

GPS to GIS

Procedural Handbook & Reference Guide

VERSION 6.0

Includes GeoXM/XT and ArcPad

prepared and compiled for the
USDA Forest Service
San Juan National Forest

by
Mark D. Roper
GIS Specialist
12/08/2003



Table of Contents

I. INTRODUCTION	4
A. BACKGROUND	4
B. COORDINATE SYSTEMS	5
C. GPS RECEIVERS	7
D. WAYPOINTS	9
E. PREPLANNING	9
F. FIRE (INCIDENT) APPLICATION	10
II. TRIMBLE RECEIVERS	10
A. GEOEXPLORER XM/XT	10
1. <i>Communication with the PC</i>	10
2. <i>Operating System and Installation of Software</i>	13
3. <i>TerraSync – Setup and Operation</i>	14
4. <i>Waypoints and Navigation</i>	16
B. GEOEXPLORER 3/3C	17
1. <i>Communication with the PC</i>	17
2. <i>Asset Surveyor -- Setup and Operation</i>	17
3. <i>Waypoints and Navigation</i>	20
III. PATHFINDER OFFICE	20
A. DATA TRANSFER	20
1. <i>GeoExplorer XM/XT</i>	20
2. <i>GeoExplorer 3/3c</i>	20
B. DIFFERENTIAL CORRECTION.....	21
C. EDITING	21
D. EXPORTING – CONVERTING DATA INTO GIS	22
E. IMPORTING – CONVERTING GIS DATA INTO GPS FOR FIELD USE	23
1. <i>GeoExplorer 3 & Geo XM/XT</i>	23
2. <i>GeoExplorer 3c</i>	24
IV. GARMIN RECEIVERS	25
A. SETUP AND OPERATION	25
B. DOWNLOADING – CONVERTING GPS DATA INTO GIS.....	25
1. <i>Using the DNR-Garmin Extension for Arcview</i>	25
2. <i>Using the GPSi Extension for ArcMap</i>	26
3. <i>Using Waypoint+</i>	27
4. <i>Using GPS Utility</i>	27
C. UPLOADING – CONVERTING GIS DATA INTO GPS FOR FIELD USE	27
1. <i>Using the DNR Extension for Arcview</i>	27
2. <i>Using the GPSi Extension for ArcMap</i>	28
V. OTHER GPS RECEIVERS	28
A. ALLEGRO DATALOGGER.....	28
1. <i>Setup and Operation</i>	28
2. <i>Data Transfer</i>	28
3. <i>Uploading Waypoints to the Allegro for Navigation</i>	28
B. GPS RECEIVERS FOR POCKET PC’S	29
VI. USING ARCPAD	30

A. GPSCORRECT WITH ARCPAD (GEO XM/XT).....	30
1. Setup.....	30
2. GPS Settings.....	30
3. Differential Correction.....	31
B. STAND-ALONE ARCPAD (IPAQ, AXIM, GEO XM/XT, ETC.).....	31
1. Setup.....	31
2. GPS Settings.....	32
3. Differential Correction.....	33
C. “THE PROJECTION SHIFT” – WGS84 VERSUS NAD27.....	33
D. ARCPAD TIPS.....	34
1. Map Projections.....	34
2. Features.....	35

VII. ARCGIS & ARCVIEW – ADDITIONAL GPS/GIS OPERATIONS.....**35**

A. ARCGIS (ARCMAP, ARCCATALOG, ARCTOOLBOX).....	35
1. Project-on-the-Fly WGS84 Data to NAD27 in ArcMap.....	35
2. Defining the Projection of a Shapefile or Feature Class.....	36
3. Changing the Projection of a Shapefile using ArcToolbox.....	37
4. Correcting Shifted Data Collected in ArcPad.....	39
5. Exporting Shapefiles to Other Formats (Geodatabase, Coverage).....	40
6. ASCII Format – Adding XY Data From a Table/Textfile.....	40
B. ARCVIEW.....	42
1. The Projection Utility – Changing the Projection of a Shapefile.....	42
2. Display Points Lat/Long Extension – Adding XY Data into a Shapefile.....	44
3. Making Grid Points for GPS Field Use.....	44

VIII. CORPSCON.....**45**

A. CONVERTING COORDINATES IN A TEXTFILE.....	45
1. Textfile format.....	45
2. Converting a Textfile.....	46

APPENDIX.....**47**

A. CREDITS.....	47
B. BASE STATION MAP.....	48
C. KEY SETTINGS.....	48
D. COMMANDS.....	49
1. Windows commands.....	49
2. UNIX commands.....	49
3. ARC commands.....	49
F. USING FTP TO DOWNLOAD BASEFILES.....	49
G. MORE TECH TIPS.....	50
H. ARCINFO FOR PC/UNIX.....	50
1. Making Pathfinder Export Files into a Coverage.....	50
2. Sample Area AML.....	52
3. Converting XY Data in a Textfile to a Coverage.....	53
4. Converting a Shapefile to a Coverage.....	53
I. OTHER METHODS FOR CONVERTING GIS DATA INTO GPS FOR THE GEOEXPLORER 3C.....	54
1. The Arcview-Excel Method.....	54
2. The “Hoops” Method in Pathfinder Office.....	55
J. WEB LINKS.....	56

I. Introduction

A. Background

This document is intended to help the GPS user doing resource grade work become more acquainted with the use of various types of GPS receivers, data collection standards, the creation of quality GIS data and GIS tips/tricks pertaining to GPS. It is intended to be a supplement to existing help documents and tutorials.

For many people, using GPS equipment for mapping can be an efficient way to collect accurate information out in the field. It is often assumed that one can just pick up a unit and go collect. Since the data exists electronically, there is a perception that it is easily transferred into the realm of GIS. However, what many people fail to realize is just how much time is involved in converting GPS data into a quality GIS.

GPS is probably the most accurate tool for mapping, but it does contain some level of error. GPS data collected with Trimble units and differentially corrected under normal conditions will yield a confidence ranging from sub-meter to five meters in accuracy. Handheld Garmin units generally do not have differential correction capability, with the exception of receivers that are DGPS and WAAS ready (see **Section I, part C**). Data collection methods play a big part in the quality of mapped features. It is important to have the unit set correctly in order to obtain quality data. Also, higher-end models tend to have the technology of increased filter capabilities that will provide for an even better GPS/GIS output.

Poor data collection techniques and errors like multipath can increase the need for editing the collected data if it is to be used in GIS correctly, preferably by the GPS user who collected it in the field. Editing in Pathfinder Office can minimize unnecessary work in the GIS.

There are a number of programs available to the user for converting GPS data into GIS. When working with Trimble units, Pathfinder Office is usually used. There are several utilities available for downloading Garmin data into GIS, some of which are covered here. GPS data can readily be exported into various GIS formats, but for the general user, the typical format is the Arcview shapefile. Master datasets that may reside in a GIS library on a network are generally stored as Geodatabases or ArcInfo coverages. GPS coordinates stored in a textfile format can also be brought into GIS using ArcMap, ArcCatalog or Arcview. It is possible to convert data without realizing that the wrong configuration settings were used. Hopefully by adhering to the following procedures, many mistakes can be avoided.

***NOTE:** GPS units and PC software are constantly changing and some models are not discussed. The program versions for the following software titles referenced in this manual are as follows:*

Pathfinder Office 2.90+	Arcview 3.2a	ActiveSync 3.7.1
DNR Garmin 4.0.6	ArcGIS 8.3	Windows 2000
GPSi 0.1	ArcPad 6.0.2	Corpscon 5.11.08
Waypoint+ 1.8.03	GPScorrect 1.01	
GPS Utility 4.10.0	TerraSync 2.4	

B. Coordinate Systems

The following are excerpts taken from the online help in ESRI's ArcMap discussing coordinate systems and datums.

Coordinate Systems:

"The features on a map reference the actual locations of the objects they represent in the real world. The positions of objects on the earth's spherical surface are measured in geographic coordinates. While latitude and longitude can locate exact positions on the surface of the earth, they are not uniform units of measure; only along the equator does the distance represented by one degree of longitude approximate the distance represented by one degree of latitude. To overcome measurement difficulties, data is often transformed from three-dimensional geographic coordinates to two-dimensional projected coordinates.

A geographic coordinate system (GCS) uses a three-dimensional spherical surface to define locations on the earth. A GCS is often incorrectly called a datum, but a datum is only one part of a GCS. A GCS includes an angular unit of measure, a prime meridian, and a datum (based on a spheroid)."

Datums:

"While a spheroid approximates the shape of the earth, a datum defines the position of the spheroid relative to the center of the earth. A datum provides a frame of reference for measuring locations on the surface of the earth. It defines the origin and orientation of latitude and longitude lines. Whenever you change the datum, or more correctly, the geographic coordinate system, the coordinate values of your data will change."

Geographic (or datum) Transformations:

"Because the geographic coordinate systems contain datums that are based on spheroids, a geographic transformation also changes the underlying spheroid. There are several methods, which have different levels of accuracy and ranges, for transforming between datums. The accuracy of a particular transformation can range from centimeters to meters depending on the method and the quality and number of control points available to define the transformation parameters. These include the Geocentric Translation, Molodensky, and Coordinate Frame methods. See *Equation-based* methods for more information. Other methods such as **NADCON** and NTV2 use a grid of differences and convert the longitude–latitude values directly. See *Grid-based* methods for more information."

NADCON:

"The United States uses a grid-based method to convert between geographic coordinate systems. Grid-based methods allow you to model the differences between the systems and are potentially the most accurate method. The area of interest is divided into cells. The National Geodetic Survey (NGS) publishes grids to convert between NAD 1927 and other older geographic coordinate systems and NAD 1983."

Throughout this document, there are references to various coordinate systems, projections and datums. The term "projection" is often used interchangeably with "coordinate system." While this is not entirely accurate, this document will use both of these terms. Additional definitions of terms used when discussing projections can be found at the following USGS address:

<http://biology.usgs.gov/geotech/documents/datum.html>

ESRI's website, ArcMap/ArcView online help and user manuals are also excellent source material for learning about map projections, coordinate systems and datums.

The Forest Service in Region 2 currently maintains its GIS data in a projected coordinate system.

projection: UTM datum: NAD27 Conus

zone: 13 N units: meters

Since the GIS data resides in the NAD27 datum (GCS_North American_1927), this requires the need to reproject GPS data from and to WGS84 (GCS_WGS_1984). In GPS applications using NAD27 coordinates, when possible, set the datum to NADCON. There is very little difference between NAD83 and WGS84 and a “leap of faith” can be made in using NADCON. Not using this method can result in several meters of error. **NOTE:** *There are WGS84/NAD27 transformation issues within ArcPad and ArcMap (see Section VI, part C and Section VII, part A).*

This document does not discuss all the complexities involving projections and datums. Instead, it simply outlines what projection and datum need to be used depending on the data situation. The following table mainly pertains to Forest Service use of data in the NAD27 datum in Region 2. Due to issues between WGS84 and NAD27, some forests have begun switching to NAD83.

USGS Topo	Polyconic NAD27, 1000m grid tics UTM NAD27 with corner tics generally using Geographic (Lat/Long) NAD27
GIS data	for Region 2, GIS data resides in UTM, NAD27 Conus, Zone 13 N, meters
GPS receivers	when collecting data, most GPS units store positions in Geographic (Lat/Long) WGS84
Waypoints	when creating waypoints, one must keep in mind what projection/datum the source coordinates are in, especially when entering the coordinates by hand. Geographic WGS84/NAD83 coordinates are different from Geographic NAD27 coordinates.
NADCON	NADCON is the Federally accepted transformation method from NAD83 to NAD27. In GPS, when desiring NAD27 coordinates, set the datum to NADCON. In GIS, when converting between WGS84/NAD83, use NADCON as the transformation. Results can vary by several meters if NADCON is not used.
Arcview	Does not support NADCON by itself. Extensions that populate coordinates into a table (like Ventura Tools and Display Points Lat/Long) will be based on the projection of the View. (ex. a NAD27 datum will yield UTM NAD27 and Geographic NAD27 coordinates.)
ArcMap	In a NAD27 dataframe, the default transformation in ArcMap does not Project-on-the-Fly WGS84 correctly. Refer to Section VII, part A for a method of projecting WGS84 to NAD27 to within a meter in the dataframe and projecting to NAD27 using Toolbox.
ArcPad	ArcPad is using equation based and not grid based transformation methods. Its problem is similar to ArcMap’s in respect to WGS84. Refer to Section VI, part C for an explanation.

The following is an example of coordinate values and how they can differ. The GIS point at 37° 15’ 00”N 107° 00’ 00”W is the Southeast corner tic of the Pagosa Springs Quadrangle.

*The correct location when displayed with GIS data in NAD27 is that generated through NADCON.

Geographic WGS84 (GPS)	Geographic NAD27 Conus	*Geographic (GIS NAD27) NADCON	UTM NAD83 Conus	UTM NAD27 Conus	*UTM (GIS NAD27) NADCON
37° 15’ 00.020401”N 107° 00’ 02.13974”W	37° 14’ 59.94772”N 106° 59’ 59.93118”W	37° 15’ 00”N 107° 00’ 00”W	322569.740E 4124482.331N	322619.757E 4124275.163N	322618.096E 4124276.810N

The user should try to have a basic knowledge of these differences in projection values in order to correctly select the projection that meets their needs. Any user that has a question or concern regarding projections and GPS should contact the local GIS specialist.

Tech Tip: #1 Know what you are working with. Ask!
 “What is the coordinate system? What is the datum?”

C. GPS Receivers

There are a variety of GPS receivers available on the forest and it is important to understand their capabilities and limitations. Keep your data needs (including type of data) in mind when selecting a unit. Trimble units are specifically designed to collect and store spatial information. Garmin units are primarily designed as a navigation tools. GIS uses the best data available (data quality can vary). It is also important to understand who will edit and/or use this data. Don't short yourself in getting the best data possible.

Currently, the San Juan GIS Team recommends the use of Trimble (or equivalent) GPS units for data collection when units are available. These units interface with GIS very well and provide quality controls that can typically yield a higher quality of data than off-the-shelf models. **However**, it is understood that cost and availability can be a deterring factor and several less expensive Garmin handheld units are available to users on the forest. *Users should be aware of the issues bringing data into GIS from a Garmin unit, much of which is addressed in this document.* Receivers that interface with Pocket PC's are also a valuable tool and contain quality controls through ArcPad. Any GPS data going into GIS layers, regardless of source, should be checked for quality.

GPS accuracy and data standards can vary between forests and agencies as well as be influenced by the type of data being collected. Some national direction has been set for certain kinds of information. The following is a brief list of some defined standards and accuracy requirements. Refer to **Appendix C** for recommended settings on resource grade GPS data collection for the San Juan NF.

GPS Standards defined

- GPS standard for GIS (draft) WO
- FGDC part 3 Geospatial Positioning Accuracy
- FSH 2409.12 Timber cruise Handbook

Various Accuracy Requirements

- NMAS 40ft (12.2m)
- NSSDA 13.9m
- FGDC 10m
- GPS design accuracy < 15m
- LAAS, WAAS for airport/aircraft requires 5 satellites.

Comparisons between various receivers can be viewed at the following addresses.

<http://fsweb.sdtc.wo.fs.fed.us/programs/im/fy03/ppc/ppc.shtml>

<http://www.fs.fed.us/database/gps/gpsusfs.htm>

General Features

1. **Trimble:** 8-12 channel (including GeoXT, GeoXM, GeoExplorer 1,2,3, ProXL, ProXR, Pathfinder Pocket)

Cost: \$-\$\$\$

Accuracy:

- a. Uncorrected data without Selective Availability: 5-15 meters
- b. Differential Correction (DGPS): submeter-5 meters
- c. Wide Area Augmentation System (WAAS) capable receivers: < 7 meters

(primarily for aircraft.) Refer to the FAA's website for a detailed description of WAAS. <http://gps.faa.gov/>

- d. Carrier Phase: Submeter

Features:

- a. Data Dictionary – to record attributes in greater detail. Can be designed to match existing GIS layer attribute fields.
- b. Postprocessing – GPS files can be differentially corrected and edited.
- c. Can average multiple positions per point to yield a more accurate point.
- d. Memory storage – generally can accommodate large amounts of data.
- e. Ideal for Point, Line and Polygon data.
- f. Can utilize background images (like orthophoto quads) in CE models.

