ASSISTANCE WITH PREPARING DOCUMENTATION OF HISTORIC CCC TRAILS AT CHIRICAHUA NATIONAL MONUMENT: Project Number ASU – 11

Cooperative Agreement No. H1200040002
Task Agreement No. J8620040020
ASU - 11

FINAL REPORT

by

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ABSTRACT

ASSISTANCE WITH PREPARING DOCUMENTATION OF HISTORIC CCC TRAILS AT CHIRICAHUA NATIONAL MONUMENT: [Project Number ASU – 11]

This project was completed through a Task Agreement by and between the National Park Service (NPS) and Arizona State University (ASU) that is carried out through the Colorado Plateau Cooperative Ecosystem Studies Unit (CPCESU) and Joint Ventures Agreement for the purpose of mutual assistance in conducting a project entitled "***Assistance With Preparing Documentation of Historic CCC Trails at Chiricahua National Monument***." The project goal was to document the status and condition assessment on the historic CCC trails at Chiricahua National Monument (CHIR) and Fort Bowie National Historic Site (FOBO), Arizona. ASU project staff in cooperation NPS staff at CHIR and FOBO completed the fieldwork portion of the project during the summer of 2006. Project staff developed a system to record GPS coordinates, digital photographs, and other condition data regarding the Historic CCC Trails for entry into the NPS FMSS (Facility Management Software System). Trails were assessed and the data in FMSS entered and updated as appropriate by the end of August 2006. All relevant trails data were entered by ASU staff into FMSS at NPS SOAR (Southern Arizona Office) in Phoenix, and work order requests were generated in FMSS for the trails.

The "***Assistance With Preparing Documentation of Historic CCC Trails at Chiricahua National Monument***" Project (ASU -11) has resulted in Chiricahua National Monument (CHIR) and Fort Bowie National Historic Site (FOBO) gaining complete and updated assessment with GPS coordinates and digital photographic records of the historic CCC trails. The project provided documentation of all public trails with data entry into FMSS that enables the Parks to administer the maintenance of the trails. The FMSS and associated digital data (GPS coordinates and tagged digital photographic record) provide visual records and condition assessments of the trail features. The records generated through this project provide essential documentation for maintenance of the trails which are the means of public access to the natural and cultural features of Chiricahua National Monument and Fort Bowie National Historic Site.

INTRODUCTION

This document reports the results of the "***ASSISTANCE WITH PREPARING DOCUMENTATION OF HISTORIC CCC TRAILS AT CHIRICAHUA NATIONAL MONUMENT PROJECT: PROJECT NO. ASU – 18***." The project was completed through the Colorado Plateau Cooperative Ecosystem Studies Unit (CPCESU) in cooperative agreement with Arizona State University (ASU). The "Chiricahua Trails Project" was funded by the National Park Service to complete the following goal: the assessment of Historic CCC Trails at Chiricahua National Monument (CHIR) and Fort Bowie National Historic Site (FOBO) and data entry into the NPS FMSS (Facilities Management Software System). The project was initiated in November 2004, field work completed during the summer of 2006, and documentation through July 2009.

The project was designed to be collaborative between the National Park Service (NPS) and ASU under the Colorado Plateau Cooperative Ecosystem Studies Unit cooperative agreement. The project benefits both cooperators as graduate student(s) in the School of Human Evolution & Social Change (SHESC) (formerly Department of Anthropology), at Arizona State University, Tempe, gain valuable experience in using GPS and other technical skills to prepare data on trail deficiencies in producing preservation proposals necessary for preservation treatment of the historic CCC trail system at Chiricahua National Monument (CHIR) and Fort Bowie National Historic Site (FOBO). CHIR staff had responsibility for training the graduate students in trail documentation for FMSS purposes. The ASU cooperators were responsible for much of the preparation of the technical data.

Dr. Arleyn Simon, Director of the Archaeological Research Institute and Office of Cultural Resource Management at SHESC, ASU, was the primary university contact for the work and selected a team of graduate students (PhD and MA level) with the skills to conduct the necessary work. The graduate students began work in June 2006. The graduate students were provided dorm housing during the work week at CHIR and use of a park vehicle at CHIR. All funding for this project was provided by the NPS.

PROJECT HISTORY

The project agreement was initiated in November 2004 with Peter Welsh, ASU, as the principal investigator. In 2004, the project was entitled "***ASSISTANCE PREPARING AUTOCAD DRAWINGS OF HISTORIC CCC TRAILS AT CHIRICAHUA NATIONAL MONUMENT PROJECT: PROJECT NO. ASU – 18.***" Due to other time commitments, Peter Welsh withdrew from the project in May 2006.

The project was transferred to Arleyn Simon, ASU, as the principal investigator in May 2006. At the time of the transfer, the project title was updated to better reflect the current goals of the project: "***ASSISTANCE PREPARING DOCUMENTATION OF HISTORIC CCC TRAILS AT CHIRICAHUA NATIONAL MONUMENT PROJECT: PROJECT NO. ASU – 18.***"

The primary goal of the project was to provide documentation of the historic CCC trails and to ready and enter associated trail data (including trail deficiencies) into the FMSS (Facilities Maintenance Software System), and to generate cost estimates, and work orders. The primary goals of the project were completed by ASU staff working with CHIR and FOBO personnel in the summer of 2006. Field work on the CCC trails and FMSS data entry were completed during June, July, and August of 2006.

The architectural photography, previously recorded by CHIR personnel of the Faraway Ranch House at CHIR and the Stage Stop and Indian Agency at FOBO were compiled into composite photos through December of 2007. Supplemental photography was completed by ASU staff to fill gaps in the composite photographs.

