APPENDIX G

SDNM RECREATIONAL TARGET SHOOTING ANALYSIS

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APPENDIX G
SONORAN DESERT NATIONAL MONUMENT RECREATIONAL TARGET SHOOTING ANALYSIS

G.1 SUMMARY

This analysis was undertaken to ascertain the suitability of recreational target shooting in Arizona's Sonoran Desert National Monument (SDNM). Increased use of public lands for recreational target shooting, the resultant impacts to resources from this activity, and concerns for visitor safety have raised awareness of management issues related to target shooting. The analysis was conducted in two parts: 1) a geographic information system (GIS) analysis was conducted to find areas with significant presence of Monument objects and high natural or cultural resource sensitivity, and to locate areas where the natural slope of the terrain may be conducive to safe target shooting; and 2) field visits to all areas not excluded from target shooting by the GIS analysis were made, whereby significant presence of Monument objects and high natural and/or cultural resource sensitivity, visitor safety and experience, and site accessibility were assessed. The GIS analysis indicated that approximately 389,989 acres, or 80 percent, of the SDNM could be adversely impacted by recreational target shooting and is unsuitable for such activity. The GIS analysis also indicated that of the remaining 96,411 acres, or 20 percent, of the SDNM, eight sites appear to have sufficient slope to allow safe target shooting. Field visits to these eight sites indicate that one 84-acre area may be highly suitable for target shooting and one area totaling approximately 107 acres may be moderately suitable for target shooting. The remaining six sites are unsuitable due to concerns for visitor safety, potential impacts to Monument objects, or inaccessibility by motor vehicles.

G.2 INTRODUCTION

Invoking his authority under the Antiquities Act of 1906, President Clinton designated the SDNM with Presidential Proclamation 7397 on Jan. 17, 2001. Since designation of the SDNM, impacts from recreational target shooting have increasingly become a management concern. Such impacts commonly include damage to protected plants, particularly saguaro; areas denuded of vegetation, both at sites from which shooting occurs and at target areas; accumulation of debris used as targets, such as discarded appliances, propane bottles, glassware, furniture, automobile tires, plywood, sheet metal, and numerous other types of trash; and safety of other visitors, particularly with regard to inadequate backstops. Currently, recreational target shooting is dispersed throughout the SDNM; however, the activity is concentrated near the northern boundary along the El Paso Natural Gas Company pipeline road, and at smaller sites adjacent to State Route 238 and Vekol Valley Road. During October-November, 2008 the Bureau of Land Management (BLM) removed six tons of debris from recreational target shooting sites in these areas. (See **Figure G-1**, Litter in Shooting Sites, for examples).

Proclamation 7397 directed the BLM to manage the SDNM for the paramount purpose of protecting its "objects." The following analysis was undertaken to determine areas of the SDNM where continued

recreational target shooting would cause unacceptable impact to the objects for which the SDNM was designated, as well as to identify areas where such activity is compatible with such objects.

G.3 METHOD OF ANALYSIS

The BLM established a two-part process using two sets of criteria with which to evaluate the potential impacts of recreational target shooting on the SDNM (see **Table G-1**, Shooting Analysis Criteria). Known concentrations of Monument objects or significant presence of high natural and/or cultural resource sensitivity were determined using GIS analysis. Portions of the SDNM that scored high for these variables from this analysis were determined to be unsuitable for continued recreational target shooting and excluded from further analysis.

Table G-1
Shooting Analysis Criteria

Phase 1: Criteria applied through GIS analysis	Phase 2: Criteria applied through on-site field visits
1. Significant presence of Monument objects or high natural resource sensitivity.	1. Significant presence of Monument objects or high natural and cultural resource sensitivity that was not captured through GIS analysis.
2. Presence of suitable terrain for shooting (existing natural backstop or berm).	2. Visitor safety and experience where shooting is incompatible with other uses or where it could result in adverse impacts to facilities, public use sites, or other BLM and private assets.
	3. Accessibility by motor vehicle.
	4. Physical suitability of terrain for shooting activity.

In areas that were not excluded due to concerns for Monument objects, GIS analysis was further used to distinguish areas where the natural slope of the terrain indicated that target shooting might be conducted safely. In order for dispersed, undeveloped target shooting to occur in a safe environment on public lands without risk to others, a natural backstop or berm with sufficient dimensions must be located behind the target. There are vast, flat areas in the SDNM where target shooting would not meet minimum safety standards due to the absence of any natural backstops. See **Figure G-2** for inappropriate shooting areas.

Following the GIS analysis, field criteria were developed for areas where significant presence of Monument objects was not expected and where adequate slopes were found. Each of these areas was visited in the field and assessed against these criteria, which are presented above in **Table G-1**.

G.3.1 PHASE ONE: GIS ANALYSIS

G.3.1.1 GIS Criteria 1: Presence of Monument Objects

Three data sets, or "overlays," indicating significant present of Monument objects and high natural resource sensitivity were used. The overlays were 1) presence of palo verde-mixed cacti vegetation community; 2) presence of high quality desert tortoise habitat; and 3) presence of Juan Bautista de Anza National Historic Trail corridor segments. These data sets were analyzed cumulatively, or merged, in the order presented above, and the cumulative acreage of the SDNM found to be unsuitable for continued recreational target shooting was tabulated. Each of these areas was visited in the field and assessed against these criteria, which are presented above in **Table G-1**, Shooting Analysis Criteria.

Presence of Palo Verde-Mixed Cacti Vegetation Community

Rationale: The palo verde-mixed cacti vegetation community, described and mapped by the U.S. Geological Survey (2004), provides the best-known image of the Sonoran Desert: dense "forests" of saguaro (*Carnegia gigantea*) and other cacti, and thick woodlands of palo verde (*Cercidium microphyllum*), mesquite (*Prosopis sp*.), and ironwood (*Olneya tesota*) trees covering the slopes and outwash plains of jagged, isolated mountain ranges. **Map G-1**, SDNM Palo verde-Mixed Cacti Vegetation Community, shows the extent of this vegetation community within the SDNM. These dominant cactus and trees species provide forage, nesting, and cover habitat for numerous wildlife species and are particularly vulnerable to damage from shooting. Intentional or incidental destruction of saguaros and trees is common at shooting sites. For examples of such damage, see **Figures G-3**, Damage to Saguaros, and **G-4**, Damage to Trees. See also **Attachment G-1, Table G-10**, Comparison of Impacts Documented at Shooting and Non-Shooting Sites.

Presence of High Quality Desert Tortoise Habitat

Rationale: The Sonoran desert tortoise (*Gopherus agassizii*) is a signature species of the Sonoran Desert and is managed by the BLM as a federally listed candidate species. The goal of BLM management with regard to the desert tortoise in Arizona is to "[c]onserve and improve where feasible, the distribution, quantity and quality of desert tortoise habitat on public lands with no net loss in quantity or quality of Category I and Category II habitats on public land" (BLM 1990). See **Map G-2**, SDNM Desert Tortoise Habitat, showing the extent of Category I and Category II habitat on the SDNM. The desert tortoise excavates and inhabits burrows in rocky hillsides against which target shooters often place targets. Sustained target shooting may cause direct mortality to desert tortoise and indirect impacts to tortoise habitat through loss of forage and cover due to damage or loss of vegetation, increased vulnerability to predation as predators are attracted to areas of trash and garbage, and ingestion of plastic and other trash.

Presence of Juan Bautista de Anza National Historic Trail Corridor

Rationale: The Juan Bautista de Anza National Historic Trail (Anza NHT) was designated in 1990 by amendment of the NHT Act and is the premier historic cultural site of the SDNM. See **Map G-3**, Anza National Historic Trail, for the trail's location within the SDNM. The Anza NHT is managed in a corridor approximately 1-mile wide across the SDNM, with the general landscape view largely

unchanged from that of 1776 when the Anza Expedition occurred. The Anza NHT corridor is frequently used by visitors to the SDNM for sightseeing, camping, and youth group educational events. Recreational target shooting poses safety concerns where the trail passes through the North Maricopa Mountains. Here, user groups are forced into close proximity to existing and potential shooting sites by the mountainous terrain, and the level terrain to the east and west of the mountains does not provide suitable backstops in the corridor.

G.3.1.2 GIS Criteria 2: Presence of Suitable Terrain

In areas that were not excluded due to concerns for Monument objects, GIS analysis was further used to distinguish areas where the natural slope of the terrain indicated that target shooting might be safely conducted. Only one overlay indicating presence of suitable terrain was used, which was the presence of existing natural backstop or berm.

Presence of Existing Natural Backstop or Berm

Rationale: There are vast, flat areas in the SDNM where safe target shooting is naturally precluded by the absence of natural backstops. Based on recommendations for managed shooting ranges (Daughtry 2007; Luke 1996), a minimum height of 15 feet for a shooting backstop is acceptable, but 20 to 25 feet is recommended. Further, the recommended slope for a backstop is 45 degrees or greater. Because these criteria were established for constructed ranges and not for unmanaged, open shooting areas, they were taken as guidelines but not strict requirements when evaluating the natural terrain's capability to provide target-shooting backstops in the SDNM. For example, areas with a 45-degree slope are scarce in the SDNM, so this was not included as a primary criterion to locate safe shooting areas. On the other hand, a hill rising to 15 or 20 feet may not be sufficiently safe depending on the slope of the hill, the position of shooter, or other factors. **Figure G-5**, Potentially Appropriate Backstops, shows examples of potentially appropriate backstops.

