

CHAPTER 8 INFORMATION RESOURCES

Texas Commission on Environmental Quality

8.12.01 GLOBAL POSITIONING SYSTEM: Policy Introduction

PURPOSE

To establish the policy and procedures for the Texas Commission on Environmental Quality (TCEQ) relating to the collection and management of positional data under its jurisdiction including, but not limited to, facilities, assessment sites, and incident sites, using Global Positioning System (GPS) technology.

To inform management, supervisory personnel, and employees of the need to establish accurate and consistent procedures for data collection using GPS across all Program Areas, and of the benefit of an Agency-wide approach to the use of GPS technology.

To provide standards for procurement of GPS hardware and software, training and certification of staff that use GPS, GPS data collection procedures, and data elements to ensure Agency-wide standards for acquisition and management of positional data obtained using GPS technology.

To provide oversight responsibility for this Policy through the TCEQ GIS Steering Committee and an employee designated to perform GPS coordination duties for the Agency.

POLICY

The TCEQ will use GPS technology in conjunction with other positioning technologies to collect and maintain accurate positional data. The Agency will create and maintain the highest level of programmatic data accuracy and consistency in conformance with these minimum policy standards to support internal and state-wide geo-positioning efforts.

DEFINITIONS

Datum - A mathematical model used by cartographers to define the shape of the earth in a specific area. Mapping applications in the United States are normally based on either the North American Datum of 1927 (NAD27) or the newer, more accurate North American Datum of 1983 (NAD 83). The coordinates of a given point depend on which datum is used.

Differential Correction - A process applied to raw GPS data that removes certain types of error; primarily, the error introduced by Selective Availability. This process requires correction data from a reference GPS receiver operating from a precisely know location. The process can be performed in “real time” if the reference receiver broadcasts the correction data and if the user can receive the correction data.

GIS - Geographic Information System. A collection of hardware, software, data and procedures to collect, store, manage, query and analyze spatial data as well as traditional tabular data. Computer mapping is a part of GIS, but beyond that, GIS adds a spatial dimension to all types of geography-based tabular data, allowing new, powerful tools for data integration, query and analysis in a wide variety of applications.

GPS - Global Positioning System. A satellite-based system managed by the Department of Defense to allow absolute geographic position measurement worldwide.

CHAPTER 8 INFORMATION RESOURCES

Texas Commission on Environmental Quality

GPS Data, Raw - Positional data obtained by a gps receiver before errors due to Selective Availability have been removed. These positions are typically only accurate to 100 meters.

GPS Data, Corrected - Positional data obtained by a gps receiver that has been differentially corrected to remove certain types of error, primarily Selective Availability. These positions are considered accurate to within twelve meters or even one meter, depending on equipment and procedures used.

Metadata - Metadata is “data about data.” In the case of positional data, the data stored in a database will include not only the latitude and longitude of a location, but also additional data elements that describe how and when the position was measured, and an assessment of the accuracy of the measurement. These additional data elements are called metadata.

Minimum Elevation - A GPS processing parameter which determines how high in the sky a satellite must be in order for the receiver to accept data from it for calculating a position. Measured in degrees of arc starting at the horizon.

PDOP - Positional Dilution of Precision. A measure of the quality of a GPS measurement taken from a given set of four satellites at a given time. If the satellites are not widely distributed from the user’s location, the PDOP value will be higher, and the quality of the measurement will be diminished. PDOP values over 6 are generally not acceptable.

SA - A procedure used by the Department of Defense to limit the positional accuracy available to non U.S. military users of GPS. Errors introduced by SA can be effectively removed through differential correction techniques.

AUTHORITY

TCEQ Commissioners

EFFECTIVE DATE

July 27, 1994

REVISED DATE(S)

March 20, 2000

November 4, 2002

CHAPTER 8 INFORMATION RESOURCES

Texas Commission on Environmental Quality

8.12.02 GLOBAL POSITIONING SYSTEM: Guidelines and Information

GPS COORDINATION

Steering Committee Role. The TCEQ Geographic Information Systems (GIS) Steering Committee consists of one voting representative from each Division that utilizes (or is beginning to utilize) GIS technologies and related technologies such as GPS. This Committee will be responsible for implementing and managing this Policy.

Coordinator Role. Certain aspects of GPS coordination are best handled by a single responsible individual. The Executive Director may reassign this responsibility at any time.

