

CHECKLIST TO DESIGNATE AREAS OF EVALUATION FOR REQUESTS FOR PROPOSAL (RFP)

MDOT PROJECT MANAGER Kelvin J. Wixtrom, P.S.			JOB NUMBER (JN) Various	CONTROL SECTION (CS) Various
DESCRIPTION IF NO JN/CS As-Needed Photogrammetry and Photogrammetric Control Survey Services - Statewide - Tasks 2320, 2321, 2322, 3310, 3320, 3321				
MDOT PROJECT MANAGER: Check all items to be included in RFP. WHITE = REQUIRED GRAY SHADING = OPTIONAL			CONSULTANT: Provide only checked items below in proposal.	
Check the appropriate Tier in the box below				
<input type="checkbox"/> TIER I (\$25,000-\$99,999)	<input type="checkbox"/> TIER II (\$100,000-\$250,000)	<input checked="" type="checkbox"/> TIER III (>\$250,000)		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Understanding of Service	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>Innovations</i>	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<i>Safety Program</i>	
N/A	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Organization Chart	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Qualifications of Team	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Past Performance	
Not required as part of official RFP	Not required as part of official RFP	<input checked="" type="checkbox"/>	Quality Assurance/Quality Control	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Location: The percentage of work performed in Michigan will be used for all selections unless the project is for on-site inspection or survey activities, then location should be scored using the distance from the consultant office to the on-site inspection or survey activity.	
N/A	N/A	<input type="checkbox"/>	Presentation	
N/A	N/A	<input type="checkbox"/>	Technical Proposal (if Presentation is required)	
3 pages (MDOT forms not counted) (No Resumes)	7 pages (MDOT forms not counted)	19 pages (MDOT forms not counted)	Total maximum pages for RFP not including key personnel resumes	

The Michigan Department of Transportation (MDOT) is seeking professional services for the project contained in the attached scope of services.

If your firm is interested in providing services, please indicate your interest by submitting a Proposal, Proposal/Bid Sheet or Bid Sheet as indicated below. The documents must be submitted in accordance with the latest "Consultant/Vendor Selection Guidelines for Service Contracts" and "Guideline for Completing a Low Bid Sheet(s)", if a low bid is involved as part of the selection process. **Referenced Guidelines are available on MDOT's website under Doing Business > Vendor/Consultant Services > Vendor/Consultant Selections.**

RFP SPECIFIC INFORMATION

BUREAU OF HIGHWAYS BUREAU OF TRANSPORTATION PLANNING ** OTHER

THE SERVICE WAS POSTED ON THE ANTICIPATED QUARTERLY REQUESTS FOR PROPOSALS

NO YES DATED 1/1/09 THROUGH 3/31/09

<input checked="" type="checkbox"/> Prequalified Services – See page <u>1</u> of the attached Scope of Services for required Prequalification Classifications.	<input type="checkbox"/> Non-Prequalified Services - If selected, the vendor must make sure that current financial information, including labor rates, overhead computations, and financial statements, if overhead is not audited, is on file with MDOT's Office of Commission Audits. This information must be on file for the prime vendor and all sub vendors so that the contract will not be delayed.
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Qualifications Based Selection – Use Consultant/Vendor Selection Guidelines

For all Qualifications Based Selections, the section team will review the information submitted and will select the firm considered most qualified to perform the services based on the proposals. The selected vendor will be contacted to confirm capacity. Upon confirmation, that firm will be asked to prepare a priced proposal. Negotiations will be conducted with the firm selected.

****For RFP's that originate in Bureau of Transportation Planning only**, a priced proposal must be submitted at the same time as, but separate from, the proposal. Submit directly to the Contract Administrator/Selection Specialist, Bureau of Transportation Planning (see address list, page 2). The priced proposal must be submitted in a sealed envelope, clearly marked "**PRICE PROPOSAL.**" The vendor's name and return address **MUST** be on the front of the envelope. The priced proposal will only be opened for the highest scoring proposal. Unopened priced proposals will be returned to the unselected vendor(s). Failure to comply with this procedure may result in your priced proposal being opened erroneously by the mail room.

For a cost plus fixed fee contract, the selected vendor must have a cost accounting system to support a cost plus fixed fee contract. This type of system has a job-order cost accounting system for the recording and accumulation of costs incurred under its contracts. Each project is assigned a job number so that costs may be segregated and accumulated in the vendor's job-order accounting system.

Qualifications Review / Low Bid - Use Consultant/Vendor Selection Guidelines. See Bid Sheet Instructions for additional information.

For Qualification Review/Low Bid selections, the selection team will review the proposals submitted and post the date of the bid opening on the MDOT website. The notification will be posted at least two business days prior to the bid opening. Only bids from vendors that meet proposal requirements will be opened. The vendor with the lowest bid will be selected. The selected vendor may be contacted to confirm capacity.

Best Value - Use Consultant/Vendor Selection Guidelines. See Bid Sheet Instructions below for additional information. The bid amount is a component of the total proposal score, not the determining factor of the selection.

Low Bid (no qualifications review required - no proposal required.) See Bid Sheet Instructions below for additional instructions.

BID SHEET INSTRUCTIONS

A bid sheet(s) must be submitted in accordance with the "Guideline for Completing a Low Bid Sheet(s)" (available on MDOT's website). The Bid Sheet(s) is located at the end of the Scope of Services. Submit bid sheet(s) separate from the proposal, to the address indicated below. The bid sheet(s) must be submitted in a sealed manila envelope, clearly marked "**SEALED BID.**" The vendor's name and return address **MUST** be on the front of the envelope. Failure to comply with this procedure may result in your bid being opened erroneously by the mail room and the bid being rejected from consideration.

PROPOSAL SUBMITTAL INFORMATION

REQUIRED NUMBER OF COPIES FOR PROJECT MANAGER 4	PROPOSAL/BID DUE DATE 3/30/09	TIME DUE 4:00 PM
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PROPOSAL AND BID SHEET MAILING ADDRESSES

Mail the multiple proposal bundle to the MDOT Project Manager or Other indicated below.

- MDOT Project Manager MDOT Other

Kelvin J. Wixtrom, P.S., Aerial Mapping Services - B220
Michigan Department of Transportation
425 W. Ottawa
Lansing, Michigan 48933

Mail one additional stapled copy of the proposal to the Lansing Office indicated below.

Lansing Regular Mail**OR****Lansing Overnight Mail**

- Secretary, Contract Services Div - B470
Michigan Department of Transportation
PO Box 30050
Lansing, MI 48909

Secretary, Contract Services Div - B470
Michigan Department of Transportation
425 W. Ottawa
Lansing, MI 48933

- Contract Administrator/Selection Specialist
Bureau of Transportation Planning B470
Michigan Department of Transportation
PO Box 30050
Lansing, MI 48909

Contract Administrator/Selection Specialist
Bureau of Transportation Planning B470
Michigan Department of Transportation
425 W. Ottawa
Lansing, MI 48933

GENERAL INFORMATION

Any questions relative to the scope of services must be submitted by e-mail to the MDOT Project Manager. Questions must be received by the Project Manager at least four (4) working days prior to the due date and time specified above. All questions and answers will be placed on the MDOT website as soon as possible after receipt of the questions, and at least three (3) days prior to the RFP due date deadline. The names of vendors submitting questions will not be disclosed.

MDOT is an equal opportunity employer and MDOT DBE firms are encouraged to apply. The participating DBE firm, as currently certified by MDOT's Office of Equal Opportunity, shall be listed in the Proposal

MDOT FORMS REQUIRED AS PART OF PROPOSAL SUBMISSION

- 5100D** – Request for Proposal Cover Sheet
5100G – Certification of Availability of Key Personnel
5100I – Conflict of Interest Statement

(These forms are not included in the proposal maximum page count.)

Michigan Department of Transportation

**SCOPE OF SERVICE
FOR
“AS-NEEDED” DESIGN SERVICES
Photogrammetry and Survey Services**

CONTROL SECTION: Various

JOB NUMBER: Various

LOCATION: Statewide

WORK DESCRIPTION: The Consultant will be expected to provide experienced personnel for Photogrammetry and Photogrammetric Control Survey services on an as needed basis for MDOT design projects. Such tasks would include but may not be limited to work in the following areas: Aerial Photography Acquisition including Digital Imagery and Multi-spectral Acquisition, Image Scanning and Printing, Photogrammetric Targeting, Photogrammetric Control Surveys, Photogrammetric Mapping, Digital Ortho-photo Production and Image Processing and LiDAR Acquisition and Processing.

NUMBER OF CONSULTANTS & MONETARY LIMITS

Up to five (5) consultants may be selected for “as-needed” contracts, up to \$450,000 each. Number of projects assigned to each consultant will be determined by future workload.

PRIMARY PREQUALIFICATION CLASSIFICATION:

Photogrammetry (P/PMS Tasks 2320, 2321, 2322, 3310)

SECONDARY PREQUALIFICATION CLASSIFICATION:

Photogrammetric Control Survey (P/PMS Tasks 3320, 3321)

DISADVANTAGED BUSINESS ENTERPRISE (DBE) PARTICIPATION: N/A

MDOT PROJECT MANAGER:

Kelvin J. Wixtrom, P.S.
Photogrammetric Consultant Project Manager
MDOT Aerial Mapping Services
425 West Ottawa, B220
Lansing, MI 48933
517-241-4527
wixtromk@michigan.gov

GENERAL INFORMATION

The Consultant will be expected to provide experienced personnel for Design Photogrammetry and Photogrammetric Control Survey services on an **as needed basis** for MDOT design projects.

Full time services will not be required on all projects at all times. This scope is for “as needed” services, based on the intermittent needs of the MDOT Lansing Design Aerial Mapping Services Unit. It must be noted that this is not a guarantee that MDOT will use the Consultant’s services and that a consultant award of Selection under this scope is not a guarantee that the consultant will receive an Authorization for work.

The MDOT Lansing Photogrammetry Project Manager will contact the Consultant for specific services through a **MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C** of this Scope of Services, stating the MDOT job number and control section, route, survey services needed, the project duration, and a timeframe in which the work shall be required for completion. The Consultant will then review this request and inform MDOT of their availability and willingness to work on this project, as well as the names of the Consultant’s personnel chosen to work on the project within two days of receiving the Request for Consultant’s Photogrammetric Staff. An estimated cost will also be submitted to MDOT prior to the Consultant beginning work. Every attempt will be made to submit requests at least one week prior to the need for personnel. If the Consultant accepts the MDOT work assignment, a meeting will be set up between MDOT and the Consultant to review the information in the Request for Consultant Photogrammetric Staff Letter and the Consultant’s proposal and personnel.

The Consultant will need to get approval of the MDOT Lansing Photogrammetry Project Manager prior to continuing work on an individual job in which the Consultant’s billable costs exceeds 7% of the estimated cost of the project. If the Consultant does not get approval for this amount over the estimate, the Consultant will be working at his own risk.

The MDOT reserves the right to grant final work authorization based on the Consultant’s understanding of the specific photogrammetry and photogrammetric survey project tasks and personnel. If the Consultant is unable to fulfill a request, MDOT may utilize a different Consultant who has been awarded Selection under this As-Needed Scope for Consultant Design Photogrammetry and Photogrammetric Control Survey Services.

There will be **up to five (5)** Consultant Selection awards made under this As-Needed Scope for Consultant Design Photogrammetry and Photogrammetric Control Survey Services.

This contract will cover “as needed” services for a period beginning April 22, 2009 and ending February 28, 2011 or ending when the monetary value has been deemed substantially expended, if earlier. Each of the **up to 5 selected firms** may receive an Authorization rotationally on a per project basis. The consultant may work on an “as-needed” basis for **up to \$450,000 in Authorizations**, provided the consultant has performed adequately on each previous project. A Consultant may not work on any more than one (1) “as-needed” job at any given time, unless directed by the MDOT Lansing Design Photogrammetry Project Manager.

When describing the qualifications of the team in the proposal, list only those individuals that will be available and dedicated to work on any one (1) "as-needed" job. This team should be available to complete one (1) "as-needed" job in its entirety. This one (1) team and their roles/experience should be clearly stated in the proposal and clearly shown on the organization chart for the proposal. Qualifications of the firm and individual staff members of the team should only show experience directly pertaining to Photogrammetry and/or Photogrammetric Control surveys. Experience related to other MDOT Survey prequalification categories **should not** be included.

CONSULTANT PAYMENT – Actual Cost Plus Fixed Fee:

Compensation for this project shall be on an **actual cost plus fixed fee** basis. This basis of payment typically includes an estimate of labor hours by classification or employee, hourly labor rates, applied overhead, other direct costs, subconsultant costs, and applied fixed fee.

All billings for services must be directed to the Department and follow the current guidelines. The latest copy of the "Professional Engineering Service Reimbursement Guidelines for Bureau of Highways" is available on MDOT's website. This document contains instructions and forms that must be followed and used for billing. Payment may be delayed or decreased if the instructions are not followed.

Payment to the Consultant for services rendered shall not exceed the maximum amount unless an increase is approved in accordance with the contract with the Consultant. Typically, billings must be submitted within 60 days after the completion of services for the current billing. The final billing must be received within 60 days of the completion of services. Refer to your contract for your specific contract terms.

