Michigan Department
Of Transportation
5100B (03/12)

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

REQUISITION NUMBER	DUE DATE	TIME DUE
1030	11/13/2012	noon EST

MDOT PROJECT MANAGER	JOB NUMBER (JN)	CONTROL SECTION (CS)
Jason Garza	117465	56021

DESCRIPTION
EPE design for M-20 over Tittabawassee River/CSX RR (ABN) in Midland (56021-R01); Midland County

MDOT PROJECT MANAGER: Check all items to be included in RFP WHITE = REQUIRED GRAY SHADING = OPTIONAL Check the appropriate Tier in the box below			**CONSULTANT:** Provide only checked items below in proposal
☐ **TIER 1 ($25,000-$99,999)**	☐ **TIER II ($100,000-$250,000)**	☑ **TIER III (>$250,000)**	
☐	☐	☑	Understanding of Service
☐	☐	☑	*Innovations*
☐	☐	☑	Organizational Chart
☐	☐	☑	Qualifications of Team
Not required as part of Official RFP	Not required as part of Official RFP	☑	Quality Assurance/Quality Control
☐	☐	☑	**Location:** The percentage of work performed in Michigan will be used for all selections unless the project is for on-site p=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	☐	Presentation
N/A	N/A	☐	Technical Proposal (if Presentation is required)
3 pages (MDOT Forms not counted) **(No Resumes)**	7 pages (MDOT Forms not counted)	14 pages (MDOT forms not counted)	Total maximum pages for RFP **not including key personnel resumes.** Resumes limited to 2 pages per key staff personnel.

PROPOSAL AND BID SHEET EMAIL ADDRESS – mdot-rfp-response@michigan.gov

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 five (5) 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
5100J – Consultant Data and Signature Sheet (Required only for firms not currently prequalified with MDOT)

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

REQUEST FOR PROPOSAL

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 Services Contracts" and "Guideline for Completing a Low Bid Sheet(S)*, if a low bid is involved as part of the selection process. **Reference 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 10/1/2012 THROUGH 12/31/2012

☑ **Prequalified Services** – See page 2 of the attached Scope of Services for required Prequalification Classifications.

☐ **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. **Form 5100J is required with Proposal for firms not currently prequalified with MDOT**

☑ **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 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.

☐ **Qualification 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. The vendor that has met established qualification threshold and 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

Bid Sheet(s) must be submitted in accordance with the "Guidelines for Completing a Low Bid Sheet(s)* (available on MDOT's website). Bid Sheet(s) are located at the end of the Scope of Services. Submit bid sheet(s) separate from the proposal, to the email address: mdot-rfp-response@michigan.gov. Failure to comply with this procedure may result in your bid being rejected from consideration.

NOTIFICATION
MANDATORY ELECTRONIC SUBMITTAL

Proposals submitted for this project must be submitted electronically.

The following are changes to the Proposal Submittal Requirements:

- Eliminated the Following Requirements:
  - Safety Program
  - Communication Plan
  - Past Performance as *a separate section*
  - Separate section for DBE Statement of goals. Include information in Qualification of Team section

- Implemented the Following Changes:
  - All proposals require an Organization Chart
  - Resumes must be a maximum of two pages
  - Only Key (lead) staff resumes may be submitted
  - Tier III proposal reduced from 19 to 14 pages
  - Forms 5100D, 5100I, and 5100G combined – 5100D
  - Forms 5100B and 5100H combined – 5100B
  - RFP's will be posted on a weekly basis -- on Mondays

The following are Requirements for Electronic Submittals:

- Proposals must be prepared using the most current guidelines
- The proposal must be bookmarked to clearly identify the proposal sections (See Below)
- For any section not required per the RFP, the bookmark must be edited to include "N/A" after the bookmark title.
  Example: Understanding of Service – N/A
- Proposals must be assembled and saved as a single PDF file
- PDF file must be 5 megabytes or smaller
- PDF file must be submitted via e-mail to MDOT-RFP-Response@michigan.gov
- MDOT's requisition number and company name must be included in the subject line of the e-mail. The PDF shall be named using the following format:
  - Requisition#XXX_Company Name.PDF
- MDOT will not accept multiple submittals
- Proposals must be *received* by MDOT on or before the due date and time specified in each RFP

If the submittals do not comply with the requirements, they may be determined unresponsive.

The Consultant's will receive an e-mail reply/notification from MDOT when the proposal is received. Please retain a copy of this e-mail as proof that the proposal was received on time. **Consultants are responsible for ensuring the MDOT receives the proposal on time.**

****Contact Contract Services Division immediately at 517-373-4680 if you do not get an auto response****

Required Bookmarking Format:

I. Request for Proposal Cover Sheet Form 5100D
   A. Consultant Data and Signature Sheet, Form 5100J (if applicable)
II. Understanding of Service
   A. Innovations
III. Qualifications of Team
   A. Structure of Project Team
      1. Role of Firms
      2. Role of Key Personnel
   B. Organization Chart
   C. Location
IV. Quality Assurance / Quality Control Plan
V. Resumes of Key Staff
VI. Pricing Documents/Bid Sheet (if applicable)

2/14/12

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Michigan Department of Transportation

SCOPE OF SERVICE
FOR
EARLY PRELIMINARY ENGINEERING (EPE)
DESIGN SERVICE
Revised 10/29/2012

CONTROL SECTION(S): 56021

JOB NUMBER(S): 117465

PROJECT LOCATION:
The project is located at M-20 over Tittabawassee River/Abandoned CSX Railroad (56021-R01) and includes the roadway from approximately 4,000 feet west of the bridge to West Indian Street (northeast of the bridge) in City of Midland, Midland County.
The project length is approximately 0.75 miles.

PROJECT DESCRIPTION:
The consultant will be tasked with determining a proposed bridge footprint along with alternatives for aesthetic treatment for the bridge, performing soil borings with a geotechnical investigation, performing the project area contamination survey (PACS) along with the preliminary site investigation (PSI), complete legal and site survey utilizing LiDAR technology, hydraulic survey (analysis to be performed by MDOT), initial utility distribution, non-motorized facility investigation, mobility impacts, renderings for the bridge alternatives proposed, and public meeting attendance to present alternatives to the local community.

ANTICIPATED SERVICE START DATE: 3/1/2013

ANTICIPATED SERVICE COMPLETION DATE: 3/3/2014

PRIMARY PREQUALIFICATION CLASSIFICATION(S):
Short & Medium Span Bridges

SECONDARY PREQUALIFICATION CLASSIFICATION(S):
Roadway Rehabilitation & Rural Freeways
Preliminary Site Investigations
Geotechnical Engineering Services
Structure Surveys (PPMS Task 3340)
Hydraulic Surveys (PPMS Task 3350)
Road Design Surveys (PPMS Task 3330)
Right-of-Way Surveys (PPMS Task 4510)
Safety Studies

DBE REQUIREMENT: N/A

MDOT PROJECT ENGINEER MANAGER:

Jason M. Garza – Cost & Scheduling Engineer
Mt. Pleasant Transportation Service Center
1212 Corporate Drive
Mt. Pleasant, MI 48858
989-775-6104 Ext. 316
989-775-6329
garzaj3@michigan.gov

CONSTRUCTION COST:

A cost estimate shall be developed for the bridge replacement and associated road work required to address different aspects of the aesthetic concerns and geometric configurations involved. Each cost estimate shall include 2018 costs (5% annual inflation). The following are the items that shall be considered:

1. Bridge replacement
2. Associated road work
3. Geometric improvements based on proposed horizontal and vertical alignments
4. Non-Motorized facilities (on bridge and also maintaining trailway under)
5. Drainage improvements
6. Permanent pavement markings/signs/signals
7. Environmental impacts
8. Additional aesthetic treatments to the bridge
9. Maintaining traffic and mobility impacts (road, river and non-motorized)
10. PACS and PSI impacts
11. ROW impact (adjacent 4f properties)
12. Miscellaneous items that will have an impact on the construction cost

REQUIRED MDOT GUIDELINES AND STANDARDS:

Work shall conform to current MDOT, FHWA, and AASHTO practices, guidelines, policies, and standards (i.e., Road Design Manual, Standard Plans, Drainage Manual, Roadside Design Guide, A Policy on Geometric Design of Highways and Streets, Michigan Manual of Uniform Traffic Control Devices, etc.).

In addition, work shall conform to current MDOT, FHWA, and AASHTO practices, guidelines, policies and standards included, but not limited to, MDOT Road Design Manual, MDOT Standard Plans, MDOT Drainage Manual, MDOT Work Zone Safety and Mobility Manual, AASHTO Roadside Design Guide, A Policy on Geometric Design of Highways and Streets, A Policy on Designs Standards Interstate System, Michigan Manual of Uniform Traffic Control Devices and the 2012 Standard Specifications for Construction.

Consultant is required to use Microsoft Office Software and MDOT's current version of Bentley

MicroStation for CADD applications and Bentley GEOPAK for road design. Consultant shall comply with all MDOT CADD standards and file naming conventions.

BACKGROUND INFORMATION:

M-20 over the Tittabawassee River/CSX RR (ABN) is a ten span, steel girder and floor beam, non-composite and a steel, multi-stringer composite structure. The bridge was constructed in 1955 utilizing HS20 live load requirements. There was a concrete overlay performed in 1979. The pin and hanger units were replaced and beams were painted in 1984. In 2007, an emergency steel repair contract was performed on the Fracture Critical portion of the structure (Spans 3S to 5S). Recent repairs include several concrete deck patches in the deck surface. The overall length of the bridge is 671'-11" and it has an out-to-out width of 67'-8". The structure carries four lanes of two-way, urban principal arterial traffic along M-20 and spans the Tittabawassee River, the Pere Marquette Trailway and a city park access road.

The subject bridge is proposed to be replaced in FY 2018. The bridge is considered fracture critical and scour critical. Based on the current condition and age, full replacement has been deemed the most practical alternative for addressing the current condition. Due to the size and complexity of the project, early preliminary engineering (EPE) will be necessary to address issues that will arise during the preliminary engineering (PE) stages of the project.

All general information shall be field verified by the consultant.

CONSULTANT RESPONSIBILITIES:

Complete the design of this project including, but not limited to the following:

The Consultant must adhere to all applicable OSHA and MIOSHA safety standards, including the appropriate traffic signs for the activities and conditions for this job and perform field operations in accordance with the Department's Personal Protective Equipment (PPE) policy as stated in the MDOT Guidance Document #10118.

Meet with the MDOT Project Manager to review project, location of data sources and contact persons, and review relevant MDOT operations. The Consultant shall review and clarify project issues, data needs and availability, and the sequence of events and team meetings that are essential to complete the design by the project plan completion date. Attention shall be given to critical target dates that may require a large lead time, such as geotechnical requirements, ROW submittal dates, utility conflict resolution, local agency meetings, monthly progress meetings, etc.

A. The MDOT Project Manager shall be the official MDOT contact person for the Consultant **and shall be made aware of all communications regarding this project**. The Consultant must either address or send a copy of all correspondence to the MDOT Project Manager. This includes all Subcontractor correspondence and verbal contact records.

B. The Consultant shall contact, in writing, the MDOT Project Manager whenever discoveries or design alternatives have the potential to require signification changes in the limits, quantities, costs, or right-of-way of the project.

C. Attend any project-related meetings as directed by the MDOT Project Manager.

D. The Consultant representative shall record and submit type-written minutes for all project related meetings to the MDOT Project Manager within two weeks of the meeting. The Consultant may bring an additional person to all meetings whose sole responsibility will be to take notes/minutes. The Consultant shall also distribute the minutes to all meeting attendees.

E. The Consultant shall investigate the presence of any utilities and perform an initial utility distribution to all in the project area.

F. The Consultant shall provide a project survey including but not limited to road design, right-of-way and hydraulic survey. The survey shall utilize the use of static terrestrial laser scanning and/or mobile mapping (mobile/terrestrial laser scanning or LiDAR) methods as per Attachment C. The survey limits will be from approximately 4,000 feet west of the bridge to West Indian Street (northeast of the bridge).

