe is culturally sensitive and should follow protocol acceptable to that tribe. Identification of specific individuals with whom consultation might take place and methodologies appropriate for collecting traditional and cultural information should be discussed and resolved in pre-fieldwork meetings.

Areas identified during the consultation process as significant to the tribes require field inspection and recordation. Field inspection may occur simultaneously with investigations for other historic property types. However, it is recommended that an individual from a tribe or with knowledge of ethnographic methodologies be present along with trained professionals who can assist in historic property location and definition. Field visits to sites with religious significance must be conducted in appropriate modes of behavior and should be discussed with trained professionals before the visit. Sufficient recordation should be undertaken to enable a determination of National Register eligibility; this information will then be appropriately safeguarded and in accordance with the request of the appropriate tribe or cultural leader.
A tribe or tribes should provide as much information as possible to determine if the historic property has an integral relationship to traditional, religious and cultural beliefs or practices and/or if the historic property is important to the transmission of the beliefs or practices. A tribe or tribes should also provide as much information as possible and determine if the condition of the historic property conveys its relationship to traditional, religious and cultural beliefs or practices. In addition, any physical alterations that might have resulted in a loss of integrity should be taken into consideration. Integrity should be considered from the eyes of the practitioners. It is possible that changes to the resource can be accommodated into the practices.

5.0 Field Procedures: Buildings, Structures, Objects, and Districts

The identification process is the same for buildings, structures, and objects and historic districts. The classification of the property type (i.e. whether a property is a building, structure, object, or district) will occur during this process. The goal of field identification inventories for buildings, structures, and objects is to determine the location and condition of known and previously unknown buildings, structures, objects, and districts within the built environment.

5.1 Field Methodology

5.1.1 Initial documentation of buildings, structures, and/or objects

Recommendations that result from the planning stage regarding expected property types, their location, and the relative size of the inventory area will determine the specific area to be investigated and the field investigation strategy. The first step is the compilation of a list of all the known buildings, structures, objects, and/or districts within those areas. The list may be compiled from map or GIS data, or from reconnaissance of the area. Because map data are dynamic, it will be necessary to field verify lists derived from such sources. The list should include the type of property, such as, but not limited to, residential, public, mine, or monument, the building number, address and/or location, and construction date if prominently displayed on the building, structure,

or object. For built structures of the U.S. Army, one should check Advisory Council for Historic Properties resources for property types that are exempted from consideration.

5.1.2 Research Questions for Identification of Buildings, Structures, Objects, and Districts

Research conducted during the identification of a building, structure, object and/or district should be directed towards capturing five areas of information. This information includes:

Construction Date. Some buildings, structures, and objects have the date of construction prominently displayed. In most cases, archival research will be necessary to determine the construction date. Possible sources for dating government-owned and built buildings, structures, and objects include Fort Irwin Real Property records, deeds, and drawings. For those resources built by civilians or private companies, keep in mind that real property records may list the date the built resource was acquired by the government as the construction date. It might be necessary to verify the construction date with other sources such as maps, photographs, and newspaper articles. Sources for dating residential buildings not originally constructed by the Army include deeds, tax records, building permits, newspaper accounts, plat maps, historic photographs and maps, and anecdotal accounts. Property deeds for specific townships provide a chain of ownership for historic properties and tax rolls specify years in which capital improvements were made. Generally, a built resource must be at least 50 years of age to be considered a historic property. A building, structure, and/or object less than 50 years of age may be eligible for the National Register if it is of exceptional importance and meets National Register Criteria Consideration G.

Modifications. Tracking the modifications to built resources over time may be useful during the evaluation of integrity. Real Property records may provide brief descriptions and the dates of modifications to built resources as may drawings and photographs.

Historic Function. Identifying the historic function of a built resource can assist in relating a resource to its historic context. At Fort Irwin, mining and ranching related resources are the bulk of non-Army built resources. Identification of original owner and/or other persons or events associated with the built resource. Ownership information may be available through a deed search. In addition, many libraries have historic information containing bibliographic sketches of former area residents.

Identification of architect, contractor, or designer. Although it is possible to identify the architect or designer of a building, structure, or object there is no consistent method or source for such information. Possible sources include building permits, local newspapers, city directories, and the archives of local architectural firms

Architectural Style. Many handbooks and websites cans assist with the identification of architectural styles. Useful sources include World War II and the U.S. Army Mobilization Program: a History of 700 and 800 Series Cantonment Construction (Wasch et al. 1993).

The purpose of field documentation is to record the building, structure, object, or district as it exists today. Field data will provide comparative information for assessing integrity, current condition, and setting. Field documentation includes the following activities:

Photography. Photographs should capture every elevation. Photography may not be permitted in sensitive/restricted areas or for sensitive/restricted buildings and structures such as ammunition depots. All photography will be cleared with the Fort Irwin CRM and appropriate military entities prior to the commencement of field surveys. The number of photographs will depend on the type of built resource being documented and the resource's level of detail.

