

## **Guideline and Summary of Requirements for Montana Department of Transportation (MDT) Surveying**

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### **GENERAL**

Surveys that are performed for the Montana Department of Transportation (MDT) may be done utilizing internal MDT staff or through external consultant contracts. Consultant-performed survey work will generally be done under one of two types of contracts: 1) as part of an overall project design contract or 2) as a term survey contract. The guidelines and requirements contained herein are applicable for all MDT surveys, regardless of the type of contract. This document is intended to summarize the requirements for MDT surveys in a “quick reference” format. All applicable Manuals and supplemental documents remain the controlling criteria for MDT surveys.

#### **Professional Land Surveyor (PLS) Oversight and Manuals**

Control and cadastral/land survey work will be completed under the direct supervision of a professional land surveyor licensed in the state of Montana. As required by 37-67-101 MCA, engineering survey work will be completed under the direct supervision of a professional land surveyor or professional engineer licensed in the state of Montana.

The PLS in charge of a control survey will submit a sealed and signed copy of the control diagram with complete coordinate listings and descriptions for horizontal and vertical control points, along with a statement that the control survey meets MDT standards. The PLS or PE in charge of the engineering survey will submit a sealed and signed statement the survey meets MDT standards.

All survey work will be done in conformance with the most current version of the *MDT Survey Manual*, supplemental MDT survey procedures, and Montana law. The *MDT Survey Manual* and supplemental documents are available on-line at: <http://www.mdt.mt.gov/publications/manuals.shtml#sur>.

#### **Project Survey Datum/Coordinate System**

All survey information (control, cadastral, topographic/engineering) will be collected and submitted in the designated project units (feet or meters) using the specified project datum and adjustment tag (e.g. - NAD83(1992), NAVD88), unless expressly stated otherwise by the MDT Helena Survey Unit.

#### **Survey Filing System**

The MDT Helena Survey Unit utilizes a legal size filing system. Materials submitted by consultants must be compatible with this filing system.

- 8½”x 14” or smaller papers
- folding of maps etc. to 8½”x 14”
- no three ring notebooks

### **Submittals**

Submit all survey information directly to the MDT section administering the design contract or term assignment. For design contracts, this is typically the Consultant Design Project Manager. For term contract assignments, this is typically the term contract manager in the District office.

Submit all electronic files in a format and on a media acceptable to the MDT (CD or other media acceptable to MDT). Submit electronic text files in an ASCII format, developed in Notepad. Spaces are used as the delimiter in these files; tabs are not allowed. Submit CADD files in the version of MicroStation currently being used by the MDT, and ensure they conform to MDT CADD standards as outlined in the *MDT CADD Standards Manual*, including file naming conventions established by MDT's Document Management System (DMS).

## **CONTROL SURVEY**

### **Description & Core Requirements**

The purpose of the control survey is to establish a permanent, recoverable horizontal and vertical control network from which subsequent project surveys will be tied to. The control survey shall consist of a network of control points surveyed either by GPS/GNSS methods or by control traverse methods outlined in the *MDT Survey Manual*. A control survey plan shall be submitted and approved by the Photogrammetry & Survey Section for each control survey prior to commencement of the survey. Control points shall conform to monumentation standards, numbering standards, and spacing standards outlined in the *MDT Survey Manual* or as otherwise outlined in the control survey plan approval. The control network shall be surveyed per standards, procedures and methodologies outlined in the *MDT Survey Manual*.

Vertical control shall be established through differential leveling procedures, approved GPS/GNSS methods and/or other approved methods as outlined in the *MDT Survey Manual*.

### **Standard Control Survey Software**

MDT utilizes the control survey software listed below. For compatibility purposes, survey deliveries are to be submitted using this software.

- Trimble Business Center version 3.81
- Trimble Access Version 2013.01 (4830)
- Trimble Survey Controller Version 12.10(Optional)
- StarNet Version 7.1.0.5 or earlier
- Microstation V8i (Select series 2) Version 08.11.07.443
- Notepad Version 6.1

### **Control Survey Deliverables**

Information to be submitted includes, but is not limited to:

- approved control plan
- original field survey notes (log sheets, obstruction diagrams, paper or electronic field notes, etc.)
- all supporting data/calculations (survey computations, datasheets, processing results, etc.)