During 2008, a reference set of field photographs from the current project were electronically tagged with GPS coordinates for future use by CHIR and FOBO personnel for management of the trails. The final report was completed in July 2009. The report and all photographic and tabular documentation generated during the project were finalized and transferred from ASU to the NPS. The final report was reviewed by David Evans, Management Assistant & Cultural Resources Specialist, Chiricahua National Monument and Fort Bowie National Historic Site, Arizona.

PROJECT STAFF

ASU Staff

The "Chiricahua Trails" Project was completed with the supervision of Dr. Arleyn Simon (ASU, Principal Investigator and Project Administrator).

Steven Swanson (ASU Graduate Associate, PhD Candidate) was the Field Director and GIS/GPS specialist.

Destiny Crider (ASU Graduate Associate, PhD Candidate) was the Field Photography specialist and documentation compiler for the final report.

The field crew and FMSS data entry assistants for the project were Christopher Richards and Thierra Nalley (ASU Graduate Assistants, MA program).

Michael Bryk (ASU Undergraduate Assistant, BA program) completed the architectural photographic processing and completed photographing the designated architectural structures [Faraway Ranch House – CHIR, and the Stage Station and Indian agency at FOBO].

Stephen Savage (ASU – ARI IT Manager) provided technical assistance with *GPS Photolink* software to tag the field photos with the GPS coordinates and related data.

NPS Staff

The development of the project work plan and completion of the project was coordinated with David Evans, Management Assistant & Cultural Resources Specialist, Chiricahua National Monument and Fort Bowie National Historic Site.

Mellony Roll, Maintenance Specialist, assisted with logistics for the ASU Staff at CHIR and FOBO.

The CHIR/FOBO Trail Crews worked with ASU staff in conducting the trails assessments.

Jim Gajkowski, Deputy Regional FMP Coordinator, provided access and training in the use of FMSS at the NPS Southern Arizona Office (SOAR), Phoenix.

Ruth Kohler, IT Specialist, SOAR, provided access to FMSS at SOAR and at CHIR.

Anne Trinkle Jones, NPS Cultural Resources Coordinator, Colorado Plateau Cooperative Ecosystem Study Unit (CPCESU), was instrumental in coordinating the project task agreement and subsequent modifications.

DISCUSSION

The priority of the present Chiricahua Trails Project was on the condition assessment of the trails at CHIR and FOBO, gathering GPS coordinates, digital photos, and condition information in a standardized format, and the entry of these data into FMSS to generate work orders.

Dr. Arleyn Simon, ASU, was the primary university contact for the work and administered the project. Field work dates and data entry were coordinated with Dave Evans, Management Assistant & Cultural Resources Specialist, Chiricahua National Monument and Fort Bowie National Historic Site and other NPS staff at CHIR and FOBO. The FMSS data entry at SOAR was coordinated with Jim Gajkowski, Deputy Regional FMP Coordinator, at the NPS Southern Arizona Office (SOAR), Phoenix. This major phase of the project was completed during the summer of 2006.

FIELDWORK

The ASU Field Director, Steve Swanson, updated the software on the CHIR GPS units. He trained the other students in the use of GPS units to gather data for the project documentation of trails. Swanson and Destiny Crider provided training in the associated digital photography. The trail assessment recordation was developed with Dave Evans and CHIR staff. Appropriate data was systematically recorded for all public trails for FMSS data entry at SOAR.

Two GPS units were provided by CHIR, and supplemented by ASU Garmin GPS handheld units. ArcPad was used to record trail features and conditions along with their GPS coordinates. ASU provided use of two digital cameras for the field documentation and the use of a Dell laptop computer for daily downloads of GPS track logs and digital photographs. Software was installed on the laptop for processing of the photographs (*Adobe Photoshop*) and tagging the photos with GPS coordinates (*GPS Photolink*). An external backup hard drive was provided by ASU to insure retention of data.

The ASU Staff (Swanson, Crider, Roberts, and Nalley) and CHIR Staff completed the fieldwork for trails assessments at CHIR and FOBO during the months of June, July, and August of 2006. The GPS work and corresponding digital photography of trail features was carried out by the ASU staff accompanied by NPS trail crew members. The trail crew members provided valuable information on the trail and water control features and conditions as well as noting deficiencies and areas needing maintenance.

The graduate students were provided dorm housing at CHIR and a park vehicle for use at CHIR. The project funding reimbursed CHIR for the use of the housing. Fieldwork was conducted in 4 – 10 hour day work weeks, to match CHIR staff and trail crew schedules. All funding for this project was provided by the NPS.

On the following three pages: ***Figure 1*** shows the map of Chiricahua National Monument (CHIR) with the named trails identified. ***Figure 2*** shows the map of Fort Bowie National Historic site with the named trails identified. The maps are PDF documents publicly available on the CHIR and FOBO websites. ***Table 1*** lists the trails and distances for CHIR and ***Table 2*** lists the trails and distances for FOBO that were assessed for this project.

FMSS DATA ENTRY

The ASU staff gained valuable experience in using GPS and other technical skills in preparing trail condition information that was then entered into FMSS at SOAR. NPS staff at CHIR and SOAR assisted with the IT access, training, and FMSS training.

The ASU staff, in consultation with CHIR staff, prepared the technical data and entry into FMSS at SOAR, in Phoenix. ASU staff completed data entry at SOAR during August 2006.

Products:

- all CHIR and FOBO trail feature deficiencies were entered into FMSS
- cost estimates calculated using the FMSS cost estimating tool
- parent and child work orders created.
- tasks successfully completed on schedule, prior to the end of August 2006.

FIGURE CAPTIONS

Figure 1 – Map of Chiricahua National Monument with named trails identified.