Field Recordation. The following information should be recorded in notes from field observations. A standardized field form is the most efficient method for data collection.

Building number
Location
Plan/footprint of building
Number of stories
Roof type(s)
Roof material(s)
Foundation material(s)
Wall material(s)
Type and location of doors
Type and location of windows
Architectural details/style
Condition of resource
Number of additions

5.2 Field Personnel

Identification of a building, structure, object, or district is conducted under the supervision of an individual meeting the Secretary of the Interior's Professional Qualification Standards.

6.0 Integration of Identification Results

The results of the background data collection, review of planning level survey, archival research, and field investigations should be integrated in order to evaluate a resource applying the National Register Criteria for Evaluation. The identification phase should provide sufficient data to classify the property, place the property in its appropriate historic context, and assess resource integrity.

Evaluation of Historic Properties

1.0 Introduction

The evaluation of a property requires an assessment of a property's significance, under an established set of criteria, and its integrity. The evaluation results in a determination of National Register eligibility. The evaluation procedures involve an assessment of the collected data against National Register criteria set forth in National Register of Historic Places (36 CFR 60), the National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation, and the Secretary of the Interior's Standards for Evaluation.

Data necessary to evaluate National Register eligibility differs somewhat among sites, PTRCI, buildings, structures, objects, and districts. Recommendations for the collection of field data specific to each property type are detailed under identification of historic properties for each property type.

A property must be significant in order to qualify for the National Register. To determine significance, the property must be evaluated within its historic context. An historic context provides a framework within which the National Register criteria are applied to specific properties or property types. Property types are defined by the National Register as sites, buildings, structures, objects, and districts. Examples of these property types include, but are not limited to, residential buildings, bridges, monuments, landscapes, habitation sites, and properties of traditional religious and cultural importance.

Historic contexts are developed around typological themes. Common examples might include the following: building use, ownership, associated ethnicity, a historical event or trend, architectural style, building material, and others. Contexts can also be either national in scope or statewide. As part of the research process, researchers should contact the National Park Service or U.S. Army Environmental Command (USAEC) to determine whether any nationwide historic contexts have been developed that might apply to historic property types on Fort Irwin. Similarly, the SHPO may have a statewide context against which the significance of a historic property can be weighed.

2.0 Evaluation Procedures

Categorize the Historic Property. Determine if the historic property is a site, property of traditional religious and cultural importance, building, structure, object, or district using National Register Bulletin 16.

Determine the Historic Property's Historic Context. Identify the theme(s), geographical boundaries, and chronological period that provide a perspective from which to evaluate the historic property's significance. Determine how the theme(s) within the context is significant to local history, the State or the nation. A theme is considered significant if scholarly research indicates that it is important in American history.

Determine if the historic property type is important in illustrating the historic context. Contexts may be represented by a single historic property type or by a variety of historic property types.

Determine how the historic property illustrates the historic context through specific historic associations, architectural or engineering values, or information potential.

Determine whether the historic property possesses the physical features necessary to convey the aspect of prehistory or history with which it is associated.

2.1 Determine Whether the Historic Property is Significant under the National Register of Historic Places Criteria

The National Register of Historic Places Criteria for Evaluation state:

- The quality of significance in American history, architecture, archeology, 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 significant persons 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 yielded, or may be likely to yield, information important in prehistory or history.

The following provides expanded details for each criterion.

<u>Criterion A: Event</u>. Under Criterion A, a historic property must be associated with one or more events important in the historic context. To establish significance under this criterion:

- Determine the nature and origin of the historic property.
- Identify the historic context with which it is associated.
- Evaluate the historic property's history to determine whether it is associated with the historic context in any important way.

<u>Criterion B: Person</u>. Criterion B applies to historic properties associated with individuals whose activities are demonstrably important within a local, State, or national context. The historic property must illustrate the person's achievement, rather than commemorate the person’s life. To determine a historic property's significance under this criterion:

- Determine the importance of the individual.
- Ascertain the length and nature of the person's association with the historic property and determine if there are other historic properties associated with the individual.

Criterion C: Design/Construction. Criterion C applies to historic properties significant for their physical design or construction, including such elements as architecture, landscape architecture, engineering, and artwork. The historic property, to qualify, may:

- Embody distinctive characteristics of a type, period, method of construction; or
- Represent the work of a master; or
- Possess high artistic value; or
- Represent a significant and distinguishable entity whose components may lack individual distinction.

Criterion D: Information Potential. Historic properties may be eligible for the National Register under Criterion D if they have yielded, or may be likely to yield, information important to prehistory (pre-contact) or history (post-contact).

