GEORGIA DEPARTMENT OF TRANSPORTATION

GLOBAL POSITIONING SYSTEM
BRIDGE CENTERLINE
DATA COLLECTION METHODOLOGY STANDARDS

Georgia Department of Transportation
Office of Transportation Data
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Introduction

Bridge Centerline Data Collection

In building and maintaining a reliable and usable data for Geographic Information System (GIS) begins with proper collection technique. Organizing work activities before going out in the field is one of the most important procedures for Global Position System (GPS) data collection. It involves:

- planning
- research
- validation
- field collection
- data processing

The Georgia Department of Transportation (GDOT) Office of Transportation Data (OTD) shapes and directs the establishment of new GPS collection methodologies and procedures, establishing a common means of GPS collection approach for field technicians. This document is a work in progress and will be developed and updated as current technology and application changes.

Acronyms and Abbreviations

Acronym or Abbreviation	Definition
BIMS	Bridge Information Management System
DLGF	Digital Line Graph Format
DOQQ	Digital Orthophoto Quarter Quadrangle
DOT	Department of Transportation
GDOT	Georgia Department of Transportation
GIS	Geographic Information System
GPS	Global Position System
ID	Identification
mph	miles per hour
NAIP	National Agriculture Imagery Program
OTD	Office of Transportation Data
PDOP	Position Dilution of Precision
RCFILE	Road Characteristics file
RDC	Regional Development Center
SDR	Service Delivery Region
USGS	United States Geologic Survey

Version History

Date	Revision Number	By	Description
September 2006	00.01	GDOT-OTD	Initial Draft
9/29/06	00.02	GDOT OTD	Incorporated review comments/suggestions
10/2/06	00.03	GDOT OTD	Incorporated review comments/suggestions
October 2006	01.00	GDOT OTD	Release version 1

Mission Planning

Mission planning is one of the most important activities in GPS data collection. Mission planning can save considerable time, cost, and effort. Following are elements necessary to proper mission planning for road centerline collection:

- OTD will provide the necessary information to the project participant's locations of bridges to be collected, based on information provided by the Bridge Maintenance Section of GDOT. OTD will provide data from the following sources: RCFILE, Bridge Information Management System (BIMS) and GIS Clearing House. The bridge data dictionary will be made available for the project.
- Accuracy is affected by the relative positions of the satellites. Therefore, field technicians should plan carefully. Use Trimble PathFinder Office to generate a QuickPlan 'Maximum Satellite/Minimum PDOP' table to show optimal collection dates and times. Prior to generating this table, ensure that you have downloaded the most current satellite almanac to PathFinder Office.
- Check the weather forecast in the county in which you will be traveling. This will set up the collection priority and avoid delays.
- Keep track of productivity levels to determine how many bridges are possible to collect in a given time period. Use Project and Routing software to develop applied collection schedule for the GPS capture of bridges in your assigned region.
- Prepare working field maps of the general area where the bridge centerlines are to be collected. Data collectors should use these maps to minimize lost time in locating these elements for collection in the field.
- Verify that basestation operation hours match your data collection schedule. It will be necessary to post-process your rover data using a functioning basestation.