G. For the hydraulic survey, the Consultant shall adhere to the requirements of Attachment D and E. The Consultant shall coordinate the Hydraulic Survey and associated tasks with the MDOT Hydraulic Unit for structure information.

H. The Consultant shall provide several different alternatives for the bridge design at the subject location including different beam types, railing types, color schemes and other aesthetic treatment to be presented to the City of Midland and other stakeholders. A footprint of each design will be needed to determine the environmental impacts, and right-of-way impacts which will also be analyzed by the Consultant. The Consultant shall also determine the impacts of the proposed bridge alternatives on the existing/proposed horizontal and vertical alignments, adjacent pavement immediately east and west of the bridge, curb and gutter, and drainage.

I. The Consultant shall provide color renderings of each bridge design to be presented to the City of Midland/stakeholders for engagement purposes (context sensitive solutions).

J. The Consultant shall determine the appropriate limits of road work needed due to the impact of the bridge construction and the need to overcome design exceptions for horizontal and vertical alignment.

K. The Consultant shall identify and document the potential need for additional ROW and the type of ROW required (consent to grade, fee, etc.) and roadside improvements proposed (i.e. fencing, turf establishment, landscaping, etc.). The ROW appraisal will be prepared by MDOT.

L. Prepare existing and proposed typical cross sections for the proposed bridge and adjacent pavement.

M. For each bridge alternative, compute and verify all quantities and provide detailed cost estimates for road and bridge construction.

N. Review and document the existing drainage system, open or enclosed, and identify areas of possible improvements.

O. The Consultant shall investigate the feasibility and cost implications of providing non-motorized features to the bridge deck and include in design alternatives, cost estimates and renderings.

P. The Consultant shall investigate if watermain and/or sanitary sewers are present within the project limits. The Consultant shall evaluate the necessity of the relocation of watermain and sanitary sewers.

Q. Submit requests to applicable utility owners for preliminary utility information. Submittals to the utility company shall include: a completed MDOT approved form, and a minimum of two (2) copies of locations map, base map and base sheets. Document and identify any possibly utility conflicts and estimate the cost of relocation and/or adjustment.

R. The Consultant shall review and document the roadside safety related items (i.e. guardrail, barriers, attenuators, etc.) which need to be modified or included in the project. Documentation to include location, existing type and condition, and the recommended treatment.

S. Perform crash analysis and recommend countermeasures. This shall include, but not be limited to, the following:

1. Performing Crash Analysis. This shall include the last three (3) years of reliable data for the analysis period. If there is a fatality within those three (3) years, the analysis shall include the details of the specific fatality. MDOT will furnish three (3) years of data.
2. Determine Countermeasures based on the Crash Analysis. Determine the construction cost for each countermeasure proposed.

T. Perform Project Area Contamination Study (PACS) according to PPMS task 2810.

U. Document and identify locations of possible environmental issues which may impact the project and estimate the cost of treatment according to PPMS 2820. The Consultant shall perform a Preliminary Site Investigation (PSI) as per Attachment A.

V. Document and identify (location and who has responsibility for) any existing lighting that has potential for being impacted, or should be included, in the project. Incorporate work into the construction estimate.

W. Prepare staging plans and special provisions for maintaining traffic during construction.

X. The Consultant shall prepare the Transportation Management Plan (TMP).

Y. The Consultant shall investigate the mobility impacts for the road, non-motorized trail (east side of the river), park access road (west side of the river), and water way access. The investigation shall also consider detouring and/or fall protection (scaffolding for non-motorized and park access). Also, these impacts shall be considered while compiling the cost estimates for each bridge alternative proposed.

Z. Provide solutions to any unique problems that may arise during the design of this project.

AA. Incorporate any MDOT identified and approved local needs/requests into project and cost estimates.

BB. The Consultant shall identify and investigate the possibility of any design exceptions that may be needed for each bridge alternative.

CC. Provide soil borings/pavement coring for plan development and pavement design as per Attachment B. See attachment F for additional guidance on geotechnical investigation for structures.

DD. Attend information meetings (i.e., public hearings, open houses, etc.) with the public and public officials to assist in responding to concerns and questions. This will require the preparation of displays such as maps, marked-up plans, bride alternative renderings, etc.

TRAFFIC CONTROL

The Consultant shall be responsible for all traffic control required to perform the tasks as outlined in this Scope of Design Services. The Consultant shall coordinate his operations with contractors performing work on other projects within or adjacent to the project limits.

MDOT PERMITS

The Consultant shall be responsible for obtaining up to date access permits and pertinent information for tasks in MDOT Right of Way (ROW). This information can be obtained through Ben Burrows, Permits Agent, at (989) 775-6104 Ext. 305.

MONTHLY PROGRESS REPORT

On the first of each month, the Consultant Project Manager shall submit a monthly project progress report to the MDOT Project Manager.

MDOT RESPONSIBILITIES:

A. Schedule and/or conduct the following:
   1. Project related meetings.
   2. Stakeholder engagement including City of Midland representatives.
   3. Public open house for proposed bridge work.

B. Furnish Special Details and pertinent reference materials.

C. Furnish bridge scoping document.

D. Furnish special details and pertinent reference materials.

E. Furnish As-Built plans of project area, as available.

F. Furnish traffic data.

G. Provide coordination assistance with stakeholders, local government, FHWA, etc.

H. Provide hydraulic information such as span, rise, underclearance elevation, scour depths, etc.

DELIVERABLES:

The Consultant shall deliver all computer files associated with the project in their native format (spreadsheets, CADD files, GEOPAK files, etc.) on DVD, CD or uploaded to ProjectWise, as directed by the MDOT Project Manager. All CADD/GEOPAK files shall be created and identified with standard MDOT file names as shown in Appendix A of the Road Design Manual. It is the Consultant's responsibility to obtain up to date MicroStation and GEOPAK seed/configuration files necessary to comply with MDOT's CADD standards which are posted to the bulletin board system. When the use of GEOPAK road design software is necessary to develop plans all pay items shall be placed into the CADD file using GEOPAK's Design and Computation Manager so that Quantity Manager can be used to transfer pay item information to SAPW/Trns*port. Any CADD/GEOPAK files that do not conform to MDOT standards will be returned to the Consultant for correction at the Consultant's expense.

Proposal documents shall be submitted in their native format with standard naming conventions as well as combined into one Adobe PDF file in the sequence specified by MDOT. To provide text search capabilities the combined proposal shall be created by converting native electronic files to PDF. Scanning to PDF is discouraged except in instances where it is necessary to capturing a legally signed document or a hard copy version of a document is all that exists.

Plan files shall be submitted in their native dgn format with standard naming conventions as well as plotted into a combined Adobe PDF file. Plan sheets shall be plotted to Adobe PDF with full text search and level on/off capabilities in half size (11" x 17") formats. A full size title sheet shall be plotted stamped and signed then scanned for inclusion with the Adobe PDF set. The original title sheet will be sent to the MDOT Project Manager.

Stand Alone Proposal Estimator's Worksheet (SAPW) shall be used to generate the txt and csv files necessary for import into the Trns*port bid letting software. The SAPW files shall be transmitted electronically by the method specified by the MDOT Project Manager.

The project construction, removal and profile sheets will require a ratio (scale) of **1:40 (English Units).**

All plans, special provisions, estimates, and other project related items shall meet all MDOT requirements and detailing practices (i.e., format, materials, symbols, patterns, and layout) or as otherwise directed by the Project Manager. All plans, specifications, and other project related items are subject to review and approval by MDOT.

Additional deliverable requirements are also located in the Attachments for specific job tasks as well.

FOR YOUR INFORMATION

For questions on specific tasks, refer to the P/PMS Task Manual located on the MDOT Bulletin Board System.

For assistance in accessing this manual, please contact:

Dennis Kelley: (517) 373-4614

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.

ATTACHMENT A
SCOPE OF SERVICE
FOR
Preliminary Site Investigations (PSI)

WORK DESCRIPTION

A. The Michigan Department of Transportation (MDOT) frequently needs to investigate parcels of property that have been identified to potentially have the presence of environmental contamination. The consultant shall review the site to determine if it is a potential site of environmental contamination during the Project Area Contamination Surveys (PACS). If the PACS identifies a parcel as a potential site of environmental contamination, a Preliminary Site Investigation (PSI), shall be initiated.

B. This scope of work consists of preparing work plans and price proposals for PSIs, conducting the PSIs and preparing PSI reports. The Consultant selected to do the PSI will do the initial site inspection and write the work plan and price proposal under the initial authorization. The same consultant will also perform the Preliminary Site Investigation and write the PSI report under the same authorization once it has been authorized.

C. Work cannot proceed without written authorization from the Project Manager. Written authorization may be delivered to the consultant by fax. The consultant shall submit a work plan and price proposal to the Project Manager within two to five work days of authorization by the Project Manager. For a typical construction project, 90 to 120 calendar days will be allowed to complete all PSI activities unless an expedited schedule is required. The Consultant may, with permission of the Project Manager continue site work outside regular hours or on weekends.

D. This work may include but is not limited to subsurface investigation, soil sampling, monitor well installation, water sampling, laboratory testing, preparing work plans, price proposals and preliminary site investigation reports.

CONSULTANT RESPONSIBILITIES

Upon request, the Consultant shall be prepared to thoroughly investigate, analyze, and prepare a preliminary site investigation report for the project.

The Consultant shall furnish all services and labor necessary to conduct and complete the requirements for preliminary site investigation services as described herein. The Consultant shall furnish all materials, equipment, supplies, and incidentals necessary to perform this service. The service shall be performed to the satisfaction of MDOT and consistent with applicable professional standards.

A. The Consultant’s principal contact with the Department shall be through the designated Project Manager.

B. The services described herein are financed with public funds. The Consultant shall comply with applicable federal and state laws, rules, and regulations. The Consultant will perform field operations in accordance with MIOSHA regulations and accepted safety practices. The Consultant will wear personal protection safety equipment in accordance with MDOT policy while on the project.

C. The Consultant is responsible for maintaining traffic during all operations. The Consultant's method of maintaining traffic shall have prior approval by the Mt. Pleasant TSC Traffic and Safety Engineer in accordance with the MUTCC and the MDOT maintaining traffic details.

D. The Consultant will demonstrate knowledge of, and performance in compliance with, the standard practices of the Department and all manuals, and guidelines needed to carry out the work in an appropriate manner. All portions of the subsurface investigation will be in accordance with the current MDOT "Scope of Services for Preliminary Site Investigations" in addition to current ASTM standards.

E. The Consultant is responsible for locating utilities by calling **MISS DIG (800-482-7171)**. The Consultant is responsible for locating utilities not on the MISS DIG system. **The Consultant is to notify the Project Manager 48 hours prior to starting work.**

F. The Consultant will notify the Project Manager, in writing, prior to any personnel changes from those specified in the Consultant's original approved proposal.

G. Utilizing all U.S. Environmental Protection Agency and Michigan Department of Environmental Quality (MDEQ) guidance and policies and all available construction plans, the consultant develops and submits a PSI report to the Project Manager containing the location, nature, extent and volume of any contamination found and recommendations for dealing with it. Recommendations will include any permits or special procedures and/or provisions that are required and pay items with an estimate of construction costs relating to any contamination present. The site investigation report must contain the following information:

a. Description of site history and definition of possible contamination sources.
b. Description of the investigative activities completed at the site and the degree to which the activities defined the contamination.
c. Location map and site plans showing areas of contamination encountered, type of contamination and concentrations.
d. Estimate the quantity of soil and/or ground water that will be encountered during construction activities that must be removed and identify these areas on the construction plans.
e. Table of chemical concentrations for each soil and water sample collected. Also provide complete set of analytical results in an appendix.
f. Description of investigative and analytical techniques such as drilling methods, sampling methods, well construction, and chemical analytic techniques.
g. Well and soil borings logs

h. Comparison of contamination levels to appropriate MDEQ Cleanup standards.
i. Recommendations for further investigation not covered in original work plan.
j. Recommendations for methods, procedures, and construction cost estimates/pay items for properly addressing contamination that intersects with proposed construction as indicated on the construction plans.

3. Revise report as requested by the Project Manager. No payment will be made until the report is approved.
4. If additional site investigation work is required, a new authorization will be required and steps B, C and D will be completed again.