2.2 Determine if the Historic Property represents a type usually excluded from the National Register of Historic Places, and if so, meets any of the Criteria Considerations

Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past fifty years will not be considered eligible for the NRHP. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

- A religious property deriving primary significance from architectural or artistic distinction or historical importance; or
- A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or
- A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his or her productive life; or
- A cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or
- A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or
- A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or
- A property achieving significance within the past fifty years if it is of exceptional importance.

2.3 Define and Evaluate Historic Property Integrity of Location, Design, Setting, Workmanship, Materials, Feeling and Association

In addition to significance, a historic property must possess integrity to be eligible for the NRHP. Integrity is the ability of a historic property to convey its significance. Integrity may be a somewhat subjective quality, but it must be based on how the historic property's physical features relate to its significance. Seven aspects are used to define integrity. Some, if not all, of these seven aspects should be present in a property in order for it to retain its integrity. The seven aspects of integrity include location, design, setting, materials, workmanship, feeling, and association. These concepts are defined as follows:

Location: the place where the historic property was constructed or the place where the historic event occurred. The relationship between a property and its location is important to conveying the sense of historic events and persons associated with the property and to understanding why the historic property was created or why the event occurred. Moved historic properties are usually not considered eligible; see Criteria Considerations for exceptions.

Design: the combination of elements that create the form, plan, space, structure, and style of a property. Design is the result of conscious decisions made during the original conception and planning of the property and includes elements such as organization of space, proportion, scale, technology, ornamentation, and materials. For districts, design includes the way sites, buildings, structures, or objects are related. For example, the spatial relationships between major features, visual patterns of a landscape, and the layout of streets and sidewalks, among other features, are important to the design of districts.

Setting: the physical environment of a historic property. This quality refers to the character of the property's location. It involves how the property is situated and its relationship to surrounding features and open space. Setting can include such features as topography, vegetation, manmade features, and relationships between buildings and other features or open space. For districts, setting is important not only within the boundaries of the property, but also between the property and its surroundings.

Materials: the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property. The choice and combination of materials reveal the preferences of the creator(s) and suggest the availability of particular types of materials and technologies. A historic property must retain the key exterior materials dating from the period of its historic significance. If rehabilitated, those materials must have been preserved. Recreated properties or recent structures or buildings made to look old are not eligible for the NRHP.

Workmanship: the physical evidence of the crafts of a particular culture or people during any given period in prehistory (pre-contact) or history (post-contact). Workmanship is the evidence of artisans' labor and skill in constructing or altering a site, building, structure, object, or district and may apply to the historic property as a whole or to individual components. This aspect of integrity provides evidence of the technology of a craft, illustrates the aesthetic principles of a prehistoric (pre-contact) or historic (post-contact) period, and reveals individual, local, regional, or national applications of both technological practices and aesthetic principles.

Feeling: a property's expression of the aesthetic or historic sense of a particular period of time. Feeling results from the presence of physical features that, taken together, convey the property's historic character.
Association: the direct link between an important historic event or person and a historic property. A historic property retains association if it is the place where the event or activity occurred and is sufficiently intact to convey that relationship to an observer.

The process of evaluating the qualities of integrity for a resource may be described as follows:
Define the essential physical features that must be present for a historic property to represent its significance. Although not all the historic physical features need to be present, those that convey its historic identity are necessary, including those that define why and when the historic property was significant. Under Criteria A and B, the historic property must retain those features that made up its character or appearance during the period of its association with the important event, historical pattern, or person(s). Under Criterion C, the historic property must retain most of the physical features that constitute that style or technique. Under Criterion D, integrity depends on the data requirements defined in the research design. The significant data contained in the historic property must remain sufficiently intact to yield the expected important information under appropriate methodologies.

Determine, except for properties of traditional religious and cultural importance, whether the essential physical features are sufficient to convey their significance.

Determine whether the historic property needs to be compared with similar properties (historic and non-historic). A comparison may help determine what physical features are essential to historic properties of that type.

Determine, based on the significance and essential physical features, which aspects of integrity are particularly vital to the evaluation of historic properties and if the features are present. For Criteria A and B, the presence of all seven aspects of integrity are the ideal, however integrity of design and workmanship may not be as important or relevant. Under Criterion C, a historic property must have integrity of design, workmanship, and materials. Location and setting are important for those historic properties whose design is a reflection of their immediate environment. For Criterion D, setting and feeling will probably not apply; location, design, materials, and possibly workmanship should be considered.