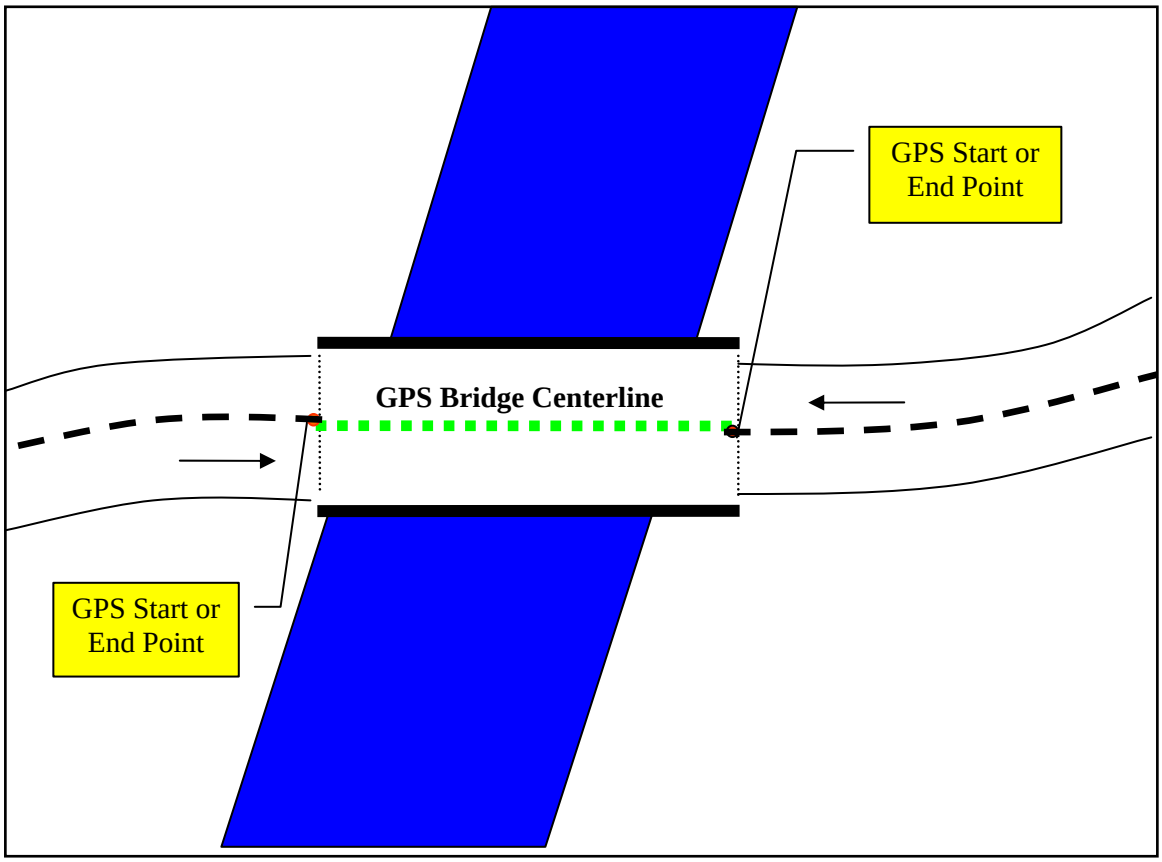
Collecting Bridge Data in the Field

GPS data collection methods used to capture bridge centerlines requires the use of a motorized vehicle (car/truck) capable of highway travel. The GPS data collection vehicle should maintain a speed of 15 mph to maximize point acquisition along the bridge centerline, particularly for short, undersized bridges. If possible, collect multiple points at the beginning and end of the bridge to enhance the positional accuracy of these to locations. Please check your offset distance to insure the center-line of the bridge is being collected.

GPS Centerline Collection for Two-Lane Bridge without Median

1. Begin GPS collection at the point where the actual bridge deck or structure starts. This is the point where the portion of the road and the bridge approach slab ends and the bridge deck begins. A longitudinal joint should be visible.

2. Stop collection at the other end of the bridge, where the bridge deck ends and road portion begins. You should see a longitudinal bridge joint.