Software: Pathfinder Office, TerraSync and GPSCorrect for ArcPad 6.x (CE models)

2. Garmin: 8-12 channel

Cost: \$

Accuracy:

- a. Uncorrected data without Selective Availability: 15 meters
- b. Garmin under trees 20-40m.
- c. DGPS (must have beacon receiver, antenna and within range of a beacon transmitter): 3-5 meters
- d. Wide Area Augmentation System (WAAS) capable receivers: < 7 meters (primarily for aircraft.) Refer to the FAA's website for a detailed description of WAAS. <http://gps.faa.gov/>

WAAS-enabled products:

eTrex Legend	GPSMAP 168 Sounder
eTrex Venture	GPSMAP 176/176C
eTrex Vista	GPSMAP 182
Geko 201	GPSMAP 188 Sounder
GPS V	GPSMAP 196
GPS 15H and GPS 15L	GPSMAP 232
GPS 16	GPSMAP 238 Sounder
GPS 17N	GPSMAP 295
GPS 72	GPSMAP 2006
GPS 76	GPSMAP 2010
GPS 152	iQue 3600
GPSMAP 76	Rino 110
GPSMAP 76S	Rino 120
GPSMAP 162	

Features:

- a. Designed and excellent for navigation.
- b. Works very well with collecting points.
- c. Small, lightweight.

Software: Several extensions available for downloading to Arcview and ArcMap. Line or Polygon data will require a lot of editing.

3. GPS receivers for Pocket PC's: 12 Channel

Cost: \$

Accuracy:

- a. Uncorrected data without Selective Availability: 5-15 meters
- b. Differential Correction (DGPS): None
- c. Wide Area Augmentation System (WAAS) capable receivers: < 7 meters (primarily for aircraft.) Refer to the FAA's website for a detailed description of WAAS. <http://gps.faa.gov/>
- d. Interface with ArcPad allows for quality control.

Features:

- a. Designed to work with the iPAQ or Dell Pocket PC.
- b. Works with ArcPad allowing the creation of shapefiles from GPS data.
- c. Small, lightweight.

Software: ArcPad 6.x

D. Waypoints

Many times, it is useful to upload GIS data to a GPS unit for use in the field, whether for updating information or for simple navigation. It is **important** to understand a little about projections (see **Section I, part B**) when preparing data for navigation back out in the field.

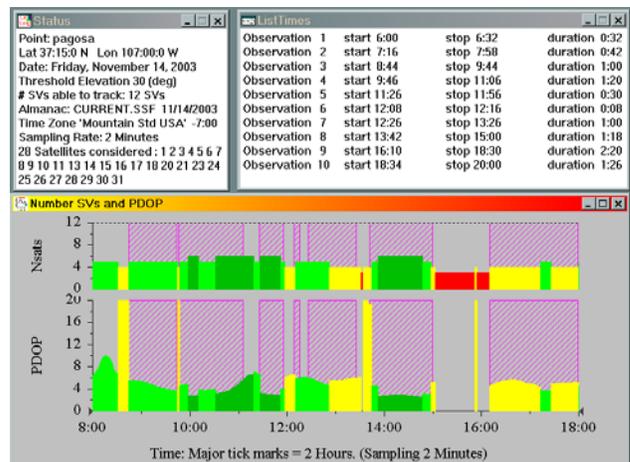
When entering waypoints manually, set the GPS/GIS projection to match the projection of the source coordinates of the point to enter. For example, if entering a Lat/Long NAD27 coordinate in Pathfinder Office that originated from GIS or a Topo, you would set the Pathfinder coordinate system to Lat/Long NADCON. If entering a Lat/Long NAD27 coordinate that originated from the GPS unit that was set to Lat/Long NAD27 Conus, you would set the Pathfinder coordinate system to Lat/Long NAD27 Conus. You can create and upload Waypoint files to a Trimble GPS unit using Pathfinder Office.

Garmin GPS12 UTM points appear to be rounded to whole numbers and tenths for Lat/Long. A point in UTM NAD27 does not necessarily match the same UTM NAD27 point entered on a Trimble. There is at least couple meters difference. Also, be aware of the difference between Geographic WGS84 and Geographic NAD27 coordinate values.

E. Preplanning

Preplanning software like Quick Plan or Trimble Planning Software enables the user to make efficient use of field time by identifying the optimum times to collect GPS based on certain conditions like PDOP and elevation. The program uses an Almanac that contains orbit information for every GPS satellite. Almanacs can be obtained from the GPS unit or the internet. Quick Plan comes with Pathfinder Office. Trimble Planning Software can be downloaded free from the following address.

http://www.trimble.com/planningsoftware_ts.asp?Nav=Collection-8425



F. Fire (Incident) Application

More and more, the firefighting community is using GPS as a tool for mapping and navigation. The wide variety of basic GPS receivers, relatively low expense and interface with GIS applications has increased the need for GIS specialists (and average users) to become more familiar with this type of data management and manipulation. Garmin receivers are probably the most common units found on an incident.

Unlike GIS specialists, who normally work in projected coordinates (UTM, State Plane), the fire community typically operates in Geographic (Latitude/Longitude) coordinate space. For standard communication purposes, the fire community (at least in Region 2) is supposed to provide coordinates in:

Latitude/Longitude
Degrees, Minutes, Decimal Seconds (DD° MM' SS.ss")

This standard does not stipulate a datum. A GIS specialist is often asked to plot these coordinates on a map. For this reason the GIS user should always ask the person providing the coordinates:

“What is the coordinate system? What is the datum?”

This only applies to hand-written coordinates or those given verbally. If data was physically collected within the GPS unit, it actually exists as Geographic WGS84 data until it is downloaded into GIS.

II. Trimble Receivers

A. GeoExplorer XM/XT

At this time, the San Juan NF only has the GeoExplorer XM. There is little real difference between the XM and XT dataloggers operationally, with the exception to the XT's sub-meter accuracy and multi-path rejection technology.

There are two (2) buttons on the unit. The larger button toggles the power on and off. The smaller button toggles the backlight on and off.

1. Communication with the PC

There are two methods of communication between the datalogger and the PC. The primary method is through the use of the cradle/support module which utilizes a USB cable. The other is the optional serial clip with a 9-pin null modem cable that plugs into a COM port. The communication options in the CE unit are governed by the method used. Initial setup will require Administrative privileges for a Windows 2000 PC.

a. Support Module (USB) setup

1. **IF** this is the first time the cradle and USB cable have been used on a Windows 2000 PC,

- it will require Administrative privileges to install the USB driver.
2. Connect the support module to the PC by plugging the USB cable into the port. The PC will find and install the new hardware.
 3. *On the CE unit*, select **Start → Settings → Control Panel**
 4. Double-click on **Communications** to access the communication properties.
 5. Select the **PC Connection** tab.
 6. The connection type should read '*USB Connection*'. If not, click the **Change Connection...** button and select **USB Connection**.
 7. Click **OK** to accept.
 8. Click **OK** to close window.
 9. Slip datalogger into the cradle, pressing down until the unit locks into place. The unit must be locked into the support module for connection (and recharging) to be made.
 10. Proceed to **ActiveSync** directions.

b. Serial Clip (Serial port) setup

1. Connect the datalogger to a 9-pin serial port (COM port) on the PC via the serial clip and null modem cable.
2. *On the CE unit*, select **Start → Settings → Control Panel**
3. Double-click on **Communications** to access the communication properties.
4. Select the **PC Connection** tab.
5. The connection type should read '*COM1 11520*'. If not, click the **Change Connection...** button and select **COM1 11520**.
6. Click **OK** to accept.
7. Click **OK** to close window.
8. Proceed to **ActiveSync** directions.

NOTE: When switching between various methods of connection, **DO NOT** forget to change the communication settings in the unit. Otherwise the datalogger will be unable to talk to the PC. Also, there is more than one COM speed available to communicate to the PC if needed.

Refer to **Section III, part A** for downloading data.

c. ActiveSync

Prior to any software installation on the unit, Microsoft's ActiveSync program must be installed on the PC. This program enables the PC to communicate with the GeoXM (or other mobile unit). Administrative privileges are required to install ActiveSync on a Windows 2000 computer. This program can be downloaded from Microsoft's website for free.

Once installed, the datalogger can now be connected to the PC.

1. *On the PC*, select **Start → Program Files → Microsoft ActiveSync**.
2. Depending on the connection used (USB or COM), you may need to adjust the connection settings in ActiveSync. Select **View → Connection Settings**. This will show the types of connections ActiveSync can look for and use.
3. As a default, all the options available are selected. It may be necessary to only select the communication option (USB or COM) that the CE unit is using. This is especially

important where multiple mobile units or dataloggers are connected to the same PC. ActiveSync can create conflicts when the user is trying to access other devices.

4. Minimize **ActiveSync** by single-clicking on the staple in the upper right-hand corner. This will put a gray ActiveSync icon in the Taskbar in the lower right-hand corner of Windows. ActiveSync must be open **prior** to connecting to the CE unit.

Initialize connection from the CE unit.

5. Connect datalogger to the PC using either the support module or the serial clip. When using the support module, the unit will automatically try to connect to the PC when inserted into the cradle. The unit will beep when connected. Skip to 7 if connected.
6. *On the CE unit*, select **Start → Programs → Communication → Connect to Desktop**. It is best to let the CE unit initialize the connection. Connecting from the PC has generally proven unsuccessful.
7. *On the PC*, once a connection has been established, select **NO** to setting up a *Partnership*. It is recommended that the datalogger be used in the *Guest* capacity only.
8. The file structure of the datalogger can now be viewed through **Windows Explorer** (not Internet Explorer). The datalogger is listed like a separate drive, but with the name of **Mobile**.
9. When disconnecting the datalogger from the PC, it is best to terminate the connection **from** the CE unit. *On the CE unit*, double-click the network icon (lower right, in the taskbar) and select **Disconnect**.

Tech Tips: Communications Troubleshooting -- Some users have experienced connection problems between the CE unit and the PC using ActiveSync. The following is a list of suggestions users can try to obtain a connection. The user manual, online help or the web may also offer suggestions.

- #2 When using the support module USB connection for the first time in a profile other than the profile the USB was installed under, the PC may “attempt” a reinstall of the USB. If no administrative privileges are present, a message stating such will be displayed. If connecting with ActiveSync, the mobile unit will generally make a connection anyway as it had been installed and used previously. Ignore the error message and click **OK**.
- #3 Communication will only be established when initiating the connection from the CE unit. This can be done by either inserting the unit into the cradle and having it automatically attempt connection or by manually initiate it with Connect to Desktop. Do not connect with the PC and do not use the ActiveSync program found on the CE unit.
- #4 IF no connection is present and the network icon is visible in the taskbar, the unit will need to be “disconnected” before any attempt is made to reconnect to the PC.
- #5 Check the Connection Settings in the CE unit to make sure the correct method (USB or COM) is being used.
- #6 Manage the Connection Settings options in ActiveSync so that only one method is being used to connect to the unit.
- #7 Install the latest version of ActiveSync.
- #8 Perform a Hard Reset on the CE unit.
- #9 There may be an conflict if multiple mobile units are connected to one machine and/or using ActiveSync or another synchronization program. It may be necessary to physically disconnect the additional mobile units during the time the GPS unit is connected.
- #10 If ActiveSync is still showing a connection (green circle icon), but the unit is not connected,

ActiveSync will need to be “disconnected” before a connection can be setup. This can be done in the Connection Settings in ActiveSync by unchecking all of the connection options. This will make the ActiveSync icon in the PC taskbar show disconnected . Setup the proper Connection Settings and reinitialize connection from the CE unit.

2. Operating System and Installation of Software

With the advent of handheld PC technology, several varieties of Windows CE Operating Systems (OS) are available for various handhelds. Two close relatives are Windows CE 3.x and Windows for Pocket PC (similar to the relationship between Windows NT, 2000 and XP). These are similar, yet separate systems and vary on what programs they can support. Windows for Pocket PC (which iPAQ and Dell operate) comes with Pocket Excel and Pocket Word. Windows CE lacks these programs, but supports Terrasync. Both systems can support ArcPad.

Trimble has redesigned their GPS dataloggers to operate in the Windows CE environment (Terrasync requires CE). This not only allows the unit to operate in a GPS capacity, but also allows the flexibility of a handheld PC in accommodating other programs, like the GIS oriented ArcPad. This environment requires the user to install software on the datalogger, just like a normal PC. Some software titles are dependent on the type of OS installed.

The GeoXM system:

Windows CE 3.0 OS revision 1.10.00 GPS Firmware version 1.03

Software installation onto the CE unit will require Administrative privileges for a Windows 2000 PC. Many titles come with an installation key in order to install the software, as well as apply any updates. Some are also requiring online registration of the software in order to acquire the access code for installation.

a. *The Soft Reset*

New program installation or OS problems may require a Soft Reset to be performed. This stops all running programs, but maintains files in the RAM.

1. Press the power button and hold down for about 5 seconds.
2. The unit will perform a reboot. The phrase *Soft Reset* will be visible on the screen.

b. *The Hard Reset*

Should problems persist (the unit become unresponsive or stop functioning correctly), it may be necessary to perform a *Hard Reset* on the CE unit. Files in RAM are erased and the OS is reloaded. To initiate the reset:

1. Press the power button and hold down for about 15-20 seconds.
2. The unit will reboot (as in Soft Reset), but keep holding the power button until the unit turns off.
3. Press the power button again to turn the unit on. The unit will reboot and OS install from the last backup.

Tech Tip #11 The CE unit contains **two** sections of internal storage space, *Main Memory* and *Disk*.

On installation of most software, it is recommended that the software be installed in the **Disk** portion of the CE unit. The reason is that the *Disk* portion can be backed up. Should the unit stop functioning normally and need to be reset, the OS (including installed programs and data) will be restored from the last backup. On a hard reset, the *Main Memory* is cleared and anything stored in there is lost.

#12 If the GeoExplorer XM will not power up and/or the screen has nothing but a white background displayed, the unit will need to have a *Hard Reset* performed on it.

#13 There are **two** separate **My Documents** directories located on the XM unit. One exists in *Main Memory* and the other in *Disk*. TerraSync GPS data should be stored in **Disk/My Documents/TerraSync**. Any other data (like ArcPad shapefiles) can go in a separate folder under **Disk/My Documents**.

3. TerraSync – Setup and Operation

This document will focus on the primary functions of the TerraSync program. For more detailed information, consult the online help or the user manual. *If using the GeoXM/XT with ArcPad, refer to Section VI, part A.* There are five main sections (or *views*) within TerraSync.

a. Setup

Setup is where the GPS system settings are managed. This includes coordinate system and accuracy controls (PDOP).

Options -- Connecting or disconnecting to the GPS receiver or external accessories.

Logging Settings -- Logging parameters for a GPS file. Feature settings can also be modified in here *if* a file is open (active).

GPS Settings -- Critical settings for data collection, includes PDOP, SNR and Elevation masks. Settings may need to be adjusted in situations where satellite acquisition is difficult, but this will affect accuracy. For Region 2, recommended settings are:

Max PDOP = 6

Min SNR = 6

Min Elevation = 15 degrees

Real-time Settings -- Set if desiring to receive some form of Real-Time correction (i.e. WAAS).

Coordinate System -- A wide variety of coordinate systems and datums are available for use. The user should set this in accordance to the needs of the project. This affects display only. **NOTE: NADCON Conus is available as a datum. If desiring a reading in NAD27, it is best to use NADCON Conus as the selection and not NAD27. This applies to both UTM and Lat/Long readings.**

Units -- Various units of measure, including the type of Lat/Long format. Again, affects display only.

External Sensors -- Settings for external equipment.

b. Status

This view shows the current status of the GPS operations and environment. Logging settings

can also be modified within this view.

Skyplot -- The current configuration of satellites visible to the datalogger. PDOP and current location are visible in this view.

Satellite Info -- Status of individual satellites.

Receiver -- Receiver information.

Real-time -- Information on Real-time if it is enabled.

Plan -- Once an Almanac has been loaded, this enables the user to, based on the current location, to view the projected PDOP and satellites available up to a 12 hour period. An Almanac is downloaded from the satellites automatically.

Sensor -- Information on any attached sensors.

Comms -- Status of the COM ports. The Geo XM has two.

UTC time -- The current Universal Time Coordinated (UTC) time. Also known as Greenwich Mean Time (GMT) or Zulu time. The San Juan NF is six hours (-6) behind UTC during Mountain Daylight Savings and seven hours (-7) during Mountain Standard time.