ATTACHMENT B
SCOPE OF SERVICE
FOR
Geotechnical Engineering Services

WORK DESCRIPTION

A. Perform geotechnical investigations for the project. These investigations may include:
   a. Full depth coring of flexible, rigid, and/or composite pavements.
   b. Soil borings for roads and bridges.
   c. Ancillary soils work including standard penetration testing, soil sampling, gradation analysis, soil classifications, split spoon sampling, shear strength, vane shear testing consolidation testing, permeability testing and materials investigations.

B. Thoroughly investigate, analyze, and prepare a recommendation for construction procedures for the subject bridge.

CONSULTANT RESPONSIBILITIES

The Consultant is required to own the equipment necessary to perform the work in this Scope of Service.

The Consultant is required to notify the Mt. Pleasant Transportation Service Center (TSC) with an "Advance Notice and Approval of Permitted Activity" (Form 2204) at least five days in advance of work commencing. This request should also be sent to the MDOT Project Manager.

The Consultant is responsible for traffic control during all operations. The MDOT Project Manager will supply the Consultant with appropriate traffic control typicals to use. In most cases the typicals will be drawn from the "MDOT Maintenance Work Zone Traffic Control Guidelines" available on the MDOT website.

The Consultant is responsible for locating utilities by calling MISS DIG (800) 482-7171. The Consultant is also responsible for location of other utilities not shown on the MISS DIG system.

The Consultant is responsible for taking all pavement cores and soil borings at the frequency requested by the Project Manager. All coring should be done with a six inch core barrel.

The Consultant is responsible for preparing all core and boring reports. The specific submission requirements will be identified for each specific request for investigation. The final report shall consist of three copies of the core/soil boring report and plan sheet in Microstation file format graphically listing all borings. Core/boring reports and plans sheets shall include the following as a minimum:
   a. Date and site of cores/borings
   b. Core location (by station), including lateral and longitudinal offsets referencing lanes and cross streets. Label mainline, shoulder, turn lane, etc. The Consultant

will also provide GPS coordinates in lat/long format, for all cores/borings performed. The GPS coordinates can be provided separate from the logs in tabular format.

c. Core/boring identification number
d. Graphic profile indication depth of each layer in the core/boring, in inches or feet, the type of pavement material and condition. In concrete, depth to reinforcing steel or lack of reinforcing steel is to be noted on the log. The graphic profile should be extended to show the gravel, subbase, the subgrade materials where borings are performed through the cores. If the soil boring information can be completely conveyed in the core report, then a separate soil boring log need not be attached. Standard Penetration Test results for US Army Corp of Engineers DCP tests may be required in some locations.
e. Indication of the presence of water, and measured depth below ground surface.
f. Names of the crew members.
g. Project may require detailed geotechnical recommendations regarding construction over unsuitable soils, slope stability, foundation bearing/settlement considerations or other more complex engineering recommendations. The Project Manager will work with the consultant to delineate specific recommendations required should this need arise, prior to commencement of the field operations.

The Consultant is responsible for patching all core holes with bituminous patching material or fast set concrete prior to leaving the specific location.

The Consultant is responsible for maintaining all field notes and cores for 60 days after submitting reports. After 60 days all cores shall be disposed of by the Consultant.

MDOT RESPONSIBILITIES

The MDOT Project Manager shall furnish to the Consultant all construction contracts, proposals, plans, plan revisions, written instruction, and other information and/or data as deemed necessary by the MDOT Project Manager for the services required herein. Unless such information is available to be downloaded on the MDOT website, then it is the Consultant's responsibility to supply the information.

The MDOT Project Manager will provide the Consultant with the appropriate traffic control scheme to use. Traffic control may be changed during the work in response to unforeseen conditions, or as dictated by emergency or other events. MDOT will review traffic control measures being used at random times during performance of the contract.

ATTACHMENT C
SCOPE OF SERVICE
FOR
Design Surveys and Mapping

WORK DESCRIPTION:

Task work could include but may not be limited to work in the following area of MDOT survey prequalification: Road Design Survey, Right of Way Survey, Structure Survey and Hydraulics Survey. Work in these areas may include static terrestrial laser scanning or mobile laser scanning (LiDAR).

NOTES: The Selected Consultant shall arrange and meet with the MDOT Project Manager and MDOT Region Surveyor to discuss the scope of this project before submitting a work plan and price proposal.

The Selected Consultant surveyor must contact the MDOT Mt. Pleasant Transportation Service Center Traffic and Safety Engineer that has jurisdiction prior to submitting a priced proposal.

The Selected Consultant will be required to submit a **detailed Survey Work Plan** addressing each specific task applicable to the project with the project price proposal. A detailed Mobile Mapping Work Plan must also be included with the project price proposal when those tasks are included in the project.

A spreadsheet estimate of hours by specific survey tasks such as research, horizontal control, vertical control, alignment, property, utilities, mapping, reports, portfolio preparation, etc. **must** be included in the **priced proposal**. Mobile mapping tasks such as control target and trajectory planning, LiDAR acquisition, trajectory and scan processing, mapping extraction, QA/QC, etc. also must be included. Also include an estimate of hours for Hydraulic Survey as described in Attachment D and E.

It is the responsibility of the Professional Surveyor to safeguard all corners of the United States Public Land Survey System, published Geodetic Control and any other Property Controlling corners that may be in danger of being destroyed by the proposed construction project.

GENERAL REQUIREMENTS:

1. Surveys must comply with **all Michigan laws** relative to land surveying and must be done under the **direct supervision** of a Professional Surveyor license to practice in the State of Michigan.
2. Work in any of the following categories: Road Design Surveys, Structure Surveys, Hydraulic Surveys, and/or Right-of-way Surveys must be completed by a firm which is pre-qualified by MDOT.

3. Surveys must meet all requirements of the Michigan Department of Transportation (MDOT) project scope (this document), the current versions of the Michigan Department of Transportation (MDOT) Design Surveys *Standards of Practice*, MDOT QA/QC Certification Checklist, The MDOT Design Survey Manual on-line, and MDOT RTK guidelines.
4. Consultants must obtain all necessary permits required to perform this survey on any public and/or private property. **The Consultant shall be responsible for obtaining an up-to-date access permits** and pertinent information from the MDOT Utilities Coordination and Permits Section for any tasks involving work with the MDOT Right of Way (ROW).
5. Prior to performing any ground survey work, the Consultant must contact all landowners upon whose land they will enter. The contact may be personal, phone, or letter, but must be documented. This notice must include the reasons for the survey upon 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 a MDOT contact person (the MDOT Project Manager).
6. The Consultant must contact any and all Railroads prior to commencing field survey on railroad property. This 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.
7. The Consultant must adhere to all applicable OSHA and MIOSHA safety standards, including appropriate traffic signs for the activities and conditions for this project.
8. Consultants are responsible for a comprehensive and conscientious research for all records, including MDOT records, essential for the completion of this project.
9. Measurements, stationing, recorded data and computations must be in International Feet.
10. Coordinate values must be based on the Michigan Coordinate System of 1983 (CORS96, GEOID09), appropriate zone. All elevations must be based on 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 Region Surveyor.
11. POST SURVEY CLEAN-UP: Once the survey is complete, all stakes must be removed to aid maintenance crews and adjacent property owners. All benchmarks and control points and their witnesses must remain in place.
12. *The Consultant shall keep the MDOT Region Surveyor updated on the progress of the entire project and including the timing of any terrestrial scanning or mobile LiDAR acquisitions.*
13. For the Road Design Survey, Hydraulic Survey, Structure Survey or Right of Way Survey, the Consultant shall provide three copies of the complete "Electronic only" Portfolios on compact discs (CDs), Digital Video Disks (DVDs) or external hard drives. The current MDOT *Standards of Practice* for Design Surveys and the current MDOT QA/QC Certification Checklist shall be utilized in preparing the deliverables.
14. All data must be recorded on acceptable electronic media. All paper files must be scanned and/or converted to Adobe Acrobat .PDF format. The data on the electronic media must be organized in the same manner as a "paper" portfolio, such as by Administrative Section, Control Section, etc. Specific format files such as text (.txt), MicroStation drawing (.dgn), and documents (.doc) must have separate access. CDs, DVDs and or external hard drives must be labeled with the Consultant name, route,

location, control section, job number, data type, files names, and date. All project reports and final CADD file deliverables shall also be converted into and submitted in a single Adobe Acrobat, linked, and book-marked, PDF file.

15. LiDAR and mobile mapping information should be prepared and placed in a separate sub-folder named "LiDAR/Mobile Mapping" under the Project Mapping Folder and contain all information and LiDAR/Mobile Mapping deliverables relative to the project.
16. To be included in the Administrative section shall be a copy of the MDOT QA/QC Certification Checklist. This document shall be signed and certified by the Professional Surveyor responsible for the project QA/QC. Failure to use and include this document may result in the immediate return of the project portfolio for completion.
17. All listings (horizontal control points, benchmarks, alignment, points, and government corners) must also be complied on the current MDOT SURVEY INFO SHEET located at: http://www.michigan.gov/documents/mdot/MDOT_SURVEYINFOSHEET_302553_7.doc and included on the submitted CD.
18. The Consultant representative shall record and submit type-written minutes for all project survey related meetings to all meeting attendees including the MDOT Project Manager and the MDOT Region Surveyor within two weeks of the meeting.
19. The MDOT Project Manager is the official contact for the consultant. The Consultant must send a copy of all survey related project correspondence to the MDOT Project Manager and the MDOT Region Surveyor. The MDOT Project Manager shall be made aware of all communications regarding this project. Any survey related questions regarding this project should be directed to the MDOT Region Surveyor.

At the completion of this survey, all field survey notes in .PDF format, mobile scanning information, all electronic data, and all research records obtained for this project will be considered the property of MDOT and must be sent to MDOT Bay Region Surveyor, 55 East Morley Drive, Saginaw, MI 48601. Please use MDOT's form 222 (5/01) entitled "SURVEY NOTES: RECEIPT AND TRANSMITTAL" for all transmittals. A copy of the transmittal form must also be sent to the MDOT Project Manager.

Acceptance of the survey by the MDOT Project Manager and/or MDOT Region Surveyor <u>does not</u> in any way relieve the Consultant of any responsibility and liability for the content of the survey.

TRAFFIC CONTROL/WORK RESTRICTIONS

The Selected Consultant shall be responsible for all traffic control required to perform the tasks as outlined in this Scope of Services.

The Selected Consultant must notify the Mt. Pleasant TSC Traffic and Safety Engineer, Jonathan Myers, prior to submitting a price proposal and prior to beginning surveying activity in the area, to obtain any potential work restrictions and to discuss Traffic Control scenarios for the project.

The TSC Traffic & Safety Engineer must be notified at least two weeks prior to shoulder or lane closures so advance notice, and related traffic issues, can be posted on the MDOT Road Construction Web Site.

No work shall be performed or lane closures allowed during holiday periods, as defined by the local Traffic and Safety Engineer who has jurisdiction over the project area. All work on the road shall be conducted during daylight hours Monday through Friday only. Lane closures may occur only between the hours of 9:00 am and 3:00 pm. Week-end work and lane closure exceptions may be permitted but only with the approval in advance from TSC Traffic & Safety Engineer and MDOT Project Manager.

Traffic must be maintained by the Consultant throughout the project in accordance with the appropriate sections of the current *Standard Specifications for Construction*, and other supplemental specifications currently in effect.

All traffic control devices shall conform to the current revision, 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. Sign covers shall be placed over existing regulatory signs that are not applicable during survey work.

All temporary signs shall be mounted at a 5 foot minimum bottom height in un-curbed areas and 7 foot minimum bottom height in curbed or pedestrian areas. All temporary signs shall be constructed with legends and symbols flush to the sign's face and not extending beyond the sign borders or edge.

Distances shown between constructions warning, regulatory, and guide signs on the maintaining traffic typicals are approximate and may require filed adjustments, as directed by the MDOT Project Manager and/or Mt. Pleasant TSC Traffic & Safety Engineer.

The consultant must have a vehicle with markings/logo that identifies the company within sight distance of the survey activity whenever they are working on or near the road.