To locate all areas in the SDNM with potentially appropriate backstop dimensions expected to be safe for target shooting, the BLM conducted a GIS terrain analysis to identify areas of the SDNM with slopes greater than 15 degrees. This lower threshold was employed so that all areas with significant elevation changes could be identified and examined for their potential as safe shooting areas. **Map G-4**, Slope of Terrain, depicts the natural slopes in the SDNM.

G.3.2 PHASE TWO: FIELD ANALYSIS

Areas of the SDNM not determined through GIS analysis to be unsuitable for recreational target shooting were each visited in the field. The objective of the field visits was to determine if such areas remained potentially suitable for recreational target shooting after evaluation against the four field criteria presented in **Table G-1**, Shooting Analysis Criteria. The criteria are:

1. Significant presence of Monument objects or high natural and cultural resource sensitivity that was not captured through GIS analysis.

2. Visitor safety and experience in areas where shooting is incompatible with other uses or where it could result in adverse impacts to facilities, public use sites, or other BLM and private assets.

3. Accessibility by motor vehicle.

4. Physical suitability of terrain for shooting activity.

G.3.2.1 Field Criteria 1: Monument Objects or High Resource Sensitivity

Rationale: The data overlays used in the GIS analysis included specific types of natural and cultural resources that represented extensive areas with a significant presence of Monument objects or with high natural and cultural resource sensitivity. The overlays do not represent comprehensive surveys of all Monument objects and resources. For example, the SDNM has not been fully surveyed for cultural resources; geological features such as prominent rock outcrops are not represented by the GIS data overlays; and resources, such as raptor nesting sites, could only be considered in the field. Target shooting sites located in such areas would be incompatible with protection of Monument objects. (For examples, see **Figures G-6**, Damage to Rocks, and **G-7**, Examples of Artifacts and Wildlife Habitat.) The BLM developed the guidelines listed below in **Table G-2**, Field Criteria for Resources and Monument Objects, to rank suitability for target shooting at specific sites with regard to protection of Monument objects.

Table G-2
Field Criteria for Resources and Monument Objects

Low Suitability for Target Shooting	• High diversity of vegetation • Exemplary plants and assemblages present • Dense vegetative cover and canopy • Within sensitive wildlife habitats • Known desert tortoise burrowing sites in area • Raptor nesting sites in area • High potential for defacing and damaging geological features • Cultural resources present
Moderate Suitability for Target Shooting	• Moderate diversity of vegetation • No exemplary plants and assemblages present • Moderate vegetative cover and canopy • Away from sensitive wildlife habitats • No known desert tortoise burrowing sites in area • No raptor nesting sites in area • Minimal potential for defacing and damaging geological features • No known cultural resources present

Table G-2
Field Criteria for Resources and Monument Objects

High Suitability for Target Shooting	• Low vegetation diversity • No exemplary plants or assemblages present or adjacent • Free of vegetative cover or sparsely vegetated • Away from sensitive wildlife habitats • No known desert tortoise burrowing sites in area • No raptor nesting sites in area • No potential for defacing and damaging geological features • No known cultural resources present

G.3.2.2 Field Criteria 2: Visitor Safety and Experience

Rationale: The location of other uses, sites, and facilities on the SDNM relative to the location of target shooting activity is an important factor in determining visitor safety, incompatible uses, and protection of property. Nearby uses and facilities that could be affected by target shooting include designated campsites, large group sites, and staging areas; corrals, stock ponds, water tanks, wells, windmills, and drinking troughs; wildlife waters; dispersed recreation areas such as trailheads; cultural sites designated for public use; utility corridors and facilities; and the location of frequently used roads and trails. Additionally, the following state laws and BLM regulations govern the discharge of firearms on public lands in Arizona:

- Arizona Revised Statute (A.R.S.) 17-309a(4): It is unlawful for a person to discharge a firearm while taking wildlife within one-fourth mile of an occupied farmhouse or other residence, cabin, lodge or building without permission of the owner or resident.

- A.R.S. 17-301b: No person may knowingly discharge any firearm or shoot any other device upon, from, across, or into a road or railway.

- 43 CFR 8365.1-4(a): No person shall cause a public disturbance or create a risk to other persons on public lands by engaging in activities, which include ... (2) Creating a hazard or nuisance.

- 43 CFR 8365.2-5: On developed recreation sites and areas, unless otherwise authorized, no person shall: (a) Discharge or use firearms, other weapons, or fireworks.

These laws and regulations were used as guidelines in the field to assess the potential for hazardous situations involving target shooting with respect to proximity to nearby residences, facilities, and other areas where visitors commonly drive or gather. The BLM developed the criteria listed below in **Table G-3**, Field Criteria for Visitor Safety and Nearby Uses and Facilities, to rank suitability for target shooting based on considerations for visitor safety and other nearby uses.

Table G-3
Field Criteria for Visitor Safety and Nearby Uses and Facilities

Low Suitability for Target Shooting	• Site is within ¼-mile of livestock waters or corrals, designated campsites, trailheads, and other temporarily occupied sites; • Roads or trails, livestock and wildlife waters, designated campsites, trailheads and other temporarily occupied sites, communication sites, utilities or other surface facilities within 1-mile shooting fan; • Occupied residences within 1.5-2.5-mile shooting fan.
Moderate Suitability for Target Shooting	• No roads or trails, livestock and wildlife waters, designated campsites, trailheads, and other temporarily occupied sites, communication sites, utilities or other surface facilities within 1 to 1.5-mile shooting fan; • Occupied residences within 2.5- to 3.5-mile shooting fan; • At least 1.5 miles from closest occupied residence or areas likely to be developed for residential use; • The site's shooting fan is at least 1.5 miles from the closest residences or areas likely to be developed for residential use.
High Suitability for Target Shooting	• Site is at least ¼-mile from livestock waters or corrals, designated campsites, trailheads, and other temporarily occupied sites; • No roads or trails, livestock and wildlife waters, designated camp sites, trailheads, and other temporarily occupied sites, communications sites, utilities, or other surface facilities within 1.5-mile shooting fan; • No occupied residences within 3.5-mile shooting fan; • At least 2 miles from closest residence or areas likely to be developed for residential use.

G.3.2.3 Field Criteria 3: Accessibility by Motor Vehicle

Rationale: Target shooting in an undeveloped setting on public lands is almost exclusively associated with sites that are readily accessible by motorized vehicle, with shooting activity occurring very near the vehicle. Accessibility by motor vehicle is considered in this analysis in order to assure that areas identified as suitable will satisfy the preference of most shooters to remain near their vehicles. Sites not located within a short walking distance (up to 400 yards) from an existing, designated BLM vehicle route are considered by most to be unsuitable for recreational target shooting.

Driving time from residence and from a paved highway is also an important consideration. Interviews conducted in the Tucson area revealed that recreational target shooters "want shooting opportunities within a 15-30 minute drive from home" (Institute for Environmental Conflict Resolution 2006). Daughtry (2007) estimated that Tucson shooters were willing to travel approximately 45 minutes, which is supported by interviews conducted with shooters throughout Arizona that indicated most travel about 45 minutes to shoot on federal lands (Responsive Management 2008). The SDNM is accessible by three paved highways: Arizona Highway 85, Arizona and Maricopa Route 238, and Interstate 8. For the purposes of this analysis, driving time was calculated as the time it took to drive from any of these three primary access routes to a site. The BLM developed the criteria listed below in

Table G-4, Field Criteria for Motor Vehicle Accessibility, to rank suitability for target shooting at specific sites with regard to access by motor vehicles.

Table G-4
Field Criteria for Motor Vehicle Accessibility

Low Suitability for Target Shooting	• Site is accessible by four wheel-drive, high clearance vehicles only • Requires one hour or more driving time to arrive from paved highway • Is not accessible by a BLM-designated existing vehicle route • No legal public access
Moderate Suitability for Target Shooting	• Site generally is accessible by two-wheel-drive, high clearance vehicles • Is located within a forty-minute drive from paved highway • Is located adjacent to a BLM-designated vehicle route
High Suitability for Target Shooting	• Site is accessible by passenger cars • Located within a twenty to forty minute drive from paved highway • Located adjacent to a BLM-designated vehicle route

G.3.2.4 Field Criteria 4: Physical Suitability of Terrain

Rationale: For dispersed, non-facilitated target shooting to occur in a safe environment on public land without risk to others, a natural backstop or berm and down range safety fan of sufficient dimensions must be present behind the target.

Recommendations given for developed shooting ranges provide that acceptable backstops be a minimum height of 15 feet (although 20 to 25 feet is desirable), wide enough to allow a horizontal shooting fan of 45 degrees or greater, and have a vertical slope of 20 degrees or greater (Daughtry 2007; Luke 1996). Although these recommendations were established for constructed and intensely managed shooting ranges rather than unmanaged shooting areas, they were taken as guidelines for evaluating the capability of natural terrain to provide appropriate target shooting site backstops in the SDNM. Examples of backstops considered safe are illustrated in **Figure G-5**. The BLM developed the criteria listed below in **Table G-5**, Field Criteria for Physical Suitability of Target Shooting, to rank physical suitability of terrain for target shooting.