If, upon evaluation, it is determined that the historic property does not retain integrity, the historic property will not considered eligible for the National Register. If, upon evaluation, it is determined that the historic property retains integrity, the appropriate Criteria for Evaluation must be examined. If it is determined that a historic property has integrity and meets one or more of the four Criteria for Evaluation, the property shall be considered eligible for listing in the National Register

3.0 Reporting

The results of all identification and evaluation efforts result in a report. The presence and absence of all identification and evaluations will be documented, as appropriate, and incorporated into the

PLS. The results of identification and evaluation may be disseminated via the NEPA process and survey reports as appropriate. In addition, the annual IMCOM data call for the report to Congress will include information on sites evaluated during the previous year. Documentation is provided in appropriate electronic format (e.g., CD or other compatible media) in PDF format for text and ArcView GIS for map data, as needed.

APPENDIX H

STANDARDS FOR ARTIFACT AND SPECIAL SAMPLE ANALYSES

One of the most significant problems confronting cultural resource management is the growth of an un-integrated database. That is, standards for artifact analysis vary from one researcher to the next, and from one report to the next, meaning that is often difficult to compare the results from different excavation projects. Comparison between and within sites is a crucial part of establishing the research context for an area, meaning that the lack of standardization seriously impedes cultural resource management. Therefore, the development of standards for artifact analysis is appropriate.

This section defines minimum standards that specify what data should be routinely collected during field or laboratory analysis of individual artifacts. Since small cultural resources may contain thousands of artifacts and other remains, analysis of all cultural material from a site is often impossible. Yet the sample analyzed should be adequate to describe and evaluate the resource, and to address the selected research topics.

The following set of standards divides the various physical phenomena found in archaeological sites into a series of classes, including flaked stone artifacts, ground stone artifacts, ceramic artifacts, historic-period artifacts, faunal remains, soil samples, and charcoal and organic samples suitable for radiocarbon dating. For each class, specific standards for analysis will be presented. Also, the analysis should be appropriate to the stage of investigation; material recovered during resource evaluation should not be analyzed as thoroughly as material recovered during data recovery, for example. To help clarify how intensive different levels of analysis should be, tables will be presented with each class specifying what attributes will be recorded for each of the classes for each of the three phases of investigation (i.e., identification, evaluation, and data recovery).

These standards are not intended to restrict innovation in the field or discourage alternative forms of analysis. Instead, they are meant to provide for comparability between investigations. Deviations from these guidelines are acceptable, but justifications for any departures should be presented in the relevant report.

Flaked Stone Artifacts

For the purposes of analysis, flaked stone artifacts are placed in two categories: tools and debitage. Tools are any flaked stone artifacts that show signs of either use-wear or purposeful modification. Debitage denotes the byproducts of lithic reduction in flakes and shatter that do not show any macroscopically obvious signs of retouch or edge damage The sections that follow will provide more details about how analysis is to be undertaken for each of these specific classes. Sections below also provide standards that are potentially applicable to all classes of flaked stone artifacts.

Any data recorded from the analysis of flaked stone artifacts should be saved in paper copy and a file and included on an IBM-formatted 3.5” disk along with the final report disk (see below). The data should also be included in an appendix or data compendium accompanying the final report.

Bifaces are any flaked stone tool that has ventral and dorsal surfaces that have been substantially modified. That is, they show evidence of bifacial flaking that is not just limited to the edge of the artifact. Relatively unrefined (i.e., Stage 1 or 2) bifaces may be modified over less than 50% of either or both faces, but all later stage bifaces must be modified over at least 50% of both dorsal and ventral faces.

Projectile points are (usually) finished bifacial tools that appear to have been hafted on the distal end of a spear, dart, or arrow shaft, and whose main function appears to have been penetrating the hide of prey. Any finished (i.e., finely worked) biface, regardless of size, with a sharp tip or evidence of hafting is considered a projectile point. Some "unifacial" projectile points that do not fulfill the entire biface definition may still be considered projectile points because of their sharp tips and evidence of preparation for hafting.

Cores (a.k.a. "objective pieces") are objects of flaked stone that did not serve as tools, but were used as sources for flakes that were then used as tools. Cores may come in a variety of forms, but amorphous cores with multiple platforms and little deliberate shaping are probably the most common. Other forms include bipolar cores (which are created through use of a hammer and anvil), bifacial cores (used to produce flakes rather than to result in a biface), and unidirectional cores, which have a single platform.

Flake tools are those flakes that show purposeful retouch to one or more of the edges, and this includes the forms that are traditionally known as side-scrapers, end-scrapers, spoke-shaves, and other, less-refined forms. They are to be separated from *edge-modified flakes*, which are flakes the edges of which have been altered only through use or post-depositional damage. Without the use of a high-power microscope, it is difficult to differentiate between purposeful edge modification and edge damage that occurs as a result of use. Flakes with modified edges will only be considered flake tools if the flake scars along the edge of the piece "invade" either the dorsal or ventral face of the tool more than 2 mm ("Extension of Retouch Scars" below). Although somewhat arbitrary, this is a standard measurement used in other studies (e.g., Barton 1988). The distinction between flake tools and edge-modified flakes will help distinguish those artifacts in which a significant amount of effort was invested in their shaping from those that were used with less refinement or suffered post de3positional damage.