The responsibilities of the GPS Coordinator will include:

- Obtaining Agency GPS certification, if s/he has not already done so.
- Maintaining a database of all Agency personnel who have been certified to collect GPS data.
- Approving certain Agency personnel to serve as certification trainers.
- Providing assistance to the Program Areas in writing specifications for GPS hardware and software purchase, and in establishing efficient, cost effective GPS data collection procedures that meet the requirements of this Policy.
- Fostering communications within the GPS user community in the Agency to promote problem solving, sharing of useful techniques, and resource sharing.
- Coordinating with other State Agencies and the Texas GIS Planning Council to ensure consistency with related external data collection efforts and compliance with emerging State-wide GPS standards.
- Keeping the GIS Steering Committee informed of any issues relating to the Agency's GPS Policy or important developments in the GPS field.

GPS TRAINING & CERTIFICATION

To ensure that the Agency receives reliable and accurate positional data, all Agency personnel and contractors that will collect positions with GPS must first be certified.

An Agency GPS certification program will serve to:

- Make appropriate GPS training easily available.
- Ensure that staff training is sufficient to cover GPS techniques normally used within the Agency.
- Identify each certified individual with a certificate number.
- Provide reasonable validation that the accuracy of positional data obtained through GPS meets the Agency's GIS Positional Data Policy.

Trainer Qualification. The GPS certification trainer must be recognized by the GPS Coordinator as being qualified to give GPS certification training. The trainer is not necessarily an Agency employee. If the trainer is an Agency employee, s/he must:

- Be currently certified.
- Be approved to perform GPS training by his/her Section Manager or Division Director.
- Have actual field GPS data collection experience.
- Agree to include the minimum class elements as listed below.

CHAPTER 8 INFORMATION RESOURCES

Texas Commission on Environmental Quality

- Be familiar with the logistical aspects of conducting a certification class (this normally involves having recently served as an assistant to another trainer).

If the trainer is not an Agency employee, s/he must:

- Have experience in GPS field data collection and GPS training.
- Provide information to show that the proposed class includes the minimum elements described below, including discussion of relevant Agency operating policies.

GPS Training. Personnel will qualify for GPS certification through successful completion of a training class which includes certain minimum elements, as identified in the following paragraphs.

Minimum lecture and/or demonstration elements include:

- Background of the Global Positioning System.
- GPS accuracy issues.
- Relevant Agency operating policies.
- Operation of GPS equipment, including basic troubleshooting.
- Data collection procedures.
- Differential correction, both real time processing and post processing.
- Coordinate averaging for point locations.
- Data output in formats appropriate for import to GIS or tabular databases.

Minimum hands-on exercises, to be successfully completed by each student, include:

- Pre-planning, including data quality objectives, equipment and materials needed, logistics of field data collection, and prediction of GPS data collection conditions.
- Navigation to a given coordinate.
- Storing and transferring raw positional data.
- Differential correction of raw data through post processing.
- Averaging corrected point data and outputting to a GIS file.

Class exercises shall also include computer plotting of point data to allow students to better understand GPS accuracy issues and the effects of differential correction and point data averaging.

Equipment For GPS Training. The student and his/her Division are responsible for providing appropriate GPS equipment required for certification training. Although each student is encouraged to use their own unit during the class exercises, the trainer may approve sharing of units, no more than two students to one unit. In the event that units are shared, it is essential that each student directly performs each of the exercise steps at least once.

Contractor Certification. A person contracted to collect GPS data for the Agency is also required to obtain certification. This can be obtained in any of three ways: completing an Agency training class, completing a suitable training class offered by an outside vendor, or by providing documentation of sufficient GPS expertise and experience. Contractors must agree to adhere to relevant Agency policies when collecting GPS data.

Certificate Numbers. After each certification class, the trainer will report the names of those who successfully completed the class, and the date of completion, to the GPS Coordinator. The Coordinator will assign certificate numbers, add the names and numbers to the certification database,

CHAPTER 8 INFORMATION RESOURCES

Texas Commission on Environmental Quality

and print certificates for distribution by the trainer.

Maintaining Certification Status. The Coordinator will monitor staff usage of GPS approximately two years after certification to determine if the employee will need refresher training in order to maintain certification status.

GPS DATA ACCURACY CERTIFICATION

The current Geographic Information Systems Positional Data Policy sets a Root Mean Square (RMS) horizontal accuracy of 25 meters. GPS positions obtained by certified personnel, using appropriate equipment (as specified below), and appropriate data collection standards (as specified below), and properly documented (as specified below) will be certified under this Policy as meeting the 25 meter horizontal accuracy standard.

Offset Measurement. It is sometimes impossible, or impractical, to place a GPS receiver immediately on top of or adjacent to the site being positioned. In this case it is appropriate to obtain a GPS position at a nearby point with a known offset (X/Y or Bearing/Range) from the site. In these cases, potential error associated with the offset measurement must be added to the potential error associated with the GPS measurement in order to assess the accuracy of the site position.