Traffic control on city streets and county roads is under the jurisdiction of the City of Midland.

COORDINATION WITH OTHER CONTRACTS IN THE VICINITY

The Consultant shall coordinate their 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 MDOT TSC Traffic & Safety Engineer and Development Engineer for information regarding project coordination.

The Consultant's attention is called to the requirement of cooperation with others as covered in the 2012 Standard Specifications for Construction. Other contracts or maintenance operations may occur during the life of the project.

No claims for extra compensation or adjustment in authorization costs will be allowed on account of delay or failure of others to complete their work unit as scheduled.

FIELD SURVEY

The purpose of a field survey is to obtain information and/or data required by/for a project design engineer, to provide a survey basis for the preparation of legal descriptions and documents to acquire rights of way, easements, and permits, to leave horizontal and vertical control in the field for future construction staking, and to provide a sufficient history of the area to enable a MDOT Design Survey Unit to perform dependable surveys in the future.

SURVEY REQUIREMENTS:

This survey must meet all requirements of the current versions of the Michigan Department of Transportation (MDOT) Design Surveys *Standards of Practice*, MDOT QA/QC Certification Checklist, The MDOT Design Survey Manual and this project scope.

Project specific and additional information:

Control:
Establish horizontal control in the Michigan State Plane Coordinate System (NAD83 MSRN CORS96 GEOID09), appropriate zone in international feet and vertical control in the NAVD88 datum throughout the project limits.

Use current MDOT guidelines to establish the **legal** alignment for the length of the project. Include in surveyor's report a detailed description of how alignment was established. If there are any existing alignment points in the field they will be witnessed using current MDOT guidelines.

A text file will be created describing each alignment course to include bearing and distances of tangent lines, and curve information (name, delta, degree of curvature, radius, tangent bearings and length, chord bearing and distance, and external). This text file should also include X and Y project coordinates and stationing for the PCs, PIs, and PTs. Include this text file on the MDOT SURVEY INFO SHEET.

Submit an alignment drawing (XXXXXXal.dgn format) as described in the QA/QC Checklist. Also show the legal right(s)-of-way on this drawing.

Property:
Right of way lines will need to be determined and shown for the project limits.

When recorded subdivision plats are part of or adjacent to the right of way, they shall be delineated and shown on the MicroStation XXXXXpl.dgn and XXXXXXal.dgn drawing. All block corner, lot corners, and platted streets located and used to calculate plat lines must also be shown.

The Consultant shall include, in the portfolio, all information that is utilized regarding the real property affected by the project. This includes, but is not limited to, copies of all pertinent recorded land corner recordation certificates, recorded plats (subdivision and condominiums), recorded certified and unrecorded surveys, and tax maps that include parcel ID, name and tax descriptions along with ties to the project coordinate system for all found or set monumentation throughout the entire project limits.

The Consultant must provide a list of property owner's names, addresses, building type, and legal descriptions, (recorded legal deeds) adjacent to the project area.

GOVERNMENT CORNERS
All Public Land Survey System (PLSS) corners, property controlling corners, and interior subdivision block corners within the project construction limits must be recovered and tied to the project coordinate system and witnesses. This includes 1/16 corners and platted subdivision corners. Lot corners do not require witnesses unless they are utilized as horizontal control points. Any PLSS corners needed to establish the legal alignment and legal right of way are required, as well are any PLSS corners in danger of obliteration by impending road construction, will meet all the same rules. All PLSS corners in hard surface roads must be protected by a monument box, regardless of impending construction.

Any section lines or quarter lines used to determine or define statutory right of way must be defined, measured and labeled and shown on the XXXXXXpl.dgn and XXXXXXal.dgn drawings.

Any section lines or quarter lines that run parallel with and are within the right of way must be defined, measured, and labeled and shown on the XXXXXXpl.dgn and XXXXXXal.dgn drawings.

Any section lines or quarter lines that intersect the right of way and the as-constructed center line(s) along with the defining PLSS corners must be defined, measured, and labeled and shown on the XXXXXXpl.dgn and XXXXXXal.dgn drawings. These government lines shall have bearing and distance where they cross or are part of the legal or as-constructed alignments.

Mapping:
The mapping information for this project will be required as described in the MAPPING section of the current MDOT Design Surveys Standards of Practice.

Complete topographic mapping is required for the entire project.

The mapping length limits will match the alignment limits (above).

The mapping width will extend 100 feet on each side of the legal .alignment or right of way width, if greater than 100 feet.

UTILITIES
The Consultant shall contact MISS DIG and map the underground utilities as marked.

All surface manifestations of utilities must be identified and their location tied to the project's coordinate system. A list of utility companies is required.

The Consultant shall be responsible for obtaining and submitting any and all copies of the as-built plans for public and private utilities in the project area, along with the name of the utility, address, phone number and contact person. All utilities shown on the plans shall be verified in the design mapping.

DRAINAGE
The Consultant is responsible for all data necessary to determine the drainage and map all surface and subsurface storm water routes within the project (inside and outside of right of way).

The Consultant shall map, measure and describe drainage structures for the project. This includes but is not limited to culverts, structures, ditches, inlets and outlets, and catch basins. At a minimum, the size, direction, composition, condition, and invert elevations of all culverts or pipes shall be measured and recorded. If drainage piping has head walls or end sections, a description and the size shall be noted. The Consultant shall deliver the horizontal coordinates for all surface drainage structures, catch basins and culverts. The consultant is required to show connectivity of these systems.

SUBMITTAL NOTES:
It is the responsibility of the consultant to insure that all electronic files submitted to MDOT conform to the required formats in the current Michigan Department of Transportation (MDOT) Design Surveys *Standards of Practice*, MDOT QA/QC Certification Checklist, and MDOT CADD standards, and that all documents are legible.

SURVEY METHODS AND TECHNOLOGIES - LiDAR and Mobile Mapping

Use of static terrestrial laser scanning and mobile mapping (mobile terrestrial laser scanning or LiDAR) methods will be considered for completion of this project providing a savings in schedule, time and costs, improved safety and reduced traffic control and costs, among other benefits.

Any use of these technologies shall conform to and utilize the **2012 or current dated MDOT Standards of Practice for Design Surveys** and the existing terrestrial scanning standards in **Appendix E (MDOT Laser Scanning Standards and Guidelines** and the Specifications/Guidelines based on the **Caltrans Survey Manual Chapter 15** Terrestrial Laser Scanning Specifications). **Project deliverables and reports shall include the information, electronic files and reports referred to in the Caltrans Specifications under MTLS Documentation**.

Mobile Mapping may be used on this MDOT project. If used, the following shall apply:
A Mobile Mapping trajectory plan and a ground control target layout plan (including the locations of any CORS GPS Stations and/or any local GPS base stations and how they are/were established) shall be submitted with the work plan and priced proposal, and prior to start of work for review by Kelvin Wixtrom, PS.

LiDAR acquisition shall also collect images along the trajectory routes to colorize the point cloud.

The trajectories, as driven, shall be processed/refined and, combined with the LiDAR data that has been acquired, shall be registered to the ground control targets. A portion of the ground control targets (typically about 1/3 to 2/3 of the total targets) shall be withheld from the registration process and used as independent points solely for validation of the point cloud and derived project data.

- Upon completion of the registration process and prior to mapping extraction, copies of the following shall be provided to Lansing Design Surveys and MDOT Region Surveyor for review:
- Reports and printouts showing the results of the registration process.
- Target to cloud registration.
- Cloud to cloud registration.
- Primary control list and adjustment reports.
- Intermediate control list and adjustment reports.
- Separate listings of Targets and Validation point listings used for the Mobile mapping and the adjustment reports for these points.
- Project Accuracy reports of IMU.
- Project Accuracy reports of GNSS data as well as PDOP and SV visibility.
- Project Trajectory reports.
- Comparison spreadsheet showing the differences (fit) of the point cloud to the validation points. This spreadsheet shall include a resultant summary in NSSDA format showing the 95% difference in horizontal X and Y, and Vertical Z for the project.

Copies of the final deliverables shall be provided to the MDOT Region Surveyor and Lansing Design Surveys and shall include the following:

- Project report describing the mobile mapping project, equipment used, and results.
- Complete listing of the Registration processing reports listed above.
- Comparison spreadsheet showing the fit of the control points/targets to the point cloud. (The TopoDOT Control points to point cloud analysis tool that outputs a spreadsheet and chart diagram is one accepted option.)
- Comparison spreadsheet showing the fit of the validation points/targets to the point cloud.
- Comparison spreadsheet showing the differences (fit) of the final project DTM surface to the validation points. This spreadsheet shall include a resultant summary in NSSDA format showing the 95% difference in horizontal X and Y, and Vertical Z for the project.
- 3D MicroStation DGN file containing all mapping.
- 3D MicroStation DGN triangle file containing the terrain surface triangles.
- Terrain surface saved as a Geopak .TIN file generated from the point cloud data.
- Terrain surface saved as an InRoads .DTM file.
- LiDAR data tiled and saved as .POD (Point Tools/Microstation point cloud file) files.
- LiDAR data collected shall be submitted in .LAS format with RGB values and intensity values.
- Photo mosaic/Images along route that support the LiDAR .LAS point cloud.

Point cloud files shall be provided on electronic media of an appropriate size to contain all project information. Two (2) copies shall be provided to the MDOT Lansing Survey Support Unit. A third (3rd) copy shall be provided for the MDOT Region Surveyor.

LiDAR and Mobile Mapping information should be prepared and placed in a separate sub-folder named "LiDAR/Mobile Mapping" under the Project Mapping Folder and shall contain all information and LiDAR/Mobile Mapping deliverables relative to the project.

When other methods of survey and mapping are also employed for the project, the data shall be combined and merged with the mobile mapping data and the merged information provided in the appropriate electronic files per the project's scope and requested deliverables.

~~REQUIREMENTS FOR~~
~~PHOTOGRAMMETRIC TARGETING AND CONTROL SURVEY~~
~~PPMS Tasks 3321 and 3320~~

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

~~**Note: Prior to starting work the Consultant shall contact Mt. Pleasant TSC Traffic and Safety Engineer.**~~

NOTES:
The 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 priced proposal.

The Consultant surveyor must discuss the scope of this survey with the project MDOT 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 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 Survey Staff Letter,

GENERAL REQUIREMENTS:
This survey includes setting out photogrammetric control targets, either by painting or cloth(or other suitable materials acceptable by MDOT) targets in non-paint areas. 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 for the placing of targets shall follow the (MDOT) Standards of Practice for Design Surveys, current version, and the MDOT Design Survey Manual.

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), NAD83 (2011) 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 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. On 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 nature of many projects. 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 of the 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 or 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 copy of the information submitted to NGS shall be included in 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 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.**~~

~~**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.**~~

~~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 and 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 terrestrial LiDAR and 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 Survey 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 should be created in a MSWord file and placed on a CD with the rest of the project files** and 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), NAD83 (2011) 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 static 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. Contact the MDOT Design Survey Project Manager to discuss specific RTK GPS survey procedures that will be acceptable for the particular project.** 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.~~

~~It is preferred that the nearest targeted points to one another (opposites on highway), be observed simultaneously to ensure measurement and adjustment quality. This generally means a minimum of four receivers may be necessary when static GPS techniques are used.~~

~~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 shall be created in MSWord and placed on a CD with the rest of the project files.** 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 the conversion of state plane grid values to ground values. **This list is to be generated using the MSWord.doc format, without tabs, as shown in Attachment – Survey Information Sheet. This list must also be placed in the JN117465SurveyInformationSheet.doc per the format shown in Attachment – Survey Information Sheet and the example on the Survey FTP site.** 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 MDOT Survey Project Manager prior to the beginning of any project.~~

~~CONTROL – Check Shots~~

~~The Consultant must contact the Survey 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 on 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 Survey 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 Design Surveys immediately upon completion of the P/PMS tasks listed here and prior to commencing the design engineering portion of the project.~~

~~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 Design Surveys as soon as possible upon completion of this task.~~

~~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 for **only** those documents that are signed or unable to be clearly scanned into an electronic format and shall be submitted in a 10" by 12" portfolio with flap cover divided into pockets.~~ ~~**Three (3) complete sets** of the **"Electronic Portfolio"** of the reports and deliverables for the entire project on CD-ROM or DVD-ROM shall be included, containing the following:~~

1. ~~In the first pocket of the portfolio, labeled **1ADMINISTRATION**, 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 contain witness information.**
   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 contain witness information.**
   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 – Survey Information Sheet.
   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 and check target control points that have been witnessed as well as horizontal alignment ties and government corners. The lists shall be delivered in **Word.Doc format** per the example form named **JN117465SurveyInformationSheet.doc** listed on the MDOT website and per Attachment – Survey Information Sheet.
   g. **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.**
   h. 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.