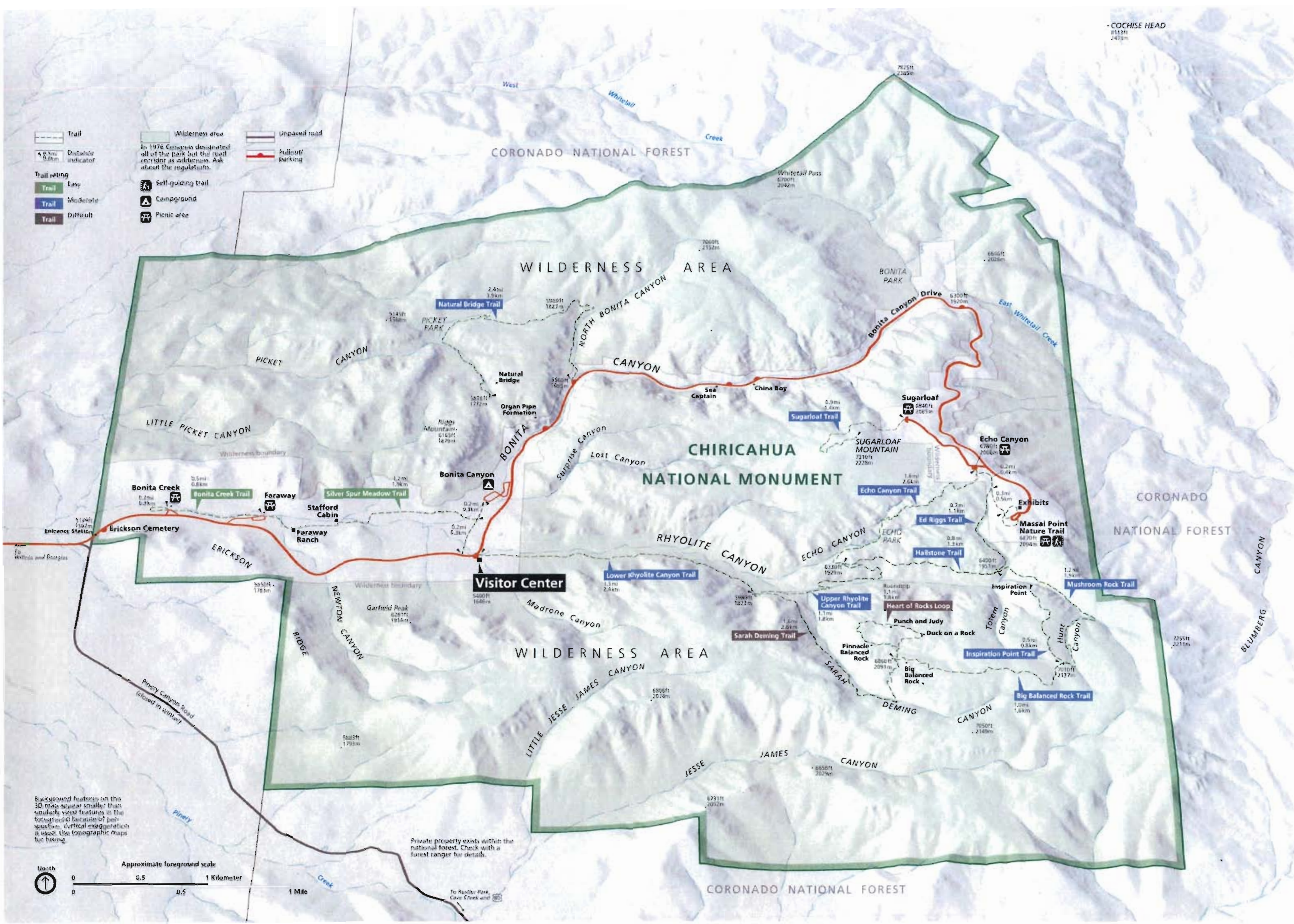
Source: http://www.nps.gov/chir/ view map

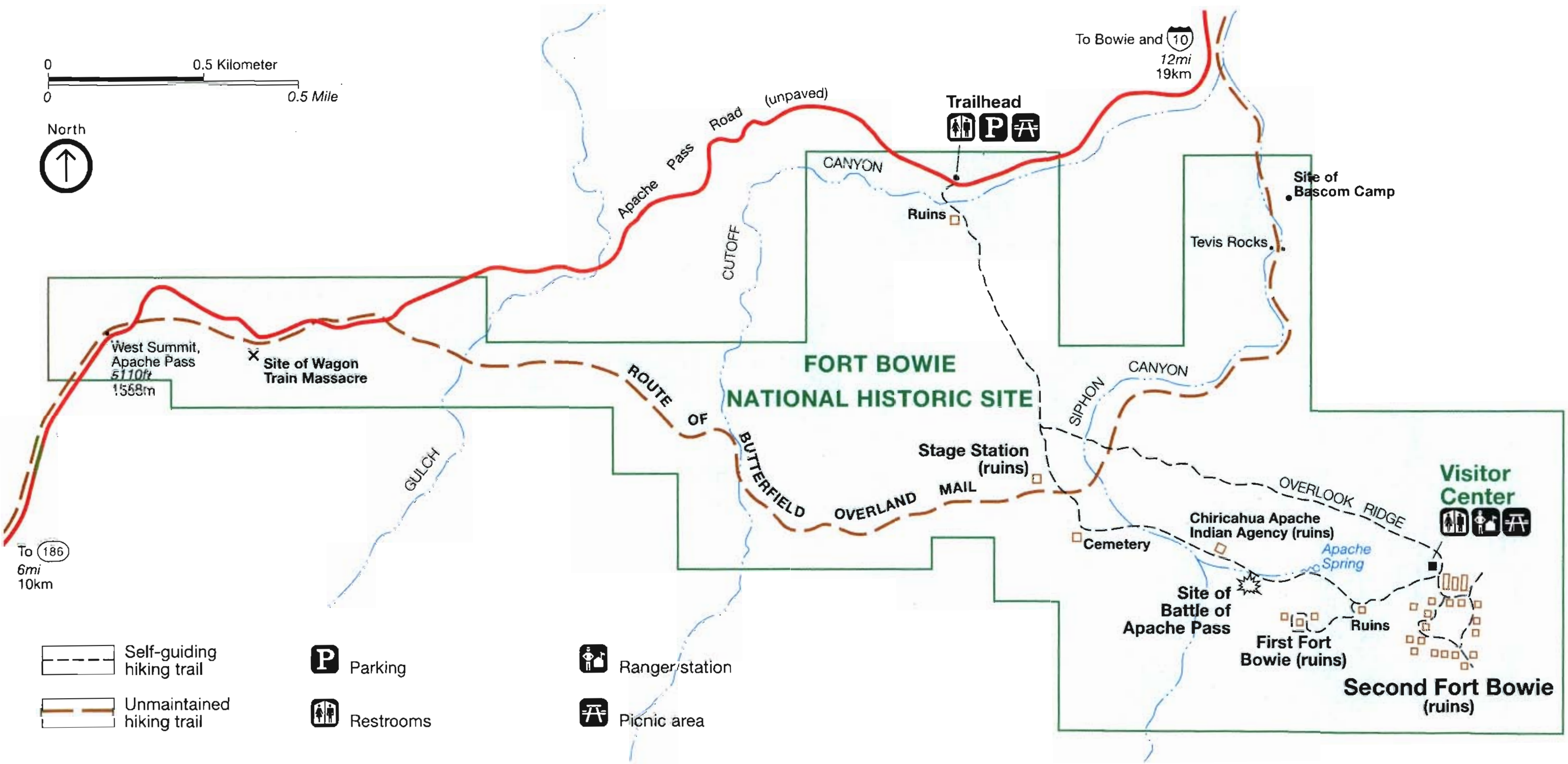
Map link:
http://www.nps.gov/PWR/customcf/apps/maps/showmap.cfm?alphacode=chir&parkname=Chiricahua%20National%20Monument