About -- Version information about TerraSync.

c. *Data*

This is the data management view where files are created, manipulated or deleted. This view also contains the Data Dictionary Editor where all dictionaries (except Trimble's *Generic* dictionary) can be modified.

New File -- The creation of a new Rover file.

Collect features -- This is for collecting new features.

Update features -- This is for updating existing features.

Options -- Options in how features are collected.

Logging interval -- Another place to set the logging interval for the features within the data dictionary being used.

Log Now/Later -- Choose whether feature logging begins immediately or on pause (easier for entering attributes).

Repeat -- The next feature created will have the attributes of the previous feature.

Segment line -- Creates a new line that is connected to the previous line.

Continue -- Continues the collection of a line that was, for example, interrupted by the collection of a point.

Close -- Closes the feature.

Create -- Creates a new feature for collection.

Existing File -- Opens an existing file.

File Manager - Copy, Delete, Rename, etc. the various file types supported by TerraSync. The Data Dictionary Editor is also found here allowing the data dictionaries available in the unit to be modified. New dictionaries can be created here.

d. *Map*

This view is a mini-GIS environment. The view allows the user to see their location in relation to other features. Some on-screen digitizing is available. Background layers can be

used as well as the setting of navigational targets.

Tools (icons) -- Select, Zoom, Pan, Digitize, Measure. Very basic GIS type tools for use within the *Map* view.

Options -- Various operations that can be performed within the *Map* view.

NavTargets -- Setting and clearing of targets for navigation. This can also be performed in the *Data* view.

Enter Coordinates -- Allows the manual entering of coordinates of a point feature. Refer to **Waypoints and Navigation** for this process.

Layers -- Options to adjust various map display features.

Background File -- Allows the user to load **one** (1) background file at a time for display. This file can be another GPS file or an image (like a digital orthoquad). The coordinate system on the unit **must** match the image's coordinate system or the image will not be displayed. All background files must be loaded into the **Disk/My Documents/TerraSync** portion of the CE unit. TerraSync 2.4 supports MrSID, JPEG, TIFF images. The San Juan NF has digital topographic and orthoquads in MrSID format.

GPS Trail -- A trail of the last 60 positions calculated (not collected) by the receiver.

Layer Formatting -- Layer color can be set here.

e. *Navigation*

This view displays navigational information to the user like time, distance, bearing, etc. from their intended target. Navigational targets are set in either the *Data* or *Map* views.

Options -- Settings for the display of navigation features.

Heading Options -- There are four heading options (out of a possible 12) displaying the status of the user's approach to the navigational target. A turn arrow will show the direction of the target in relation to the direction of travel.

4. Waypoints and Navigation

There are no longer Waypoints, as such, in the TerraSync environment. Trimble has done away with Waypoints as a GPS feature. This means that the creation of features for navigational purposes, whether GPS'd or manually entered, are now done within a standard Rover file. Any waypoint files generated in Pathfinder Office and transferred to the CE unit are converted into Rover files. GIS data can also be imported (see **Section III, part E.**)

a. *Manually Entering a Coordinate in TerraSync*

1. In the *Data* view, create a new file or open an existing one.
2. **IF** the receiver is connected, select **Options → Log Later**. If disconnected, go to step 3.
3. Switch to the *Map* view and select the **Digitize** mode by clicking the drop-down next to the black selection arrow.
4. If the receiver is not connected, load a background file by selecting **Layer → Background File** and select one from the list. (One must already be loaded onto the *Disk*.) This will help setup coordinate space. *Remember*, the projection display in the CE unit and the image **must** match.

5. Click the **Create Feature** button (● blue dot) and select a point feature to create (providing a point feature is available in the data dictionary being used.) This will switch back to the *Data* view with the feature ready for data entry.
6. Enter the attributes desired using the digital keyboard. **DO NOT** click *OK*, but switch back to the *Map* view.
7. Select **Options** → *Enter Coordinates*.
8. Enter the desired coordinates and click **OK**.
9. Click the **Stop** button (■ red square). This will commit and store the feature in the Rover file.

B. GeoExplorer 3/3c

1. Communication with the PC

There are two methods of communication between the datalogger and the PC. The primary method is through the use of the cradle/support module. The other is the optional serial clip. Both use the 9-pin null modem cable.

a. Support Module setup

1. Connect the support module to the PC.
2. Place the datalogger into the cradle.
3. *On the datalogger*, select **SYS** (button) → **Setup** (tab) → **Configurations** → **Data Transfer: Support Module**.

b. Serial Clip setup

1. Attach the serial clip to the datalogger
2. Using a 9-pin null modem cable, connect the datalogger to the PC.
3. *On the datalogger*, select **SYS** (button) → **Setup** (tab) → **Configurations** → **Data Transfer: Serial Clip**.

NOTE: When switching between various methods of connection, **DO NOT** forget to change the communication settings in the unit. Otherwise the datalogger will be unable to talk to the PC.

Refer to **Section III, part A** for downloading data.

2. Asset Surveyor -- Setup and Operation

Dan Greene – 10/19/2001, modified by Mark Roper 5/30/2002

Black On/Off key

Power down or on
Check Power and Memory (SYS KEY)

Other Keys

SYS – check for satellites, power, setup, coordinate system for navigation, etc
DATA – enter point, line or polygon data
LOG – pause or start logging data

NAV – navigate to a known location
CLOSE – close a menu
OPTION – options off of sys, data or nav
 FN with **OPTION** = more options
ARROWS – up, down, right, left for menus

Coordinate system for GPS Unit

The user should select a coordinate system they are most comfortable with for display purposes. If there are several units assigned to a particular project/resource unit, then all should be set to the same coordinate system. This should be decided by the project or resource unit leader. It does not matter what coordinate system is set on the GPS as it always collects data using Geographic (Lat/Long) WGS84. The user will convert the data into a desired projection using the export function in Pathfinder Office.

***NOTE:** The coordinate system can make a difference when entering waypoints or referencing a map. The user needs to keep in mind the coordinate's source when manually entering a point. For example, USGS Topographic maps generally have Geographic NAD27 grid tics on them.*

Coordinate System: LAT/LONG
Datum: NAD27 Conus
Altitude Reference: MSL
Altitude Units: FEET

If you choose to use UTM rather than Latitude and Longitude, refer to **Appendix C**.

Satellites

SYS key – tracking for GPS when solid black fill. This is dependant on the GPS setting of PDOP and SNR best set with the bar graph. The higher the PDOP number the worse the spatial accuracy. When changing settings on the bar, you can see that PDOP and SNR are related and both change. Region 2 standards recommend a PDOP of 6 or less, but that is not always possible. If this accuracy is not obtainable, any adjust should be documented. The message on the screen will let you know if there are not enough satellites based on your settings. Preplanning is a good way to determine when the optimum time to collect will occur based on Specified settings.

SYS Function Key

FN OPTION for main menu (setup, config)

DATA

Log between features OFF
Log PPRT data NO
Log velocities NO
Antenna height 1 meter or 3.28 feet (about waist high)

Allow GPS update NO
Warning distance N/A
Filename prefix R (default is R but you could set to your initials)

UNITS

Set the Units to what is practical for finding your way around on the ground.
These are not related to what you will export for GIS.

Distance Feet
Area Acres
Velocity Feet/Second
Angle Degrees
North Reference True
Declination Auto (the unit figures it out)

GPS

PDOP Mask 6.0 using the custom settings. However if you can't get Satellites you may need to use a higher number. 6 is a good starting point but you can change it on the fly. If the recorder stops reading you can keep it on the GPS screen and lower or raise as you are recording data
SNR Mask 6.0 using the custom setting. This dictates that a satellite's signal will not be used if less than 6.0.
Elev Mask 15 degrees or default with sliding bar
Min Satellites 4

NOTE: Remember, changing these values affects accuracy and data quality.

COORDINATES

See above recommendation for Latitude/Longitude
Refer to the Export Settings for UTM recommendations.

FORMAT

Language English
Offset Horz/Verticle
Degrees DD MM SS
Time 24 hr
Time Zone (-7 without daylight savings, -6 daylight savings)
7 hours less than Greenwich time
Coordinate Order Lat/Long

DATA Function Key

This is for entering new data. Before entering data check to see if you have enough satellites.

Files are used to store data sets. A set of GPS data is a collection of lines, points and polygons (areas). You may use the LOG key to switch between points or different features. As an alternative, you may use different files for different feature types.

Delete Files (All files are retained unless you specifically delete them)
Option, Delete Files

Create New File
Point
Line
Area

The point, line and area are default types. If you use the data dictionary (preferably using Pathfinder Office, then you can establish your own feature types that also have data collection fields. This is very easy to do and when done you can easily upload the files from the PC to the hand held unit. See the video on CD for an excellent tutorial on how to do this. Data dictionaries should be set up before going to the field.

3. Waypoints and Navigation

The GeoExplorer 3 and 3c differ in the fact that the 3c cannot upload data files for navigation. It can only use waypoint files. Refer to **Section III, part E** on importing data for navigation.

III. Pathfinder Office

A. Data Transfer

Data Transfer of Trimble GPS files can be accomplished by running the Data Transfer program.

1. GeoExplorer XM/XT

- a. Start ActiveSync on the PC if it is not already running. **Start → Program Files → Microsoft ActiveSync.**
- b. Connect datalogger to ActiveSync.
- c. *In Pathfinder Office*, select **Utilities → Data Transfer.**
- d. The program will try to automatically connect with the unit. It may be necessary to select the correct datalogger option, **GPSdatalogger on Windows CE.**
- e. Click **Add → Data File** (for GPS Rover files).
- f. Highlight the desired files and click **Open.**
- g. Click **Transfer All.**

2. GeoExplorer 3/3c

Data transfer of Trimble GPS files can be accomplished by running the Data Transfer program from within Pathfinder Office or by using the stand-alone program found in **Start → Program Files → GPS Pathfinder Office → Data Transfer.**

To transfer GPS Rover files to the PC:

- a. Select **Utilities → Data Transfer.**
- b. The program will try to automatically connect with the unit. Depending on the GPS

- receiver, it may be necessary to select to proper device.
- c. Click **Add** → **Data File** (for GPS Rover files).
- d. Highlight desired files and click **Open**.
- e. Click **Transfer All**.

This method is also used to transfer Data Dictionaries, Waypoints, Configuration files, etc. to and from the GPS receiver. Simply select the desired file type using the **Add** button and the directionality tab **Send/Receive**.

B. Differential Correction

Differential Correction of GPS files can be accomplished by running the Differential Correction program from within Pathfinder Office or by using the stand-alone program found in **Start** → **Program Files** → **GPS Pathfinder Office** → **Differential Correction**. To correct GPS Rover files:

1. Select **Utilities** → **Differential Correction**.
2. Recently downloaded files will be visible in the window. If the desired files are not, select the files to be corrected by clicking on **Browse**, navigate to the proper location, highlight and click **Open**.
3. **After** selecting the Rover files to be corrected in the Differential Correction window, click **Internet Search** to bring up Internet Search window.
4. **If** the desired **Base Data Provider** is available from the pull down menu, select the provider and click **OK**. Skip to 7. (**For San Juan Public Lands users, refer to the Base Station Map in Appendix B.**) Base files are good to within 500 kilometers (310 miles).
5. **If** the desired base station is not visible in the window, click **New**.
6. Selecting a provider:
 - a. If you have never copied provider list from Trimble:
 1. Select **copy most up-to-date list** and click **OK**.
 2. Click **Yes**.
 3. Select provider and click **OK**.
 - b. If you have current provider list:
 1. Select **from current list** and click **OK**.
 2. Select provider and click **OK**.
7. Click **Yes**. The program begins downloading base files to the directory you have set up for the project.
8. Click **OK**. Do not adjust the Reference Position unless it differs from the website.
9. Click **OK**. The files will now be visible in the base file window.
10. Click **OK** to start correcting the Rover files.
11. Click **Close** to finish. You may need to review the Log file if there were problems.

NOTE: *If needed, see Appendix F for instructions on using FTP to download base files.*

C. Editing

Edit GPS files in Pathfinder Office to eliminate unwanted features and positions (vertices) first by removing spikes, position strays and other errors in features.

1. To eliminate a feature:

- a. Right-click on the feature → **Delete** → *Yes*.
 - b. **Not In Feature** positions will be visible where the delete position was. Remove these if desired by using the **Delete Block** tool on the tool bar. It is recommended that any feature layers be turned off before using this tool or you might delete additional positions.
2. To eliminate unwanted positions:
 - a. Right-click on the position (vertex) to be deleted and select **Delete Position**. To remove a group of positions, use the **Delete Block** tool.
 - b. **Save often**. This will minimize the need to edit these errors in GIS making the data a little easier to manage.
 - c. A deleted position or feature can be undeleted if needed.
 3. Visually check the data to ensure it represents what was mapped in the field as much as possible. Any major discrepancies should be documented. The intent is to have a file as clean as possible prior to being loaded into a GIS.

D. Exporting – Converting Data into GIS

If your intent is to gather GIS data, setting up your export properly is one of the most important things to do. You can control the resulting GIS projection from the export regardless of what projection was used on the handheld unit. Most GPS receivers use WGS84 geographic coordinates. If the export projection does not match the GIS, then the data will not be located in the right part of the world.

1. Open the **Export Utility** in Pathfinder Office by selecting **Utilities** → **Export** from the main menu. This will open the **Export** window.
2. Select the file(s) to export by using the **Browse** button.
3. If needed, select the **Output Folder** by using the **Browse** button. The **Output Folder** is the destination of where you want the exported files to go. This folder typically has been setup during the project selection at the Pathfinder Office startup.
4. Choose an **Export Format**: *Arcview Shapefile* (preferred), *ArcInfo* or *ASCII*. (It is highly recommended that copies of these formats be used instead of the samples. Make a copy of a setup using *New Setup*.)
5. Set the export settings to the Region 2 standard by clicking **Properties**.
 - a. Coordinate System
 1. Check **Use Export Properties** and click **Change**.

System:	UTM
Zone:	13 North
Datum:	NADCON (Conus)
Units:	Meters
 2. If using Altitude reference (relevant for XYZ in 3D use), set to **MSL, Other** → **Geoid99 (Conus)**
 3. Export coordinates as XY. Only use XYZ for 3D application.

NOTE: *NADCON (Conus)* should be used when converting GPS (WGS84/NAD83) data to the *NAD27 datum*. DO NOT use the *NAD27 (Conus)* setting as it does not use the correct transformation algorithm.

b. Position Filter

1. Minimum Satellites set to **3D (4 or more SVs)**
2. Maximum PDOP set to **ALL**. (PDOP standard is 6 and should be set in the unit. Sometimes this number is adjusted by the user if satellite acquisition is difficult.)
3. Everything except **UNCORRECTED** is checked as default. If you process uncorrected data, then check uncorrected.

c. Units

1. Check **Use Export Units**. Set to **Meters, square meters and meters per Second**.

d. Attributes (personal preference)

1. Date Recorded
2. Data file Name
3. PDOP
4. Receiver Type

e. Output

1. Combine all input files and output to the export is checked.
2. Leave as windows files.

6. Once the options have been set, click **OK**. The settings for these formats will remain saved unless manually changed by another user. On PCs with multiple user profiles, these setting may differ from profile to profile. It is recommended to confirm the settings prior to running the export utility.
7. Check to ensure the correct settings appear under the **Export Setup**. Click **OK** to export. The message box should say **X# features exported**.

***NOTE:** If you inadvertently select points on the GPS unit when you intended to collect lines, you can choose to export each individual GPS reading.*

8. Read **Export Completed** window to check for a successful export. If there is an error in the export process review the log file by clicking on **More Details**. A common error results from trying to export files with mismatched data dictionaries. To resolve this, export the files with different dictionaries separately.
9. Click **Close**. Depending on how many exports are performed, it may be necessary to put files into multiple folders to avoid overwriting files. Export creates files based on feature name.

Tech Tip #14 You can export multiple files together.

#15 You can continue the ID increment from the previous session.

#16 Files with different data dictionaries will need to be exported separately.

E. Importing – Converting GIS Data into GPS for Field Use

1. GeoExplorer 3 & Geo XM/XT

- a. GIS data can be in Shapefile or Waypoint format prior to importing.

