Memorandum

Federal Highway Administration
Pavement Performance Division

6300 Georgetown Pike
McLean, Virginia 22101-2296

Subject: **ACTION**: LTPP Directive GO-34
Measurement and Update of Location Coordinates

Date: March 16, 2005

From: Jack Springer
Long Term Pavement Performance Team

Reply to
Attn of: HRDI-13

To: Dr. Frank Meyer, PM - LTPP North Atlantic Regional Contract
Dr. Frank Meyer, PM - LTPP North Central Regional Contract
Mr. Mark Gardner, PM - LTPP Southern Regional Contract
Mr. Kevin Senn, PM - LTPP Western Regional Contract

Attached is the Long Term Pavement Performance (LTPP) Directive GO-34 which provides instructions on field measurements, estimates, and processing procedures to update pavement test section, Automated Weather Station (AWS) coordinates, and traffic scale locations using modern Global Position System Receivers (GPSR) and related mapping software. The LTPP Regional Support Contractors (RSC) shall perform the following measurements, estimates, and updates to location coordinates in accordance with the attached directive. New measurements and updates shall be completed by May 2007. This directive should be transmitted to all appropriate personnel as soon as possible. This directive supersedes Directive S-10.

If you have any questions concerning this transmittal, please do not hesitate to call me at (202) 493-3144.

Attachments: 2

LONG TERM PAVEMENT PERFORMANCE PROGRAM DIRECTIVE

For the Technical Direction of the LTPP Program

Program Area:	General Operations	Directive Number:	GO-34
Date:	March 16, 2005	Supersedes:	S-10
Subject:	Measurement and Update of Location Coordinates		

This directive provides instructions on field measurements, estimates, and processing procedures to update pavement test section, Automated Weather Station (AWS) coordinates, and traffic scale locations using modern Global Position System Receivers (GPSR) and related mapping software. The LTPP Regional Support Contractors (RSC) shall perform the following measurements, estimates, and updates to location coordinates in accordance with the following guidelines. New measurements and updates shall be completed by May 2007.

The data collection forms have been designed for use in performing location measurements at Weigh-In-Motion (WIM) and Automated Vehicle Classification (AVC) sites. Coordinates for WIM sites included in the SPS traffic pooled fund study shall be performed. Measurement of the location of other traffic monitoring devices being used to provide data to LTPP shall be performed at the direction of FHWA.

- GPSR used for these measurements shall meet the following minimum standards:
    1. Has Wide Area Augmentation System (WAAS) capability or a potential location accuracy of less than 3-m.
    2. Display measured latitude and longitude coordinates to a resolution of 0.00001 degrees
    3. Provide an estimate of measurement accuracy in meters
    4. 12 parallel channel tracking capability
    5. Allow electronic storage of measurements as waypoints

- GPSR units used for these measurements shall be approved by FHWA.

- Test section location measurements should be performed at the beginning of the monitoring portion of each test section (station 0+00) as close as practical to the outside pavement edge either at the pavement shoulder interface or edge stripe.

- Measurements of LTPP AWS shall be performed at the base of the air sensor temperature support. If a measurement is not possible in this location, then a location as near as possible, but less than 10-m away, shall be selected for location measurement.

- Location measurements performed on WIM or AVC sites shall be performed at the approximate center of the sensor array, or in the case of WIM scale, at the location of the weight sensor, as close as practical to the outside pavement edge, either at the pavement shoulder interface or the edge stripe. Measurements shall be performed on the same side of the road on which the LTPP pavement test section is located.

- Measurements and location estimates shall be made using the World Geodetic System (WGS) 84 datum.

- Measurements shall be recorded on Inventory Data Sheet 1B. Only measurements performed on the same day shall be recorded on a given data form. Record all measurements perform on the data form.

- Measurement procedure

    1. The first measurement shall be attempted as soon as safely possible after arrival at a site. If an accuracy of less than 12-m is obtained on the first measurement, no further measurements are required.
    2. If an accuracy of less than 12-m is not obtained on the first measurement, perform repeat measurements as follows:
        a. When possible, perform up to 3 repeat measurements at time intervals more than 15-minutes apart, once a measurement with an error less than 12-m is obtained, no more measurements are required. After 4 repeat measurements are performed, no further measurements are required.
        b. If conditions restrict the amount of time at the location, the time interval between repeat measurements can be reduced to 5 minutes. If the time at the site or measurement location is restricted to less than 20 minutes, an alternative is to use an averaging function, on GPSR units so equipped. When using the averaging function, wait until at least 100 measurements have been taken. Record the resulting error and coordinates on the data sheet; no more measurements are required.
        c. Other alternative measurement procedures can be used as approved by FHWA.