Figure 2 – Map of Fort Bowie National Historic Site with named Trails identified.

Source: http://www.nps.gov/fobo/ view directions, then park map

Map link:
http://www.nps.gov/fobo/planyourvisit/upload/FOBOParkmMap3.pdf


CHIRICAHUA
NATIONAL MONUMENT
CORONADO NATIONAL FOREST
WILDERNESS AREA
Trail
Distance indicator
Trail rating
Easy
Moderate
Difficult
Wilderness area
In 1976 Congress designated all of the park but the road corridor as wilderness. Ask about the regulations.
Self-guiding trail
Campground
Picnic area
Unpaved road
Pullout/parking
Visitor Center
Bonita Canyon Drive
Entrance Station
Erickson Cemetery
Bonita Creek
Bonita Creek Trail
Faraway
Faraway Ranch
Stafford Cabin
Silver Spur Meadow Trail
Bonita Canyon
Natural Bridge
Natural Bridge Trail
Organ Pipe Formation
Sea Captain
China Boy
Sugarloaf
Sugarloaf Trail
SUGARLOAF MOUNTAIN
Echo Canyon
Echo Canyon Trail
Ed Riggs Trail
Hailstone Trail
Exhibits
Massai Point Nature Trail
Mushroom Rock Trail
Inspiration Point
Inspiration Point Trail
Big Balanced Rock Trail
Heart of Rocks Loop
Punch and Judy
Duck on a Rock
Pinnacle Balanced Rock
Big Balanced Rock
Upper Rhyolite Canyon Trail
Lower Rhyolite Canyon Trail
Sarah Deming Trail
COCHISE HEAD
BONITA PARK
PICKET PARK
ECHO PARK
Whitetail Pass
Garfield Peak
Riggs Mountain
PICKET CANYON
LITTLE PICKET CANYON
NORTH BONITA CANYON
BONITA CANYON
Surprise Canyon
Lost Canyon
RHYOLITE CANYON
ECHO CANYON
Madrone Canyon
NEWTON CANYON
ERICKSON
RIDGE
LITTLE JESSE JAMES CANYON
JESSE JAMES CANYON
SARAH DEMING CANYON
Totem Canyon
Hunt Canyon
BLUMBERG CANYON
West Whitetail Creek
East Whitetail Creek
Pinery Creek
Pinery Canyon Road (closed in winter)
Wilderness boundary
Background features on this 3D map appear smaller than similarly sized features in the foreground because of perspective. Vertical exaggeration is used. Use topographic maps for hiking.
Private property exists within the national forest. Check with a forest ranger for details.
North
Approximate foreground scale
0
0.5
1 Kilometer
1 Mile



0
0.5 Kilometer
0
0.5 Mile
North
To 186
6mi
10km
West Summit, Apache Pass
5110ft
1558m
Site of Wagon Train Massacre
Apache Pass Road
(unpaved)
GULCH
CUTOFF
CANYON
Trailhead
Ruins
To Bowie and 10
12mi
19km
Site of Bascom Camp
Tevis Rocks
FORT BOWIE
NATIONAL HISTORIC SITE
ROUTE OF BUTTERFIELD OVERLAND MAIL
SIPHON
CANYON
Stage Station (ruins)
Cemetery
OVERLOOK RIDGE
Chiricahua Apache Indian Agency (ruins)
Apache Spring
Site of Battle of Apache Pass
First Fort Bowie (ruins)
Ruins
Visitor Center
Second Fort Bowie (ruins)
Self-guiding hiking trail
Unmaintained hiking trail
Parking
Restrooms
Ranger station
Picnic area

Table 1. Trails and distances at Chiricahua National Monument, AZ.

