MONTANA DEPARTMENT OF TRANSPORTATION

Geotechnical Section
Findings & Recommendations

October 29, 2021

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U.S. CAD
ACHIEVE MORE.

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Montana Department of Transportation
Geotechnical Section
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Thank you for taking the time to complete the U.S. CAD Discovery Process. During this journey your team has helped us gain a deeper understanding about the Geotechnical Section. By taking the information you provided in the Discovery Workbook and through our Discovery Workshop, we've compiled the information and summarized the findings within this document.

Our goal through this process is to help the Geotechnical Section achieve more. We understand the challenges that exist within the industry and your significant investments to make your Department of Transportation great. Through this process we trust that you will have also gained more insight into your organization.

Herein you will find our findings and recommendations. We trust that you will find this information useful in your pursuit to achieve more as an organization.

We look forward to strengthening our partnership with MDT and the Geotechnical Section.

Best Regards,

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EXECUTIVE SUMMARY

Montana Department of Transportation (MDT) enlisted U.S. CAD to gather information about your section and provide recommendations based on our experience and knowledge. Through our Discovery Process U.S. CAD was able to uncover insights about how the Geotechnical Section performs business, technologies currently used, required deliverables, existing pain points, objectives, and goals. The information gathered from the completed Discovery Workbook(s) and Discovery Workshop was used to help us better understand these areas of your organization and to prepare this document.

During our review of your Discovery Workbook(s), and while performing the Discovery Workshop we identified/noted the following items:

- The need for timely survey data
- Desire for CAD software training for reviewing and viewing
- Point cloud considerations
- Improve internal communication and collaboration

This report highlights our understanding of the items listed above and our proposed recommendations as a part of the MDT CADD Implementation process.

This report is broken out into the following sections:

Discovery Findings	This section highlights key elements uncovered during the Discovery Process.
Department Profile	The organizational structure of the division and interactions with internal and external teams.
Current State	Current processes and solutions used, including pain points, receivables, and deliverables.
Desired State	This section captures our understanding of the team's desire state, wish list items, goals, and objectives.
Recommendations	In this section we provide our specific recommendations on process and solutions based on our findings during the Discovery Process.

DISCOVERY FINDINGS

The following section highlights specific areas that were included in the Discovery process. Within each of the subsections below, U.S. CAD made specific notes regarding current challenges the Geotechnical Section faces, data used for analysis, and the collaboration of data between MDT bureaus. These highlighted items are expanded upon in the Recommendations section further in the document.

The Discovery Findings have been summarized and included in the following sections:

- Department Profile,
- Current State, and
- Desired State.

The information documented in these sections provides the background for U.S. CAD's recommendations.

DEPARTMENT PROFILE

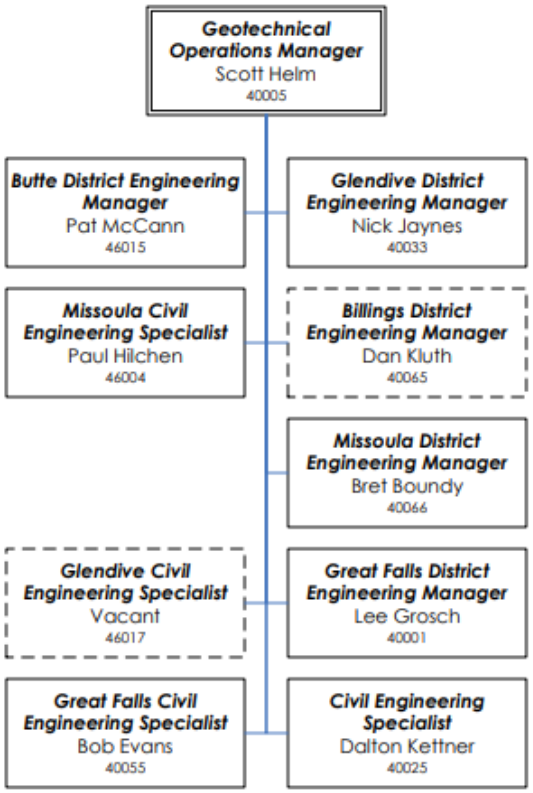
The Department Profile section provides our understanding of the organizational structure, key staff within the organization, departmental relationships, and how the Geotechnical Section interacts with other internal MDT sections/bureaus.

The Geotechnical Section primarily focuses on researching, analyzing, and reporting geotechnical findings and recommendations to the design functional areas within MDT. The Geotechnical Section also participates by answering questions, reviewing designs, and making comments and recommendations for design projects.

During the Discovery process, U.S. CAD was introduced to seven (7) key staff members who are integral components of the MDT Geotechnical Section; Scott Helm, Pat McCann, Nick Jaynes, Paul Hilchen, Dan Kluth, Bret Boundy, and Lee Grosch. These employees have immense knowledge and skills working within the Geotechnical Section's ecosystem. Their knowledge of the inner workings of MDT's Geotechnical Section provided us with the needed details for a thorough understanding of day-to-day operations.