- research materials
- control diagrams
  - one signed and sealed paper copy with complete coordinate listings and descriptions for horizontal and vertical control points
  - a MicroStation file containing an electronic copy of the control diagram
- electronic coordinate files and lists (ASCII format)
- data collector files
- ASCII point recovery description files
- GPS/GNSS files

MDT standard format files and brief descriptions for Control Survey submittals are as follows:

- XXXXXXXXSUCONZOX.IFT – ASCII English coordinate file (Point, Northing, Easting, Elevation) Include a note of the datums and adjustment used, Geoid, horizontal coordinates shall be in international feet and elevations shall be in U.S. survey feet.
- XXXXXXXXSUCONZOX.DES – ASCII file with descriptions of points in the vicinity of the project
- XXXXXXXXSUCONZOX.DES – ASCII file with descriptions of all points used for the project
- XXXXXXXXSUCONZOX.DGN – 2D Microstation file of the control points
- XXXXXXXXSUCONZOX.PTS – ASCII file with geodetic, ellipsoid height, metric state plane, elevation, scale factor, and convergence of all marks (include a note of the datums and adjustment used, geoid, and what marks were held)
- XXXXXXXXSUCONZOX.ZIP – Compressed file of all the information and data files for the project
- XXXXXXXXSURMEZOX.TXT – Text (Notepad) file explaining the submitted files and an explanation of how the survey was performed (include a note of the datums and adjustment used, geoid, and what marks were held)

\*Note – the above files are in a specific format that will be strictly adhered to.

### **Metric Processing for GNSS Surveys**

Control surveys are to be processed in metric units using MDT's current version of processing software. Metric coordinates are to be converted to project units using the appropriate conversion factor if the project units are not meters.

### **OPUS Solutions**

Online Positioning User Service (OPUS) may be used in certain situations as outlined in the *MDT Survey Manual*. When using OPUS solutions MDT requires a minimum of two four-hour sessions for each occupied point.

## **CADASTRAL/LAND SURVEY**

### **Description and Core Requirements**

Survey work under this category includes the relocation and/or reestablishment of public land survey system corners, property corners, MDT right-of-way, railroad right-of-way, and other property boundaries necessary to determine ownership boundaries for right-of-way acquisition or location. Cadastral/land survey work shall meet the following requirements:

- All required lost or obliterated corners will be reestablished in accordance with provisions of Montana law.
- All corners will be recorded in conformance with the Corner Recordation Act of Montana. Corner forms will describe the methods used to reestablish the corners. The consultant will furnish the MDT a copy of all recorded corner recordation forms.
- All found stones, posts, unmarked monuments, and reestablished corners will be monumented with 30"x2½" flared base monuments with ¾" caps and witnessed with a post and sign or yellow MARLS placard. In the event the corner position falls within the driving surface of a highway or road a monument meeting the requirements of ARM 24.183.1101(b) shall be set at the corner. In addition, reference monuments shall be set in a safe location off the roadway and shown on the corner recordation along with other ties to nearby features. The MDT will furnish flared base monuments upon request. Existing monuments that can clearly be identified (i.e. - a BLM brass cap, or monuments meeting specifications per ARM 24.183.1101(b)) and are in good condition do not need to be remonumented.
- A search for all existing right-of-way monuments and property corners along the project will be made. Ties will be made to all found monuments using property tie procedures outlined in the *MDT Survey Manual*. A complete description of the found monument will appear in the notes and be shown on any drawings. Missing property corners will not be reestablished unless specifically requested.
- All property controlling corners will be tied to the project control network using closed traverse methods, double side tie procedures, or GPS/GNSS procedures outlined in the *MDT Survey Manual*. Ties shall meet all standards, procedures and methodologies outlined in the MDT Survey Manual.
- Survey notes will be kept in a format acceptable to the MDT including size and form of field book sheet. Note keeping specifics are outlined in the *MDT Survey Manual*.
- Numbering of survey points shall be in accordance with the *MDT Survey Manual* and numbering of points shall be consistent throughout all project survey documents.
- If only a single section line tie is required, a certificate of survey is not required. In lieu of the certificate of survey, corner recordation forms will be prepared showing record and found bearings and distances between the corners. Prior to filing certificates of survey and corner recordations the consultant will provide copies to the MDT for review and comment. The MDT will provide comments or request the information be filed. Upon filing, the consultant will provide one copy of the recorded instruments to the MDT.
- If more than one section line tie is required, a certificate of survey using as many sheets as necessary to clearly show all record and found bearings and distances, found and set controlling property corners, and methods used to reestablish controlling property corners will be filed with the appropriate county Clerk and Recorder. A coordinate table with point numbers and coordinates listed in MDT project units shall be included on the certificate of survey. Prior to filing certificates of survey and corner recordations the consultant will provide copies to the MDT for review and comment. The MDT will provide comments or request the information be filed. Upon filing, the consultant will be requested to provide one copy of the recorded instruments to the MDT.
- If a retracement survey of the existing right-of-way is required, a certificate of survey using as many sheets as necessary to clearly show all record and found bearings and distances, found and set controlling property corners, and method used to reestablish controlling property corners will be filed with the appropriate county Clerk and Recorder. A coordinate table with point numbers and coordinates listed in MDT project units shall be included on the certificate of survey. Prior to filing certificates of survey and corner recordations, the consultant will provide copies to the MDT for review and comment. The MDT will provide comments or request the information be filed. Upon filing, the consultant will be requested to provide two copies of the recorded instruments to the MDT.

