

**EXHIBIT A
SCOPE OF SERVICES**

ENHANCED CAPABILITIES OF BULLREPORTER AND BULLCONVERTER

BACKGROUND

BullReporter and BullConverter are software packages for weigh-in-motion (WIM) data processing and reporting tools developed for MnDOT by the University and have been used by MnDOT's Traffic Forecasting and Analysis (TFA) section since its initial delivery in 2009. The objective of this project is to expand the existing conversion and reporting capabilities of BullReporter and BullConverter to meet the current and expected future needs. Data needs change over time, and the members of the TFA section identified several new functions that would improve efficiency and quality of current TFA services and be prepared future needs. This upgrade will include implementation of new reporting and conversion functions as well as modification or addition of options to the current version.

OBJECTIVE

MnDOT's TFA section originally funded the University for development of BullConverter and BullReporter software packages in September 2006, and the initial version was delivered in January 2009. Since then MnDOT TFA has been successfully using these packages for various data analysis and reporting needs. The reporting functions were upgraded few times as the needs change over time. Presently, BullReporter can generate 34 different types of reports with multiple user selectable options. As data reporting and analysis needs evolve, implementation of new functions are needed. This project will add more functions and more options as described later in this scope of work. Proposed additions are expected to immediately benefit MnDOT by complementing existing functions as well as availability of new tools. For example, addition of the "Vehicle View" reporting function would help monitor classification accuracy by allowing the user to view vehicle images along with vehicle records. Misclassification cases could be more readily discovered and incorporated into the classification scheme to improve classification accuracy. Increased classification accuracy would lead to generation of higher quality data, which in turn would lead to providing better traffic forecasting and decision makings.

SCOPE

The tasks of this project are mainly software developments, involving writing codes for new reporting functions and additional option implementations. Therefore, the basic methodology would follow a well-defined software development process, i.e., development of requirements, design of algorithm, implementation, verification, and debugging. Requirements of each task are already well established and only minor details need to be worked out. Design of algorithms would be the next step and require a large portion of the time allocation. Implementation is the process of writing codes and will be a straight forward process. The last two steps, verification and debugging, are extremely important steps and would require MnDOT's participation. The University's Principal Investigator (PI) will closely work with MnDOT's Technical Liaison (TL) and the Technical Advisory Panel (TAP) to ensure that implemented functions match with the TFA expectation and work correctly.

There currently exists some uncertainties and unknowns, which may lead to inability to deliver the expected outcomes on time. For example, Task 2 involves integration of image processing and outputting of the result to a pdf file. It is a new type of task and how much time and efforts it would require is unknown until it is tried.

ASSISTANCE

This project needs MnDOT TFA assistance in obtaining raw data. This includes sample Intercomp data, sample vehicle image data, and raw IRD WIM data. In addition, MnDOT TFA's assistance in testing the software functionality and data accuracy and providing feedback to PI is needed.

WORK PLAN

Completion of the following project tasks will result in delivery of new versions of BullReporter and BullConverter software packages through the University's on-line web site. MnDOT holds the right to download unlimited number of copies and install at unlimited number of MnDOT PCs.

Task Descriptions

Task 1: Addition of Intercomp Data Conversion Capability in BullConverter

MnDOT's TFA section is planning a project to compare a WIM system composed of an International Road Dynamics (IRD) controller on Kistler sensors versus an Intercomp controller on Intercomp sensors. This comparative study needs a data conversion utility in order to directly compare the data through BullReporter. Presently, BullConverter provides data conversion to MnDOT standard csv files from IRD produced binary WIM files but no converter is available for data produced by Intercomp controllers. In this task, the PI will add a new conversion capability in BullConverter in the form of a new tab, i.e., a new tab will be dedicated for Intercomp data conversion. Presently, IRD occupies one tab and PEEK occupies another tab for conversion. One of the challenges expected would be converting Intercomp error messages to the standard MnDOT csv error numbers. A different set of errors are coded by different systems, and consolidating the errors codes is not simple due to un-matched error conditions. The PI will work with MnDOT WIM section to ensure the conversion is acceptable to MnDOT.

Task 2: Implementation of "View Vehicles" Report Function in BullReporter

"View Vehicles" report is one of the IRD reporting functions that provides individual vehicle records along with a digital picture of the vehicle. This report helps visual verification of class and other aspects of data such as unusual weights or axle configurations. This function is presently not available in BullReporter, and MnDOT proposed implementation of an enhanced version of the "View Vehicles" report in BullReporter. This enhanced function includes an ability to look at specific hours of the day, lane, and class. In addition, the user may be able to specify vehicles with the gross vehicle weight (GVW) or steer axle weight above a certain limit. This search capability would greatly enhance efficiency of using the "View Vehicles" report. Another enhancement is inclusion of a link that would allow display of the full-size vehicle picture in a separate window for detailed visual inspection.

