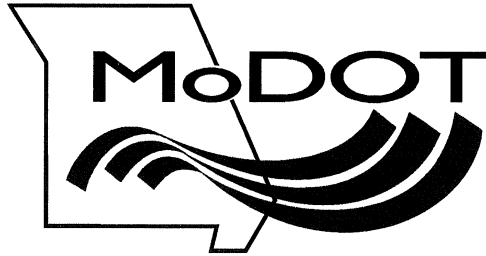


*Missouri
Department
of Transportation*



105 West Capitol Avenue
P.O. Box 270
Jefferson City, MO 65102
(573) 751-2551
Fax (573) 751-6555
www.modot.org

Pete K. Rahn, Director

November 3, 2006

Dear Consultant:

The Missouri Highways and Transportation Commission is requesting the services of a photogrammetric consulting firm to provide control survey on the projects listed on the attached sheet. The projects are scattered over the entire state with a great portion being large corridor projects with at least 10 miles in length.

Please limit your letter of interest to no more than two pages. This letter should include any information, which might help us in the selection process, such as the qualifications of the firm to perform this service, and similar projects your company has recently completed or is now doing. We will utilize the consultant information already on file so we will not need a lengthy submittal of other general company information. Any firm unable to provide services on one of the projects listed will not be considered to provide services on any of the listed projects.

We encourage DBE firms to submit letters of interest. You must list any sub consultants that you need to complete the professional services requested by MoDOT.

If your firm would like to be considered to provide these services, you must submit letters of interest by 4:00pm, November 22, 2006 to the address listed below.

Missouri Department of Transportation
P.O. Box 270
601 W. Main
Jefferson City, MO 65203
Attention: Alexa Mitchell – Photogrammetry

You may also submit letters of interest by fax to (573) 526-4535 or E-mail at Alexa.Mitchell@modot.mo.gov. A fax or E-mail will be sent to notify the sender that the letter of interest was received. If you have any questions feel free to contact Alexa Mitchell at (573) 751-6591.

Sincerely,

Dave Nichols
Director of Program Delivery

am
Attachments

cc: Mr. Shyam Gupta – br
Mrs. Kathy Harvey – de
Mr. Lester Woods - cm



EXHIBIT I

SCOPE OF SERVICES

The work covered by this agreement shall include furnishing equipment, materials, professional, technical, and personnel resources necessary for the performance of photogrammetric surveying services for design and development of the specified highway project.

The following information will explain and define the items of importance relating to this project. All the elements of work that are necessary to satisfactorily complete the surveying of this project may not be listed. The lack of a specific listing of an element or item of mapping does not in itself constitute a basis for additional services or work supplement, and/or adjustment in compensation.

- I. **PROJECT.** Control surveying for the specified project area. The services shall provide data necessary for application in preliminary highway design.
- II. **PROJECT LOCATION AND LIMITS.** Refer to table II-1 for project locations.

TABLE II-1
PROJECT LOCATION

Job Number	County	Route	Length	Location
J4P0979	Henry	7	3.4 mi	1.4 mi N/O and 2 mi S/O Rte O
J4P01103	Lafayette	13	4.0 mi	1.7 mi W/O 224 / 24 to Rte 13 / Higginsville Rd.
J4S1940	Jackson	291	1.2 mi	2 mi N/O 291 / Courtney Rd to 6 mi N/O 291
J5P0925	Morgan	52	12.5 mi	Rte 5 in Versailles to Rte W
J5P0922	Benton	52	11.2 mi	Rte W to Rte 65
J7P0820	Jasper	171	5.5 mi	Rte 96 to Rte 43
J8S0853	Dallas	73	1.0 mi	Relocation of Rte 73 to Rte 65
J8S0836	Greene	60	1.0 mi	1 mi N/O Rte 60 and MM to 0.9 mi S/O Rte M/ZZ

III. SERVICES AND DATA PROVIDED BY THE COMMISSION

The COMMISSION will provide available information of record to the CONSULTANT. In addition, the following specific items will be furnished or performed by the COMMISSION:

- 1) The project location and limits (.dgn format).