Direct expenses, if applicable, will not be paid in excess of that allowed by the Department for its own employees in accordance with the State of Michigan's Standardized Travel Regulations. Supporting documentation must be submitted with the billing for all eligible expenses on the project in accordance with the Reimbursement Guidelines. The only hours that will be considered allowable charges for this contract are those that are directly attributable to the activities of this project.

The use of overtime hours is not acceptable unless prior written approval is granted by the MDOT Region Engineer/Bureau Director and the MDOT Project Manager. Reimbursement for overtime hours that are allowed will be limited to time spent on this project in excess of forty hours per person per week. Any variations to this rule should be included in the priced proposal submitted by the Consultant and must have prior written approval by the MDOT Region Engineer/Bureau Director and the MDOT Project Manager.

The fixed fee for profit allowed for this project is 11.0% of the cost of direct labor and overhead.

This scope is for "as needed" services. As such, any hours provided are only an estimate. The Consultant will be reimbursed a proportionate share of the fixed fee based on the portion of the authorized total hours in which services have been provided to the

Department. Fixed fee on “as needed” projects is computed by taking the percent of actual labor hours billed to labor hours authorized, then applying that percentage to the total fixed fee authorized.

MONTHLY PROGRESS REPORT

On the first day of each month, the Consultant shall submit a monthly project progress report to the MDOT Project Manager. The monthly progress report shall address the following items:

1. Work accomplished during the previous month.
2. Anticipated work and goals for the coming month.
3. Real problems which occurred during the month, and anticipated problems for the coming month.
4. Any updates on the project schedule including explanations for any delays or changes in schedule, scope, or work plan.
5. Any early reviews or submittals such as adjustments, computations, or alignment.

See Attachment “B” for a sample progress report.

GENERAL NOTES

The Consultant will know the scope for each “as needed” project. Each of the work area tasks below will be discussed for each job.

The Selected **Consultant** shall arrange and meet (or phone conference) with the MDOT Photogrammetric Project Manager to discuss the scope of this Photogrammetric Mapping and Photogrammetric Control Survey Project, before submitting a work plan and price proposal.

For projects that include Photogrammetric Ground Control surveys, the selected **Consultant surveyor** must contact the TSC or Region Traffic and Safety Engineer closest to the proposed project for work restrictions in the project area prior to submitting a work plan and price proposal.

The selected Consultant will be required to submit a **detailed Photogrammetry Work Plan** addressing each specific photogrammetry task applicable to the project, such as scanning, aerial triangulation, map compilation, CAiCE DTM surface, etc., with the project price proposal. A **detailed Photogrammetric Control Survey Work Plan** must also be included with the project price proposal.

A **spreadsheet estimate** of hours broken down by specific photogrammetry task such as flight, image scanning, targeting, aerial triangulation, mapping, etc., and photogrammetric control survey task, such as research, horizontal control, vertical control, targeting, reports, portfolio, etc., **must** be included in the **priced proposal**.

GENERAL REQUIREMENTS

1. Photogrammetric mapping and ground field surveys must comply with **all Michigan law** relative to land surveying.
2. Photogrammetric Mapping must be done under the **direct supervision** of an ASPRS Certified Photogrammetrist. Photogrammetric Control Surveys must be done under the

direct supervision of a Professional Surveyor licensed to practice in the State of Michigan.

3. Work in any of the following categories of photogrammetry and survey: Photogrammetry, Photogrammetric Control Surveys, Road Design, Structure, Hydraulic, and/or Right-of-Way must be completed by a Consultant which is pre-qualified by MDOT for work in that category.
 - a. Any task(s) for which the Consultant is not prequalified must be completed by a SubConsultant that is pre-qualified for that task(s). The DEPARTMENT'S prequalification is not a guarantee or warranty of the SUBCONTACTOR'S ability to perform or complete the work subcontracted. The CONSULTANT remains fully responsible to the DEPARTMENT for completion of the work according to the *authorization* as if no portion of it had been subcontracted. The DEPARTMENT may direct the immediate removal of any SUBCONSULTANT working in violation of this subsection. Any costs or damages incurred are assumed by the CONSULTANT by acceptance of the *authorization*. It is further understood that the CONSULTANT'S responsibilities in the performance of the contract, in case of an approved subcontract, are the same as if the CONSULTANT had handled the work with the CONSULTANT'S own organization.

4. Photogrammetric Mapping and Surveys must meet all requirements of the Michigan Department of Transportation (MDOT) project scope (this document) and the current revision of MDOT Standards for Photogrammetric Mapping, the National Standard for Spatial Data Accuracy (NSSDA), currently in effect, DRAFT ASPRS Aerial Photography Standards, September 1995, the MDOT Design Surveys *Standards of Practice*, current version, the MDOT Design Survey Manual on-line, and the MDOT RTK guidelines. Please contact the Design Support Area / Aerial Mapping Services office to clarify any specific questions regarding these standards.
 - a. **The Consultant is responsible for using the latest MDOT electronic software support files which are available on the MDOT File Transfer Protocol (FTP) site.** These files include, but are not limited to:
 - i. CAiCE feature table, CAiCE cell, seed and tugboat files
 - ii. MicroStation V8 cell and seed files
 - iii. MDOT Microstation Road Resource file and MDOT Bridge Resource file
 - iv. MDOT Photogrammetry Check List.
 - v. MDOT Photogrammetric Control Surveys Check List
 - vi. The MDOT FTP site for Consultants is:
<ftp://ftp.michtrans.net>
username: survcons
password: \$urvcon\$

 - b. **The CAiCE software and the MDOT Tugboat used must be the latest version accepted by MDOT. MDOT currently uses CAiCE Version 10 SP7 but will accept use of CAiCE Version 10 SP4 or later. The Consultant must also use the MDOT approved version of MicroStation V8.**

- c. **MDOT Standards of Practice for Design Surveys, current dated version, shall be used for this project. This scope and the MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C, shall hold when conflicts occur between the scope and the Standards of Practice for Design Surveys.**
5. Consultant must obtain all necessary permits required to perform this survey on any public and/or private property, including an up-to-date permit from the MDOT Utilities Coordination and Permits Section. The **Consultant shall be responsible for obtaining up to date access permits** and pertinent information for any tasks involving work in the MDOT Right of Way (ROW).
6. Prior to performing any ground survey, the Consultant must contact all landowners upon whose lands they will enter. The contact may be personal, phone or letter, but must be documented. This notice must include the reasons for the survey on private land, the approximate time the survey is to take place, the extent of the survey including potential brush cutting (which must be minimized), and an MDOT contact person (the MDOT Project Manager).
7. The Consultant must contact any and all Railroads prior to commencing field survey on railroad property. The cost for any permit, flaggers and/or training that is required by the Railroad will be considered as a direct cost, but only if included in the Consultant's priced proposal.
8. The Consultant must adhere to all applicable OSHA and MIOSHA safety standards, including use of the appropriate traffic signs for the activities and conditions for this job.
9. Consultants are responsible for a comprehensive and conscientious research of all records, including MDOT records, essential for the completion of this project.
10. Measurements, stationing, recorded data, and computations must be in **International Feet** units, unless specified otherwise by the MDOT Project Manager.
11. Coordinate values shall be based upon the Michigan State Plane Coordinate System of 1983, NAD83/CORS96, North, Central or South Zone. A local project coordinate control system is acceptable only on approval of the MDOT Project Manager, the MDOT Photogrammetric Project Manager or the MDOT Supervising Land Surveyor. All elevations must be based upon the North American Vertical Datum of 1988 (NAVD88) if control is available within four miles. **Use of other datums must be approved by the MDOT Design Division, Supervising Land Surveyor.** The datums to be used must be clearly stated in the Photogrammetric Control Survey Work Plan. A preliminary submittal of the adjusted Horizontal and Vertical control for the project shall be submitted to the MDOT Photogrammetric Project Manager for review and acceptance as soon as it is available and prior to commencing any photogrammetric map compilation.

13. **All data**, whether electronic or paper, **must be recorded on non-rewritable Compact Discs or Digital Video Disks** (CD's or DVD's). All paper files, including MicroStation files, must be scanned and/or converted to Adobe Acrobat .PDF format. CD's must be organized in the same manner as the portfolio, such as by Administrative section, Flight and Image Scanning section, etc. A Table of Contents in Adobe Acrobat format is required that has all .PDF pages of the CD bookmarked/linked so each place in the .PDF archive can be accessed with a single click of the computer mouse. Specified format files such as ASCII text, CAiCE and MicroStation must have separate access. Disks must be labeled with the control section, job number, data type and file names.
14. Documents are to be submitted as follows:
 - a. All recorded instruments on 8.5" x 11" sheets.
 - b. All text files printed on 8.5" x 11" sheets.
 - c. All plots on 24" x 36" sheets.
 - d. All documents and plots are to be legibly printed or reproduced on white paper.
15. The Consultant representative shall record and submit type-written minutes for all project related meetings to the MDOT Project Manager and MDOT Photogrammetric Project Manager within two weeks of the meeting. The Consultant may distribute the minutes to all meeting attendees, as directed by the Project Manager.
16. The MDOT Project Manager is the official contact for the Consultant. The Consultant must send a copy of all photogrammetric and survey project correspondence to the MDOT Photogrammetric Project Manager and the MDOT Project Manager. The MDOT Project Manager shall be made aware of all communications regarding this project. Any Photogrammetry or Photogrammetric control survey related questions, in regard to this project, should be directed to the MDOT Design Photogrammetric Consultant Project Manager, Kelvin J. Wixtrom, P.S. at 517-241-4527, or e-mail wixtromk@michigan.gov.

At the completion of this photogrammetric survey, legible copies of all field survey notes, all electronic data, and all research records obtained for this project will be considered the property of MDOT and **must be sent to** the MDOT, Design Support Area, Aerial Mapping Services, Photogrammetric Project Manager, P.O. Box 30050, Lansing, MI 48909. **Please use MDOT's Form 0222P(02/09) entitled "PHOTOGRAMMETRIC INFORMATION: RECEIPT AND TRANSMITTAL" for all Photogrammetry related transmittals.** Please use MDOT's Form 0222(05/01) entitled "SURVEY NOTES: RECEIPT AND TRANSMITTAL" for all Photogrammetric Control Survey transmittals. A copy of the transmittal forms must also be sent to the MDOT Project Manager.

Acceptance of this Photogrammetric Mapping and Survey by the MDOT Photogrammetry Project Manager, MDOT Supervising Land Surveyor and/or the MDOT Project Manager does not relieve the Consultant of any liability for the content of the survey.

Electronic Files

The following are acceptable means of electronic file transfer:

1. Digital electronic scans of aerial photograph negatives can be submitted on DVD's, or

external USB/Firewire hard drives.

2. Electronic triangulation deliverables shall be submitted on DVD's, or CD ROM, or external hard drives. Files attached to an e-mail are acceptable for gaining MDOT approval to start mapping as long as a final version is delivered by one of the above methods.
3. Preliminary files can be transferred by compressing and attaching the files to an e-mail.
4. Final mapping shall be submitted on DVD's, or CD ROM, or external hard drives.

General Deliverables – Reporting

1. It is desirable to include as much electronic data as possible on Compact Disc or DVD, including scanned items, to facilitate future electronic storage and transmission of survey data.
2. Electronic files must be recorded on non-rewritable Compact disks (CD's). All data, whether electronic or paper, including MicroStation files, must be scanned or converted to Acrobat PDF format and recorded on CD. CD's must be organized in the same manner as the portfolio, by sections, 1 Administration, 2 Flight Plan, 3 Targeting, 4 Photography, 5 Image Scanning, 6 Airborne Control, 7 Control, 8 Aerial Triangulation, 9 Mapping, 9A Ortho-Imagery, 9B LiDAR, Miscellaneous, etc. as applicable to this particular Photogrammetry project.
3. For Photogrammetric Control Surveys, the CD's, PDF and Portfolios shall all be organized in the same manner, by sections, 1 Administration, 3 Targeting, 7 Control, Horizontal Control, Vertical Control, Field Notes and Miscellaneous.
4. CD's must be labeled with the Consultant name, route, location, control section, job number, data type, file names and date.
5. A Table of Contents is required in the PDF file and will have all parts/pages of the portfolio book-marked/linked so that any part/page of the portfolio can be accessed immediately. Microsoft Word files can be saved directly into PDF format. MicroStation drawings and research data, etc. will need to be scanned into PDF format.
6. **All project reports and final CADD file deliverables shall be also converted into and submitted in a single Adobe Ver. 6, linked and book-marked, PDF file.**
7. It is the responsibility of the Consultant to insure that all electronic files submitted to MDOT conform to the required format and all documents are legible.

PROJECT SCHEDULE

The Selected Consultant shall use the details of the scopes included and events required to prepare the proposed implementation schedule and Gantt chart as required in the ***“Guidelines for the Preparation of Priced Proposals”***.

The Consultant shall keep the Photogrammetric Project Manager updated on the progress of the entire project and including the timing of the flight to obtain the aerial photography.

COSTS PROPOSAL FOR THE TASKS AND DELIVERABLES ABOVE:

As part of the Price Proposal phase, man-hours shall be estimated for each task or sub-task and the appropriate rate and cost shall be used in the calculation of the total. The Selected Consultant may add tasks that are necessary in the completion of the tasks listed in this scope. The Selected Consultant shall prepare a proposal of cost derivation forms as required as part of the *“Guidelines for the Preparation of Priced Proposals”*.