- b. In **Pathfinder Office**, select from the main menu **Utilities → Import**.
- c. Click **Browse** to locate and select the file to import.
- d. Select the **Import Setup** for Arcview Shapefile (recommend make a copy of the setup and edit the copy).
- e. Set coordinate system properties if necessary.
 - System: UTM**
 - Zone: 13 North**
 - Datum: NADCON(Conus)**
 - Units: Meters**
- f. Click **OK**. The file created will have an **.imp** extension. This can now be transferred using **Data Transfer**.
- g. Select **Utilities → Data Transfer**.
- h. Once connected, select the **Send** tab to transfer the file to the GPS unit.
- i. Click **Add → Data File**.
- j. Highlight desired files and click **Open**.
- k. Click **Transfer All**.

2. GeoExplorer 3c

Since the Geoxplorer 3c lacks the ability to upload data files, a user desiring to take data back out into the field must convert a shapefile (**.shp**) into a waypoint file (**.wpt**) somehow. The following is probably the easiest method to use. Refer to **Appendix I** for two other methods.

a. The Semi-Manual Method

1. GIS data should be in Shapefile format prior to importing.
2. In **Pathfinder Office**, select from the main menu **Utilities → Import**.
3. Click **Browse** to locate and select the shapefile to import.
4. Select the **Import Setup** for Arcview Shapefile (recommend make a copy of the setup and edit the copy).
5. Set coordinate system properties if necessary. For SJNF data, use:
 - System: UTM**
 - Zone: 13 North**
 - Datum: NADCON(Conus)**
 - Units: Meters**
6. Click **OK**. The file created will have an **.imp** extension.
7. Open the new import file using **File → Open**. The file should now be visible in the map window. *It is recommended that the **Feature Properties** and **Position Properties** windows are visible.*
8. In the Main Menu, select **File → Waypoints → New** to create a new waypoint (**.wpt**) file. Give a new name and location for the waypoint file. Click **OK**.
9. In the **Waypoint Properties** window, click **Create**.
10. Check the box next to **Pick From Map**.
11. Using the black selection arrow, select one of the feature points of the imported file. A new waypoint should now show in the Waypoint window and the feature should have a square around it. Click **Save** to save the point. Repeat the create process as desired. **NOTE: You can view the **Feature Properties** to rename the new waypoint to something meaningful.**

12. When finished, click *Close*.
13. Click **File** → **Waypoints** → *Close*.
14. You can now connect to the datalogger and transfer the *.wpt* file.

IV. Garmin Receivers

A. Setup and Operation

NOTE: Different models have different levels of precision. A number of the Garmin GPS units on the San Juan National Forest are GPS12 models. There may be a precision issue with these units compared to other models and may yield slightly different results when used with Garmin GIS utilities.

Due to the wide variety of Garmin units available on the market, it is impractical to describe each unit's usage in this document. Refer to the unit's reference manual for detailed instructions.

B. Downloading – Converting GPS Data into GIS

1. Using the DNR-Garmin Extension for Arcview

DISCLAIMER: *It is not recommended that Garmin data be used as a substitute for resource grade GPS work for inclusion into the corporate GIS. The quality of Garmin data can vary depending on the units used.*

a. Installation

Data transfer of waypoints and tracks from a Garmin hand-held unit can be accomplished through the use of the DNR Garmin Extension for Arcview. This is a free downloadable program available at the following address. *NOTE: for USFS users, installation of this program may require Administrative privileges.*

<http://www.dnr.state.mn.us/mis/gis/tools/Arcview/extensions/DNRGarmin/DNRGarmin.html>

This program utilizes NADCON in transforming WGS84 coordinates into NAD27. However, if coordinate shifting occurs on either download from or upload to the GPS unit, it may be necessary to reinstall the DNR program. A “clean” install is required for DNR to operate correctly. *NOTE: Administrative privileges are required.*

1. Uninstall previous version of DNRGarmin. **Start** → **Settings** → **Control Panel** → **Add/Remove Programs**.
2. Highlight DNRGarmin and select **Remove**.
3. In **Windows Explorer**, perform a search on local drives for all files named *dnrgarmin.** If found, remove.
4. Perform a search on local drives for all files named *pcogarmin.** If found, remove.
5. Reinstall DNRGarmin.

b. Usage

1. Connect the Garmin unit to the PC via a download cable.

2. Select **DNR Garmin** → *Set Projection* to confirm the correct projection is set. For the SJNF, it is UTM NAD27 Zone 13.
3. In **Arcview**, activate the extension by selecting **File** → **Extensions** → *DNR Garmin-Arcview*.
4. In the main menu, select **DNR Garmin** → *Open Garmin GPS*. This will open a separate program that will automatically connect to the unit to Arcview.
5. Download POINTS
 - a. Select **Waypoint** → *Download*.
 - b. Select **File** → **Save To** → **Arcview** → *Shapefile*.
 - c. If a point shapefile exists in the View, select *New Shapefile* (or *Append to Existing Shapefile*) → **name of shapefile**.
6. Download LINES or AREAS
 - a. Select **Track (or Route)** → *Download*.
 - b. Select **File** → **Save To** → **Arcview** → **Shapefile** → *Point/Line/Poly*.
 - c. Click **OK**.
 - d. If a line or polygon shapefile exists in the View, select *New Shapefile* (or *Append to Existing Shapefile*) → **name of shapefile**.

NOTE: An ArcMap version of DNRGarmin is currently being tested.

2. Using the GPSi Extension for ArcMap

Data transfer of waypoints and tracks from a Garmin hand-held unit can also be accomplished through the use of the GPSi Extension for ArcMap (which does NOT support Polygons at this time). This is a free downloadable tool available at the following address. *NOTE: There is an installation process that you will need to go through to make this work in ArcMap. Refer to the documentation contained in the download.*

<http://arcscripsts.esri.com> and search for GPSi.

WARNING: *GPSi version 0.1 maintains the shapefile in its Geographic WGS84 coordinates.*

a. Usage

1. Connect the Garmin unit to the PC via a download cable.
2. In **ArcMap**, make sure the **GPS Interface** tool is active. If not, in the **Main Menu**, select **Tools** → **Customize** and check the **GPSi** box.
3. Download POINTS
 - a. Select **GPS Interface** → **Waypoints** → *Download Waypoints*.
 - b. Checkmark the waypoints for downloading or select *All*. Click **Save**.
 - c. Browse to the location you want to store the new file, name it and click **Save**.
The new shapefile is placed in the dataframe.
4. Download LINES
 - a. Select **GPS Interface** → **Tracks** → *Download Tracks*.
 - b. Checkmark the tracks for downloading or select *All*. Click **Save**.
 - c. Browse to the location you want to store the new file, name it and click **Save**.
The new shapefile is placed in the dataframe.

3. Using Waypoint+

Waypoint+ is a stand-alone utility that allows the downloading of waypoints, tracks and routes from Garmin units. Coordinates are downloaded in Geographic WGS84, decimal degrees and can be stored in a comma-delimited format. There are several ways to bring this into GIS, **Section VII, part A** for ArcMap or **Appendix H** for ArcInfo. The program can be downloaded from the following address. Refer to the program's help section for operational instructions.

<http://www.tapr.org/~kh2z/Waypoint/>

WARNING: *Waypoint+ maintains the data in Geographic WGS84 coordinates.*

4. Using GPS Utility

GPS Utility is a stand-alone utility that allows the downloading of waypoints, tracks and routes from Garmin, Magellan and several other varieties of GPS units. Coordinates are downloaded in Geographic WGS84 and can be saved in several formats, including shapefile. The program can be downloaded from the following address. Refer to the programs help section for operational instructions.

<http://www.gpsu.co.uk/>

C. Uploading – Converting GIS Data into GPS for Field Use

1. Using the DNR Extension for Arcview

- a. Connect the Garmin unit to the PC via a download cable.
- b. In **Arcview**, activate the extension by selecting **File → Extensions → DNR Garmin-Arcview**.
- c. In the main menu, select **DNR Garmin → Open Garmin GPS**. This will open a separate program that will automatically connect to the unit to Arcview.
 1. Upload POINTS
 - a. Select **File → Load From → Arcview → Theme**. Make sure the theme containing the points to be transferred is active in the view window.
 - b. Select a unique field (ex. **ID**) that is a number or text.
 - c. Select a comment text field, usually a description or name of the point. Click **OK**. DNR will read **loaded X# of waypoints** at the bottom of the window.
 - d. Select **Waypoint → Upload**. This will transfer the points to the Garmin.
 - e. Click **OK**.
 2. Upload LINES or AREAS
 - a. Select **File → Load From → Arcview → Theme**. Make sure the theme containing the points to be transferred is active in the view window.
 - b. Select a unique field (ex. **ID**) that is a number or text.
 - c. Select a comment text field, usually a description or name of the point. Click **OK**. DNR will read **loaded X#** at the bottom of the window.
 - d. Select **Track → Upload**. This will transfer the points to the Garmin.
 - e. Click **OK**.

NOTE: *An ArcMap version of DNRGarmin is currently being tested.*

2. Using the GPSi Extension for ArcMap

WARNING: *It appears that uploading to a Garmin using this extension is not as simple as downloading. The shapefile must contain the three fields **Waypoint**, **Symbol**, and **Altitude** and all must be capitalized. Even then, uploading may be unsuccessful due to errors in formatting.*

- a. The shapefile must be in Geographic WGS84 coordinates prior to uploading. Refer to **Section VII, part A** for this process.
- b. Connect the Garmin unit to the PC via a download cable.
- c. In ArcMap, make sure the GPS Interface tool is active. If not, in the **Main Menu**, select **Tools** → **Customize** and check the GPSi box.
- d. Upload POINTS
 1. Select **GPS Interface** → **Waypoints** → **Send Waypoints to GPS**.
 2. Browse for the newly projected WGS84 shapefile. Click **OK**.
 3. Checkmark the waypoints for downloading or select **All**. Click **Upload**.
- e. Upload LINES
 1. Select **GPS Interface** → **Tracks** → **Send Tracks to GPS**.
 2. Browse for the newly projected WGS84 shapefile. Click **OK**.
 3. Checkmark the tracks for downloading or select **All**. Click **Upload**.

V. Other GPS Receivers

A. Allegro Datalogger

Sally Zwisler – 5/13/2002

1. Setup and Operation

Documents on the use of the Allegro Datalogger and GPS receiver have been prepared by Sally Zwisler and can be found on the server at:

K:\unit\res\gisteam\gps_notes\allegro_user_notes.doc

K:\unit\res\gisteam\gps_notes\allegro_wypts_process.doc

2. Data Transfer

K:\unit\res\gisteam\gps_notes\allegro_user_notes.doc

3. Uploading Waypoints to the Allegro for Navigation.

There are a couple ways to generate comma-delimited waypoint files in WGS84 coordinates from shapefiles for use within the Allegro. The following procedure is probably the fastest and requires Pathfinder Office.

- a. Using Pathfinder's **Import Utility**, follow **Section III, part E** to create an .imp file.
- b. Open the **Export Utility** in Pathfinder Office by selecting **Utilities** → **Export** from the main menu.

- c. Select the **.imp** file to export by using the *Browse* button.
- d. If needed, select the **Output Folder** by using the *Browse* button.
- e. Create a new Export format called **WaypntWGS84**. Click **New** → **New Setup** → **Configurable ASCII**. (This will only need to be setup once.)
- f. Click *Properties*.
- g. **Configurable ASCII Tab**
 1. Click *New*. Name it **arcmap** (or **waypoint**).
 2. In the Template Editor Window
 - a. Enter *csv* for the **Output File Extension**.
 - b. Apply to **Points**.
 - c. In the Worksheet Window, add the following.
 {Latitude}{Longitude}{Feature ID}{Attributes}
 - d. Click *OK*.
- h. **Coordinate System Tab**
 1. Check **Use Export Properties** and click *Change*.
 System: **Lat/Long**
 Zone:
 Datum: **WGS84**
 Units: **Meters**
- i. Once the options have been set, click *OK*.
- j. Check to ensure the correct settings appear under the **Export Setup**. Click *OK* to export. The message box should say **X#** features exported.
- k. Read **Export Completed** window to check for a successful export.
- l. Click *Close*. The new **.csv** file generated will contain coordinates in decimal degrees. The table can now be edited in Microsoft Excel to add the necessary fields LandMark PC requires. **WARNING:** *There is an 8-character limit for the name of the .csv file. Any longer, and LandMark PC will not open the file.*
- m. In **Excel** you will see that the longitude value will already have negative sign (-). Arrange data columns into the following order:

<u>latitude</u>	<u>longitude</u>	<u>alt</u>	<u>time</u>	<u>fix</u>	<u>pdop</u>	<u>feature</u>
37.364736	-107.354637	0	00:00:00	0	0	BLAN627_2

(example of data line)

 - a. Insert a – before the longitude if not already present.
 - b. Delete the header line, and all other columns of data.
 - c. Save as a **.csv** file in **Excel**.
- n. Open the **LandMark PC** program on the desktop and bring in the 8 character **.csv** file that you just created.
- o. Export as waypnt file with WGS84 datum. (Under **File** → **Datum** be sure WGS84 is selected.)
- p. Copy waypnt file onto ALLEGRO for waypoint navigating to plot locations.

Another way to generate the .csv file is detailed in the document prepared by Sally Zwisler.

K:\unit\res\gisteam\gps_notes\allegro_wypts_process.doc

B. GPS Receivers for Pocket PC's

Refer to **Section VI** for using a GPS receiver with a Pocket PC and ArcPad.

VI. Using ArcPad

ArcPad is a GIS program that can be run on any device that runs Windows CE or Windows for Pocket PC. The San Juan NF currently has four CE devices that work with GPS receivers; the GeoXM, iPAQ Pocket PC with NavMan receiver, Dell Pocket PC with CruxII receiver and the Allegro Datalogger. Setup for the Allegro is mentioned in **Section V**. This chapter will focus on key program items of ArcPad and recommended GPS settings and is not intended to replace the ArcPad online help.

To fully utilize this equipment, the ActiveSync program must be installed on the host PC. ArcPad must be installed on the PC prior to installing on the CE device.

There are a variety of accessories that can be purchased to increase Pocket PC functionality. For example, external battery packs can increase battery life up to eight (8) times. Various brands of a sleeve GPS receivers may use less power. A completely wireless GPS receiver is also available on the market.

Refer to the following FSWEB intranet sites for additional PDR and ArcPad information.

<http://fswweb.ftcol.wo.fs.fed.us/frs/rangelands/pdr/index.shtml>

http://sandy1.sandy.wo.fs.fed.us/terra_docs/articles/pdr-2.htm

A. GPSCorrect with ArcPad (Geo XM/XT)

1. Setup

- a. GPSCorrect must first be loaded onto the CE unit. *The following settings are automatically set upon installation.*
- b. Start **ArcPad**.
- c. Open the ArcPad **Options** .
- d. **Protocol** Tab
 1. Protocol → **Trimble GPSCorrect**.
 2. GPS → **WGS84** (Do not change this!)
 3. Height is optional.
- e. **GPS** Tab
 1. Port → **COM3**
 2. Baud → **9600**
 3. Parity → **Odd**

2. GPS Settings

- a. In **ArcPad**, click on the GPSCorrect icon.
- b. In **Skyplot**, click the wrench icon.
- c. Uncheck the box next to the slider bar to enter the recommended custom values for Region 2.
Max PDOP = 6
Min SNR = 6
Min Elevation = 15 degrees
- d. Click **OK**. Close GPSCorrect.
- e. In **ArcPad**, open the ArcPad **Options** .

f. **Quality Tab**

1. Select **No Warnings**. The GPS quality is controlled in GPSCorrect.

g. **Capture Tab**

1. Check **Enable Averaging**.
2. **Points** → **60** (variable based on the user's needs). The unit will not collect more than the positions set. When in capture mode, you can save the feature before it has reached the full number of positions averaged. There is a progress indicator on the feature window and in the Geometry Tab of the feature.
3. **Vertices** → set **only if** you want to average vertices for lines/polys.
4. **Streaming Vertices Interval** → **4** (this is variable based on the user's needs). This setting is the logging rate for lines and polygons. In this example, the unit will collect 1 vertex every 4 seconds.

d. **Paths Tab**

1. Set **Default Maps & Data Path** → `|Disk|My Documents|<user created directory>`

*NOTE: It is a good idea to create a folder in the |Disk|My Documents directory for all ArcPad data. If a Hard Reset needs to be done, then data won't be lost. For example:
|Disk|My Documents|arcpad_data*

3. Differential Correction

a. Post-processing: Pathfinder's ShapeCorrect utility

1. Connect the CE unit to **ActiveSync**.
2. Using **Windows Explorer** (not Internet), transfer all GPS shapefiles **AND** the .ssf file created by GPSCorrect to a directory on the PC.
3. Correct the .ssf file like any other Rover file. Refer to **Section III, part B** for the correction process.
4. After the file has been corrected, open the **ShapeCorrect** utility by clicking on **Start** → **Program Files** → **GPS Pathfinder Office** → **ShapeCorrect**.
5. Click on **Browse** and select the shapefiles needing to be corrected.
6. Click **OK**. The shapefile has been adjusted using the corrected positions.