- Electronic storage of locations using the waypoint feature. All location measurements shall be stored in the unit's memory as a waypoint. If multiple measurements are required, the measurement with the smallest measurement error should be saved. This will allow electronic download of the coordinates into a mapping program to verify the measurements. It is recommended that the LTPP site naming convention be used as the label for the waypoint; STATE_CODE+SHRP_ID for test sections and AWS_ID for

weather stations. In all cases measurements results shall be manually recorded on the data collection form.

- It is desired to measure the locations of all test sections and AWS contained in the pavement performance database. For out of study test sections or AWS, an attempt should be made to locate the previous locations in the field and obtain measurements.

- For test sections on which field measurements cannot be performed or are cost prohibitive to perform, previous location measurements shall be confirmed and updated using current mapping software, based on the WGS84 datum, and approved by FHWA. Location estimates shall be adjusted so that the location plots on the correct roadway or approximate location of an AWS. Evaluate the accuracy of the begin point location from previous measurements against location indicated by the mapping software. Using engineering judgment, make adjustments to the locations.

- Prior to entry into the database, field measured locations should be verified by comparing to previous measurements and plotting the locations on digital maps.

- Use computational checks to determine that the difference between begin points of coordinates of the test sections co-located on SPS project are approximately equal to the distances recorded in **SPS_PROJECT_STATIONS**.

- GPSR measured field elevations should be used to evaluate elevations previously entered in the database. If gross discrepancies are found between the elevation contained in the database and the measured values, others sources of information, such as highway agency construction plans, should be consulted before changes are made to test section elevations.

- Use Inventory Data Sheet 1C to convert and or record the new information to be entered into the pavement performance database.
    - For field measurements, the measurement with the smallest measurement error shall be entered. When multiple measurements are obtained with the same measurement error, but different coordinates, select one set of coordinate sets to enter. Complete the other information requested on the data form as appropriate.
    - For locations estimated by means other than direct measurements using modern GPSR equipment, provide locations on Inventory Data Sheet 1C to a maximum precision of $1x10^{-4}$ degrees. The accuracy field can be left blank for these records. Enter other requested information on the form as appropriate.

Prepared by: TSSC Team

Approved by:

Aramis López, Jr.
LTPP Program Manager

Inventory Data Sheet 1B

This data sheet is used to record field location measurements of objects using GPSR equipment.

STATE CODE. State code is the two digit number used to identify the State or Canadian province the site is located in. The state codes are defined in Table A.1, Appendix A of the LTPP Data Collection Guide.

SHRP_ID is the 4 character code used to designate the site in the LTPP database. For test sections, it is the 4 characters assigned each test section as indicated in the field. For AWS locations, the SHRP_ID associated with the AWS_ID used in the pavement data base shall be entered. For traffic monitoring equipment locations, the SHRP_ID entered on the form should be the one associated the test section or project in the traffic database; for test sections that entered the program in a GPS experiment, the SHRP_ID should be GPS test section SHRP_ID; for SPS projects, the SHRP_ID should be the project level ID used in the traffic database.

1. *Location*. Enter the number corresponding to the type of location being measured. If the type of location being measured is other, enter a description on the line labeled other.
2. *GPSR Manufacturer*. Enter the name of the manufacturer of the Global Positioning System Receiver used for the measurement.
3. *GPSR Model*. Enter the designation of the Global Positioning System Receiver used for the measurement.
4. *Station*. For test sections, enter the test section level station where the measurement was performed. This should normally be 0.0. Leave the entry null if location measurements are being performed on AWS or traffic monitoring equipment. If an "other" feature is being measured on a test section, enter its test section level station.
5. *Datum*. The datum should always be WGS84. If a different datum was used, please notify FHWA.
6. *Waypoint Name*. If the location was stored as a waypoint in the measurement device, enter the name given to the waypoint.
7. *Measurements*. For each measurement performed, record the latitude, longitude, elevation, and measurement accuracy.
8. *Comments*. Comments concerning details of the measurement, such as measurement performed in non-standard locations, measurement time, if no measurements were possible at a location due to lack of signal, or equipment problems should be noted in this field.

The person performing the measurements shall enter their three initials in the preparer field, their employers name in the employer field and the date the measurements were performed in the date field.