- 2) Flight plans (ASCII and .dgn format)
- 3) Mapping & photography limits (.dgn format)
- 4) Found horizontal and vertical control points to be used in the control survey.

IV. SCOPE OF WORK. Work covered in this document shall include furnishing the professional, technical, and other personnel necessary for targeting and control survey for the project. The services shall address the following:

- 1) **Planning.** The CONSULTANT is responsible for project planning as it relates to coordination the photo control targeting prior to the photo mission.
- 2) **Standards.** The CONSULTANT shall comply with the most recent and applicable state and federal laws.

V. SPECIFICATIONS FOR SURVEYING

- 1) **Project Limits.** Targeting and control surveying will be performed within the limits that are graphically marked and indicated on the COMMISSION provided map files.
- 2) **Target Planning.** All projects requiring mapping are targeted. Projects are to be targeted so that the use of vertical only points and photo identifiable points are not required. The flight plan designates the mapping area and any additional photo coverage requested by the district. Control of the largest practical area will be done to allow for the possibility of mapping extra area if needed. Target placement at a minimum must satisfy the control requirements of the mapping area.
- 3) **Notification of Target Placement.** The survey consultant shall notify the photogrammetric consultant upon placement of targets for each job. This notification may be by phone if followed up by e-mail.
- 4) **Material for Targets.** White paint or reflective white marking tape is used for targets on paved surfaces. Unbleached muslin or white plastic is used for grass, dirt and aggregate surfaces
- 5) **Placement of Targets.** The mapping project must begin and end with three control targets, which are placed roughly in a triangular pattern.



The two lateral targets should be spaced at the offset distance and the third target should be near the mapping corridor. No mapping will be done beyond the last target so enough targets should be placed to ensure adequate coverage. Position targets in locations with a good field of view to minimize the cutting of vegetation and reduce the number of required ground setups. Targets are located as required for visibility from the air in areas free of shadows. When targets are placed upon paved shoulders of the roadway, it is suggested that the northern shoulder be used to avoid obscuring the target with shadows from objects on the southern side of the road. When cloth targets are placed, they should be located on level areas, with all underbrush and weeds adjacent to the targets removed.

Targets are located where they are least likely to be disturbed. Targets are placed so that the time lapse between placing the targets and the photography is held to a minimum. If the time lapse is of such duration as to cause doubt of the target condition, the targets are to be checked immediately prior to photography.

GPS locations shall be collected for each target placed (5/8 x 12-15 inch iron pin with center punch or chiseled X-cut set below the ground surface). This will allow the pin to be re-located if the target is removed. Guard lath shall be driven next to targets where possible. The name and phone number of the survey consultant shall be on the lath.

- 6) **Size and Shape of Targets.** The acceptable target is a three-legged propeller. Each leg of the target is a rectangle panel measuring ½ ft. by 3 ft. The legs are placed so that the corner of each panel touches thereby creating a triangular area in which to center the pin. The legs should be separated radially by 120 degrees.
- 7) **Control Survey.** The CONSULTANT shall perform a control survey for the project. This survey will ensure precise positions of traverse stations and/or GPS network stations throughout the project. The survey shall comply with the following specifications.
 - a. **Horizontal Control.** The control point pairs will be tied to the National Spatial Reference System (NSRS) through direct GPS ties to first or second order stations as defined in 20 CSR 2030 –18.010 NSRS horizontal and vertical monuments using post-processing software or by NGS OPUS solutions. All OPUS solutions shall be based on a minimum of two hours of dual frequency data. On projects with more than one intervisible



pair, the adjacent pairs will be tied together. On projects of two or three pairs the beginning and end points shall be joined by a GPS vector. On projects having four or more pairs, the beginning and ending pairs so connected will have ties into the NSRS. The control station is to be described in such manner as to facilitate navigation and recovery of its location. Only static or rapid-static GPS procedures are permitted for this survey type.