Debitage Analysis

Debitage analysis should be undertaken in all resource evaluation and data recovery studies. This class of artifact can reveal important information about the types of manufacturing processes undertaken at project sites and the stages of production. This information can, in turn, be used to determine the nature of on-site activities and duration of occupation.

Two approaches to debitage analysis have developed in American archaeology. The first, also known as the "replicative approach," is based on technologically accurate replications of aboriginal tools. Debitage created during these experiments are placed into a variety of classes based on distinctive combinations of attributes that correspond to specific manufacturing techniques (Flenniken 1983). For example, biface thinning flakes, which usually have longitudinal curvature, multifaceted platforms, multiple dorsal flake scars, and ventral lips, indicate that biface production occurred at a site. The focus of this sort of analysis is the classification of the debitage from a site into specific classes or types.

The "replicative approach" has been criticized as being overly subjective (Shott 1994), leading to the development of what has been called the "non-typological approach." This tact on debitage analysis focuses on measurable attributes of debitage like weight, the number of dorsal flake scars, and dorsal cortex coverage to characterize whole debitage assemblages. After the attributes of

individual pieces of debitage are recorded, the data from all of the debitage in an assemblage is grouped together and statistically analyzed. The data becomes interpretable through comparison of the archaeological data to data derived from debitage created under controlled experimental conditions. For example, Ingbar et al. (1989) found that they could determine, in a sequence of flake removals from a replicated biface, when a particular piece of debitage was created by measuring the length, width, thickness, and number of dorsal flake scars of that piece of debitage. The focus of this sort of analysis is the range of variability in particular debitage attributes taken singly or in combination.

Because it allows for more reliable comparisons between assemblages, the "non-typological approach" to debitage analysis should be followed at Fort Irwin. At a minimum, the attributes listed in Table H-1 should be collected from a sample of the debitage recovered.

Table H-1
Debitage Attributes to be Recorded

Attribute	Possible Values
Raw material type	Varies (section 4.2.5.2.2)
Completeness	Complete (C), proximal (P), distal (D), medial (M), longitudinal split (L), shatter (S), and other (O)
Platform type	Cortical (C), single faceted (S), multifaceted (M), split (L), split & cortical (LC), abraded (B), none (N), and other (O)
Dorsal cortex class	Decortication (100%), primary (99-75%), secondary (74-1%), tertiary (0%)
Maximum width	In 0.1 mm increments
Exterior platform angle	In 5° increments (see Raab et al. 1979)
Weight	In 0.1 g increments

Biface Analysis

Biface analysis can lead to the identification of the types of manufacturing activities conducted on-site. Table H-2 lists the attributes that should be recorded for bifaces.

Six numerical attributes are to be recorded for each of biface: length, width, thickness, and weight. All of the distances should be measured to the nearest 0.1 mm with a sliding caliper, while weight should be measured as described above. Three categorical attributes should also be recorded: condition or fragment type, presence/absence of cortex, and breakage type.

Table H-2
Attributes to be Recorded on Bifaces

Attribute	Values
Raw material type	Varies (section 4.2.5.2.3)
Condition	Complete, fragmentary
Stage	1 - 5 (see Callahan 1979)
Breakage type	End shock, crushing break, perverse fracture, longitudinal snap, overshot, none (see Callahan 1979 and Crabtree 1972)

Maximum length	In 0.1 mm increments
Maximum width	In 0.1 mm increments
Maximum thickness	In 0.1 mm increments
Cortex	Water-worn, primary geological, none
Weight	In 0.1 g increments

Projectile Point Analysis

The guidelines for projectile point analysis developed for the draft final Fort Irwin Historic Preservation Plan are still current, and the paragraph describing those procedures is quoted below.

Projectiles are an important artifact group in determining relative age of and cultural change in the artifact assemblages of the Fort Irwin area. The morphological point typology is designed primarily to isolate and define time sensitive forms or attributes. This is essentially the same goal for which Thomas' (1981) projectile point typology was developed, and the Fort Irwin Projectile Point Typology is a modified version of the Thomas key. The modifications comprise additional attributes that make it possible to classify certain local Mojave Desert and western Great Basin points (e.g., Pinto and Gatecliff) within a single taxonomic system. Numerical and nominal observations are recorded on the Projectile Point Analysis File, a d-Base II file, for each projectile point. These observations represent a wide range of attributes that can be utilized for further refinement of existing projectile point typologies, while maintaining comparability and consistency with earlier systems. The attributes recorded for projectile points are as follows: site identification number, artifact identification number, color, condition, blade edge form, biface shape, base shape, shoulder form, stem form, presence of serration, presence of basal notching, presence of side notching, cross section general form, actual length, length reconstructed, length at longitudinal axis, actual width, width reconstructed, position of maximum width, maximum blade width, position of maximum blade width, thickness, position of maximum blade thickness, blade length, stem length, neck width, shoulder width, basal width, maximum stem width, position of maximum stem width, shoulder height, proximal shoulder angle, distal shoulder angle, notch opening, side notch width, basal notch width, side notch depth, and basal notch depth. All measurements are recorded metrically or in degrees [Warren 1986:5.25].