Table G-5
Field Criteria for Physical Suitability of Target Shooting

Low Suitability for Target Shooting	• Only one shooting party at a time could be supported • Backstop provides narrow horizontal shooting fan that is less than 15 degrees and a vertical fan less than 5 degrees • Backstop surface composed predominantly of hard rock or hard pan material • Site located in uneven, broken terrain with drainages, washes, dense vegetation, or other obstacles that hinder observation of others during target setup/retrieval and shooting
Moderate Suitability for Target	• Site could support two to three shooting parties at one time

Table G-5
Field Criteria for Physical Suitability of Target Shooting

Shooting	• Backstop provides horizontal shooting fan from 15 to 45 degrees and a vertical fan from 5 to 20 degrees • Backstop surface composed of mixed hard rock and unconsolidated material • Site located in uneven, broken terrain with drainages or vegetation that could impede observation of others during target setup/retrieval and shooting
High Suitability for Target Shooting	• Site could support multiple shooting parties at one time (more than three parties) • Backstop provides wide horizontal shooting fan that is greater than 45 degrees and a vertical shooting fan greater than 20 degrees • Backstop surface composed predominantly of unconsolidated, loose soil material • Site located in even, open terrain with little or low vegetation that allows for ready observation of others during target setup/retrieval and shooting

G.3.2.5 Field Rating

Using the "Field Rating Sheet" illustrated in **Attachment G-10**, the field criteria presented in **Tables G-1 to G-5** were applied to areas of the SDNM that remained potentially suitable for recreational target shooting following application of the GIS analysis. The potentially suitable areas were assessed by traveling the existing vehicle route system and recording observations relating to the field criteria on the form. Representative photographs of each area were taken, as were photographs of outstanding features or additional considerations.

G.4 RESULTS OF ANALYSIS

G.4.1 PHASE ONE: GIS ANALYSIS

G.4.1.1 Results from Significant Presence of Monument Objects

The results of step one - GIS analysis for significant presence of Monument objects or high natural resource sensitivity - are presented below in **Table G-6**, GIS Overlays and Cumulative Acreage of the SDNM Not Suitable for Recreational Target Shooting, and in **Map G-5**, Areas Incompatible with Target Shooting. Approximately 389,989 acres, or 80.2 percent, of the SDNM were determined to not be suitable for recreational target shooting based on the cumulative application of the GIS criteria presented in **Table G.1**, Shooting Analysis Criteria.

Excluding the acres determined through GIS analysis to be unsuitable for recreational target shooting, 12 areas remained (totaling approximately 96,411 acres, or 19.8 percent, of the SDNM) where potentially suitable target shooting sites might be found. Each of these potentially suitable target-

shooting areas was given a geographic name and is illustrated on **Map G-6**, Areas of Potential Suitable Target Shooting Sites. Results from the GIS analysis were used to formulate Alternative B in the Lower Sonoran-SDNM Draft RMP. (See Section 2.8.4, Recreation Management (RM) and **Map 2-13b**.)

Table G-6
GIS Overlays and Cumulative Acreage of the SDNM Not Suitable for Recreational Target Shooting

Data Overlay	Total Acres	Cumulative Acres
Palo Verde-Mixed Cacti Vegetation Community	303,308	303,308
Desert Tortoise Habitat, Category I and II	290,706	81,646
Juan Bautista de Anza National Historic Trail Corridor	7,793	5,035
Total	601,807	389,989

G.4.1.2 Results from Presence of Suitable Terrain

The results of the terrain analysis of the SDNM are shown on see **Map G-6**, Areas of Potential Suitable Target Shooting Sites. Within the twelve areas where potentially suitable target-shooting sites may be found, eight locations exhibited slopes of 15 degrees or greater. These areas total approximately 1,726 acres in extent, and range from 37 acres (Hidden Valley [B]) to 682 acres (Gap Tank [B]).

G.4.2 PHASE TWO: FIELD ANALYSIS

G.4.2.1 Step 1: Summary Rankings by Area and Field Criteria

A summary of the field analysis for each of the eight potentially suitable target-shooting sites of the SDNM is provided below in **Table G-7**, Summary of Field Analysis for Sites Potentially Suitable for Recreational Target Shooting in the SDNM. These rankings offer an indication of the overall suitability of each site; however, the BLM also believes it is important to provide a single summary ranking for each potential site to contrast overall suitability between sites and compare findings. To do this, values were assigned to each ranking: High = 2, Moderate = 1, and Low = 0. Then, each category of field criteria was weighted to reflect the significance of the criteria with regard to the purpose of the shooting analysis.

Table G-7
Summary of Field Analysis for Sites Potentially Suitable for Recreational Target Shooting in the SDNM

	Field Criteria			
SDNM Sites Potentially Suitable for Target Shooting	Presence of Monument Objects*	Visitor Safety and Nearby Uses	Motor Vehicle Access	Physical Suitability
Gap Tank (A) (427 acres)	L	H	L	M
Gap Tank (B) (682 acres)	H	H	L	H
Gap Tank (C) (56 acres)	L	L	H	M
Gap Well (A) (107 acres)	L	M	H	M
Hidden Valley (A) (94 acres)	H	L	M	H

Table G-7
Summary of Field Analysis for Sites Potentially Suitable for Recreational Target Shooting in the SDNM

SDNM Sites Potentially Suitable for Target Shooting	Field Criteria			
	Presence of Monument Objects*	Visitor Safety and Nearby Uses	Motor Vehicle Access	Physical Suitability
Hidden Valley (B) (37 acres)	H	M	L	M
Hidden Valley (C) (84 acres)	H	M	H	H
Pipeline 1 (A) (239 acres)	M	L	H	H
Total Acres: 1,726				

*H = High; M = Moderate; L = Low

G.4.2.2 Step 2: Numeric Suitability Rankings by Area and Field Criteria

Management concerns related to target shooting on the SDNM focus more on resource damage than any other factor. The paramount purpose of the SDNM is protection of Monument objects, and the primary consideration relating to target shooting on the SDNM is the protected status of the biological, cultural, and geological resources of the SDNM. Therefore, areas found to be of "low" suitability with regard to presence of Monument objects were excluded from further consideration. Human safety is of concern with target shooting activities; therefore, the criteria for safety and nearby uses and facilities were given a weight of three (3). Although the physical suitability of an area partially addresses safety issues, these criteria also focus on accommodation of shooting and the manageability of an area. These are less significant factors in determining appropriate shooting locations, so this category was given a weight of two (2). Finally, although accessibility was a necessary factor to consider in this analysis, access by motor vehicle was probably the least significant because it is relative to each shooter. For this reason, the accessibility factor was given a weight of one (1). Site rankings based on values assigned to each rating and weights given to each category are shown in **Table G-8**, Numeric Suitability Rankings for Sites Potentially Suitable for Target Shooting in the SDNM.

Table G-8
Numeric Suitability Rankings for Sites Potentially Suitable for Target Shooting in the SDNM

Site	Resources & Monument Objects (Weight = 3)	Safety, nearby uses and facilities (Weight = 3)	Motor Vehicle Access (Weight = 1)	Physical Suitability (Weight = 2)	Numeric Suitability Ranking (Total Score = 0 to18)
Gap Tank (A)	Excluded for presence of Monument objects				
Gap Tank (B)	6	6	0	4	16
Gap Tank (C)	Excluded for presence of Monument objects				
Gap Well (A)	Excluded for presence of Monument objects				
Hidden Valley (A)	6	0	1	4	11
Hidden Valley (B)	6	3	0	2	11
Hidden Valley (C)	6	3	2	4	15
Pipeline 1 (A)	3	0	2	4	9

G.4.2.3 Step 3: Site Categorization Based on Numeric Ranking

The next step of the process was to categorize each site based on its numeric suitability ranking. By dividing the 18-digit scale in thirds to generate ranges for Low (0-6), Moderate (7-12), and High (13-18), the sites fall into the categories summarized in **Table G-9,** Summary of Potentially Suitable Target Shooting Sites by Numeric Ranking.

Table G-9
Summary of Potentially Suitable Target Shooting Sites by Numeric Ranking

Low Suitability (0-6)	Moderate Suitability (7-12)	High Suitability (13-18)
Gap Tank (A) (427 acres)	Hidden Valley (A) (94 acres)	Gap Tank (B) (682 acres)
Gap Tank (C) (56 acres)	Hidden Valley (B) (37 acres)	Hidden Valley (C) (84 acres)
Gap Well (A) (107 acres)	Pipeline 1 (A) (239 acres)	
Total Acres: 590	Total Acres: 370	Total Acres: 766

G.5 SUMMARY CONCLUSIONS

Based on the criteria used for this analysis, two areas were identified on the SDNM that may be highly suitable for recreational target shooting: Gap Tank (B) and Hidden Valley (C). Hidden Valley (C) is currently used as a target shooting area but is only moderately safe as a shooting site using the criteria presented in this analysis (see **Figure G-8** (C), view to the south **Figure G-9** (C) view to the north,), and Gap Tank (B) is not accessible by motor vehicle. Three areas were identified to be moderately suitable for recreational target shooting; however, one of these, Hidden Valley (B), is not accessible by motor vehicle and two others, Hidden Valley (A) and Pipeline 1 (A), were determined to be unsafe shooting sites (see **Map G-7**, Sites Potentially Suitable for Target Shooting).

These findings are important because they show that very few locations on a landscape level qualify as appropriate places for recreational target shooting activity on the SDNM. The results of this analysis also indicate that shooting activity, for reasons of potential impacts to Monument objects, visitor safety, accessibility, and physical suitability of terrain, would likely be limited to one area, Hidden Valley (C).