The Selected Consultant shall also **provide a photogrammetric specific spreadsheet detailing the costs** associated with each task and sub-task and providing a **total of the man-hours and the total dollars** separated out for each task or sub-task. The following list of costs shall be used in formatting the photogrammetric specific spreadsheet costs:

1. Costs for Mobilization to site
2. Costs for Preparing Pre-flight Targeting plan
3. Costs for Flight
4. Costs for Airborne GPS data
5. Costs for Scanning Imagery from Negatives
6. Costs for Developing, Printing and Indexing Film, and Contact Prints
7. Costs for Aerial Triangulation
8. Costs for Planimetric mapping and Terrain mapping compilation
9. Costs for CAiCE terrain surface and Geopak files
10. Costs for Digital Ortho-photos
11. Costs for Lidar Data Collection and Processing
12. Costs for Reports, Accuracy Certifications and Final Deliverables

In addition, the Selected Consultant shall provide a Photogrammetric Ground Control Survey **specific spreadsheet detailing the costs** associated with each task and sub-task and providing a **total of the man-hours and the total dollars** separated out for each task or sub-task. The following list of costs shall be used in formatting the spreadsheet:

1. Costs for Mobilization to site
2. Costs for Pre-flight Targeting
3. Costs for Photogrammetric Ground Control Survey (broken down by work sub-tasks such as Recovering or Placing Monumentation, Horizontal Control survey, Vertical Control survey, Survey Target locations, etc.)
4. Costs for Reports and Final Deliverables

Please contact the MDOT Photogrammetric Project Manager to discuss any photogrammetric specific questions related to preparation of the cost proposal.

TRAFFIC CONTROL / WORK RESTRICTIONS

The **Consultant shall be responsible for all traffic control** required to perform the tasks as outlined in this Project Scope of Design Services. When any ground survey tasks are required and any project site visits are made to gather project information, the Consultant must contact the TSC Traffic and Safety Engineer closest to the proposed project area prior to submitting a priced proposal and prior to beginning work activities in the project area to discuss Traffic Control scenarios and work restrictions for the project.

The MDOT TSC Traffic & Safety Engineer must be notified at least two weeks prior to lane closures so advance notice can be posted on the Web site.

No work shall be performed or lane closures allowed during the Memorial Day, Independence Day, or Labor Day holiday periods. The Memorial Day and Labor Day holiday periods are defined as beginning on Thursday at 6:00 PM until normal starting time on Tuesday. The Independence Day holiday period will be as defined by the Traffic & Safety Engineer at the MDOT TSC.

The Consultant may be allowed to close a lane to traffic as necessary for safety. The Consultant shall contact the Traffic and Safety Engineer for the acceptable times allowed for closures between Monday through Friday. Only one lane may be closed at any particular time. The Consultant shall use MDOT standard lane closure “maintaining traffic” typicals for any and all lane closures. Lighted arrow panels, all signing and channelizing devices shall be required and utilized at all times where workers are present as indicated in each of the traffic control sequences, except where adjustments in the traffic control devices are necessary to fit actual field conditions as directed by the MDOT Traffic Engineer.

All traffic control devices shall conform to the current edition, as revised, of the *Michigan Manual of Uniform Traffic Control Devices* (MMUTCD). All warning signs for maintenance of traffic used on this project shall be fabricated with prismatic retro-reflective sheeting. The Consultant shall be familiar with and use the most **current** edition of the *Michigan Manual of Uniform Traffic Control Devices Part 6* (MMUTCD) located on-line at http://mdotwas1.mdot.state.mi.us/public/tands/Details_Web/mmutcdpart6.pdf.

Traffic shall be maintained by the Consultant throughout the project in accordance with Sections 812, 922, 103.05 and 103.06 of the *Standard Specifications for Construction*, 2003 edition, www.mdot.state.mi.us/specbook/, and Supplemental Specification 03SS001(2) Errata to the 2003 Standard Specifications and all other supplemental specifications currently in effect against the Standard Specifications for Construction. All traffic control devices shall conform to the current edition, as revised, of the *Michigan Manual of Uniform Traffic Control Devices* (MMUTCD). All warning signs for maintenance of traffic used on this project shall be fabricated with prismatic retro-reflective sheeting, and shall be set up five feet above ground.

The Consultant shall use MDOT standard “maintaining traffic” typicals for any and all closures. Typical MDOT traffic control diagrams are available on line at www.mdot.state.mi.us/tands/plans.cfm

COORDINATION WITH OTHER CONTRACTS IN THE VICINITY

The Consultant shall coordinate operations with contractors performing work on other projects within or adjacent to the Construction Influence Area (CIA).

MDOT maintenance crews and/or Contract Maintenance Agencies may perform maintenance work within or adjacent to the CIA. The Maintenance Division of MDOT and/or Contract Maintenance Agency will coordinate their operations with the MDOT Project Manager or Designate to minimize the interference to the Consultant.

The Consultant must contact the Development Engineer at the nearest MDOT TSC for information regarding project coordination.

The Consultant's attention is called to the requirements of cooperation with others as covered in Article 104.07 of the 2003 Standard Specifications for Construction. Other contracts or maintenance operations may occur during the life of the project.

No claim for extra compensation or adjustment in contract unit prices will be allowed on account of delay or failure of others to complete work unit scheduled.

AERIAL PHOTOGRAPHY ACQUISITION
(including Digital Imagery and Lidar acquisition)
P/PMS Task Numbers 2320, 2321, 2322

The Specific parameters and details such as flight limits, photo scale, coverage width, targets, etc. related to these flight and acquisition of photography tasks will be part of the scoping details listed in the MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C for each as-needed job. The actual work required for each as-needed job may include some or all of the following and is not limited to the following tasks:

Description of Work for Task 2320(Aerial Flight): Aerial photography acquisition (flights).

Description of Work for Task 2321(Prepare for Aerial Photography): Project planning, Flight planning, and Target planning.

Description of Work for Task 2322(Finish/Print Aerial Photography): Aerial photograph film processing, image scanning and printing.

SCOPE OF CONSULTANT DUTIES

The Consultant shall provide:

A. Photography

1. Black & White "Vertical" aerial photography of the entire project(s) site taken from a suitable fixed-wing aircraft or helicopter. (Color RGB or Color infrared photography/imagery may be requested for certain projects.)
2. **The flight altitude** will be the **nominal height in feet** as determined from the project photo scale, above average ground elevation to produce vertical aerial photography at the scales required for the project(s). This altitude will be listed in the **MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C**.
3. Black and white (Panchromatic) aerial negative film used shall be **Agfa Aviphot Pan 200, Agfa Aviphot Pan 400S, Kodak Double-X Aerographic 2405 film, or equivalent** high speed fine grained aerial film suitable for high accuracy use at lower flight altitudes. For Helicopter type very low level photography, high speed black and white aerial film such as the **Agfa Aviphot Pan 400S, Agfa Aviphot Pan 200 or equivalent shall be used along with faster shutter speed and exposure settings. Please note: MDOT**

requires stringent adherence to obtaining the highest quality imagery possible to provide the best possible mapping accuracy. Imagery shall be obtained with specific exposure parameters that will produce **no perceptible image blur or smear** when viewed at a magnification of 8X or less. Because transportation work requires high accuracy to support good design, MDOT uses lower altitude flights than generally used for other applications. This usually requires modified exposure settings and use of **fast shutter speeds, such as 1/250 to 1/300 for the Agfa Pan 200 and 1/700 to 1/1000 for the Kodak 2405**, to help eliminate movements caused by turbulence not accounted for by FMC or other means.

- a. The combination of film, exposure settings used, and film processing shall be done to meet an **average gamma equal to 1.0** (average gradient equal to 0.95).
 - b. Along with the film, a process control strip containing the density gradients from the film processing shall be submitted to MDOT.
 - c. Sensitometric curve graphs of the processing of the film showing the characteristic curve graph and the average gradient/developing time shall be provided.
 - d. The specific exposure settings and processing settings used for the project shall be listed and outlined in the project report.
4. A precision aerial mapping camera shall be used that has a nominal focal length of 6 inches, (153 mm).and having a nominal 9 inch by 9 inch film format. A motion compensation system is recommended.
- a. **Submit camera calibration certificate (not more than three years old).**
 - b. **Camera shall have an AWAR rating of not less than 90-100.**
5. Each consecutive photograph will overlap the previous exposure by at least 60% of the image area. The entire project area will be covered with overlapping images.
6. Each photograph and flight line will be centered on the median centerline of the highway, to provide complete coverage of the paved portions of the roadway, **or as specified and approved by the MDOT Photogrammetry Project Manager.**
7. **Digital Sensor Imagery** - The Consultant may be requested to provide digital imagery for the project instead of the traditional photography.
- a. When requested, the digital imagery shall be obtained using digital frame sensor "camera". Frame format images such as produced by the Z/I Imaging DMC are preferred.
 - b. The consultant shall contact the MDOT Photogrammetric Project Manager to discuss the flight parameters, altitude, ground sample distance, overlap, image data post-processing parameters, any multi-spectral requirements, and any other specific details for the project.
 - c. Special reporting and deliverables requirements are listed in the deliverables section below.

B. Flight Diagram(s) and Target Diagram(s)

1. **MDOT** will generally provide a diagram with a suggested layout of flight lines, exposures, targets and check targets.
2. **The Consultant** shall review the MDOT flight plan and prepare a Consultant flight/target/exposure diagram for each flight altitude **prior to flight**. Any deviations from the conventional MDOT Flight Planning shall be discussed with and approved by the MDOT Photogrammetry Project Manager. The diagram shall be **submitted to the Photogrammetry Project Manager for approval prior to flight**.
3. **The Consultant must notify** MDOT Photogrammetry Project Manager with a **projected date for flight** and keep the MDOT Photogrammetry Project Manager informed on the progress of the flight and project.
4. Targets shall be placed on the ground prior to flight. See Specific Scope of Services for Photogrammetric Targeting and Ground Control Survey for more details on placing targets.

C. Airborne GPS(ABGPS)

1. The Consultant shall collect the ABGPS raw data files for all flight lines and exposures for the project.
 - a. This ABGPS data is not to be a substitute or used in place of ground control.
 - b. ABGPS will be used as initial EO positions to aid the Aerial Triangulation process. This will also be used as check data to compare against the aerial triangulation results.
2. The GPS files for the base stations along with the GPS files of the aircraft shall be collected and delivered to MDOT in RINEX format.
 - a. The Consultant is urged to utilize the MDOT CORS stations as much as possible for the base stations. MDOT CORS data may be acquired from the MDOT CORS Website at <http://mdotcors.org/>
 - b. Provide offsets for GPS antenna, Inertial Measurement Unit (IMU), etc. to Camera exposure center along with a sketch of the offsets and location of and dimensions between the GPS antenna, IMU and camera within the aircraft.
3. The Consultant shall provide to MDOT the final EO coordinates for each exposure formatted in ASCII, comma delimited files.
 - a. The file information shall be arranged as follows:
Flight number, Photo number, X, Y, Z, Kappa, Phi, Omega
4. If IMU orientation information can be collected, the Consultant shall provide the precise exposure orientation readings (Kappa, Phi and Omega) for each exposure in the ASCII formatted files.

- a. If an IMU is not used, **approximate orientation values shall be recorded or derived and shall be submitted** in ASCII format for each exposure for use during aerial triangulation.

D. Aerial Photograph Negative Scanning

1. The Consultant shall scan each image from the negatives exposed in the aerial photography taken for this project and provide digital files on DVD's, CD-ROM's or external USB/Firewire hard drives.
2. Scan parameters and specifications:
 - a. Scan all images exposed for this photography acquisition project.
 - b. Scan Resolution between 7.5 microns and 15 microns, with a preferred scan rate of 12 or 14 microns. Scan rate shall not be re-sampled to meet these resolutions
 - c. A full set of over-views shall be produced and delivered for each scan.
 - i. **Overviews shall be created using the preferred Gaussian Method or if unavailable, use the Averaging Method. Use of the Subsampling method is not acceptable.**
 - d. Scan orientation shall be with fiducial #1 located in the lower left corner.
 - e. File names of scans shall contain flight line number, photo symbol and exposure number such as: 1GNJ10.cmp or 12GNZ59.cmp.
 - f. File formats of scans shall be preferably in Intergraph (*.cmp) format [JPEG compressed COT (Continuous Tone) files]. COT is an Intergraph native file format.
 - i. Q Factor for Black and White Photography shall be **10** based on a Z/I ImageStation workstation. Regardless of the numeric Q factor used, **no** compression artifacts shall be visible when viewed at a 1:1 ratio.
 - ii. Q Factor for Color Photography shall be between 3 and 7 based on a Z/I ImageStation workstation. **No** compression artifacts shall be visible when viewed at a 1:1 ratio.
3. **Scanning** of negatives **shall be done** as soon as possible after negatives are exposed and **prior to titling and printing** of diapositives and contact prints.
4. Scans of all raw images shall be submitted to MDOT on DVD's, CD ROM's or external hard drives in Intergraph (*.cmp) or Tiff format. CD ROM's and DVD's shall be delivered without case in standard letter size three ring binders holding plastic sheets capable of containing 4 CD's or 8 CD's per sheet.