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 _____ Date ____**~~
~~**Project QA/QC Officer**~~
~~**Michigan PS # _____**~~

~~ATTACHMENT – Survey Information Sheet~~

~~Formats for control point lists, benchmark lists, alignment point lists, and Government corner witness lists. This formatting is required to be used to create the Survey Information Sheet for use in the construction plans set. Text shall be entered using all capital letters.~~

~~A WORD.doc file must be created and submitted with the appropriate control point, benchmark and witness data. This file must be named **JN117465SurveyInformationSheet.doc**. An example is available on the MDOT Web site.~~

~~The data is organized as shown in the following example:~~

~~COMPANY NAME~~
~~PHOTOGRAMMETRIC CONTROL SURVEY~~
~~I-96/M-14 FROM SHELDON ROAD EAST TO 1000 FT. EAST OF TELEGRAPH ROAD~~
~~CS: 82122 JN: 89095C PN: 918~~

~~HORIZONTAL DATUM: NAD83 (NSRS2007) MICHIGAN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (2113)~~
~~VERTICAL DATUM: NAVD88~~
~~ESTABLISHED IN DECEMBER 2009~~

~~DI6271 - RECOVERED A 4 IN. ALUMINUM HEIGHT MODERNIZATION DISK IN A 16 IN. DIAMETER CONCRETE CYLINDER AT THE NW QUADRANT OF BECK ROAD AND N. TERRITORIAL ROAD~~
~~COORDINATES: N: 321058.47 E: 13354761.59 Z: 836.87~~
~~STANDARD DEVIATIONS: SDN: FIXED SDE: FIXED SDZ: FIXED~~
~~WITNESSES:~~
~~1. SOUTH 75.0 FT. TO CENTERLINE OF N. TERRITORIAL ROAD~~
~~2. NORTH 70.5 FT. TO CENTERLINE OF THE EXTENDED FIRE STATION DRIVE ADDRESS 13600~~
~~3. S45W 55.6 FT. TO A PEDESTAL BOX~~
~~4. SOUTH 19.5 FT. TO NORTH EDGE OF SIDEWALK~~

~~82347 - SET 3/4 IN. ALUMINUM ROD, DRIVEN TO REFUSAL, SET IN 6 IN. DIA. PVC WITH LID STAMPED 82347 2009, 66 FEET SOUTH OF CENERLINE OF SOUTHERLY DRIVE TO THE AUTOMOTIVE COMPONENT BUILDING.~~
~~COORDINATES: N: 323562.553 E: 13362594.740 Z: 790.816~~
~~STANDARD DEVIATIONS: SDN: 0.010 SDE: 0.010 SDZ: 0.007~~
~~COMBINED SCALE FACTOR: 0.999912331234~~
~~WITNESSES:~~
~~1. N00E 66.0 FT. CENTERLINE OF SOUTHERLY DRIVE TO AUTOMOTIVE COMPONENT BUILDING~~
~~2. S90W 28.0 FT. PHYSICAL CENTERLINE OF SOUTHBOUND SHELDON ROAD~~
~~3. S90W 2.4 FT. CARSONITE WITNESS POST~~
~~4. S45W 24.9 FT. CENTER OF TELEPHONE PEDESTAL~~

PROJECT DELIVERABLES:
The MDOT Standards of Practice for Design Surveys, January 2012 and the 2012 Survey QA/QC Checklist shall be utilized in preparing the deliverables. The Consultant shall provide "Electronic only" Portfolios containing the deliverables listed in this Scope.

FINAL REPORT: DELIVERABLES FOR SURVEY PROJECT
Three complete "Electronic portfolio" sets are required copied on the appropriately sized electronic media with a label containing the project information.
One complete "Electronic portfolio" set copied to CD/DVD and labeled with project information is also required.

The consultant must organize and label the various sections of the "Electronic portfolios" as required by the Standards of Practice for MDOT Design Surveys dated January 2012. 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.

The Final Report for this project shall include the following:

1. In the **Administrative** section of the portfolio, the project's Professional Surveyor's Report on company letterhead consisting of the following:
    a. A comprehensive synopsis of the work performed on this project, written in non-technical language and signed by the project's Professional Surveyor.
    b. The source and the methods used to establish the project horizontal coordinates, elevations, and the alignments for this project.
    c. A detailed explanation of anything discovered during the survey of this project that may create a problem for the designer or another surveyor.

2. In the **Control** section,
    a. Coordinate lists, calculations, OPUS or least squares adjustments for any horizontal and vertical control used in the project.
    b. Witness lists for the horizontal control points and bench marks, as well as alignment points and government corners in Word .doc format, per current MDOT Standards. Only upper case letters are to be used in the Word .doc file.

5.

3. In the **Alignment** section,
    a. A MicroStation .DGN drawing containing all alignments, annotated, showing curve data with stationing, horizontal coordinates, and source of stationing.
        i. A statement defining the alignment(s) as **legal, non-legal, as-constructed, etc. per the new alignment requirements as part of MDOT Standards of Practice for Surveys, January 2012.**
        ii. Stationing, source of stationing, and station equation to existing stationing
        iii. Horizontal coordinates of P.I.'s, at a minimum
        iv. Curve data
        v. Alignment points found or set
        vi. Control points
        vii. Reference lines and angles of crossing (if appropriate)
        viii. Government corners and ties to government lines

b. Each alignment saved and provided in .xml format with each file named appropriate to the type of alignment.
c. Legible recorded copies of all Land Corner Recordation Certificates (LCRC's) for the P.I.'s, P.C.'s, and P.T.'s recovered and tied in.

4. In the **Property** section,
a. Ownership/taxpayer names/contacts for the project area.
b. Coordinates and LCRC's for all government corners tied in.
c. Legible recorded copies of all Land Corner Recordation Certificates (LCRC's) for the government corners (PLSS corners, Private Claim corners and Property Controlling Corners) used for computations and/or in danger of obliteration by impending construction.
d. Tax maps and descriptions with owner names, addresses and phone numbers, if Right of Way is to be acquired, or if riparian ownerships are required.
e. Maps, plats, and recorded surveys.
f. Documents such as plats, Act 132 Certificates and/or tax maps marked with point numbers as property ties, if Right of Way is to be acquired.

5. In the **Mapping** section,
a. If CAiCE is used for the project, an archived CAiCE project file which includes survey mapping points and control points as well as DTM.
b. If PowerGEOPAK is used, the 3d Microstation . DGN and all associated .GPK and Geopak project files should be provided containing survey mapping points and control points, as well as edited DTM.
c. A MicroStation Version 8 .DGN of the planimetric and contours for this project utilizing the most recent MDOT Design Division symbology. The alignment must be included.
d. Geopak file of the DTM (.dat file)
e. 3D Microstation triangle file of the DTM.
f. 3D Microstation DGN file containing all mapping.
g. 2D Microstation DGN file containing all mapping created by saving as 2D from the above 3D Microstation DGN file after at completion of project.
h. 3D Microstation DGN containing the terrain surface triangle file of the DTM.
i. Terrain surface saved as a Geopak .TIN file.
j. Terrain surface saved as an InRoads .DTM file.
k. The Consultant is responsible for verifying all plots by a field inspection. One certification statement, as specified in the Standards of Practice for MDOT Design Surveys dated January 2012, covering all mapping for the project shall be provided. This certification must be signed and sealed by a resident Professional Surveyor licensed in the State of Michigan who certifies to the accuracy of the mapping.
l. Structure details and information per MDOT 2012 Survey QA/QC Checklist.
m. Digital photographs taken along the project and of each intersection, as well as drains and river crossings.

n. ~~Field survey notes, calculation sketches, and any research records obtained for this project. No raw survey data is required. All deliverables shall be in electronic format. No paper portfolio information shall be submitted.~~

6. ~~In the **Miscellaneous** section,~~
   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.~~

ATTACHMENT D
SCOPE OF SERVICE
FOR
Hydraulic Survey

R01 of 56021
M-20 over the Tittabawassee River
Midland County

The Consultant shall perform a hydraulic survey, which provides geometric data on the stream channel upstream and downstream of the structure. **Two weeks** prior to starting the hydraulic survey, the Consultant surveyor shall schedule a site visit with an MDOT Hydraulics engineer by contacting the Design Engineer-Hydraulics/Hydrology Chris Potvin at 517-335-1919 or Assistant Design Engineer-Hydraulics/Hydrology Larry Wiggins at 517-373-1713. The purpose of the site visit is to discuss details of the survey and to clarify the intent of the survey. The Consultant must take notes at the site visit and submit them promptly to the MDOT Survey Coordinator and MDOT Hydraulics engineer.

Prior to performing the 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, and an MDOT contact person (the MDOT Project Manager or Consultant Survey Coordinator or Region Surveyor).

The Consultant must make every effort to minimize brush cutting on private property. The use of paint on private property is prohibited.

Cross-sections shall be taken at the limits and intervals specified by the MDOT Hydraulics Engineer as shown in Attachment E. Channel cross-sections shall be taken normal to the direction of ***flood*** flow and tied to the project coordinate system so they can be accurately plotted. The sections shall be extended to the edge of the floodplain, to the elevation of the top of the road at the structure, or to a distance beyond the river bank agreed upon with the MDOT Hydraulics engineer at the site visit. Shots must be taken at approximately six foot intervals through the stream, and at significant break points. Any high water marks and date of occurrence (if available) shall be noted.

Since the hydraulic analysis is to be performed by MDOT staff, the Consultant shall meet the following requirements for hydraulic cross-sections:

1. Cross-sections shall be submitted electronically in a CAiCE software file, or in a format acceptable to the Design Engineer-Hydraulics/Hydrology.

2. Each cross-section shall be a separate chain in CAiCE named “HYDRO9, HYDRO2", etc. These **HYDRO** chain numbers need not be in sequence, but each HYDRO chain must have a description of 10, 20, 30, etc., in sequence, starting with 10 at the downstream end. Each individual point should have its own particular identifying MDOT Feature Code and the same

alpha prefix, such as RBOT, VEGE, TB.

3. A profile of the **highpoints of all berms** such as roads, railroads, or driveways that cross the stream must be included as a separate chain in CAiCE, with a Feature Code of "**HIPT**" and named "HIPT3, HIPT1", etc. These HIPT chain numbers need not be in sequence, but each HIPT chain must have a description of 10, 20, 30, etc., in sequence, starting with 10 at the downstream end. Each HIPT chain must also have a description that identifies the type of centerline, such as "railroad berm" or "farm drive." **HIPT chains must be sequenced separately from the HYDRO Chains.** Each individual point should have its own particular identifying MDOT Feature Code and the same alpha prefix, such as CL, SW, WALLB.

4. Each HYDRO and HIPT cross-section shall be submitted with the points in the chain running all left to right, looking downstream.

5. The cross-sections generally must extend a minimum of 100 feet into the flood plain from the stream top of bank.

6. For each cross-section, the vegetation break point (the "friction point" between the natural channel and the surrounding vegetation) shall be shot with an alpha prefix and Feature Code of "**RBK**" or "**LBK**" on the right or left side of the waterway, looking downstream. It should have a description of "break point."

7. Subsequent vegetation break points, if applicable, shall be shot with an alpha prefix and Feature Code of "**VEGE**" with a description such as "friction point – grass to shrub," or "friction point – shrub to trees" as appropriate.

8. The water surface elevations at each cross section shall have a Feature Code and alpha prefix and of "**LWS**" and "**RWS**", taken at the left edge of water and right edge of water looking downstream. The Consultant must note if any stream bed cross sections were dry, and LWS/RWS shots were unavailable. The note should be shown on the MicroStation drawing.