### **Standard Cadastral Survey Software**

MDT utilizes the cadastral survey software listed below. For compatibility purposes, survey deliveries are to be submitted using this software.

- Trimble Business Center version 3.81 (RTK Processing)
- Trimble Access Version 2013.01 (4830)
- Trimble Survey Controller Version 12.10 (Optional)
- MicroStation V8i (Select series 2) Version 08.11.07.443
- GEOPAK V8i (Select series 2) Version 08.11.07.615
- Notepad Version 6.1

### **MDT Standard Data Collection Files**

Cadastral and right of way surveys are to be developed using MDT's standard data collection feature files or current version including:

- CADASTRAL2.FXL – MDT's data collector feature file
- CADASTRAL\_ENG\_01.SMD – MDT's Geopak feature file
- CADASTRAL\_01.CEL) – MDT's MicroStation cell library file

### **Cadastral Survey Deliverables**

Information to be submitted includes, but is not limited to:

- certificates of survey
- corner recordations
- original field survey notes (log sheets, obstruction diagrams, paper or electronic field notes, etc.)
- all supporting data/calculations (survey computations, GLO notes, aerial photos, deeds, exhibits, right-of-way plans, surveys of record, processing results, etc.)
- coordinate files and lists
- data collector files
- GPS/GNSS files

MDT standard format files and brief descriptions for Cadastral Survey submittals are as follows:

- XXXXXXXXSUCADZ0X.DGN – 2D Microstation file of the Certificate of Survey
- XXXXXXXXSUCADZ0X.PDF – Adobe file of the recorded Certificate of Survey (recording information required)
- XXXXXXXXSUCADZ0X.PDF –Adobe file of the recorded Certified Corner Recordations (recording information required)
- XXXXXXXXSUCADZ0X.TXT – ASCII file of the points shown on the Certificate of Survey (Point, Northing, Easting, Elevation, Feature, Description)
- XXXXXXXXSUCADZ0X.TXT - ASCII file of all points (Point, Northing, Easting, Elevation, Feature, Description)
- JOBXXX.GPK – GEOPAK COGO file (including points, lines, and curves)
- XXXXXXXXSUCADZ0X.ZIP – Compressed file of all the information and data files for the project
- XXXXXXXXSURMEZ0X.TXT – Text (Notepad) file explaining the submitted files and an explanation of how the survey was performed

\*Note – the above files are in a specific format that will be strictly adhered to.

## **ENGINEERING SURVEY**

### **Description and Core Requirements**

Survey work under this category will include all engineering and miscellaneous survey work including but not limited to: topographic surveys, construction surveys, hydraulic surveys, bridge surveys, remote sensing verification surveys, pickup surveys, and utility surveys.