- b. **Vertical Control.** The control points will be referenced to NGS Vertical control. Benchmarks near the project should be used for the vertical reference for a project. If the NGS vertical control marks are not found nearby or a considerable distance away, then the GPS derived elevations should be used for the project. If any portion of the survey does not comply with these specifications, a written report substantiating the material variances from the specification with the responsible surveyor's signature is required. The COMMISSION reserves the right to disallow variation.
 - c. **Benchmarks.** Benchmarks should be placed approximately 1200 to 1800 feet apart throughout a project. Benchmarks should be without movement and set on objects and in locations that will remain undisturbed. Some examples listed in order of preference are bridge abutments and culvert headwalls that aren't involved in a project, anything on a concrete structure that can be located (square in sidewalk near building, etc.), fire hydrants, railroad spikes in power polls, and railroad spikes in trees. A tie to these benchmarks is required in the form of a navigation description to the benchmark and three-point reference ties.
- 8) **Linear measures.** Linear measures will be made in the English System. The base unit will be the United States Survey Foot (and decimal parts thereof).
 - 9) All coordinates shall be based on the State Plane Coordinate System, North American Datum (NAD) of 1983 (1997) in the appropriate zone.
 - 10) The elevations shall be based on the North American Vertical Datum (NAVD) of 1988.
 - 11) Consultant will use Global Positioning System (GPS) survey technology to establish the ground control. The elevations shall be based upon ellipsoidal heights that have been modified by the NGS Geoid 03 model.



12) **Projection Factor.** The CONSULTANT is responsible for developing a project projection factor based on the Missouri Coordinate System of 1983 Manual for Land Surveyors.

- a. **Scale Factor.** Using the most easterly and westerly control points within the project to develop a centroid point for a project. Use the converted English easting of the centroid point in the correct zone formula below.

$$\text{East Zone} = (\text{easting} - 820,208.3333) * 0.00000000045 * (\text{easting} - 820,208.3333) + 0.9999333 = 393,700$$

$$\text{Central Zone} = (\text{easting} - 1,640,416.6665) * 0.00000000045 * (\text{easting} - 1,640,416.6665) + 0.9999333 = 393,700$$

$$\text{West Zone} = (\text{easting} - 2,788,708.3331) * 0.00000000045 * (\text{easting} - 2,788,708.3331) + 0.9999412 = 393,700$$

- b. **Elevation Factor** is determined by dividing the ellipsoid radius by the ellipsoid radius plus the mean elevation for the project.

$$\text{Elevation Factor} = \frac{20909689}{[20909689 + (\text{elevation in feet} - 100.065)]}$$

- c. **Grid Factor** is the result of multiplying the Elevation Factor by the Scale Factor of the centroid point of the project.

$$\text{Grid Factor} = \text{Elevation factor} \times \text{Scale factor}$$

- d. **Projection Factor** is the reciprocal of the grid factor

$$\text{Projection Factor} = 1 / \text{Grid factor}$$

13) **Types of Control Points:**

- a. **Primary Control.** A Primary Control Survey Network (PCSN) consisting of semi-permanent, intervisible, control point pair(s) (5/8x12-15 inch iron pin with center punch or chiseled X-cut set below the ground surface) will be set and referenced at each site. One intervisible control point pair will be established for approximately each mile of alignment. A constrained least squares adjustment shall be made for all the points that comprise the PCSN. If a single project exceeds twenty miles in length, a supplemental control tie to the NSRS shall be made at



the approximate midpoint. The survey report shall include a summary of closures and accuracies for the PCSN. A minimum of three reference ties to recoverable accessories will be made for each control station. The control station is to be described in such manner as to facilitate navigation and recovery of its location. Only static or rapid-static GPS procedures are permitted for this survey type.

- b. **Photo Control Points** (targets/photo-identifiables). The consultant will plan and establish horizontal and vertical photo control points required for the topographic mapping. The CONSULTANT shall place targets to be used for project control. Pins will be recessed for targets that are not located on a paved surface. The elevation of both the target and the pin will be reported. With the ground elevation going to the .CTL file and the pin elevation going to the .REC file. The accuracies shall be sufficient to support the topographic mapping requirements. Photo-identifiable control points can be used to supplement the ground control. These points include, but are not limited to utility poles, corners of concrete structures, painted stripes, manhole covers, etc. Photo control points will not be referenced. RTK GPS survey procedures are permitted for this survey type.
- c. **Field Check Points.** Random supplemental checkpoints at varying offsets from centerline will be obtained by the Consultant, resulting in approximately ten (10) points per mile of alignment. The points must be inside the mapping corridor limits. The accuracies shall be sufficient to support horizontal and vertical accuracy checks of the topographic mapping. The supplemental control points will not be referenced. RTK survey procedures are approved for this survey type.