The key staff members along, with the additional Geotechnical Section staff create, consume, and share data with the MDT design functional areas. Some of the tools used by the Geotechnical Section include: gINT, Microsoft Excel, Microsoft Word, Agile Assets, Pathweb, LPile, APile, Rocscience Rocfall, Geo-Slope (SlopeW), Shaft, Pile Buck, GRLWEAP, SPW911, ArcGIS, Pix4D, CloudCompare and MicroStation. As-Built plans are also frequently leveraged for data.

Below is the Organizational Chart of the MDT Geotechnical Section supplied by MDT.



CURRENT STATE

The Current State section captures our understanding of the existing workflow, processes, and solutions used within the organization:

Geotechnical Section – Current Process Map

There are typically four (4) phases of a project, research project information, field investigation, analysis and design recommendations, and construction support. The research of project information phase, in general, involves leveraging tools like Google Earth, PathWeb, As-Builts, maintenance records, ground water data, and bridge management systems. A preliminary report is then issued as a memo to the design functional area to help establish the alignment and grade.

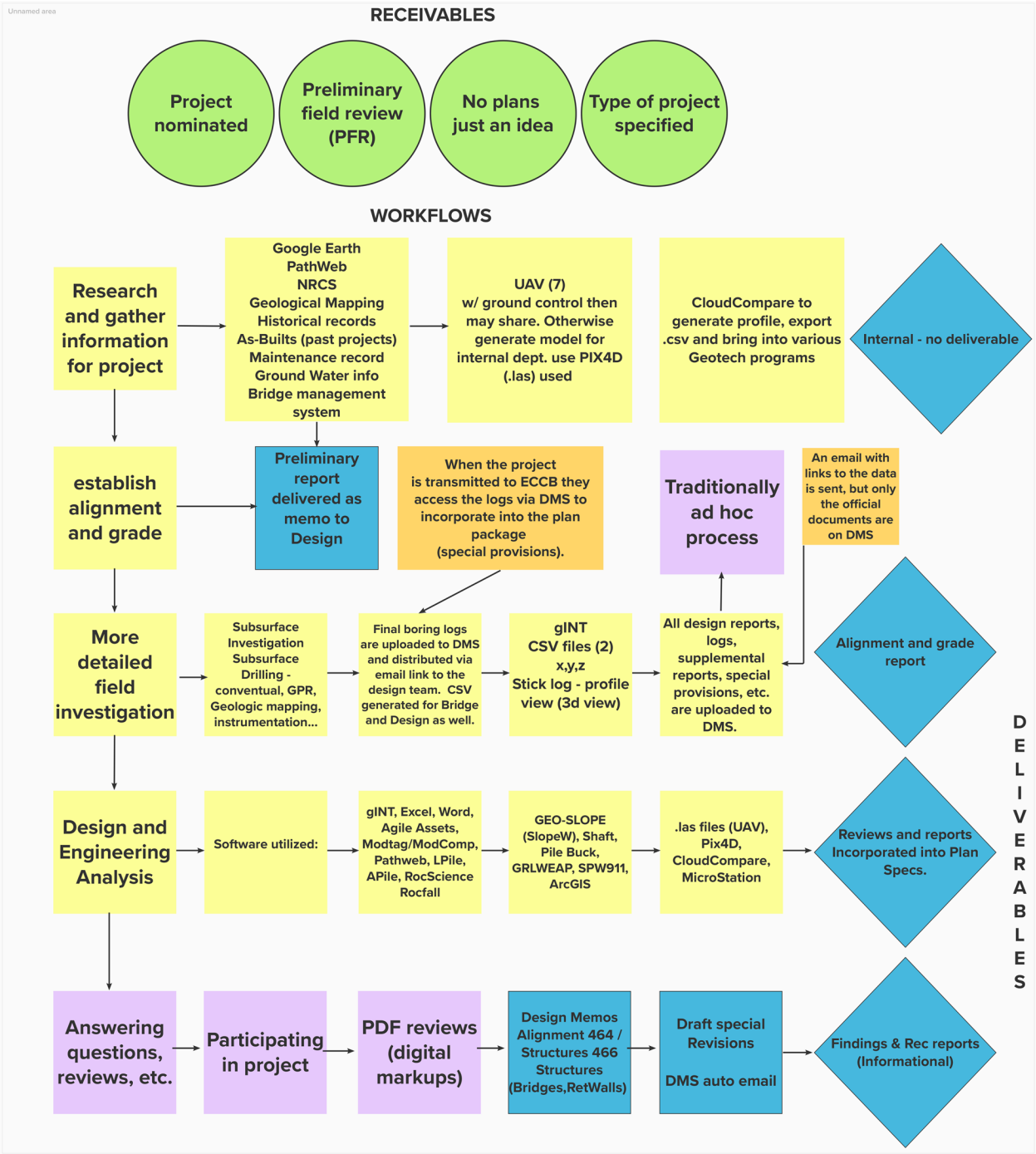
The more detailed field investigation phase consists of subsurface investigation, drilling, ground penetrating radar (GPR) and geologic mapping. Once the Geotechnical Section has collected all relevant data for a specific project, the data is analyzed and processed into the specific deliverable format. Deliverable formats include a PDF of the boring logs and .csv file(s). Deliverables comprise of recommendations and reports to the design functional areas via the internal Document Management System (DMS) or email of PDF's. It is our understanding that DMS will soon be changed to PCMS.