E. Lidar Point Data Acquisition

1. Lidar data may be requested by MDOT on some projects. When Lidar is requested the Consultant shall contact the MDOT Photogrammetric Project Manager to fully discuss the parameters and requirements of the Lidar data to be acquired for that project.
2. The Lidar data may be requested as its' own product or may be requested to support and merge with data from other sources.

3. Lidar data shall be reported, and deliverables submitted, to MDOT per the deliverables listed below and the scope as defined for that particular project.
4. The consultant shall refer to and follow the ASPRS Lidar Guidelines – Horizontal Accuracy Reporting and the ASPRS Guidelines – Vertical Accuracy Reporting for Lidar Data.

Unless otherwise specified, the general specifications for vertical aerial photography shall follow the criteria set forth in the DRAFT Aerial Photography Standards, ASPRS Professional Practice Division, Specifications and Standards Committee, September 1995; OR as set forth in the SURVEY AND MAPPING MANUAL, US. Department of Transportation, Federal Highway Administration, November 1985.

Also see MDOT Specifications for Photogrammetric Mapping.

Compliance with these standards will be the burden of the Consultant.

DELIVERABLES for Aerial Photography Acquisition

A. General Deliverables – Reporting

1. Follow reporting requirements outlined above in the “General Deliverables – Reporting” section above.

B. Flight Deliverables

1. A Report containing information relative to the Flight, Camera, Film and Printing for this project.
2. The original black and white negatives; to be 9 x 9 inch aerial film roll format.
 - a. The exposed aerial film will be processed (developed) into negative images. The negatives are to remain un-cut. The un-cut negatives will be titled and numbered consecutively. The use of automated numbering and title information printed by the camera/camera software is encouraged. The numbering scheme will be specified by the Project manager for each project. Project numbers for exposure labels will be assigned by the Project manager. *See labeling detail in MDOT Standards for Photogrammetric Mapping or per MDOT Photogrammetric Project Manager.*
 - b. The **process control strip containing the density gradients** used in processing the film.
3. A flight index map/flight diagram showing the flight lines, flight numbers, model limits, targets/check point locations and the beginning and ending photograph numbers in each flight line on a topo quad, photo image, or ortho-photo background will be submitted. The original flight and target diagram may be used.
4. Trimmed photographic paper positive contact print photographs of all exposures.
 - a. The number of sets of prints will be listed in the **MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C.**
 - b. One set shall be marked with the control used for the project.

- c. See details in MDOT Standards for Photogrammetric Mapping for specifications on trimming prints.
5. Each flight of each set of paper prints and diapositives will be in separate envelopes. Each envelope will be labeled with the Project Name (Route Name), Project Numbers [CS, JN and PN (Photogrammetry Number)], Photography Symbol, Date of Photography, Photo Scale, Flight Line Number, and the range of photo numbers contained in the envelope.
 6. Survey Report showing the number of each target placed, the location of each target (a copy of the target diagram maybe used), the type of target (painted or otherwise), and at least two witnesses to permanent objects from the location of the target. (Only required if targeting is listed above as part of this contract.)
 7. Provide camera calibration report(s) for each aerial camera used for the project. Camera calibration certificate must not be more than three years old.

C. Airborne GPS(ABGPS) Deliverables

1. The GPS files for the base stations along with the GPS files of the aircraft shall be collected and delivered to MDOT in RINEX format.
 - a. Consultant is urged to utilize the MDOT CORS stations as much as possible for the base stations. MDOT CORS data may be acquired from the MDOT CORS Website at <http://mdotcors.org/> but copies of the data files utilized for this project must be submitted as part of the deliverables.
 - b. Provide offsets for GPS antenna, Inertial Measurement Unit (IMU), etc. to Camera exposure center along with a sketch of the offsets and location of the GPS antenna, IMU and camera within the aircraft.
2. The Consultant shall provide to MDOT the final EO coordinates for each exposure formatted in ASCII, comma delimited files.
 - a. The file information shall be arranged as follows:
Flight number, Photo number, X, Y, Z, Kappa, Phi, Omega
3. If IMU orientation information can be collected, the Consultant shall provide the precise exposure orientation readings (Kappa, Phi and Omega) for each exposure in the ASCII formatted files.
 - a. If an IMU is not used, **approximate orientation values shall be recorded or derived and shall be submitted** in ASCII format for each exposure for use during aerial triangulation.

D. Image Scanning Deliverables

1. Scanning Report outlining scanning methods, operations and details for the scanning of the exposures for this project.
2. **The raw image scans** of all exposures on DVD's, CD-ROM's or external USB/Firewire hard drives in Intergraph (*.cmp) format.
3. Scan parameters used for this project.

E. Project Report Deliverables

1. **A Photogrammetrist's Project Report on company letterhead** discussing the project and the following as applied to this project: aerial photography, raw image scanning, ground control, AAT, LiDAR data, map compilation, digital ortho-photos, final mapping files, any problems encountered and how they were resolved, and any issues of interest to the next Surveyor, Photogrammetrist, or Engineer that are involved with the project. In addition the Photogrammetrists Project report shall include the project, datums, coordinate systems and units used for the deliverable products and the accuracies attained as submitted for the deliverable products.
2. See more **detailed information** related to the **format of the portfolio contents** as outlined near the end of this scope.

F. Digital Camera Imagery Deliverables and Reports - When acquisition by digital camera is requested as part of the project, the following deliverables shall be submitted to MDOT:

1. The acquisition of the information by digital camera, the processing and the final imagery data shall be fully described in the project reports and shall include a complete listing of the flight parameters, camera settings, altitude, overlap, GSD (ground sample distance), pixel resolution and image data post-processing parameters, and all other pertinent parameters (meta-data) used in this project.
2. **Level 1 Digital Images shall be submitted to MDOT.** (“Raw” DMC digital image files obtained during the Digital Camera Imagery Acquisition shall be processed to the stage that creates a viewable image that would be considered the equivalent of images obtained from scanning film negatives, and which are ready for use in potential future photogrammetric map compilation processes using soft-copy methods.)
 - a. Level 1 images shall be provided in **natural Color RGB format. Black and White, Color Infra-red (CIR) and/or Multi-spectral formats shall be supplied when requested by MDOT** and shall be provided on large capacity 1 TB, 2 TB or similar **portable hard drive digital storage media.** Files shall be in TIFF or GeoTiff format.
3. **Photogrammetric project files** – Provide complete Z/I Imaging formatted project files containing photogrammetric project parameters, settings, camera info, aerial triangulation, exterior orientation, etc. that could be utilized with the level 1 images to set models and compile mapping, if necessary.
4. Applicable standard portfolio reports, documents and certifications as described in this As-Needed Scope and the Photogrammetry Check list, as they pertain to the acquisition of digital imagery and this project in general, shall be prepared and submitted with the final portfolio/PDF. Hard copies of large documents, such as AAT results, are not required however the electronic files must be included.

5. The consultant shall report the actual accuracies obtained/used on this project along with a narrative statement discussing any qualifying issues contributing to these values and the intended use of the above products. (e.g. all pertinent metadata associated with the data products relative to this project area.)

G. Lidar Deliverables

1. A Lidar Report shall provide a detailed listing of the equipment, methods and processes used to obtain the Lidar data as well as a comprehensive narrative describing the Lidar data set and resulting products.
2. Lidar Settings – Prepare a listing of the equipment settings, acquisition parameters, flight settings, etc. Provide the information listed in the Photogrammetry Checklist.
3. The Horizontal accuracies attained for the acquired Lidar data shall be reported. The consultant shall utilize the ASPRS Lidar Guidelines – Horizontal Accuracy Reporting.
4. The Vertical Accuracies attained for the acquired Lidar data shall be reported. The consultant shall utilize the ASPRS Guidelines – Vertical Accuracy Reporting for Lidar Data.
5. Lidar Raw data shall be provided in ASPRS .LAS Version 1.2 format.
6. Lidar Raw data shall be also provided in ASCII format.
7. Lidar based digital elevation model (DEM) processed to a Bare Earth Model (BEM), 3D Microstation file shall be provided.
8. Lidar DSM (Digital Surface Model of the first reflective surface) in a 3D Microstation file.
9. Lidar Index file containing an index of the tiles in a 3D Microstation file.
10. Lidar Enhanced by Photogrammetry in a 3D Microstation file.

AERIAL PHOTOGRAMMETRIC MAPPING **(including Lidar data and Digital Ortho-photos)** **P/PMS Task Number 3310**

The Specific parameters and details such as limits, photo scale, mapping widths, etc. related to this photogrammetric mapping task will be part of the scoping details listed in the MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C for each as-needed job.

Description of Work for Task 3310(Prepare Aerial Topographic Mapping): The actual work required for each as-needed job may include some or all of the following but is not limited to the following tasks: Aerial triangulation, planimetric mapping, terrain mapping, CAiCE surface generation and contour mapping, map merging, use of and merging of Lidar data, and digital ortho-photos.

SCOPE OF CONSULTANT DUTIES

The Consultant will provide:

1. Ground control surveying will be the responsibility of the Prime Consultant and be accomplished by an MDOT qualified firm, if the Prime is not pre-qualified for photogrammetric control surveys. **New ground control is generally required as part of new project mapping. Reference PPMS task # 3320.**

A. CONTROL – Check Shots

The **Consultant must contact** the Photogrammetry Project Manager **prior** to commencing work to **discuss the Check Shots to be used** for this project. The Check Shots are to be with-held from the Analytical Aerial Triangulation (AAT) adjustment and compared with the AAT adjustment results. **This comparison shall be documented in tabular form or spreadsheet along with a written report discussing the AAT adjustment and check shots, and delivered to MDOT as part of the intermediate AAT review prior to commencing map compilation.** Once MDOT has reviewed the AAT report, the Consultant shall utilize the check shots in the map compilation process to verify proper model setup prior to mapping. **As part of the final mapping deliverable, the Consultant shall provide additional data to the spreadsheet that shows the comparison of the check points to the final map coordinates and elevations determined after aerial map compilation is complete.**

2. Topographic Mapping of the project as specified and including:
See MDOT Specifications for Photogrammetric Mapping.

A. Aerial Triangulation Data for the project.

1. Aerial triangulation to establish the photogrammetric mapping control parameters shall be performed as part of this scope.

B. Planimetric map data.

1. Collect data for map scale of project.
2. Mapping shall be compiled from the photography acquired for this project.

C. Digital Terrain Model DTM data.

(Exact values will be provided in the MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C. The following spatial data accuracies are for example only.)

1. Spatial data accuracy of **0.04 feet (rmse) [0.09 feet (95%)]** for hard surface features and well defined points.
2. Spatial data accuracy of **0.10 feet (rmse) [0.20 feet (95%)]** for terrain and other not well defined points.

CAiCE terrain surface (DTM) shall be generated, edited and named "EXPHO".

(NOTE: See *MDOT Specifications for Photogrammetric Mapping* for CAiCE terrain surface specifications.)

D. Contour generation from DTM.

1. Contour Interval shall be computed at **2.00 feet**.

(Note: Contour interval is for display only and shall not be used as criteria for the determination of vertical accuracy of mapping being requested.)

E. Composite map generation and editing.

1. These files must be created with the current MDOT English seed and cell files.
2. Current MDOT symbology must be used exclusively as shown on the MDOT FTP site.
3. The FTP site for consultants is: <ftp://ftp.michtrans.net>
username: survcons
password: \$urvcon\$
4. Mapping data shall be displayed, with the appropriate descriptive attributes, Microstation levels, size of text, etc. as noted in on the FTP site. The Consultant is required to use the latest MDOT Tugboat (macro) to produce the final project deliverables.
5. The Consultant photogrammetrist, surveyor or CAiCE/CADD technician is expected to use due judgment in the event of necessary deviations from this standard. Survey chains (line items) will be processed and edited so as to be displayed as lines and smooth curves as appropriate and displayed at the requested scale with the appropriate pattern. All descriptive text shall be arranged such that text shall not overwrite each other. The delivered product should be legible and professional in appearance and portray an accurate representation of existing field conditions. As there are many variations in standard practices throughout the industry, it is recommended that the consultant refer to the MDOT FTP site and the MDOT Design Division Plans Preparation Guidelines for additional information regarding such things as font size, display attributes, symbology, levels, etc., to be displayed in the submitted planimetric file. Questions or confusion should be immediately brought to the attention of the MDOT Project Manager for clarification.
6. A Digital Terrain Model (DTM) will be created from the appropriate terrain data using the CAICE terrain modeling format. It shall be checked for accuracy and edited as necessary to provide a true representation of the existing terrain. All triangles in the triangulation network that fall outside of the limits of this survey, or are deemed inappropriate in the judgment of the photogrammetrist or surveyor, are to be obscured so as to have no effect on cross-sections, contours and profiles developed from the model. These would include triangles which have legs so long as to cross areas that contain no survey data. Contours are to be generated from the Digital Terrain Model (DTM), to depict the site conditions for this project and plotted as noted above.