VI. SPECIFICATIONS FOR SURVEY DELIVERABLES

The CONSULTANT shall provide to the COMMISSION the following items:

- 1) Three ASCII coordinate files all containing the primary control, photo control and check points for the project survey. These files are:
 - a. **Ground Elevations.** The photogrammetric control file. A file listing control positions by point number, X, Y, and Z values in project units. These values are referenced to the Missouri Coordinate System of 1983, zone name Zone, in an ASCII file format. The file will be named J#####.ctl with specifications



for file setup in Appendix A, Item 1.

- b. **Pin Elevations.** The survey control file. A file listing control positions by point number, X, Y, and Z values in project units referenced to the Missouri Coordinate System of 1983, zone name Zone, with X and Y values modified by the projection factor. This ASCII formatted file will be named J#####.rec with specifications for file setup in Appendix A, Item 2.
 - c. **The Geodetic Control File.** A file containing latitude and longitude information for all control points named J#####.txt with file format listed in Appendix A, Item 3. All OPUS solution sheets and/or data sheets from post processed static GPS sessions. Calculations for grid and projection factor including the centroid point, mean elevation and the final grid and projection factor will also be listed in this file.
 - d. **MoDOT Survey Report.** A MoDOT survey project report for each project. See Appendix A, Item 5.
- 2) Copies of all intervisible control survey pair station descriptions along with all benchmark descriptions and field ties. A sketch of each point shall be provided showing the relative location of field ties to the point being referenced.
- 3) The CONSULTANT shall provide a letter certifying that the below mentioned surveying specifications have been achieved for this project. The letter shall document the relative positional accuracies in parts per million, the confidence level in percent, and the post adjustment residual values in centimeters that were achieved on this project.

The survey report documents proof of these specifications:

- a. Fixed preprocess baseline solutions.
- b. Control station relative positional accuracies of 10 ppm in relation to adjacent stations at the 95% confidence level.
- c. Post adjustment residual values < 3 cm in any dimension for control stations.
- d. A map of no greater than 1:24,000 scale (USGS Topography map) with all survey control points plotted and labeled on



hardcopy, digital or both.

- 4) The CONSULTANT shall provide a set of contact prints from film aerial camera with the photo control and north arrow graphically depicted on the front of the photo and a description of the point(s) printed on the back of the photo.
- 5) The CONSULTANT shall furnish the files on CD ROM format. All submittals shall consist of two CD ROMs, one shall be labeled "working set" and one set labeled "archive set". In addition the CD ROMs shall contain a text file describing the contents including project name, file names, consultant's name and the date of submittal. This file shall be named CONTENTS.TXT and be located in the root directory of the disk.

VII. ACCEPTANCE OF COMPLETED WORK

- 1) The CONSULTANT shall submit all completed work promptly to allow time for proper review. Work reviewed and found in accordance with the specifications shall be considered to constitute "satisfactorily completed and accepted work."
- 2) The Missouri Department of Transportation will determine which photography work is in accordance with these specifications and represents acceptable work. Failure to produce acceptable work as specified, and after the CONSULTANT has exercised the right to verify the quality of the work will cause the following:
 - a. The Missouri Department of Transportation may reject that portion of the work and the CONSULTANT will accept a hundred (100) percent reduction in payment, at the agreement price, for the affected portions of work.
 - b. In the event that some work is found to be unacceptable in accordance with the specifications, and reworking is deemed necessary, the CONSULTANT agrees that it shall complete such work without expense to the Missouri Department of Transportation, even though final payment may have been received. The CONSULTANT must give immediate attention to these changes so there will be a minimum delay. The above and foregoing is not to be construed as a limitation of the Missouri Department of Transportation right to seek recovery of damages for negligence on the part of the consultant.



