Hydraulics Section
Discovery Review Findings Summary

November 3, 2021

Prepared by:

U.S. CAD
ACHIEVE MORE.

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November 3, 2021

Montana Department of Transportation
Hydraulics 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 Hydraulics Section. By reviewing the Autodesk's Discovery Documentation and the information you provided during our Discovery Review Session, we've compiled the information and summarized the findings within this document.

Our goal through this process is to help the Hydraulics 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 Hydraulics 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. Prior to U.S. CAD's Discovery Review Session, the Hydraulics Section participated in a thorough discovery process performed by Autodesk. Through our Discovery Process, U.S. CAD was able to verify existing workflows and uncover insights about how the Hydraulics Section performs business, technologies currently used, required deliverables, existing pain points, the Hydraulics Section objectives, and goals. The information gathered from the completed Autodesk's Discovery Documentation and U.S. CAD Discovery Review Session was used to help us better understand these areas of your organization and to prepare this document.

During our review of your Autodesk Discovery Documents, and while performing the Discovery Review Session we identified/noted the following items:

- Design change notifications.
- Memos, documentation, and reporting functions not automated.
- Utilized data for the HY Map Setup not georeferenced or assigned incorrect coordinate systems.
- Some activities start early and often require rework due to design changes and data analysis.
- Design changes to storm or sanitary models require multiple and tedious iterations.

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

U.S. CAD did observe several immediate opportunities that would allow the Hydraulics Section to utilize the AEC Collection. Note, in the future, once other bureaus have completed their migration to the Autodesk AEC Collections, there could be potential opportunities for increased cross collaboration.

This report is broken out into the following sections:

Department Profile	The organizational structure of the division and interactions with internal and external teams.
Recommendations	In this section we provide our specific recommendations on process and solutions based on our findings during the Discovery Process.
Training Program	This section identifies the potential training opportunities based on the team's wish list items, pain points, goals, and objectives.
Next Steps	In this section we provide our specific recommendations on process and solutions utilizing a Production Project where additional "Fit Gaps" may be exposed requiring additional training.

DEPARTMENT PROFILE

The Department Profile section provides our understanding of the organizational structure, key staff within the organization, departmental relationships, and how the Hydraulics Section interacts with other internal MDT bureau's/departments, external agencies and consultants.

The Hydraulics Section primarily focuses on existing and proposed hydraulic studies within the construction limit of highway projects. The section obtains survey data, soil samples, existing utilities, irrigation reports, and as-built data for MDT design functional areas to identify hydraulic structures, culverts, etc. Data sources utilized include but not limited to survey data (hydraulic and road design), photogrammetry, GIS, LiDAR, MicroStation (DGN), As-built plans, floodplain data, aerials imagery, and Google Earth.

During the Discovery process, U.S. CAD was introduced to several staff members who are integral components of the MDT Hydraulics Section. These employees have immense knowledge and skills working within the hydraulic ecosystem. Their knowledge of the inner workings of MDT's Hydraulics Section, and outside entities, provided us with the needed details for a thorough understanding of day-to-day operations.

The key staff members along, with the additional Hydraulics Section staff create, consume, and share data with the MDT design functional areas.

Some of the tools currently used by the Hydraulics Section include:

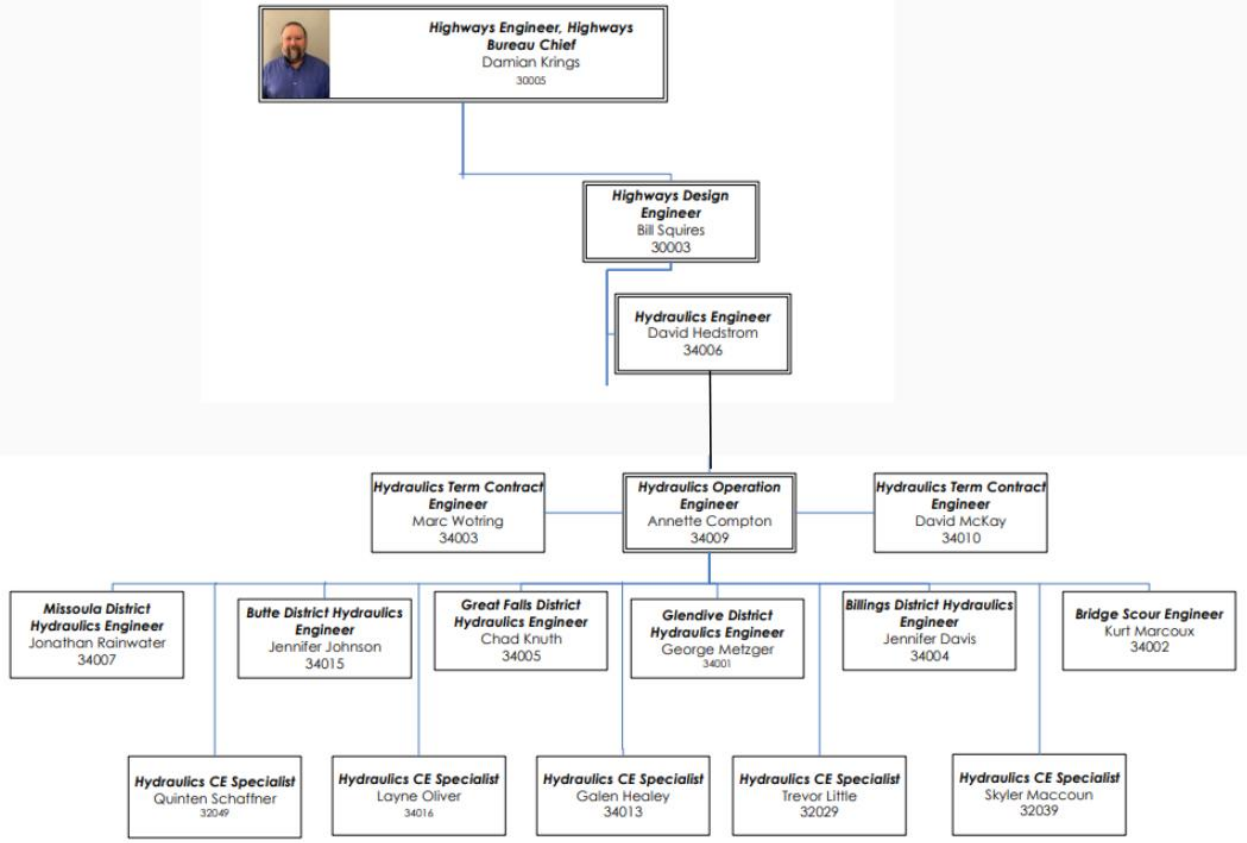
Activity	Solution(s)	Additional Solution(s)
Location Hydraulic Study Report (LHSR)	MicroStation, As Builts (PDF)	MS Word/Excel, Google Earth
Hydrologic Analysis	MicroStation	StreamStats, Excel, WMS*
Hydraulic Analysis Bridge	SMS/SRH-2D, HEC-RAS, MicroStation	Hydraulic Tool Box (Scour)
Hydraulic Analysis Culverts	MicroStation, HY-8	HEC-RAS, Excel, Hydraulic Tool Box
Hydraulic Analysis Storm Drains	MicroStation, SSA, StormCAD	Hydraulic Tool Box, Excel
Hydraulic Analysis Irrigation	MicroStation, HY-8	HEC-RAS, Flowmaster, Hydraulic Tool Box
Deliverable: Drawing (Design File & Details)	MicroStation (DGN)	
Deliverable: Memo/Reports	Adobe (PDF)	Word
Deliverable: Special Provisions	Word	

*Watershed Modeling System (WMS)

While performing the Discovery Workshop staff members voiced several concerns, challenges, and fears they have for the software migration as shown:

- With multiple applications changing all at once, will the timeline for the migration to these applications be too slow or too fast to become proficient?
- How are growing pains and learning gaps in knowledge going to affect projects timeline?
- Will the training be thorough so projects can be completed in a timely manner?
- Will there be documented processes?
- Will each district continue to have a different process?
- How will Federal Aid Projects that are in the que be affected?
- How are older projects, still active, going to be handled?

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



RECOMMENDATIONS

Based on the information shared by the Hydraulics Section through the Autodesk Documented Discoveries and U.S. CAD Discovery Review session, 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.