The combination of moderated and highly potentially suitable areas for recreational target shooting were used to formulate Alternative C in the DRMP (Section 2.8.4, Recreation Management (RM) and **Map 2–13c**). These areas total 1,136 acres, or 0.2 percent of the SDNM; however, four of these areas received only moderate or low rankings for concerns over visitor safety.

The BLM does not compromise on the safety of its visitors. Improving user and visitor safety at the Hidden Valley (C) location would require direct management, funding, and development. Current policy guidance provides two methods for allocating public lands for target shooting: direct sale under Section 203 of FLPMA or through patents issued under the Recreation and Public Purposes (R&PP Act) of 1926 (Washington Office Instruction Memorandum No. 2008-074). Neither of these methods would be compliant with the provisions provided under the Monument proclamation or management goals and objectives identified in the DRMP, and they are not presented or analyzed as alternatives in the DRMP. From these concerns, as well as concerns about impacts to Monument objects discussed throughout this analysis, Alternatives D and E were formulated in the DRMP (see Section 2.8.4, Recreation Management (RM)). Under these alternatives, 486,400 acres, or 100 percent, of the SDNM will be unavailable for recreational target shooting.

Figure G-1. Litter in Shooting Sites

Examples of shooting areas denuded of vegetation and littered with debris.

Figure G-2. Inappropriate Shooting Sites

Examples of shooting areas that are inappropriate or do not have backstops.

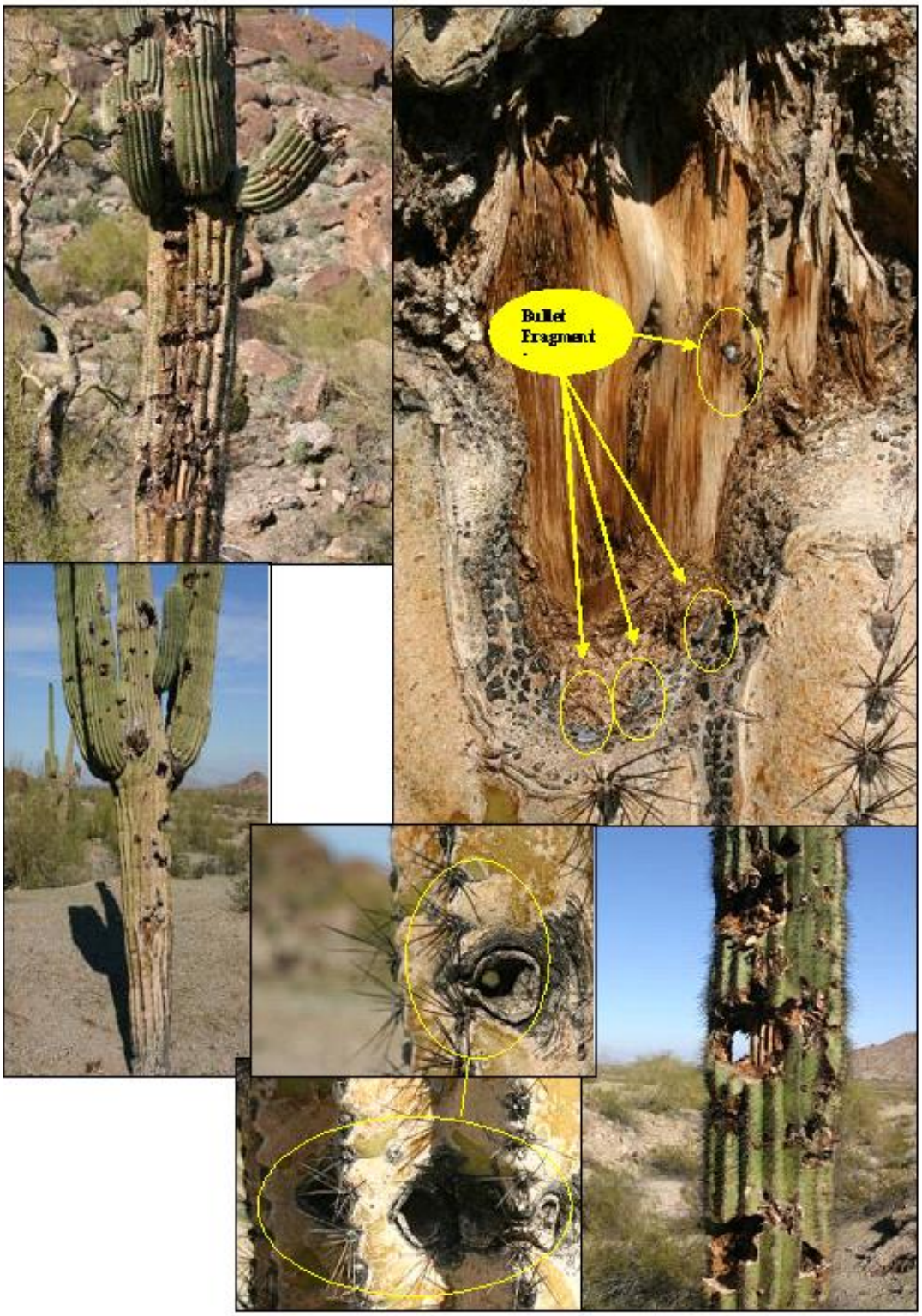


Figure G-3. Damage to Saguaros

Examples of damage to saguaros from firearms use at recreational target-shooting sites in the SDNM.

Figure G-4. Damage to Trees

Bullets lodged in trees, broken branches, and bullet-scarred trees and shrubs are common at shooting sites in the SDNM.

Potentially appropriate backstops include areas with a wide horizontal shooting fan greater than 45 degrees; vertical shooting fan greater than 20 degrees; backstop surface composed predominantly of unconsolidated, loose soil material; location in even, open terrain with little or low vegetation that allows for ready observation of others during target setup/retrieval and shooting; and minimum height of 15 feet.

Figure G-5. Potentially Appropriate Backstops

Rock outcrops are easily damaged from bullet impact and inappropriate targets, such as cans of paint, and pose visitor safety concerns from bullet ricochet.

Figure G-6. Damage to Rocks

Scattered artifacts, such as pottery shards and unoccupied raptor nests, in themselves do not necessarily render an area unsuitable for target shooting; however, a prevalence of artifacts or presence of high-value wildlife habitat render it inappropriate for target shooting.

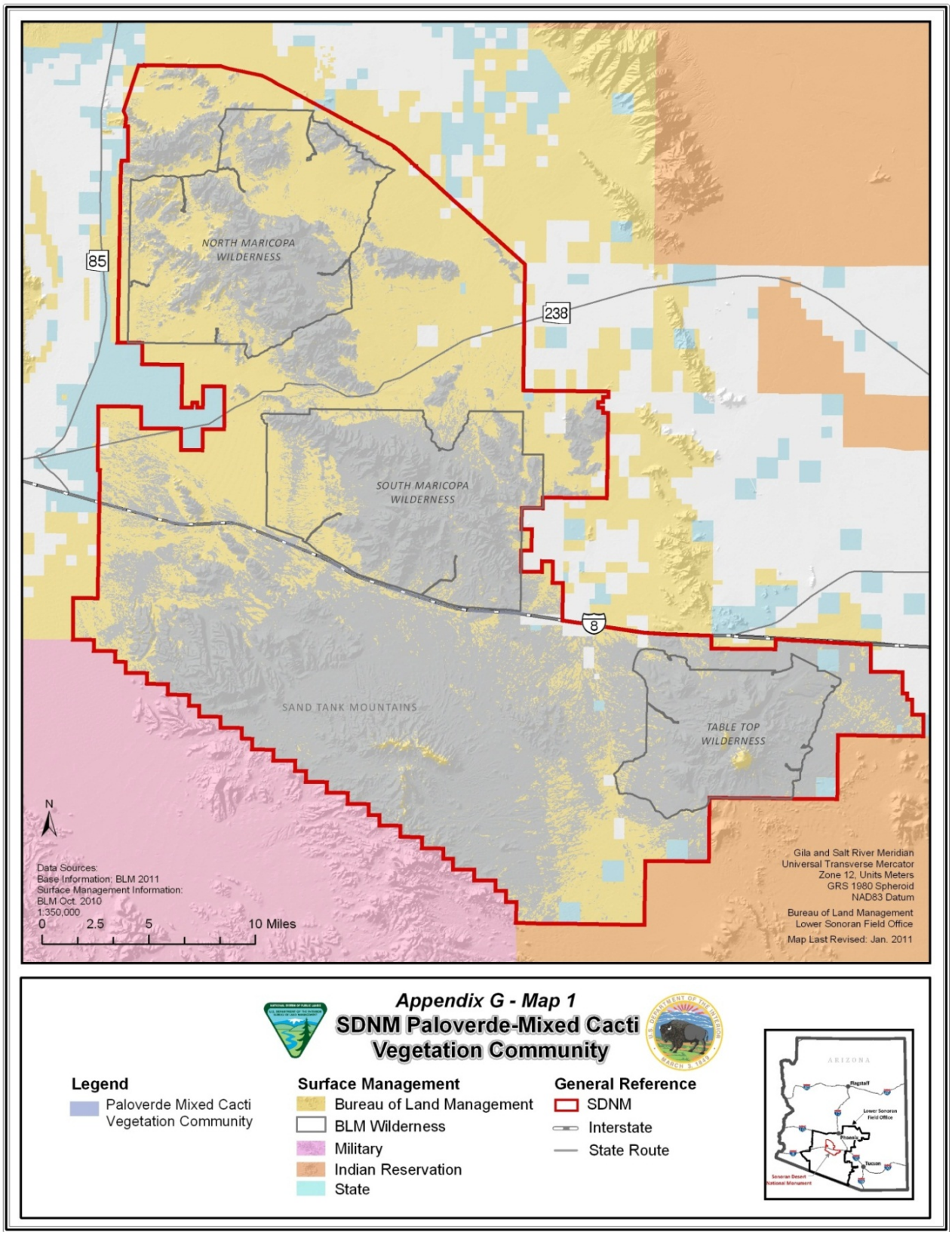
Figure G-7. Examples of Artifacts and Wildlife Habitat