- 3) **Return of Source Data.** The CONSULTANT shall return to the COMMISSION all of the provided source data, including all aerial photographs and maps.
- 4) **Data Quality.** The CONSULTANT shall be responsible for the professional quality, technical accuracy and the coordination of data, documents and other services furnished for this project.
- 5) **Additional Services.** The COMMISSION reserves the right to request additional work beyond the scope of services addressed in this document. In this event, a supplemental agreement shall be executed and approved prior to the performance of additional services. Changes in compensation will be addressed in the supplemental agreement.
- 6) **Documentation.** The CONSULTANT shall provide any documentation necessary to explain, support and clarify the procedures used for data development.
- 7) **Data Ownership.** All data and documents prepared in performance of this scope of services shall be delivered to and become the property of the COMMISSION upon suspension, abandonment, cancellation, termination, or completion of the CONSULTANT'S services.

VIII. SCHEDULE AND DELIVERY

- 1) **Schedule.** Projects that have targeted ground control points must be coordinated with the placing of targets and the photo mission so that a minimum of time will elapse between targeting and photography. MoDOT will identify priority sites needing final reports for mapping. The CONSULTANT will continuously prosecute the work and survey deliverables shall be submitted to MoDOT as they are completed. The time of completion for all of the work addressed in these documents shall be August 1, 2007.
- 2) The COMMISSION will grant time extensions for unavoidable delays beyond the control of the CONSULTANT. Requests for extensions of time shall be in writing by the CONSULTANT, before plans are due, stating fully the reasons for the request.



3) Materials to be delivered.

- a. A set of contact prints from film aerial camera with a north arrow and the photo control graphically depicted on the front of the photo and a description of the point(s) and a reference to the corresponding field book printed on the back of the photo.

Example:

Station# _____
Book _____ Page _____
Desc. of point _____
Ground Elev. _____

- b. Survey reports and sketches.

4) All material shall be delivered to:

Missouri Department of Transportation
P.O. Box 270
200 Harrison St.
Jefferson City MO 65102
Attention: Photogrammetry



APPENDIX

1. **Example of File Format for the Photogrammetric Control File.** This file is described in the Specifications for Control Survey Deliverables, item 1) a).

This file lists control positions by point number, X, Y, and Z values in project units. These values are referenced to the Missouri Coordinate System of 1983, _____Zone, in an ASCII file format with the following column assignments.

Columnized Feature	Point #	X Coordinate	Y Coordinate	Elevation	
Column #'s	1 – 3	5 – 15	17 – 27	29 – 36	

The file is space delimited.

```
801 2822698.048 1049380.027 879.890
802 2822109.962 1046386.240 833.220
803 2824745.770 1047848.664 866.570
804 2827979.396 1045633.469 807.810
805 2830295.248 1046379.796 767.000
806 2832731.880 1045946.490 770.860
807 2833973.971 1045530.297 823.210
808 2834925.754 1045765.585 785.850
809 2840304.352 1044862.477 872.640
810 2841701.376 1044426.162 894.570
811 2844038.780 1045215.527 918.880
812 2844065.693 1044044.473 914.890
813 2846978.128 1043812.817 924.270
814 2849221.801 1043268.513 946.570
815 2851956.658 1042880.686 974.720
816 2853466.225 1041758.320 934.200
817 2855618.327 1041573.120 946.820
818 2857946.557 1043634.129 892.230
819 2857249.308 1040920.208 939.330
901 .000 .000 883.130
903 .000 .000 759.860
904 .000 .000 832.470
```



2. **Example of File Format for the Survey Control File.** This file is described in the Specifications for Control Survey Deliverables, item 1) b).

This file lists control positions by point number, X, Y, and Z values in project units. These values are referenced to the Missouri Coordinate System of 1983, _____ Zone and modified by the projection factor. This is an ASCII file-format with the following column assignments.