Chiricahua Trails	mi	km	notes
Bonita Creek Loop	0.2	0.3	
Bonita Creek	0.5	0.8	
Silver Spur Meadow	1.2	1.9	Faraway Ranch
Visitor Center (Admin)	0.2	0.3	
Campground	0.2	0.3	
Natural Bridge	2.4	3.9	
Sugarloaf Lookout	0.9	1.4	
Echo Canyon	1.6	2.6	
Massai Point	0.3	0.5	includes Handicap and Nature Trail
Ed Riggs	0.7	1.1	
Hailstone	0.8	1.3	
Mushroom Rock	1.2	1.9	
Inspiration Point	0.5	0.8	
Big Balanced Rock	1.0	1.6	
Heart of Rocks	1.1	1.8	
Sarah Deming	1.6	2.6	
Upper Rhyolite	1.1	1.8	
Lower Rhyolite	1.5	2.4	
Total Trail Distance	**17.0**	**27.3**	

Table 2. Trails and distances at Fort Bowie National Historic Site, AZ.

Fort Bowie Trails	mi	km	notes
Ft. Bowie	1.5	2.4	includes access and ruins
Overlook	1.0	1.6	alternate segment
Butterfield Route	2.0	3.2	
Total Trail Distance	**4.5**	**7.2**	

ARCHITECTURAL PHOTOGRAPHS

The project was loaned previously taken digital photographs of architectural structures including the Faraway Ranch House at CHIR, and the Stage Stop and Indian Agency at FOBO. These consisted of sets of photographs which had been taken with the intent of forming composite images that also may be used for future AutoCAD recording of the structures.

In 2007-08, Michael Bryk, ASU Staff, used *Adobe Photoshop* software to digitally join the photographs into composite views for each of the structures. It was noted that there were a few missing portions in the photographic coverage of the structures. Bryk used one field day at CHIR and FOBO to re-photographed these segments. The additional digital images were used in conjunction with the previous photographs to provide more complete coverage of the structures.

Color prints of the composite views of the structures prepared by Destiny Crider are included with the project documentation. The color prints are provided as well as electronic copies on CDs were made for use by NPS staff. The digital images printed for the project documentation are 8.5" x 11", but the electronic files may be printed to any size to meet future needs of CHIR and FOBO.

- The Faraway Ranch House at CHIR includes composite architectural views of each side of the house.
- The composite views of the Stage Stop at FOBO are plan view (taken from a ladder) of the wall segments. Composite views of each wall were completed.
- The composite views of the Indian Agency at FOBO are profile views (side views) of the wall segments and each wall is presented as a composite view.

The collection of architectural photographs, individual and composite views, provide documentation of architectural details of the structures at given points of time. These will be useful for maintenance of the structures and historical references in the future.

TRAILS PHOTOGRAPHIC DOCUMENTATION

All CHIR and FOBO trail GPS coordinates and assessments were entered into FMSS. However, the project also generated extensive photographic documentation of the trials. ASU Staff, Destiny Crider, prepared archival copies of GPS coordinate logs and related tagged digital photographs on CDs as part of the project documentation.

In addition to the electronic documentation on CDs, one complete set of archival notebooks of the GPS tagged color laser printouts of the trail features for Chiricahua National Monument (CHIR) and Fort Bowie National Historic Site (FOBO) have been produced. The printing was completed at the Archaeological Research Institute, ASU.

This collection of CHIR and FOBO Trail photographs serves two purposes:

1) as a hard copy backup of the digital records stored on CDs, and
2) as readily accessible on-site photographic references for use by CHIR and FOBO Staff.

AutoCAD DRAWINGS

CHIR personnel had previously produced detailed measured field drawings of trail segments (and some of the historic structures) and these are archived at CHIR. These drawings provide a study of the historic CCC trails and their construction features at that time. Copies of the trail drawings were loaned to ASU staff for our reference during this project. The copies were returned to CHIR with the project report and documentation.

We note that although the initial title of the project indicates "*Assistance Preparing AutoCAD Drawings of Historic CCC Trails at Chiricahua National Monument*", actual AutoCAD drawings of the trails were not undertaken as this activity was not designated as a priority at the time the project was implemented in 2006. The focus of this project was the documentation of the historic CCC trails through condition assessment and using GPS coordinates and digital photography. The FMSS data entry of the condition assessments was completed as designated in the Scope of Work.

SUMMARY

The condition assessment data on the historic CCC Trails at Chiricahua National Monument and Fort Bowie National Historic Site have been updated in FMSS. The tasks outlined in the project scope-of-work and task list have been successfully completed.

As of the end of August 2006, Arizona State University staff completed the field objectives of the project to conduct assessments of the CCC Trails at CHIR and FOBO and to complete the FMSS data entry and generate work orders.

The architectural structure photography component of the project was completed by December 2007. Supplementary photography was conducted to fill gaps in the previous photography.

This report serves as documentation of the work accomplished, and an overview of the project. All GPS coordinates and associated tagged digital photographs of CHIR and FOBO trails features are included on an archival CD.

The loaned copies of trails drawings have been returned to CHIR. The previous architectural structure photographs and CDs are returned to CHIR. The composite photographs of the structures and the new individual and composite digital photos of the structures are included on an archival CD and transferred to CHIR with the final version of this report.

The report was reviewed by David Evans, Management Assistant & Cultural Resources Specialist, Chiricahua National Monument and Fort Bowie National Historic Site. This final report was submitted August 7, 2009, as final documentation of the completed project.

Copies of the Final Report and associated CDs are on file with the Chiricahua National Monument and the Colorado Plateau CESU, Flagstaff, AZ.

APPENDIX

Scope of Work

Assistance with Preparing Documentation of Historic CCC Trails at Chiricahua National Monument.

Purpose:

The purpose of this project is to provide technical assistance to Chiricahua National Monument (CHIR) for preparing documentation of historic Civilian Conservation Corps (CCC) trails in the park. By using GPS and other technical means to prepare trail condition information for entry into the National Park service (NPS) Facility Management System (FMSS), Arizona State University (ASU) will provide a useful product that can be incorporated into the FMSS data base.