NOTE: This program applies corrections from a corrected GPS file to the shapefile. This changes the original shape file and not a copy.

Tech Tip #17 **IF** correcting POINT shapefiles, the file must contain at least two (2) point features or the shapefile cannot be corrected.

b. Real-time: WAAS Differential (DGPS) collection

1. In GPSCorrect, click on **Skyplot** and switch to **Setup**.
2. Select **Integrated WAAS**.
3. Click **OK**.

B. Stand-alone ArcPad (iPAQ, Axim, Geo XM/XT, etc.)

1. Setup

NOTE: Pocket PC's like iPAQ or Axim generally require the installation of certain files in order

to communicate with the specific GPS receiver being used with ArcPad and/or WAAS. Refer to the Rangelands intranet site or the gps manufacturer's website for further instructions.

Standard NMEA (non-Differential) collection

a. iPAQ 3900 series, Axim X5

1. Open **GPS Setup** from **Programs** or the quick launch in Pocket PC. On access, this will return the CE device GPS setup back to the default NMEA configuration. This is standard, non-differential collection (3D, 2D).
2. Close **GPS Setup**.
3. Start **ArcPad**.
4. Open the ArcPad **Options** .
5. **Protocol** Tab
 - a. Protocol → **NMEA 0183**.
 - b. GPS → **WGS84** (Do not change this!)
 - c. Height is optional.
6. **GPS** Tab
 - a. Port → *iPAQ 3900 series* - **COM 6**, *Axim X5* – **COM8**
 - b. Baud → *iPAQ 3900 series* - **57600**, *Axim X5* – **4800**
 - c. Parity → **None**

b. Geo XM/XT (without GPScorrect)

1. Start **ArcPad**.
2. Open the ArcPad **Options** .
3. **Protocol** Tab
 - a. Protocol → **NMEA 0183**.
 - b. GPS → **WGS84** (Do not change this!)
 - c. Height is optional.
4. **GPS** Tab
 - a. Port → **COM2**
 - b. Baud → **9600**
 - c. Parity → **Odd**

2. GPS Settings

In order to obtain quality GPS data in the field, the following ArcPad settings are recommended.

a. In **ArcPad**, open the ArcPad **Options** .

b. Quality Tab

1. Select **Compulsory Warnings**. This makes any quality masks that are set mandatory. The unit will not use GPS data that does not meet these settings. (**Non-Compulsory Warnings** gives the user the option to accept or reject data that does not meet the desired setting.)
2. Check **Maximum PDOP** → **6**.
3. Check **3D Mode Only**.
4. If **only** DPGS data is desired, check **DGPS Mode Only**. WAAS must be enabled.

c. Capture Tab

1. Check **Enable Averaging**.

2. **Points** → **60** (variable based on the user's needs). The unit will not collect more than the positions set. When in capture mode, you can save the feature before it has reached the full number of positions averaged. There is a progress indicator on the feature window and in the Geometry Tab of the feature.
3. **Vertices** → set **only if** you want to average vertices for lines/polys.
4. **Streaming Vertices Interval** → **4** (this is variable based on the user's needs). This setting is the logging rate for lines and polygons. In this example, the unit will collect 1 vertex every 4 seconds.

d. **Paths Tab**

1. Set **Default Maps & Data Path** → `|Disk|My Documents|<user created directory>`

***NOTE:** It is a good idea to create a folder in the |Disk|My Documents directory for all ArcPad data. If a Hard Reset needs to be done, then data won't be lost. For example:
|Disk|My Documents|arcpad_data*

3. Differential Correction

a. *Post-processing*

Post-processing is not available for stand-alone ArcPad.

b. *Real-time: WAAS Differential (DGPS) collection*

1. Open **GPS Setup** from Programs or the quick launch in CE. On access, this will return the CE device GPS setup back to the default NMEA configuration.
2. Select **Start Configuration** to switch from NMEA to WAAS. Three additional buttons will become active.
3. Select **DGPS Settings** → **WAAS Correction**. This will only need to be enabled once for WAAS.
4. Close GPS Setup. WAAS will remain enabled until **GPS Setup** is accessed again.

***NOTE:** WAAS requires FULL power from the Pocket PC unit. This will reduce battery life 35-40 minutes on a 2-3 hour battery. Also, WAAS DGPS reception can be intermittent. In general, expect to collect both GPS and DGPS data with WAAS enabled, unless the DPGS option is made mandatory in the ArcPad Options.*

C. "The Projection Shift" – WGS84 versus NAD27

Issue: GPS data shifts 12-15 meters from the correct location when using the NAD27 datum.

Basically, this is the same issue that ArcMap has with Project-on-the-fly WGS84 to a NAD27 datum. ArcPad only supports equation-based, and not grid-based (i.e. NADCON), datum transformation methods. This means incoming WGS84 GPS coordinates are being transformed into NAD27 using a different method than how the original data was transformed.

In addition, the NAD27 datum has close to 20 different transformation methods to choose from for North America (i.e. Alaska, Western US, Caribbean, etc.). Theoretically, the correct datum transformation needs to be used depending on the part of the country you're in. ***The first time the NAD27 projection is set in ArcPad, the default transformation for WGS84 to NAD27 is #1530 (top of***

list). This is the reason for the shift in GPS location. **Do not use #1530!**

Solution:

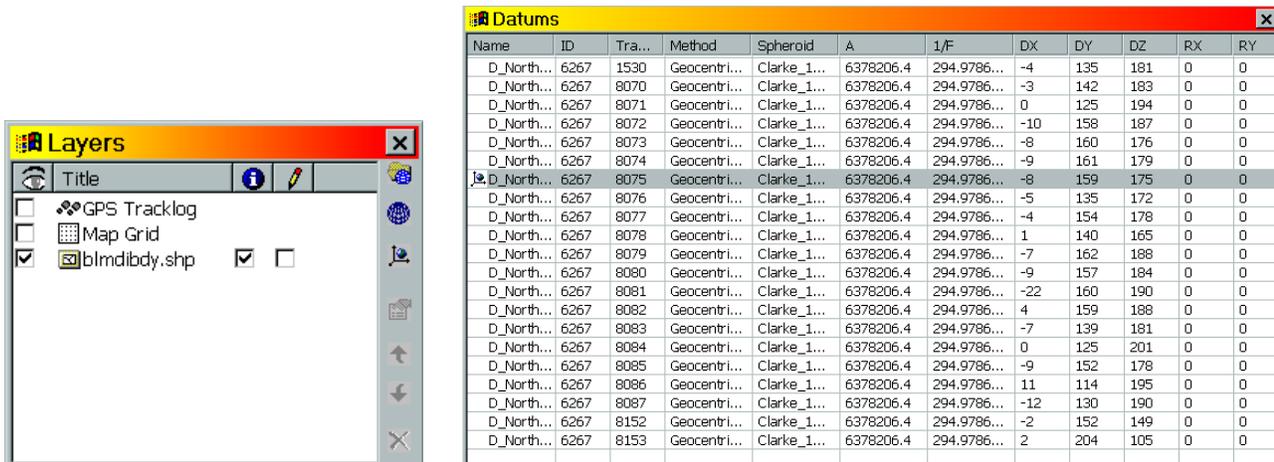
One of two datum methods must be set within the Layer Properties using the datum transformation option . At this time, the recommendations for Region 2 are:

If using GPSCorrect with ArcPad

8075 (-8, 159, 175) /* Mean for **Western** US (CONUS West of Mississippi River) (PE_GT_NAD_1927_TO_WGS_1984_6)

If using Stand-alone ArcPad, real-time uncorrected GPS data

8074 (-9, 161, 179) /* Mean for **Eastern** US (CONUS East of Miss. River including MN, MO, and LA) (PE_GT_NAD_1927_TO_WGS_1984_5)



Name	ID	Tra...	Method	Spheroid	A	1/F	DX	DY	DZ	RX	RY
D_North...	6267	1530	Geocentri...	Clarke_1...	6378206.4	294.9786...	-4	135	181	0	0
D_North...	6267	8070	Geocentri...	Clarke_1...	6378206.4	294.9786...	-3	142	183	0	0
D_North...	6267	8071	Geocentri...	Clarke_1...	6378206.4	294.9786...	0	125	194	0	0
D_North...	6267	8072	Geocentri...	Clarke_1...	6378206.4	294.9786...	-10	158	187	0	0
D_North...	6267	8073	Geocentri...	Clarke_1...	6378206.4	294.9786...	-8	160	176	0	0
D_North...	6267	8074	Geocentri...	Clarke_1...	6378206.4	294.9786...	-9	161	179	0	0
D_North...	6267	8075	Geocentri...	Clarke_1...	6378206.4	294.9786...	-8	159	175	0	0
D_North...	6267	8076	Geocentri...	Clarke_1...	6378206.4	294.9786...	-5	135	172	0	0
D_North...	6267	8077	Geocentri...	Clarke_1...	6378206.4	294.9786...	-4	154	178	0	0
D_North...	6267	8078	Geocentri...	Clarke_1...	6378206.4	294.9786...	1	140	165	0	0
D_North...	6267	8079	Geocentri...	Clarke_1...	6378206.4	294.9786...	-7	162	188	0	0
D_North...	6267	8080	Geocentri...	Clarke_1...	6378206.4	294.9786...	-9	157	184	0	0
D_North...	6267	8081	Geocentri...	Clarke_1...	6378206.4	294.9786...	-22	160	190	0	0
D_North...	6267	8082	Geocentri...	Clarke_1...	6378206.4	294.9786...	4	159	188	0	0
D_North...	6267	8083	Geocentri...	Clarke_1...	6378206.4	294.9786...	-7	139	181	0	0
D_North...	6267	8084	Geocentri...	Clarke_1...	6378206.4	294.9786...	0	125	201	0	0
D_North...	6267	8085	Geocentri...	Clarke_1...	6378206.4	294.9786...	-9	152	178	0	0
D_North...	6267	8086	Geocentri...	Clarke_1...	6378206.4	294.9786...	11	114	195	0	0
D_North...	6267	8087	Geocentri...	Clarke_1...	6378206.4	294.9786...	-12	130	190	0	0
D_North...	6267	8152	Geocentri...	Clarke_1...	6378206.4	294.9786...	-2	152	149	0	0
D_North...	6267	8153	Geocentri...	Clarke_1...	6378206.4	294.9786...	2	204	105	0	0

Another thing that can be done is modify or replace the apDatums.dbf by moving #8074 or #8075 to the top of the D_North_American_1927 list. This file is located in \System directory of the ArcPad installation. *On the GeoXM, this is \Disk\ESRI ArcPad 6.0.2\System.*

Tech Tip #18 Do not use #8074 with GPSCorrect. Upon post-processing, the corrected data will be placed too far south.

#19 To completely eliminate this issue, the NAD83 datum can be used.

D. ArcPad Tips

1. Map Projections

- a. ArcPad’s default map projection is WGS84.
- b. When using SJNF data, a projection file (.prj) must accompany the shapefiles over to the CE device. The projection file tells ArcPad what coordinate system the data resides in. For the San Juan, it is UTM, NAD27 Zone 13.
- c. **IMPORTANT:** When creating a new GPS shapefile in ArcPad, add a projected UTM, NAD27 layer to the map **before** creating the GPS file. This sets the map to the projected layer’s coordinates, in this case UTM. Otherwise, the new GPS shapefile will inherit the

default map projection of WGS84 and require a conversion in order to display with any of the forest data. Another way is to use an existing projected file (with or without data) for the GPS data.

- d. Data collection within Region 2, set the datum transformation  to:
- ArcPad with GPSCorrect -- #8075 (*Western US*)
 - Stand-alone -- #8074 (*Eastern US*)

2. Features

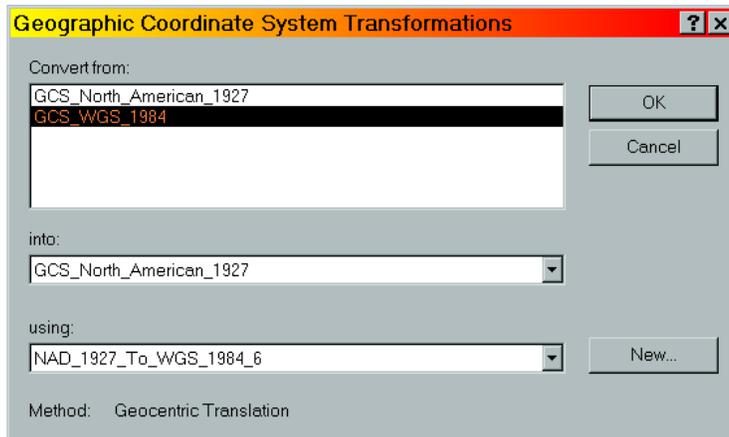
- ArcPad is similar to ArcMap in symbology and functions.
- Multiple layers can be in edit mode simultaneously.
- Three key buttons control the collection of GPS data in the Edit toolbar.  1) The first button on the left captures a Point feature with the GPS. 2) The second captures a single GPS vertex in a Line or Poly. The user initiates this each time a vertex is desired. 3) The third button continuously captures GPS vertices for a Line or Poly at a set interval based on the **Streaming Vertices Interval** value set in ArcPad **Options**. Logging can be toggled on or off by tapping this button.
- The GPS Position Window will show GPS status, satellite information, compass, PDOP, etc. This is independent from GPSCorrect's SkyPlot.
- You can manually enter a coordinate value for a point by creating a new feature (either manually or with the GPS) and editing the feature's location in the **Geography** tab.
- A number of Applets (similar to extensions) are available for download off of ESRI's website.

VII. ArcGIS & Arcview – Additional GPS/GIS Operations

A. ArcGIS (ArcMap, ArcCatalog, ArcToolbox)

1. Project-on-the-Fly WGS84 Data to NAD27 in ArcMap

- In **ArcMap**, set the projection of the dataframe to UTM NAD27.
 - This can be done in an empty dataframe by adding a layer containing a NAD27 projection file to the dataframe.
 - Or, set the dataframe projection by right-clicking on the dataframe name (**Layers**) → **Properties** and select the NAD27 projection from the *Predefined* folder.
- The **Current Coordinate System** window should now have a NAD27 projection listed. Click **OK** to close the properties.
- Add a WGS84 projected layer to the dataframe. If a question box pops up, click **OK**.
- Access the dataframe properties again and select **Transformations...**
- In the **using:** dropdown, select **NAD_1927_To_WGS_1984_6** as shown in the following diagram. This will bring the layer to within approximately one meter of the true location.

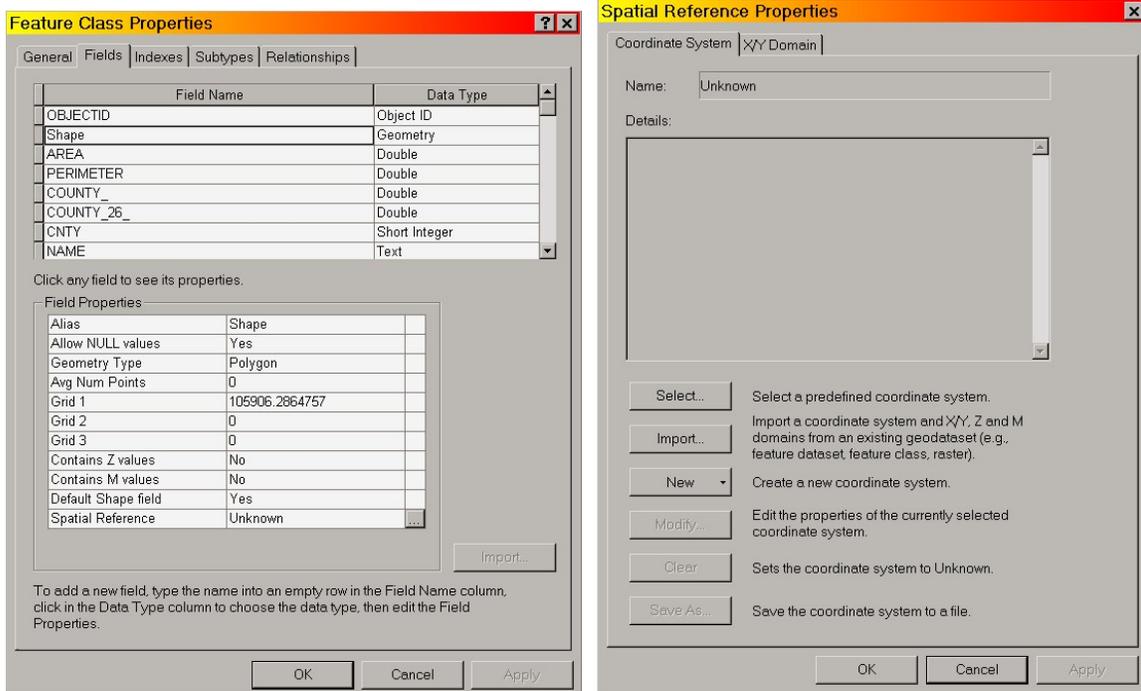


- f. Click **OK**.
- g. Click **OK** to close the dataframe properties.