Columnized Feature	Point #	X Coordinate	Y Coordinate	Elevation	
Column #'s	1 – 5	7 – 21	22 – 36	38 – 49	

The file is comma delimited. Spaces are needed before decimal with trailing zeros after decimal to five places.

```
801, 2822698.04800, 1049380.02700, 879.89000,  
802, 2822109.96200, 1046386.24000, 833.22000,  
803, 2824745.77000, 1047848.66400, 866.57000,  
804, 2827979.39600, 1045633.46900, 807.81000,  
805, 2830295.24800, 1046379.79600, 767.00000,  
806, 2832731.88000, 1045946.49000, 770.86000,  
807, 2833973.97100, 1045530.29700, 823.21000,  
808, 2834925.75400, 1045765.58500, 785.85000,  
809, 2840304.35200, 1044862.47700, 872.64000,  
810, 2841701.37600, 1044426.16200, 894.57000,  
811, 2844038.78000, 1045215.52700, 918.88000,  
812, 2844065.69300, 1044044.47300, 914.89000,  
813, 2846978.12800, 1043812.81700, 924.27000,  
814, 2849221.80100, 1043268.51300, 946.57000,  
815, 2851956.65800, 1042880.68600, 974.72000,  
816, 2853466.22500, 1041758.32000, 934.20000,  
817, 2855618.32700, 1041573.12000, 946.82000,  
818, 2857946.55700, 1043634.12900, 892.23000,  
819, 2857249.30800, 1040920.20800, 939.33000,  
901, 0.00000, 0.00000, 883.13000,  
903, 0.00000, 0.00000, 759.86000,  
904, 0.00000, 0.00000, 832.47000,
```



3. **Example of File Format for the Geodetic Control File.** This file is described in the Specifications for Control Survey Deliverables, item 1) c).

A file containing latitude and longitude information for all control points.

Columnized Feature	Point #	Name of Station	Geodetic Position	Map Coordinates	Scale & Convergence
Column #'s	1 – 8	10 – 24	30 – 48	52 – 62	65 – 80

MISSOURI COORDINATE SYSTEM OF 1983

CAMDEN RTE. 54
JOB # 5P347
OSAGE BEACH BY PASS WEST TO
RTE. KK TO GLAIZE BRIDGE

PROJECTION FACTOR 1.0001041
GRID FACTOR .9998959
Zone = Missouri Central

POINT	NAME	LATITUDE & LONGITUDE	STATE PLANE (FEET)	CONVERGENCE
239		N 38°07'33.666917" N W 92°41'14.262069" E	834741.3171 446123.0874	- 0°06'56.2857"
240		N 38°07'19.125203" N W 92°41'35.040821" E	833273.8370 444459.6998	- 0°07'09.0759"
241		N 38°07'17.505657" N W 92°41'32.972773" E	833109.6780 444624.6167	- 0°07'07.7949"
242		N 38°05'53.679786" N W 92°40'42.072381" E	824622.6549 448675.7757	- 0°06'36.1670"
243		N 38°05'57.349493" N W 92°40'37.844930" E	824993.1943 449014.4065	- 0°06'33.5675"



4. **Example of GPS Report Files.** These files contain information reporting the observation, adjustment and analysis details of GPS measurements. These reports illustrate the survey's compliance to the Control Survey Specifications of the Scope of Service.

The files document proof of these specifications:

- Fixed* preprocess baseline solutions.
- Preprocessed ratios between variances generated in the integer search > two (2).
- Reference variances < ten (10).
- Control station relative positional accuracies of 10 ppm in relation to adjacent stations at the 95% confidence level.
- Post-adjustment residual values < 3 cm in any dimension for control stations

From Station	To Station	Solution Type	Slope Distance (meters)	Ratio	Reference Variance	From Ant. Ht. (meas. meters)	To Ant. Ht. (meas. meters)
1 1 GRS CA01	803	iono free fixed	1050.358	47.8	0.720	1.468	1.574
2 1 GRS CA01	801	iono free fixed	1113.209	48.3	0.695	1.468	1.569
3 1 GRS CA01	802	iono free fixed	894.368	28.1	1.695	1.468	1.520
4 802	803	iono free fixed	161.246	37.4	1.671	1.520	1.574
5 802	801	iono free fixed	234.541	45.1	1.393	1.520	1.569
6 803	801	iono free fixed	150.591	73.6	0.517	1.574	1.569
7 803	805	iono free fixed	759.694	15.4	1.177	1.574	1.529