- F. Merging of photogrammetric aerial mapping, ground survey mapping and all other forms of mapping information necessary for the project. The Consultant is responsible for obtaining and providing personnel with the necessary expertise in CAiCE, Microstation and map merging methods and procedures to prepare complete and accurate terrain surface (DTM) and mapping files. The Consultant shall include a detailed narrative in their work plan, describing the personnel and procedures to be used for any merging required on this project. (Typical items requiring merging include, obscured mapping areas, utilities, detailed hard surface elevation mapping, etc.)
- G. **Digital Rectified Ortho-Photo maps** generated from the aerial photography, and utilizing the terrain data from a standard altitude flight or in combination with terrain mapping from VLAP photography.
1. Ground Pixel resolution of the final image shall be **0.25 feet** unless otherwise stated in the individual job parameters.
 2. Prepare two dimensional (2-D) digital orthometric images of the subject area, or as defined. The photographs will be digitally scanned, or the digital image may be re-sampled to produce a ground pixel resolution of **0.25 feet** for the final ortho image. Individual stereo image models or alternate aerial photographs maybe used, to create the orthometric images. The individual orthometric images will be re-projected to their true ground position on the DTM (digital terrain model) for the specified area.
 - a. Width of Digital ortho-photos shall extend to the neat limits of the photography
 3. The individual re-projected orthometric images will be assembled into a digital mosaic to produce one seamless orthometric image for the specified area.
 4. Digital Terrain Model (DTM) data for Digital ortho-photos.
 - a. Spatial data accuracy for Digital Ortho-photos of **0.25 feet** or as specified.
 - b. The terrain data collected for the Microstation terrain file and the CAiCE surface shall be utilized to minimize compilation efforts.
 - c. In addition to the DTM in 4.b. the Consultant shall collect Digital Elevation Model (DEM) data out beyond the DTM coverage to extend the elevation data necessary to produce Digital ortho-photos covering the entire neat model width of the photography.
 5. Horizontal accuracy of Digital ortho-photo shall be **1.0 feet or better**.
 6. The Digital ortho-photo image files shall be in uncompressed Intergraph COT format, geo-referenced tiff or tiff/world tiff format. The image files shall be delivered in tiles of approximately 40mb to 60mb for black and white and color images.

7. **Prepare MrSID files** of the seamless image mosaic with a compression ratio of 10:1 or less.

Unless otherwise specified, the general specifications for vertical aerial photography and mapping shall follow the criteria set forth in the DRAFT Aerial Photography Standards, ASPRS Professional Practice Division, Specifications and Standards Committee; September 1995, OR as set forth in the SURVEY AND MAPPING MANUAL; US. Department of Transportation, Federal Highway Administration; November 1985. In addition, the Consultant shall follow and comply with MDOT Specifications for Photogrammetric Mapping. Compliance with these standards will be the burden of the Consultant.

ALL OF THE TASKS CITED ABOVE RELATE TO MDOT'S PPMS TASK # 3310, AND SHOULD BE REFERENCED ON BILLING.

PROJECT SCHEDULE for Aerial Photogrammetric Mapping

The schedule for the project shall be consistent with the schedule for the engineering report scope and be approved by the Project Manager/Road Design Engineer.

The aerial mapping deliverables should be submitted for MDOT review as soon as possible after completion and prior to commencing Design from this information.

The Selected Consultant must provide a detailed schedule in his work plan which must be reviewed and approved by the MDOT Photogrammetric Project Manager and MDOT Project Manager.

The schedule **must include** the following:

- Date to Submit Flight & Target Diagram(s) for MDOT Review and Approval.
- Date Aerial Targets Completed
- Date Flight Completed
- Date Photogrammetric Control Survey Completed & Submitted for MDOT Review
(include 1 set of marked up contact prints)
- Date of Submitting Aerial Triangulation & First Model for MDOT Review and Approval
- Date of Submitting Final Photogrammetric Mapping Deliverables including merged survey information
- Date of Submitting Final Supplemental Road Survey Deliverables including data merged with photogrammetric mapping

DELIVERABLES for Aerial Photogrammetric Mapping

A. General Deliverables – Reporting

1. Follow reporting requirements outlined above in the “General Deliverables – Reporting” section on page 9 above.

B. Aerial Triangulation

1. Hard copy and electronic data file containing a listing of interior orientation results for each photo.

2. Listing of relative orientation results for all strips.
3. Listing of the final least squares adjustment including files of:
 - a. All initial parameter settings set for the adjustment, including datum, units, apriori, standard deviation error estimates. etc.
 - b. All input data.
 - c. Initial run with all control points in solution unless previous runs have been removed.
 - d. Final run that will be used to determine the exterior orientation parameters.
 - e. Results file containing all possible reports of adjustment.
 - f. Report explaining the reasons for withholding any point.
4. Listing of the final exterior orientation parameters.
5. Electronic orientation files necessary to set up the project's models on an Intergraph Image station (Bluh, Bingo, Patb, Patm, PEX, Phorex, BCPI & SD BCPI).
6. Spreadsheet of comparison results between the AAT adjustment and the Check Shots.

C. **Photogrammetric Mapping**

All mapping will be transmitted to MDOT by the scheduled date as set forth in the project scope. The electronic files shall conform to the **current** MDOT standards for MicroStation and CAiCE software versions and MDOT CADD standards. The following shall be submitted as specified in the scope:

1. A three-dimensional Micro Station file, containing all compiled planimetric and terrain information and formatted to current MDOT V8 CADD requirements. This file will be used to translate all the information into CAiCE to develop the terrain surface and merge data with any supplemental conventional survey.
 - a. This file shall be named similar to: **902Photo_3D.dgn**
2. A two-dimensional Micro Station file created by saving the 3D Photogrammetric compiled planimetric and terrain data in item 1 above as a 2D Micro Station file for use as the project planimetric base map.
 - a. This file shall be named similar to: **902Photo_PL.dgn**
3. A two-dimensional Micro Station contours file shall be created as a separate file using the MDOT CAiCE tugboat. At the present time, this process requires manual interaction during the running of the tugboat and the consultant shall verify the correct process to be used by contacting the Photogrammetric Project Manager prior to beginning the mapping process. At the present time, the plan file created from the tugboat should not be used to recreate a photogrammetrically compiled file because of orientation issues related to cell placement. However, the contours created from the tugboat operation shall be out put and used as a reference file.
 - a. The Photogrammetric based 2D Microstation contour file that corresponds to the Photogrammetry CAiCE surface should be created from CAiCE and named similar to the following: **902Photo_Con.dgn**

4. Geopak related deliverable files:
 - a. A three-dimensional Micro Station triangle file for use in Bentley Geopak created through the use of the MDOT CAiCE tugboat.
 - i. For the Photogrammetry based CAiCE surface this file shall be named similar to: **902_Triangle_EXPHO.dgn**.
 - ii. For a Combined Photogrammetry and Supplemental ground survey Merged surface, the file shall be named similar to: **902_Triangle_EXMERG.dgn**
 - b. Project deliverables will include **Geopak (.DAT) files for each surface**. These files must be created with the current MDOT English seed and cell files and included in the CAiCE archive file. Current MDOT symbology must be used exclusively as shown on the MDOT FTP site.
5. A fully edited CAiCE archive (.zip) file and the CAiCE translation table file (T-file) along with the 3D Microstation V8 file that was used to input the mapping data into CAiCE.
 - a. The Photogrammetry based CAiCE archive file shall be named similar to: **902.zip**
 - b. The Supplemental ground survey based CAiCE archive file shall be named similar to: **84130C.zip**
6. Edited CAiCE terrain surface of the photogrammetric data named "EXPHO". The MDOT **current version** of CAiCE shall be used to produce the terrain surface and the entire CAiCE project is to be delivered in a CAiCE archive file. **(See MDOT Specifications for Photogrammetric Mapping for CAiCE terrain surface specifications.)**
7. Two-dimensional Micro Station Contour file created as an output from the CAiCE tugboat containing the contours from the final edited surface that was merged from the photogrammetric and ground survey information, **only if a full project merge is required** as part of this contract/scope. This file shall be named similar to: **902Photo_Con_EXMERG.dgn**
8. All necessary merged data products in CAiCE, Microstation, or other formats prepared as a result of combining the photogrammetric mapping, ground survey mapping and any other data needed for the project.
9. Digital ortho-photos in uncompressed geo-referenced Intergraph tiff or world tiff format.
10. Digital mosaic in one seamless orthometric image file for the specified area in Intergraph tiff or world tiff format (if the file size will be extremely large contact the MDOT Photogrammetry Project Manager for alternatives).
11. MrSid file format with compression ratio of 10:1 or less, of the project area using the geo-referenced, ortho-photo image mosaic.
12. The three-dimensional Microstation terrain data file used strictly to generate the ortho-photo images.

13. **The raw image scans** of all exposures on DVD's, CD-ROM's or external USB/Firewire hard drives in Intergraph tiff (*.cmp) format.
14. The original negatives that were exposed as part of the project or were supplied by MDOT for this project.
15. Marked-up contact prints and flight maps and any materials originally supplied by MDOT.
16. **Spreadsheet of comparison results** showing the **Check Shots** and the comparison to the **AAT adjustment results**.
17. **Spreadsheet of comparison results** showing the **Check Shots** and the comparison to the **final compiled mapping coordinates**.
18. **A Photogrammetrist's Project Report on company letterhead** discussing the project and the following as applied to this project: aerial photography, ground control, AAT, LiDAR data, map compilation, digital ortho-photos, final mapping files, any problems encountered and how they were resolved, and any issues of interest to the next Surveyor, Photogrammetrist, or Engineer that are involved with the project. In addition the Photogrammetrists Project report shall include the project, datums, coordinate systems and units used for the deliverable products and the accuracies attained as submitted for the deliverable products.
 - a. See more **detailed information** related to the **format of the portfolio contents** as outlined near the end of this scope.
19. **Accuracy certification statements** shall be provided as a signed statement on company letterhead containing the following information:

Project Description
 Job Number
 Control Section
 Photo Job Number
 Photo Scale & Date
 Mapping Scale
 Ground Pixel Resolution of Digital Ortho-Photos
 Horizontal Datum and Units
 Vertical Datum and Units

Include a separate accuracy statement for each type of deliverable including the planimetric mapping, terrain mapping, the CAiCE DTM surface, digital ortho-photos and LiDAR terrain data, etc. in a format similar to the following:

(Type of deliverable) was/were compiled by (Consultant's Name) for the Michigan Department of Transportation on (Completion Date) to meet _____feet accuracy

(horizontal) at 95 percent confidence level and _____ feet accuracy (vertical) at 95 percent confidence level for hard surface and well defined points and to meet _____ feet accuracy (horizontal) at 95 percent confidence level and _____ feet accuracy (vertical) at 95 percent confidence level for terrain and not well defined points based on the National Standard for Spatial Data Accuracy(NSSDA), (date of standard), currently in effect. This statement should be signed by the Certified Photogrammetrist in responsible charge of the work preformed.

(Note: Separate accuracies for both well-defined hard surface locations and for ground/mass point locations shall be described in the above statement. Accuracies based on the NMAS or based on contour intervals and map scale, are not acceptable.)

D. Lidar Deliverables

1. A Lidar Report shall provide a detailed listing of the equipment, methods and processes used to obtain the Lidar data as well as a comprehensive narrative describing the Lidar data set and resulting products.
2. The Horizontal accuracies attained for the acquired Lidar data shall be reported. The consultant shall utilize the ASPRS Lidar Guidelines – Horizontal Accuracy Reporting.
3. The Vertical Accuracies attained for the acquired Lidar data shall be reported. The consultant shall utilize the ASPRS Guidelines – Vertical Accuracy Reporting for Lidar Data.
4. Lidar based digital elevation model (DEM) processed to a Bare Earth Model (BEM), 3D Microstation file shall be provided.
5. Lidar DSM (Digital Surface Model of the first reflective surface) in a 3D Microstation file.
6. Lidar Index file containing an index of the tiles in a 3D Microstation file.
7. Lidar Enhanced by Photogrammetry in a 3D Microstation file.

E. QA/QC Certification Statement

1. Each submittal must be accompanied by the following certification statement contained in a letter format on the Consultant’s letterhead and signed by the lead QA/QC person in responsible charge on this contract.
2. If the submittal does not contain the following statement, the submittal is subject to a reduction in the QA/QC costs for the submittal at the MDOT Project Manager’s discretion.

I _____ certify as lead QA/QC person in charge on this contract that I have thoroughly reviewed the project and any corrections identified have been completed.

Name of Certified Photogrammetrist
Project QA/QC Officer
ASPRS Certified Photogrammetrist No. _____

Date

The portfolio shall contain the following 12 sections. Each section in the portfolio shall be named with the titles listed below to identify the type of data contained in the section. **Each sheet in the portfolio must be labeled with the MDOT Photogrammetry Project Number, Job Number, Control Section, and Page Number. CD's, DVD's and electronic storage media shall be labeled with the MDOT Photogrammetry Project Number, Job Number, Control Section, and Date of the latest revision.** The MDOT Photogrammetric Project Check List shall be prepared and included in the Administration section.