2. Defining the Projection of a Shapefile or Feature Class

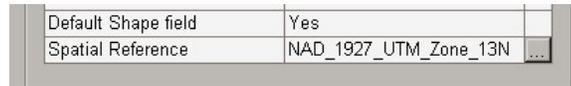
a. ArcCatalog

1. In **ArcCatalog**, right-click on the feature to set the projection for and select **Properties**.
2. Click on the **Fields** tab and, under **Field Name**, single-click on **Shape** to activate the field properties.



3. Click on the **...** **Properties** button located next to **Spatial Reference | Unknown** to open the **Spatial Reference Properties** window.
4. Click on **Select**. Browse to find the desired projection. Click **Add**.

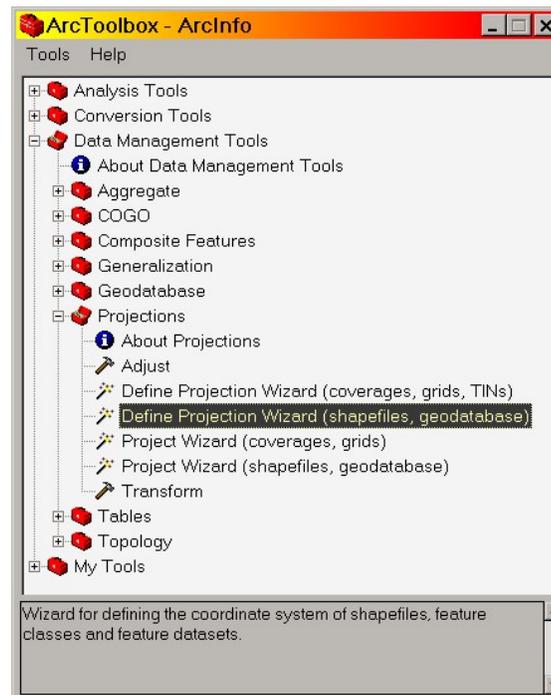
- Click **OK**. You will now notice the Spatial Reference contains the selected projection. In this example, **NAD_1927_UTM_ZONE_13N**. The layer has been projected to the correct coordinates.



- Click **Ok**. Close **ArcCatalog**.

b. ArcToolbox

- In **ArcToolbox**, open **Data Management Tools** → **Projections** → **Define Projection Wizard (shapefiles, geodatabases)**.



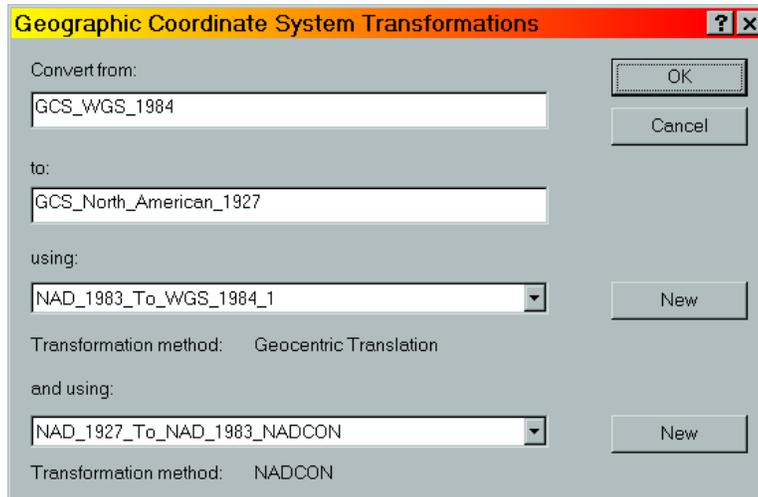
- The Wizard will then guide you through the steps, much of which is similar to ArcCatalog.
- When finished, close **ArcToolbox**.

3. Changing the Projection of a Shapefile using ArcToolbox

a. WGS84 → NAD27

- In **ArcToolbox**, select **Data Management** → **Projections** → **Project Wizard (shapefiles, geodatabases)**
- Browse for the file you need to change the projection on. Click **Add**. The shapefile will now be visible in the window and should say **GCS_WGS_1984** for the coordinate system. Click **Next**.
- Specify an output location using the browse. Name the new file.
- Select **Coordinate System** → **Select** (or Import from an existing feature with a projection file) → **Projected Coordinate Systems** → **UTM** → **Nad1927** → **NAD_1927_UTM_Zone_13N.prj**

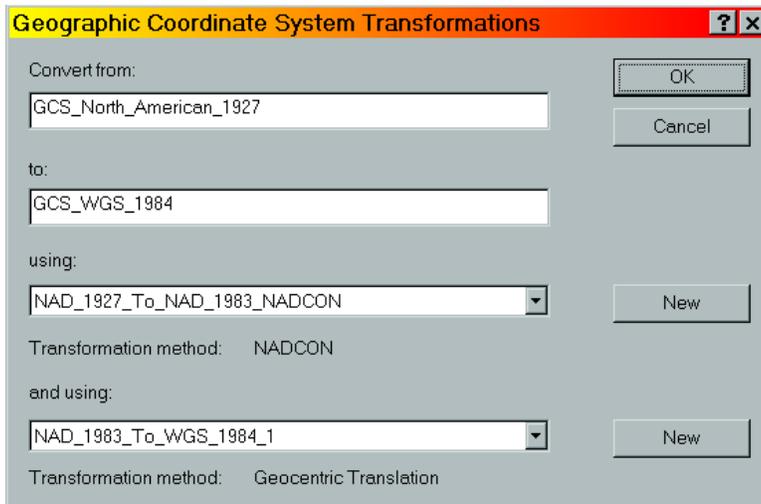
5. Click *OK*.
6. Click *Next*.
7. Click *Set Transformation*.
8. **IMPORTANT:** Use the following settings as identified in the following diagram to yield the correct transformation. You must use *NAD_1983_To_WGS_1984_1* and using *NAD_1927_To_NAD_1983_NADCON*. This uses the correct transformation into UTM NAD27.



9. Click *OK*.
10. Click *Next*.
11. Click *Next*.
12. Click *Finish*.

b. NAD27 → WGS84

1. In **ArcToolbox**, select **Data Management** → **Projections** → **Project Wizard** (*shapefiles, geodatabases*)
2. Browse for the file you need to change the projection on. Click *Add*. The shapefile will now be visible in the window and should say *NAD_1927_UTM_Zone_13N* for the coordinate system. Click *Next*.
3. Specify and output location using the browse. Name the new file.
4. **Select Coordinate System** → **Select** (or Import from an existing feature with a projection file) → **Geographic Coordinate Systems** → **World** → **WGS 1984.prj**
5. Click *OK*.
6. Click *Next*.
7. Click *Set Transformation*.
8. **IMPORTANT:** Use the following settings as identified in the following diagram to yield the correct transformation. You must use *NAD_1927_To_NAD_1983_NADCON* and using *NAD_1983_To_WGS_1984_1*. This uses the correct transformation from UTM NAD27.



9. Click **OK**.
10. Click **Next**.
11. Click **Next**.
12. Click **Finish**.

4. Correcting Shifted Data Collected in ArcPad

NOTE: This process corrects NAD27 data collected in ArcPad using the #1530 (default) datum transformation.

If you have ArcPad GPS data in NAD27 collected with the #1530 datum transformation, this data can be fixed by reprojecting it back into WGS84 and then reprojecting again into the proper NAD27 datum of your choice. The solution is to use a custom datum transformation.

Now, in order to do this you need to know that when using 1530, ArcPad data going from **WGS84 → NAD27** is transformed using the following numbers:

- Transform X (m) 4
- Transform Y (m) -135
- Transform Z (m) -181

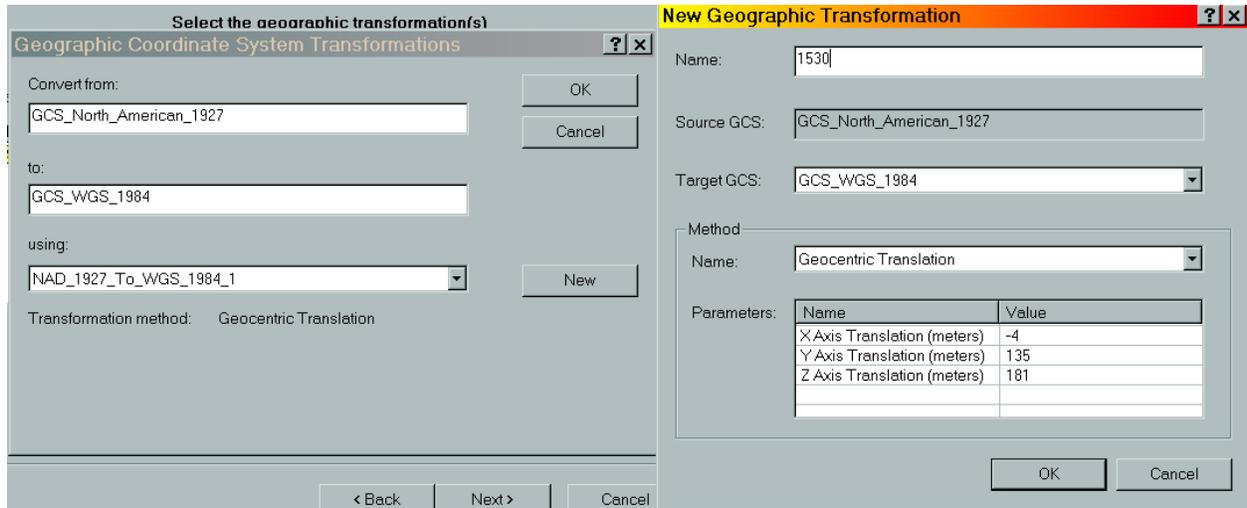
This matches the **apDatums.dbf** file in ArcPad.

In order for this shifted data to go from **NAD27 → WGS84**, you will need to reproject using the following numbers:

- Transform X (m) -4
- Transform Y (m) 135
- Transform Z (m) 181

Positive and Negative numbers are reversed depending on which direction you go.

- a. In **ArcToolbox**, follow steps 1-7 outlined in **part A-3b** of this section.
- b. At the *geographic transformations(s) screen*, click **New**.



- c. Enter the values of **-4, 135, 181** for X, Y, Z. A new name is optional. Click **OK**.
- d. Follow steps 10-12 outlined in **part A-3b**. The shapefile has been transformed back into WGS84 correctly.
- e. Follow steps 1-12 outlined in **part A-3a** of this section to correctly project the new file into NAD27.

5. Exporting Shapefiles to Other Formats (Geodatabase, Coverage)

a. ArcCatalog (one file)

1. Right-click on the shapefile and choose **Export → Shapefile to Geodatabase** (or **Coverage**).
2. Select the file destination. Click **OK**.

b. ArcToolbox (multiple files)

1. Set **Tools → Options → Precision → Double** and **Double**.
2. Expand **Conversion Tools**.
3. Expand **Export from Shapefile**.
4. Select **Shapefile to Geodatabase** (or **Coverage**).
5. Follow the wizard directions. The shapefile(s) must already have a defined projection.

6. ASCII Format – Adding XY Data From a Table/Textfile

Tables containing XY positions and attributes can be converted into point feature classes a couple of different ways using ArcCatalog and ArcMap. Common files ArcMap can use are TXT, DBF and CSV.

a. Textfile format for adding XY data

Prior to adding XY data from a textfile into ArcGIS, it is important to have the textfile in the correct format.

1. Projected Coordinates

If using projected coordinates (i.e. UTM, NAD27), an example of a simple format that

can be created in Notepad, WordPad or any text editor that can save in comma-delimited format (.csv, .txt) is as follows:

```
East, North, Comment
358000, 4120233, gate
322300, 4129000, diversion
```

The top row contains the field names. *East* is the **X**, *North* is the **Y** and *Comment* is the **attribute**. The textfile can be made more detailed if desired.

2. Geographic Coordinates

If using geographic coordinates (Lat/Long), the coordinates must be in **decimal degrees** for ArcGIS to be able to read them. The following format is an example:

```
Longitude, Latitude, Comment
-107.000594373, 37.250005671, SE Pagosa Springs
```

The top row contains the field names. *Longitude* is the **X**, *Latitude* is the **Y** and *Comment* is the **attribute**. **Note the negative sign (-) before the longitude value.** ArcMap requires this for coordinates in the western hemisphere.

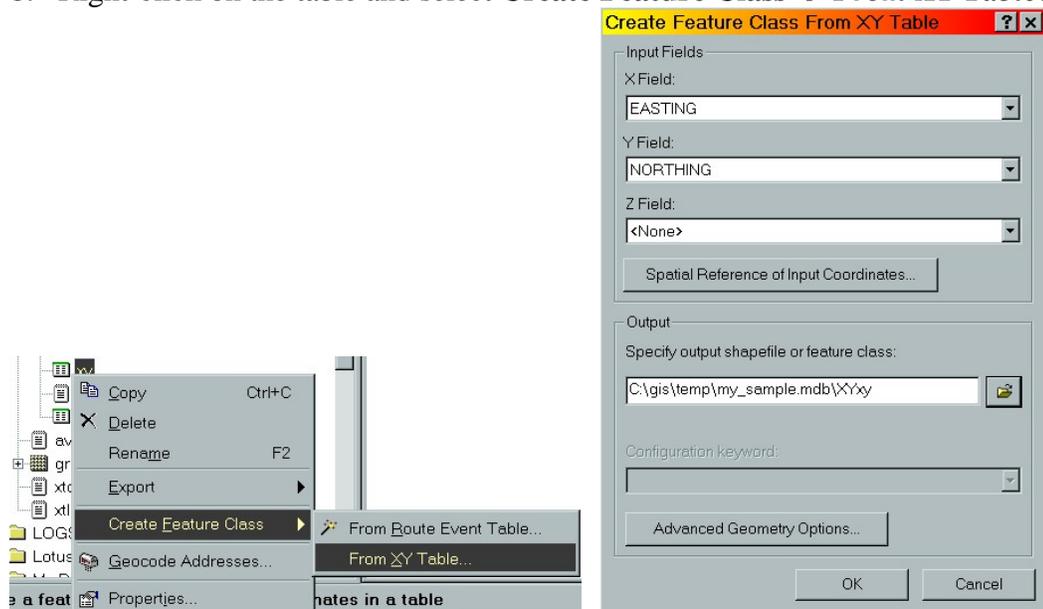
Tech Tip #20 Remember to keep track of what projection and datum the coordinates came from as this will need to be specified in ArcGIS.

#21 Also, if the coordinates are WGS84, then the dataframe transformation method will also need to be set correctly (**Section VII, part A-2**).

b. Adding XY Data

1. ArcCatalog

- Open **ArcCatalog** and find the table containing the coordinates.
- Right-click on the table and select **Create Feature Class → From XY Table**.



- c. Select the fields that contain the **X** and **Y** data (i.e. *Easting* and *Northing*).
- d. Select **Spatial Reference of Input Coordinates** and set the native projection of the coordinates.
- e. Specify an output location, be it a shapefile or within a geodatabase.
- f. **If necessary**, set the output projection in *Advanced Geometry Options* if the native coordinates are different than the desired coordinates (i.e. State Plane to UTM).
- g. Click **OK**. The new feature class (including attributes) has been created and can be added as a layer in ArcMap.