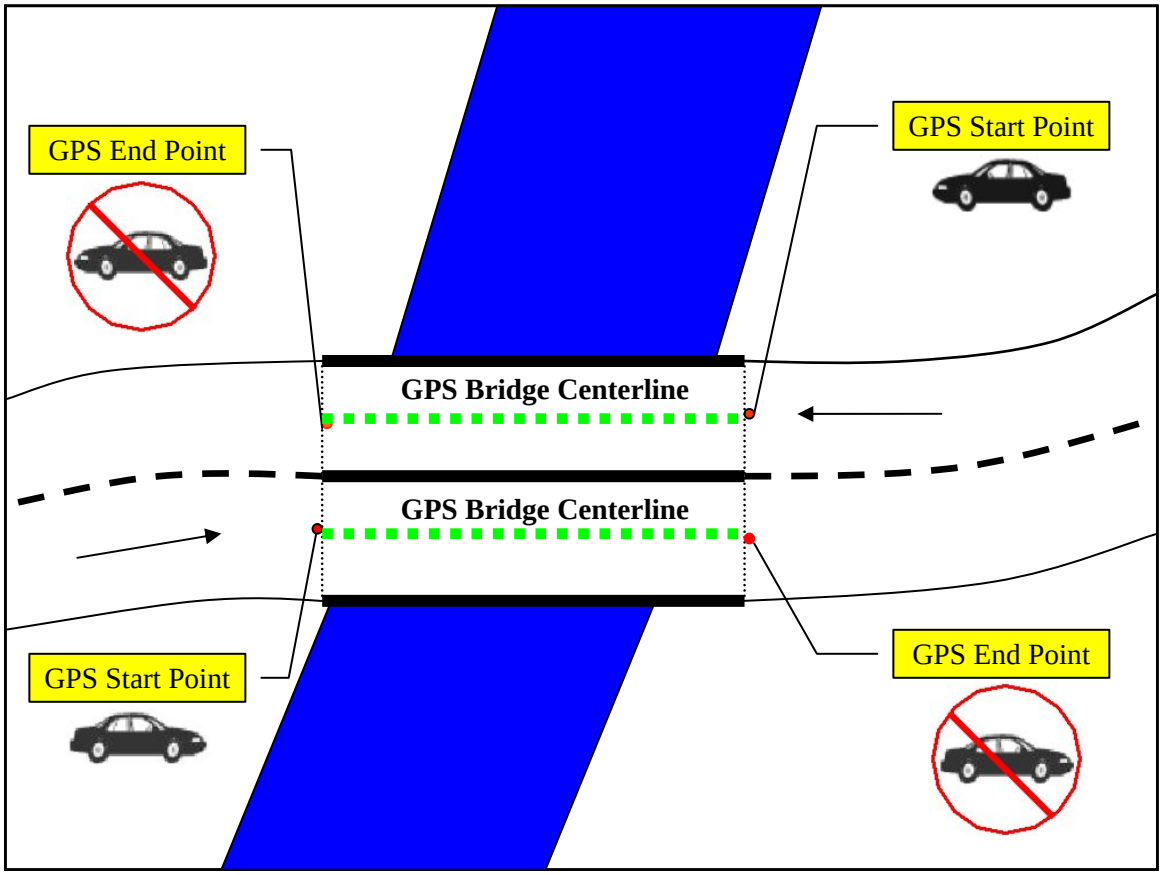


GPS Centerline Collection for Two Lane Bridge with Median

For a bridge with a median in the center that separates the different directions of travel, collect centerlines of both sides of the divided bridge. Each side of a bridge with a median is treated as a one-way bridge road.

1. Begin GPS collection at the point where the actual bridge deck or structure starts. This is the point where the portion of the road and the bridge approach slab ends and the bridge deck begins. A longitudinal joint should be visible.