The project surveyor must ensure that all required information is legible and in a form which is easily accessible to the Hydraulics/Hydrology Unit. A CAiCE software file (Version 10.6 or newer) or a HEC-RAS file in MDOT format is acceptable. Other formats must be discussed in advance with the MDOT Survey Project Manager or Region Surveyor. Only one CAiCE file per project is desired. The Consultant should not submit separate CAiCE files for Hydraulics and Road/Structure, unless the Hydraulics Survey is required to be delivered first, in which case the Road/Structure Survey CAiCE file would be continued/appended to the Hydraulics Survey CAiCE file.

All elevations shall be referenced to the North American Vertical Datum of 1988 (NAVD88), or project datum, if established and different. If a project datum is used, the MDOT Hydraulics Engineer may require a reference to the North American Vertical Datum of 1988 (NAVD88) or the National Geodetic Vertical Datum of 1929 (NGVD29). Two benchmarks must be established at the stream crossing, one on each side of the stream. All benchmarks must be accurately described. Benchmark leveling shall be a closed loop of at least third-order accuracy, which requires an error of closure between known benchmarks of not more than 0.06

feet times the square root of the distance in Miles.

Note: It is not necessary to provide least squares analyses for horizontal and vertical control for a Hydraulics Survey upstream and downstream from the structure. Electronic evidence of horizontal and vertical closure is required. The surveyor must use professional judgment to determine whether the closures are acceptable for use on a Hydraulics Survey. It is necessary to provide accurate elevations for underclearances, road and berm profiles, weirs, and anything that controls flow. It is not necessary to provide extremely accurate closures for vertical and horizontal control used for hydraulics cross-sections.

It is not necessary to provide a witness list of horizontal control points set for hydraulics cross-sections.

A list containing at least two benchmarks, one on either side of the bridge, with descriptions, elevations and datum, must be provided. Since these benchmarks will be used for road/bridge design and construction, least squares analysis is required.

THE NOTES FOR THE HYDRAULIC SURVEY MUST BE PACKAGED IN A SEPARATE PORTFOLIO. All field measurements, notes, sketches, and calculations must be included in the final transmission. Two separate, identical, and complete portfolios must be provided.

ATTACHMENT E
SCOPE OF SERVICE
FOR
Hydraulic Survey (Additional Information)

R01 of 56021
M-20 over the Tittabawassee River
Midland County

Please provide the following information:

1. All pertinent structure data including water surface elevations, flow lines, and underclearance elevations, both upstream and downstream, at the structure. Include a sketch of the structure showing all of this information.

2. One road profile along the crown of the existing roadway.

3. Two cross sections, one at the upstream and one at the downstream face of the structure excluding roadway embankment.

4. A cross section 200 feet from the upstream face of the structure.

5. A cross section 700 feet from the upstream face of the structure.

6. A cross section 300 feet from the downstream face of the structure.

7. A downstream cross section at the confluence of the Chippewa River.

8. **The survey must be tied into the 2010 Flood Insurance Study for city of Midland**. To obtain current elevation, description, and/or location information about the bench marks shown in the study, contact the Information Services Branch of the National Geodetic Survey at (301)713-3242, or visit their website at http://www.ngs.noaa.gov.

9. All pertinent structure data including water surface elevations, flow lines, and underclearance elevations at any other structures encountered within the reach of the survey. Include sketches of these structures showing all of this information.

10. First floor elevations of all buildings within the survey limits.

11. The riparian owners in the four quadrants of the structure.

12. Water surface elevations at each section must be provided, with the date taken. The water

surface elevations at each cross section shall be taken at the left edge of water and right edge of water. All water surface elevations should be taken on the same day if possible. If not, note the date taken and any event which may affect the evaluation.

13. A point list in ASCII format shall be provided, containing columns for point number, North (or Y), East (or X), elevation, and description.

14. One control sketch to scale, or CAD drawing, showing the relationship of the cross-sections to the structure and the road.

15. One control sketch to scale, or CAD drawing, of the area at the stream crossing, showing a basic map of the bridge including abutments and cross section shots (numbered).

ATTACHMENT F

GEOTECHNICAL INVESTIGATION AND ANALYSIS REQUIREMENTS FOR STRUCTURES

March 2004

MICHIGAN DEPARTMENT OF TRANSPORTATION

CONSTRUCTION & TECHNOLOGY SUPPORT AREA

GEOTECHNICAL SERVICES UNIT

A. DESCRIPTION

1. The work performed by the consultant geotechnical engineer under these requirements shall consist of making a complete foundation investigation for the adequate design and construction of bridges and other associated structures.

   A complete foundation investigation and analysis shall consist of an adequate program of field sampling, laboratory testing, and engineering analysis and evaluation, with the results presented in report form. The investigation and analysis shall be performed in compliance with the procedures outlined in this document and generally accepted principles of sound engineering practice. The investigation and analysis shall be under the general supervision and subject to the approval of the M•DOT foundation analysis engineer. Unless otherwise subsequently noted, later references to as approved or directed will imply as approved or directed by the M•DOT foundation analysis engineer.

B. PERFORMANCE OF FIELD WORK ON PRIVATE PROPERTY

1. Entry Permission
   It is the responsibility of the consultant geotechnical engineer to obtain permission for entry from each property owner whose property must be entered for any reason.

2. Damages
   It is also the responsibility of the consultant geotechnical engineer acting as a representative of the Michigan Department of Transportation or local public agency to compensate the property owners for any damage incurred to their property because of the geotechnical investigation.

3. Railroad Expenses
   This item consists of the actual cost invoiced by the railroad for railroad permits, flagman, right of entry, etc. The consultant geotechnical engineer shall obtain the written approval of the State before incurring any railroad expense.

C. EQUIPMENT

1. The equipment used shall be hand operated or power drilling, and/or driving equipment, or other tools or equipment considered suitable or necessary for determination of the limits and conditions of the various soil strata, and for obtaining samples for examination, field classification, and laboratory analysis.

D. LOCATION AND DEPTH OF BORINGS

1. General
   This section is to be used as a guide in planning the boring program. It is not the intent that the location, boring interval, and depth specified herein be rigidly

adhered to. The consultant shall make use of available soils and geologic maps, water well records, reports, publications, aerial photographs, and other reference material which are available to prepare a preliminary boring program. Borings shall then be selectively located during a field check attended by the consultant geotechnical engineer and by the M•DOT foundation analysis engineer or his appointed representative.

The actual location, spacing, and depth of borings shall be dictated by the topography, geologic conditions, visible soil conditions, and design considerations, and in accordance with the practices set forth herein.

2. Depth of Exploration

Borings should extend through any unsuitable or questionable foundation materials and sufficiently deep into stable soils that the potential for settlement from compression of that layer or that the deeper underlying soils is determined. If deep excavations are required for building the structure, the explorations should be carried to at least 1.5 times the depth of the excavation in order to locate and determine groundwater levels in any aquifers that may exist below the level of excavation. This is necessary to design a dewatering system that may be required in such deep excavations and to avoid heave or disturbance to the bottom of the excavations.

3. Spacing and Number of Borings

Often borings are made in several stages. In the first stage, relatively few borings are made. Based upon these findings, additional borings may be made between the initial borings to define soil conditions in greater detail. The selection of sample type and frequency is determined by soil conditions and requirements of the structure. Where soil conditions are favorable, especially for small structures, all borings are often completed in the first phase of the investigation. If soil conditions are well known with fairly thick individual layers of consistent physical properties, relatively widely spaced borings may be sufficient. If, however, soil conditions vary appreciably from place to place, more closely spaced borings will be required. The number and spacing must be determined by engineering judgment as the work progresses. There should be a sufficient number to determine the stratification and interrelation of the soils to the extent economically feasible. The exploration should be conducted considering the requirements of the structure. All soil data necessary for the selection of the foundation and its design must be obtained.

4. Guidelines for Subsurface Investigations

With the above general concepts in mind, the following guidelines for location and depth of borings are to be followed. The boring frequency for most structures is one boring per substructure unit (such as a bridge pier) under 100 feet long and two borings for footings longer than 100 feet. For retaining walls and sewers, one boring every 300 feet, and for deep cuts and high fills, one boring every 200 to 500 feet depending on soil conditions. The sampling frequency for sands and

gravels is every 5 feet in depth where a standard penetration (resistance to driving) test (SPT) is obtained. If spread footings are proposed, the borings are extended until sufficient information has been obtained to complete the settlement analysis. If piles are anticipated, the boring is stopped 10 feet below the estimated bottom of the piling. The sampling frequency for cohesive (clay-like) materials is every 5 feet in depth to a depth of two times the footing width or 30 feet, whichever is greater, below the bottom of the proposed footing elevation. If the field consistency of the sample indicates an unconfined compressive shear resistance of less than 3,200 pounds/square foot, undisturbed samples are obtained for laboratory analysis. SPTs are taken in place of undisturbed samples if consistency is greater than 3,200 pounds/square foot. If piles are anticipated, the depth of boring is controlled by the estimated piling bottom as noted above. The strength testing for sands, gravels, and cohesive materials with consistency greater than 3,200 pounds/square foot is usually limited to in-place SPTs. For lower strength cohesive materials, undisturbed samples are collected for laboratory analysis. Groundwater table information is obtained at each boring location.

The above M•DOT guidelines are for routine foundation investigations. They are modified as necessary by the foundation analysis engineer to meet the needs of individual projects.

E. BORING AND SAMPLING

1. General

a. Standard Penetration Tests

Generally, all borings should be performed with split-spoon sampling. Samples should be taken at two-and-one-half-foot intervals for the upper ten feet and five foot intervals thereafter.

Split-spoon samples shall be obtained with the standard spoon of 2 inches O.D. and 1-3/8 inches I.D., driven with a 140-pound hammer, dropped 30 inches. The number of blows of the drop hammer to drive the spoon 18 inches, measured in 6-inch increments, shall be recorded. The penetration resistance, or N-value, shall be as defined in ASTM D 1586, and is normally the number of blows to drive the sampler the last 12 inches.

b. Split-Spoon Samples

Two jar samples approximately five inches long shall be obtained from each spoon for laboratory examination and/or testing. Care shall be taken to keep the jar samples as intact as possible. The samples shall be immediately placed in sealed glass containers to prevent loss of moisture.

c. Sample Handling

All of the samples should be delivered to the consultant geotechnical engineer's laboratory for representative classification tests and other tests

as required.

All samples shall be retained by the consultant geotechnical engineer for at least 90 days after final acceptance of the geotechnical report during which time the State may request that all or part of the samples be delivered to the Geotechnical Services Unit of the Michigan Department of Transportation.

d. Sample Identification

All laboratory samples shall be suitably marked up and identified to show sample number, project number, road number, county, structure number, depth below ground surface, boring number, and blow count for each 6-inch interval (if applicable). Undisturbed samples should, in addition, have a description of the soil. (Also see Sections E.3. and F.)

e. Groundwater Readings and Backfilling Bore Holes

After measuring the groundwater level at completion of the borings, the bore holes shall be suitably covered so that there will be no hazard to people, animals, or equipment. After the 24-hour groundwater level has been measured and all other observations, records, and information have been obtained, the holes shall be filled in such a manner as to prevent a hazard. Borings drilled through existing pavement should be suitably patched. Backfilling and plugging of all borings shall be in accordance with all Department of Natural Resources Regulations.