Inventory Data Sheet 1C

This data sheet is used to prepare location information to be entered into the database.

STATE_CODE. State code is the two digit number used to identify the State or Canadian province in which the site is located. The state codes are defined in Table A.1, Appendix A of the LTPP Data Collection Guide.

SHRP_ID is the 4 character code used to designate the site in the LTPP database. For test sections, it is the 4 characters assigned each test section as indicated in the field. For AWS locations, the SHRP_ID associated with the AWS_ID used in the pavement data base shall be entered. For traffic monitoring equipment locations, the SHRP_ID entered on the form should be the one associated the test section or project in the traffic database; for test sections that entered the program in a GPS experiment, the SHRP_ID should be GPS test section SHRP_ID; for SPS projects, the SHRP_ID should be the project level ID used in the traffic database.

1. *Location*. Enter the number corresponding to the type of location being measured. If type of location being measured is other, enter a description on the line labeled other.
2. *Station*. For test sections, enter the test section level station where the measurement was performed. This should normally be 0.0. Leave the entry null if location measurements are being performed on AWS or traffic monitoring equipment. If an "other" feature is being measured on a test section, enter its test section level station.
3. *Location Coordinates*. For field measurements, enter the measurement set with the smallest measurement error. Enter estimated coordinates to a precision of $1x10^{-4}$ degrees.
4. *Accuracy*. For field measured values, entered the accuracy of the measurement. For estimated coordinates, the accuracy can be left null.
5. *Datum*. The datum should always be WGS84. If a different datum was used, please notify FHWA.
6. *Elevation*. Enter the elevation of the measured object. For pavement test sections, the elevations should be based on information other than GPSR measurements. In most cases the existing elevation for the test section as currently contained in the database should be entered. If a new elevation for a test section is being recommended, check mark the box labeled new. For traffic monitoring devices, elevations based on GPSR measurements can be entered.
7. *Coordinates Determination*. Enter a number in the field corresponding to how the new coordinates were determined. Enter 2 if the field measured coordinates were adjusted based on map verification.
8. *Comments*. Enter comments for input into the database that will be useful to the users of this data.

The person performing the measurements shall enter their three initials in the preparer field, their employer in the employer field and the date the measurements were performed in the date field.

LTPP INVENTORY DATA GLOBAL POSITIONING MEASUREMENTS INVENTORY DATA SHEET 1B	STATE_CODE [__ __] SHRP_ID [__ __ __ __]

1. Location [__]
   1-Pavement Test Section 2-AWS 3-WIM scale 4-AVC 5-Other
   Other: _____

2. GPSR manufacturer _____

3. GPSR model _____

4. Station, m [__ __ __.__]
   (For a test section should be 0.0, null for AWS, WIM, AVC)

5. Datum [_____]

6. Waypoint name _____

7. Measurements

#	Latitude N Degrees	Longitude W Degrees	Elevation meters	Accuracy meters
1	__ __.__ __ __ __ __°	__ __ __.__ __ __ __ __°	__ __ __ __	__ __ __
2	__ __.__ __ __ __ __°	__ __ __.__ __ __ __ __°	__ __ __ __	__ __ __
3	__ __.__ __ __ __ __°	__ __ __.__ __ __ __ __°	__ __ __ __	__ __ __
4	__ __.__ __ __ __ __°	__ __ __.__ __ __ __ __°	__ __ __ __	__ __ __

8. Comments _____

_____

_____

Preparer _____ Employer _____

Date _____

LTPP INVENTORY DATA GLOBAL POSITIONING MEASUREMENTS DATABASE ENTRY WORKSHEET INVENTORY DATA SHEET 1C	STATE_CODE [__ __] SHRP_ID [__ __ __ __]

1. Location [__]

   1-Pavement Test Section 2-AWS 3-WIM scale 4-AVC 5-Other

   Other: _____

2. Station, m [__ __ __.__]

3. Location Coordinates - Converted measurement for Database input.

   Latitude (degrees) [__ __.__ __ __ __ __]

   Longitude (degrees) [-__ __ __.__ __ __ __ __]

4. Accuracy, m (can be null if estimated) [__ __ __]

5. Datum [WGS84]

6. Elevation, m [__ __ __ __]

7. Coordinate determination: [__]
   1-Direct field measurement 2-Estimated

8. Comments _____

_____

_____

Preparer _____ Employer _____

Date Prepared _____

Date Entered in Database _____

Data entry checked by _____ Date _____