Project Description:

The primary project components are listed below:

1. Graduate student will be trained in evaluating trail feature condition and gathering information by a skilled trail worker and an FMSS specialist at CHIR.
2. Trail information gathered to conform to FMSS guidelines.
3. Information gathered will be reviewed by CHIR before being accepted.

Collaborative Nature of Project:

Under the Colorado Plateau Cooperative Ecosystem Studies Unit cooperative agreement, a collaborative project between the National Park Service (NPS) and ASU is proposed. This project benefits both cooperators as graduate student(s) in the Anthropology Department at the university gain valuable experience in using GPS and other technical skills to prepare trail deficiencies in producing preservation proposals necessary for preservation treatment of our historic CCC trail system. CHIR will be responsible for training the graduate student(s) in trail documentation for FMSS purposes. The ASU cooperators will be responsible for much of the preparation of the technical data. Dr. Arleyn Simon, Director, Archaeological Research Institute, School of Human Evolution & Social Change (formerly Department of Anthropology, ASU, will be the primary university contact for the work and will assist in selecting a graduate students best equipped to conduct the necessary work. The graduate students would begin work in May 2006. The graduate student will be provided housing in a dorm at CHIR and a park vehicle at CHIR. In the event that a vehicle or housing is not available, the university will be reimbursed according to guidelines established by the federal travel authorization. All funding for this project will be provided by the NPS.

Products:

All CHIR trail feature deficiencies entered into FMSS, cost estimates calculated using the FMSS cost estimating tool, and parent and child work orders created.

Budget:	Rate	Hours	Cost
Student Worker	16.19	741	12,000.00
ERE	10%		1,200.00
Supplies, Travel, Misc.			3,821.00
Direct Cost Total			17,021.00
Indirect Cost Total	17.5%		2,979.00
Total			20,000.00

Annual Project Schedule:

May15, 2006 Initiate Project
August 15, 2006- Draft Report- Up to 90%
September 30, 2006- Final Report- Up to 100%

Invoice Payable up to 90% on February 25, 2006 for completion of draft report and 100% payable upon completion of final drawings and final report.

Primary Contacts: Dr. Arleyn Simon, ASU, 480-965-6957, arleyn.simon@asu.edu
H. David Evans, CHIR, 520-824-3560 x205, dave_evans@nps.gov

Note: No cost extensions were approved to extend the project final documentation phase to September 1, 2009.

NOTEBOOK A **Project No. ASU-11**

Natural Bridge, Sugarloaf Lookout
TRAIL PHOTOGRAPHS TAGGED WITH GPS COORDINATES
CHIRICAHUA NATIONAL MONUMENT

NOTEBOOK B **Project No. ASU-11**

Hailstone, Heart of Rocks, Inspiration Point,
Big Balanced Rock, Mushroom Rock
TRAIL PHOTOGRAPHS TAGGED WITH GPS COORDINATES
CHIRICAHUA NATIONAL MONUMENT

NOTEBOOK C **Project No. ASU-11**

Upper Rhyolite, Lower Rhyolite
TRAIL PHOTOGRAPHS TAGGED WITH GPS COORDINATES
CHIRICAHUA NATIONAL MONUMENT

NOTEBOOK D **Project No. ASU-11**

Campground, Bonita Creek, Silver Spur Meadow
Faraway Ranch
TRAIL PHOTOGRAPHS TAGGED WITH GPS COORDINATES
CHIRICAHUA NATIONAL MONUMENT

NOTEBOOK E **Project No. ASU-11**

Sarah Deming, Massai Point
TRAIL PHOTOGRAPHS TAGGED WITH GPS COORDINATES
CHIRICAHUA NATIONAL MONUMENT

NOTEBOOK F **Project No. ASU-11**

Ed Riggs, Echo Canyon
TRAIL PHOTOGRAPHS TAGGED WITH GPS COORDINATES
CHIRICAHUA NATIONAL MONUMENT

NOTEBOOK 1 **Project No. ASU-11**

Admin, First Fort, Ruins, Overlook Ridge
TRAIL PHOTOGRAPHS TAGGED WITH GPS COORDINATES
FORT BOWIE NATIONAL HISTORIC SITE

NOTEBOOK 2 **Project No. ASU-11**

Butterfield, Access
TRAIL PHOTOGRAPHS TAGGED WITH GPS COORDINATES
FORT BOWIE NATIONAL HISTORIC SITE

Trimble GPS Data Categories (Guide Sheet)

Trail Point

Types

Trailhead, Trail end, Intersection, Corner, Landmark, Switchback, Other

Corridor

Deficiencies

Social trail: Blockage: Boulder, Brush, Fallen tree, Stump; Hazard leaning tree

Tread

Types

Native Tread, Rip Rap, Aggregate, Aggregate stabilize, Asphalt, Pavement, Causeway

Deficiencies

Rutting, Causeway fill exposed, Causeway loose or missing rocks, Washed out/eroded, Gullies, Berms Present, Poor drainage, Braid/parallel trails, minor surfacing hazard, sloughing, Causeway tread washout, potholes, Cracks transverse, Cracks longitudinal, Cracks alligator

Wall

Types

Retaining Wall Dryrock, Retaining Wall Wetrock, Retaining Wall log, Retaining wall sloped, Switchback corner

Deficiencies

Collapsing of Wall, Eroded Footing, Loose or Missing Capstones, Loose or missing chinking, Loose or missing rocks, Missing fill, Poor rock contact, Foundation movement, Overhung/loose foundation, Exposed pins, Loose/damaged pins, Switchback cut/eroded, Slipping joints, Loose/deterior logs

Drain

Types

Step/Check rock, Step/Check wood, Dip Drain swale, Drain ditch inside, Drain ditch outside, Waterbar rock, Waterbar wood, Culvert open