Core Analysis

Along with bifaces and debitage, cores analysis can serve to provide important information about on-site manufacturing. Table H-3 reports the attributes to be recorded.

Table H-3
Core Attributes to be Recorded

Attribute	Values
Raw material type	Varies (section 4.2.5.2.8)
Core type	Unidirectional, multidirectional, bifacial (a.k.a. Stage 1 & 2 bifaces), bi-directional, bipolar, unpatterned, other
Cortex type	Water-worn, primary geological, none
Maximum length	In 0.1 mm increments
Maximum width	In 0.1 mm increments
Maximum thickness	In 0.1 mm increments
Weight	In 0.1 g increments

Flake Tool Analysis

Some analysts subdivide flake tools into patterned vs. unpatterned or formed vs. groups. While differentiating between those flake tools that reflect a relatively great investment of energy from those that

reflect a relatively smaller investment is important to the present study, other, more quantifiable measures of energy investment should be used. The categorical attributes recorded for flake tools were similar to those for debitage, and included completeness and dorsal cortex class. Numerical attributes of flake tools recorded include length, width, thickness, weight, the number of modified edges, angle of retouch scars, and extension of retouch scars. With the data supplied by measuring the angle of retouch scars and extension of retouch scars, one can calculate Kuhn's (1990) *t/T* index, which is a measure of how used-up a flake tool is at the time of discard, providing a measure of the extent of maintenance. Kuhn's *t/T* index ranges from 0.0 to 1.0, with the index increasing as the tool becomes more worn out.

Modified or Utilized Debitage Analysis

Modified debitage should be treated in the same way as the debitage, but additional attributes are also recorded, including length, thickness, and the nature and number of modified edges.

Provenance Analysis of Obsidian and Other Lithic Raw Material Types

All pieces of obsidian greater than 10 mm in length or width should be submitted to a qualified expert for geochemical analysis and characterization. All geochemical data should be reported in parts per million (ppm), as opposed to spectrum intensities, and the values of reference standards should also be reported by the lab. Primary data regarding the concentration of any trace elements should be included as an appendix in the report.

Provenance analysis of other lithic raw materials is more difficult, particularly for cherts. Attempts to set up a raw material type collection based on the classification system developed by Far Western Anthropological Research Group (e.g., Hall 1993) showed that there was an unacceptably high level of overlap between their types. Provenance analysis systems based solely on macroscopic visual characteristics like FWARG's often result in incorrect source attributions. Therefore, Fort Irwin may conduct a long-term project to sample major chert source areas on installation and develop geochemical "signatures" for each of those source areas. Some recent chert provenance analysis projects in other parts of the nation that have relied on geochemical techniques have been successful (e.g., Hess 1996; Hoard et al. 1992; Luedtke 1992). Any data generated by these studies should be reported in the same way as the obsidian data.

Ground Stone and Cobble Artifacts

With only one or two exceptions, the only types of ground stone tools that have been found on Fort Irwin are millingstones and handstones, and the following guidelines for their analysis was derived from a recent report covering the Tiefort Basin (Hall 1993). Three types of millingstones were defined for Fort Irwin:

Thin slabs, having a maximum thickness of less than 6.0 cm; *thick slabs*, ranging from 6.0 to 13.0 cm thick; and *blocks*, thicker than 13.0 cm. Empirically derived from the attribute profiles obtained for the Drinkwater Basin millingstones (cf. Basgall, Hall, and Hildebrandt 1988), these dimensional breaks are applied here for the sake of continuity and comparison. Additional millingstone characteristics monitored include: surface configuration (slightly convex, flat/ planate, slightly concave or dished [<0.5 cm deep], and basin [>0.5 cm deep]); surface texture (smooth, irregular); size (length, width, thickness, weight); condition (shaped/unshaped, whole or fragmentary, burning); material (cf. Table 3); and primary (ground surfaces, polish/striations) and secondary (pecking, batter) use-wear patterns [Hall 1993:38].