2. Boring Methods

a. Mobilization

This work shall consist of mobilization of all necessary equipment, tools, and supplies to, and demobilization, from the drilling site. It shall be the responsibility of the consultant geotechnical engineer to determine the equipment needs of each site and to mobilize equipment needed to perform the necessary work. Payment will be made per each approved mobilization. Mobilization of barge equipment is excluded from this item as it is a separate pay item.

b. Remobilization

Remobilization shall be paid only after having received authorization prior to equipment removal from the project site, or if an unforeseen change in the scope of work is made after the initial demobilization. Payments for the remobilization will be made per remobilization, which are previously authorized in writing.

c. Hand Borings

This work shall consist of using and hand auger of minimum 1-1/2-inch-diameter, 1-inch-retraction piston sampler, peat sampler, 3-inch-

minimum-diameter, post-hole-type auger, or a hand guide power auger for obtaining samples for determining the geotechnical profile. This work shall be performed in accordance with AASHTO T 203. The increment of advance of hand augers shall not exceed six inches. Payments shall be made from the ground surface to the maximum depth of auger penetration.

d. Truck Drilling

(1) Truck-Mounted Borings with Split-Spoon Sampling

This work shall consist of using a truck-mounted drill rig to advance a hole of sufficient diameter for the purpose of taking 2-inch-O.D. split-spoon samples and making standard penetration tests at two-and-one-half-foot intervals for the first ten feet and at five-foot intervals thereafter, including a sample at the bottom of the boring with the possibility of taking 3-inch-O.D. Shelby tubes and 2-1/8-inch-diameter rock cores. This work shall be performed in accordance with AASHTO T 206, and as stated in Sections E.1.a. and E.1.b. Payment will be made from the ground surface to the maximum depth of penetration of the last split spoon.

A maximum of two wraps of rope around the cathead shall be used to minimize reduction of the energy due to frictional resistance of the falling hammer. Other precautions shall be exercised to insure a free-falling hammer.

Drilling fluid or other authorized practices shall be used in circumstances where sand heaves into the casing, or as previously approved. Any unusual sampling procedures or results shall be noted on the boring log.

Driving of the split-spoon will be discontinued when blow counts reach 100 for a penetration of 12 inches or less.

If a sample is not recovered upon retraction of the sampler, one attempt with an appropriate entrapment device shall be made in order to retrieve a sample for visual classification.

(2) Truck-Mounted Rock-Core Borings

This work shall consist of using a truck-mounted drill rig for rock-core drilling. Standard diamond core bits and series "X" or "M" double-tube core barrels to obtain 2-1/8-inch-diameter cores shall be required for making rock core borings. The maximum length of core barrels, and the maximum length of each core run, shall be five feet, unless otherwise approved. All rock cores recovered shall be retained and protected.

Rock cores shall be placed securely in suitable compartmented

wooden boxes with wooden lids, in the order in which removed from the boring, with dividers between core runs, with the top and bottom depths of each run suitably labeled. Suitable labeling shall also be done on the outside end of the core box. Payment will be made for the actual number of lineal feet cored.

e. Skid Drilling

The following item is to be used when site conditions are such that a skid-mounted, dozer-mounted, all-terrain-vehicle drill rig or any other type mount previously approved is required to obtain the borings. Borings where the consultant geotechnical engineer is required to use a dozer to get a rig to the boring location shall also be considered under this item. If the consultant geotechnical engineer chooses to use a skid-mounted, dozer-mounted, or all-terrain-vehicle rig to obtain borings which could have been obtained by a truck rig, they shall be considered as truck borings.

(1) Skid-Mounted Borings With Split-Spoon Sampling

This work shall be the same as described in E.2.d.(1), except for the drilling equipment required.

(2) Skid-Mounted Rock-Core Borings

This work shall be the same as described in E.2.d.(2), except for the drilling equipment required.

f. Floatation Equipment

The following item is to be used when floatation equipment is required to make borings over water. Floatation equipment is described as a barge, raft, boat, or platform of sufficient size to properly and safely support the drilling equipment and have sufficient area for working and storage of the necessary tools and supplies required to make water borings. The barge and drilling equipment shall be of sufficient size to operate on any body of water within or bordering the state of Michigan, and be able to penetrate to depths as required. The equipment shall also be capable of obtaining 3-inch-O.D. Shelby tubes at depths requested by the consultant geotechnical engineer with prior approval. Water borings shall be generally defined as those where water is to a depth where it is not feasible to drill with equipment resting on a stream bed or earth ramp, all subject to prior approval. It shall be the consultant geotechnical engineer's responsibility to determine the elevation and depth of the water at the time the drilling is performed.

g. Floating Equipment for Machine Borings

This item shall consist of mobilization, demobilization, equipment rental, and setting up of equipment required for barge machine boring at a drilling site. This item shall also consist of the rental support equipment required

to perform barge machine borings on nonnavigable and navigable water. A quantity of one lump sum will be paid for the project, if required.

h. Soundings

This work shall consist of making continuous-flight auger borings with a truck-mounted rig, skid-mounted rig, barge-mounted rig, a powered hand auger, or a hand auger for the purpose of determining the depth to rock or the depth through surficial peat, other unstable soils, man-made waste deposits, etc. Samples do not need to be obtained.

This item shall also include borings advanced through soil for the express purpose of making core borings in rock or obtaining undisturbed samples at a certain depth in which a casing or drilling fluid is not used to keep the hole open. Measurement shall be from the ground surface to the depth augered.

i. Casing

This shall consist of furnishing and installing either hollow-stem auger or driven casing, as previously approved, through air, water, soil, shale, and/or weathered rock to a specified elevation for the purpose of obtaining Shelby tubes, rock cores, installing field instrumentation, etc., if required. Measurement shall be from the water surface (if casing is placed through water) or the ground surface (for land borings).

j. Field Geotechnical Engineer

This work shall consist of furnishing a qualified consultant geotechnical engineer for field work for all time in excess of one day per week per rig. The payment will be made at the price per work day, which payment shall include costs for travel and living expense at the site. Any time in excess of one day per week per rig must first be authorized.

3. Soil Sampling

a. Undisturbed Samples

Undisturbed samples, if required, shall be obtained by methods and equipment previously approved. This work shall consist of obtaining undisturbed samples by pressing 3-inch-O.D., thin-walled tubes into the soil with a continuous punch. In soils which are too soft to obtain good recovery by conventional means, a 3-inch-O.D., stationary-piston sampler may be used. An attempt shall be made to push the tube a maximum of 24 inches. Tube length shall be that recommended in Table 1 of AASHTO T 207 or longer to avoid overfilling of the tube during sampling. Payment will be made per each undisturbed sample only when recovery is 50 percent or greater, with a minimum of 6 inches unless otherwise approved. Smaller, testable samples may be used if previously approved. This work shall be performed in accordance with AASHTO T 207, except where

superseded by the following.

Immediately after trimming and cleaning the ends, the samples shall be sealed with approved expanders or by pouring petrowax or comparable materials into each end, placing suitable filler in the remaining void space to prevent movement of the sample, and covering each end with a metal or plastic cap. Bolt holes in the tube shall be covered with tape and both ends of the tube shall be dipped into petrowax or comparable material. Samples shall be kept in a vertical position with the top always up during transportation and storage. Samples shall not be jarred or vibrated and should be properly marked and identified. Tubes should be protected from temperature extremes and under no circumstance should tube samples be allowed to freeze.

b. Additional Split-Spoon Samples

This item shall consist of obtaining additional 2-inch-O.D., split-spoon samples as specified above by the Standard Penetration Test Procedure in accordance with AASHTO T 206. Payment shall be for split-spoon samples obtained in addition to those required in Items E.2.d.(1) and E.2.e.(1).

F. FIELD RECORD

1. All material encountered in each boring shall be carefully examined and visually classified at the time of boring, and a written record (boring log) should be prepared. The boring log shall be on a sheet 8-1/2-by-11 inches in size, and shall show the following information: (a) project designation and project location; (b) boring number; (c) final location of boring by reference to station, offset, and survey line; (d) method of boring, type drill rig and sampling; (e) date of boring and weather; (f) ground elevation measured utilizing a transit or level instrument and referencing to a USC&GS Benchmark or other points of known elevation; (g) numerical thickness and depth of various soil layers to be shown in feet below ground surface or by elevation; (h) a complete description of each soil layer including color, moisture, consistency or density, and visual grain-size classification; (i) the elevation of free water during the drilling, at completion of drilling and 24 hours later; (j) any additional information obtained during the boring shall be shown; (k) blows per 6-inch increment of drive of split-spoon sampler, sample number, and depth of top and bottom of samples taken; (1) percent recovery on split-spoon and undisturbed samples, rock cores, etc.; (m) county; (n) driller; (o) inspector.

When rock is encountered and cored, the boring log shall also include the following remarks: (a) numerical thickness and depth of rock unit; (b) a complete description of each rock unit including color, texture, significant mineralogy, degree of weathering etc.; (c) percent recovery and RQD values (rock quality designation); (d) a description of joints, fractures, and bedding planes (i.e., degree

of openness, spacing, inclination, etc.); (e) location of core fracturing; (f) type and size of core barrel and depths where casing is used; (g) general descriptions of penetration rate, with significant changes in rate noted; (h) zones of drilling fluid loss; (i) zones of water gain (when air is the drilling fluid); (j) any unusual occurrences such as sudden drop of drill rods, change in color of return wash water, etc.

Fill or embankment material depth limits should be shown on all boring logs, as well as the classification of the soil comprising the fill or embankment. This information should be checked for accuracy by referring to original construction plans to determine the original embankment height.

The boring logs shall contain all necessary information required to plot the final geotechnical profile, and such information shall also serve as the basis for determining pay quantities.

G. LABORATORY TESTING

1. General

Boring samples shall be submitted from the soil strata for laboratory analysis as the work progresses.

All laboratory tests shall be performed in accordance with AASHTO and/or ASTM Standard Methods of Testing as listed herein, except as described below. Tests for which standard or tentative procedures have not been adopted by the above societies shall be governed by Standard Michigan Test Methods, by the publication "Soil Testing for Engineers" by T. William Lambe, or by other procedures previously approved.

When AASHTO or ASTM Specifications govern, the most current Standard or Interim Specification shall be used for reference.

2. Classification Tests

These tests shall be performed on samples that were obtained for verification of the field classification of the major soil types encountered during the investigation. The number shall be limited to that established by the agreement in effect unless prior approval is given, or to those necessary to reasonably establish the stratification without duplication. A minor soil type, if not critical, may be given a visual classification, instead of performing classification tests for reference.

a. Sieve Analysis

This work shall consist of determining the gradation of a sample in accordance with AASHTO T 88. Sieves used shall be U.S. Sieve sizes 3", 2", 1", and 3/8" and U.S. Sieve Nos. 4, 10, 40, and 200, decanted over the No. 200. A grain-size distribution curve shall be provided as a part of this

item.

b. Hydrometer Analysis

This work shall consist of performing the hydrometer analysis in accordance with AASHTO T 88, and includes a Specific Gravity Determination performed in accordance with AASHTO T 100. If 20 percent or more passes the No. 200 Sieve, a hydrometer analysis shall be performed. A grain-size distribution curve shall be provided and should include the combined results of the sieve analysis.

c. Liquid Limit

This shall consist of the determination of the liquid limit in accordance with AASHTO T 89, Method "A" only. Three points shall be determined and no payment will be made for nonplastic (N.P.) soil.

d. Plastic Limit and Plasticity Index

This work shall consist of the determination of the plastic limit and plasticity index in accordance with AASHTO T 90. If the soil is found to be nonplastic, then the liquid limit shall not be performed, and the AASHTO group index shall be reported as zero.

e. Shrinkage Limit

This work shall consist of the determination of the shrinkage limit in accordance with AASHTO T 92. No payment will be made for nonplastic (N.P.) soil. This test shall be performed only with prior approval.