Figure G-8. Potential Shooting Site

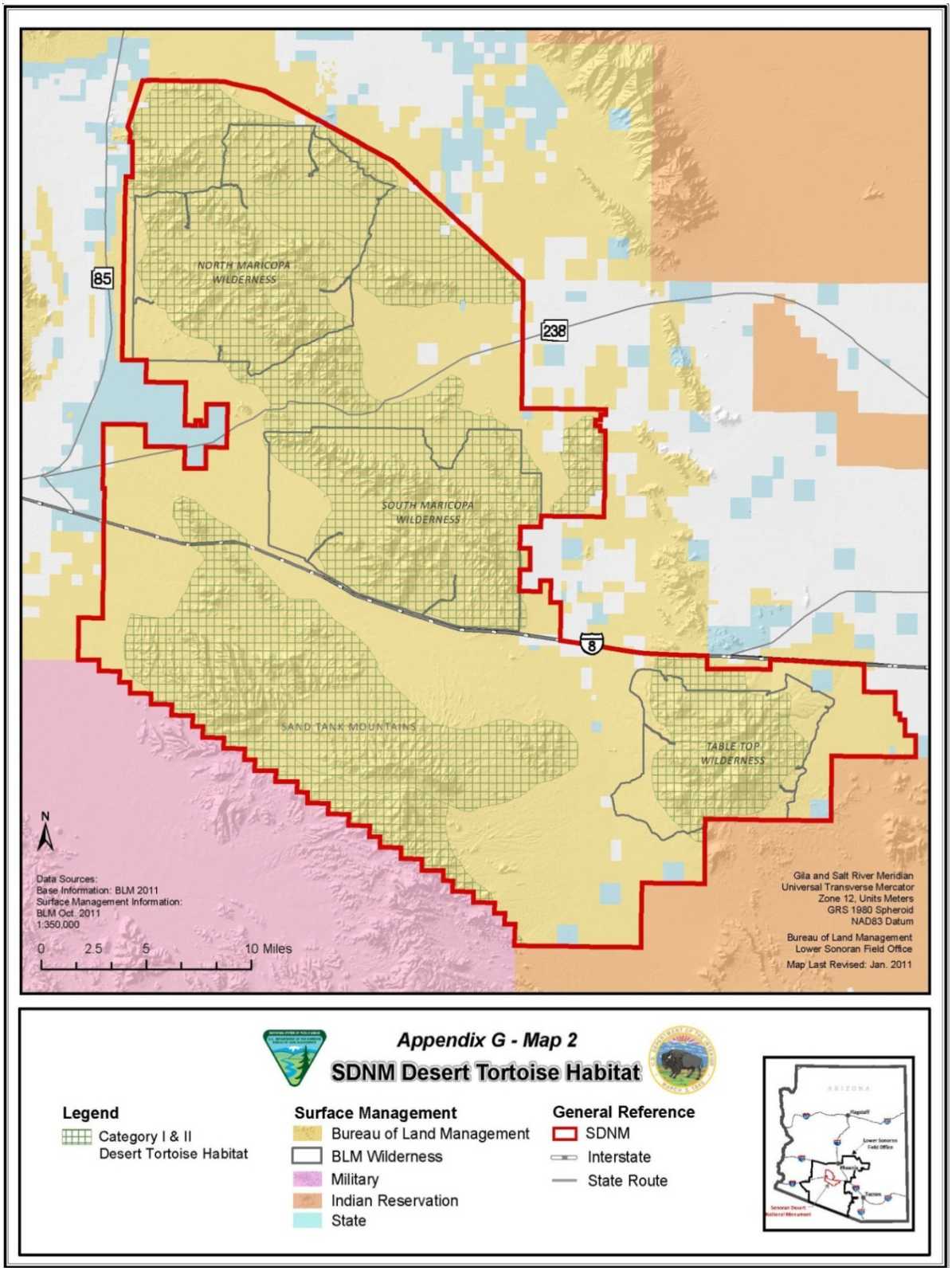
Hidden Valley (C), view to the south

Figure G-9. Potential Shooting Site

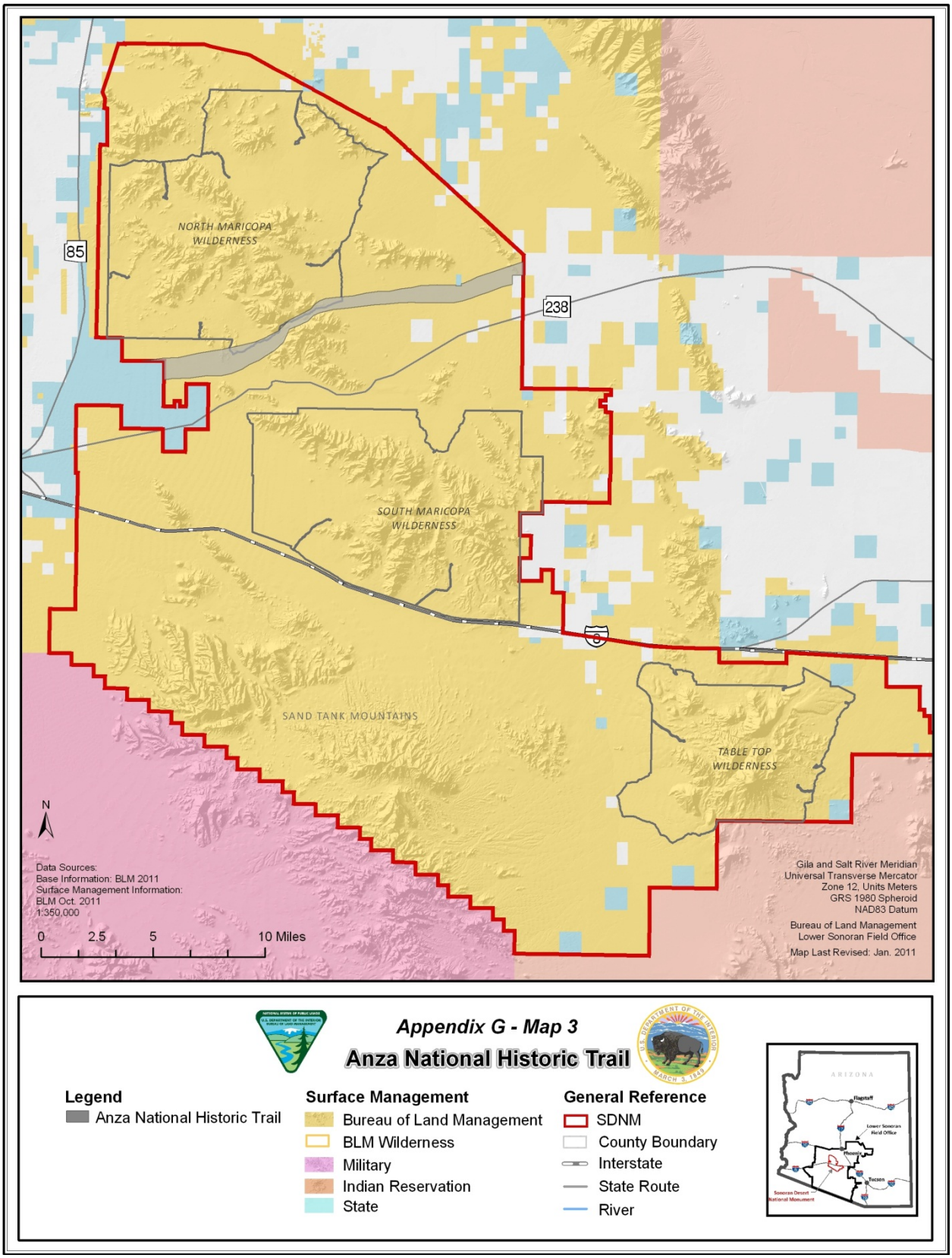
Hidden Valley (C), view to the north



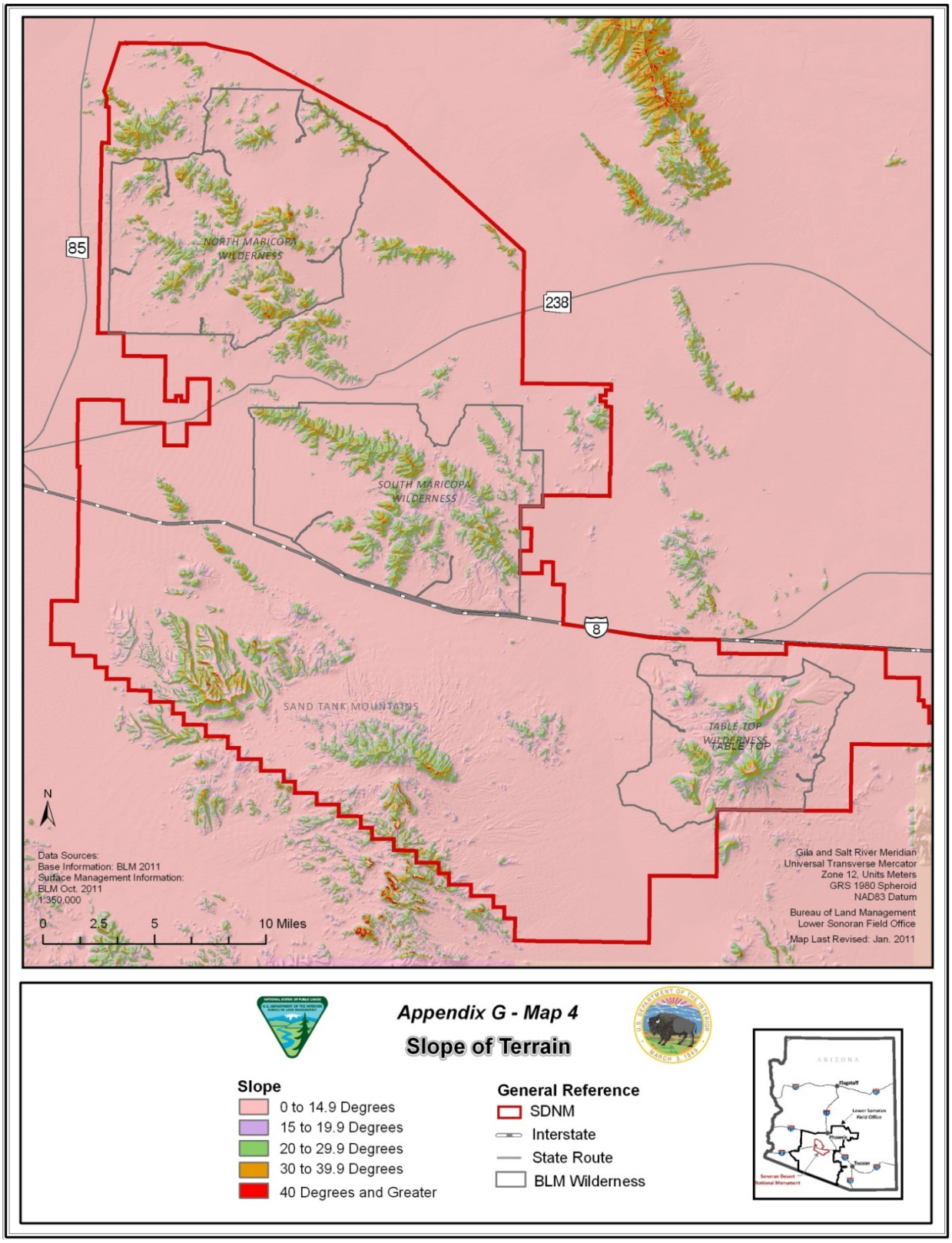
Map G-1. SDNM Paloverde-Mixed Cacti Vegetation Community