Hydraulics Section (Overall)

U.S. CAD believes that by integrating the use of Civil 3D in all relevant bureaus and having one localized set of standards for all MDT Civil 3D data would provide easy access to all MDT bureaus and external entities if shared. The true intent of the Civil 3D standardization would be to provide accurate and consistent data/plans for users to access and reduce errors and omissions. The capabilities of Civil 3D would improve collaboration by providing access to maps, specific project site data, current/past projects, as-built plans, etc. Incorporating this information into the existing projects and utilizing automated processes in Civil 3D would reduce rework and provide for faster project turnaround leading to overall workflow improvement for the Hydraulics Section.

Civil 3D

Currently, the Hydraulics Section utilized Civil 3D on a limited basis as well as other applications available in the Autodesk AEC Collection for analyzing and reporting hydraulic data and calculations. The Section could, however, benefit from being made aware of other automated and collaboration tools available within Civil 3D and the Autodesk AEC software Collection. Civil 3D takes the process of designing in a 2D environment and instantly turns elements into intelligent and georeferenced 3D model components that are dynamic in nature. As a result of this dynamic capability, designers can make a change in one area of the project, and several other connected areas will be updated as a result. Civil 3D's dynamic capability will assist in the use of tables which currently are static and must be updated when the design changes. This can save a tremendous amount of time by reducing the editing process as well as eliminating potential errors. Civil 3D also automates the process of reporting because of utilizing intelligent Civil objects that not only are inter-connected but also possess a rich collection of data. Having knowledge of the available tools and how they are being leveraged within other MDT bureaus will help bridge the data gap and improve efficiencies between functional areas.

Map 3D

In addition, the capabilities and use of a centralized MDT GIS database would provide access to maps, specific project site data, current/past projects, as-built plans, etc. By incorporating the Hydraulics Section data/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 Hydraulics Section.

InfraWorks

InfraWorks can be used for preliminary research, importing, and exporting data from Civil 3D, Map 3D, GIS applications and additional software platforms. This makes InfraWorks an excellent resource for starting projects that do not have survey data to begin with. Various data sources can be integrated into the InfraWorks model during the life cycle of the model as well. As a result, InfraWorks can create intelligent 3D project models that can be shared with design functional areas to create collaboration between MDT bureaus.

SSA & Hydraflow

SSA (Storm and Sanitary Analysis) and Hydraflow provide the tools and working environment and takes advantage of the software's interactive, dynamic design functionality and the SSA hydrology and hydraulic modeling capabilities for analyzing a project. Two additional calculation and analysis tools within Civil 3D Hydraflow are for designing culverts, channels, inlets, weirs, detention ponds and watersheds.

BIM 360

The Autodesk cloud collaboration tool, BIM 360, will be a crucial piece to the Hydraulics Section 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.

The following table outlines the Hydraulics Section current activities and recommended Autodesk (and other) solutions to be implemented. These solutions are the basis for the proposed Training Program outlined below.

Activity	Solution(s)	Additional Solution(s)
Location Hydraulic Study Report (LHSR)	Civil 3D	MS Word/Excel, Google Earth
Hydrologic Analysis	Civil 3D	StreamStats, Excel, WMS*
Hydraulic Analysis Bridge	SMS/SRH-2D, HEC-RAS, Civil 3D	Hydraulic Tool Box (Scour)
Hydraulic Analysis Culverts	Civil 3D, HY-8	HEC-RAS, Excel, Hydraulic Tool Box
Hydraulic Analysis Storm Drains	Civil 3D, SSA*	Hydraulic Tool Box, Excel
Hydraulic Analysis Irrigation	Civil 3D, HY-8	HEC-RAS, Flowmaster, Hydraulic Tool Box
Deliverable: Drawing (Design File & Details)	Civil 3D (DWG)	
Deliverable: Memo/Reports	Adobe (PDF)	Word
Deliverable: Special Provisions	Word	

*WMS (Watershed Management System) may not be needed. Workflow with Autodesk AEC solutions will need to be validated.
[+]SSA (Storm and Sanitary Analysis)

TRAINING PROGRAM

U.S. CAD recommends performing a high-level demonstration of the tools within the Autodesk products to the Hydraulics Section to give them further insight on what file types can be imported and exported. With this knowledge U.S. CAD feels the Hydraulics Section will have a better understanding of what the design departments' capabilities are. Topics may include consuming, leveraging, and delivering parcel data. Topics may also include what types of data will be published to BIM 360 for the Hydraulics Section's use.