Remote sensing verification surveys shall include acquiring field surveyed check shots at the beginnings and ends of projects and other critical areas such as bridge ends to confirm mapping elevations and coordinates in areas where improvements will not be altered. In addition, random field surveyed check shots/cross sections throughout the survey limits are to be collected by the consultant and compared to the remote sensing data. A sufficient number of check shots/cross sections shall be collected to verify and certify the accuracy of the remote sensing data.

The consultant will survey and locate all existing public and private utilities in the project corridor above and below ground. A subsurface utility engineering (SUE) firm approved by the MDT will locate underground utilities, if deemed necessary.

### **Standard Engineering Survey Software**

MDT utilizes the topographic/engineering survey software listed below. For compatibility purposes, survey deliveries are to be submitted using this software.

- MicroStation V8i (Select series 2) Version 08.11.07.443
- GEOPAK V8i (Select series 2) Version 08.11.07.615
- Survey Pro Version 5.4.2
- Notepad Version 6.1

### **MDT Standard Data Collection Files**

Topographic/engineering surveys are to be developed using MDT's standard data collection feature files or current version including:

- MDTRV006\_0\_2.FEA – MDT's data collector feature file
- SURVEYENG.SMD – MDT's Geopak feature file
- SURVEYSTE.CEL – MDT's MicroStation cell library file

### **Engineering Survey Deliverables**

Information to be submitted includes, but is not limited to:

- original field survey notes (log sheets, obstruction diagrams, paper or electronic field notes, etc.)
- research materials
- all supporting data/calculations (survey computations, etc.)
- coordinate files and lists
- data collector files
- final engineering/topographic maps in MicroStation and GEOPAK format
- GPS/GNSS files

MDT standard format files and brief descriptions for Engineering Survey submittals are as follows:

- XXXXXXXDIMAPZ0X.DGN – 3D Microstation file
- XXXXXXXDIDTMZ0X.TIN – TIN file
- JOBXXX.GPK – GEOPAK COGO file (including points and survey chains)
- XXXXXXXDINEZZ0X.TXT – ASCII file of all surveyed points (Point, Northing, Easting, Elevation, Feature, Attribute)
- XXXXXXXDINEZZ0X.TXT – ASCII file with all culvert information (Point, Northing, Easting, Elevation, Type, Coating, Usage, Size, Culvert End, End Treatment, Edge Protection, Damaged End, Condition, Comment)
- XXXXXXXDINEZZ0X.TXT – ASCII file with hydraulics information (Point, Northing, Easting, Elevation, Feature)
- XXXXXXXDIGPAZ0X.ZIP – Compressed file of all the information and data files for the project
- XXXXXXXDIRMEZ0X.TXT – Text (Notepad) file explaining the submitted files and an explanation of how the survey was performed

\*Note – the above files are in a specific format that will be strictly adhered to.

## **PHOTOGRAMMETRIC AND OTHER REMOTE SENSING SURVEY**

Survey work under this category will include all survey work using photogrammetric and other remote sensing methods, primarily for the development of topographic maps and orthophotos.

All aerial photography, photogrammetric mapping and other remote sensing methods shall conform to the most current MDT practices. The MDT is in the process of developing specifications for several remote sensing methods. Until these specifications are fully developed and adopted, the use of these remote sensing methods will be allowed on a case by case basis using the following process:

1. A written request detailing proposed remote sensing methods to be used will be made and submitted to the Supervisor of Photogrammetry & Survey through MDT's contract administering section before any acquisition activities are started. The request shall address all information pertinent to proposed remote sensing activities including but not limited to:
  - a description of the remote sensing technology to be used and the steps and processes involved
  - a list and description of equipment to be used (brand, model, specifications, number of units, etc.)
  - a description of horizontal and vertical survey datums to be used and how ties to existing project control will be made
  - a detailed description of all generated data throughout the remote sensing process
  - a detailed description of proposed deliverables
  - a description of the survey accuracies to be achieved
2. Prior to commencement of remote sensing activities, the Supervisor of Photogrammetry & Survey or designee will review and approve the plan or request that modifications be made to the plan to assure that desired results can be obtained.
3. Upon completion of the survey, all compiled data will be submitted for review. As a minimum the submittal shall include a detailed overview of the project and a description of all submitted data.

All photogrammetric mapping and remote sensing products will be required to be field verified and will include a map accuracy certification acceptable to the MDT.