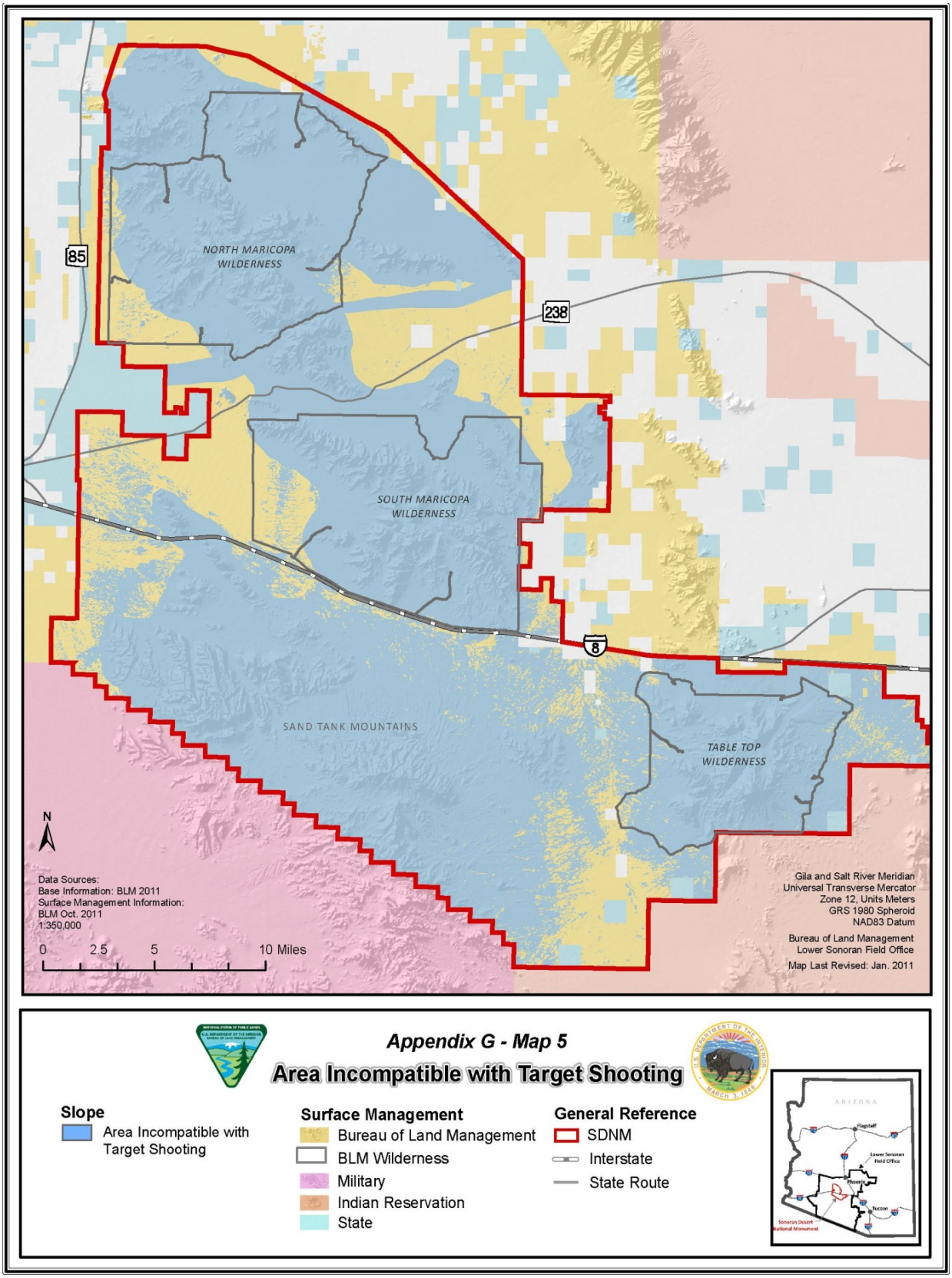
Map G-2. SDNM Desert Tortoise Habitat



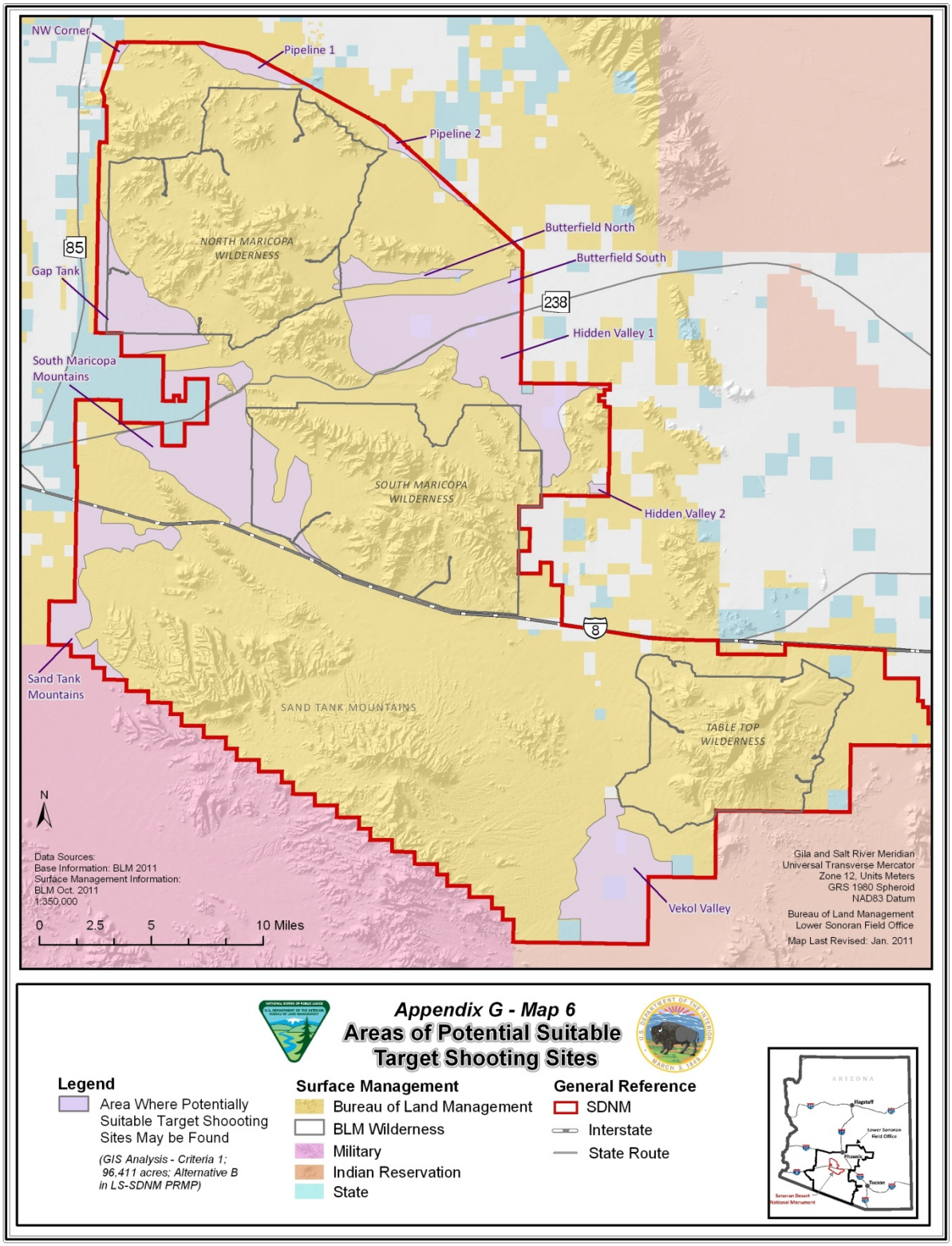
Map G-3. Anza National Historic Trail



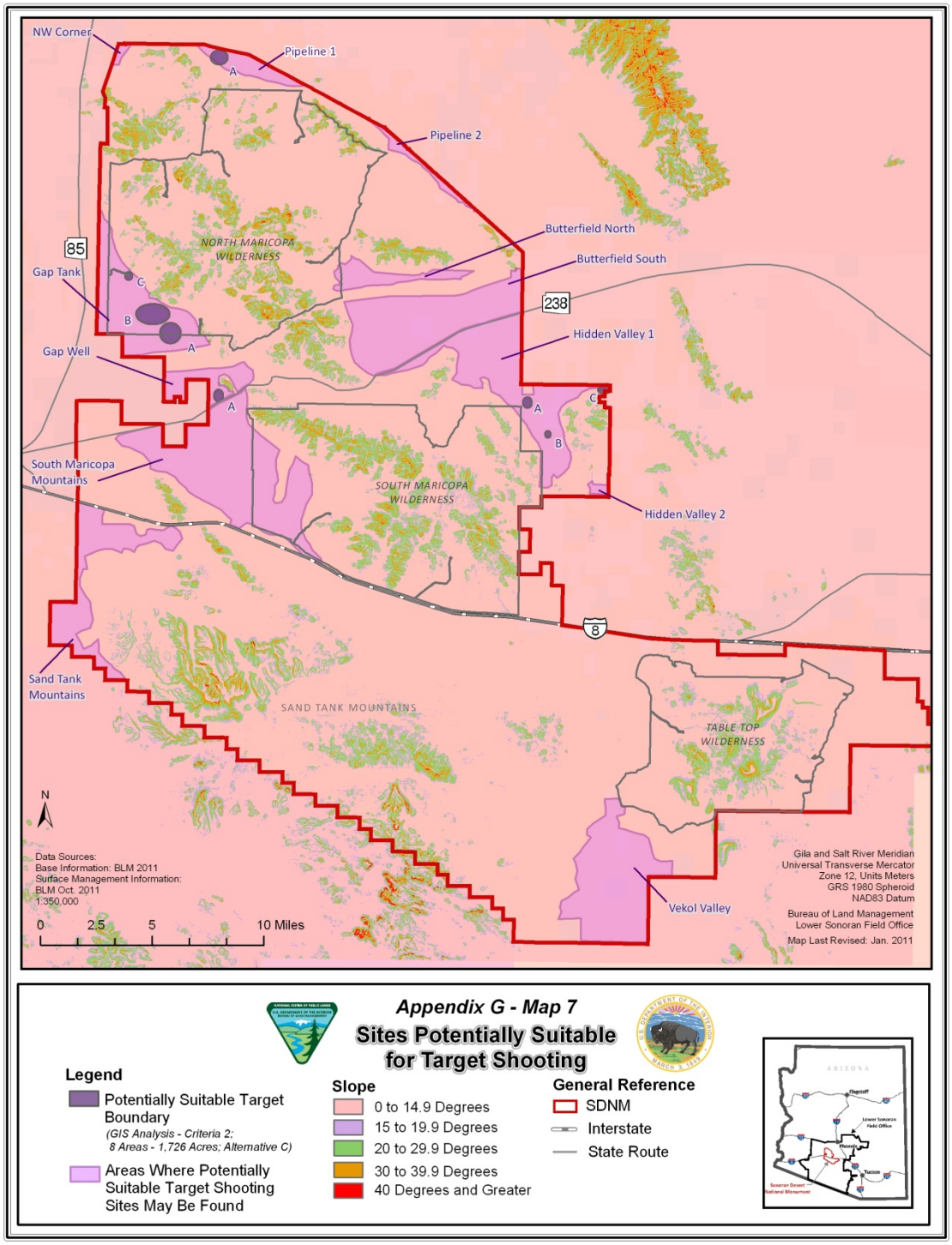
Map G-4. Slope of Terrain



Map G-5. Areas Incompatible with Target Shooting



Map G-6. Areas of Potential Suitable Target Shooting Sites



Map G-7. Sites Potentially Suitable for Target Shooting

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G.7 ATTACHMENT G-1: COMPARISON OF IMPACTS DOCUMENTED AT SHOOTING AND NON-SHOOTING SITES

G.7.1 DATA ANALYSIS

During 2003-2005, the extent of recreation impacts to the Sonoran Desert National Monument was determined with a comprehensive inventory of all recreation impact sites visible from the vehicle route network. At each site, impacts were assessed for a variety of impact variables and sites were categorized into five levels of relative impact based on the presence of these impacts. Sites were also categorized as "non-shooting sites" or "shooting sites," based primarily on the presence of shooting-related litter such as spent ammunition casings and clay pigeons (Foti and Chambers 2005). This inventory identified 243 recreation sites that predominantly were used for activities other than target shooting and 63 sites that were predominantly used for target shooting (see Recreation Impact Sites in the SDNM). Impacts are summarized **Table G-10,** Comparison of Impacts Documented at Shooting & Non-Shooting Sites in the SDNM, 2003-2005. Impacts identified at the two types of sites were analyzed to determine if significant differences existed between non-shooting and shooting sites with respect to management of Monument objects.

The major types of impacts relevant to this analysis were defined as follows:

Damage to Saguaro Cactus. Evidence of human-caused damage such as chopping, shooting, painting, and vehicle collisions; number of incidents counted.

Damage to Rock Formations. Evidence of human-caused disturbance or damage such as bullet marks, painting, and displacement; number of incidents counted.

Damage to Trees. Evidence of human-caused damage such as chopping, breaking, burning, and vehicle collisions; number of incidents counted and grouped into classes of occurrence.

Damage to Shrubs. Evidence of human-caused damage such as chopping, breaking, uprooting, and crushing (particularly with vehicles); number of incidents counted and grouped into classes of occurrence.

Presence of Litter. One piece of litter ranged from the very small, such as a bottle cap, to the very large, such as a discarded home appliance; number of pieces counted and grouped into classes of occurrence.

Presence of Off-Road Vehicle Impact. Number of vehicle tracks; number of tracks counted and grouped into classes of occurrence.

Number of Barren Cores. A common measurement of recreation site impacts, the "barren core" is that area that has been disturbed to the point of being cleared for recreational use, often for campsites. The barren core size was measured as the area observed to be disturbed due to recreation activities. On the SDNM, one barren core is a minimum of 400 square feet in area. Number of barren cores counted.