2. Stop collection at the other end of the bridge, where the bridge deck ends and road portion begins.



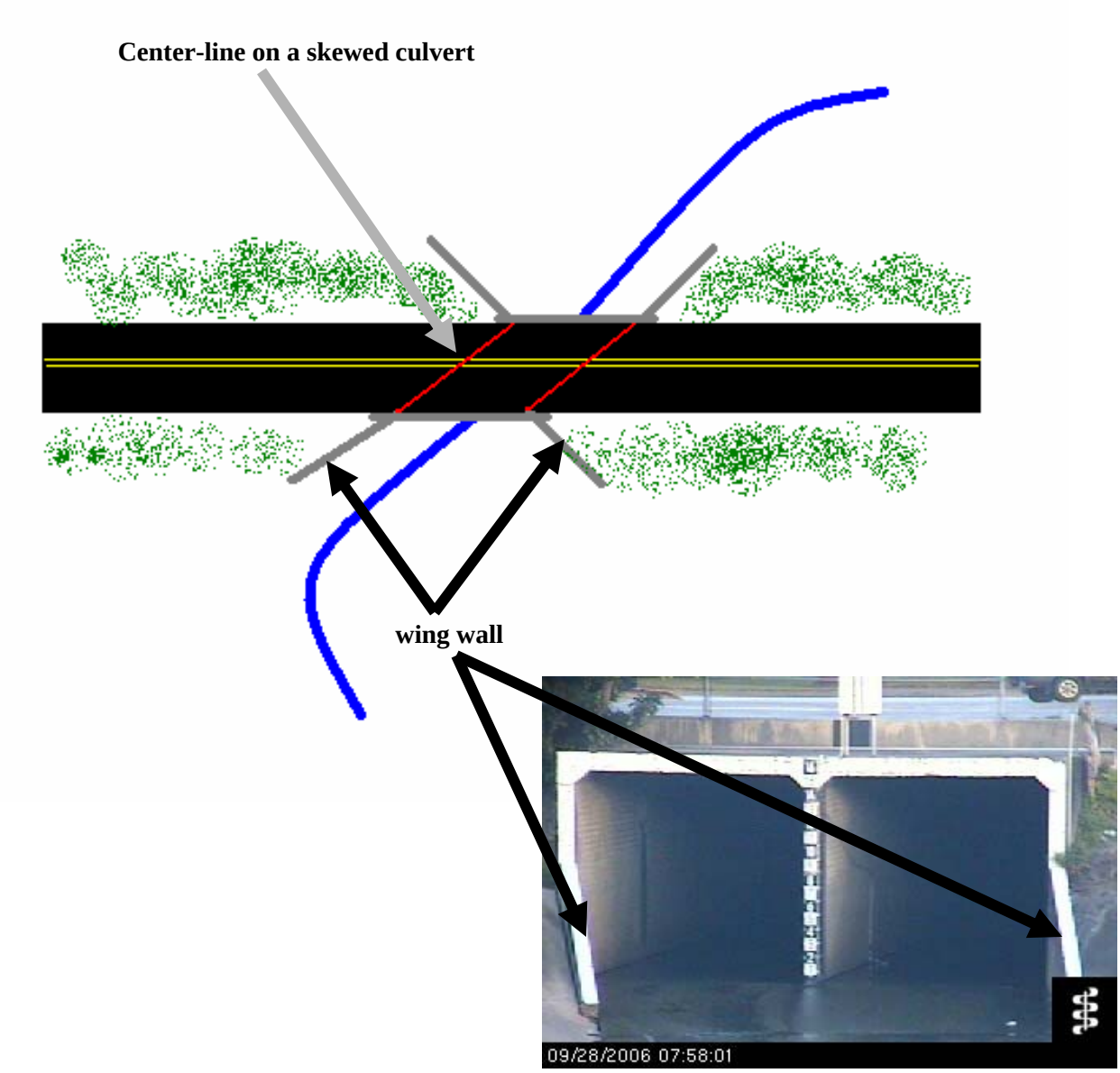
Bridge ID Verification

1. Before collecting the bridge centerline, check the bridge's assigned identification (ID) number using the BIMS, Clearing-house and Road Inventory data. The BIMS data is the primary data and should be used whenever available.
2. Compare the bridge's assigned ID number against the posted bridge tag or plate ID.
   - If the numbers do not match, use the assigned bridge ID number from the BIMS data.
   - If the bridge number is not available in the field or from the BIMS data, leave blank

GPS Centerline Collection for Culverts

For a culvert that has been identified as having a Bridge ID or Serial No., collect centerline of these structures in the same manner as a bridge. You will have to exit your vehicle to identify the starting and ending points for culverts.

1. Begin GPS collection at the point where the wing wall ties into the culvert.
2. Stop collection at the other end of the culvert, where the wing wall ties into the culvert.
3. If the culvert is skewed, locate the start and end points from both sides of the road and align the starting point with the location where the start bisects the center line.



Loss of Signal

1. Use the distinctive audible capabilities of the GPS data logger to ascertain when the signal is lost and regained.
2. In areas of high multi-pathing (dense tree canopy, mountainous areas, or urban areas) or curvilinear centerline, the signal may be lost. During signal loss, slow the collection pace or come to a complete stop and wait for the signal to return.

   If loss of signal occurs more than several hundred feet, the shape of the feature being collected may become distorted and will require recapture at a later date/time.

Offsets

An offset is a known distance set away from the antennae location of the GPS unit that is used to collect feature in areas of difficult accessibility.

Offset Type	Description
instant offset	Offset at the time of data collection
constant offset	Offset prior to data collection

Most often, instant offsets will be applied to the collection of long bridge centerlines when using vehicular travel.