1. In the first pocket of the portfolio, labeled **1 ADMINISTRATION**, the following will appear:
 - a. Table of Contents (Adobe PDF files should contain this bookmarked on left side of screen)
 - b. MDOT Photogrammetric Information Receipt and Transmittal form to MDOT
 - c. QA/QC Certification, signed by lead QA/QC person
 - d. **MDOT Photogrammetric Project Check List**
 - e. Photogrammetrist's Project Report containing detailed information about the project
 - f. Project Accuracy Certification by Photogrammetrist
 - g. MDOT Authorization to Proceed
 - h. MDOT Scope of Work
 - i. Consultant Proposal and Work Plan
 - j. Work Permits required for the project
 - k. Correspondence including meeting minutes, e-mails, and phone conversations
2. In the second pocket of the portfolio, labeled **2 FLIGHT PLAN**, the following will appear :
 - a. Flight Report
 - b. Flight diagram showing flight line, model limits and targets/check point locations on a topo quad, high altitude photographic image, or ortho-photo background
 - c. Listing of Flight parameters (also include text file for input to Ascot)
3. In the third pocket of the portfolio, labeled **3 TARGETING**, the following will appear:
 - a. Targeting Report
 - b. Target Parameters, including size, shape, material and location types
 1. Include the location of and description of the type of semi-permanent object (nail, re-rod, iron, etc.) and how it is positioned within the target, (ie. PK nail in center of cross or plus, nail in center intersection of "T")
 - c. Check Point Target Parameters, including size, shape, material and location types
 - d. Witness sketches of all targets with enough information for another person to be able to locate the target.
4. In the fourth pocket of the portfolio, labeled **4 PHOTOGRAPHY**, the following will appear:
 - a. Camera, Film and Printing Report
 - b. Camera Calibration(s) (must be current within last 3 years)
 - c. Negatives - Original un-cut film negatives in roll
 - d. Contact Prints – Scanning done prior to printing contact prints and diapositives

5. In the fifth pocket of the portfolio, labeled **5 IMAGE SCANNING**, the following will appear:
 - a. Scanning Report
 - b. Scanning settings and parameters
 - c. Raw image scans of all exposures

6. In the sixth pocket of the portfolio, labeled **6 AIRBORNE CONTROL**, the following will appear:
 - a. Airborne GPS information, including raw data files for base stations, CORS, and aircraft, and final coordinate file for exposure centers
 - b. Offset information from GPS antenna to Camera exposure center
 - c. Airborne GPS relation to Ground Control

7. In the seventh pocket of the portfolio, labeled **7 CONTROL**, the following will appear:
 - a. Ground Control Report
 1. Explain how ground control coordinates and data fit into this project and any issues associated with the control survey.
 - b. Include copies of all ground control information supplied by surveyors to the photogrammetric work group and used to prepare the aerial triangulation and mapping.
 - c. Reference any separate portfolios prepared for Task 3320 Photogrammetric Control Survey.
 - d. Ground Control Coordinate Listing including specification of datums, units, etc.

8. In the eighth pocket of the portfolio, labeled **8 AERIAL TRIANGULATION**, the following will appear:
 - a. Aerial Triangulation Report
 - b. Aerial Triangulation solution and all associated Aerial Triangulation project settings, adjustments and output report files
 - c. Comparison of AT solution to check point data (Spreadsheet format)

9. In the ninth pocket of the portfolio, labeled **9 MAPPING**, the following will appear:
 - a. Mapping Report including planimetric and terrain accuracies
 - b. Report and spreadsheet comparison of compiled mapping to checkpoints and resulting accuracies for project
 - c. 3D Microstation File in MDOT V8 format
 - d. Planimetric information and Planimetric Microstation files
 - e. Terrain information and Terrain Microstation files
 - f. CAiCE DTM information and CAiCE archive file containing complete edited surface
 1. Use of MDOT CAiCE Tugboat is encouraged
 - g. Contour files in Microstation format generated from CAiCE
 - h. Combined Mapping containing Photogrammetric and Supplemental Ground Survey, if required by scope. (Ground survey may be provided from MDOT or a separate Survey Consultant. See requirements of Scope.)
 1. CAiCE DTM of edited, Merged Terrain surface information. Merged CAiCE project contains both Photogrammetric and supplemental Ground Survey information

2. Provide separate Supplemental ground survey information used to enhance hard surface information, fill in obscured areas and in general supplement the photogrammetric mapping.
 - i. Geopak formatted files. Use of MDOT tugboat macros is encouraged.
 1. Provide Geopak for each of the following conditions
 - a. Photogrammetric data
 - b. Merged Photogrammetric and Ground Survey data
10. In the tenth pocket of the portfolio, labeled **9A ORTHO-IMAGERY**, the following will appear:
- a. Digital Ortho-photo Report
 - b. Digital Ortho-photo Parameters and Accuracies
 - c. Digital Ortho-photo files
 - d. MrSid Parameters
 - e. MrSid Files
11. In the eleventh pocket of the portfolio, labeled **9B LiDAR**, the following will appear:
- a. Lidar Report
 - b. Lidar Settings
 - c. Horizontal accuracies attained
 - d. Vertical Accuracies attained
 - e. Lidar Raw data in ASPRS .LAS Version 1.2 format
 - f. Lidar Raw Data in ASCII format
 - g. Lidar DEM processed to a Bare Earth Model (BEM) 3D Microstation file
 - h. Lidar DSM (Digital Surface Model) 3D Microstation file
 - i. Lidar Index file containing and index of the tiles 3D Microstation file
 - j. Lidar Enhanced by Photogrammetry in a 3D Microstation file
12. In the twelfth pocket of the portfolio, labeled **MISCELLANEOUS**, the following will appear:
- a. Include other items relevant to the project but not fitting in above categories. The Photogrammetrist's Project Report must detail any items included in this area.

General Notes

The above outline contains a sample listing of typical information to be provided for the final photogrammetric reports and PDF file. The final project report required by the project scope may contain some or all of these items and/or additional items not listed here and shall provide the complete information needed for another Photogrammetrist or Professional Surveyor to determine what was done as part of this project.

It is the responsibility of the Consultant to insure that all electronic files submitted to MDOT conform to the required format and that all documents are legible.

PHOTOGRAMMETRIC TARGETING AND CONTROL SURVEY
PPMS Tasks 3321 and 3320

SURVEY DESCRIPTION: Ground Control Survey to support photogrammetric aerial flights and mapping. Use a point numbering sequence as assigned in the **MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C** for the Photo control targets and Check targets or as designated by the MDOT Photogrammetry Project Manager.

This project will be performed in International Feet.

Note: Prior to starting work the Consultant shall contact MDOT Traffic and Safety in the TSC closest to the project site.

NOTES

The Selected Consultant surveyor **must** submit a **detailed Survey Work Plan**, with an **estimate** of hours, by specific survey task, such as targeting, traversing, leveling, etc., as part of the project price proposal.

The Selected Consultant surveyor must discuss the scope of this survey with the project MDOT Photogrammetric Project Manager before initiating any work on this project. Notes of this meeting and a detailed Survey Work Plan with an estimate of hours broken down by specific survey task must be submitted to the MDOT Photogrammetric Project Manager within two weeks of this meeting.

The MDOT Standards of Practice for Design Surveys, current dated version, shall be used for this project. This scope and the MDOT Request for Consultant Photogrammetry and Survey Staff Letter, Attachment C shall hold when conflicts occur between the scope and the Standards of Practice for Design Surveys.

GENERAL REQUIREMENTS:

This survey includes setting out photogrammetric control targets, either by painting or cloth targets in non-paint areas. All non-painted targets, those with cloth panels, will need location witnesses. A panel/target diagram with target locations and numbers must be submitted and approved by the MDOT prior to the placement of the targets. A panel/target diagram must also be returned with the survey with any changes so noted. The requirements of the Photogrammetric Control portion of the Michigan Department of Transportation (MDOT) Standards of Practice for Design Surveys, current version, and the MDOT Design Survey Manual must be followed for the placing of targets.

This survey also requires the gathering of ground control for all points, and this may be completed with GPS techniques. This ground control survey shall be completed as specified below and delivered for MDOT review as soon as this task is completed.

1. All of the General requirements noted near the top of this document shall be complied with.

PROJECT SCHEDULE for Photogrammetric Control Survey

The photogrammetric control survey deliverables should be submitted for MDOT review as soon as possible after completion and prior to commencing the aerial triangulation and mapping portion of this project.

FIELD SURVEY – Photogrammetric Ground Control Survey

The purpose of the field survey is to obtain all information and/or data required to support photogrammetric mapping, to leave control in the field for future construction staking, and to provide a sufficient history of the area to enable the MDOT surveyors to perform dependable surveys in the future.

The field survey must include, but is not limited to, the following:

CONTROL - Primary

HORIZONTAL CONTROL - (State Plane Coordinate System)

A three dimensional coordinate network has been established for this project. The horizontal component of this coordinate network is based on the Michigan Coordinate System (MCS 83), NAD 1983/CORS96, Michigan Appropriate Zone, North, Central or South. **The horizontal least squares adjustment statistics must be reported at the 95% confidence level.**

The vertical component of this network is based upon the North America Vertical Datum of 1988 (NAVD 88). All subsequent control must be based on the established control. Any traverse points or bench marks established must adhere to the Michigan Department of Transportation (MDOT) Design Surveys *Standards of Practice*, current version and be listed in the Control pocket of the portfolio.

The Consultant must contact the MDOT Photogrammetric Project Manager prior to commencing work to discuss the existing control, amount of new control to be used for this project and the locations to be used for placing new control monuments. It is intended that generally pairs of inter-visible primary control monuments shall be placed for the project. In some projects, primary control that is not inter-visible may be requested to be placed for the project. The control pairs are to be **located out of the proposed construction area** and in the most permanent places possible given the urban location of the project. It is intended, to the extent possible, that the Primary control would be **placed to last for 5 to 10 years** and be usable for future construction projects. The Consultant shall use CORS and existing NGS control monumentation to establish the Primary Control. OPUS shall be used **only as a check** and verification of the control coordinates established by other means.

For any and all OPUS solutions, a RINEX format file with a minimum of two hours of GPS data must be included, as well as the OPUS solution from NGS. All OPUS solutions must be verified within 0.10 feet, either by a separate OPUS position from an independent occupation, or by a NGS/CORS adjustment.

Upon request, the MDOT Design Survey Unit will supply descriptions of nearby published Nation Geodetic Survey (NGS) control stations and bench marks. A complete history, as well as

a recovery description with new witnesses to be submitted in DDPROC to NGS, for each NGS horizontal and vertical control station and bench mark **used and/or searched** for this project must be included in the final report submitted to the MDOT Design Survey Unit. The DDPROC program is available through the MDOT Design Survey office. The Consultant may opt to use the Mark Recover Entry Form on the NGS Website at www.ngs.noaa.gov. If this is done, a printed copy of the Mark Recovery Entry Form shall be submitted with the portfolio.

The horizontal control for this project will be classified as primary project control according to the MDOT Standards of Practice, current version. These points are intended for control and staking and should be located outside the proposed construction area to insure their availability for all phases of construction. Each control point must be accurately described and witnessed to at least three nearby features.

Please contact the MDOT Photogrammetric Project Manager to discuss the specifics of the placement of the control monuments.

GPS TECHNIQUES

When using GPS techniques to obtain coordinates on the primary control networks, a closed network must be run and adjusted between three or more known horizontal points and four or more known vertical points. If the above mentioned benchmarks are observable, they may be used as known vertical for this project. Open radial vectors are **NOT** acceptable. Unadjusted network vector measurements must produce an error of closure of not greater than 1:100,000. **Any permissible error of closure shall be distributed throughout the network by means of a least squares adjustment software program which meets the approval of MDOT.** GPS processing software must be capable of importing and using the most current NGS antenna definitions files. Initial error estimates shall be set equal to or less than 0.03 feet + 1ppm for both horizontal and vertical.

The primary control points must be inter-visible pairs that are observed simultaneously, and must not be set less than 2640 feet nor more than 5280 feet apart, semi-permanent in nature, and located outside the proposed construction area to insure their availability for all phases of construction. A minimum of two pairs of primary control are required on each project, with a pair required every 5.0 miles. All data collection on photogrammetric control points must be tied to the primary control established for this project. Primary control notes must include all least squares adjustment information.

The use of fixed height tripods for GPS observations is highly recommended.

VERTICAL CONTROL - NAVD88

The vertical component of this project must be based upon the North America Vertical Datum of 1988 (NAVD 88). Software currently accepted by MDOT for Vertical adjustments includes LevProc and Starnet-Pro/StarLev. The vertical least squares adjustment statistics must be reported at the 95% confidence level.

New benchmarks may be required to be established for the project if no acceptable vertical control exists on the project. Using the criteria outlined below to support control for VLAP

(very low altitude aerial photography) mapping or SAP (standard altitude aerial photography) mapping, provide the necessary results showing both the existing benchmarks for this project, if any, and all newly established benchmarks.

New bench marks must be set on **massive structures** at or near **1000 foot spacing** along the corridor, outside the proposed construction area. Chiseled squares or 'X' in concrete is acceptable but must be clearly identifiable, well described, with good witnesses. Chiseled marks of any kind are **not acceptable** in galvanized sign bolts due to the destructive nature and corrosion it subsequently causes. Each bench mark must be accurately described by four witnesses or its horizontal position referenced by measurement from a horizontal control point and by plus and outs from stenciled alignment stationing.

Bench mark leveling must be performed to meet **0.03 feet times the square root of the distance in Miles for VLAP mapping or 0.05 feet times the square root of the distance in Miles for SAP standard altitude mapping as designated by the MDOT Photogrammetric Project Manager**. Any error of closure must be distributed throughout the level runs by means of a suitable least squares adjustment software program. Closed level loops are to be run. Open level loops are **NOT** acceptable.