2. ArcMap

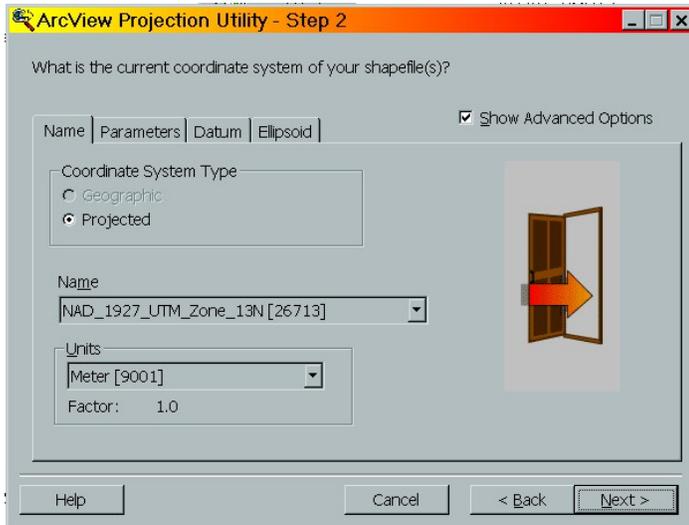
- a. Select **Tools** → *Add XY Data*.
- b. Select a table from the dataframe or browse for the file.
- c. Select the fields that contain the **X** and **Y** data (i.e. *Easting*, *Northing* or *Longitude*, *Latitude*).
- d. Select **Spatial Reference of Input Coordinates** and set the native projection of the coordinates.
- e. Click **OK**. There is now a new event layer derived from the table in the dataframe. This can be saved as a Layer File or exported as a feature class.

B. Arcview

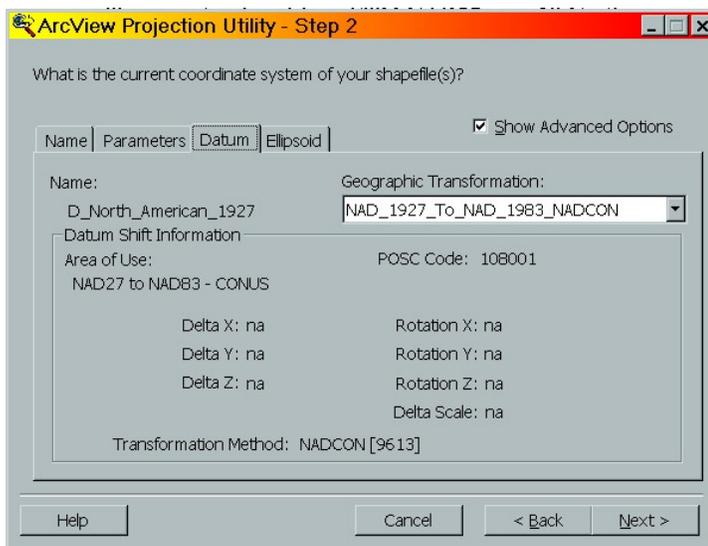
1. The Projection Utility – Changing the Projection of a Shapefile

To project a *UTM NAD27 zone 13 North* shapefile into *NAD83* or *WGS84*:

- a. In **Arcview**, turn on the **Projection Utility Wizard** through **File** → *Extensions*.
- b. **File** → *Arcview Projection Utility*. This starts the utility.
- c. *Step 1*: Select the shapefile to project, if not already identified, by using the **Browse** button. When selected, click *Next*.
- d. *Step 2*: You may need to set the current coordinate system of the file. Make sure **Show Advanced Options** is checked. In the **Name** tab, make sure **Projected** is checked and set the projection to *NAD_1927_UTM_Zone_13N [26713]*



- e. **IMPORTANT:** select the Datum tab and change the *Geographic Transformation:* to *NAD_1927_to_NAD_1983_NADCON.*



- f. Click **Next**.
- g. **Step 3:** Set the new projection of the file in the Name tab. If you want:
1. Geographic WGS84 -- check **Geographic** and select **GCS_WGS_1984 [4326]**
 2. UTM NAD83 – check **Projected** and select **NAD_1983_UTM_Zone_13N [26913]**
- h. Click **Next**.
- i. **Step 4:** Use **Browse** to give a new name and location for the new file. Click **Next**.
- j. Click **Finish**.
- k. You will be asked if you want to load the data into the view. It is recommended that the new file be placed in a **new** view.

2. Display Points Lat/Long Extension – Adding XY Data into a Shapefile

NOTE: This process requires the use of the Display Points Lat/Long extension in Arcview. This can be obtained at no cost from ESRI's Arcscripts website at:

<http://arcscripts.esri.com/>.

a. Setup

1. In Arcview, add the desired themes to a View.
2. Add a Point theme, either existing or new, to the View.
3. Set the map units to units the data resides in (generally meters for the USFS). **View → Properties → Map Units → meters**. Set the distance units if desired. Click **OK**.
4. Load the *Display Points Lat/Long* extension into the project by checking the box in **File → Extensions**. Three new buttons appear on the toolbar. 

b. Add XY Data

1. Make the Point theme active and click on the **XY** button.
2. Set the Projection for the GIS data. (Region 2 users, UTM – 1927, Zone 13).
3. Choose the coordinate format (display units) that will be used to enter the new points. Click **Yes** for *Lat/Long* in *DDMMSS* or **No** for Projection units (Region 2 is *UTM*). *NOTE: When entering Lat/Long coordinates, add a space between Degrees and Minutes and Seconds. If the existing coordinates are in Decimal Degrees (37.5786), add a zero for the Minutes and Seconds (37.5786 0 0).*
4. Enter the coordinates and click **OK**.
5. The coordinate has been added to the shapefile. Check the point to see if the placement looks correct.

c. Populate Attribute Table with XY coordinates.

1. If you want to populate coordinates in a Point theme's attribute table, click on the button to the right of **XY** (looks like a square frame).
2. Click **No** to any question boxes.
3. The attribute table has now been populated with both Lat/Long and Projected coordinates. *NOTE: The datum of the Lat/Long coordinates will be the same as the datum of the GIS, in this case NAD1927.*

Tech Tip #22 When adding coordinates, the datum of the coordinates should match the datum of the point theme they are being added to in the View. If the coordinates exist in a different datum, they will either have to be projected into the correct datum (the program Corpscon works well) or the point theme will need to be reprojected and the Arcview projection set to the correct datum.

3. Making Grid Points for GPS Field Use

NOTE: This process requires the use of two (2) extensions in Arcview, Coordinate Grid Maker and XTools. These can be obtained at no cost from ESRI's Arcscripts website at:

<http://arcscripts.esri.com/>.

- a. In Arcview, add the desired project area for to the View for creating grid points.
- b. Set the map units to units the data resides in (generally meters for the USFS). **View →**

- Properties** → **Map Units** → *meters*. Set the distance units if desired. Click **OK**.
- c. Load extensions *Coordinate Grid Maker* and *XTools* into the project by checking the boxes in **File** → **Extensions**.
 - d. Click the Grid Maker icon  and draw a rectangle around the area you want to create the points. Be sure to include all the area needing to be covered. Click **OK**.
 - e. Select the **Grid Extent**. There are four options. Click **OK**.
 - f. Set the **Grid Type** by selecting the *XY tic* option to allow setting the grid up in measured units. Click **OK**.
 - g. Set the **Scale of Map**. This will govern the default grid spacing and tic size. The smaller the scale, the smaller the sizes. Click **OK**.
 - h. Set the **X and Y grid spacing**. Distance will be in the projected units (in this case, meters). If feet is desired, then a conversion into meters will be needed. Click **OK**.
 - i. Select a color. Click **OK**.
 - j. Select *no labels*. Click **OK**.
 - k. Use the default tic size. Click **OK**.
 - l. Click **No** to creating an outline. Click **No** to creating a Mask.
 - m. Click **Yes** to save grid as a shapefile. **Browse** to store file in a desired location. This file is temporary.
 - n. With the new file active, select **XTools** → **Convert Shapes to Centroids**. This will create a point at the center of each tic feature. Partial tics will not have the point at the intersection, but offset.



- o. Edit the shapefile to keep only the points desired.
- p. The new point shapefile can now be brought into GPS by utilizing one of the methods described in this document. The process is governed by the type of GPS receiver being used.

VIII. Corpscon

Corpscon is a freely downloadable coordinate convertor program developed by the military. It can transform coordinates between Lat/Long and UTM as well as NAD27, NAD83 and State Plane. There is also a conversion for Decimal Degrees to Degrees Minutes Seconds. This program can convert single points or coordinates in a textfile. The program is available at the following address:

<http://crunch.tec.army.mil/software/corpscon/corpscon.html>

A. Converting Coordinates in a Textfile

1. Textfile format

For Corpscon to operate correctly, it is important to have the textfile in the correct format.

a. Projected Coordinates

If using projected coordinates (i.e. UTM, NAD27), an example of a simple format that can be created in Notepad, WordPad or any text editor that can save in comma-delimited

format (.csv, .txt) is as follows:

```
374300, 4120556, sign
321200, 4123800, monument
end
```

Notice **end** at the bottom of the file. This is required if all values are to be read. A header row (East, North, Comment) may be added, but it will not be carried over into the output file Corpscon creates. The textfile can be made more detailed if desired. Corpscon can handle up to six (6) fields in the textfile.

b. Geographic Coordinates

Corpscon can convert three formats: DD.dddd, DD-MM.dddd and DD-MM-SS.dddd. The following textfile format is an example:

```
107 00 15.88, 37 05 16.23, shack
107 14 29.90, 37 22 12.932, mine shaft
end
```

OR

```
107.22345, 37.889223, plot 3442
107.23322, 37.449993, plot 3443
end
```

Notice **end** at the bottom of the file. This is required if all values are to be read. A header row (Long, Lat, Comment) may be added, but it will not be carried over into the output file Corpscon creates. The textfile can be made more detailed if desired. Corpscon can handle up to six (6) fields in the textfile. **NOTE:** *In contrast to ArcMap, there is no negative value (-) for Longitude. Corpscon cannot use negative Longitude values.*

2. Converting a Textfile

NOTE: *The following directions will use the example of converting a file with Lat/Long coordinates in NAD27 Degrees-Minutes-Seconds into a file containing NAD27 Decimal Degrees. The basic process of converting a textfile into other types of coordinates is the same.*

- a. In **Corpscon**, select **Send Data → To Output File**. A checkmark will be added. This will turn the Output File option **ON** in the *Send Data* window.
- b. Select the Input Format. **Input Format → Geographic Coordinates NAD27...**
- c. Select the Output Format. **Output Format → Geographic Coordinates NAD27...**
- d. Select **Convert → User Defined Input File**.
- e. **Input File**
 1. In the **Field Specifications** box:
 - a. *Field 1*, select **Longitude**.
 - b. *Field 2*, select **Latitude**.
 - c. *Field 3*, select **Point Name**.
 2. In the **Other** box:
 - a. *Delimiter*, select **Comma**.
 - b. *Degree Format*, select **Degrees-Minutes-Decimal Seconds**.

3. **Browse** for the Input File containing the coordinates to convert. Click **OK**.
- f. **Output File**
 1. In the **Field Specifications** box:
 - a. *Field 1*, select **Longitude**.
 - b. *Field 2*, select **Latitude**.
 - c. *Field 3*, select **Point Name**.
 2. In the **Other** box:
 - a. *Delimiter*, select **Comma**.
 - b. *Degree Format*, select **Decimal Degrees**.
 3. Name the new Output File and select a destination. Click **OK**.
- g. A Status window will appear showing if the conversion was successful.
- h. Check the output file to make sure all values were converted and that the values are what they are supposed to be. In this example, the values would be in Lat/Long NAD27 Decimal Degrees.

Appendix

A. Credits

In addition to myself, the following individuals contributed information for this document. My apologies to anyone I may have missed.

Dan Greene (R2, USFS)	Michele Huffman (R4, USFS)	John Varner (R2, USFS)
Sally Zwisler (R2, USFS)	Charlotte Quarnburg (R4, USFS)	Geri Morris (R2, USFS)
Tom Effinger (R2, USFS)	Tim Loesch (MN, DNR)	Ros Wu (R2, USFS)
Carl Sumpter (R2, USFS)	Joel Cusick (Alaska, NPS)	

Reference material, program documentation and screen captures were used from software/sites provided by:

ArcGIS, ArcMap, ArcCatalog, ArcToolbox, ArcPad, ArcInfo, and Arcview are registered trademarks of:
Environmental Systems Research Institute, Inc. (ESRI)
 380 New York Street. Redlands, CA 92373-8100. 1-909-793-2853

Pathfinder Office, Trimble Planning, GeoExplorer 1, 2, 3, XM/XT, Pathfinder ProXR series, Pathfinder Pocket, GPSCorrect and TerraSync are registered trademarks of:
Trimble Corporate Headquarters
 645 North Mary Avenue Sunnyvale, CA 94086

Windows NT, 2000, XP, Windows CE, Windows for Pocket PC and ActiveSync are registered trademarks of:
Microsoft Corporation

DNR Garmin is a registered trademark of:
Minnesota Department of Natural Resources
 Garmin Communications using **pcoGarmin** by Ron Whately (<http://www.c-nav.com>)

Corpscon is provided by:
U.S. Army Corps of Engineers
 Topographic Engineering Center, Alexandria, Virginia.

GPS Utility is registered to:

GPS Utility Limited

GPS Utility Limited, 30 Cadland Court, Ocean Village,
SOUTHAMTON, SO14 3GP, ENGLAND

Waypoint+ is registered to:

B. Hildebrand

GPSi is registered to:

Waymex IT Ltd.

2 Victoria Mill, Belmont Wharf, Skipton,
North Yorkshire, BD23 9LW.

CompassCom, Inc.

6770 S. Dawson Circle, Unit 1A. Centennial, Colorado 80112
303-680-3221 Fax 303-766-2488

B. Base Station Map

The base station map can be found on the server at the following address. Click on the address to open the file.

K:\unit\res\gis_team\gps_notes\base_station.jpg

C. Key Settings

GPS

- PDOP Mask -- **6.0** (using the custom setting) *Recommended*
NOTE: If you can't get satellites, you may need to use a higher number.
- SNR Mask -- **6.0** (using the custom setting) This dictates that a satellite's signal will not be used if less than 6.0.
- Elev Mask -- **15** degrees
- Min Satellites -- **4** (unit will collect in 3D mode)

Export/Import Coordinate System (between WGS84 and NAD27)

- System -- **UTM**
- Zone -- **13 North**
- Datum -- **NADCON (Conus)**
- Units -- **Meters**
- Altitude -- **MSL**

Export/Import Units

- Distance -- **Meters**
- Area -- **Square Meters**
- Velocity -- **Meters per Second**

NOTE: Modifying GPS of Export/Import Settings affects accuracy and data quality.

D. Commands

1. Windows commands

- copy** -- copy file(s) to a destination.
- del** -- deletes file(s).
- dir** -- lists the contents of a directory.
- move** -- moves file(s) to a different location.
- ren** -- rename file(s)
- cd** -- change directory.
- md** -- creates a directory.
- rd** -- removes a directory.

2. UNIX commands

- ll** -- list long (lists files in a directory including date and file size.)
- ls** -- list short (lists files in a directory, name only.)
- pwd** -- lists current directory.
- cd** -- changes directories.

3. ARC commands

- lc** -- list cover (lists coverages in a workspace.)
- kill** -- removes coverages from workspace.
- copy** -- copies coverages from one location to another.
- cw** -- creates a workspace.
- q** -- quits ArcInfo
- <>** -- items in <> define the names of files/folder or options the user needs to use in association with ARC commands.

F. Using FTP to Download Basefiles

1. Before selecting Rover files to be corrected you will have to download to necessary base files.
2. You must know the timeframe in UTC (Greenwich, England) your rover files cover in order to retrieve the appropriate base files. Mountain Daylight Time is UTC minus 6 hours
Mountain Standard Time is UTC minus 7 hours.
3. *For Windows 2000* Open the FTP Hummingbird Window.
Click **Start** → **Programs** → **Hummingbird Connectivity v7.1** → **Exceed** → **Host Explorer** → **FTP for Windows Explorer**
4. Double-click on **New FTP Profile** to open FTP Site Properties Window.
 - a. Enter *Host Address* -- ftp.compasscom.com (check base station web pages for other examples.)
 - b. Enter *User Name* -- check the anonymous box.
 - c. Enter *Password* -- typically autogenerated with the user's e-mail address or use ftp.
 - d. Enter *Initial Dir* [optional]
 - e. Click **Ok**
 - f. This creates an icon for that FTP site. Double-click on newly created icon to connect to the site.
5. Navigate to the desired directory and identify the correct base files.
6. There are now two windows open showing a filing structure. One is the server that you just connected to and the other is the C drive of your network PC. It is recommended that base

files be put on the C drive in a common base folder directory. Navigate to the appropriate directory on the C drive.