In addition to the millingstones, Hall (1993:38) defined three main types of handstones, and his summary provides sufficient guidelines for recording their attributes:

Three handstone variants are recognized: shaped forms, with extensive margin modification, definite shoulders, and well-developed grinding surfaces; unshaped forms, without evidence of formalization or heavy use but possessing clearly demarcated grinding facets; and incipient forms, otherwise unmodified

cobbles with ephemeral traces of grinding wear. The latter artifacts are marginal handstones in a functional sense and often show signs of secondary use as pounding implements. These three basic categories are further characterized with regard to a number of other attributes: planar shape (flat or planate in section when viewed from either axis, slightly convex along one or both axes, strongly convex, irregular [grinding restricted to margins or raised areas]); dimensional parameters (length, width, thickness, weight); condition (whole or fragmentary, burning); material type . . . and primary (number of ground surfaces, presence of polish/striations) and secondary (pecking, batter) use-wear features.

Finally, Hall (1993:38-39), also provided a classification of battered stone artifacts based on two main types: Core-cobble tools, rounded or angular cobble fragments with battered, percussion-flaked margins; and cobble-hammers, items which lack flaked margins and are battered on the original, usually somewhat rounded, rock surface. These implements are further characterized as to size (length, width, thickness, and weight); edge configuration (angle on core-cobble tools, location of damage [end, margin]; and material type.

Ceramic Artifacts

Probably the most crucial aspect of ceramic analysis at Fort Irwin is assigning any recovered ceramics to their proper regional type. After fragments have been assigned to a type, one can usually determine the age of the site by reference to regional ceramic chronologies, and it may even be possible to determine the ethnic affiliation of the site's inhabitants. The draft final Fort Irwin Historic Preservation Plan (Warren 1986) provides specific details about how to analyze any prehistoric ceramic artifacts. While these guidelines are technically sound, it is advisable to submit any ceramic artifacts to recognized experts in ceramic analysis and typology. Because of the subtleties of the differences between types, regional experience with a wide range of types, including styles from the Greater Southwest, is necessary to identify ceramics from Fort Irwin. Suggested resources for identification of ceramic types include the Lost City Museum and the Museum of Northern Arizona.

Historic-Period Artifacts

The following guidelines are adopted in whole from the draft final Fort Irwin Historic Preservation Plan because they remain technically adequate.

Analysis priority is given to artifacts that are especially diagnostic of occupation periods. These include coins, ceramics with maker's marks, embossed glass and metal, iron nails, and bullet shells. Metal, leather, wood, and other organic materials are stabilized for long-term storage. Preservative techniques are selectively applied to the most diagnostic items, however, and not to fragmentary objects. Preparation for final curation depends on artifact objects, and artifacts of public or interpretive value are stored in a manner facilitating easy access [Warren 1986:5.35].

Faunal Remains

The following guidelines are adopted from the draft final Fort Irwin Historic Preservation Plan, but they have been updated to reflect changes in faunal analysis techniques.

The purpose of faunal analysis is two-fold: (1) to identify the variety of fauna present in the local environment over a long period of time, and (2) to identify the species of animals and birds that were included in the human diet, and their ratios diachronically.

Bones and fragments (bone chips, splinters, or pieces that have no diagnostic joints, foramina, etc.) are identified by comparing them to reference specimens in an osteological collection. Much of the bone recovered at Fort Irwin is very small and requires examination under a dissecting microscope. The types of data that are recorded include skeletal element, side (left, axial, right), portion (proximal, shaft, distal, complete), age (adult, subadult, juvenile), burned (slight to black), calcination (bluish to white), butchering

(includes marrow fracturing), alteration (bone tools and ornaments), presence of polish, deposits of caliche, rounding, weathering, gnaw marks, and any other comments [Warren 1986:5.34].

To allow for intersite comparisons, it is important that the number of identifiable specimens (NISP) be reported per level per unit, and any tables presenting faunal data should be clearly labeled with the type of data presented, be that NISP, the minimum number of individuals (MNI), minimum number of animal units (MAU), or some other unit of faunal analysis.

Soil Samples

During site evaluation or data recovery excavations, soil samples should be collected from any cultural features (e.g., hearths, concentrations of fire-cracked rock, areas of stained soil) that are encountered during excavations for possible flotation and macrobotanical analyses. If possible these samples should contain about 1 liter of sediment. Additional samples should be collected during data recovery excavations, including l liter samples from each of the major strata found in the site. To facilitate the systematic collection of these soil samples, column samples measuring 25 cm x 25 cm are recommended, and they should be excavated in 10 cm levels.

Charcoal and Organic Samples

Charcoal and samples of other organic materials, including shellfish, bone, and soil humates, may be submitted for radiocarbon dating. Caution should be used, though, in the selection of items for radiocarbon dating, and preference should be given to those items that are clearly tied to cultural phenomena. Disassociated flecks of charcoal found in a site may or may not relate to the human activities undertaken at the site, so they may constitute an unreliable basis for dating. The minimum necessary weights of different materials using conventional and accelerator mass spectrometry (AMS) radiocarbon dating is given in Table V-4.