1. During data collection, use offsets to capture the true centerline for bridges with an even number of lanes

   Exercise caution when applying offsets during data collection. Apply the correct side, measurement and units for the offset prior to data collection. If unnoticed during data collection, offset errors can render an entire data collection effort useless. Offset errors are hard to ascertain during the post-processing phase. If you suspect an offset error at the post-processing phase, use Digital Orthophoto Quarter Quadrangle (DOQQ) or other aerial imagery to perform quality control.

   If offset errors are detected during the post-processing phase, it may be possible to use PathFinder Office to correct any mistakes made, due to miscalculation of distance or direction. However, if there are too many offset errors and a clear method cannot be established to correct the mistakes, re-collect the centerlines.

Post-Processing of GPS Data

After field collection, the next phase of data collection is post-processing. The post-processing phase consists of:

- quality control inspection of all collected data
- editing out instances of high multi-path errors
- the correction of all rover data collected using the differential correction engine provided by PathFinder Office

1. Download the captured rover data to a field-based laptop or back at the office, using a desktop computer for post-processing procedures.
2. Create a backup of all rover data collected. This will ensure the ability to re-build the bridge centerline if the data becomes corrupted.
3. Keep all text based log file information generated by PathFinder Office during the post-processing phase. This information will be useful by GDOT during their inspection and review of the data submitted.
4. Inspect the following spatial qualities of the collected rover data:

Spatial Quality	Description
Shape	Does the bridge centerline look accurate based on GDOT-DLGF base map?
Curvature	Did you collect with sufficient vertices to accurately represent the curves in the bridge centerline?
Alignment	Is the centerline in the right place relative to other features visible in either ArcView or PathFinder Office?

5. Use the following data layers for visual inspection tools:
   - 1993 panchromatic USGS DOQQ
   - 1997 color infrared USGS DOQQs (if available)
   - 2005 3band color RGB NAIP DOQQ available from the Georgia GIS Clearing House
   - GDOT Tr_roads centerline data set
   - GDOT statewide bridge layer
   - GIS Clearing House bridge layer
   - Other scale relevant GIS data layers available to the Regional Development Center's
   -
6. Re-collect bridge centerlines that do not meet visual inspection standards.
7. Use the following steps to edit the collected rover data:
   1. Use PathFinder Office or ArcView GIS software only.
   2. Use DOQQs, aerial photos or other appropriate control data sources as a background.
   3. Remove multi-pathing errors (bad data spikes).
   4. Do not add or move vertices. Maintain data integrity by keeping the data true to its original collection.

8. Delete measurements that do not meet the following collection specifications.

   Note that filters can be set in PathFinder Office to assist in this process.

   Bridge Centerlines

   - PDOP (positional delusion of precision) greater than 6
   - SNR (signal to noise ratio) less than 6
   - Any features not differentially corrected or captured in real-time
   - Any features not collected in 3-D

9. Check the attribute information using the 'feature properties' in PathFinder Office or the 'feature tables' in ArcView. Check the following:

   - Spelling
   - No abbreviations
   - Missing or incomplete attribute information

10. Save all edits. This will allow GDOT to inspect edited rover files.

11. Use PathFinder Office to create the final shape file of captured bridge centerlines for a county.

    1. Export the corrected rover files (*.COR) into ArcView shapefile format.

    2. Verify that the proper code values, attributes, and coordinate projection/units information are transferred correctly. The number of positions should match the number exported.

    3. Ensure that you perform a geographic transformation during the export process to accurately project the road centerline data from WGS84 to NAD83.

       - Use the ArcView 3.x Projection Utility or ArcToolbox 8.x to perform the geographic transformation.
       - In ArcView 3.x, use the WGS_1984_1_to_NAD_1983 geographic transformation option located in the 'Datum Options' section of the Projection Utility.
       - In ArcToolbox 8.x, use the 'Set Transformation' button and select the 'North America/North American Datum 1983' option.

12. Use SMMS or ArcGIS 8.x metadata software programs to create FGDC compliant metadata. A sample copy of a GDOT FGDC compliant metadata is available on the provided CD-ROM.