Accuracy Level. A Program Area may impose higher accuracy requirements for certain purposes, as appropriate. It is the Division's responsibility to develop the proper procedures, including training for specialized techniques such as offset measurements, to ensure that the Division's required accuracy level is obtained. In the event that a position is needed that cannot meet the 25 meter accuracy standard, the position will not be considered certified, and the lower accuracy level will be reflected in the associated metadata.

GPS EQUIPMENT STANDARDS

Many models of GPS receivers and accessories are available from a number of manufacturers. These receivers differ greatly in accuracy and features; some are incapable of making measurements that meet the Agency's horizontal accuracy standard. To ensure that the Agency can get maximum benefit from its investment, the following minimum specifications will apply to all GPS equipment procurements:

GPS Receiver. A GPS receiver can be either a standalone unit, or a GPS module plugged into a portable computer. The GPS receiver must:

- Have six channel parallel reception or better.
- Employ these processing parameters:
 - Position acquisition rate - 1/second or better
 - Position mode - 3D (uses 4 satellites)
 - Maximum PDOP - 6 (or less)
 - Minimum Elevation - User-selectable*

**The elevation mask requirement may be waived if the Division can show that post-processing differential correction will never be needed on raw data obtained by the receiver.*

- Have the ability to perform real-time differential correction.
- Have the ability to store at least 180 raw position measurements for the purpose of post-processing differential correction. *(This requirement may be waived if the Division can show*

CHAPTER 8 INFORMATION RESOURCES

Texas Commission on Environmental Quality

that it will never need to perform post-processing differential correction on raw data obtained by the receiver.)

- Have the ability to transfer almanac and position data to a personal computer via a serial port.
- Include software to perform mission planning, differential correction, point data averaging, and conversion to common formats.
- Have a water and shock resistant case.
- Include portable power source(s) which will last a full working day.

Real-time Correction Receiver. This may be a standalone unit, or it may be integrated within the GPS receiver. The real-time correction receiver must:

- Receive correction data from a recognized, reliable source, and which is appropriate for real-time correction in the geographic area in which the GPS measurements will be made.
- Output correction data in RTCM-SC-104 (Radio Technical Commission of Maritime Service - Special Committee Paper No. 104) format via an RS-232 cable which matches the GPS receiver.
- Include portable power source(s) which will last a full working day.

GPS DATA COLLECTION STANDARDS

Detailed data collection procedures will be developed at the Division level and will be in accordance to this Policy. Divisions are strongly encouraged to utilize real-time differential correction techniques whenever possible, to reduce staff time and to eliminate the possibility that an error may occur during post-processing differential correction. The Division's procedures should take into the account the possible need for post-processing differential correction in the event that real-time correction fails due to signal loss.

- When using real-time correction, the correction data must be obtained from a recognized, reliable source, as determined by the GPS Coordinator.
- A single position reading obtained through appropriate use of real-time correction will be certified under this Policy as meeting the 25 meter horizontal accuracy standard. However, in the interest of obtaining better accuracy for little cost (about two minutes of staff time), staff is encouraged to average 100 or more positions to arrive at a final measured position.
- When using post-processing correction to measure a point location, staff must store at least 180 uncorrected positions in a file. Correction data must be obtained from a recognized, reliable source (such as the reference network maintained by the Texas Department of Transportation), as determined by the GPS Coordinator. The corrected positions should be averaged to produce a final measured position.
- All GPS measurements should be taken using a set of four satellites which are in a favorable configuration. The Positional Dilution of Precision (PDOP) is a recognized method to quantify how well the satellites are configured. The GPS receiver must be set to not record positions during times that the PDOP exceeds a value of 6.

MINIMUM DATA ELEMENTS

The Geographic Information Systems Positional Data Policy charges the GIS Steering Committee with implementing a minimum set of common data elements for positional data. All site positions measured with GPS and stored in an Agency database or spreadsheet file will include, at a minimum, the following data elements:

- Latitude – in decimal degrees, using NAD83 datum.

CHAPTER 8 INFORMATION RESOURCES

Texas Commission on Environmental Quality

- Longitude – in decimal degrees, using NAD83 datum.
- Method of Collection – using standard EPA codes.
- Date of Collection – date the GPS measurement was taken.
- Horizontal Accuracy Assessment – value in meters.
- GPS Certificate Number – to identify who made the measurement.

Data Dictionary. The Steering Committee will produce a data dictionary to aid in implementing these data elements in all databases that receive GPS positions.

Geographic Identification Number. An additional data element, called a Geographic Identification Number, is required under the GIS Positional Data Policy when positions are entered into a Geographic Information System.