Table H-4
General Sample Size Requirements for Radiocarbon Dating

Material	Recommended Weight for Conventional Dating	Min. Weight for Conventional Dating (Extended Count)	Recommended Weight for AMS Dating	Minimum Weight for AMS Dating
Charcoal	15-30 gms	2-4 gms	20-50 mgs	3-5 mgs
Shell	40-100 gms	7-10 gms	500-100 mgs	15-30 mgs
Bone	300-500 gms	200 gms	10 gms	Variable
Soil	500 gms	N/A	2-10 gms	Variable

Note: This table based on information provided by Beta Analytic, Inc.

Obsidian Hydration Dating

Although questions still remain about the reliability of obsidian hydration dating as an absolute dating technique, it can still be useful, especially as a relative dating technique. It is important that hydrating dating be done in concert with obsidian source analysis because hydration rates are source specific. In addition, any original reports generated by hydration analysis labs should be incorporated into the main report as an appendix.

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Appendix I

Cultural Resources Field Guidance

IMNT-PWE 23 September 2015

SUBJECT: Guidance for Recording Archaeological Sites and Isolates

1. Purpose: Provide guidance for the recording of archaeological sites and isolates during cultural resources surveys at Fort Irwin.

2. Authority:

   a. Department of Defense Directive 4715.16, Cultural Resource Management, 18 September 2008.

   b. Army Regulation 200-1, Environmental Protection and Enhancement, 13 December 2007.

3. Discussion:

   a. In accordance with long established practice and discussions with SHPO staff, Fort Irwin cultural resources staff and Contractor personnel will record archaeological Sites in the following manner:

      1) We will continue to follow the long established practice of recording sites based on the presence of midden, or significant features, or at least three classes of artifacts (e.g., flake, modified flake, biface, core, projectile point, sherd, shovel, pick, bottle, horse shoe), or the presence of at least 20 items (e.g. unmodified flakes, tin cans), in a 10 meter radius.
      2) Care must be taken to ascribe site boundaries. Do not include a buffer within the boundary. If a buffer is necessary to adequately protect a site it will be set as part of the protection process.

   b. In accordance with long established practice and discussions with SHPO staff, Fort Irwin cultural resources staff and Contractor personnel will record archaeological Isolates in the following manner:

      1) We will record (GPS) the location of all Isolates, including unmodified flakes. We will complete individual Primary Record forms only for noteworthy Isolates, e.g. dateable, time-diagnostic or rare items that would be collected. These Isolates, and only these Isolates will be collected and curated. All collected Isolates will be photographed with scale in the field and may be drawn or sketched as appropriate to adequately record detail.
      2) We will complete one Primary Record form with map and table for all other Isolates of any nature that are recorded within a discrete survey area, e.g., a project APE or a

square kilometer of a large survey or project APE. The Primary Record will show the location of all Isolates recorded and give some information such as would be listed and described in the artifact form. We will include the location of such Isolates on report maps and they will be listed and described in report tables and text.

4. The above discussion is guidance, not an unalterable directive. The person in charge of recording cultural resources in the field is responsible for making informed decisions in applying this guidance and will provide justification on Site and Isolate forms for the recordation decisions made.

IMNT-PWE 23 September 2015

SUBJECT: Guidance for Monitoring Archaeological Sites

1. Purpose: Provide guidance for monitoring of cultural resources at Fort Irwin to standardize language and data.

2. Authority:

   a. Department of Defense Directive 4715.16, Cultural Resource Management, 18 September 2008.
   b. Army Regulation 200-1, Environmental Protection and Enhancement, 13 December 2007.

3. Discussion: In accordance with professional standards and data needs for effective evaluation and management, we will monitor once per federal fiscal quarter all cultural resources listed in, determined eligible or recommended eligible for listing in, the National Register of Historic Places.

4. Monitoring shall be executed using the following protocols:

   - Inspect and record (GPS) the location of all loci, features, significant artifacts, and other noted cultural or natural elements, e.g., shelters, erosion, vandalism, vehicle intrusion that have not been recorded previously.
   - Complete a Fort Irwin Archaeological Site Monitoring Form, with map and table if appropriate.
   - Record the resource with at least one photograph, direction noted, depicting current condition.
   - Collect only those artifacts that are dateable, time diagnostic or rare.
   - Provide meaningful, fact-based information that compares the condition of the resource with previous monitoring report(s) and/or site record(s) that are referenced.
   - Check and, if necessary, accurately record site boundaries and locations of features, artifacts and landmarks.
   - Correct errors in text and maps of previous monitoring reports and site records. Always date and identify yourself and clearly state the correction, e.g., mano not millstone, north of not east of, creosote not sagebrush, 4 m not 10 m, projectile point base not tip, etc.