Developing this enhanced "Vehicle View" report is a challenge due to involvement in image processing and pdf outputs. The query conditions may need to be refined based on efficiency of report generation time. For example, creating a pdf file takes a large amount of time if the number of vehicles queried is large in comparison to web browser display. Thus, implementation of an option of producing a pdf file should be studied as well as limiting the number of total vehicle to print. The PI will be creating a draft "View Vehicles" report version and work with MnDOT TFA to rigorously test the implementation. The PI will deliver the final result early enough so that MnDOT has at least one month of time to review and test. The feedback will be incorporated to the final version.

Task 3: Histogram of Weight and Equivalent Single Axle Loads Data

MnDOT's TFA presently produces histogram of vehicles over 88 kips in a monthly table. BullReporter does not have this capability, and thus this data table is manually produced through multiple steps. To increase efficiency of the monthly report generation, MnDOT would like to not only integrate this function into BullReporter and produce data through a simple press of a button but also enhance its capability. MnDOT TFA proposed to add user options of setting the weight limit, selecting a class, selecting GVW or Steer axles, and setting the histogram bin size. In addition, all of these options would also be available for Equivalent Single Axle Loads (ESAL) histogram. The PI will implement the requested capabilities into two reporting functions: one for histogram of weights and the other for histogram of ESALs. To ensure that this data function is properly implemented, the PI will closely work with MnDOT TFA and rigorously test and verify the accuracy. The PI will also analyze all of the options suggested by MnDOT TFA, create a draft implementation, seek a feedback, and incorporate the suggestions into the final version.

Task 4: Hourly and Monthly Data Reporting Options in BullReporter

BullReporter presently generates hourly reports for speed, vehicle counts, errors, warnings, weigh violations, and ESAL totals. With availability of portable WIM (PWIM) data, there is a need for user to select hours allowing reporting of hourly data. Another area pointed out by TFA is unavailability of a month-by-month option in reporting. This unavailability makes production of yearly reports tedious because the user must manually process 12 months one month at a time. For this task, the PI will work with MnDOT TFA to first identify where in the reporting exactly needs hourly, daily, or monthly data options. Based on this identification, current reporting functions will be enhanced to include more options. Other minor revisions such as increasing ESAL values to 3 decimal places will be also done in this task. In addition, documentation on classification scheme changes will be provided along with training as a part of this task.

Task 5: Compile Draft Report, Technical Advisory Panel Review and Revisions

The University will prepare a draft report, following MnDOT’s publication guidelines, to document project activities and new reporting functions implemented. This report will need to be reviewed by the Technical Advisory Panel (TAP), updated by the Principal Investigator to incorporate technical comments, and then approved by Technical Liaison before this task is considered complete. Holding a TAP meeting to discuss the draft report and review comments is strongly encouraged. The University may consultant TAP members for clarification or discussion of comments.

Task 6: Editorial Review and Publication of Final Report

During this task, the Approved Report will be processed by MnDOT’s Contract Editors. The editors will review the document to ensure it meets the publication standard. This task must be completed within the contract time because the editors will provide editorial comments and request information from the University.

Task Deliverables

Task:	Deliverable(s):
1:	A new version of BullConverter that implements Intercomp data conversion
2:	A new version of BullReporter that implements “View Vehicles” Report
3:	A new BullReporter function that generates histograms of weight and ESAL
4:	A new version of BullReporter that implements proposed functions in this task
5:	A Draft Report and Final Report Approved for Publication
6:	Final Published Report

PROJECT SCHEDULE

Task Completion Dates

Task:	Draft Deliverable Due Date:	Final Task Approval Date:
1:	September 30, 2015	November 30, 2015
2:	April 30, 2016	June 30, 2016
3:	September 30, 2016	November 30, 2016
4:	January 31, 2017	March 31, 2017
5:	June 30, 2017	August 31, 2017
6:		December 31, 2017

Task Durations

Months:	2015						2016											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Task 1	X	X	X	X	X													
Task 2				X	X	X	X	X	X	X	X	X						
Task 3											X	X	X	X	X	X	X	
Task 4																X	X	X
Task 5																		
Task 6																		

Months:	2017											
	19	20	21	22	23	24	25	26	27	28	29	30
Task 1												
Task 2												
Task 3												
Task 4	X	X	X									
Task 5		X	X	X	X	X	X	X				
Task 6									X	X	X	X