By exposing the civil tools included in the Autodesk products, to all MDT bureaus, staff will have the knowledge needed for making informed decisions on what data is available and how to access it. Providing the Hydraulics Section with tools to import survey, GIS, as-built, and other related data and utilize this data in their current workflows is key to removing existing inefficiencies and frustrations within the Section. It is equally important for the Section to export data capable of being consumed by the other MDT Bureaus.

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

- **101 AutoCAD Fundamentals for Bentley Users** - This course, intended to assist those who have utilized Bentley products and have limited or no Autodesk AutoCAD experience, is focused on basic interface and functions within the AutoCAD product.
- **201 Civil 3D Fundamentals I** – This course will introduce the Civil 3D user interface and terminology and provide an understanding of Parcels, Surfaces and Survey.
- **202 Civil 3D Fundamentals II** – This course continues creating the knowledge of Civil 3D features and their functions.
- **203 Civil 3D Fundamentals III** – This course delivers insight into Sections, Section Views, Templates, Styles, Data Shortcuts, Printing, Sheet Setup, Sheet Set Manager and Quantities.
- **610 SSA I** – This course offers an introduction to the tools and working environment and takes advantage of the software's interactive, dynamic design functionality and the SSA hydrology and hydraulic modeling capabilities for analyzing a project.
- **640 Hydraflow I** - This course provides two additional calculation and analysis tools within Civil 3D for designing culverts, channels, inlets, weirs, detention ponds and watersheds.
- **301 BIM360 Collaborate Pro for Infrastructure I** - This course provides an overview of what the web- based collaboration tool has to offer and how it can be leveraged to collaborate with internal divisions, field personnel and consultants. The course will also deliver the tools necessary to manage the account, set up new projects, activate various modules, where to set up workflows, and manage project members and settings.
- **601 InfraWorks I** - This course covers the steps on how to import and configure data from within InfraWorks and utilize available tools to create, leverage, and analyze design alternatives for 3D design concepts and visualizations.

By exposing the Hydraulics 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 Hydraulics Section with tools to import, utilize and share data in their current workflows is key to removing existing inefficiencies and frustrations within the Section. It is equally important for the Hydraulics Section to export data capable of being consumed by other MDT Bureaus.

NEXT STEPS

A Production Project will be identified by the MDT CAD Implementation Executive Team. A Production Project provides opportunity for MDT to refine proposed future MDT workflows, identify gaps, and give insight into configuration needs. This process has already led to the creation (and implementation) of the MDT State Kit. The State Kit was utilized on prior Pilot Projects giving deeper insight into how best to update and configure the solution. The Production Project will also provide insight into the requirements for additional content that needs to be included in MDT's State Kit as well as other key configuration elements that will help with production efficiencies.

The MDT CAD Implementation Executive Team have identified early adopters within each functional design area. U.S. CAD will work closely with the early adopters to develop workflow processes and procedures, as mentioned in our recommendations, to ensure their portion of the project can be completed utilizing Autodesk's AEC Collection. U.S. CAD will provide support and mentoring throughout the production project.

- During this phase additional "Fit Gaps" may be uncovered. If there are, additional training may be recommended.
- U.S. CAD and Autodesk will remain engaged with MDT to ensure successful implementation and Production Project completion.
- U.S. CAD and Autodesk will arrange regular meetings with MDT staff to assist them in attaining their goals and objectives.
- Upon completion of the Production Project, MDT to meet with U.S. CAD and Autodesk to explore expanded implementation options and identify the most effective path forward and to meet MDT's larger BIM goals.

In addition to the Production Project, Workflow Road Maps will be developed and presented to MDT. With several MDT Pilot Projects already completed, (or currently being executed) the process of refining the workflows based on MDT feedback can begin. The goal is to confirm workflows that will be included in the initial stages of the broader implementation and training at MDT. The Workflow Road Maps are important to gain clarity of the scope and schedule of the Training and Implementation requirements, as well as the configuration needs for MDT's state-wide rollout of the AEC Collection solution.