Table G-10
Comparison of Impacts Documented at Shooting & Non-Shooting Sites in the SDNM, 2003-2005

Type of Impact	Number of Sites Exhibiting Evidence of Impact		Percentage of Sites Exhibiting Evidence of Impact (%)		Difference is Significant ($p < 0.01$)
	Non-Shooting Sites (n=243)	Shooting Sites (n=63)	Non-Shooting Sites	Shooting Sites	
Damage to Saguaro Cactus	13	18	5.3	28.6	Yes
Damage to Rock Formations	72	29	29.6	46.0	No[1]
Damage to Trees					
0 incidents of damage	88	0	36.2	0.0	Yes
1 to 5 incidents of damage	84	12	34.6	19.0	
6 to 30 incidents of damage	57	23	23.4	36.5	
31 to 60 incidents of damage	12	23	4.9	36.5	
61 to 90 incidents of damage	2	3	0.8	4.8	
More than 90 incidents of damage	0	2	0.0	3.2	
0 incidents of damage	21	8	8.6	12.7	
1 to 5 incidents of damage	100	9	41.1	14.3	
6 to 30 incidents of damage	82	27	33.7	42.9	
31 to 60 incidents of damage	29	15	11.9	23.8	
61-90 incidents of damage	7	1	2.9	1.6	
More than 90 incidents of damage	4	3	1.6	4.8	
Presence of Litter					
0 pieces of litter	16	7	6.6	11.1	Yes
1 to 5 pieces of litter	83	1	34.2	1.6	
6 to 30 pieces of litter	72	5	29.6	7.9	
31 to 60 pieces of litter	34	9	14.0	14.3	
61 to 90 pieces of litter	7	10	2.9	15.9	
More than 90 pieces of litter	31	31	12.8	49.2	
Presence of Off-Road Vehicle Impact					
0 incidents	125	17	51.4	27.0	Yes
1 to 5 incidents	61	15	25.1	23.8	
6 to 30 incidents	49	18	20.2	28.6	
31 to 60 incidents	5	9	2.1	14.3	
61 to 90 incidents	1	1	0.4	1.6	
More than 90 incidents	2	3	0.	4.8	

Table G-10
Comparison of Impacts Documented at Shooting & Non-Shooting Sites in the SDNM, 2003-2005

Type of Impact	Number of Sites Exhibiting Evidence of Impact		Percentage of Sites Exhibiting Evidence of Impact (%)		Difference is Significant (p < 0.01)
	Non-Shooting Sites (n=243)	Shooting Sites (n=63)	Non-Shooting Sites	Shooting Sites	
Number of Barren Cores					
0 barren core	5	6	2.1	9.5	Yes
1 barren core	175	29	72.0	46.0	
1 barren cores	35	11	14.4	17.5	
2 barren cores	13	7	5.3	11.1	
3 barren cores	8	4	3.3	6.3	
4 barren cores	4	2	1.6	3.2	
5 barren cores	2	2	0.8	3.2	
6 barren cores	0	0	0.0	0.0	
7 barren cores	0	2	0.0	3.2	
9 barren cores	1	0	0.4	0.0	

[1]Difference is significant at $p < 0.05$.

G.7.2 STATISTICAL ANALYSIS

G.7.2.1 Method

Data for "Damage to Saguaro Cactus" and "Damage to Rock Formations" were tested for significant differences by normal approximation of binomial probabilities. A normal probability distribution was used to approximate binomial probabilities because only two mutually exclusive outcomes were possible (impact or no impact), the observations were independent, the probability of observations remained constant at each location, and the number of observations was greater than 30 in both populations. The tests were conducted with a 1 percent chance of rejecting the null hypothesis that the proportions of impacts observed at non-shooting sites and shooting sites were not different when, in fact, they were different.

Data for other variables was collected in classes; therefore, testing for differences between non-shooting and shooting sites was conducted against a chi-square probability distribution. The tests were conducted with a 1 percent chance of rejecting the null hypothesis that the frequencies of impacts observed at non-shooting sites and shooting sites were not different when, in fact, they were different.

Standard Normal Approximation

Three steps are involved to analyze the relative proportions of two populations, culminating in determination of the "z statistic," or the standardized value of a normal distribution equating the sample

population mean to zero (0) and standard deviation to one (1). The calculated z statistic is then compared to the critical value of z to determine the likelihood of rejecting the null hypothesis based on the level of significance required, i.e. 1 percent.

Step 1. Pool the two sample proportions:

$1 = n_1p_1 + n_2p_2 / n_1+n_2$

Where: 1 = pooled sample proportions; n_1 = number of observations in population 1; n_2 = number of observations in population 2; p1 = proportion of population 1 exhibiting variable 1; p_2 = proportion of population 2 exhibiting variable 2

For "Damage to Saguaro Cactus," 1 = [(243 * 0.05350) + (63 * 0.28571)] / (243+63)

= 0.10131

Step 2. Determine the standard error of difference between the two sample proportions:

$Qp_1\text{-}p_2$ = Square Root $1(1\text{-}1)/n_1 + 1(1\text{-}1)/n_2$

Where: Qp1-p2 = standard error of difference

For "Damage to Saguaro Cactus," $Qp_1\text{-}p_2$ = Square Root [0.10131(1-0.10131)/243 + 0.10131(1-0.10131)/63]

= 0.04254

Step 3. Calculate the value of the standard normal z statistic for testing the null hypothesis that there is no difference between the two population proportions:

$z = p_1 – p2 / Q\ p_1\text{-}\ p_2$

Where: z = standard normal value where population mean = 0 and standard deviation = 1

For "Damage to Saguaro Cactus," z = 0.05350-0.28571 / 0.04254

= -5.45863

Interpretation of Standard Normal Approximation. The null hypothesis stated that the proportion of "Damage to Saguaro Cactus" observed at non-shooting sites is no different than the proportion of "Damage to Saguaro Cactus" observed at shooting sites.

Given a 1 percent chance (p = 0.01) of rejecting the null hypothesis when it is in fact true, the critical z statistic is +/- 2.58. The calculated z statistic for "Damage to Saguaro Cactus" is -4.35015, less than the critical z statistic of -2.58. Thus, there is a less than 1 percent chance that the observed higher proportion of damage to saguaro cactus at shooting sites is not different than the proportion of damage to saguaro cactus observed at non-shooting sites.

Chi-Square Test

Two steps are required to test for differences among several population proportions, culminating in calculation of a chi-square statistic. The calculated chi-square statistic is then compared to the critical value for chi-square corresponding to the relevant proportion of the chi-square distribution for a given level of significance, i.e. 1 percent, with X degrees of freedom. Degrees of freedom are the number of variables free to vary within the calculation, and are calculated by multiplying the number of data classes (r), less one, by the number of sample populations (k), less one.

Step 1. Calculate the expected frequency of observation in each population:

fe = (fr * fk) / n

Where: fe = Expected Frequency; fr = Sum of Observed Frequency for Data Category, r; fk = Sum of Observations for Population, k; n = Total Observations

For "Damage to Trees, 0 incidents of damage, Non-Shooting Sites"

fe = [(88 + 0) * 243] / 306

= 69.9

Step 2. Calculate Chi-Square

Chi-Square = Sum of [(fo - fe)2 / fe]

Where: fo = Observed Frequency for Data Category; fe = Expected Frequency for Data Category

For "Damage to Trees," Chi-Square = [(88-69.9)2/69.9] + [(96-76.2)2/76.2] + [(80-63.5)2/63.5] + [(35-27.8)2/27.8] + [(5-4)2/4] + [(2-1.6)2/1.6]

= 85.97

and degrees of freedom = (6-1) * (2-1) = 5

Interpretation of Chi-Square Test. The null hypothesis stated that the frequency of "Damage to Trees" observed at non-shooting sites is not different from the frequency of "Damage to Trees" observed at shooting sites.

Given a 1 percent chance (p = 0.01) of rejecting the null hypothesis when it is in fact true, and with five (5) degrees of freedom, the critical chi-square statistic is 15.09. The calculated chi-square statistic for "Damage to Trees" is 85.97, greater than the critical value for chi-square. Thus, there is a less than 1 percent chance that the observed higher frequency of damage to trees at shooting sites is not different than the frequency of damage to trees observed at non-shooting sites.

Field Rating Sheet, Suitability for Target Shooting, SDNM

Area: HIDDEN VALLEY (c)

Observer(s): SCARBOROUGH Date: 7-6-2010

Criteria		
1. Significant presence of monument objects / high natural and cultural resource sensitivity.		
Diversity of Vegetation • exemplary plants & assemblages • dense vegetative cover/canopy	scattered saguaro + palo verde but not in dense clumps or "forests"	Yes No
Sensitive Wildlife Habitat • desert tortoise burrowing sites • raptor nesting sites	none evident	Yes No
Geological Features • rock outcrops	some rock outcrops / boulders but not predominant. Hill on N. side much rockier	Yes No
Cultural Resources • evidence of site presence	none evident	Yes No
Suitability Rating • High: 4 No • Moderate: 1 Yes • Low: ≥ 2 Yes		**High** **Moderate** **Low**
2. Visitor safety and nearby uses and facilities.		
Safe Site Location • distance from facilities >1/4-mi **Shooting Fan** • downrange distance	no facilities w/in 1/4-mile; Schumacher road within 1.2 miles; occupied ~~resi~~ residences w/in 1.75 miles Bldg route + wildcat routes behind backstops & would need to be closed / managed	**High** **Moderate** **Low**

photos: 3578, 3579, 3580, - view to south
3581, 3582, 3583 - view to north

Figure G-10. Sample Field Rating Sheet

3. Motor vehicle accessibility.		
Site is Physically Accessible • vehicle clearance • 4wd v. 2wd	Site is accessible by high clearance 2wd	Yes No
Driving Time is Reasonable • distance / time from pavement	driving time from pavement is approx. 30-min.	Yes No
Site is adjacent to BLM-designated Route • proximity to BLM route	adjacent to blm route 8037 & Unnumbered blm route on Lower Sonoran F.O.	Yes No
Suitability Rating • High: 3 Yes • Moderate: 2 Yes • Low: ≤ 1 Yes		**High** **Moderate** **Low**
4. Physical suitability.		
Number of Parties • room for more than two		Yes No
Safe Backstop • dimension of horizontal fan • dimension of vertical fan • backstop material	horizontal & vertical dimensions appropriate; backstop material not predominantly rocky (vertical slope ~20%)	Yes No
Character of terrain • Allows for safe target setup / retrieval • Allows for observation of others		Yes No
Suitability Rating • High: 3 Yes • Moderate: 2 Yes • Low: ≤ 1 Yes		**High** **Moderate** **Low**