3. Special Tests

These are tests which are performed on bag samples, jar samples, undisturbed samples, and/or split-spoon samples to obtain additional information about the soils and their condition. This information is used in analysis of conditions and preparation of recommendations for design and construction.

a. Moisture Content Test

This work shall consist of the determination of moisture content in accordance with AASHTO T 265, on representative samples of soil from each major stratum in each boring, except sands or gravels. When this test is performed as part of a primary test, it will not be considered a pay item.

b. Unit Weight Determination

This work shall consist of the determination of the unit weight by measurement of the length and diameter as performed in accordance with the appropriate part of AASHTO T 234. When this test is performed as a part of a primary test, it will not be considered a pay item.

c. Consolidation Test

This work shall consist of performing the consolidation test in accordance

with AASHTO T 216, except the load increments shall be 1/16, 1/8, 1/4, 1/2, 1, 2, 4, 8, and 16 tons/square foot. This test also includes specific gravity, initial and final moisture content tests, initial and final degrees of saturation and unit weights (density). Time curves for all load increments and e-log-p curve shall also be furnished.

d. Unconfined Compression Test

This work shall consist of performing the unconfined compression test in accordance with AASHTO T 208. This test shall include initial and final moisture content test, unit weight determination, visual description of the soil, average strain at failure and average rate of strain to failure. This test shall be performed on 3-inch undisturbed samples unless other types are specifically approved in advance. This test shall not be performed on nonplastic soils.

e. Triaxial Test

This work shall consist of performing the triaxial test in accordance with AASHTO T 234. Each test shall consist of three points for plotting a Mohr failure envelope and determining the strength parameters. This test shall include initial and final moisture content tests, specific gravity, Atterburg limits, initial and final void ratio, initial and final degrees of saturation, initial and final unit weights (densities), visual textural description, cohesion, plot of Mohr circles and envelope, and sketch of failure. The test shall be one of the following:

(1) Unconsolidated — undrained (UU) test
(2) Consolidated — undrained (CU) test
(3) Consolidated — drained (CD) test

Pore pressure measurements may be required with the UU or CU tests and will be paid for in addition to this test.

f. Direct Shear Test

This work shall consist of performing the direct shear test of soils under consolidated — drained conditions in accordance with AASHTO T 236. Each test shall consist of three points for plotting of Mohr failure envelope and determining the strength parameters. This test shall include initial and final moisture content tests, initial and final degrees of saturation, sample thickness and void ratio before and after consolidation, dry unit weight (density), and plotted Mohr envelope.

g. Housel Transverse Shear Test

This work shall consist of the determination of the ultimate shearing resistance of cohesive soils by measuring the force required to cause the failure in double shear of a soil cylinder of 1-1/2-square-inch, cross-sectional area in accordance with Michigan Test Method 401-76.

h. Loss on Ignition Test

This work shall consist of the determination of the loss-on-ignition (organic content in accordance with AASHTO T 267.

4. Classification of Soils

The soil description and classification is to be based on the distribution and behavior of fine-grained (passing No. 200 sieve) and coarse-grained (retained on the No. 200 sieve) soil constituents, as described in ASTM D 2487 and D 2488.

a. Soil descriptions contained on exploration logs and in field/laboratory reports shall be consistent with the visual-manual procedure of ASTM D 2488. The visual-manual method employs visual observations and simple manual test (index tests) to estimate the size and distribution of the coarse-grained soil reactions and to indicate the plasticity characteristics of fine-grained fractions. These index tests should be performed on representative samples from each soil unit.

b. Soil classifications are determined based on soil descriptions and laboratory testing. Representative soil samples that are submitted for laboratory testing shall be classified using the procedure of ASTM D 2487, which generally requires grain size and plasticity testing (Atterburg limits).

H. GEOTECHNICAL REPORT

1. General

The geotechnical report shall be the presentation of all data obtained during the investigation, both in the field and laboratory, all engineering analyses, and recommendations for the use or satisfactory treatment of various soils and soil conditions encountered on the project. A maximum of ten copies of the geotechnical report will be required, with the actual number being requested by M•DOT.

2. Contents of Report

a. General Information

(1) A discussion of the location of the project (including the beginning and ending stations), project identification and background, scope of proposed construction, field and laboratory investigation procedures, etc.

(2) The date, month, and year when the field investigation was made.

(3) A general description of climatic conditions during field investigation.

(4) A general description of the geology and soils encountered on the project, and a description of the terrain, to include drainage, erosion patterns, high water elevation, flooding, and any other specific conditions which may be of value in the design of bridges, culverts, and other structures.

(5) Any other information which may be of value for the proper interpretation of the field survey data.

b. General Recommendations

The Geotechnical Report shall include general recommendations concerning design and construction procedures for bridges, retaining walls, culverts, and other structures, as applicable.

c. Detailed Geotechnical Conditions and Recommendations

The soils at the site shall be generally described; specific problems or conditions shall be explained; and recommendations with the results of engineering analyses (where applicable) shall be made relative to any special embankment construction; cut slope recommendations in soil or rock; subgrade removal, replacement, or treatment; removal of unsuitable soil; drainage installations; the use of channel change materials; and/or any other factors affecting design or construction of the project. Any investigation of channel relocations shall also be a part of the report.

Whenever it is recommended to install field monitoring equipment and/or devices such as piezometers, settlement plates, and shoulder stakes, the recommendations should include the purpose and/or objective, proposed locations, an approximate schedule as to the frequency of readings, controls which can be used during construction to assure proper performance based on the design assumptions, etc.

d. Borings Logs

Logs of all borings along with a location plan shall be included in the appendix of the report. The logs shall be based on the field logs and laboratory test data. The logs shall contain all the information recorded on field logs as specified in Section F., Field Record, and the grain-size classification based on laboratory test data, and each soil layer shall be referenced to a laboratory sample number.

e. Test Data

The results of all laboratory tests on various samples shall be tabulated and included in the appendix of the report. The tabulation shall identify each sample as to boring number, depth, and sample number, and shall include all results obtained under items G.2. and G.3., as set out under Section G., Laboratory Testing. Separate tabulations shall be included for

classification test results, strength test results, and other special test results.

f. Engineering Analysis

The work described herein shall include review and correlation of various test results as to embankment stability, material placement, and other geotechnical engineering considerations. Sketches, assumptions, calculations, etc., (where applicable) of all final engineering analyses shall be included in the appendix of the report. The source of the analysis, the input and output data (properly labeled) all shall be provided if computerized analysis methods are utilized. The consultant geotechnical engineer shall also attend all field checks, conferences, etc., as requested by the State. Methods of analysis shall be as approved in the proposed work plan.

(1) Settlement Analysis

This work shall consist of performing settlement analysis at a specific cross section based on consolidation test results in fine-grained soils or based on blow count and the soil gradation in granular soils. The consultant geotechnical engineer shall furnish computations for total estimated settlement, a plot of percent total estimated settlements vs. time assuming the most likely drainage conditions, etc. The analysis can be for the proposed structure, a proposed and existing structure, etc. A quantity of one will be paid for each point analyzed.

(2) Sliding Block Slope Stability Analysis

This work shall consist of making sliding block slope stability analyses at specific sections to analyze proposed or existing conditions. One analysis will be authorized for payment for each cross section analyzed.

Factor of safety computations shall be made for various assumed failure surfaces until an apparent minimum factor of safety has been established for each analysis. The model used shall be as approved in the proposed work plan.

(3) Rotational Slope Stability Analysis

This work shall consist of making rotational slope stability analyses at specific sections to analyze proposed or existing conditions. One analysis will be authorized for payment for each cross section. The model used shall be as approved in the proposed work plan.

(4) Bridge Foundation Analysis

This work shall consist of bridge foundation analysis, including

recommendations. This shall include all analyses and computations required to make complete recommendations for a satisfactory foundation to support the proposed loading conditions at each bridge support, such as bearing capacity, settlement, and stability and constructability, as required.

A separate generalized subsurface profile shall be prepared for each bridge foundation analysis and included as part of the calculations. The drawing shall show the existing ground line, the proposed grade line, the location of the structure and its supports, the estimated soil and rock stratification within the limits of the proposed structure, the location of each structure boring, hydrologic data, standard penetration values adjacent to the boring location, groundwater levels, etc., as applicable. Each bridge analyzed shall be considered as one analysis.

(5) Retaining Structure Analysis

This work shall consist of retaining structure analysis, including recommendations which shall include conventional retaining walls, bridge abutments, bin walls, or drilled-in piers. Separate pay items as defined below will be made for either (a) shallow foundation or (b) deep foundation or any other retaining-type structures. The analyses and recommendations shall include all computations necessary to assure the constructability; and the stability of the retaining structure, including bearing-capacity settlement and stability, as required.

The analyses and computations required shall include the determination of the lateral loads which will be imposed on the structural elements, the depth of embedment required for stability of a typical section, etc. The final recommendations shall include the station limits of the structural elements, their offsets, penetration depths, and the soil and/or rock stresses for which the elements of the retaining structure should be designed. Any other design parameters which are pertinent to the recommendations for such a retaining structure should also be included as part of this item.

If a tie-back system is required, the recommendations for the tie-back shall include the capacity of the tie-backs, the penetration required for resistance and stability, the spacing of the tie-backs, and any other design parameters pertinent to the tie-back system recommendations.

A separate generalized subsurface profile shall be prepared for each retaining structure analysis as described above for bridge

foundation analysis.

(a) Shallow Foundation

This item shall include all analyses and computations required to make complete recommendations for a satisfactory shallow foundation to support the proposed loading conditions at each section. Shallow foundations are defined as spread footings, reinforced concrete mats, etc. A quantity of one will be paid for each section of shallow foundation retaining structure analyzed.

(b) Deep Foundation

This item shall include all analyses and computations required to make complete recommendations for a satisfactory deep foundation to support the proposed loading conditions at each section. Deep foundations are defined as piles, drilled-in piers, tie-back systems, etc. A quantity of one will be paid for each section of deep foundation retaining structure analyzed.

g. Geotechnical Profile

(1) The geotechnical profile shall consist of the following:

(a) Sheet 1 — Title Sheet. This may be a reproducible of the title sheet used by the design consultant for the design plans, modified as necessary.

(b) Sheet 2 — Legend Sheet.

(c) Sheet 3 — Tabulation of Classification Test Data

Classification test data shall be tabulated on a separate sheet of the geotechnical profile. Such tabulation shall include laboratory sample number, field sample number, boring number, station, offset, depth of sample, color, textural or grain-size classification, ASTM classification and the test results obtained from mechanical analysis, liquid limit, plastic limit, plasticity index, and shrinkage limits.

(d) The geotechnical profile plan and profile sheets with the borings and data shall be plotted to a vertical scale of not more than 1" = 10', and to a horizontal scale of not more than 1" = 100'. Each sheet shall be identified by control section, structure number, and project and route number,

and the scale to which it is drawn.

(e) Elevation of subsurface water levels recorded during the boring, at completion of boring, and 24 hours later, shall be indicated by suitable symbols. The use of color as a symbol will not be permitted.

(f) Additional sheets as required shall be used to plot soil or rock cross sections, peat or unstable soil profiles, rock profiles, etc.

(2) The geotechnical profile shall be prepared in ink on linen, mylar, or other material with prior approval, to provide permanent originals which will not deteriorate or fade with age.

I. SUPERVISION

1. General

All phases of the geotechnical investigation, including boring and sampling, laboratory testing, analyses, and preparation of the geotechnical report, shall be under the direct supervision of the qualified geotechnical engineer.

2. Scheduling

After the preliminary field check, as previously mentioned, the scope of work for the project should be defined on a tentative basis. The consultant geotechnical engineer shall send in writing a work plan for the completion of the field work and the date when the complete geotechnical report and profile will be transmitted to the M•DOT foundation analysis engineer immediately after the preliminary boring location plan is approved. If it appears that the aforementioned schedule must be altered during the progress of the work, the consultant geotechnical engineer shall send in writing to the M•DOT foundation analysis engineer the revised schedule and a statement explaining the reasons for the schedule change.

3. Field Supervision

During the boring and sampling phase, the consultant geotechnical engineer shall so organize the work that the consultant geotechnical engineer can spend at least one day per week per rig (minimum) with the drilling crews. If more than one drill crew is used, they shall be so operated that the consultant field geotechnical engineer can supervise them with a minimum of travel from one crew to another. Prior authorization shall be obtained regarding field supervision in excess of one day per week per rig.

4. Maintaining Cost Records

The consultant geotechnical engineer shall maintain records to reflect the running total of work accomplished for all items of work, including testing, as the work progresses. These records shall be up to date and available for inspection at all times. As the work progresses, it may be advantageous for the consultant

geotechnical engineer to consult with the M•DOT foundation analysis engineer prior to executing certain laboratory tests and/or engineer analyses. The consultant geotechnical engineer may elect to proceed with the work using reasonable engineering judgment without consulting with the M•DOT foundation analysis engineer, as long as the actual quantities used do not exceed the estimated agreement quantities. If at any time, it appears that an overrun will be necessary, the consultant geotechnical engineer shall obtain approval prior to performing work which will be in excess of the estimated amounts.