In the analysis and design recommendations phase the Geotechnical Section leverages software to evaluate data and generate reports that are included in the plan specifications. The software used in this phase includes gINT, Excel, Word, Agile Assets, Pathweb, LPile, APile, Rocscience Rocfall, SlopeW, Shaft, Pile Buck, Pix4D, Cloud Compare and MicroStation.

Construction support involves providing geotechnical recommendations for project assistance.

Geotechnical Section – Current In House Workflow

The graphic shown below represents our understanding of the current workflow. The graphic was created using an on-line whiteboard during the Discovery Workshop with key section staff.



DESIRED STATE

The Desired State section documents information shared by the Geotechnical Section regarding the future desired workflows, processes, and solutions. While it is understood that not all items shared by the team members during the Discovery Process are addressed within this section, U.S. CAD has identified potential solutions and recommendations to help the Geotechnical Section move closer to achieving their goals. The potential solutions and recommendations are outlined and located under Recommendations section of this document.

The Geotechnical Section expressed the following desires and wish lists during the U.S. CAD Discovery Workshop:

- Need for tools to create 3D boring logs for project model
- Ability to create subsurface surface models (DTMs)
- Collaboration with GIS data
- Leverage Trimble Business Center (TBC) for UAV image processing
- Have document versioning and searchability

The Geotechnical Section would like the ability to create three dimensional models of boreholes and software to create subsurface surface models within their current workflow. GIS data is being used, but it was mentioned that the need to incorporate and manage historical data in a GIS environment would be valuable. The use of Unmanned Aerial Vehicles (UAV) has been incorporated in the section's workflow and the tools within the Trimble Business Center (TBC) for processing imagery and aerial data efficiently was conveyed during the discovery workshop. Another topic discussed was the ability to utilize a data management system that would allow for document version control and searchability.

RECOMMENDATIONS

Based on the information shared by the Geotechnical Section through the Discovery Workbook and Discovery Workshop, U.S. CAD has prepared a summary of our recommendations. This information is prepared for you to consider as you make investments in moving forward toward your goals and objectives. We look forward to the discussions around these recommendations and next steps.

U.S. CAD believes that by integrating the use of Autodesk's AEC Collection in all relevant sections/bureaus and having one localized source for all MDT data will provide collaborations between all MDT bureaus and external entities, if shared. U.S. CAD believes the software, within the AEC Collection, that will be leveraged most often by the Geotechnical Section will be Civil 3D, Autodesk Map 3D, InfraWorks, and BIM 360.

Civil 3D's Geotechnical module can be used to generate and visualize 3D models of boreholes, 3D geology strata surfaces, dynamic geotechnical profile views of borehole log strips and import geotechnical field data. Civil 3D also contains GIS collaboration through integrated tools for ArcGIS and ESRI. Autodesk's Map 3D is an additional GIS tool for creating and managing GIS data.

The capabilities of the GIS database would provide access to maps, specific project site data, current/past projects, as-built plans, etc. By incorporating this additional information into the existing GIS foundation already in place and being used, the MDT GIS database would become an invaluable resource for all MDT departments, inherently improving the workflow for the Geotechnical Section.

InfraWorks can be used for preliminary research, importing, and exporting data from Civil 3D Map 3D, GIS applications and additional software platforms. InfraWorks can create intelligent 3D project models that can be shared with design functional areas to create collaboration between MDT sections/bureaus.

The Autodesk cloud collaboration tool, within BIM 360, will be a crucial piece to the Geotechnical Section's future workflow. Being able to share, review, and manage data in one centralized location will be a huge benefit. Autodesk's BIM 360 provides access to data anywhere and anytime as well as design collaboration, project management, and document management tools.

Future Considerations

U.S. CAD recommends the following training courses for the Geotechnical Section staff.

- AutoCAD Fundamentals
- Civil 3D Fundamentals
- InfraWorks
- BIM 360

By exposing the Geotechnical Section to the Autodesk software tools included in the list above, staff will have the knowledge needed for making informed decisions on what data is available and how to access it. Providing the Geotechnical Section with tools to import, utilize and share data in their current workflows is key to removing existing inefficiencies and concerns within the Section. It is equally important for the Section to export data capable of being consumed by other MDT Sections/Bureaus.

Next Steps

U.S. CAD will create and present a training outline and plan that will specify the courses we feel would benefit the Geotechnical Section. U.S. CAD will work with the MDT CAD Implementation executive team to assign dates and times for these courses.