13. Prepare and submit all required electronic deliverables to GDOT, as per the requirements set forth in the Electronic Data Delivery section of this document.

Exporting GPS Data

1. Use Pathfinder Office into either an ArcView shapefile or an ArcGIS generate file to export all the corrected bridge centerline rover data (*.COR). The rover data should be in the WGS84 datum (lat/long – decimal degrees). Do not use PathFinder Office to project the data into another mapping coordinate system.
2. Verify that the code values, attributes, and coordinate projection/units information are transferred correctly. The number of positions should match the number exported.
3. After exporting the GPS data, use the ArcView Projection utility or ArcGIS to project the data into the following coordinate system parameters:

Parameter	Value
Projection	UTM
Units	Meters
Datum	NAD83
Spheroid	GRS80

4. Perform a geographic transformation during the projection process to accurately change the bridge centerline data from WGS84 to NAD83. It is important to maintain data integrity, because a projection from WGS84 to NAD83 is not possible without using a geographic transformation. Consult your ArcView or ArcGIS documentation for more details.

Electronic Data Delivery Guidelines

Unless specifically governed by the contract, addendums, or additional standards furnished by the Georgia Department of Transportation, the following section applies to the submittal of electronic deliverables under the Transportation Services Contract between the Department and Regional Development Centers (RDC).

All data deliverables and monthly progress reports shall be submitted to GDOT on CD-ROM to the Statewide Transportation Data Coordinator on a monthly basis.

1. Prior to submitting data to GDOT, verify the completeness of all deliverables. A complete data set includes the following: In addition, all data should be thoroughly scanned for viral or other malicious code virus prior to submission.

    - Rover Files (Corrected and Uncorrected)
    - FGDC Compliant Metadata
    - GPS Basestation Files
    - ArcView Shapefiles
    - Log files generated by PathFinder Office

2. Prior to submitting data to GDOT, thoroughly scan all data for viral or other malicious code virus.

3. Complete a "Properties Summary" dialogue box for every Microsoft Office document submitted to GDOT. This provides GDOT staff with quick information as to what SDR created the document, date of creation and a quick synopsis of the document's purpose. Properties can be accessed from the 'File' menu option in any Microsoft Office document.

All data submitted to GDOT will adhere to the following Standard File Formats:

Microsoft

GDOT accepts deliverables created with the following Microsoft Office Professional Suite products: Word 2003, Excel 2003, Access 2003, PowerPoint 2003, and Project 2003. GDOT uses the following operating system.

ems	Win2K, NT4.0 (SP5 and 6a) and Windows XP. Do not send files that cannot be read in these operating environments.
Compression	GDOT accepts the use of the WinZip (v. 7.0, 8.0 and 8.1) file compression utility and formats.
Graphics	Use high-resolution properties when creating graphics. Graphics may be created or exported into the following formats: • JPEG File Interchange format (*.JPG) • Graphics Interchange Format (*.GIF) • Windows Bitmap (*.BMP) • Adobe Acrobat (*.PDF)
Digital Photography	GDOT supports JPEG (*.JPG) for digital camera photography. Do not submit images in TIFF format unless specifically requested.
Screen Captures	Screen captures are accepted as a graphic submittal to GDOT. Make certain that all screen captures conform to one of the four accepted standard graphics formats listed above.
GIS/GPS Formats	GDOT uses ESRI GIS software products and accepts most ESRI data formats. Specifically, GDOT uses ArcView and ArcGIS GIS software.

4. The packaging of the deliverable shall be of professional quality, using widely available and standard CD packaging materials.
   - Use CD-R media only. CD-ROMs must be created using standard CD burning hardware and published in such a way that all computers with standard CD-ROM drives are able to read the information contained on the disc.
   - All CD-ROMs submitted to GDOT shall be in an industry standard, clear plastic CD jewel case.
   - Each jewel case shall have side labels on both sides, in the following format:

FY 2003 1st Quarter GDOT Transportation Services Contract
SDR 01 – Middle Regional Development Center

FY 2003 1st Quarter
(07/01/02 –10/31/02)
GDOT Transportation Services Contract

Service Delivery Region 01

Full Name Regional Development Center

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