Deficiencies

Blockage, Compromised ineffective, Low rock contact, Downstream berm absent, High hanging undercut, Shallow gradient, Loose anchoring, Loose/missing chinking, Loose/missing rocks, Missing fill, Drain needed, Steps/checks needed, Steps > 10", Drain width <18", Step/check too small, Stones not keyed, Steps dislodged, Loose/missing logs, Deteriorating logs

Sign

Types

Signage, Bulletin Board

Defieciencies

Post corrosion, Cracking, Damaged brick/stone, Mortar deteriorating, Erosion/ Vegetation, Sign loose/damaged, Illegible or missing, Gone causing damage, Out of level, Out of plumb, Rot decay of posts, Scaling, Spalling, Split/cracked post, UV damage to case, Warp/rot shingles

Furniture

Types

Bench, Table, Other

Deficiencies

Structuraly unsound, Gouges slivers, Protruding fasteners, Erosion/vegetation

Fencing

Types

Riprap barrier, Fence panel/railing, Fence post wood, Fence post metal, Fence post concrete, Fence piers, Gate wood, Gate metal

Deficiencies

Corrosion no coating, Corrosion pit/blister, Erosion/vegetation, Loose connection/anchor, Missing/broken rocks, Out of plumb, Parasite damage, Rot/decay/fungus, Split/Broke/cracking

Field Data Collection with Global Positioning Systems
Standard Operating Procedures and Guidelines
06/05/02

The purpose of this document is to address instrument settings, field operation, and data processing for GPS data collection and to make recommendations for standards in recording of positional data.

Definition of the Global Positioning System

GPS (Global Positioning System) is currently a constellation of 25 Department of Defense satellites that orbit the earth approximately every 12 hours, emitting signals to Earth at precisely the same time. The position and time information transmitted by these satellites is used by a GPS receiver to trilaterate a location coordinate on the earth using three or more satellites.

The satellites broadcast on two carrier frequencies in the L-band of the electromagnetic spectrum. One is the "L1" or 1575.42MHz and the other is "L2" or 1227.6MHz. On these carrier frequencies are broadcast codes, much like a radio or television station broadcast information on their channels (frequencies). The satellites broadcast two codes, a military-only encrypted Precise Position Service (PPS) code and a civil-access or Standard Position Service (SPS) code.

GPS Receivers

All commercially available consumer GPS receivers are SPS receivers. There are two basic types of SPS receivers, those that use the broadcasted code to do positioning (code-phase) and those that do carrier phase measurements (carrier-phase). PPS or P(Y)-Code (Rockwell PLGR and Trimble Centurion) receivers utilize the P(Y)-code broadcast on the L2 carrier frequency for positioning. This type of receiver is only available to the military and some government agencies.

Positional Data

The National Map Accuracy Standard (NMAS) published by the USGS is the NPS minimum standard for map data accuracy. Typically a GPS will provide much better accuracy then NMAS if it is used carefully and with full attention to the parameters that the user can set or track. To achieve a reasonable and reliable level of accuracy with a GPS, please use the parameter settings described below. Please note that different GPS units use different names for these parameters or define them slightly differently. The discussion below tries to accommodate for these differences. If you have any questions please contact Tim Smith at Tim_Smith@nps.gov or your regional GIS coordinator.

GPS Positional Accuracy

Positional accuracy for autonomous, code-phase, resource grade or C/A-code receivers range from 100 meters to less than 2 meters. Accuracy for carrier-phase units (commonly referred to as geodetic receivers) can be measured in millimeters.

Accuracy is dependent on a number of factors. Several factors that can significantly impact data accuracy can be monitored in the field: the number of satellite vehicles, Positional Dilution of Precision (PDOP), signal-to-noise (SNR) and Estimated Horizontal Error (EHE). One should always acquire at least 4 satellites. This gives you a 3D position. More satellites are better than fewer. PDOP relates to satellite geometry at a given time and location. Keep the PDOP as low as possible (ideally, maximum PDOP=4) when collecting mapping data. Some receiver's have the ability to limit collection of GPS data if certain GPS quality measures such as PDOP, SNR and number of satellites are out of range. These are referred to as masking. Most receivers (but not all) give you a field estimate of horizontal error (EHE or EPE). With the Rockwell PLGR and Garmin line of receivers, the EHE (or EPE) has been shown to be a very good indicator of overall positional accuracy (most of the time your accuracy is going to be better than the EHE). In the field, EHE is not presently available on the Trimble GeoExplorer 3.

Positional accuracy for both C/A-Code and carrier-phase types of receivers strongly depends on a process called differential correction. In order to achieve greater accuracy, the differential correction procedure is used to limit Selective Availability (controlled by the Department of Defense (DoD) and Ionospheric/Tropospheric degradation of the satellite signals. Although DoD has now set Selective Availability degradation to zero, Ionospheric / Tropospheric degradation can add from 1 - 7 meters of error to your position. Therefore, differential corrections are required to improve accuracy, maintain positional integrity (confidence), and make a survey tie to a ground-based geodetic survey network.

Differential corrections should be used whenever possible. This removes the greatest source of errors remaining in the GPS error budget. Real-time differential corrections are available through the NDGPS/Coast Guard Beacon System, the WAAS (FAA) satellite based differential system, OmniStar, or a variety of paid private differential services. Post-process differential GPS can be obtained from the NGS base stations available from the web or local community base stations.

Real-time differential corrections should be used whenever possible. This saves both time and money.

Receiver-Specific Recommended Settings:
Garmin and PLGR units:

1. EHE: less then or equal to 12 meters. This will keep you just within the NMAS for a 1:24,000 map, which is the maximum acceptable.
2. Minimum of 4 satellites (3D) for every position.
3. Position Type: If possible and practical, real-time differentially corrected positions should be collected.

** Note: Because neither of these units operating in autonomous mode can mask for GPS quality, it is up to the user to monitor constantly the Satellite page for quality.

