

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

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 statement that the control survey meets MDT standards. The PLS or PE in charge of the engineering survey will submit a statement that 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 using the specified project datum and adjustment tag (e.g. - NAD83(2011) & 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 Autodesk CADD files in the version 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 (PCMS).

CONTROL SURVEY

Description & Core Requirements

The purpose of the control survey is to establish a permanent, repeatable 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*.

MDT in partnership with the MSL (Montana State Library) is currently developing a RTN (Real Time Network) referred to as the MTSRN (Montana State Reference Network). At this time the MTSRN has limited VRS service and MDT is in the process of developing survey standards to be used with the MTSRN. Once the survey standards are completed the MTSRN may be an option for control surveys where VRS service coverage meets MDT standards but that will be evaluated on a case-by-case situation.

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 5.90
- StarNet Version 7.1.0.5 or earlier
- Notepad Version 6.1

Control Survey Deliverables

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

- approved control plan
- Field survey notes (log sheets, obstruction diagrams, paper, or electronic field notes, etc.)

- all supporting data/calculations (survey computations, datasheets, processing results, including TBC *.VCE files, etc.)
- research materials
- 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:

- XXXXXXXXSUCONZ01.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.
- XXXXXXXXSUCONZ01.DES – ASCII file with descriptions of points in the vicinity of the project
- XXXXXXXXSUCONZ02.DES – ASCII file with descriptions of all points used for the project.
- XXXXXXXXSUCONZ01.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)
- XXXXXXXXSUCONZ01.ZIP – Compressed file of all the information and data files for the project
- XXXXXXXXSURMEZ01.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)
- XXXXXXXXSUCONZ01.VCE – TBC file format set to the correct Datum and Geoid with all control points from the IFT file set to control quality.
- XXXXXXXX.jxl – Data collection file format exported from the TBC control *.vce file.

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

Note – the Z after the class CON designates Consultant files. Remove the Z for in-house reports.

GNSS Surveys can be processed in International Feet for the horizontal coordinates and US Survey feet for the vertical coordinates using the MDT’s current version of processing software. When preparing the final reports, the XXXXXXXXSUCONZ01.PTs file will be submittal as a metric file.

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 the 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 MDT with 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 in 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*.
- The numbering of survey points shall be in accordance with the *MDT Survey Manual* and the 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 recordation's 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 recordation's 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 recordation's, 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 5.90 (RTK Processing)
- Autodesk Civil3D – Using the current State kit version?
- Carlson Survey
- 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:

- MDTCadastral_2.0– MDT's current data collector feature file. Check for updates prior to start of survey.

Cadastral Survey Deliverables

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

- certificates of survey
- corner recordation's
- 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:

- XXXXXXXXSUCADZ01.DWG – 2D Autodesk file of the Certificate of Survey
- XXXXXXXXSUCADZ01.PDF – Adobe file of the recorded Certificate of Survey (recording information required)
- XXXXXXXXSUCADZ02.PDF –Adobe file of the recorded Certified Corner Recordation's (recording information required)
- XXXXXXXXSUCADZ01.TXT – ASCII file of the points shown on the Certificate of Survey (Point, Northing, Easting, Elevation, Feature, Description)
- XXXXXXXXSUCADZ02.TXT – ASCII file of all points (Point, Northing, Easting, Elevation, Feature, Description)
- XXXXXXXXSUCADZ01.ZIP – Compressed file of all the information and data files for the project
- XXXXXXXXSURMEZ01.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.

*Note – the Z after the class CAD designates Consultant files. Remove the Z for in-house reports.

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. Enough 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 Autodesk Civil 3D for the topographic/engineering survey.

- Autodesk Civil3D – Using the current state kit version.
- Notepad Version 6.1
- Trimble Business Center Version 5.90

MDT Standard Data Collection Files

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

- MDTSurvey_2.4.fxl – MDT's current data collector feature file. Check for updates prior to start of survey.

Engineering Survey Deliverables

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

- Field survey notes
- research materials
- all supporting data/calculations (survey computations, etc.)
- coordinate files and lists
- data collector files
- final engineering/topographic maps
- GPS/GNSS files
- Engineering surveys will contain Breaklines, features , Etc.

MDT standard format files and brief descriptions for Engineering Surveys submitted in **AutoCAD Civil3D format** are as follows:

- XXXXXXXDIMAPZ01.DWG – 3D Autodesk file
- XXXXXXXDIDTMZ01.XML – The final surface model in LandXML file format
- XXXXXXXDINEZZ01.CSV – CSV with Attributes (Point ID, Northing, Easting, Elevation, Feature Code, Attributes)

- XXXXXXXDINEZZ01.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)
- XXXXXXXDINEZZ02.TXT – ASCII file with hydraulics information (Point, Northing, Easting, Elevation, Feature)
- XXXXXXXDIGPAZ01.ZIP – Compressed file of all the information and data files for the project
- XXXXXXXDIRMEZ01.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

MDT survey work under this category will include all survey work using aerial photography, photogrammetric mapping, Aerial Lidar, and UAV photogrammetry generated point clouds for the design mapping process.

Being developed with the new survey manual.