7. Highlight the appropriate files of the internet server with the mouse and/or keyboard. Be sure to retrieve enough base files to cover your rover files.
8. With the files highlighted, right mouse click → **Copy**.
9. Open the base folder on the PC and right mouse click → **Paste**.
10. When finished with the FTP, click **File** and **Exit**.
11. Proceed with the correction process as described in **Section III, part B** of this document.

G. More Tech Tips

- #23** Areas can have labelpoints occur outside of their perimeter that can cause attributes to be dropped when generating a coverage. In ArcInfo, overlapping Areas will create new polygons without attributes and labelpoints.
- #24** Labelpoints are necessary for Areas if attributes are to be appended from the attribute table.
- #25** Lines and Areas need editing to remove spikes and squiggles as much as possible before they are made into coverages.
- #26** Depending on the types of Line features (roads, streams, etc.), they will need to be snapped (connected) together to form continuous data.
- #27** Length, perimeter and area values may differ in GIS vs. the original (edited) GPS corrected file. Any editing done in GIS will alter the values further.
- #28** Arc may not allow the use of comma-delimited files with uppercase file extensions.
- #29** Exporting files together with different data dictionaries will cause Pathfinder Office's Export Utility to stop and will require files containing such to be exported separately.
- #30** Comma-delimited files sometimes have hidden carriage returns within the file that must be removed using the VI editor in UNIX for use in AML's.

H. ArcInfo for PC/Unix

1. Making Pathfinder Export Files into a Coverage

- a. *For Windows 2000* Open a AIX Terminal (Xsession) window in Exceed either by clicking on the AIX Terminal icon on the or by going to:
 - a. **Start → Programs → Hummingbird Connectivity v7.0 → Exceed → Xsession**
 - b. Highlight **xstart aixterm window** and select **Run!**
- b. Enter username and password.
- c. At the command prompt, navigate to the path (directory structure) where the exported GPS files are to be located.
- d. At the command prompt in the AIX window, type **arc** to run ArcInfo.
- e. For working with files and coverages, a workspace will need to be created at the ARC prompt if one does not exist already. A workspace is a directory that contains coverages, an INFO subdirectory and other related ARC files. Additional directories or workspaces can be added underneath the original workspace.

Arc: **cw** <workspace>
(i.e. Arc: cw gps_data)

- f. Move or copy files from the PC to the desired workspace using Windows Explorer. Check to

make sure filenames are in lower case letters.

g. Before creating covers, the AML file for each feature must be modified:

1. Open Windows Explorer and find the AML for the feature located in the workspace on the server.
2. Right mouse click → **Open With** → select **WordPad**.
3. edit AML file to include the path (location) of the attribute file after **ADD FROM**. **For area amls, the clean tolerances need to be changed from # to 0.00000001.** (see sample Area AML)
(i.e. `ADDFROM /fsfiles/office/so/recreation/gps_data/camps.aml`)
4. Click **Save** and **Close**.
5. Edit .pts file for area covers (polygons) if needed to correct mislocated label points. The label point is based on the centroid of the entire feature and that point may lie outside of the area. Labels outside of the area will result in the attributes not being appended to the polygon attribute table. In other words, certain polygons will lack attributes. To correct: pick any coordinate that is within the area and change the bad coordinate in the .pts file using the corresponding ID number as a reference.
(i.e. 1, 456211.002, 4865222.921. The *I* is the ID.) **Save** and **Close** file.
6. Repeat the process for each feature.

h. Run the corrected AML at the ARC prompt to create cover.

Arc: **&r** <aml file>
(i.e. Arc: **&r** camps.aml)

i. Rename the coverage. Use **lc** to list available coverages if needed.

Arc: **rename** <old_cover> <new_cover>
(i.e. Arc: **rename** camps fs_camps)

NOTE: Coverage names should not start with a number, be no longer than 13 characters and do not have spaces within the name.

j. Overlapping Polygons

If overlap polygons occur, a new polygon is created void of attributes and labelpoints. This will make it necessary to either:

1. edit polygons in Pathfinder Office so no overlaps occur.
- or
2. add new fields to the attribute table, re-enter the missing attributes and create labelpoints for the new polygons.

NOTE: For the addition of new fields and labelpoints, consult your GIS specialist. It may be necessary to use regions if overlaps are present.

k. If necessary, combine multiple covers of like features into one coverage by using the **append** command (or consult your GIS specialist). This command requires that the covers being merged have identical attribute fields. If they don't, these fields must be edited or append will not work.

Arc: **append** <out_cover> <point | line | poly>

l. If errors occur at any time during METHOD I (Arc bailing out of the AML for example), it

will be necessary to kill the attempted coverage. This command is also used for removing older covers.

Arc: **kill** <cover> **all**

m. Sometimes corrupted covers and/or files cannot be removed with kill or delete. To remove these, quit Arc and use the following:

: **rm -R** <file>

n. Proceed to further fine-tune and edit the new coverage within ArcInfo software (Arcedit, ArcTools, ArcMap). This procedure may need to be done by a GIS specialist.

Tech Tip #31 Never drag and drop coverages. Always copy a coverage when moving it to a different destination by using the **copy** command in Arc or by copying it in ArcCatalog.

2. Sample Area AML

Use uppercase letters. Field names for attributes following DEFINE are generated from the data dictionary and export settings and will vary between projects. The fields listed are examples only.

```
GENERATE <cover>
INPUT <coordinate arc file>
LINE
INPUT <coordinate point file>
POINT
QUIT
```

```
CLEAN <cover> <cover> 0.0000001 0.0000001 POLY
```

```
&DATA ARC INFO
ARC
DEFINE <attribute file>
<cover>-ID, 5, 5, I
SITE-NAME, 18, 18, C
WEED-SPECIES, 20, 20, C
SITE-DESCRPT, 20, 20, C
DENSITY, 20, 20, C
MGT-RESTRICTIONS, 20, 20, C
CANOPY, 20, 20, C
MAX-PDOP, 8, 5, F, 1
RCVR-TYPE, 36, 36, C
GPS_DATE, 8, 8, D
FEAT-NAME, 20, 20, C
DATAFILE, 20, 20, C
UNFILT-POS, 10, 10, I
```

```
ADD FROM /<path>/<attribute file>
Q STOP
&END
```

```
JOINITEM <cover>.PAT <attribute file> <cover>.PAT <cover>-ID <cover>-ID
```

3. Converting XY Data in a Textfile to a Coverage

The only reason to use this export type is if substantial editing to the attribute table is needed. Even so, the ArcInfo format can also accommodate this need as the .aa, .pa and .gen files are essentially comma-delimited (.csv) which can be opened in most spreadsheets. Covers can also be generated from ASCII files that were produced in a spreadsheet providing the files are saved in comma-delimited format.

- a. Copy or move files into workspace.
- b. Using the sample AML as a guide, insert the proper names for the files requested. When defining the attribute file, enter the field names that correspond with the data's attributes. DO NOT use the fields listed in the samples as a default. They are only intended to be used as a guide. Save the file when through editing the AML.
- c. Files created or saved in .csv format (not the .aa or .pa) contain carriage returns that must be removed before the AML is run. Edit the files using VI editor in Unix.

```
> vi <filename>
:g/[cntrl]v[cntrl]m/s///
:wq (this saves the file and exits VI editor)
```

- d. **END** (uppercase letters) must be added at the end of coordinate files. (In an arc or poly file, there will actually be two **END**'s at the bottom of the file.) *Save* files when finished and *Close*.
- e. Run AML

```
Arc: &r <aml file>
```

4. Converting a Shapefile to a Coverage

- a. Ensure the Arc environment is set to **precision double double**, if needed type this on the command line. Anything else will incur arc or polygon movement within the coverage. SINGLE precision covers have a larger tolerance default value than DOUBLE. This gives arcs and polys greater freedom to move around creating potential accuracy problems.

- b. Convert shapefile into a coverage.

```
Arc: shapearc <shapefile> <cover> <subclass>
(i.e. Arc: shapearc camps.shp fs_camps poly)
```

***NOTE:** Subclass should be used if converting area data into a polygon coverage. This will create regions containing the area attribute data. If no subclass is used, the attributes will be attached to the arcs, not the polygons.*

- c. Redefine tolerances of the new coverage.

```
Arc: tolerance <cover> <type> <value>
```

The <type> is the tolerance to define and <value> is the value of the tolerance. The following is a list of suggested values. Depending on the data, it may be necessary t

adjust these values.

<u>Type</u>	<u>Value</u>
weed	0
grain	1
node	1
snap	1

- d. The cover will then need to be cleaned to remove intersect errors involving line and area coverages. Polygon features are converted into Regions so overlapping polys are allowed.

Arc: **clean** <old_cover> <new_cover> **0.0000001 0.0000001** {line|poly}
(i.e. Arc: clean fs_camps fs_camps2 0.0000001 0.0000001 poly)

Use **regionpoly** if polygon topology is needed. This converts regions into a separate polygon coverage.

Arc: **regionpoly** <in_cover> <out_cover> <in_subclass> <out_table>
(i.e. Arc: regionpoly fs_camps2 fs_camps3 poly polytable)

- e. Kill unnecessary covers using:

Arc: **kill** <cover> **all**

- f. Rename coverages as needed.

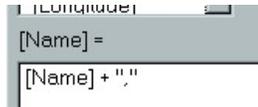
Arc: **rename** <old_cover> <new_cover>

I. Other Methods for Converting GIS Data into GPS for the GeoExplorer 3c

1. The Arcview-Excel Method

***NOTE:** This method requires the use of the **Display Points Lat/Long** extension in Arcview (or any extension that populates coordinates into the attribute table.) The file can be downloaded from <http://arcscripts.esri.com> or is available from the GisTeam upon request. The file must be stored in the C:\fsapps\ESRI\AV_GIS30\ARCVIEW\EXT32 directory on the PC.*

- Make a copy of the shapefile you want to convert.
- In Arcview, activate the **Points Coordinates** extension.
- In the **View Properties**, set **Map Units** → **Meters**.
- With the Theme active, select the  button of the Points Coordinates extension to populate the table with coordinates. The coordinates calculated are UTM, NAD27 and Geographic, NAD27.
- With the attribute table active, enter edit mode with **Edit** → **Start Editing**.
- Identify the text field (if one exists) to use for the Waypoint ID. Add a comma (,) to all the values in that field by using the field calculator. The syntax to use would be something like the following:



This will ensure quotes around our text field when saved to a .csv format.

NOTE: Pathfinder's Waypoint utility requires quotes around the Text field. That is why we added the comma in Arcview.

- g. **Stop editing** the table and **save** edits. **Close** Arcview.
- h. Open Microsoft Excel.
- i. **File** → **Open** and browse for the edited shapefile's **.dbf**.
- j. Delete all fields EXCEPT, the Easting and Northing coordinates and the text field for the waypoint ID.
- k. The table's field order must be put into the following:
Easting, Northing, Text
 - l. Delete the header row and save the file as **Comma Delimited Format (.csv)**
- m. In Pathfinder Office, **File** → **Waypoints** → **ASCII Import**.
- n. Select the new **.csv** file and click **Open**.
- o. Select the coordinate system of the **.csv** file.
UTM, 13 North, NADCON Conus
 - p. Click **OK**. If the table format is not correct, you will receive an error.
 - q. Give the new waypoint file a name. Click **OK**.
 - r. Click **File** → **Waypoints** → **Close**.
 - s. You can now connect to the datalogger and transfer the **.wpt** file.

2. The "Hoops" Method in Pathfinder Office

- a. In **Arcview** and using a copy of the shapefile you want to edit, delete all fields EXCEPT the one you want to use as a Waypoint ID.
- b. In **Pathfinder Office**, select from the main menu **Utilities** → **Import**.
- c. Click **Browse** to locate and select the shapefile to import.
- d. Select the **Import Setup** for Arcview Shapefile (recommend make a copy of the setup and edit the copy).
- e. Set coordinate system properties if necessary. For Region 2 data, use:
 System: **UTM**
 Zone: **13 North**
 Datum: **NADCON(Conus)**
 Units: **Meters**
- f. Click **OK**. The file created will have an **.imp** extension.
- g. Open the **Export Utility** in Pathfinder Office by selecting **Utilities** → **Export** from the main menu.
- h. Select the **.imp** file to export by using the **Browse** button.
- i. If needed, select the **Output Folder** by using the **Browse** button.
- j. Select the **Geo3c ASCII** export format. Go to step *l*.
- k. If **Geo3c ASCII** does not exist, create a new Export format called **Geo3c ASCII**. Click **New** → **New Setup** → **Configurable ASCII**. (This will only need to be setup once.)
 1. Click **Properties**.
 2. In the **Configurable ASCII** tab, click **New**. Name it **Geo3c**.
 3. In the **Template Editor** Window

- a. Enter *csv* for the **Output File Extension**.
 - b. Apply to **Points**.
 - c. In the Worksheet Window, add the following.
{Easting}{Northing}{Attributes}
 - d. Click **OK**.
4. In the **Coordinate System Tab**
- a. Check **Use Export Properties** and click **Change**.

System:	UTM
Zone:	13 North
Datum:	NADCON(Conus)
Units:	Meters
5. Once the options have been set, click **OK**.
- l. Check to ensure the correct settings appear under the **Export Setup**. Click **OK** to export.
 - m. The message box should say **X# features exported**.
 - n. Read **Export Completed** window to check for a successful export.
 - o. Click **Close**. The new **.csv** file generated will contain coordinates in UTM.
 - p. In Pathfinder Office, **File → Waypoints → ASCII Import**.
 - q. Select the new **.csv** file and click **Open**.
 - r. Select the coordinate system of the **.csv** file.
UTM, 13 North, NADCON Conus
 - s. Click **OK**. If the table format is not correct, you will receive an error.
 - t. Give the new waypoint file a name. Click **OK**.
 - u. Click **File → Waypoints → Close**.
 - v. You can now connect to the datalogger and transfer the **.wpt** file.

J. Web Links

1. Definitions

Datum definitions

http://arcsdeonline.esri.com/capi_functions/include_files/pedef.htm

<http://biology.usgs.gov/geotech/documents/datum.html>

2. Software

Corpscon software download page

<http://crunch.tec.army.mil/software/corpscon/corpscon.html>

ESRI Arcscripts website

<http://arcscripts.esri.com/>

Trimble Planning Software and Ephemeris/Almanac download

http://www.trimble.com/planningsoftware_ts.asp?Nav=Collection-8425

DNR Garmin software page

<http://www.dnr.state.mn.us/mis/gis/tools/Arcview/extensions/DNRGarmin/DNRGarmin.html>

GPS Utility software page

<http://www.gpsu.co.uk/>

Waypoint Plus software page

<http://www.tapr.org/~kh2z/Waypoint/>

3. GPS/GIS sites

San Juan NF GIS/GPS intranet page

<http://fsweb.sanjuan.r2.fs.fed.us/gis.shtml>

US Forest Service National GPS website

<http://www.fs.fed.us/database/gps/>

CompassCom homepage

<http://www.compasscom.com/>

ESRI homepage

<http://www.esri.com/>

Trimble homepage

<http://www.trimble.com/>

Mesa County, Colorado GPS website

http://www.co.mesa.co.us/GPS_Survey/GPS_Survey.htm#Top

Garmin homepage

<http://www.garmin.com/>

Federal Aviation Administration GPS website

<http://gps.faa.gov>

National Geodetic Survey homepage

<http://www.ngs.noaa.gov/CORS/cors-data.html>

4. PDR and Evaluation information

Rangeland Management Service Center

<http://fsweb.ftcol.wo.fs.fed.us/frs/rangelands/pdr/index.shtml>

NRIS software

http://sandy1.sandy.wo.fs.fed.us/terra_docs/articles/pdr-2.htm

Mobile computing (PDR) evaluations

<http://fsweb.sdtc.wo.fs.fed.us/programs/im/fy03/ppc/ppc.shtml>

What's New, including GPS receiver evaluations, at the US Forest Service National GPS website

<http://www.fs.fed.us/database/gps/gpsusfs.htm>