Trimble units Pathfinder Systems (PRO XR's, XRS's and GeoExplorers):

1. PDOP: less then or equal to 6 (we recommend starting with a PDOP maximum of 4 and shifting to 5 if data collection is not successful at 4; this will keep you around the NMAS for a 1:5,000 map).
2. Minimum of 4 satellites (3D) for every position.
3. SNR: less then or equal to 5.
4. Elevation Mask: 15.
5. Antenna height: be sure to check for correct antenna height setting. This setting should be the typical height at which the antenna will be carried. If the antenna is attached to a pole, it must be located above the user's head and the antenna height setting should be the height of the top of the pole. Wherever possible, the antenna should be clear of any obstructions.
6. Position Type: Must be post-processed or real-time differentially corrected.

All GPS units:

1. Check the graphics data collection screen regularly to see if you are getting multi-path or other apparent distortions to the data. Garmin and PLGR's require the user to monitor the screen and stop data collection during poor PDOP or SNR windows. Trimble receiver's set to the appropriate mask will stop collecting automatically.
2. Be aware of the possibility of multi-path interference and use offsets or other methods to keep the antenna away from building overhangs, tall fences or walls, and heavy canopy wherever possible.
3. ALWAYS do differential corrections, either real-time or post processed.
4. Feature settings:

Point

· Trimble - minimum of 30 positions, collected at 1 second interval and averaged.

· All Others - 90 to 120 positions, collected at 1-2 second interval and averaged.

Line/Polygon

· use a 2-5 second interval for walking and for road driving, depending on the road type and speed of the vehicle, force (i.e. wait for) a position at each corner, and use a minimum of 3 positions to define any curve/change in direction.

** Note: If maximum accuracy is required, it is important to sync the collection rate with the base station logging rate. Stations log anywhere from 1 to 30 second data. It is recommended that logging rates to be in multiples of 1 or 5 for best differential corrections. Setting logging rates other than 1 and 5 may reduce the number of positions that are in sync with base data and reduce accuracy.

5. Try to map all features in a single area in a single day or on consecutive days.

Attribute Data

Data dictionaries (e.g. Trimble) or data collection forms (e.g. ArcPAD) are designed to simply, efficiently, and without redundancy, describe features (landscape, biological, cultural, or historical). A data dictionary or form organizes data into types or 'themes' and reduces user error when entering values. It is an efficient use of time and energy to employ this type of data collection. Set up a menu and picklists in a database and load them into the GPS unit or data collection device prior to going out into the field. Create and use a data dictionary or data collection form whenever possible to collected attribute data.

Coordinate Metadata

Record the following at a minimum:

1. EHE/EPE or maximum PDOP (using 4 satellites)
2. Coordinate datum
3. Coordinate projection
4. Projection Zone, if using UTMs or State Plane

The following parameters should be used in selection of datum and projection:

Projection and Coordinate System

All digital geospatial data should reference the coordinate system appropriate for it's use and it should be documented in the metadata. All spatial data collected or submitted for national, regional, or network NPS programs shall be geo-referenced and provided in a standard projection. Digital geospatial data should be referenced to two coordinate systems--the current standard system used by the individual park (generally UTM, NAD83) and a regional-scale system (Geographic, NAD83). The steps used to get the data into the proper projection must be documented in the metadata. The project manager must specify, approve and document any deviation from these projection standards.

NPS-wide and Regional Data Standard

The standard projection for most NPS regions and national programs is geographic with the following parameters as per Executive Order 12906 (http://www.fgdc.gov/publications/documents/geninfo/execord.html) and the Federal Geographic Data Committee (FGDC) standards:

Datum North American Datum 1983
Spheroid GRS 1980
Units Decimal Degrees

Park Unit Data Standard

The standard projection for most NPS regions and national programs is Universal Transverse Mercator (UTM) with the following parameters:

Projection Universal Transverse Mercator
Datum North American Datum 1983
Spheroid GRS 1980

False Easting 500,000
False Northing 0
Units Meters

Unit Standards for Exceptions
In addition to the systems noted above, several NPS units require additional specific standards for data delivery (e.g., Cabrillo and Craters of the Moon National Monuments). Parks in Hawaii and other Pacific islands will be in the datum and projection specified by each park. Because of their geographic location, the NPS Alaska Region also requires a specific datum and projection as noted below. However, data sets for use regionally and systemwide should be provided in latitude / longitude (decimal degrees) and NAD-83.

Alaska Region
The standard projection for Alaska Region parks uses the following parameters:

Projection Alaska Albers Equal Area
Datum North American Datum 1927
Spheroid Clark 1866
False Easting 0
False Northing 0
Central Meridian -154 00 00
1st Standard Parallel 55 00 00
2nd Standard Parallel 65 00 00
Units Meters

Horizontal / Vertical Accuracy and Precision
All spatial data collected shall be analyzed for their spatial accuracy and shall meet or exceed the National Map Accuracy Standards for the particular scale intended (for more information see http://mapping.usgs.gov/standards/). Longitude and Latitude coordinates for geographic data should be recorded to a minimum 5 significant digits to the right of the decimal point and stored in double precision attribute or database fields. Any calculations done with location data should be done at double precision with the results rounded or truncated to the appropriate propagated error limits. All calculations and processing completed on the spatial data shall be reported in the metadata.

Additional Data Collection Notes

· Positional coordinate data should not be recorded in NAD-27 in the field. Datum conversions should be done as an office, post-process activity using software that utilizes a full NADCON datum conversion in order to assure accuracy and precision.
· When estimating distances, Latitude / Longitude decimal degrees can be used the same as Universal Transverse Mercator coordinates (UTMs). The digit in the fifth decimal place of decimal degrees can be used as approximately a meter.
· Real-time differential techniques should be employed whenever possible for efficiency and time savings.

· The distance between the base station and the remote GPS receiver should be kept to a minimum, preferably less than 150 mi.