The bench mark notes must include all field observations, the unadjusted loop closures and the final adjusted elevations. A **bench mark list** must be developed that includes datum, benchmark designations, descriptions and elevations. All benchmarks observed in the course of leveling are to be included in the bench mark list, including NGS and fixed benchmarks along with all new benchmarks. **This bench mark list must be printed on 8.5" x 11" sheets and placed on a CD with the rest of the project files. This list must be generated in ASCII format, without tabs, as shown in Attachment A.** The printed list and the CD are to be submitted with the Consultant's final report.

CONTROL - Intermediate

The three dimensional coordinate network, as established above under Primary control for this project, shall be used as the basis for the intermediate control. The horizontal component of this coordinate system must be based upon the Michigan Coordinate System (MCS 83), NAD 1983/CORS96, Michigan Appropriate Zone, North, Central or South. The vertical component of this system must be based upon the North America Vertical Datum of 1988 (NAVD 88). All photogrammetric control points shall be classified as intermediate control for this project and shall be tied as a network to the primary control as established.

The elevations on photogrammetric targets along one side of the project shall be measured during the benchmark leveling and adjusted as part of the primary vertical control. The targets on the opposite side may be observed with GPS and adjusted by constraining the target elevations on the leveled side as fixed, or they may be measured by conventional leveling. Doing so will ensure elevations to accuracies necessary for this project.

A closed network must be run and adjusted holding the horizontal and vertical control as fixed to obtain coordinates on the photogrammetric targets. Open radial vectors are **NOT** acceptable. Adjacent Photogrammetric targets falling in the same model shall be occupied in the same

simultaneous session. **All points shall be occupied at least two times and at least 10% shall be occupied three or more times. Only non-trivial baselines shall be used as part of the adjustment. The consultant shall ensure that in the final network adjustment, all network baseline connections used shall contain at least two vector measurements from independently observed sessions. The network adjustments shall contain redundant vectors/baselines for all connections.**

Rapid/Fast static procedures are preferred although RTK GPS is acceptable provided the Consultant follows the **MDOT Standards and Specifications for RTK GPS Surveys**. Unadjusted network vector measurements must produce an error of closure of not greater than 1:20,000. Any permissible error of closure shall be distributed throughout the network by means of a suitable least squares adjustment software program approved by MDOT.

The nearest targeted points to one another (opposites on highway), shall be observed simultaneously to ensure measurement and adjustment quality. This generally means a minimum of four receivers may be necessary.

All field observations, unadjusted network computations and final adjusted coordinates must be included in the notes. A list of all photogrammetric control points must be developed which includes a header with 1983 State Plane Coordinate datum and zone, and contains all point designations, state plane coordinates (X & Y), elevation (Z) and standard deviations for each component. **This list must be printed on 8.5" x 11" sheets and placed on a CD with the rest of the project files. This list must be generated in ASCII format, without tabs, as shown in Attachment A.** The printed list and the CD are to be submitted with the Consultant's final report. All data relating to the horizontal component of the system must be included in the portfolio.

All field observations, unadjusted traverse computations and final adjusted coordinates must be included in the notes. A **list of all horizontal control points** must be developed which includes datum, point designations, descriptions, horizontal coordinates with standard errors, station and offset, witnesses and combined scale factors. This list must also provide a formula for a grid to ground conversion. **This list must be generated in ASCII format, without tabs, as shown in Attachment A.** A Microsoft Word file format, with tabs, is also acceptable (for importation through the MicroStation-Axiom-Microsoft Office Importer), as long as it maintains the integrity of the form shown in Attachment A. This list must be printed on 8.5" x 11" sheets and placed on CD. All data relating to the horizontal component of the system must be included in the control section of the portfolio.

When using GPS techniques to obtain coordinates on either Primary or Intermediate Control points, two of the following three methods must be used:

1. A minimally constrained CORS solution
2. An OPUS solution with at least 2 hours of occupation per point. For any and all OPUS solutions, a RINEX format file with a minimum of two hours of GPS data must be included, as well as the OPUS solution from NGS. All OPUS solutions must be verified within 0.20 foot, either by a separate OPUS position from an independent occupation, or by a NGS/CORS adjustment.

3. The procedure outlined in Section 7.2.1 of the MDOT Survey Manual.

Open radial vectors are not acceptable.

Unadjusted network vector measurements must produce an error of closure of not greater than 1:100,000 for primary control and 1:20,000 for intermediate control. Any permissible error of closure shall be distributed throughout the network by means of a suitable least squares adjustment software program. The difference in global location between the two chosen methods must not exceed 0.20 feet (0.0610 m). A narrative explaining the process and errors must be included in the Surveyor's Report.

Use of RTK GPS mapping methods needs to be discussed with the Photogrammetric Project Manager prior to the beginning of any project.

CONTROL – Check Shots

The Consultant must contact the Photogrammetry Project Manager prior to commencing work to discuss the Check Shots to be used for this project. The Consultant shall obtain coordinates and elevations for Check shots. **Check Shots** shall be obtained and are to be taken in areas between photogrammetric target groups and not directly adjacent to an existing control point or target. Approximately **three (3) check shots** shall be spaced across the photo model and approximately centered on the highway corridor. The Consultant shall obtain check shot groups along the flight line at approximately **6 to 10 model intervals** along each flight line or as defined by the MDOT Photogrammetric Project Manager. Short flight lines shall have a minimum of three check shot group areas, to include one group near each end of the flight line and one spaced evenly in the middle. Where flight lines overlap, a check shot group may be located so that the one group is useable for both flight lines. For cross-flight lines on crossroads check shot groups consisting of a minimum of 2 targets with at least one target being located near the center of the model (Flight line centerline) and one the cross road hardsurface.

Additional photogrammetric targets painted on hard surfaced areas and specifically set for check shots are preferred. Easily identified hard surfaced physical objects with sharp edges or intersections that would be identifiable from aerial photography may be acceptable. Objects with rounded corner edges, utility poles, objects on bridges, objects in shadows, etc., are not acceptable for check shots.

The Check Shots are to be with-held from the Analytical Aerial Triangulation (AAT) adjustment and compared with the AAT adjustment results. **This comparison shall be documented in tabular form or spreadsheet along with a written report discussing the AAT adjustment and check shots, and delivered to MDOT as part of the intermediate AAT review prior to commencing map compilation.** Once MDOT has reviewed the AAT report, the Consultant shall utilize the check shots in the map compilation process to verify proper model setup prior to mapping. **As part of the final mapping deliverable, the Consultant shall provide additional data to the spreadsheet that shows the comparison of the check points to the final map coordinates and elevations determined after aerial map compilation is complete.**

Check Shots are to be surveyed with the same standards as intermediate control points. The same standards and accuracies used to obtain the coordinates and elevations for the photogrammetric target control points (see the section labeled GPS Techniques above) shall be used to obtain the coordinates for these Check Shots. **As an optional method, Check Shots may be surveyed using Real Time Kinematic (RTK) GPS provided the methods used adhere to the MDOT Standards and Specifications for RTK GPS Surveys and the Consultant obtains prior approval from the MDOT Photogrammetric Project Manager.**

The methods used to establish the horizontal and vertical components of the project coordinate control system must be fully discussed in the Surveyor's Project Report.

MISCELLANEOUS

Any information that would not be appropriately placed in the control section must be included in this section. General photographs and local newspaper articles and project-related comments from residents are examples of miscellaneous data.

TARGETING AND CONTROL SURVEY DELIVERABLES

The following outline contains a list of deliverables by P/PMS task number that must be submitted to MDOT Aerial Mapping Services immediately upon completion of the P/PMS tasks listed here and prior to commencing the design engineering portion of the project.

All deliverables must be done in conformance with the MDOT project scope, the current revision of MDOT Standards for Photogrammetric Mapping, the National Standard for Spatial Data Accuracy (NSSDA), currently in effect, the Standards of Practice for MDOT Design Surveys(current version) and the MDOT Design Survey Manual.

DELIVERABLES FOR PHOTOGRAMMETRIC CONTROL SURVEY

P/PMS Task 3320 - (Conduct Photogrammetric Control Survey)

P/PMS Task 3321 - (Set Aerial Photo Targets)

The following deliverables shall be submitted to MDOT Aerial Mapping Services (Photogrammetry) as soon as possible upon completion of this task and is a more detailed and complete report and deliverable than what was intended above to be part of the Photogrammetry reports.

When MDOT PPMS Tasks 3320 and 3321 (Photogrammetric Control Survey and Targeting) is part of the project scope, all data, reports and deliverables associated with that task shall be organized and delivered in its own separate portfolio. **QA/QC review and signature for a Task 3320 portfolio must be provided by a Michigan Professional Surveyor having MDOT Prequalification in Photogrammetric Control Surveys.**

The **FINAL REPORT shall include 1 complete set** of hardcopies and shall be submitted in a 10" by 12" portfolio with flap cover divided into pockets. **3 complete sets** of the electronic format of the reports and deliverables on CD-ROM or DVD-ROM shall be included, with both electronic and paper versions containing the following:

1. In the first pocket of the portfolio, labeled **1 ADMINISTRATION**, the following will appear:
 - a. MDOT's Form 222(05/01) entitled "SURVEY NOTES: RECEIPT AND TRANSMITTAL"
 - b. The project's Professional Surveyor's Report on company letterhead consisting of:
 1. Limits of Survey
 2. A comprehensive synopsis of the work performed on this project, **signed and sealed** by the project's Professional Surveyor.
 3. The source and methods used to establish the project horizontal and vertical control for this project.
 4. A statement from the Consultant surveyor supervising the project certifying compliance with Michigan Department of Transportation (MDOT) Design Surveys *Standards of Practice*, current version.
 5. A detailed explanation of anything discovered during the survey of this project that may create a problem for the designer or another surveyor. The stamped concrete shoulder stationing numbers should be referenced.
 - c. **MDOT QA/QC Certification Check List for Photogrammetric Control Surveys** filled out and signed/sealed by a Professional Surveyor.
 - d. MDOT Authorization and copy of Contract
 - e. Original MDOT Photogrammetric Control Survey Scope
 - f. The Consultant's detailed Work Plan and Cost Derivation
 - g. Three duplicate CD's with all documents scanned or converted into PDF files. Each page must be inserted in a master PDF file and bookmarked for easy retrieval. An example can be provided upon request.
 - h. All supporting and supplemental information/data. Include any instructions from the Prime Consultant.
2. In the second pocket of the portfolio, labeled **3 TARGETING**, the following will appear:
 - a. Targeting Report
 - b. Target Parameters, including size, shape, material and location types
 1. Include the location of and description of the type of semi-permanent object (nail, re-rod, iron, etc.) and how it is positioned within the target, (ie. PK nail in center of cross or plus, nail in center intersection of "T")
 - c. Check Point Target Parameters, including size, shape, material and location types
 - d. Witness sketches of all targets with enough information for another person to be able to locate the target
 - e. Aerial Photogrammetric target or panel diagram. Note any changes in target positions from planned location to location as surveyed.
 - f. Contact prints marked up with the target locations and point numbers as surveyed.
3. In the third pocket of the portfolio, labeled **7 CONTROL**, the following will appear:
 - a. Synopsis Report on Control

- b. Sketch or printout of the Control Network.
 - c. Photogrammetric Target X,Y,Z list with standard deviations of each X,Y,Z component, in ASCII text file format, without tabs. The file shall be formatted with one point per line and shall **not** be arranged per Attachment A.
 - d. Check Shot X,Y,Z list with standard deviations of each X,Y,Z component, in ASCII text file format, without tabs. The file shall be formatted with one point per line and shall **not** be arranged per Attachment A.
 - e. Check Shot Description list containing the X,Y,Z coordinates and description of object. The list shall be delivered in text files, in ASCII format per Attachment A.
 - f. Witness lists for the primary horizontal control points, bench mark lists including descriptions, Control Point witness list for all intermediate control used, and any photogrammetric target control points that have been witnessed. The lists shall be delivered in text files, in ASCII format per Attachment A.
 - g. Text files in ASCII format, hard copy and on CD, which contain the witness lists for the horizontal alignment ties, horizontal control points, benchmarks and government corners.
 - h. **A 3d Microstation file shall be prepared and submitted that includes all primary control, intermediate control, photogrammetric targets, check targets, and benchmarks plotted in their correct 3d coordinate positions. This data shall be prepared using the most current MDOT Cadd symbology and formats. The point number/name and elevation text shall be labeled next to each point.**
 - i. A MicroStation file shall be prepared and submitted with the appropriate control point, benchmark and witness data for this project's horizontal and vertical primary, intermediate, photo targets and check targets per the format shown in Attachment A. This file must be named (PhotoNumber)PNxxxwit.dgn. An example is available upon request.
 - j. Copies of all Mark Recovery Information submitted to NGS for all NGS control monumentation used during the project documentation of submission of the data to NGS via the NGS web site http://www.ngs.noaa.gov/FORMS_PROCESSING-cgi-bin/recvy_entry_www.prl
4. In the fourth pocket of the portfolio, labeled **HORIZONTAL CONTROL**, the following will appear:
- a. Synopsis Report of Horizontal Control
 - b. Documentation of horizontal datum sources.
 - c. GPS raw data in electronic format
 - d. Least squares adjustments (including both minimal and constrained versions) and analysis for the horizontal control, along with the input or *.dat files used.
 - e. **A vector diagram/map of each GPS survey and adjustment for the project.**
 - f. The Consultant is responsible for verifying all residuals and standard deviations to ensure they meet this scope and the Standards of Practice for MDOT Design Surveys, current version.
5. In the fifth pocket of the portfolio, labeled **VERTICAL CONTROL**, the following will appear:
- a. Synopsis Report of Vertical Control
 - b. Documentation of vertical datum sources.

- c. Least squares adjustments (including both minimal and constrained versions) and analysis for the vertical control, along with the input or *.dat files used.
 - d. **A diagram/map showing the location of all vertical control and the level runs/loops performed for the project.**
 - e. The Consultant is responsible for verifying all residuals and standard deviations to ensure they meet this scope and the Standards of Practice for MDOT Design Surveys, current version.
6. In the sixth pocket of the portfolio, labeled **FIELD NOTES**, the following will appear:
- a. A copy of all field survey notes shall be submitted including data gathering sheets at each point, all electronic data, and all research records obtained for this project. All survey notes are to be included on CD with the rest of the project files, in ASCII format. Data collection files may be in electronic format only, no hard copy is necessary for submission.
7. In the seventh pocket of the portfolio, labeled **MISCELLANEOUS**, the following will appear:
- a. Any photographs taken for clarity of an area.
 - b. Any newspaper clippings related to the project.
 - c. Any information not covered in this scope that will be of benefit to the designer or another surveyor.

General Notes

- a. It is the responsibility of the Consultant to insure that all electronic files submitted to MDOT conform to the required format and that all documents are legible.
- b. The Consultant must organize and label the various sections of the portfolio as required by this scope and the Standards of Practice for MDOT Design Surveys, current version.
- c. It is desirable to limit paper and to include as much electronic data as possible on Compact Disc, including scanned items, to facilitate future electronic storage and transmission of survey data. **Three sets of duplicate CD's must be included in the portfolio, with one set labeled "Region Surveyor".**

Electronic files must be recorded on non-rewritable Compact Disks (CD's). All data, whether electronic or paper, including MicroStation files, must be scanned or converted to Acrobat PDF format and recorded on CD. CD's must be organized in the same manner as the portfolio, such as by Administrative section, Control section, etc. CD's must be labeled with the Consultant name, route, location, control section, job number, data type, file names and date. A Table of Contents is required in the PDF file and will have all parts/pages of the portfolio book-marked/linked so that any part/page of the portfolio can be accessed immediately. Microsoft Word files can be saved directly into PDF format. MicroStation drawings and research data, etc. will need to be scanned into PDF format.

A. QA/QC Certification Statement

1. Each submittal must be accompanied by the following certification statement contained in a letter format on the Consultant's letterhead and signed by the lead QA/QC person in responsible charge on this contract.
2. If the submittal does not contain the following statement, the submittal is subject to a reduction in the QA/QC costs for the submittal at the MDOT Project Manager's discretion.

I _____ certify as lead QA/QC person in charge on this contract that I have thoroughly reviewed the project and any corrections identified have been completed.

Name of Professional Surveyor
Project QA/QC Officer
Michigan PS # _____

Date

ATTACHMENT "A"

Formats for control point lists, benchmark lists, alignment point lists, and Government corner witness lists. This formatting is required to import the lists in to the MicroStation drawing.

1. ASCII files must be generated exclusively in ASCII Text format, in a program such as Notepad. Conversions from Rich Text Format, Word, etc. are not acceptable unless the file can be imported directly into MicroStation in proper form (see #6 below).
2. Do not use Tabs to align text. Use spaces only.
3. Use normal keyboard keys for fractions. (Example $\frac{1}{2}$)
4. For Special characters use only the following ASCII characters for conversion to MicroStation:
 - +/- = \pm (plus or minus)
 - CL = Centerline
 - dia = \varnothing (diameter)
 - ^ = $^{\circ}$ (degree)

[See the FTP site for an example.](#)

5. A Microsoft Word file format, with tabs, is also acceptable for importation through the MicroStation-Axiom-Microsoft Office Importer, as long as it maintains the integrity of the form shown in #6 below. Holding the ALT key down while typing 248 produces the degree symbol.
6. Data must be organized as shown in the example below:

CONTROL PT#: CP660

DESCRIPTION: Set 5/8 in. x 3 ft re-rod and yellow S&W cap in West edge of M-95 gravel shoulder, and +/- 150 ft. North of CL of Norway Dr.

Station 47+38.27, Offset 20.02 ft. Lt

COORDINATES: N = 409,047.647 E = 13,232,571.566 Elev = 892.864

Combined Scale Factor: 0.999967411155

WITNESSES:

- | | | |
|----------|----------|---|
| 1. East | 19.4 ft. | CL of N-S concrete M-95 |
| 2. South | 6.0 ft. | North edge of concrete base of City Limits sign |
| 3. S84°W | 16.8 ft. | Set nail and S&W tag in North face of power pole |
| 4. S43°E | 73.8 ft | Set nail and S&W tag in S.W. face of 6 in. dia. maple |

7. Prior to importing text files into MicroStation, the font must be set to DESV8FONT, height must be set to 12, width must be set to 10 and line spacing must be set to 1.2 in the MicroStation-Element-Text Styles Dialog Box. Also, in the same dialog box, single line and multi-line justification must be set to left center. Text Node must be turned off.
8. A MicroStation file must be saved and submitted with the appropriate control point, benchmark and witness data. This file must be named **(JN)xxxxxwit.dgn**. An example is available on the MDOT FTP site.

ATTACHMENT “B”
SAMPLE Monthly Progress Report

MONTHLY PROGRESS REPORT

Project Route: I-96, from US-127 to Meridian Road, Ingham County
CS 12345 – JN 12345C - PN 902

Control Section 12345
Job Number 12345C
Photogrammetry Number 902
Date 01/31/07

- A. Work accomplished during the previous month.
 - 1. During the last month we completed the Final Right of Way plans and submitted them to Thomas Nelson, Jr. on 05/01/99.

- B. Anticipated work items for the upcoming month.
 - 1. Submit the Preliminary Plans and related material on 03/11/99.
 - 2. Attend the meeting regarding the Ameritech lines on the bridge, scheduled for 03/12/99.

- C. Real or anticipated problems on the project.
 - 1. We foresee no problems at this time.

- D. Update of previously approved detailed project schedule (attached), including explanations for any delays or changes.
 - 1. The design is falling behind schedule because we had problems resolving the geometries of the ramps in relation to the bridge. The Preliminary Plan submittal will be the only task affected by this delay because we will make up the lost time prior to submitting the Final Plans and Specifications.

- E. Items needed from MDOT.
 - 1. Prior to final Plan submittal we will need the latest Special provision and Supplemental Specification checklist.

- F. Copy of Verbal Contact Records for the period (attached).
 - 1. Discussed bridge and ramp geometries with Tom Myers of MDOT Traffic and Safety Division on 07-24-95.

ATTACHMENT "C"**MDOT Request for Consultant Photogrammetry and Survey Staff Letter**

February 18, 2007

Consultant Firm Name
 Attn: Project Manager, C.P. / P.S.
 Address 1
 Address 2

MDOT requests consultant photogrammetry and survey staff and services for the following project under the contract number 2008-#### (#), SCOPE OF SERVICES FOR AS-NEEDED PHOTOGRAMMETRY AND PHOTOGRAMMETRIC CONTROL SURVEY SERVICES, Lansing Design Support Area/Aerial Mapping Services Unit.

PHOTO NUMBER: ### JOB NUMBER: ##### CONTROL SECTION: #####

ROUTE: I-96 from US-127 to Meridian Road, Ingham County, Michigan.

TYPE OF SURVEY: Photogrammetry; P/PMS Task 2320, 2321, 2322, 3310
 Photogrammetric Control Survey; P/PMS Task 3320, 3321

PROJECT DUE DATE: 8 WEEKS after final work authorization is issued.

PROJECT LIMITS: I-96 from 3000 feet Westerly of Pine Tree Road (Sycamore Creek West of US-127) Easterly to 1 mile East of Meridian Road (Burkley Road), located in Ingham County. See attached map for the location of the project.

Photography Acquisition Limits: I-96 from 3000 feet Westerly of Pine Tree Road (Sycamore Creek West of US-127) Easterly to 1 mile East of Meridian Road (Burkley Road), located in Ingham County, including full coverage of interchanges. Crossroads included are College Road, Okemos Road and Meridian Road. See attached map for the location of the project.

Photogrammetric Mapping Limits: I-96 from 250 feet east of PineTree Road to 500 feet east of Meridian Road and including full interchanges. Crossroads include College Road, Okemos Road and Meridian Road.

Description of Work for Photography Acquisition Tasks: Aerial photography (flights), aerial photograph image scanning. See scope for targeting and ground control survey required to support this project.

Description of Work for Mapping Tasks: Aerial triangulation, planimetric mapping, terrain mapping, CAiCE surface generation and contour mapping, Digital Ortho-photos.

Photogrammetric Project Details:

Photo Symbol:	GPC	Photo Scale:	1:2400 (1" = 200')
Length of Project:	Approx. 9.25 miles	Map Scale:	1:600 (1" = 50')
Length of Photography - Flight Line Miles:	TBD (Approximately 11.5 miles)		

The Flight altitude will be **nominally 1200 feet** above average ground elevation to produce vertical aerial photography at the above photo scale required for the project(s).

Consultant shall discuss the placement of flight lines with the MDOT Photogrammetric Project Manager prior to preparing the price proposal and prior to flight. Multiple flight lines are required to cover the corridor and interchanges.

Number of Flight Lines Proposed: TBD (approximately 4)

Number of Exposures Proposed: TBD (approximately 84)

Number of Targets Proposed: TBD (approximately 50)

Number of Check Point Targets Proposed: TBD (approximately 22)

Width of Photography and Mapping each side of CL: 150 feet or to a minimum of 25 feet outside of ROW.

Length of Photography and Mapping on Cross Roads / Streets: 500 feet from the flight line or to the limits of Photography.

Width of Photography and Mapping each side of CL along Cross Roads / Streets: 75 feet.

Width of Coverage for Digital Ortho-photos each side of CL: Generally to the limits of the width of photography.

Length of Coverage for Digital Ortho-photos along Cross Roads / Streets: To the limits of Photography.

Width of Coverage for Digital Ortho-photos each side of CL along Cross Roads / Streets: To the limits of the width of photography.

Sets of Contact Prints Required: 3 sets

Planimetric Mapping = Required

Digital Terrain Model (DTM) compilation = Required

CAiCE DTM Surface = Required

Contour Interval = 2 foot

Digital Terrain Model DTM data.

1. Spatial data accuracy of **0.04 feet (rmse) [0.09 feet (95%)]** for hard surface features and well defined points.
2. Spatial data accuracy of **0.10 feet (rmse) [0.20 feet (95%)]** for terrain and other not well defined points.

Digital Elevation Model (DEM) = Required to support generation of Digital Ortho-photos. (DEM may be prepared from a combination of terrain data collected from the corridor mapping for the DTM and additional data to extend out to the limits of the photography).

Digital Ortho-Photos = Required

Note: This project will be performed in English Units (International Feet).

The coordinate system shall be NAD83/CORS96 Michigan State Plane, South Zone.

Horizontal Datum = NAD83/CORS96 Michigan South Zone

Vertical Datum = NAVD88

Description of Work for Photogrammetric Targeting and Control Survey PPMS Tasks 3321 and 3320: Ground Control Survey for **standard altitude flights** to support photogrammetric aerial mapping. Use a numbering sequence of **600-700 series** for Photo control targets, **900-999 series** for Check targets, or as designated by the MDOT Photogrammetry Project Manager. **Approximately 50 regular targets** and **approximately 22 check targets** are anticipated for the flights. A total of **72 targets** are anticipated to be needed for this project.

PROJECT DELIVERABLES:

The Consultant shall provide the standard MDOT Photogrammetry and Survey Portfolios, **all deliverables listed in the original Scope of Services for As-Needed Photogrammetry and Photogrammetric Control Survey Services and this MDOT Request for Consultant Photogrammetry and Survey Staff Letter.** Any deviations in standard deliverables are as noted in this MDOT Request for Consultant Photogrammetry and Survey Staff Letter.

Receipt of this request requires the **Consultant to notify** the undersigned regarding the **availability of the Consultant's staff** to work on this project and **acceptance of the above terms and conditions**, in writing, **within two working days.** A signature below indicates that the Consultant agrees to the terms and conditions detailed in the original Scope of Services for As-Needed Photogrammetry and Photogrammetric Control Survey Services and this MDOT Request for Consultant Photogrammetry and Survey Staff Services letter **including the project due date.** A detailed cost proposal with a breakdown of man hours and tasks will be required and reviewed prior to obtaining a final work authorization.

Kelvin J. Wixtrom, P.S.
MDOT Aerial Mapping Services
Photogrammetric Consultant Project Manager
FAX: 517-241-4631

Date: _____

Consultant Signature
ASPRS Cert. Photogrammetrist or Michigan Professional Surveyor
Name:
Title:
Firm:

Date: _____

Consultant Signature Authorized for Negotiating MDOT Contracts
Name:
Title:
Firm:

Date: _____